SZEGED SCIENTISTS ACADEMY

YEARBOOK 2020/21

SZEGEDI TUDÓS AKADÉMIA
SZEGED SCIENTISTS ACADEMY

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SZEGEDI TUDÓS AKADÉMIA
SZEGED SCIENTISTS ACADEMY

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LÁSZLÓ VÍGH

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Doctor of HAS, representative of the Dean of the Faculty of Medicine, University of Szeged, 2013–2014

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Academician, former Dean of the Faculty of Medicine, University of Szeged, 2013–2014

FERENC BARI

Doctor of HAS, Dean of the Faculty of Medicine, University of Szeged, 2014-2018

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Nobel Laureate cell physiologist, Max Planck Institute für Neurobiologie, Munich

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Doctor of HAS, Professor of the Faculties of Medicine,
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Doctor of HAS, Professor of the Department of Pharmacology and
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DEPUTY DIRECTOR (SECONDARY SCHOOL EDUCATION)

Leading biology teacher at Radnóti Miklós Experimental Grammar School, Szeged

ZOLTÁN RAKONCZAY

DEPUTY DIRECTOR (UNIVERSITY EDUCATION)

Doctor of HAS, Professor and Head of the Department of Pathophysiology at the
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CONTACT: INFO@NOBEL-SZEGED.HU WWW.NOBEL-SZEGED.HU

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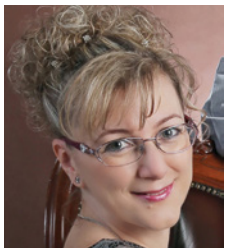

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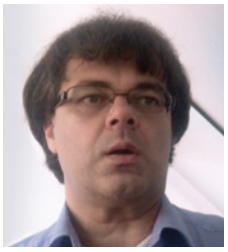

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SOCIAL AND CULTURAL
PROGRAM ORGANIZER

JÓZSEF TOLNAI
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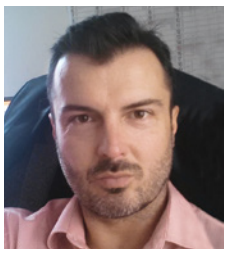

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SZEGEDI TUDÓS AKADÉMIA
SZEGED SCIENTISTS ACADEMY

SECONDARY SCHOOL PROGRAM

NATIONAL BASE SCHOOLS

RADNÓTI MIKLÓS EXPERIMENTAL GRAMMAR SCHOOL SZEGED

HEADMASTER: **DR. ANETT NAGY**

SENIOR TEACHER: **ANDREA BORBOLA** *(See page 18)*

The Radnóti Miklós Experimental Grammar School of Szeged saw many profile changes throughout its 120 year old history. Originally named after Gábor Klauzál, it served as a boys' real school for Szeged's middle class. After the second World War a mixed education was introduced, adding the training of skilled workmanship next to the real school. The current general gymnasial profile – aiming to achieve scientific excellence – was gradually built up starting from 1957. The school's building is as old as the institute itself, historically decorated yet equipped with state of the art laboratories and ICT appliances. At the moment six different departments are operated: Mathematics-Physics, Chemistry, Biology, Mathematics, General Studies (with increased English or Spanish classes), Humanities and a talent care division focusing on students with underprivileged backgrounds.

The students achieve the best results in Mathematics and Sciences. The average grades of the final examinations and the number of students accepted to universities both mark efficiency of the education and talent care. It is also known that not many schools can exceed the 'Radnóti' when it comes to results at national and international competitions. While the faculty is proud of the students' achievements, they consider these competitions as a means of education, not as a main goal. During the preparation the students can learn confidence, persistency, self-knowledge and cooperation next to the professional knowledge. Hence the school's motto: 'Sapere aude' – 'Dare to know'.

The construction of the Specialized Laboratory for Scientific Education (TERMOSZ Laboratory) was finished in 2015. The laboratory is located at the school's area yet plays a central part in the renewal of scientific education collaborating with 18 other schools in the Szeged school district. The associates also help with the preparations and executions of international competitions, in addition they play a key role in the national biological talent care.

NÉMETH LÁSZLÓ SECONDARY AND GRAMMAR SCHOOL – HÓDMEZŐVÁSÁRHELY

HEADMASTER: **LÁSZLÓ ÁRVA**

SENIOR TEACHER: **EDIT CSALÁNÉ BÖNGYIK** *(See page 19)*

Németh László Secondary and Grammar School was established in the 1980s to serve the Hódtó district of Hódmezővásárhely. Originally it was a minor elementary school, however it launched its gymnasial classes in 1995 which quickly helped to raise its ranks amongst the other high schools of the town. Besides the general gymnasial educational structure, the school also emphasizes language and IT (Information Technology) studies along with natural science.

It is an absolute advantage that the students can carry out their studies in one institute – the talent care and education starting from early age until their final examination. This counts as a unique feature in Hungary and it helps to maintain a smooth cooperation between the elementary and high school educators, helping out the long-term correction and design of the training plan. The students have proven themselves at several competitions and perform well on their final examinations – marking the good student-teacher collaboration.

The school's modern building provides a luminous, well established location and atmosphere to carry out high standard education. In addition, a botanical garden is being built which will be a green spot in the neighborhood.

The József Gyulai Scientific Workshop (József Gyulai Laboratory) was established in 2012, offering quality training with modern equipment. All the neighboring elementary students can use the laboratory under the supervision of its trained attendants.

SZTE PRIMARY AND SECONDARY GRAMMAR SCHOOL

HEADMASTER: **DR. JÁNOS DOBI**

SZENT-GYÖRGYI SENIOR TEACHER: **ISTVÁN CSIGÉR** *(See page 20)*

SZTE Primary and Secondary Grammar School can look back on a 66-year history. Its legal predecessor, the initially unnamed "New Grammar School", was established in 1955 as a practicing school of the Attila József University due to the increased number of teacher training and the increase in the number of high school students. It became known in the region - and nationally - as the Endre Ságvári High School from January 1956, then it operated as JATE, later under the name SZTE Endre Ságvári High School until 2015 when it received its current title due to forced name change and merger with the primary school of the same name.

Class types and class profiles gradually formed during the operation of the grammar school. French, English-Russian, mathematics-physics, and general curriculum classes operated for decades. The bilingual Hungarian-French training started in 1993, and in 2000 the board of teachers established the class structure that - with more or less changes - is still in place. Thus, pupils can choose between special mathematics and physics, Hungarian language and history, advanced biology developing natural science thinking, Hungarian-French bilingual, technical informatics and a general curriculum of six classes with English language orientation classes.

In the last 35-40 years, the competitive and cultural achievements of special mathematics, science subjects and humanities have rightly made it a recognized school in the region and the country.

The Szeged Regional Natural Science Laboratory for Pupils has been operating in the grammar school building since 2013, maintaining contacts with 18 partner schools for providing biology, physics, geography and chemistry laboratory classes.

Since 2015, the school and the laboratory have been the regional base institution of the secondary school program of the Szeged Scientists Academy and then, while maintaining this function, it has been operating as a national base school since June 2020.

REGIONAL BASE SCHOOLS

TÓTH ÁRPÁD SECONDARY SCHOOL – DEBRECEN

Headmaster: Amália Fenyősné Kircsi
Szent-Györgyi Senior Teacher: József Gőz *(p. 25)*

NAGY LAJOS GRAMMAR SCHOOL OF THE CISTERCIAN ORDER – PÉCS

Headmaster: Márta Bodáné Gálosi
Szent-Györgyi Senior Teacher: dr. Zsolt Nyisztor *(p. 32)*

PREMONSTRATENSIAN ST. NORBERT SECONDARY SCHOOL – GÖDÖLLŐ

Headmaster: Borbála Takácsné Elek
Szent-Györgyi Senior Teacher: Zoltán Kerényi *(p. 27)*

CALVINIST GRAMMAR SCHOOL OF KECSKEMÉT

Headmaster: Anna Durucz
Szent-Györgyi Senior Teacher:
Adrien Lengyel *(p. 31)*

FÖLDES FERENC HIGH SCHOOL – MISKOLC

Headmaster: Róbert Fazekas
Szent-Györgyi Senior Teacher: Csilla Szentesi *(p. 34)*

ELTE TREFORT ÁGOSTON SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: Zoltán Csapodi
Szent-Györgyi Senior Teachers: Norbert Faragó *(p. 23)*,
László Kutrovácz *(p. 30)*

TÁNCSICS MIHÁLY SECONDARY GRAMMAR SCHOOL OF KAPOSVÁR

Headmaster: László Vámosi
Szent-Györgyi Senior Teachers:
Beatrix Bagi Kertész *(p. 29),* Róbert Kertész *(p. 28)*

DEÁK TÉRI LUTHERAN GYMNASIUM – GÖDÖLLŐ

Headmaster: Edit Gadóné Kézdy
Szent-Györgyi Senior Teacher: Andrea Fazakas *(p. 24)*

LOVASSY LÁSZLÓ GRAMMAR SCHOOL – VESZPRÉM

Headmaster: Zoltán Schultz
Szent-Györgyi Senior Teacher: Tünde Tóth Szalainé *(p. 33)*

Photo: Gábor Magyar

FAZEKAS MIHALY PRIMARY AND SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: dr. Erős-Honti Zsolt
Szent-Györgyi Senior Teacher:
dr. Zsolt Erős-Honti (p.22), Julianna Erős-Honti *(p. 21)*

ELTE BOLYAI JÁNOS PRACTICE PRIMARY AND SECONDARY GRAMMAR SCHOOL – SZOMBATHELY

Headmaster: Tibor Papp
Szent-Györgyi Senior Teacher: József Baranyai *(p. 17)*

GÖDÖLLŐ REFORMED SECONDARY SCHOOL

Headmaster: Árpádné Bajusz
Szent-Györgyi Senior Teacher: Zsolt Horváth *(p. 26)*

SZTE PRIMARY AND SECONDARY GRAMMAR SCHOOL – SZEGED

Headmaster: Dr. János Dobi
Szent-Györgyi Senior Teacher: István Csigér *(p. 20)*

SZENT-GYÖRGYI SENIOR TEACHERS

"Those who affect children's imagination essentially influence their future existence as well."

József Eötvös

Szent-Györgyi Senior Teachers are the secondary school teachers who constantly recognise young talents and provide them with additional, extensive knowledge of biology and chemistry. Their students also actively participate in the national and international natural sciences competitions.

Szent-Györgyi Senior Teachers select youths who have the opportunity to get more acquainted with the scientific activities of the Faculty of Medicine at the University of Szeged and the Biological Research Center. The most important tasks of *Szent-Györgyi Senior Teachers* are to introduce the selected youths to the Szeged Scientists Academy's program, to encourage them to inquire into areas of research supervised by mentors of the Academy, and to emphasize all the potentials to reach the top of their profession with the help of the Academy's scholarships.

With the assistance of *Szent-Györgyi Senior Teachers*, it is possible to achieve an interconnection between secondary schools and higher education, which then facilitates the development of young talents to become creative, successful scientists.

Currently there are 18 *Szent-Györgyi Senior Teachers* in the program representing a number of schools in different cities all over the country, and their mutual goal is to develop young talents into prominent researchers of Hungarian science.

SÁNDOR BÁN

PROFESSIONAL LEADER OF THE SECONDARY SCHOOL PROGRAM

Radnóti Miklós Experimental Grammar School Szeged

Address: Tisza Lajos krt. 6-8., H-6720 Szeged, Hungary

TEACHING CAREER IN BRIEF

I started my career in 1993 at the Dugonics András Piarist Grammar School, Szeged, where I taught chemistry and biology, both as part of the regular curriculum and in advanced elective courses as well as special after-school lessons. In 1998–99, I played a leading role in designing and equipping the science section of the school's new building. I was also the head of the department of biology and chemistry for four years. Since 2002, I have taught in the special biology, chemistry and mathematics programs at the Radnóti Miklós Grammar School in Szeged, mostly in small groups. Between 2005 and 2012, I headed the biology department, which developed into the most successful high school biology workshop in the country during that period, based on advanced Matura examination and competition results. My colleagues and I have also established a state-of-the-art high school molecular biology laboratory. This facility has been made available to biology teachers from other schools for in-service trainings as well as to students for selection tests for international biology competitions. My colleagues and I have attended in-service trainings in molecular biology at the EMBL laboratories in Cambridge, Heidelberg and Monterotondo on a number of occasions. Since 2009, I have been the team leader of the Hungarian national teams at the International Biology Olympiad (IBO) and mentor to our national teams at the European Union Science Olympiad (EUSO). In 2010, I won the Rátz Lifetime Achievement Award. I am currently head of the EU-funded high school science laboratory.

PUBLICATIONS

Bán S. (1998). Gondolkodás a bizonytalanról: a valószínűségi és korrelatív gondolkodás fejlődése. [Thinking about the uncertain: developing probabilistic and correlative thinking]. In Csapó B. (Ed.): Az iskolai tudás. Budapest: Osiris Kiadó.

Bán S. (2010). A tanulás természetes jellemzőinek érvényesülése az iskolai biológiaoktatásban [Implementing natural features of learning in biology instruction]. Mester és Tanítvány 28: 48-56.

Bán S et al. (Eds.). (2003). From Vandal to Voter: Active Citizenship in Europe - Analysis and Methods. Szeged-Paris: KIFE.

SUCCESSFUL STUDENTS

Márton Szentirmai
Faculty of Medicine
University of Szeged, Szeged
- IBO 2011, silver medal
- EUSO 2010, gold medal
- IBO 2010, bronze medal

Petra Varga
Faculty of Medicine
University of Szeged, Szeged
- IBO 2016, silver medal
- EUSO 2015, gold medal
- iGEM 2014, Best Experimental Measurement Prize

Márk Harangozó
Faculty of Medicine
University of Szeged, Szeged
- EUSO 2015, silver medal
- iGEM 2014, Best Experimental Measurement Prize

Fatime Hawchar
Faculty of Medicine
University of Szeged, Szeged
- IBO 2011, bronze medal
- National Secondary School Competition (OKTV) Biology 4th place

Márton Pipicz
Faculty of Medicine
University of Szeged, Szeged
- Student research: Department of Anatomy, Faculty of Medicine, University of Szeged, Szeged
- 2011. Pro Scientia gold medal

JÓZSEF BARANYAI

ELTE Bolyai János Practice Primary and Secondary Grammar School

Address: Bolyai utca 11., H-9700 Szombathely, Hungary

TEACHING CAREER IN BRIEF

I completed my biology degree at the József Attila University (University of Szeged) in 1994. During my university years, I was a demonstrator at the Department of Zoology, and I stayed on as an assistant lecturer after receiving my degree. I have much to thank the excellent staff at the department (Drs. Róbert Gábriel, Éva Fekete and Katalin Halasi) for my professional development. They inspired me to become an outstanding student and assistant lecturer. Soon afterward, I was invited by János Iker to the newly established Bolyai Grammar School in Szombathely and have been teaching there since then for over 20 years. I am an advocate of problem-/inquiry-based learning, but also believe that there is not one single right method: one must always dynamically adjust to the problem at hand and tailor the methods accordingly. I have worked on a number of professional boards (Hungarian National Institute for Educational Research and Development (OKI/OFI) in curriculum development, dealing with the National Curriculum etc.). I am the head of our talent center, and I am proud of all the results of all my students. In 2011, I received the Rátz Lifetime Achievement Award, and in 2013 the Bonis Bona National Talent Award.

PUBLICATIONS

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 10. [Intermediate biology Matura examination papers 10]. Budapest: Nemzeti Tankönyvkiadó.

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 11. [Intermediate biology Matura examination papers 11]. Budapest: Nemzeti Tankönyvkiadó.

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 12. [Intermediate biology Matura examination papers 12]. Budapest: Nemzeti Tankönyvkiadó.

SUCCESSFUL STUDENTS

Ramón Hegedüs
biophysics researcher – Barcelona
established own firm
- Intel International Science and Engineering Fair 2001, 1st prize

Péter Korcsmár
practising physician – Germany
- Bolyai Prize for Youth 2001

Krisztina Berek
intern – Second Department of Medicine and Cardiology Center, Szeged
- National Scientific and Innovation Contest for Youth 2004, 1st place

Péter Novinszky
physician – Szombathely
- IBO 2011, silver medal

Bence Hajnal
medical student
Semmelweis Medical University, Budapest
- IBO 2013, silver medal

ANDREA BORBOLA

Radnóti Miklós Experimental Grammar School Szeged

Address: Tisza Lajos krt. 6-8., H-6720 Szeged, Hungary

TEACHING CAREER IN BRIEF

I've been an associate at the TERMOSZ Laboratory since 2014, I consider it as a prime element in my life. During my high school years I had the opportunity of assisting at the Cell Biology and Evolutional Micropaleontology Laboratory of the University of Szeged, which helped me start my scientific work. Throughout my university studies I was co-authoring several English publications, participated in an Indian-Hungarian joint research and for years I was the technical editor of the Plant Cell Biology and Development (Szeged) issue. In addition I also acquired some successful applications (Pro Renovanda Cultura Hungariae Fund – 'Students for Science' foundation).

My interests shifted towards molecular biology - starting from 2001, I carried out my PhD studies at the Genetic Institute of the Biological Research Center (Hungarian Academy of Sciences); later on I worked there as a science assistant. Next to learning the basic molecular biology techniques and elaborating new methods I also participated in several conferences. At the moment I'm teaching Biology at the Radnóti Miklós Experimental Grammar School and tending to the TERMOSZ Laboratory.

PUBLICATIONS

Kiss E, Olah B, Kalo P, Morales M, Heckmann AB, **Borbola A**, Lozsa A, Kontar K, Middleton P, Downie JA, Oldroyd GED, Endre G: (2009) Lin, a novel type of u-box/wd40 protein, controls early infection by rhizobia in legumes. **PLANT PHYSIOLOGY 151**:1239-1249

Borbola A: (2004) Construction of a linkage map for Medicago truncatula RIL population and its comparative analysis with other Medicago genetic maps. **ACTA BIOLOGICA SZEGEDIENSIS 48:**51

Kedves M, Párdutz Á and **Borbola A**: (1998) Transmission electron microscopy of X-ray irradiated teliospores of Ustilago maydis. **GRANA 37:**29-34.

EDIT CSALÁNÉ BÖNGYIK

Németh László Grammar School
Address: Ormos Ede u. 18., H-6800 Hódmezővásárhely, Hungary

TEACHING CAREER IN BRIEF

I began teaching in the Commercial and hospitality secondary school of Hódmezővásárhely in 1998, parallel with my university studies and I have been working in the Németh László Grammar School since 2015. I have been teaching biology and chemistry and during my years in the vocational secondary school my students performed well at professional competitions. I have always felt fortunate to be a teacher, I am one of the few persons whose job is their hobby. I regularly attend professional trainings and always embrace varied pedagogical methods and educational forms. Recently, I have been committed to digital pedagogy. I was teaching complex nature for a long time, I also prepared a workbook for internal use with one of my colleagues. Thanks to this I became closer to the activities of the Öveges labs and also had the opportunity to participate in the elaboration of complex labotatory workbooks. I was also engaged for two years in a teacher training for renewing STEM thinking. I gladly contribute to project writing, I am proud of my two successful National Talent Projects. I held Visible Natural Science – Digital Teaching Practice course as a trainer of MDOE from 2018. In the spring of 2020, I was invited to develop professional recommendations in line with the new NAT. In December 2020, I won the Digital Educator Award in the Tempus competition. At present, I am teaching students committed to natural sciences at each grade above 8th and also the ones who wish to perform the advanced level biology final exam.

PUBLICATIONS

(2001) K. Hernádi, I. Pálinkó, **E. Böngyik**, I. Kiricsi, Biomimetic oxygen transfer by Co and Cu complexes immobilized in porous matrices, **Studies in Surface Science and Catalysis** (https://www.sciencedirect.com/science/article/abs/pii/S0167299101818607?fbclid=IwAR0Bjxq2VFVhqnFrsiEJZDJS3EVEmpI6j-lbyL5IuL2zC7RhBZwtu6ooSo8)

(2016) Mobileszközök az oktatásban konferencia, Okostelefonokkal a természettudományos oktatásban, Debreceni Egyetemi Kiadó, Veszprém 2016

SUCCESSFUL STUDENTS

Lemaitre Lucien
- Rajki Zsuzsa award
- Szent-Györgyi competition 6. prize

ISTVÁN CSIGÉR

SZTE Primary and Secondary Grammar School

Address: Szentháromság utca 2., H-6722 Szeged, Hungary

TEACHING CAREER IN BRIEF

I earned my degree at the József Attila University (University of Szeged) in 1985, which qualified me to teach biology and chemistry in secondary school. Right after I completed my studies, I started my career at the Vocational School for Forestry amd Water Resources Engineering and Management in Barcs, where I spent six years. I taught biology and chemistry to students in the forestry stream and chemistry and lab practice to students in the water resources engineering and management stream. In acknowledgement of my work, I received a Ministerial Commendation in 1989. In 1991, I came to my current workplace, the University of Szeged Grammar School and Primary School (previously the University of Szeged Ságvári Endre Grammar School) as a mentor teacher in biology. My basic job has been to teach biology and to train university students studying to become biology teachers (supervising student teaching and administering examinations to student teachers). I also work as the lead teacher for biology in the Szeged Regional Student Science Laboratory, established by our high school and by the University of Szeged, which supports it financially. Within the limits of reason, I endeavour to develop relationships with my high school and university students based on collegiality and respect, never compromising on quality work standards or the requirements of consistent and rigorous assessment. In acknowledgement of my teaching activities, I received the Golden Rostrum Commemorative Plaque in 2001. I first became involved in the Szeged Scientists Academy in 2012, which honored me with the title of Szent-Györgyi Teacher and then in 2016 with that of Szent-Györgyi Senior Teacher. I have endeavoured to aid the academy from the beginning to discover and cultivate young talent.

PUBLICATIONS

Csigér I, Juhász K, Vargáné Lengyel A. (2011). Biológia 11 [Biology 11]. Szeged: Maxim Könyvkiadó.

Csigér I, Juhász K, Vargáné Lengyel A. (2012). Biológia 12 [Biology 12]. Szeged: Maxim Könyvkiadó.

Csigér I, Németh E. (2005). Néhány szakmai észrevétel dr. Lénárd Gábor Biológia II. és Biológia III. Tankönyvéről [Some observations on Dr. Gábor Lénárd's Biology II and Biology III coursebooks]. A biológia tanítása 2. szám: 7-19

SUCCESSFUL STUDENTS

Tamás Kovács
forest engineer
- Kitaibel Pál Competition 1988, 4th place

Magdolna Gaál
dermatologist, associate professor
Dermotology Clinic,
Faculty of Medicine,
University of Szeged, Szeged

Attila Vass
ophthalmologist
Eye Clinic, Faculty of Medicine,
University of Szeged, Szeged

László Pecze
biologist
University of Fribourg, Switzerland
- National Secondary School Competition (OKTV) 1997, 17th place

JULIANNA ERŐS-HONTI

Fazekas Mihaly Primary and Secondary Grammar School

Address: Horváth Mihály tér 8., H-1082 Budapest, Hungary

TEACHING CAREER IN BRIEF

I completed my studies as a research biologist at Eötvös Loránd University, Budapest, with a concentration in evolutionary biology, systematics and ecology. Later, at the same institution, I studied in the Theoretical Ecology Program within the Doctoral School for Biology. In the meanwhile, I also earned a teaching degree. I conducted my research in the field of plant ecology, examining the distribution of grass species in the Dolomites. In my research work, I gained experience in planning research. I can thus assist students in carrying out independent research and writing articles. I taught biology at Fazekas Mihály Primary and Grammar School for 8 years. Here I gained experiences in nurturing excellence, preparing students for competitions, as well as in giving demonstrative lessons. Actually, I work in the ELTE Trefort Ágoston Grammar School, where I also mentor candidate teachers in addition to the above mentioned tasks. A great emphasis is placed on academic competitions at our school, for which we continuously prepare our students. I consider my most signficant tasks to be the special after-school lessons for nurturing excellence and the summer biology camps that I organise, in which our students can become acquainted with the mentality of the researcher and the diversity of the academic field. In addition to teaching, I have worked as an educational developer for the Hungarian National Institute for Educational Research and Development (OFI), and I also contribute to the work of the Matura examination, as assigned by the Office of Education.

PUBLICATIONS

Mihók B, Erős-Honti Zs, Gálhidy L, Bela Gy, Illyés E, Tinya F, **Erős-Honti J**, Molnár Á, Szabó R. (2006). A Borsodi-ártér természeti állapota a helyben élők és az ökológusok szemével - interdiszciplináris kutatás a hagyományos ökológiai tudásról [The natural state of the Borsod flood plain through the eyes of locals and ecologists: interdisciplinary research on traditional ecological knowledge]. TERM. VÉD. KÖZL. 12: 79-103.

Dobolyi K, **Erős-Honti J**, Botta-Dukát Z. (2008). Habitat preference of Linum dolomiticum (Linaceae) STUDIA. BOT. HUNG. 39: 135–144.

Dobolyi K, **Erős-Honti J**, Rédei T. (2010). Az Odvas-hegy flórája és vegetációja [The flora and vegetation of the Odvas Mountain]. In Molnár Cs, Molnár Zs, Varga A. (Eds.): „Hol az a táj szab az életnek teret, Mit az Isten csak jókedvében teremt." Válogatás az első tizenhárom MÉTA-túrafüzetből MTA-ÖBKI, Vácrátót, 2003-2009. pp. 191-199.

SUCCESSFUL STUDENTS

Balázs Striker
university student – Imperial College London
- National Secondary School Competition (OKTV) biology, category II, 2018. 2nd place
- Dr. Árokszállásy Zoltán National Biology and Environmental Protection Competition, category III, 2017. 1st place

Kinga Tomcsányi
university student – Semmelweis University
- National Secondary School Competition (OKTV) biology, category II, 2018. 4th place

Csaba Szilágyi
university student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) biology, category II, 2013, 2nd place

Eszter Székely
university student – chemistry
Faculty of Sciences,
Eötvös Loránd University, Budapest
- OKTV biology, category I, 2012, 6th place

Dániel Zahemszky
university student – biology
University of York
- Dr. Árokszállásy Zoltán National Biology and Environmental Protection Competition 2013, 5th–7th place

ZSOLT ERŐS-HONTI

Fazekas Mihaly Primary and Secondary Grammar School

Address: Horváth Mihály tér 8., H-1082 Budapest, Hungary

TEACHING CAREER IN BRIEF

I am a research biologist with a PhD as well as having been trained as a specialized translator and secondary school biology teacher. For several years I had been working as an active reasercher at the Faculty of Horticultural Science, Szent István University. Ever since I received my teaching degree, I have been teaching biology to secondary school students (both in Hungarian and English). I participate in the nurturing excellence program at the school, preparing students for both domestic and international competitions, including the International Biology Olympiad. I also organise camps and prepare students for the Matura examination. I have developed teaching materials for public education, edited and published educational methodolgy coursebooks, and provided professional editing for materials used in public education. I participated in a Social Renewal Operational Program (TÁMOP) project dealing with the implementation of the framework curriculum in the Hungarian National Institute for Educational Research and Development (OFI), and I was also a member of a working group that harmonised the requirements of the Matura examinations with those of the framework curriculum. Since 2012, I have regularly completed assignments for the Office of Education. Currently, I am working as a biology teacher and vice principal at the Fazekas Mihály Primary and Grammar School of Budapest. As someone previously involved in higher education, it is my conviction that development and nurturing excellence should not be a process tied to particular educational phases. It should be an overarching effort. I am also convinced that success in the education system depends on effective communication between public and higher education.

PUBLICATIONS

Erős-Honti Zs. (2011). A kertészeti növények alaktana [Morphology of horticultural plants]. Egyetemi jegyzet. Budapest: BCE-KeTK.

Erős-Honti Zs. (2015). Az info-kommunikációs technológiák (IKT) alkalmazásának lehetőségei a kertészeti oktatás szakmódszertanában [Options for using Information and Communications Technology (ICT) in teaching horticulture]. In Szakmódszertani jegyzet az agrár-mérnöktanárok és -hallgatók számára (mezőgazdasági gépészet, mezőgazdaság, kertészet és parképítés) (Erős-Honti Zs, Nagy J). Budapest: BCE.

Jakucs E, **Erős-Honti Z**, Seress D, Kovács G M. (2015). Enhancing our understanding of anatomical diversity in Tomentella ectomycorrhizas: characterization of six new morphotypes. MYCORRHIZA 25(6): 419-429

NORBERT FARAGÓ

ELTE Trefort Ágoston Secondary Grammar School

Address: Trefort u. 8., H-1088 Budapest, Hungary

TEACHING CAREER IN BRIEF

I began my teaching career at the Terézváros Bilingual Primary and Grammar School in Budapest in 2001. I also taught biology and chemistry at a private grammar school concurrently. Since 2005, I have taught at the Trefort Ágoston School in Budapest, mostly biology. I have been a mentor teacher since 2006. In 2010, I received a certificate in mentoring candidate teachers. At school, I teach seventh- to twelfth-grade students as well as preparing the eleventh- and twelfth-grade students in advanced elective courses. Our students have achieved strong results at the Herman and Kitaibel competitions as well as at the National Secondary School Competition (OKTV) and the Árokszállásy biology and environmental protection competition. I regularly prepare students in groups for the advanced Matura examination. Since 2013, I have been head of the school's TÁMOP-funded science laboratory.

PUBLICATIONS

Faragó N., Szászné H J. (2013). Biológia lépésről lépésre [Biology step by step]. Budapest: Bölcselet Egyesület.

Czédulás K, **Faragó N,** Solymoss M, Szászné H J. (2013). Még egy lépés a biológia érettségihez [One more step toward the biology Matura examination]. Budapest: Bölcselet Egyesület.

SUCCESSFUL STUDENTS

Eszter Tóth
university student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) biology 2010, 2nd prize

György Varga
university student
Faculty of Sciences,
Eötvös Loránd University, Budapest
- Herman Competition 2010, 2nd prize - Árokszállásy Competition 2011, 1st prize EUSO XI, 2012, silver

Anna Uzonyi
university student
Technische Universität München
- Árokszállásy Competition 2014, 1st prize OKTV 2014, 1st prize
- IBO 2013, silver
- IBO 2014, silver

ANDREA FAZAKAS

Deák Téri Lutheran Gymnasium

Address: Sütő u. 1., H-1052 Budapest, Hungary

TEACHING CAREER IN BRIEF

I graduated with a secondary school teaching degree in biology and chemistry at József Attila University (University of Szeged) in 1988. I began teaching at the Deák Tér Lutheran Grammar School in Budapest in 1993. I quickly learned the importance of an encouraging school atmosphere in nurturing talented students. I developed Matura examinations for the Hungarian National Institute for Educational Research and Development (OFI) between 2003 and 2006. In 2004, I attended a Training for Trainers program to implement the two-tier Matura examination, and in 2004–05, I held talks on this new system for my colleagues. I have also participated in administering the advanced Matura examination since 2005. Meanwhile, in 2005, I passed a qualifying examination to become a mentor teacher at the Faculty of Sciences, Eötvös Loránd University, Budapest. I have always been happy to mentor future teachers. I have seen five of my candidates complete their teacher training. I received the BONIS BONA for the Nation's Talent Award in 2013 in acknowledgement of my efforts in preparing students for the National Secondary School Competition (OKTV). In 2015, I applied for the master teacher rank and received it the following year. I consider it important during my work to instil a passion for biology in my students and introduce them to the logic of the natural sciences. Various extracurricular events offer excellent opportunities in that regard. During the academic year, we usually take hiking trips, mainly in the Danube–Ipoly National Park (DINP). In addition, we also visit laboratories and attend lectures organised for students by the Hungarian Academy of Sciences. During the summer holidays, I take my students to one-week ecocamps. We have already visited the Kis-Balaton, Szatmár, Őrség and Lake Velence regions in and around Hungary as well as the North Hungarian Mountains.

PUBLICATIONS

Dr. Kisfaludy A, Dombóvári L, **Fazakas A,** Dr. Lóczy D. (2008). Természettudományi Enciklopédia [Encyclopaedia of science]. Budapest: Nemzeti Tankönyvkiadó.

SUCCESSFUL STUDENTS

Katalin Czöndör
researcher – assistant lecturer
Department of Physiology and Neurobiology,
Eötvös Loránd University, Budapest;
postdoc, University of Bordeaux
- L'Oréal-UNESCO for Women in Science International Prize 2014

Dóra Pálya
university student
Faculty of Medicine, Semmelweis University, Budapest
- National Secondary School Competition (OKTV) Biology 2015, 1st prize
- Curie Environmental Protection Competition 2014, 8th place
- Szentágothai Competition 2016, 1st prize

Orsolya Gresits
physician
Orthopedic Clinic,
Semmelweis University, Budapest
- OKTV Biology 2008, 11th place

Huba Szebik
university student – biology
Eötvös Loránd University, Budapest
- OKTV Biology 2013, 9th place
- OKTV Biology 2014, 31st place
- IBO national selection finals 2014

Bence Domokos
university student
Faculty of Medicine,
Semmelweis University, Budapest
- OKTV biology 2015, 11th place
- OKTV Biology 2016, 28th place
- Szentágothai Competition 2016, 5th place

JÓZSEF GŐZ

Tóth Árpád Secondary School

Address: Szombathi István u. 12., H-4024 Debrecen, Hungary

TEACHING CAREER IN BRIEF

I have been teaching biology and chemistry at the Tóth Árpád Grammar School in Debrecen since 2000. During my career, I have earned a qualification in specialized Hungarian–English translation as well as passing a mentor teaching examination and receiving the title of master teacher. At my job, in addition to teaching in the specialized biology program, I also joined the Arany János Nurturing Excellence Program, the International Baccalaureate Program and the Öveges Scientific Laboratory Program, as well as being involved in grant projects and in mentoring candidate teachers. In our school we are engaged in a specialized high school program for Biology and Chemistry that enjoys the longest history in the country. An integral part of this is nurturing excellence, developing projects, and preparing students for competitions and the Matura examinations. As a Matura examiner, I operate an online database which aids in the students' preparations for the examination with items on the written part presented in a system. My main area of interest and research is the methodology of teaching biology and, within that, digital innovation. In my work, I do my best to combine the facilities of ICT and the international environment with the traditional values embodied by my workplace and the domestic professional community. In 2018, I was awarded the Szent-Györgyi Trophy by the University of Szeged, and the MESTER-M award by the MOL Foundation.

PUBLICATIONS

Dobróné Tóth M, Futóné Monori E, **Gőz J**, Revákné Markóczi I. (2015). Biológiatanítás az IKT és IBL világában [Biology teaching in a world of ICT and IBL]. Debrecen: Debreceni Egyetemi Kiadó

SUCCESSFUL STUDENTS

Anna Nagy
university student, Eötvös Loránd University, Budapest
- Kitaibel Pál Competition 2015, 1st prize

Barbara Hinnah
university student, Faculty of Medicine, University of Debrecen
- Szent-Györgyi Competition 2016, 2nd prize

Erika Bereczki
university student, Faculty of Medicine, University of Debrecen
- Szent-Györgyi Competition 2016, 2nd prize

Bálint Ugrin
university student, Eötvös Loránd University, Budapest
- Bugát Pál Competition 2017, 3rd prize

Bettina Bán
university student, University of Technology and Economics, Budapest
- Bugát Pál Competition 2017, 3rd prize

Benedek Szathmári
university student - University of Szeged, Faculty of Sciences
- Biology National Secondary School Competition 2020, 36th place
- Szent-Györgyi Competition 2019 1st place
- Árokszállás Competition 2020 5th place
- Árokszállás Competition 2019 7th place
- Árokszállás Competition 2018 4th place

Dóra Pintye
university student - University of Debrecen, Faculty of Medicine
- Árokszállás Competition 2019 21th place
- Árokszállás Competition 2018 12th place

ZSOLT HORVÁTH

Gödöllő Reformed Secondary School

Address: Szabadság tér 9., H-2100 Gödöllő, Hungary

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry from the Kossuth Lajos University (University of Debrecen) in 1995 and have been working since then at the Reformed Church Grammar School in Gödöllő. During the first years of my career, I learned about the BISEL biological water quality assessment method, and in 2000 I participated in the Bioindication and Internet 2000 EU Leonardo in-service training for teachers in Belgium. Then in summer 2002, I organised the BISEL bioindication water quality assessment method 2 accredited in-service training. Between 2006 and 2008, I was asked to update high school biology coursebooks written by Gábor Lénárd and published by Nemzeti Tankönyvkiadó publishers. My tasks included editing (the Prizma series written by Mrs József Berger), preparing digital teaching materials (a CD-ROM with images, figures and experiments for the Lénárd biology coursebook series) and holding lectures (at the start-of-the-year Nemzeti Tankönyvkiadó conference). I have participated in designing biology competition items since 2008. Between 2011 and 2012, I edited digital teaching materials for chemistry and biology called Yenka and Sunflower, and I prepared a series of histological images for Mozaik Publishers. In 2015, I edited digital teaching materials entitled "The molecular cell biology of autolysis, apoptosis and cell regeneration", created by the Department of Anatomical, Cell and Developmental Biology, Eötvös Loránd University, and took part in a training for trainers on the advanced Matura examination in biology. As of 2016, my school (along with three other Hungarian high schools) has participated in a health protection program based on the TANTUdSZT contemporary teaching project, which won a teaching methodology competition announced by the Hungarian Academy of Sciences. In 2016, I had three articles published in the Eduvital column of Élet és Tudomány (Life and Science), a popular science weekly.

PUBLICATIONS

Horváth Zs. (2008). Képek, ábrák és kísérletgyűjtemény a Lénárd-féle biológia-tankönyvcsaládhoz [Images, figures and experiments for the Lénárd biology coursebook series]. Budapest: Nemzeti Tankönyvkiadó Zrt.

Horváth Zs. (2016). Fehérjebontás a sejtekben [Proteolysis in cells]. ÉLET ÉS TUDOMÁNY 71: 140-142.

Papp T, Szekeres Zs, Huoranszki Cs, **Horváth Zs.** (2016). Mindennapi kenyerünk 1-2 [Our daily bread 1–2]. ÉLET ÉS TUDOMÁNY 71: 468-470.

Horváth Zs. Biology assignments for those preparing for advanced level graduation and OKTV Mozaik Publisher, Szeged, 2019

Horváth Zs. Test maturity task sets 10 task sets with solutions and explanations Mozaik Publisher, Szeged, 2020

SUCCESSFUL STUDENTS

Éva Hamar
PhD student
Vegetable Crop Research Department, National Agricultural Research and Innovation Center

- National Secondary School Competition (OKTV) 2011, 7th place
- TUDOK National Finals: Medicine-biology section: special prize for best presentation

ZOLTÁN JÁNOS KERÉNYI

Premonstratensian St. Norbert Secondary School, Technical School for Church Music and Dormitory

Address: Takács Menyhért út 2., H-2100 Gödöllő, Hungary

TEACHING CAREER IN BRIEF

I earned a degree from the József Attila University (University of Szeged) as both a biology teacher and a biologist with a specialization in ecology. I began my teaching career as a part-time biology teacher at the Dugonics András Piarist Grammar School in Gödöllő, moving on to the Premonstratensian (Norbertine) Grammar School in the same town in 1998. I taught biology to students within the regular curriculum and advanced elective courses in biology for those preparing to study the subject at university as well as other enthusiasts. We launched a specialized program in biology and chemistry in 2014–15, and, as department head, I played an active role in developing its content and structure. Since our school boasts a great many outstanding students, my teaching activity has become focused on engaging with young people with particular talent. In order to carry out the work in a truly professional manner, I also completed a course to become a talent development teacher at the University of Debrecen and attended the Geniusz in-service training ("Nurturing excellence among talented biology students"). One regular, favourite form of dealing with talented young people is the Path to Science program, through which research teams of five students are formed to learn and improve thinking through joint research activity on a particular topic area. At the end of the project, the research teams share their results in a presentation every year at the TUDOK regional and national conferences. For my work in nurturing excellence, I have so far received the Kontra György Award (2010), Bonis Bona Award (2013), a Ministerial Certificate of Recognition (2016) and the Pro Progressio Award.

PUBLICATIONS

Kerényi Z. (2004). Pilisjászfalu madárvilága [The bird world of Pilisjászfalu]. In Pilisjászfalu I. Pilisjászfalu: Pilisjászfaluért Közalapítvány.

Kerényi Z. (2011). A Gödöllői-dombság állatvilága [The animal world of the Gödöllő Hills]. In Szabó L. (Ed.): A Gödöllői-dombság természeti- és gazdaságföldrajzi viszonyai. Budapest: Agroinform Kiadó.

Kerényi Z, Ivók E. (2013). Nestsite characteristics of the European Bee-eater (Merops apiaster L.) in the Gödöllő Hills. ORNIS HUNGARICA 21(2): 23-32.

SUCCESSFUL STUDENTS

Bence Prehoda
university student, Faculty of Medicine, Semmelweis University, Budapest
- National Secondary School Competition (OKTV) Biology 2012, 4th place
- OKTV Biology 2013, 12th place
- IBO national selection, 3rd place

Flóra Takács
university student
University College London
- OKTV Biology 2014, 8th place
- IBO 2015, silver medal
- ICYS 2015, silver medal

Márton Csaba
university student, Faculty of Medicine, Semmelweis University, Budapest
- OKTV Biology 2015, 12th place
- TUDOK national finals 2015, grand prize
- KutDiák essay-writing competition 2014, 1st prize
- Avram Hershko Science Competition 2014. and 2015, 1st prize

István Krisztofer Tóth
Bartók Conservatory, Liszt Academy
- Hlavay József National Environmental Science Students Conference 2014, 1st prize
- TUDOK national finals 2015, grand prize

Gergely Csigi
university student, Faculty of Medicine, Semmelweis University, Budapest
- Hlavay József National Environmental Science Students Conference 2016, 1st prize
- OKTV Biology 2017, 21st place and 2018, 15th place
- International Conference of Young Scientist 2017, bronze medal, 2018, silver medal
- TUDOK national finals 2017, 2nd place

RÓBERT KERTÉSZ

Táncsics Mihály Secondary Grammar School of Kaposvár

Address: Bajcsy-Zsilinszky utca 17., H-7400 Kaposvár, Hungary

TEACHING CAREER IN BRIEF

I earned my secondary school teaching degree in biology and chemisry at the József Attila University (University of Szeged) in 1993. I started working at the Department of Botany there and then moved to Kaposvár in 1997. Since then, I have been teaching biology and chemistry in the regular and specialized curricular programs at my alma mater there, Táncsics Mihály Grammar School. Since the Research area of the two-tier Matura examinations, I have participated in the work of the advanced Matura examination boards, I have corrected advanced written Matura examinations and was even requested to oversee examination marking. I passed two specialized examinations (at the University of Szeged and the Budapest University of Technology and Economics) and have incorporated the knowledge I have thus acquired into my everyday practice. In 2014, I received the rank of master teacher, so I am now also called on to provide consultations, through which I endeavour to improve the position of my scientific subjects, which are continually being pushed into the background. During my work in secondary school, I have always laid great stress on nurturing excellence – I have prepared my students for various competions in both of my subjects. I consider it important to aid my students in strengthening their own innate interest and developing their own high professional standards.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Ábel Perjés
research fellow
National Institute for Sports Medicine
• National Secondary School Competition (OKTV) Biology 2009, 9th place

András Horváth
research fellow
Institute of Enzymology, Hungarian Academy of Sciences, Budapest
• OKTV Biology 2002

Szabolcs József Vigvári
physician
Department of Emergency Medicine, University of Pécs
• OKTV Biology 2002

Szilveszter Ziegenheim
PhD student
University of Szeged
• OKTV Biology 2010

BEATRIX CSILLA BAGI KERTÉSZ

Táncsics Mihály Secondary Grammar School of Kaposvár

Address: Bajcsy-Zsilinszky utca 17., H-7400 Kaposvár, Hungary

TEACHING CAREER IN BRIEF

I earned my teaching degree in biology and chemistry at the József Attila University (University of Szeged) in 1993. I rounded out my degree with a postgraduate qualification in environmental protection in 1995. I taught at the Corvin Mátyás Vocational School in Hódmezővásárhely for four years, and I have been teaching in my current workplace at the Táncsics Mihály Grammar School in Kaposvár since 2001. Throughout my career, I have placed a major emphasis on nurturing excellence in my professional work. My students have achieved success at various competitions in chemistry, biology and environmental protection, many of them having gone on to study medicine, pharmacy,

biology and chemistry. I teach advanced elective courses in both my subject areas, and I was the form teacher for three of the groups in the school specializing in biology and chemistry as well as their teacher in those subjects. I have aided my students with a great deal of useful experience by regularly participating in the advanced Matura examinations in both of my subjects. I have always considered it important to learn about and apply an objective measurement of knowledge. I therefore did a specialized examination in teaching with a specialization in educational assessment at the University of Pécs in 2011. I feel responsible for the future of my academic subjects. My aim is for us to engage in a truly appealing science education in our schools at a high standard, an effort I strive to support as a consultant with a master teacher qualification. Finally, I think one needs sufficient professional humility and endurance to be successful in one's work, not only talent.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Bence Bajzik
medical student – Faculty of Medicine, University of Pécs
- Árokszállásy 2011, 5th place
- OKTV Biology (II.) 2013, 34th place
- Fodor 2013, 2nd prize

Eszter Kovács
medical student – Faculty of Medicine, Semmelweis University, Budapest
- Árokszállásy 2017, 4th place
- OKTV Biology (II.) 2017, 7th place

Krisztina Bőhm
- Árokszállásy 2021, 3rd place
- Oláh 2021, 7th place

Zsombor Esküdt
- EUSO sc. 2020, 6th place

Botond Szikra
- Árokszállásy 2018, 3rd place, 2019, 1st place, 2020, 1st place, 2021, 4th place
- Fodor 2019, 3rd place, 2021, 1st place
- Irinyi 2019, 6th place
- Kitaibel 2019, 1st place
- Oláh 2021, 6th place
- OKTV Biology(II.) 2021, 9th place
- OKTV Chemistry (II.) 2021, 14th place
- IBO sc. 2021, 5th place
- Young Scientists Biology 2021, 8th place,
- Young Scientists Chemistry 9th place
- SZTA Excellent Student Award 2021.

Máté Szekér
- Irinyi 2018, 12th place, 2019, 8th place
- Oláh 2021, 3rd place
- Fodor 2021, 3rd place
- OKTV Biology(II.) 2020, 24th place, 2021, 14th place
- OKTV Chemistry (II.) 2020, 19th place, 2021, 15th place
- Young Scientists Biology 2021, 9th place
- IBO sc. 2021, 4th place

LÁSZLÓ KUTROVÁCZ

ELTE Trefort Ágoston Secondary Grammar School

Address: Trefort utca 8., H-1088 Budapest, Hungary

TEACHING CAREER IN BRIEF

I started my teaching career in autumn 2002 at the Eötvös Loránd University Trefort Ágoston School in Budapest, where I have worked ever since. I have trained candidate teachers as a mentor teacher in chemistry there for nine years, and I have been department head since 2011. As a form teacher, I will see my second group of students complete their Matura examinations. In 2010, I received the Trefort Ágoston Certificate of Recognition from the Eötvös Loránd University Senate. In the same year, I was certified as a mentor teacher with a specialization in nurturing excellence. My goal is to shed light on the beauty and importance of scientific connections and their close ties to our everyday lives. I lay a great deal of emphasis on mentoring talented students in special after-school lessons. Two of my students have reached the National Secondary School Competition (OKTV) finals in biology and two have done so in chemistry. One of my students became a member of the national team for the International Mendeleev Chemistry Olympiad. In 2018 I received the Lórrántfy Zsuzsanna Award from the ELTE Senate, and in 2019 I received the Bonis Bona Award from the Ministry of Human Resources.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Borbála Bognár
psychologist
- National Secondary School Competition (OKTV) biology 2007,13th place

Susanne Prokop
medical researcher – KatonaLab – Momentum Laboratory of Molecular Neurobiology
- Irinyi János National Chemistry Competition 2008, 25th place
- National Secondary School Competition (OKTV) chemistry 2010, 30th place (could not participate in the finals)

Eszter Tóth
doctor
- National Secondary School Competition (OKTV) biology 2010, 2nd place

Anna Baumann
student
- National Secondary School Competition (OKTV) chemistry 2017, 25th place
- Dürer Chemistry Competition 2017, 1st place

Péter Kalapos
student
- Irinyi János National Chemistry Competition 2015, 10th place
- Oláh György National Chemistry Competition 2015, 2nd place
- National Secondary School Competition (OKTV) chemistry 2016, 13th; 2017, 7th place
- Dürer Chemistry Competition 2017, 1st place
- Baltic Chemistry Competition, 8th place
- Member of the Mengyelejev International Students Olympics Team
- International Chemistry Students Olympics 2017, silver medallion

ADRIEN LENGYEL

Calvinist Grammar School of Kecskemét

Address: Szabadság tér 3/a, H-6000 Kecskemét, Hungary

TEACHING CAREER IN BRIEF

Being a student at the József Attila University of Szeged, I concluded my studies as a Biology and Chemistry teacher. My first employment was at the Katona Secondary School at Kecskemét, then I changed to the Calvinistic Secondary School where I'm working up to this day. Upon launching the six-grade education program, my task was to develop the Chemistry curriculum, later I became the head of the teacher's team. We are frequent participants of the TUDOK (Annual Conference of National Scientific Students' Associations) with remarkable success. The achieved results truly enhanced my personal development. Along with a colleague, I'm organizing the Biology field trips which are quite popular amongst our students. I'm also an evaluating teacher at the advanced level final examinations. Throughout the years my main focus has been to modernize Biology education; especially reaching out for students who show interest in this field - for this achievement I received an award. Other significant professional steps were publishing textbooks and books assisting the preparation for final examinations (MAXIM publishing). These activities demand great devotion, lots of reading, consulting and many working hours, yet offer the best way for self-improvement in the dynamically changing subject of Biology. In addition, I handled full readership of a laboratory project and held advanced education to my colleagues. I find these activities both challenging and exciting.

PUBLICATIONS

Juhász K., **Vargáné L.A.** Theme Outlines for Biology Final Examination, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** 130 themes of Biology, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** Colourful thesmes of Biology, Maxim Publishing, Szeged, 2017.

Csigér, I., Juhász, K., **Vargáné Lengyel, A.** (2011).Biológia 11 (Biology 11). Szeged: Maxim Könyvkiadó

Csigér, I., Juhász, K., **Vargáné Lengyel, A.** (2012).Biológia 12 (Biology 12). Szeged: Maxim Könyvkiadó

SUCCESSFUL STUDENTS

Andor Kenyeres
medical student at SZOTE
• OKTV Biology 2010, 35th place

Emese Klément
medical student at Semmelweis University
• OKTV Biology 2012, 30th place

Márk Svévis
doctor at the Honvéd Hospital Budapest
• ORKV Chemistry 2001, 1st place

ZSOLT NYISZTOR

Nagy Lajos Grammar School of the Cistercian Order

Address: Széchenyi tér 11., H-7621 Pécs, Hungary

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry at the University of Pécs. During my studies, I was engaged in an ecological study of barn owls, among other topics, as well as a molecular biology project involving the processing of samples collected in the field for taxonomic purposes. During this time, I also spent half a year in Italy as an ERASMUS student at the University of L'Aquila. In 2001, I began teaching at the Nagy Lajos Cistercian Grammar School in Pécs, where I have been a teacher ever since. I graduated from the Doctoral School of Biology and Sportbiology of University of Pécs in 2019. I studied the development of the mammalian retina. I would like to pass on to my students my enthusiasm for the sciences and the ability to wonder at the myriad beauty of the created world. I believe that Hungary should be represented among the scientific elite of the world through diligence and endurance. I consider it important for my students to leave high school not only strengthened in knowledge, but also in moral and spiritual values.

PUBLICATIONS

Nyisztor, Zs. (2015) Biológia munkafüzet 11-12. osztály [Biology workbook grades 11–12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 11. osztály [Biology teacher's guide grade 11]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 12. osztály [Biology teacher's guide grade 12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs., Dénes, V., Kovács-Valasek, A., Hideg O., Berta G., Gábriel R. (2018). Pituitary adenylate cyclase activating polypeptide (PACAP1-38) exerts both pro and anti-apoptotic effects on postnatal retinal development in rat. **Neuroscience** 385, 59-66.

Denes, V., Hideg, O., **Nyisztor, Zs.**, Lakk, M., Godri, Z., Berta, G., Geck, P., Gábriel, R. (2019). The neuroprotective peptide, PACAP1-38 contributes to horizontal cell development in postnatal rat retina. Investigative **Ophtalmology and Visual Science**.

SUCCESSFUL STUDENTS

Eszter Mária Végh
resident – Semmelweis University Heart Center, Budapest
- National Secondary School Competition (OKTV) biology, 12th place

Sándor Szabó
medical student – Faculty of Medicine, Semmelweis Medical University, Budapest
- OKTV Biology 2010, 14th place
- Árokszállásy Zoltán Biology Competition 2010, 20th place

Viktória Kornélia Takács
biologist – Department of Pathology, University of Pécs
- Kitabel Pál Biology Competition 2008, 23rd place
- OKTV biology 2010, 9th place
- TUDOK national finals 2010, grand prize

Dóra Kinga Kevey
medical student – Faculty of Medicine, University of Pécs
- TUDOK national finals 2013, grand prize
- OKTV biology 2013, 12th place
- Árokszállásy Zoltán Biology Competition
- 2014 national finals, 21st place

Bence Szélig
medical student – Faculty of Medicine, University of Pécs
- OKTV biology 2015, 11th place
- Árokszállásy Zoltán Biology Competition 2016, 7th place

Fanni Kóródi
student – Nagy Lajos Cistercian Grammar School in Pécs
- TUDOK national finals 2013, grand prize

TÜNDE SZALAINÉ TÓTH

Lovassy László Grammar School

Address: Cserhát ltp. 11., H-8200 Veszprém, Hungary

TEACHING CAREER IN BRIEF

I have been an educator since 1982 and continue to derive great joy from my work to the present day. In addition to my daily teaching responsibilities, I have endeavoured to use and pass on my knowledge and experience at the school, municipal, county and national levels. I consider it a priority to nurture excellence: so far, 45 of my students have reached the final round of Hungary's highly respected National Secondary School Competition (OKTV) in biology, two of them won first place, two of them won second place, and 13 of them finished in the top ten. My students have achieved great success in numerous other prominent competitions for young scholars. As an acknowledgement of my work in nurturing excellence, I received the Rátz Life Achievement Award in 2014, the „Excellent Competition Preparator" title in 2017 and the MOL-Mester-M Award in 2018, as well as a Ministerial Certificate of Recognition. I have also been awarded the Ranolder Prize from the City of Veszprém and the Pro Talento Prize from the Veszprém County Institute of Education. I take part in organising county and national competitions as well as school events. I am a master teacher, consultant, board chair for the Matura examination and multiplier as well as participating in bringing grant projects to fruition. I was a form teacher for 19 years. I enjoy professional challenges, and I have worked as an educational developer in several projects for the Hungarian National Institute for Educational Research and Development (OFI). I have often published in Élet és Tudomány (Life and Science), a popular science weekly, in which studies by my students are also occasionally published. Since 2014, I have participated in the work of the National Teachers Chamber (NPK) as a national delegate, and I have been the national chair of the Man and Nature section of the Chamber since 2015.

PUBLICATIONS

Feith H, Melicher D, Máthé G, Gradvohl E, Füzi R, Darvay S, Hajdú Zs, Nagyné Horváth E, Soósné Kiss Zs, Bihariné Krekó I, Földvári-Nagy Lászlóné, Molnár E, **Szalainé Tóth T**, Urbán V, Kassay A, Falus A. (2016). Tapasztaltok és motiváltság: magyar középiskolások véleménye az egészségnevelő programokról [Experience and motivation: Hungarian high school students' views on health education programs]. ORVOSI HETILAP 2: 65-69.

Szalainé Tóth T. (2015). Megváltoztatható-e, ami génjeinkben meg van írva? [Can we change what is written in our genes?] ÉLET ÉS TUDOMÁNY 48: 1526-1528.

Szalainé Tóth T, Dr. Szűcsné Kerti A. (2017). Érettségi mintafeladatsorok biológiából (10 írásbeli emelt szintű feladatsor) [Sample Matura examinations in biology (10 advanced written examination papers)]. Szeged: Maxim Kiadó.

SUCCESSFUL STUDENTS

Lilla Kepes
physician, anaesthesiology resident
St. Anna-Virngrund-Klinik, Ellwangen, Germany
- National Secondary School Competition (OKTV) biology 2006, 1st place
  Kitaibel Pál Biology and Environmental Protection Competition 2003, 7th place
  Kitaibel Pál Biology and Environmental Protection Competition 2004, 4th place

Bence Szalai
postdoctoral medical researcher
Joint Research Center for Computational Biomedicine, RWTH Aachen Uniklinik, Germany
- OKTV biology 2001, 6th place
- OKTV biology 2000, 12th place
- Kitaibel Pál Biology and Environmental Protection Competition 1999, 3rd place

Norbert Hőgye
Medical doctor – Semmelweis University, General Medicine
- Biology National Secondary School Competition 2012, 2nd place
- Biology National Secondary School Competition 2011, 17th place

Attila Kékesi
University student, Eötvös Loránd University, biology-physics major
- Biology National Secondary School Competition 2017, 2nd place

Patrícia Stark
University student, Corvinus University
- Biology National Secondary School Competition 2016, 1st place
- 2017: Richter Gedeon Talentum Foundation scholarship

CSILLA SZENTESI

Földes Ferenc High School

Address: Hősök tere 7., H-3525 Miskolc, Hungary

TEACHING CAREER IN BRIEF

I completed my studies in biology and geography at the Kossuth Lajos University (University of Debrecen) in 1998. To this day, I have taught in my former high school, Földes Ferenc Grammar School in Miskolc. In 1998, I also completed a teaching degree in the field of environmental protection at the Eszterházy Károly College in Eger. In 2005, I passed an examination in public school management and teaching. In 1996, I joined the County Institute of Education, and I was appointed a municipal consultant in biology and environmental protection between 1998 and 2011. Since 2005, I have been a board chair for the advanced Matura examination in my subject areas and am also engaged in coordinating the corrections for the advanced written Matura examination. During my career, I have organised lectures and held practical in-service training for my colleagues in the county. I have participated in testing digital teaching materials, preparing task sheets and editing geography coursebooks as well as serving as a mentor teacher for a number of student teachers from the University of Debrecen.

As of 2015, I have also worked as a master teacher and an educational inspection and teacher certification expert. In 1997, my colleagues and I launched the Árokszállásy Biology and Environmental Protection Competition, of which I am the main organiser. My school has had a great natural sciences tradition. My work in preparing my students for the advanced Matura examination and in my capacity as a form teacher is a top priority for me. I prepare my students continuously, hold special after-school lessons, and organise fieldwork and lectures. I have received a number of certificates at national competitions through my students as well as a certificate of appreciation from the city. My greatest source of pride is my students' success and the happy smiles on their faces when they achieve their goals.

PUBLICATIONS

Szentesi Cs. (2014). Biológia munkafüzet és tanári segédlet 7.8.10. évfolyam [Biology workbook and teacher's guide for grades 7, 8 and 10]. Miskolc: Miskolc Megyei Jogú Város Önkormányzat

SUCCESSFUL STUDENTS

Bálint Lakatos
PhD student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) Biology 2010, 45th place

Lukács Lesinszki
demonstrator
Semmelweis Medical University, Budapest
- OKTV Biology 2014, 5th place
- Árokszállásy Competition 2014, 2nd prize

Ábel Major
student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) Biology 2017, 10th place

Mátyás Sajgó
student
- National Secondary School Competition (OKTV) Biology 2017, 16th place

SZEGEDI TUDÓS AKADÉMIA
SZEGED SCIENTISTS ACADEMY

UNIVERSITY PROGRAM

RESEARCH CENTERS

UNIVERSITY OF SZEGED

The University of Szeged is one of the leading universities of Hungary, committed to maintaining quality higher education.

The University was established by the integration of Attila József University, Albert Szent-Györgyi Medical University, Szeged College of Food Industry, Gyula Juhász Teacher Training College and the College of Agriculture in Hódmezővásárhely. The University of Szeged offers a wide range of educational opportunities for the students: hundreds of basic, master, doctoral and higher educational professional training programs, just like adult training and postgraduate specialist training courses. With its nearly 25,000 students and 7,000 employees (out of which 2,400 are academic researchers and teachers), the University of Szeged is one of the largest institutions of the Southern Great Plain region. Teaching and research are performed by the 12 Faculties while medical health care is the task of the Albert Szent-Györgyi Health Center. The mission and aim of the University is to cultivate science and internationally competitive research work and to advance its research university nature.

BIOLOGICAL RESEARCH CENTER

The Biological Research Center (BRC) is an outstanding institution of the internationally acknowledged Hungarian biological research. It was founded in 1973. The 4 institutes of BRC - the Institutes of Biophysics, Biochemistry, Genetics and Plant Biology - employ about 260 scientists whose work is hall-marked by highly appreciated international scientific publications and patents. The research topics include several fields of molecular and cell biology from the industrial utilization of bacteria through controlled improvement of cultivated plants to the problems of human health and environmental protection. BRC is mainly a scientific basic research center, but scientists of BRC play an initiative role in the foundation and promotion of biotechnological companies, as well as in educational duties. The successful activity and high-level scientific research pursued in BRC were also acknowledged by the European Molecular Biological Organization (EMBO) and in 2000 the European Union awarded the title of “Center of Excellence“ to BRC.

(http://www.brc.hu/about_brc.php)

SZENT-GYÖRGYI MENTORS

"If I go out into nature, into the unknown, to the fringes of knowledge, everything seems mixed up and contradictory, illogical, and incoherent. This is what research does; it smoothes out contradictions and makes things simple, logical, and coherent."

Albert Szent-Györgyi

Szent-Györgyi Mentors of the Szeged Scientists Academy are researchers, who engage in internationally highly reputable scientific activities, supervise their own research groups, and whose works are published in prestigious scientific journals.

Szent-Györgyi Mentors are committed to participate in the education of the *Szent-Györgyi Students*, offering them the opportunity to join their research groups that provide the required conditions for research. *Szent-Györgyi Mentors* also personally assist in training and developing the young talents, primarily focusing on the importance of nurturing talent.

Szent-Györgyi Mentors also undertake to involve other mentors from among his or her foreign partners in the activities of the Szeged Scientists Academy as *Szent-Györgyi International Mentors* so as to provide *Szent-Györgyi Students* with the ability to participate in the projects of foreign laboratories as well.

Currently, there are 44 *Szent-Györgyi Mentors* supporting the *Szent-Györgyi Students* of the Szeged Scientists Academy. They are renowned and recognised scientists of the University of Szeged and the Biological Research Center, and they are all part of a widespread international network of scientists and researchers. They engage in internationally admired microbiological, genetic and biomedical research.

ZOLTÁN RAKONCZAY

PROFESSIONAL LEADER OF THE UNIVERSITY PROGRAM

University of Szeged
Faculty of Medicine
Department of Pathophysiology

Address: Semmelweis u. 1., H-6725 Szeged, Hungary

RESEARCH AREA

Acute pancreatitis is a sudden inflammation of the pancreas which can have mild or severe course. Unfortunately, the latter form still has an unacceptably high mortality. The reason for this is, at least in part, due to the facts that the pathomechanism of acute pancreatitis is unclear and we have no specific treatment of the disease. The main aims of our group are to investigate the roles of various inflammatory factors, mitochondria and the recently identified pancreatic ductal cells in the development of acute pancreatitis. Our hope is to eventually open up new therapeutic possibilities in acute pancreatitis.

TECHNIQUES AVAILABLE IN THE LAB

Induction of acute pancreatitis in animals, isolation of pancreatic acinar and ductal cells, measurement of enzyme (amylase, trypsin, myeloperoxidase, lacatate dehydrogenase) activities, confocal microscopy, histological analysis, ELISA, microspectrofluorimetry (intracellular H^+, Ca^{2+} concentration), microperfusion of pancreatic ducts, measurement of pancreatic ductal fluid secretion, Western blot analysis, RT-PCR.

SELECTED PUBLICATIONS

Biczó, G., Végh, E.T., Shalbueva, N., Mareninova, O.A., Elperin, J., Lotshaw, E., Gretler, S., Lugea, A., Malla, S.R., Dawson, D., Ruchala, P., Whitelegge, J., French, S.W., Wen, L., Husain, S.Z., Gorelick, F.S., Hegyi, P., **Rakonczay Jr., Z.**, Gukovsky, I., Gukovskaya, A.S. (2018) Mitochondrial dysfunction, through impaired autophagy, leads to endoplasmic reticulum stress, deregulated lipid metabolism, and pancreatitis in animal models. **Gastroenterology 154:** 689-703.

Pallagi, P., Hegyi, P., **Rakonczay Jr., Z.** (2015) The physiology and pathophysiology of pancreatic ductal secretion: the background for clinicians. **Pancreas 44:** 1211-1233.

Pallagi, P., Balla, Z., Singh, A.K., Dósa, S., Iványi, B., Kukor, Z., Tóth, A., Riederer, B., Liu, Y.J., Engelhardt, R., Jármay, K., Szabó, A., Janovszky, Á., Perides, G., Venglovecz, V., Maléth, J., Wittmann, T., Takács, T., Gray, M.A., Gácser, A., Hegyi, P., Seidler, U., **Rakonczay Jr., Z.** (2014) The role of pancreatic ductal secretion in protection against acute pancreatitis in mice. **Crit Care Med 42:** e177-88.

Biczó, G., Hegyi, P., Dósa, S., Shalbuyeva, N., Berczi, S., Sinervirta, R., Hracskó, Z., Siska, A., Kukor, Z., Jármay, K., Venglovecz, V., Varga, I.S., Iványi, B., Alhonen, L., Wittmann, T., Gukovskaya, A., Takács, T., **Rakonczay Jr., Z.** (2011) The crucial role of early mitochondrial injury in L-lysine-induced acute pancreatitis. **Antioxid Redox Signal 15:** 2669-81.

Rakonczay Jr., Z., Hegyi P., Takács T., McCarroll J., Saluja A.K. (2008) The role of NF-κB activation in the pathogenesis of acute pancreatitis. **Gut 57:** 259-267.

FERENC BARI

University of Szeged
Faculty of Medicine
Faculty of Science and Informatics
Department of Medical Physics and Informatics

Address: Korányi fasor 9., H-6720 Szeged, Hungary

RESEARCH AREA

Adequate and continuous blood supply of the brain requires a very precise regulatory mechanism. Investing the properties of the cerebral microcirculation opens a unique way for understanding the details (components, dynamics) of blood flow regulation in both the healthy and the injured brain. We have been studying the major characteristics of the neurovascular coupling (enhanced neuronal activity is followed by changes in the local blood perfusion) for more than 20 years. We have obtained considerable knowledge on the nature of excitatory amino acid release and the concomitant changes in local microcirculation. We have intensively studied the vascular consequences of hypoxic-ischemic injuries and tested various, potentially neuroprotective strategies. We study cerebral micro-circulation in various animal models. Our major approach is using optical methods (intravital microscopy, laser Doppler flowmetry, laser speckle contrast analysis [LASCA]). In addition, we perform *ex vivo* studies in order to characterize morphological alterations and changes in protein expression in the injured brain. Recently, we have been working on new neuroprotective approaches.

During the last years our research interest involves the question how medical informatics could help in stroke prevention and treatment of stroke victims.

TECHNIQUES AVAILABLE IN THE LAB

Intravital microscopy, laser Doppler flowmetry, laser speckle contrast image analysis, brain electrophysiology,monitoring of vital functions of anesthetized animals, data evaluation and analysis.

SELECTED PUBLICATIONS

Clark, D., Tuor, U.I., Thompson, R., Institoris, A., Kulynych, A., Zhang, X., Kinniburgh, D.W., **Bari, F.,** Busija, D.W., Barber, P.A. (2012) Protection against recurrent stroke with resveratrol: endothelial protection. **PLOS One 7:** e47792.

Domoki, F., Zölei, D., Oláh, O., Tóth-Szűki, V., Hopp, B., **Bari, F.,** Smausz, T. (2012) Evaluation of Laser-speckle contrast image analysis techniques inthe cortical microcirculation of piglets. **Microvasc Res 83:** 311-7.

Hugyecz, M., Mracskó, E., Hertelendy, P., Farkas, E., Domoki, F., **Bari, F.** (2011) Hydrogen supplemented air inhalation reduces changes of prooxidant enzyme and gap junction protein levels after transient global cerebral ischemia in the rat hippocampus. **Brain Res 1404:** 31-8.

Mracsko, E., Hugyecz, M., Institoris, A., Farkas, E., **Bari, F.** (2010) Changes in prooxidant and antioxidant enzyme levels during cerebral hypoperfusion in rats. **Brain Res 1321:** 13-9.

Lenti, L., Domoki, F., Gáspár, T., Snipes, J.A., **Bari, F.**, Busija, D.W. (2009) N-methyl-D-aspartate induces cortical hyperemia through cortical spreading depression-dependent and in-dependent mechanisms in rats. **Microcirculation 16:** 629-39.

ZSUZSANNA BATA-CSÖRGŐ

University of Szeged
Faculty of Medicine
Department of Dermatology and Allergology

Address: Korányi fasor 6., H-6720 Szeged, Hungary

RESEARCH AREA

Psoriasis is the most common inflammatory skin disease among Caucasians. Our research focus is on the pathomechanism of this disease. The disease is polygenic with complex pathology therefore our work has different aspects: immunology, epidermal and dermal biology, regulation of cell proliferation and differentiation and extracellular matrix biology. We are engaged in classical theory driven research, but also use large scale studies. The research group is closely related to the clinic that makes it possible to use human tissues and cells for some of our work, which enhances the clinical relevance of our results. Some of our work is more basic research, we investigate normal and pathological functions of keratinocytes, fibroblasts and melanocytes.

TECHNIQUES AVAILABLE IN THE LAB

Separation and culture of various cells, immunostaining techniques on tissues and on cells, flow cytometry methods, cell cycle analysis, Western blot, RT-PCR, proteomic techniques.

SELECTED PUBLICATIONS

Gál, B., Dulic, S., Kiss, M., Groma, G., Kovács, L., Kemény, L., **Bata-Csörgő, Z.** (2017) Increased circulating anti-α6-integrin autoantibodies in psoriasis and psoriatic arthritis but not in rheumatoid arthritis. **J Dermatol 44:** 370-374

Göblös, A., Danis, J., Vas, K., **Bata-Csörgő, Z.**, Kemény, L., Széll, M. (2016) Keratinocytes express functional CARD18, a negative regulator of inflammasome activation, and its altered expression in psoriasis may contribute to disease pathogenesis. **Mol Immunol 73:** 10-18.

Gubán, B., Vas, K., Balog, Z., Manczinger, M., Bebes, A., Groma, G., Széll, M., Kemény, L., **Bata-Csörgő, Z.** (2016) Abnormal regulation of fibronectin production by fibroblasts in psoriasis. **Br J Dermatol 174:** 533-41.

Belső, N., Széll, M., Pivarcsi, A., Kis, K., Kormos, B., Kenderessy, A.S., Dobozy, A., Kemény, L., **Bata-Csörgõ, Z.** (2008) Differential expression of D-type cyclins in HaCaT keratinocytes and in psoriasis. **J Invest Dermatol 128:** 634-42.

Bata-Csorgo, Z., Hammerberg, C., Voorhees, J.J., Cooper, K.D. (1995) Kinetics and regulation of human keratinocyte stem cell growth in short-term primary *ex vivo* culture. Cooperative growth factors from psoriatic lesional T lymphocytes stimulate proliferation among psoriatic uninvolved, but not normal, stem keratinocytes. **J Clin Invest 95:** 317-27.

Bata-Csorgo, Z., Hammerberg, C., Voorhees, J.J., Cooper, K.D. (1993) Flow cytometric identification of proliferative subpopulations within normal human epidermis and the localization of the primary hyperproliferative population in psoriasis. **J Exp Med 178:** 1271-81.

ANTAL BERÉNYI

University of Szeged
Faculty of Medicine

MTA-SZTE 'Lendület'
Oscillatory Neuronal Networks Research Group
Department of Physiology

Address: Dóm tér 10., H-6720 Szeged, Hungary

RESEARCH AREA

Recent technical development gave a new momentum to experiments studying the brain, although the extremely complex structure of the nervous system still supplies the researchers with an endless inventory of open questions.

In our research we investigate the possible therapeutic effects of Transcranial Electrical Stimulation (TES) on epileptic seizures. Particularly, we plan to develop a focused stimulation protocol both in time and space to interact only with the desired brain areas within an appropriate time-frame. To determine the appropriate focal points of stimulation, we investigate the internal dynamics of neural networks involved in seizure generation. We do this by performing a throughout analysis of networks on microscopic and mesoscopic scale with extremely high spatial and temporal resolution. The same approach is used to focus on the role of hippocampus and related circuitries in memory formation and spatial navigation. We pay special interest to the role of sensory information in this field.

Our long-term vision is to develop a closed-loop, implantable seizure suppressor device that continuously monitors the patterns of brain activity, and delivers electrical pulses in order to terminate any occurring seizures. We are hoping to translate our laboratory-stage experimental results into clinical trials within a few years.

TECHNIQUES AVAILABLE IN THE LAB

Extra- and juxtacellular recording techniques, transcranial electrical stimulation, freely moving animal models to study the correlation of behavior and neuronal activity patterns, basic histology and immunohistochemistry, double transgenic animal models for optogenetical research, analog and digital electronics development, microcontroller programming, signal processing algorithms, advanced data mining techniques, Matlab and Labview programming languages, non-supervised pattern recognition algorithms.

SELECTED PUBLICATIONS

Oliva, A., Fernández-Ruiz, A, Buzsáki, G., **Berényi, A.** (2016) Role of Hippocampal CA2 Region in Triggering Sharp-Wave Ripples. **Neuron 91:** 1342-55.

Agarwal, G., Stevenson, I.H., **Berényi, A.**, Mizuseki, K., Buzsáki, G., Sommer FT. (2014) Spatially distributed local fields in the hippocampus encode rat position. **Science 344:** 626-30.

Berényi, A., Somogyvári, Z., Nagy, A.J., Roux, L., Long, J.D., Fujisawa, S., Stark, E., Leonardo, A., Harris, T.D., Buzsáki, G. (2014) Large-scale, high-density (up to 512 channels) recording of local circuits in behaving animals. **J Neurophysiol 111:** 1132-49.

Berényi, A., Belluscio, M., Mao, D., Buzsaki, G. (2012) Closed-loop control of epilepsy by transcranial electrical stimulation. **Science 337:** 735-737.

Madisen, L., Mao, T., Koch, H., Zhuo, J.M., **Berényi, A.**, Fujisawa, S., Hsu, Y.W., Garcia, A.J. 3rd., Gu, X., Zanella, S., Kidney, J., Gu, H., Mao, Y., Hooks, B.M., Boyden, E.S, Buzsáki, G., Ramirez, J.M., Jones, A.R., Svoboda, K., Han, X., Turner, E.E., Zeng, H.A. (2012) Toolbox of Cre-dependent optogenetic transgenic mice for light-induced activation and silencing. **Nat Neurosci 15:** 793-802.

ZSOLT ENDRE BOLDOGKŐI

University of Szeged
Faculty of Medicine
Department of Medical Biology

Address: Somogyi B. u. 4., H-6720 Szeged, Hungary

RESEARCH AREA

The main projects of our research group:

1. Genetic regulation in various viral families: We have been assembling the transcriptome atlases of various viruses using short- and long-read sequencing technologies. We have currently been investigating the following viruses: herpes simplex virus, pseudorabies virus, varicella-zoster virus, human cytomegalovirus, Epstein-Barr virus, vaccinia virus, influenza virus, a baculovirus, an endogenous retrovirus, a circovirus, various RNA viruses, etc.

Additionally, we have been examining how the transcriptions as well as the transcription and the DNA replication are interrelated with each other. We have put forward two hypotheses for assuming a genome-wide interplay among the transcription and replication machineries, which are the Transcription Interference Network (TIN) hypothesis and the Transcription and replication Network (TRIN) hypothesis, respectively.

2. Generation of intelligent viral vectors for brain research: Application of genetically modified pseudorabies virus for tansneuronal tract-tracing, as well as analysis of neural activity using optical methods.

3. Examination of the genetic basis of major depression and suicide: high-coverage whole-exome analysis of depression.

TECHNIQUES AVAILABLE IN THE LAB

1. Long-read and short-read sequencing: Illumina next generation sequencing; Oxford Nanopore Technologies and Pacific Bioscience third-generation sequencing platforms. We have tested various methods using these platforms, including Cap-selection, direct RNA sequencing, targeted sequencing, etc.

2. Molecular cloning: application of restriction endo-nucleases and CRISPR-Cas9 technology, recombinant virus technology, etc.

3. PCR and real-time RT PCR: These techniques are used for quantitative analysis of gene expression.

4. Microscopy: light microscopy, as well as, confocal and fluorescence microscopy.

SELECTED PUBLICATIONS

Tombácz, D., Prazsák, I., Szűcs, A., Dénes, B., Snyder, M., **Boldogkői, Z.** (2018) Analysis of the transcriptome of Vaccinia virus using long-read sequencing techniques. **GigaScience 7:** 139.

Tombácz, D., Prazsák, I., Moldován, N., Szűcs, A., **Boldogkői, Z.** (2018) Lytic Transcriptome Dataset of Varicella Zoster Virus Generated by Long-read Sequencing. **Front Genet 9:** 460.

Balázs, Z., Tombácz, D., Szűcs, A., Snyder, M., **Boldogkői, Z.** (2017) Long-read sequencing of the human cytomegalovirus transcriptome with the Pacific Biosciences RSII platform. **Sci Data 4**: 170194.

Tombácz, D., Maróti, Z., Kalmár, T., Csabai, Z., Balázs, Z., Takahashi, S., Palkovits, M., Snyder, M., **Boldogkői, Z.** (2017) High-coverage whole-exome sequencing identifies candidate genes for suicide in victims with major depressive disorder. **Sci Rep 7:** 7106.

Fekete, R., Cserép, C., Orsolits, B., Martinecz, B., Lénárt, N., Tóth, K., Méhes, E., Szabó, B., Németh, V., Gönci, B., Sperlágh, B., **Boldogkői, Z.,** Kittel, Á., Baranyi, M., Ferenczi, S., Kovács, K.J., Szalay, G., Rózsa, B., Webb, C., Hortobágyi, T., West, B.L., Környei, Z., Dénes, Á*. (2018) Microglia control neurotropic virus infection via P2Y12-mediated recruitment and phagocytosis. **Acta Neuropathol 136:** 461-482.

IMRE MIKLÓS BOROS

Biological Research Center
Institute of Biochemistry

University of Szeged
Faculty of Science and Informatics
Department of Biochemistry and Molecular Biology

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RESEARCH AREA

Transcription of eukaryotic genes is a multistep process that involves a large number of functionally different proteins and requires the ordered assembly of giant multiprotein complexes. In recent years the important role of chromatin structure in transcription regulation has been recognized and new directions in transcription research have been initiated. It is hoped that a better understanding of the roles of functionally distinct classes of transcription regulatory proteins and chromatin modifiers will provide keys to decipher why and how can these drive development and can be de-regulated in diseases like cancer.

In joint laboratories located at the BRC and at the Biochemistry and Molecular Biology Department of SzU we use combined approaches to characterize proteins which modify chromatin structure. In one area of research we focus our studies on histone proteins used only under specific conditions for example at the very early stage of embryonic development. For these studies we use Drosophila model, as this permits us to combine genetic and cell- and molecular biology methods. Another research approaches we study gene expression changes in cancer cells. For this we use clinical samples and are primarily interested in identifying the genetic alterations that contribute tumor formation.

TECHNIQUES AVAILABLE IN THE LAB

The techniques we use regularly to study different aspects of gene expression consist of a very broad range of genetic, biochemical, cell biology and molecular biology methods. That means daily use of techniques of genetic engineering including the classic ways of DNA manipulations and cloning and also the latest methods of targeted genome editing, chromatin immunoprecipitation and next generation sequencing. In addition to DNA we work extensively with proteins and use diverse methods for purify proteins from different sources and analyze protein–protein interactions.

SELECTED PUBLICATIONS

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Vedelek B., Maddali A.K., Davenova N., Vedelek V., **Boros I.M.** (2020) TERT promoter alterations could provide a solution for Peto's paradox in rodents. **Sci Rep 10:** 20815.

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Ujfaludi, Zs., Tuzesi, A., Majoros, H., Rothler, B., Pankotai, T., **Boros, I.M.** (2018) Coordinated activation of a cluster of MMP genes in response to UVB radiation. **Sci Rep 8:** 2660.

Borsos, B.N., Huliak, I., Majoros, H., Ujfaludi, Z., Gyenis, A., Pukler, P., **Boros, I.M.**, Pankotai, T. (2017) Human p53 interacts with the elongating RNAPII complex and is required for the release of actinomycin D induced transcription blockage. **Sci Rep 7:** 40960.

Pahi, Z., Borsos, B.N., Vedelek, B., Shidlovskii, Y.V., Georgieva, S.G., **Boros, I.M.**, Pankotai, T. (2017) TAF10 and TAF10b partially redundant roles during Drosophila melanogaster morphogenesis. **Transcription 8:** 297-306.

Borsos, B.N., Pankotai, T., Kovacs, D., Popescu, C., Pahi, Z., **Boros, I.M.** (2015) Acetylations of Ftz-F1 and histone H4K5 are required for the fine-tuning of ecdysone biosynthesis during Drosophila metamorphosis. **Dev Biol 404:** 80-7.

Vedelek, B., Blastyak, A., **Boros, I.M.** (2015) Cross-Species Interaction between Rapidly Evolving Telomere-Specific Drosophila Proteins. **Plos One 10:** 0142771.

Gyenis, A., Umlauf, D., Ujfaludi, Z., **Boros, I.M.**, Ye, T., Tora, L. (2014) UVB Induces a Genome-Wide Acting Negative Regulatory Mechanism That Operates at the Level of Transcription Initiation in Human Cells. **PLoS Genet 10:** 1004483.

MIHÁLY BOROS

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RESEARCH AREA

Surgical research can bring together many clinical disciplines and interests, ranging from cardiovascular biology to gastroenterology. The ischemia-reperfusion (I/R)-induced cellular hypoxia - reoxygenation, and subcellular oxido-reductive stress are major determinants of mortality and morbidity in many areas of clinical practice, such as sepsis or shock situations, and investigations targeting the I/R-caused microcirculatory dysfunction are essential for development of treatment strategies for several clinical pathologies. From a general perspective, it is worth pointing out that any intervention protecting microcirculation is likely to result in protection of tissue function and structure. In this scheme we have characterized the anti-inflammatory potential of membrane-forming phospholipids in I/R-induced antigen-independent inflammation, and the observation that methane formation from phosphatidylcholine metabolites occurs in ischemic systems opened up new avenues for future research. Currently we examine the possible biological roles of endogenous methane formation and whether methane - or potentially methane-releasing agents influence IR-induced microcirculatory dysfunctions and modulate the outcome of inflammation.

TECHNIQUES AVAILABLE IN THE LAB

Fundamental surgical techniques with complete hemo-dynamic monitoring and distinct imaging possibilities, such as intravital fluorescence microscopy and orthogonal polarization spectral imaging for *in vivo* microcirculatory analysis. Confocal laser scanning endomicroscopy for *in vivo* gastrointestinal histology. Detection of whole body methane emission by photoacoustic spectroscopy. High-resolution respirometry for mitochondrial studies.

SELECTED PUBLICATIONS

Benke, K., Jász. D.K., Szilágyi, Á.L., Baráth, B., Tuboly, E., Márton, A.R., Varga, P., Mohácsi, Á., Szabó, A., Széll, Z., Ruppert, M., Radovits, T., Szabó, G., Merkely. B., Hartmann, P., **Boros, M.** (2021) Methane supplementation improves graft function in experimental heart transplantation. **J Heart Lung Transplant 40**: 183-192.

Boros, M., Keppler, F. (2019) Methane production and bioactivity - A link to oxido-reductive stress. **Front Physiol 10**: 1244.

Szűcs, S., Bari, G., Ugocsai, M., Lashkarivand, R.A., Lajkó, N., Mohácsi, Á., Szabó, A., Kaszaki, J., **Boros, M.**, Érces, D., Varga, G. (2019) Detection of intestinal tissue perfusion by real-time breath methane analysis in rat and pig models of mesenteric circulatory distress. **Crit Care Med 47: e**403-e411.

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Boros, M., Ghyczy, M., Érces, D., Varga, G., Tőkés, T., Kupai, K., Torday C., Kaszaki, J. (2012) The anti-inflammatory effects of methane. **Crit Care Med 40**: 1269-1278.

PÉTER BURKOVICS

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RESEARCH AREA

Duplication of the genetic material is essential for every living organism. In our laboratory, located at the Institute of Genetics in the Biological Research Center, we examine the replication of eukaryotic cells. The replicative protein complex works with high speed and high fidelity, but several circumstances can interfere with this process. These could be different damage or structural barriers formed on the template DNA strand. The focus of our research interest is the replication of stable secondary structures, which formation is induced by the endogenous nucleotide sequence of the DNA. There are several types of the stable secondary structures, but our laboratory examines the replication of G-quadruplex (G4) structures. Computational analysis identified that there are more than 700,000 G4 motifs in our genome. Thus, the replication of the G4 in cells is challenging.

G4 is a tetramer structure formed by stacking of guanine quartets on single-stranded nucleic acid (DNA or RNA) via Hoogsteen's base pairing. The most well examined form of G4 structures are the telomeres, which ensure the stability of the chromosome ends. Our work focuses on the replication of intrachromosomal G4 structures. Since G4 structures are very stable in physiological conditions, they can block the movement of the replicative machinery, which could lead to genome instability. On this basis, it is expected that the amount of G4-forming sequences is reduced during evolution, but the opposite is true. In E. coli and C. elegans the amount of G4-forming sequences in the genome is 0.42% and 0.89%, respectively, but in human cells 4.17% of the genome can form G4 structures that highlights the important function of G4s in the nuclear processes. Recently it has been described, that G4 structures can regulate the gene expression, the initiation of replication, the recombination and the epigenetic code. Therefore, fast end precise replication of G4 structures is essential, otherwise important nuclear functions might be damaged. For the efficient replication special DNA helicases and regulatory proteins are needed, which can synchronize the action of G4 unwinding DNA helicases and the replication apparat. In our laboratory we examine the function of these regulatory proteins.

TECHNIQUES AVAILABLE IN THE LAB

Yeast and Caenorhabditis elegans genetic methods Construction of deletion and overexpression mutants, killing curve, genome stability assay), recombinant DNA techniques (DNA isolation and RNA isolation, PCR, cloning, Southern blot), protein purification, characterization of purified proteins, enzyme reactions, characterization of the functional domains of the proteins, Western blot, techniques used for human cell cultures and microscopy.

SELECTED PUBLICATIONS

Zacheja T., Toth A., Harami G.M., Yang Q, Schwindt E., Kovács M., Paeschke K., **Burkovics, P.** (2020) Mgs1 protein supports genome stability via recognition of G-quadruplex DNA structures. **FASEB J 34:** 12646-12662.

Paeschke, K., **Burkovics, P.** (2020) Mgs1 function at G-quadruplex structures during DNA replication. **Curr Genet 67:** 225-230.

Toth, A., Hegedus, L., Juhasz, S., Haracska, L., **Burkovics, P.** (2017) The DNA-binding box of human SPARTAN contributes to the targeting of Polη to DNA damage sites. **DNA Repair (Amst). 49:** 33-42.

Burkovics, P., Dome, L., Juhasz, S., Altmannova, V., Sebesta, M., Pacesa, M., Fugger, K., Sorensen, C.S., Lee, M.Y., Haracska, L., Krejci, L. (2016) The PCNA-associated protein PARI negatively regulates homologous recombination via the inhibition of DNA repair synthesis. **Nucleic Acids Res 44:** 3176-89.

Smith, R., Lebeaupin, T., Juhász, S., Chapuis, C., D'Augustin, O., Dutertre, S., **Burkovics, P.**, Biertümpfel, C., Timinszky, G., Huet, S. (2019) Poly(ADP-ribose)-dependent chromatin unfolding facilitates the association of DNA-binding proteins with DNA at sites of damage **Nucleic Acids Res 47:** 11250-11267.

TAMÁS CSONT

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RESEARCH AREA

Cardiovascular diseases and especially acute myocardial infarction are among the leading causes of death worldwide. Although prevention and the therapy of myocardial infarction have been significantly improved in the last decades, mortality is still unacceptably high. Therefore, development of new therapies aiming to attenuate infarct size is very relevant. Thus, our research group investigates the molecular mechanisms of infarction as well as the adaptive responses of the myocardium to ischemic stress (pre- and postconditioning) to develop novel potential therapies for the treatment of myocardial infarction. Since the risk of myocardial infarction is increased by the presence of several co-morbidities and risk factors including high cholesterol level, diabetes, obesity, hypertension, smoking, lack of exercise, kidney failure, etc., we also look at the effects of certain risk factors on the myocardium as well as on adaptive mechanisms of the heart.

TECHNIQUES AVAILABLE IN THE LAB

Induction and treatment of disease models (e.g. diabetes, hypercholesterolemia) in experimental animals, echo-cardiographic assessment of cardiac morphology and function, surgical interventions to induce disease models (myocardial infarction, heart failure, kidney failure, etc.), isolated heart perfusion, determination of infarct size, induction and maintenance of cell culture, viability assays, transfection, general biochemical methods to determine metabolites, proteins and nucleic acids (spectroscopy, western blot, ELISA, flow cytometry, histochemistry, PCR, etc.).

SELECTED PUBLICATIONS

Sárközy, M., Szűcs, G., Fekete, V., Pipicz, M., Éder, K., Gáspár, R., Sója, A., Pipis, J., Ferdinandy, P., Csonka, C., **Csont, T.** (2016) Transcriptomic alterations in the heart of non-obese type 2 diabetic Goto-Kakizaki rats. **Cardiovasc Diabetol 15:** 110.

Pipicz, M., Varga, Z.V., Kupai, K., Gáspár, R., Kocsis, G.F., Csonka, C., **Csont, T.** (2015) Rapid ventricular pacing-induced postconditioning attenuates reperfusion injury: effects on peroxynitrite, RISK and SAFE pathways. **Br J Pharmacol 172:** 3472-83.

Varga, Z.V., Kupai, K., Szűcs, G., Gáspár, R., Pálóczi, J., Faragó, N., Zvara, A., Puskás, L.G., Rázga, Z., Tiszlavicz, L., Bencsik, P., Görbe, A., Csonka, C., Ferdinandy, P., **Csont, T.** (2013) MicroRNA-25-dependent up-regulation of NADPH oxidase 4 (NOX4) mediates hypercholesterolemia-induced oxidative/nitrative stress and subsequent dysfunction in the heart. **J Mol Cell Cardiol 62:** 111-21.

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Csont, T., Görbe, A., Bereczki, E., Szunyog, A., Aypar, E., Tóth, M.E., Varga, Z.V., Csonka, C., Fülöp, F., Sántha, M., Ferdinandy, P. (2010) Biglycan protects cardiomyocytes against hypoxia/reoxygenation injury: role of nitric oxide. **J Mol Cell Cardiol 48:** 649-52.

MÁRIA DELI

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RESEARCH AREA

Organisms are protected by biological barriers from harmful effects. These barriers also impede drug penetration. Our lab investigates methods to increase drug delivery on culture models of the blood-brain, nasal, corneal, respiratory and intestinal barriers. The pathways examined are (i) reversible opening of tight intercellular junctions by peptides or small molecules; (ii) targeting solute carriers at barriers for drug delivery by nanoparticles. Cellular toxicity of active ingredients and pharmacautical excipients are measured by a real-time impedance-based method. Double and triple co-culture models are used for experiments, and a microfluidic integrated chip has been developed in a collaborative project. Our other major research interest is the examination of blood-brain barrier injury and dysfunctions in different diseases, like Alzheimer's disease, acute pancreatitis and diabetes. The goal of these experiments is to reveal the effect of disease pathogenic factors on blood-brain barrier functions and to identify protective molecules. The protection of brain endothelial cells and the improvement of BBB functions in pathological conditions, the exploration of new approaches for drug transport/targeting to brain may have therapeutic potential in the treatment of central nervous system diseases.

TECHNIQUES AVAILABLE IN THE LAB

Mammalian cell culture; primary cultures from brain and brain microvessels; models of biological barriers by double and triple co-cultures; cell culture models in microfluidic chips; electric resistance measurements of cell layers; permeability of drugs across culture models; immunohistochemistry; phase contrast, fluorescent and confocal microscopy; ELISA; measurement of nitric oxide and reactive oxygen species production in cells; colorimetric and impedance-based toxicity tests.

SELECTED PUBLICATIONS

Mészáros, M., Porkoláb, G., Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., **Deli, M.A.**, Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci 123:** 228-240.

Veszelka, S., Tóth, A., Walter, F.R., Tóth, A.E., Gróf, I., Mészáros, M., Bocsik, A., Hellinger, É., Vastag, M., Rákhely, G., **Deli, M.A.** (2018) Comparison of a rat primary cell-based blood-brain barrier model with epithelial and brain endothelial cell lines: gene expression and drug transport. **Front Mol Neurosci 11:** 166.

Walter, F.R., Valkai, S., Kincses, A., Petneházi, A., Czeller, T., Veszelka, S., Ormos, P., **Deli, M.A.,** Dér, A. (2016) Versatile lab-on-a-chip tool for modeling biological barriers. **Sens Actuators B Chem 222:** 1209-1219.

Bocsik, A., Walter, F.R., Gyebrovszki, A., Fülöp, L., Blasig, I., Dabrowski, S., Ötvös, F., Tóth, A., Rákhely, G., Veszelka, S., Vastag, M., Szabó-Révész, P., **Deli, M.A.** (2016) Reversible opening of intercellular junctions of intestinal epithelial and brain endothelial cells with tight junction modulator peptides. **J Pharm Sci 105:** 754-765.

Veszelka, S., Tóth, A.E., Walter, F.R., Datki, Z., Mózes, E., Fülöp, L., Bozsó, Z., Hellinger, E., Vastag, M., Orsolits, B., Környei, Z., Penke, B., **Deli, M.A.** (2013) Docosahexaenoic acid reduces amyloid-β induced toxicity in cells of the neurovascular unit. **J Alzheimers Dis 36:** 487-501.

ANDRÁS DÉR

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RESEARCH AREA

Bioelectronics has a double meaning in scientific literature. On the one hand, as a branch of basic biophysical sciences, it deals with electric phenomena appearing on any organization level of living systems. On the other hand, as a recently developed discipline of information technological science, it explores the potential of biological materials for application in molecular electronics. These two areas of research are in close interaction not only with each other, but also with other disciplines of basic applied sciences.

Our main goal is to develop novel methods on integrated micro- and nanotechnological platforms for the investigation of light-induced processes in biological membranes, and utilize them in both branches of bioelectronic science. The most important scientific problems to be solved are, on the one hand, concerned with the investigation of electric properties of single cells and cellular interfaces, while on the other hand with the application of photochromic proteins in optoelectronics and photonics. Besides its impact on basic biophysical science, our research is expected to have utilizations in various branches of applied bioelectronics.

TECHNIQUES AVAILABLE IN THE LAB

Photoelectric measuring techniques, absorption kinetics, polarisation methods, electro-optics, photolithography, laser-assisted microstructure building, surface coating techniques, TIRF-microscopy, MATLAB programing, LabVIEW programing.

SELECTED PUBLICATIONS

Dér, A., Kelemen, L., Fábián, L., Taneva, S.G., Fodor, E., Páli, T., Cupane, A., Cacace, M.G., Ramsden, J.J. (2007) Interfacial Water Structure Controls Protein Conformation. **J Phys Chem B 111:** 5344-5350.

Ormos, P., Fábián L., Oroszi L., Ramsden, J.J., Wolff, E.K., **Dér, A.** (2002) Protein-based integrated optical switching and modulation. **Appl Phys Lett 80:** 4060-4062.

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Dér, A., Keszthelyi, L. (2001) Charge motion during the photocycle of bacteriorhodopsin. **Biochemistry (M) 66:** 1234-1248.

Dér, A., Oroszi, L., Kulcsár, Á., Zimányi, L., Tóth-Boconádi, R., Keszthelyi, L., Stoeckenius, W., Ormos, P. (1999) Interpretation of spatial charge displacements in bacteriorhodopsin in terms of structural changes during the photocycle. **Proc Natl Acad Sci USA 96:** 2776-2781.

LÁSZLÓ DUX

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RESEARCH AREA

The Biochemitsry Department follows the traditions of the school of Albert Szent-Györgyi in muscle research. Former achievements in the area, as the discovery of actin, the characterization of actin-miosin-ATP involvement in muscle contraction, crystallization of the calcium pump enyzme in muscle paved the way until now. Recent re search interest is focused on the development, differentiation and regeneration of muscle tissues at the molecular level. Neural and humoral factors, as well as extracellular matrix components involved in these processes are under study. Another main field our of research and development activities is the standardization, quality assurance of diagnostic methods in clinical biochemistry and molecular biology. The development and application of reference materials for the area.

TECHNIQUES AVAILABLE IN THE LAB

Qualitative and quantitave protein and nucleic acid analytical methods, cell and tissue culture, histo chemistry and immunohistochemistry, morphometry, flow cytometry, characterization of molecular regulatory systems.

SELECTED PUBLICATIONS

Becsky, D., Gyulai-Nagy, S., Balind, A., Horvath, P., **Dux, L.**, Keller-Pinter, A. (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823.

Sztretye, M., Dienes, B., Gönczi, M., Czirják, T., Csernoch, L., **Dux, L.**, Szentesi, P., Keller-Pintér, A. (2019) Astaxanthin, a potential mitochondrial targeted antioxidant treatment in diseases and with aging. **Oxid Med Cell Longev 2019:** 3849692.

Szentesi, P., Csernoch, L., **Dux, L.**, Keller-Pinter, A. (2019) Changes in redox signaling in skeletal muscle during aging. **Oxid Med Cell Longev 2019:** 4617801.

Keller-Pinter, A., Szabo, K., Kocsis, T., Deak, F., Ocsovszki, I., Zvara, A., Puskas, L., Szilak, L., **Dux, L.** (2018) Syndecan-4 influences mammalian myoblast proliferation by modulating myostatin signalling and G1/S transition. **FEBS Lett 592:** 3139-3151.

Kocsis, T., Trencsényi, Gy., Szabó, K., Baán, J. A., Müller, G., Mendler, L., Garai, I., Reinauer, H., Deák, F., **Dux, L.**, Keller-Pintér, A. (2017) Myostatin propeptide mutation of the hypermuscular Compact mice decreases the formation of myostatin and improves insulin sensitivity. **Am J Physiol Endocrinol Metab 312:** E150-E160.

ATTILA GÁCSER

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RESEARCH AREA

Infectious diseases are one the leading causes of mortality worldwide, killing millions of people every year. While bacteria and viruses cause the majority of deadly infections, notably the number of fungal diseases is increasing at an alarming rate. In fact, it is estimated that nearly as many people die annually from invasive fungal infections as from the greatly feared tuberculosis (1.4 million) or malaria (1.2 million). Our research program focuses on the most common human fungal pathogens, the opportunistic *Candida* species with special focus on *C. parapsilosis*. We investigate the basic mechanisms of fungal pathogenesis and host immunity, and we aim to improve diagnosis and identify novel biomarkers of infection. Recently, we also investigate the role of the human "mycobiome" in health and disease development and progression.

TECHNIQUES AVAILABLE IN THE LAB

In vitro infection models using phagocytes (murine and human cell lines, primer immune cells). Measurement of fungal cell phagocytosis with Flow Cytometry or microscopy, cytokines-chemokines with ELISA, host damage with LDH-assay. Quantitative imaging using FlowSight. *In vivo* infection models using wild type and transgenic mice. Colony formig unit measurements from different organs, histological analysis, immune cell preparation from infected animals. Basic and advanced molecular techniques, qRT-PCR, Western blot, Southern blot, CRISPR/Cas9 technology, GATEWAY-cloning system.

SELECTED PUBLICATIONS

Tóth, A., Zajta, E., Csonka, K., Vágvölgyi, C., Netea, M.G., **Gácser, A.** (2017) Specific pathways mediating inflammasome activation by Candida parapsilosis. **Sci Rep 7:** 43129.

Pryszcz, L.P., Nemeth, T., Saus, E., Ksiezopolska, E., Hegedusova, E., Nosek, J., Wolfe, K.H., **Gácser, A*.**, Gabaldon, T.* (2015) The Genomic Aftermath of Hybridization in the Opportunistic Pathogen Candida metapsilosis. **PLOS Genetics 11:** e1005626. 29 p. *joint senior authors

Tóth, R., Alonso, M.F., Bain, J.M., Vágvölgyi, C., Erwig, L-P., **Gácser, A.** (2015) Different Candida parapsilosis clinical isolates and lipase deficient strain trigger an altered cellular immune response. **Front Microbiol 6:** 1102.

Toth, A., Csonka, K., Jacobs, C., Vagvolgyi, C., Nosanchuk, J.D., Netea, M.G., **Gácser, A.** (2013) Candida albicans and Candida parapsilosis Induce Different T-Cell Responses in Human Peripheral Blood Mononuclear Cells. **J Infect Dis 208:** 690-698.

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LAJOS HARACSKA

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RESEARCH AREA

Stalling of the DNA replication machinery, which occurs as a consequence of encountering unrepaired DNA damage, is a challenge for cells. To rescue the stalled replication fork, different DNA damage bypass mechanisms have evolved that promote replication through DNA lesions. In humans, increased error-prone bypass of DNA lesions causes increased mutagenesis and, as a consequence, a rise in the incidence of cancers. Error-free bypass processes, by contrast, keep mutagenesis low and reduce the frequency of cancers. Our research laboratory is interested in the driving forces and molecular mechanisms of mutagenesis and carcinogenesis. In particular, we investigate the following questions: What are the common roots of evolution and carcinogenesis? What are the molecular mechanisms of chromosomal rearrangements and the formation of point mutations? Why do we observe increased genome instability during carcinogenesis? What is the role of the recently described DNA repair genes in cancer suppression? Why do mutations in certain genes predispose to cancer? Which genes are commonly mutated in cancer, and how do these mutations contribute to tumour development and drug resistance? We investigate these challenging problems using human tissue culture-based reporter systems, next-generation DNA sequencing and purified proteins in reconstituted reaction pathways. Our research provides more insight into the molecular events of genome instability, carcinogenesis and has the potential to identify new tumour markers and drug targets as well as to improve personal cancer treatment.

TECHNIQUES AVAILABLE IN THE LAB

Next-generation DNA sequencing, PCR, qPCR, protein microarray, human tissue culture-based reporter assays such as cell survival, mutagenesis, homologous recombination and various tests, confocal microscopy-based techniques such as protein localization, DNA replication and chromosomal rearrangements, protein overexpression and purification, immunological assays, biochemical enzyme assays, and yeast genetic methods.

SELECTED PUBLICATIONS

Fenteany, G., Gaur, P., Sharma, G., Pintér, L., Kiss, E., **Haracska, L.** (2020) Robust high-throughput assays to assess discrete steps in ubiquitination and related cascades. **BMC Mol Cell Biol 21:** 21.

Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., Wéber, E., Hackler, L., Martinek, T., Puskás, L.G., **Haracska, L.** (2019) Multilevel structure-activity profiling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. **Sci Rep 9:** 12801.

Morocz, M., Zsigmond, E., Toth, R., Enyedi, M.Z., Pinter, L., **Haracska, L.** (2017) DNA-dependent protease activity of human Spartan facilitates replication of DNA-protein crosslink-containing DNA. **Nucleic Acids Res 45**: 3172-3188.

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Blastyak, A., Pinter, L., Unk, I., Prakash, L., Prakash, S., **Haracska, L.** (2007). Yeast Rad5 protein required for postreplication repair has a DNA helicase activity specific for replication fork regression. **Molecular Cell 28**: 167-75.

Johnson, R.E., Washington, M.T., **Haracska, L.**, Prakash, S., Prakash, L. (2000) Eukaryotic polymerases ι and ζ act sequentially to bypass DNA lesions. **Nature 406**: 1015-1019.

Haracska, L., Yu, S.L., Johnson, R.E., Prakash, L., Prakash, S. (2000) Efficient and accurate replication in the presence of 7,8-dihydro-8-oxoguanine by DNA polymerase η. **Nat Gen 25**: 458-461.

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RESEARCH AREA

Epithelial cells form a sheet-like contiguous layer that covers both the external and internal free surfaces of the body, e.g. the surface of skin or inner surface of hollow organs such as in the gastrointestinal tract (GIT). The epithelial cells in the GIT secrete over 10 liters of digestive fluid daily into the lumen - and after digestion - absorb the fluid and nutrients from the lumen. Derangement of this secretory process can lead to severe disorders such as cystic fibrosis or secretory diarrhoea. One of our main research interests is to understand the physiology and pathophysiology of secretory mechanisms.

Most recently we have shown that epithelial fluid and ion secretion plays a crucial role in acute pancreatitis which is one of the most severe inflammatory diseases of the GI tract. Therefore, repairing the damaged secretion may lead to a new specific therapeutic way in acute pancreatitis. Besides our interest in the pancreas we work on understanding the oesophageal, gastric and colonic fluid and ion transport mechanisms.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of epithelial cells from human and animal, culturing of cells, measurement of fluid secretion using video-technique, measurement of intracellular ion (H^+, Ca^{2+}) concentrations using fluorescence imaging microscopy, western blotting, working with DNA and RNA, measurement of mitochondrial damage using confocal microscopy, *in vivo* experimental animal models.

SELECTED PUBLICATIONS

Maléth, J., Balázs, A., Pallagi, P., Balla, Z., Kui, B., Katona, M., Judák, L., Németh, I., Kemény, L.V., Rakonczay Jr., Z., Venglovecz, V., Földesi, I., Pető, Z., Somorácz, Á., Borka, K., Perdomo, D., Lukacs, G.L., Gray, M.A,, Monterisi, S., Zaccolo, M., Sendler, M., Mayerle, J., Kühn, JP., Lerch, M.M., Sahin-Tóth, M., **Hegyi, P.** (2015) Alcohol disrupts levels and function of the cystic fibrosis transmembrane conductance regulator to promote development of pancreatitis. **Gastroenterology 148:** 427-39.

Pallagi, P., Venglovecz, V., Rakonczay, Z., Borka, K., Korompay, A., Ozsvári, B., Judák, L., Sahin-Tóth, M., Geisz, A., Schnúr, A., Maléth, J., Takács, T., Gray, M.A., Argent, B.E., Mayerle, J., Lerch, M.M., Wittmann, T., **Hegyi, P.** (2011) Trypsin reduces pancreatic ductal bicarbonate secretion by inhibiting CFTR Cl- channels and luminal anion exchangers. **Gastroenterology 141:** 2228-2239.

Hegyi, P., Pandol, S., Venglovecz, V., Rakonczay, Z. (2011) The acinar-ductal tango in the pathogenesis of acute pancreatitis. **Gut 60:** 544-52.

Maléth, J., Venglovecz, V., Rázga, Z., Tiszlavicz, L., Rakonczay, Z., **Hegyi, P.** (2011) Non-conjugated chenodeoxycholate induces severe mitochondrial damage and inhibits bicarbonate transport in pancreatic duct cells. **Gut 60:** 136-8.

Venglovecz, V., Rakonczay, Z., Ozsvári, B., Takács, T., Lonovics, J., Varró, A., Gray, M.A., Argent, B.E., **Hegyi, P.** (2008) Effects of bile acids on pancreatic ductal bicarbonate secretion in guinea pig. **Gut 57:** 1102-12.

JUDIT HOHMANN

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RESEARCH AREA

Natural products play an important role in drug discovery because of their unmatched structural diversity, amazing, and often complex structures. The aim of our group is to perform purposeful research by rational selection of plant extracts and compounds to be isolated, in order to obtain efficiently new secondary plant metabolites, which are perspective for drug discovery. Literature data, ethnomedicinal knowledge, results of screen investigations and metabolomic approaches are considered for selection of plant species. Compounds are isolated from the very complex multi-component extracts exhibiting efficacy in the used tests, with the aid of different chromatographic methods by guidance of bioassay. The structures of the purified compounds are determined by means of spectroscopic methods (NMR and MS). The biological activity is usually investigated in collaborations.

TECHNIQUES AVAILABLE IN THE LAB

Solid-solid and solid-liquid extraction techniques, evaporators; chromatographic techniques (OCC, GC, VLC, CPC, Flash, SE, SFC, MPLC, HPLC) coupled with UV-Vis, PDA, light scattering and MS detectors; ESIMS, HRMS, 1D and 2D NMR for structure elucidation; microplate reader, bioassays for antimicrobial, antitumor, ion channel activity in collaboration.

SELECTED PUBLICATIONS

Ványolós, A., Dékány, M., Kovács, B.t, Krámos, B., Bérdi, P., Zupkó, I., **Hohmann, J.**, Béni Z. (2016) Gymnopeptides A and B, cyclic octadecapeptides from the mushroom Gymnopus fusipes. **Org Lett 18:** 2688-2691.

Vasas, A., Forgo, P., Orvos, P., Tálosi, L., Csorba, A., Pinke, G., **Hohmann, J**. (2016) Myrsinane, premyrsinane, and cyclomyrsinane diterpenes from Euphorbia falcata as potassium ion channel inhibitors with selective G protein-activated inwardly rectifying ion channel (GIRK) blocking effects. **J Nat Prod 79:** 1990-2004.

Hajdu, Z., Nicolussi, S., Rau, M., Lorantfy, L., Forgo, P., **Hohmann, J.**, Csupor, D., Gertsch, J. (2014) Identification of endocannabinoid system-modulating N-alkylamides from Heliopsis helianthoides var. scabra and Lepidium meyenii. **J Nat Prod 77:** 1663-1669.

Vasas, A., Rédei, D., Csupor, D., Molnar, J., **Hohmann, J.** (2012) Diterpenes from European Euphorbia species serving as prototypes for natural-product-based drug discovery. **Eur J Org Chem 2012:** 5115-5130.

Hohmann, J., Molnár, J., Rédei, D., Evanics, F., Forgo, P., Kálmán, A., Argay, G., Szabó, P. (2002) Discovery and biological evaluation of a new family of potent modulators of multidrug resistance: reversal of multidrug resistance of mouse lymphoma cells by new natural jatrophane diterpenoids isolated from Euphorbia species. **J Med Chem 45:** 2425-2431.

PÉTER HORVÁTH

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RESEARCH AREA

Recent advances in light microscopy have changed the way biological research is conducted. The ability to acquire massive amounts of image data has given rise to new fields such as high content screening (HCS) or 3D imaging, which promise to open new doors both for basic research and drug discovery. However, with such massive amounts of data comes a need for automatic analysis tools. Our research concentrates on how human knowledge can be best integrated into intelligent computer algorithms for automated microscopy. To reach this goal, we have interest in image processing that is concerned with extracting biologically relevant quantitative information in 3-4-5D imaging and multi-parametric machine learning analysis that is necessary to make sense of this information. Recently, machine learning algorithms have become a popular solution for analyzing large single cell-based imaging scenarios. We concentrate on improving the state-of-the-art by detecting unusual patterns corresponding to unknown phenotypes.

TECHNIQUES AVAILABLE IN THE LAB

Various microscopy and computational techniqes are available in the BIOMAG laboratory. These include high-content screening, confocal, laser microdissection, light-sheet, point scanning confocal microscopy; and various image analysis and machine learning approaces and software and hardware infrastructure.

SELECTED PUBLICATIONS

Pfisterer, S., Gateva, G., **Horvath, P.**, Pirhonen, J., Salo, V., Karhinen, L., Varjosalo, M., Ryhänen, S., Lappalainen, P., Ikonen, E. (2017) Role for formin-like 1-dependent acto-myosin assembly in lipid droplet dynamics and lipid storage. **Nat Commun 8:** 14858.

Horvath, P., Aulner, N., Bickle, M., Davies, A., Del Nery, E., Ebner, D., Montoya, M., Ostling, P., Pietiainen, V., Price, L., Shorte, S., Turcatti, G., von Schantz, C., Carragher, N. (2016) Screening out irrelevant cell-based models of disease. **Nat Rev Drug Discov 15:** 751–769.

Molnar, Cs., Jermyn, I., Kato, Z., Rahkama, V., Ostling, P., Mikkonen, P., Pietiainen, V., **Horvath, P.** (2016) Accurate morphology preserving segmentation of overlapping cells based on active contours. **Sci Rep 6:** 32412.

Piccinini, F., Kiss, A., **Horvath, P**. (2015) CellTracker (not only) for dummies. **Bioinformatics 32:** 955-957.

Smith, K., Li, Y., Piccinini, F., Csucs, G., Balazs, C., Bevilacqua, A., **Horvath, P.** (2015) CIDRE: an illumination-correction method for optical microscopy. **Nat Methods 12:** 404–406.

Banerjee, I., Miyake, Y., Nobs, S. P., Schneider, C., **Horvath, P.**, Kopf, M., Matthias, P., Helenius, A., Yamauchi, Y. (2014) Influenza A virus uses the aggresome processing machinery for host cell entry. **Science 346:** 473-7.

ATTILA HUNYADI

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RESEARCH AREA

Cancer is a leading cause of morbidity and mortality worldwide, and it is expected that annual cancer cases will rise from 14 million in 2012 to around 22 million within the next two decades. Resistance is a major factor promoting failure of chemotherapy and there is an urgent need for new therapeutic strategies.

By following a natural product inspired drug discovery strategy, our group focuses on novel chemical approaches to fight cancer and particularly multi-drug resistant cancer. In this endeavor, we aim at the preparation of nature-inspired chemical scaffolds that can act as chemo-sensitizers on resistant tumor cells, hence can be used as non-toxic adjuvants in combination with chemotherapeutics. A broad scale of interesting natural products is utilized as starting materials, e.g. well-known antioxidants, insect hormones utilized as anabolic food supplements, etc. Thanks to this and to our intensive international collaboration, an inspiring multidisciplinary working environment awaits the candidates to join our team.

TECHNIQUES AVAILABLE IN THE LAB

Extraction and preparation of herbal constituents, as well as simple chemical reactions for their structural modification, a wide array of separation techniques used in natural product chemistry, including analytical and preparative HPLC, supercritical fluid HPLC (SFC), centrifugal partition chromatography (CPC), rotational planar chromatography, TLC and column chromatography, structure elucidation by spectroscopic techniques (NMR, MS, UV-VIS).

SELECTED PUBLICATIONS

Fási, L., Di Meo, F., Kuo, C.Y., Stojkovic Buric, S., Martins, A., Kúsz, N., Béni, Z., Dékány, M., Balogh, G.T., Pesic, M., Wang, H.C., Trouillas, P., **Hunyadi, A.** (2019) Antioxidant-inspired drug discovery: antitumor metabolite is formed in situ from a hydroxycinnamic acid derivative upon free radical scavenging. **J Med Chem 62:** 1657-1668.

Hunyadi, A. (2019) The mechanism(s) of action of antioxidants: from scavenging reactive oxygen/nitrogen species to redox signaling and the generation of bioactive secondary metabolites. **Med Res Rev 39:** 2505-2533.

Vágvölgyi, M., Martins, A., Kulmány, Á., Zupkó, I., Gáti, T., Simon, A., Tóth, G., **Hunyadi, A.** (2018) Nitrogen-containing ecdysteroid derivatives vs. multi-drug resistance in cancer: Preparation and antitumor activity of oximes, oxime ethers and a lactam. **Eur J Med Chem 144:** 730-739.

Hunyadi, A., Herke, I., Lengyel, K., Báthori, M., Kele, Z., Simon, A., Tóth, G., Szendrei, K. (2016) Ecdysteroid containing food supplements from *Cyanotis arachnoidea* on the European market: evidence for spinach product counterfeiting. **Sci Rep 6:** 37322.

Csábi, J., Hsieh, T.J., Hasanpour, F., Martins, A., Kele, Z., Gáti, T., Simon, A., Tóth, G., **Hunyadi, A.** (2015) Oxidized Metabolites of 20-Hydroxyecdysone and their Activity on Skeletal Muscle Cells: Preparation of a Pair of Desmotropes with Opposite Bioactivities. **J Nat Prod 78:** 2339-2345.

GÁBOR JUHÁSZ

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RESEARCH AREA

Autophagy is a fundamental catabolic pathway in eukaryotic cells. During the main route, portions of cytosol and organelles are captured into double-membrane autophagosomes, which then fuse with lysosomes to deliver their cargo for degradation and reuse. Our group is studying the role and mechanisms of autophagy mainly using the popular animal model Drosophila. We are also working on related trafficking pathways including endocytosis and crinophagy (secretory granule degradation). In recent years, we have started experiments to understand the regulation of lysosomal function.

TECHNIQUES AVAILABLE IN THE LAB

Genetic manipulation of Drosophila and cultured human cells: gene knockouts, transgenic reporter constructs, mosaic analysis. Confocal microscopy, autophagic degradation and endocytic uptake and degradation assays. Transmission electron microscopy. Western blots, immunoprecipitations, proteomic analysis (done by the core facility). Cell culture facilities, yeast twohybrid, molecular cloning, RT-PCR and qPCR. Purification of recombinant proteins, biochemical binding and structural assays, antibody production.

SELECTED PUBLICATIONS

Lőrincz, P., Kenéz, L.A., Tóth, S., Kiss, V., Varga, Á., Csizmadia, T., Simon-Vecsei, Z., **Juhász, G.** (2019) Vps8 overexpression inhibits HOPS-dependent trafficking routes by out-competing Vps41/Lt. **Elife 8:** e45631.

Csizmadia, T., Lőrincz, P., Hegedűs, K., Széplaki, S., Lőw, P., **Juhász, G.** (2018) Molecular mechanisms of developmentally programmed crinophagy in Drosophila. **J Cell Biol 217:** 361-374.

Katheder, NS., Khezri, R., O'Farrell, F., Schultz, S.W., Jain, A., Rahman, M.M., Schink, K.O., Theodossiou, T.A., Johansen, T., **Juhász, G.**, Bilder, D., Brech, A., Stenmark, H., Rusten, T.E. (2017) Microenvironmental autophagy promotes tumour growth. **Nature 541:** 417-420.

Lorincz, P., Lakatos, Z., Varga, A., Maruzs, T., Simon-Vecsei, Z., Darula, Z., Benko, P., Csordas, G., Lippai, M., Ando, I., Hegedus, K., Medzihradszky, K., Takats, S., **Juhasz, G.** (2016) MiniCORVET is a Vps8-containing hemocyte- and nephrocyte-specific early endosomal tether in Drosophila. **Elife 5:** e14226.

Takats, S., Nagy, P., Varga, A., Pircs, K., Karpati, M., Varga, K., Kovacs, A.L., Hegedus, K., **Juhasz, G.** (2013) Autophagosomal Syntaxin17-dependent lysosomal degradation maintains neuronal function in Drosophila. **J Cell Biol 201:** 531-539.

JÓZSEF KASZAKI

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RESEARCH AREA

Sepsis remains one of the leading causes of death in the intensive care units which necessitates the development of new diagnostic tools and novel, more efficient therapeutic possibilities. The basic problem in sepsis is the discrepancy between oxygen delivery and oxygen consumption which can lead to irreversible oxygen extraction deficit and energy shortage. The cornerstone of acute care should be to prevent, assess and treat oxygen debt globally. We propose that causative factors and signs of oxygen deficit have to be examined together on microcirculatory, cellular (endothelial) and subcellular (mitochondrial) levels in different shock-affected organs (e.g. the intestine and lung) by employing sufficiently long-term, clinically relevant experimental models. With this theoretical background, the major goal of our study is to find optimal, clinically applicable manoeuvres for microcirculatory recruitment and mitochondrial resuscitation to minimize the energy deficit of organs during the septic response.

TECHNIQUES AVAILABLE IN THE LAB

Our research laboratories are equipped with instruments to identify macro- and microcirculatory changes (hemodynamic computerized data-acquisition and analysis systems, laser-Doppler flowmetry, fluorescence-based intravital microscopy, orthogonal polarisation spectral imaging). Fluorescence confocal laser scanning endomicroscopy technique offers the possibility of acquiring precise *in vivo* data for histological analysis. A high resolution respirometer is available for examination of mitochondrial function (activities of the components of electron transport chain) and additional laboratory facilities (ELISA) to study inflammatory biomarkers. Animal house and fully-equipped operating theatres are available for surgical intervention of small (rats) and larger animals (minipigs).

SELECTED PUBLICATIONS

Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., Varga, G., Szűcs S., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., **Kaszaki, J.** (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia- reperfusion. **Free Radic Biol Med 120:** 160-169.

Érces, D., Nógrády, M., Varga, G., Szűcs, S., Mészáros, A.T., Fischer-Szatmári, T., Cao, C., Okada, N., Okada, H., Boros, M., **Kaszaki, J.** (2016) Complement C5a inhibition improves late hemodynamic and inflammatory changes in a rat model of nonocclusive mesenteric ischemia. **Surgery 159:** 960-971.

Érces, D., Nógrády, M., Nagy, E., Varga, G., Vass, A., Süveges, G., Imai, M., Okada, N., Okada, H., Boros, M., **Kaszaki, J.** (2013) Complement c5a antagonist treatment improves the acute circulatory and inflammatory consequences of experimental cardiac tamponade. **Crit Care Med 41:** 344-351.

Boros, M., Ghyczy, M., Érces, D., Varga, G., Tőkés, T., Kupai, K., Torday, Cs., **Kaszaki, J.** (2012) The anti-inflammatory effects of methane. **Crit Care Med 40:** 1269-1278.

Kaszaki, J., Érces, D., Varga, G., Szabó, A., Vécsei, L., Boros, M. (2012) Kynurenines and intestinal neurotransmission – the role of N-methyl-D-aspartate receptors. **J Neural Transm 119:** 211-223.

ANIKÓ KELLER-PINTÉR

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RESEARCH AREA

Skeletal muscle is a highly dynamic tissue that can undergo successful regeneration upon injury, and change in size in response to exercise, aging or due to diseases (e.g. cancer cachexia, immobilization, or denervation). The muscle stem cells, satellite cells are stimulated by local damage to proliferate extensively and form myoblasts that will subsequently migrate, differentiate and fuse to form muscle fibers. Our research aims are to study (i) the signaling pathways and mechanisms in myoblast migration, differentiation, and fusion (ii) the role of exosomes in cell migration, (iii) the biology of satellite cells. Moreover, we investigate the molecular mechanisms regulating skeletal muscle mass, and we aimed to find new nanotechnological approaches for the local treatment of muscle atrophy. Skeletal muscle has an important role in whole-body metabolism, it accounts for 40% of adult human body weight, and about 90% of insulin-stimulated glucose uptake occurs in skeletal muscle. The vesicular transport of GLUT4 glucose transporters is impaired in cases of insulin resistance and type-2 diabetes mellitus leading to decreased glucose uptake of skeletal muscle and increased blood glucose level. Our further aim is to study this mechanism and to find new signaling pathways regulating glucose uptake of skeletal muscle. Our work is mainly basic research and we have strong scientific collaborations with clinicians.

TECHNIQUES AVAILABLE IN THE LAB

Mammalian tissue culture techniques, *in vivo* animal models, primary cell isolation, single myofiber and satellite cell isolation, immunocytochemistry, immunohistochemistry, fluorescent microscopy techniques, image analysis, analysis of cell migration, flow cytometry, cell cycle analysis, cell proliferation assays, spectrophotometry (measurement of enzyme activities, metabolites), PCR, co-immunoprecipitation, GTP-ase activity assays, Western blotting, glucose tolerance test, insulin tolerance test.

SELECTED PUBLICATIONS

Becsky, D., Gyulai-Nagy, S., Balind, A., Horvath, P., Dux, L., **Keller-Pinter, A.** (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823.

Szentesi, P., Csernoch, L., Dux, L., **Keller-Pinter, A.** (2019) Changes in redox signaling in skeletal muscle during aging. **Oxid Med Cell Longev 2019:** 4617801.

Keller-Pinter, A., Szabo, K., Kocsis, T., Deak, F., Ocsovszki, I., Zvara, A., Puskas, L., Szilak, L., Dux, L. (2018) Syndecan-4 influences mammalian myoblast proliferation by modulating myostatin signalling and G1/S transition. **FEBS Lett 592:** 3139-3151.

Kocsis, T., Trencsenyi, G., Szabo, K., Baán, J.A., Müller, G., Mendler, L., Garai, I., Reinauer, H., Deak, F., Dux, L., **Keller-Pintér, A.** (2016) Myostatin propeptide mutation of the hypermuscular Compact mice decreases the formation of myostatin and improves insulin sensitivity. **Am J Physiol Endocrinol Metab 312:** E150-E160.

Keller-Pinter, A., Bottka, S., Timar, J., Kulka, J., Katona, R., Dux, L., Deak, F., Szilak, L. (2010) Syndecan-4 promotes cytokinesis in a phosphorylation-dependent manner. **Cell Mol Life Sci 67:** 1881-94.

LAJOS KEMÉNY

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RESEARCH AREA

Trillions of bacteria, fungi and viruses colonize the skin surface, collectively comprising the skin microbiome. There is a continous interaction in between the microbas and the different cells in the skin. Recent data suggest, that the skin commensal bacteria play an important role in providing a protection against more harmful bacteria, and in the regulation of skin immune system. Commensal bacteria can activate the different cells in the skin to produce inflammatory mediators. However, it is not known, how the skin cells can differentiate in between commensal and pathogenic bacterias? How do we tolerate the great number of bacteria without inducing inflammation in the skin? In special circumstances, the commensal flora has been suggested to play a role in the induction or in the maintenace of chronic inflammatory skin diseases, such as acne, rosacea or psoriasis. Important member of the skin's commensal flora is the bacterium called *Propionibacterium acnes (P. acnes)*. Even though it resides in the pilosebaceous unit of the skin, under certain circumstances it may also play an important role in the pathogenesis of acne, the most common inflammatory skin disease. We investigate how and when this commensal microbe turns pathogenic and how this bacterium influences the skin immune system.

TECHNIQUES AVAILABLE IN THE LAB

Various cell separation techniques, cell culturing methods, flow cytometry, immune-staining techniques of tissues and cells, protein, mRNS detection, cell cycle analysis, cell proliferation measurements.

SELECTED PUBLICATIONS

Buzas, K., Marton, A., Vizler, C., Gyukity-Sebestyen, E., Harmati, M., Nagy, K., Zvara, A., Katona, R.L., Tubak, V., Endresz, V., Németh, I., Olah, J., Vigh, L., Biro, T., **Kemeny, L.** (2016) Bacterial sepsis increases survival in metastatic melanoma: Chlamydophila pneumoniae induces macrophage polarization and tumor regression. **J Invest Dermatol 136:** 862-865.

Tax, G., Urbán, E., Palotás, Zs., **Kemény, L.**, Szabó, K. (2016) Propionic acid produced by Propionibacterium acnes strains contribute to their pathogenicity. **Acta Derm Venereol 93:** 43-49.

Manczinger, M., **Kemény, L.** (2013) Novel factors in the pathogenesis of psoriasis and potential drug candidates are found with systems biology approach. **Plos One 8:** e80751.

Szabó, K., **Kemény, L.** (2011) Studying the genetic predisposing factors in the pathogenesis of acne vulgaris. **Human Immunol 72:** 766–773.

Kinyó, A., Kiss-László, Z., Hambalkó, S., Bebes, A., Kiss, M., Széll, M., Bata-Csörgő, Z., Nagy, F., **Kemény, L.** (2010) COP1 contributes to UVB-induced signaling in human keratinocytes. **J Invest Dermatol 130:** 541–545.

ZSIGMOND TAMÁS KINCSES

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RESEARCH AREA

One of the best method to acquire data about brain structure and function is magnetic resonance imaging (MRI). The structure can be measured at different levels: the volume of the brain, gray and white matter and the subcortical structures can be estimated from structural scans, and microscopic information about the tissue integration can be gathered from diffusion weighted MRI images.

Brain regions activating during certain tasks can be identified with MR sequences sensitive for the blood oxygen content. And the very same functional MRI acquisition can be utilised to detect the resting activity fluctuations in the brain. The synchronous activity fluctuations of remote brain regions identifies functional networks. The time-dependent changes of these connections mark out brain states.

In our research group we investigate the alterations of brain structure and function in various neurological disorders.

Headache disorders: Our studies pointed out that the pathomechanism in migraineurs experiencing aura symptoms before the headache is very different from those patients who has no aura symptom. The microstructure of the white matter shows marked differences in the two subtype of the disease that is correlated with the resting activity fluctuation of the white matter.

Multiple sclerosis: We showed that the disintegration of the periventricular white matter has a close relationship with the cortical atrophy. Our results called attention to the fact that various forms of clinical disability and cognitive disfunction is defined by different set of MRI measured parameters.

Stroke: Our investigations showed that the resting activity fluctuation of the hypoperfused brain is delayed as compared to the homologous contralateral normal side. Furthermore we showed that the functional hyperaemia is delayed in stroke patients. Our newest results indicated that the functional connectivity of the contralesional motor cortex is altered that is a function of functional recovery.

TECHNIQUES AVAILABLE IN THE LAB

Theory of the MRI measurements. Human neurophysiological techniques: EEG, evoked potentials, transcranial magnetic and direct current stimulations.

Structural MRI investigations: Brain volumetry, processing of diffusion tensor images, tractography.

Functional MRI investigations: Detection of task-related brain activation patterns, evaluation of resting state fMRI data, independent component analysis, dynamic functional connectivity

Basic programming skills: Matlab, Python, bash

Statistical approaches: conventional modell based approaches, permutation, bootsrapping

Neurological examination of patients. Neuroradiological evaluation of MRI images.

SELECTED PUBLICATIONS

Faragó, P., Tóth, E., Kocsis, K., Kincses, B, Veréb, D., Király, A., Bozsik, B., Tajti, J., Párdutz, Á., Szok, D., Vécsei, L., Szabó, N., **Kincses, Z.T.** (2019) Altered Resting State Functional Activity and Microstructure of the White Matter in Migraine With **Aura. Front Neurol 10:** 1039.

Kincses, B., Hérák, BJ., Szabó, N., Bozsik, B., Faragó, P., Király, A., Veréb, D., Tóth, E., Kocsis, K., Bencsik, K., Vécsei, L., **Kincses, Z.T.** (2019) Gray Matter Atrophy to Explain Subclinical Oculomotor Deficit in Multiple Sclerosis. **Front Neurol 10:** 589.

Kocsis, K., Csete, G., Erdei, Z., Király, A., Szabó, N., Vécsei, L., **Kincses, Z.T.** (2019) Lateralisation of the white matter microstructure associated with the hemispheric spatial attention dominance. **PLoS One 14: e**0216032.

Tóth, E., Faragó, P., Király, A., Szabó, N., Veréb, D., Kocsis, K., Kincses, B., Sandi, D., Bencsik, K., Vécsei, L., **Kincses, Z.T.** (2019) The Contribution of Various MRI Parameters to Clinical and Cognitive Disability in Multiple Sclerosis. **Front Neurol 9:** 1172.

Veréb, D., Szabó, N., Tuka, B., Tajti, J., Király, A., Faragó, P., Kocsis, K., Tóth, E., Kincses, B., Bagoly, T., Helyes, Z., Vécsei, L., **Kincses, Z.T.** (2018) Correlation of neurochemical and imaging markers in migraine: PACAP38 and DTI measures. **Neurology 91:** e1166-e1174.

BÁLINT KINTSES

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RESEARCH AREA

The human body is a complex ecosystems consisting of the host and its associated microbiota made up of hundreds of beneficial commensal and disease causing pathogenic and opportunistic pathogenic bacterial species. As modern human lifestyles keep changing the ecological environment of the human microbiota at an unprecedented pace, these bacteria respond to these changes with continuous adaptation. A well known consequence of this process is the global antibiotic resistance crisis which is responsible for over 700,000 deaths annually, primarily driven by the emergence of multi-drug resistant opportunistic pathogenic bacteria. In our laboratory, we develop novel technologies in the field of synthetic biology, genomics and genome engineering for two complementary goals. First, to understand the evolutionary dynamics of antibiotic resistance development, and second, to develop novel therapeutic approaches designed to selectively target multi-drug resistant pathogenic bacteria. Beyond asking fundamental scientific questions, we are interested in the utilisation and commercialisation of our inventions.

TECHNIQUES AVAILABLE IN THE LAB

Functional genomics and functional metagenomics, bacterial genome engineering, phage biology and phage engineering, directed evolution, molecular biology and DNA cloning techniques, classic and state-of-the-art microbiology techniques, working with biology safety level 2 pathogenic bacteria, 16S rRNA sequencing of the gut microbiome, next-generation sequencing techniques, data analysis and bioinformatics in R.

SELECTED PUBLICATIONS

Kintses, B., Kumar, P., Jangir, PK,, Fekete, G., Számel, M., Méhi, O., Spohn, R., Daruka, L,, Martins, A., Hosseinnia, A., Gagarinova, A., Kim, S., Phanse, S., Csörgö, B., Györkei, A., Ari, E., Lázár, V., Faragó, A., Bodai, L., Nagy, I., Babu, M., Pál, C., Papp, B. (2019) Chemical-genetic profiling reveals cross-resistance and collateral sensitivity between antimicrobial peptides. Preprint 2019/1/1 **bioRxiv, pages: 542548**, Cold Spring Harbor Laboratory

Kintses, B., Méhi, O., Ari, E., Számel, M., Györkei, Á., Jangir, PK., Nagy, I., Pál, F., Fekete, G., Tengölics, R., Nyerges, Á., Likó, I., Bálint, A., Molnár, T., Bálint, B., Vásárhelyi, BM., Bustamante, M., Papp, B., Pál, C. (2019) Phylogenetic barriers to horizontal transfer of antimicrobial peptide resistance genes in the human gut microbiota. **Nat Microbiol 4:** 447-458.

Nyerges, Á., Csörgő, B., Draskovits, G., **Kintses, B.**, Szili, P., Ferenc, G., Révész, T., Ari, E., Nagy, I., Bálint, B., Vásárhelyi, BM., Bihari, P., Számel, M., Balogh, D., Papp, H., Kalapis, D., Papp, B., Pál, C. (2018) Directed evolution of multiple genomic loci allows the prediction of antibiotic resistance. **Proc Natl Acad Sci U S A 115:** E5726-E5735.

Colin, PY., **Kintses, B.**, Gielen, F., Miton, C., Fischer, G., Mahomed, M., Hyvonen, M., Morgavi, DP., Janssen, DB., Hollfelder, F. (2015) Ultrahigh-throughput Discovery of Promiscuous Enzymes by Picodroplet Functional Metagenomics. **Nat Commun 6:** 10008.

Notebaart, RA., Szappanos, B., **Kintses, B.***, Pál, F., Györkei, Á., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Ruppin, E., Pál, C., Papp, B. (2014) Network-level architecture and the evolutionary potential of underground metabolism. **Proc Natl Acad Sci U S A** 111: 11762-7.

MÓNIKA KIRICSI

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RESEARCH AREA

The general strategy to treat cancer relies largely on traditional chemotherapy using small molecular drugs. Although conventional chemotherapy has a decent success rate it frequently causes severe side effects and can even result in the evolution of multidrug resistant cancer phenotypes. Nanoparticle based treatment of solid tumors is regarded as a novel, attractive strategy to improve cancer therapy, since approximately 10-200 nm sized materials are selectively accumulated in tumor tissues due to the passive targeting effect, where many of them, especially metallic particles can exert direct anti-cancer activity. Owing to their large surface area nanomaterials can also serve as controllable delivery platforms of various cytotoxic drugs for active tumor targeting. Our research group investigates the cellular and molecular events behind the anti-cancer activity of different types of metal nanoparticles in *in vitro* and *in vivo* animal model systems.

TECHNIQUES AVAILABLE IN THE LAB

Standard cell and tissue culture techniques, *in vitro* model systems, co-cultures, testing drugs and nanomaterials, toxicity screens, cell migration and invasion assays, biochemical and molecular biology methods, ELISA, Western blot analysis, RT-qPCR, next generation sequencing, fluorescent and confocal microscopy, histological analysis, immunocytochemistry, reporter systems, gene silencing.

SELECTED PUBLICATIONS

Gopisetty, M.K., Kovács, D., Igaz, N., Rónavári, A., Bélteky, P., Rázga, Z., Venglovecz, V., Csoboz, B., Boros, I.M., Kónya, Z., **Kiricsi, M.** (2019) Endoplasmic reticulum stress: major player in size-dependent inhibition of P - glycoprotein by silver nanoparticles in multidrug-resistant breast cancer cells. **J Nanobiotechnol 17:** 9.

Huliák, I., Bodai, L., Czepán, M., Kovács, D., Szabó, A., Tiszlavicz, L., Lázár, G., Rakonczay, Z. Jr, Hegyi, P., Boros, I.M., **Kiricsi, M.** (2019) Genetic, epigenetic and transcriptional comparison of esophagus tumor-associated and adjacent normal myofibroblasts. **Oncology Rep 41:** 839-852.

Igaz, N., Kovács, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Modulating chromatin structure and DNA accessibility by deacetylase inhibition enhances the anti-cancer activity of silver nanoparticles. **Colloids Surf B Biointerfaces 146:** 670-7.

Kovács, D., Igaz, N., Keskeny, C., Bélteky, P., Tóth, T., Gáspár, R., Madarász, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Silver nanoparticles defeat p53-positive and p53-negative osteosarcoma cells by triggering mitochondrial stress and apoptosis. **Sci Rep 6:** 27902.

Kovács, D., Szőke, K., Igaz, N., Spengler, G., Molnár, J., Tóth, T., Madarász, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Silver nanoparticles modulate ABC transporter activity and enhance chemotherapy in multidrug resistant cancer. **Nanomedicine 12:** 601-10.

ISTVÁN KRIZBAI

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RESEARCH AREA

The central nervous system is one of the most complex and meantime the most sensitive part of our organism. For its proper function the central nervous system needs a steady state environment which is largely provided by the neurovascular unit. In this respect changes in functions of the neurovascular unit have important consequences in causing or aggravating a large number of neurological diseases. The main goal of our research is to understand the molecular mechanisms underlying the function of the neurovascular unit under physiological and pathological conditions. For this purpose, we use different *in vitro* models and *in vivo* two-photon microscopy. On the one side, we investigate the role of neurovascular unit in the formation of brain metastases and the mechanisms of migration of tumour cells into the brain. On the other hand, we investigate how cellular components of the neurovascular unit (brain endothelial cells, pericytes, astrocytes) communicate with each other in neurological disorders associated with aging and with inflammatory processes.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of different cell types from mammalian brain, cell culture, *in vitro* model systems including disease models, barrier permeability studies, biochemical and molecular biology methods, ELISA, fluorescence and confocal microscopy, *in vivo* two-photon and superresolution (STED) microscopy.

SELECTED PUBLICATIONS

Haskó, J., Fazakas, C., Molnár, K., Mészáros, Á., Patai, R., Szabó, G., Erdélyi, F., Nyúl-Tóth, Á., Győri, F., Kozma, M., Farkas, A.E., **Krizbai, I.A.***, Wilhelm, I.*. (2019) Response of the neurovascular unit to brain metastatic breast cancer cells. **Acta Neuropathol Commun. 7:** 133. *corresponding authors

Wilhelm, I., Fazakas, C., Molnár, K., Végh, A.G., Haskó, J., **Krizbai, I.A.** (2018) Foe or friend? Janus- faces of the neurovascular unit in the formation of brain metastases. **J Cereb Blood Flow Metab 38:** 563-587.

Nyúl-Tóth, Á., Kozma, M., Nagyőszi, P., Nagy, K., Fazakas, C., Haskó, J., Molnár, K., Farkas, A.E., Végh, A.G., Váró, G., Galajda, P., Wilhelm, I., **Krizbai, I.A.** (2017) Expression of pattern recognition receptors and activation of the non-canonical inflammasome pathway in brain pericytes. **Brain Behav Immun 64:** 220-231.

Nyúl-Tóth, Á., Suciu, M., Molnár, J., Fazakas, C., Haskó, J., Herman, H., Farkas, A.E., Kaszaki, J., Hermenean, A., Wilhelm, I., **Krizbai, I.A.** (2016) Differences in the molecular structure of the blood-brain barrier in the cerebral cortex and white matter: an in silico, in vitro and ex vivo study. **Am J Physiol Heart Circ Physiol 310:** H1702-14.

Nagyőszi, P., Nyúl-Tóth, Á., Fazakas, C., Wilhelm, I., Kozma, M., Molnár J., Haskó, J., **Krizbai, I.A.** (2015) Regulation of NOD-like receptors and inflammasome activation in cerebral endothelial cells. **J Neurochem 135:** 551-64.

MÁTÉ MANCZINGER

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RESEARCH AREA

The immune system has to differentiate between harmful and non-harmful agents. Inadequate immune recognition can lead to infectious diseases, allergy, autoimmunity and cancer.

We examine the adaptive immune recognition and its role in different diseases. We are focusing on MHC molecules, which are essential elements of this process by presenting short peptide fragments to immune cells. The genes encoding these molecules show extreme genetic variability, which means that two individuals rarely carry the same MHC variants.

During our work, we analyze large datasets to reveal general features of MHC molecules, which make people susceptible to different diseases.

TECHNIQUES AVAILABLE IN THE LAB

Programming in "R" language; big data analysis; modern statistics; database processing, data visualization.

SELECTED PUBLICATIONS

Manczinger, M., Koncz, B., Balogh, G. M., Papp, B. T., Asztalos, L., Kemény, L., Papp, B. & Pál, C. (2021) Negative trade-off between neoantigen repertoire breadth and the specificity of HLA-I molecules shapes antitumor immunity. **Nat Cancer 2:** 950-961.

Manczinger, M., Boross, G., Kemény, L., Müller, V., Lenz, T. L., Papp, B., Pál, C. (2019) Pathogen diversity drives the evolution of generalist MHC-II alleles in human populations. **PLoS Biol 17:** e3000131.

Manczinger, M., Kemény, L. (2018) Peptide presentation by HLA-DQ molecules is associated with the development of immune tolerance. **PeerJ 6:** e5118.

Manczinger, M., Bodnár, V., Papp, B. T., Bolla, B. Sz., Szabó, K.,Balázs, B., Csányi, E., Szél, E., Erős, G.,Kemény, L. (2018) Drug repurposing by simulating flow through protein – protein interaction networks. **Clin Pharmacol Ther 103:** 511-520.

Manczinger, M., Kemény, L. (2013) Novel factors in the pathogenesis of psoriasis and potential drug candidates are found with systems biology approach. **PLoS One 8:** e80751.

Manczinger, M., Szabó, E.Z., Göblös, A., Kemény, L., Lakatos, L. (2012) Switching on RNA silencing suppressor activity by restoring argonaute binding to a viral protein. **J Virol 86:** 8324-7.

TAMÁS MARTINEK

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RESEARCH AREA

The aim of our research group is to create new macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein-protein, protein-membrane and protein-carbohydrate interactions by these chemically well defined substances is a great challenge and holds promise. While small molecule drugs can not effectively decouple macromolecule interactions in general because of their geometry, the right sized and often used antibodies have many disadvantages. We utilize foldamers as artifical self-organizing protein mimetics to modulate protein interactions, to develop diagnostic tools and novel antibacterial materials.

TECHNIQUES AVAILABLE IN THE LAB

Foldamers are synthetised chemically by using automated methods and the desing heavily relies on computer modelling. Their structure is analyzed by HPLC-MS. To analyze protein-ligand interactions, NMR spectrometry is deployed with a special emphasis on protein NMR methods including 3D structure refinement and the analysis of protein dynamics. Proteins are produced via bacterial expression systems. We analyze protein – ligand interactions with the help of isothermal titration calorimetry and various fluorescent techniques. Biological activity of the compounds are tested in cell-based assays.

SELECTED PUBLICATIONS

Bartus, E., Hegedüs, Z., Wéber, E., Csipak, B., Szakonyi, G., **Martinek, T.A.** (2017) De Novo Modular Development of a Foldameric Protein-Protein Interaction Inhibitor for Separate Hot Spots: A Dynamic Covalent Assembly Approach. **ChemistryOpen 6:** 236-241.

Hegedus, Z., Makra, I., Imre, N., Hetényi, A., Mándity ,I.M., Monostori, É., **Martinek, T.A.** (2016) Foldameric probes for membrane interactions by induced β-sheet folding. **Chemical Communications 52:** 1891-4.

Olajos, G., Hetényi, A., Wéber, E., Németh, L.J., Szakonyi, Z., Fülöp, F., **Martinek, T.A.** (2015) Induced Folding of Protein-Sized Foldameric β-Sandwich Models with Core β-Amino Acid Residues. **Chemistry 21:** 6173-80.

Hegedus, Z., Weber, E., Kriston-Pal, E., Makra, I., Czibula, A., Monostori, E., **Martinek,** T.A. (2013) Foldameric alpha/beta-Peptide Analogs of the beta-Sheet-Forming Antiangiogenic Anginex: Structure and Bioactivity. **J Am Chem Soc 135:** 16578-84.

Berlicki, Ł., Pilsl, L., Wéber, E., Mándity, I.M., Cabrele, C., **Martinek, T.A.,** Fülöp, F., Reiser, O. (2012) Unique α,β- and α,α,β,β-peptide foldamers based on cis-β-aminocyclopentanecarboxylic acid. **Angew Chem Int Ed Engl 51:** 2208-12.

LAJOS MÁTÉS

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RESEARCH AREA

Cancer is the leading cause of death in the developed world. According to estimates from the International Agency for Research on Cancer, there were 8.2 million cancer deaths in 2012 worldwide.

Cancer research began as early as at the end of the 19th century, indicating the social efforts to control this devastating disease. In recent years, the tremendous advances reached in molecular biology and genomics has given further impetus to the development of this field. Among other things, the recently developed high-throughput sequencing technology platforms have generated massive amounts of genetic variation data from a huge number of cancer samples. The collected data support the concept that cancer is a disease of our genome, because in the majority of tumors tens or even hundreds of thousands of mutations have been detected. These data also show that the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. The key feature of cancer cells, allowing them to rapidly evolve more and more new mutations, is the instability of their genetic material.

The long-term objective of our laboratory is to explore genetic alterations fuelling malignant transformation by undermining the stability of the genome.

TECHNIQUES AVAILABLE IN THE LAB

Basic molecular biological methods, involving isolation manipulation and analysis of DNA, RNA and proteins, standard mammalian tissue culture techniques, basic mouse colony management techniques, gene knockout and gene knockdown techniques, advanced gene delivery methods used in tissue culture and in animal models.

SELECTED PUBLICATIONS

Katter, K., Geurts, A.M., Hoffmann, O., **Mátés, L.,** Landa, V., Hiripi, L., Moreno, C., Lazar, J., Bashir, S., Zideke, V., Popova, E., Jerchowc, B., Beckerc, K., Devarajc, A., Walterj, I., Grzybowksib, M., Corbettb, M., Filhol, A.R., Hodgesb, M.R., Baderc, M., Ivics, Z., Jacob, H.J., Pravenec, M., Bősze, Z., Rülicke, T., Izsvák, Z. (2013) Transposon-mediated Transgenesis, Transgenic Rescue, and Tissue-specific Gene Expression in Rodents and Rabbit. **FASEB J 27:** 930-941.

Xue, X., Huang, X., Nodland, S.E., **Mátés, L.,** Ma, L., Izsvak, Z., Ivics, Z., LeBien, T.W., McIvor, R.S., Wagner, J.E., Zhou, X. (2009) Stable gene transfer and expression in cord blood-derived CD34+ hematopoietic stem and progenitor cells by a hyperactive Sleeping Beauty transposon system. **Blood 114:** 1319-1330.

Mátés, L., Chuah, M.K., Belay, E., Jerchow, B., Manoj, N., Acosta-Sanchez, A., Grzela, D.P., Schmitt, A., Becker, K., Matrai, J., Ma, L., Samara-Kuko, E., Gysemans, C., Pryputniewicz, D., Miskey, C., Fletcher, B., VandenDriessche, T., Ivics, Z., Izsvak, Z. (2009) Molecular evolution of a novel hyperactive Sleeping Beauty transposase enables robust stable gene transfer in vertebrates. **Nature Genet 41:** 753-761.

Ivics, Z., Li, M.A., **Mátés, L.**, Boeke, J.D., Nagy, A., Bradley, A., and Izsvak, Z. (2009) Transposon-mediated genome manipulation in vertebrates. **Nat Methods 6:** 415-422.

Mátés, L., Izsvak, Z., Ivics, Z. (2007) Technology transfer from worms and flies to vertebrates: transposition-based genome manipulations and their future perspectives. **Genome Biol 8 Suppl 1:** S1.

JÓZSEF MIHÁLY

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RESEARCH AREA

Coordinated regulation of the actin and microtubule cytoskeleton is known to play a pivotal role in the growth and proper navigation of neuronal axons and dendrites that are necessary to the formation of a functional nervous system. One of our major scientific interests is to gain a better understanding of the molecular mechanisms of axonal growth and guidance by uncovering the role of the growth cone cytoskeleton regulatory proteins. In addition, we are interested in the mechanisms of myofibrillogenesis. Myofibrils are composed of repeated sarcomeres that are extremely highly ordered macromolecular assemblies where structural organization is intimately linked to their functionality as contractile units. Recently, we developed a powerful nanoscopic approach that allowed us to determine the position of 27 muscle proteins with a quasi-molecular localization precision, and by means of template based protein structure modelling, we assembled a refined I-band and H-zone model with an unparalleled scope and resolution. We aim to combine this method with genetic approaches to investigate the molecular mechanisms of sarcomere assembly during muscle development.

Our studies are of potential biomedical relevance as they may help to develop more efficient neuronal regeneration methods, and to understand sarcomere assembly and function in healthy and disease conditions.

TECHNIQUES AVAILABLE IN THE LAB

Classical and molecular Drosophila genetics, molecular biology, cell biology, cytoskeleton analysis, immunohistochemistry, the basic methods of biochemistry, confocal and super-resolution microscopy, behavioral tests, live imaging, digital image analysis.

SELECTED PUBLICATIONS

Szikora, S., Gajdos, T., Novák, T., Farkas, D., Földi, I., Lenart, P., Erdélyi, M., **Mihály, J.** (2020) Nanoscopy reveals the layered organization of the sarcomeric H-zone and I-band complexes. **J Cell Biol 219:** e201907026

Szikora, S., Földi, I., Tóth, K., Migh, E., Vig, A., Bugyi, B., Maléth, J., Hegyi, P., Kaltenecker, P., Sanchez-Soriano, N., **Mihály, J.** (2017) The formin DAAM is required for coordination of the actin and microtubule cytoskeleton in axonal growth cones. **J Cell Sci 130:** 2506-2519.

Nelson, K.S., Khan, Z., Molnár, I., **Mihály, J.,** Kaschube, M., Beitel, GJ. (2012) Drosophila Src regulates anisotropic apical surface growth to control epithelial tube size. **Nat Cell Biol 14:** 518-525.

Matusek, T., Gombos, R., Szécsényi, A., Sánchez-Soriano, N., Czibula, A., Pataki, C., Gedai, A., Prokop, A., Raskó, I., **Mihály, J.** (2008) Formin proteins of the DAAM subfamily play a role during axon growth. **J. Neurosci 28:** 13310-13319.

Boutros, M., **Mihaly, J.**, Bouwmeester, T., Mlodzik, M. (2000) Signaling specificity by Frizzled receptors in Drosophila. **Science 288:** 1825-1828.

LÁSZLÓ NAGY

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RESEARCH AREA

We are interested in the general principles of genomes evolution, that of the evolution of organismal complexity, fungal development and their biotechnological applications. Fungi are the most ubiquitous microbes in modern biotechnology which, despite centuries of research, offer huge unharnessed potentials. Our research focuses on gene regulatory networks underlying fungal morphogenesis and the degradation of complex plant polysaccharides (e.g. lignocellulose). Complex plant polysaccharides, such as lignin and cellulose, are the most abundant repositories of sequestered carbon on Earth. Fungi can most efficiently reintroduce this sequestered carbon into the carbon cycle, contributing a key step to ecosystem functioning worldwide. However, the genes and gene regulatory networks that underlie the fungal decomposition of complex plant biomass are unknown. Gene regulatory networks are finely tuned circuits that regulate precise spatial and temporal expression of genes. We use modern -omics, genetic, phylogenetic and bioinformatic approaches to uncover the evolutionary origins and genetic bases of fungal morphogenesis, multicellularity and to translate basic research results into biotechnological applications.

TECHNIQUES AVAILABLE IN THE LAB

Students applying to our research group can learn diverse techniques in the field of bioinformatics, modern high-throughput -omics, molecular and microbiology. We employ a wide repertoire of molecular biology methods, including polymerase chain reaction (PCR), gene knockout, CRISPR. Cas9, vector construction, protein and gene expression visualisation and various microscopy techniques. Of '-omics' methods, we employ genomics, genome-sequencing, transcriptome sequencing and perform bioinformatic analyses of data gerenated by these approaches. We employ state of the art long-read technologies (NanoPore). We use diverse bioinformatic pipelines for data-analysis, phylogenetic reconstruction, molecular clock, comparative genomic questions as well as develop novel algorithms and routines.

SELECTED PUBLICATIONS

Varga, T., et al., **Nagy, G.L.** (2019) Megaphylogeny resolves global patterns of mushroom evolution. **Nat Ecol Evol 3**: 668-678.

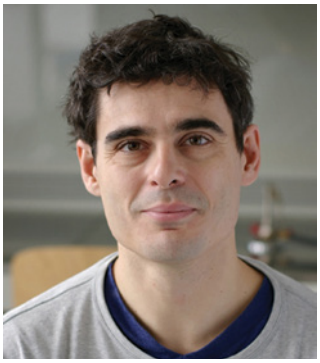
Krizsán, K., et al., **Nagy, G.L.** (2019) A transcriptomic atlas of mushroom development highlights an independent origin of complex multicellularity. **Proc Natl Acad Sci USA 116**: 7409-7418.

Kiss, E., Hegedus, B., Varga, T., Merenyi, Z., Koszo, T., Balint, B., Prasanna, A.N., Krizsan K., Riquelme, M., Takeshita, N., **Nagy, G.L.** (2019) Comparative genomics reveals the origin of fungal hyphae and multicellularity. **Nat Commun 10**: 4080.

Nagy, G.L., Kovács, G.M., Krizsán, K. (2018) Complex multicellularity in fungi: evolutionary convergence, single origin, or both? **Biol Rev Camb Philos Soc 93:** 1778-1794.

Sipos, G., et al., **Nagy, G.L.** (2017) Genome expansion and lineage-specific genetic innovations in the forest pathogenic fungi Armillaria. **Nat Ecol Evol 1:** 1931-1941.

CSABA PÁL



Biological Research Center
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Synthetic and Systems Biology Unit

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RESEARCH AREA

We focus on bacterial pathogens and the problem of antibiotic resistance. We found that multidrug resistance mutations in bacteria simultaneously enhance sensitivity to other unrelated antibiotics (collateral sensitivity). This finding has led to the design of new antibiotic cocktails. Using bacterial genome engineering, we aim to develop novel resistance-free antibiotics. Finally, we study the evolution of adaptive immune system in response to pathogens and cancer.

More details: *http://www.brc.hu/sysbiol*

TECHNIQUES AVAILABLE IN THE LAB

Bacterial genome engineering, laboratory evolution, systems biology, bioinformatics.

SELECTED PUBLICATIONS

Kintses, B., Méhi, O., Ari, E., Számel, M., Györkei, Á., Jangir, P.K., Nagy, I., Pál, F., Fekete, G., Tengölics, R., Nyerges, Á., Likó, I., Bálint, A., Molnár, T., Bálint, B., Vásárhelyi, B.M., Bustamante, M., Papp, B., **Pal, C.** (2019) Phylogenetic barriers to horizontal transfer of antimicrobial peptide resistance genes in the human gut microbiota. **Nature Microbiology 4:** 447-458.

Lázár, V., Martins, A., Spohn, R., Daruka, L., Grézal, G., Fekete, G., Számel, M., Jangir, P.K., Kintses, B., Csörgő, B., Nyerges, Á, Györkei, Á., Kincses, A., Dér, A., Walter ,F.R., Deli , M.A., Urbán, E., Hegedűs, Z., Olajos G., Méhi, O., Bálint, B., Nagy, I., Martinek, T. A., PappB., **Pal C.** (2018) Antibiotic-resistant bacteria show widespread collateral sensitivity to antimicrobial peptides. **Nature Microbiology 3:** 718-731.

Pal, C., Papp, B., Pósfai, G. (2014) The dawn of evolutionary genome engineering. **Nat Rev Genet 15:** 504-512.

Pal, C., Macia, M., Oliver, A., Schacher, I., Buckling, A. (2007) Coevolution with viruses drives the evolution of bacterial mutation rates. **Nature 450:** 1079-81

Pal, C., Papp, B., Lercher, M.J., Csermely, P., Oliver, S.G., Hurst, L.D. (2006) Chance and necessity in the evolution of minimal metabolic networks. **Nature 440:** 667-670.

BALÁZS PAPP

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RESEARCH AREA

Metabolism is central to life as it provides the building blocks and energy for all biological processes. While its fundamental tasks are highly conserved across all life forms, there are substantial differences in the details of how metabolism works across species and individuals. Humans are no exception. Any two of us show large metabolic differences and many diseases are known to involve changes in metabolism. However, not all metabolic differences are harmful and identifying those that impact human health is of paramount importance for medicine. Our laboratory uses computational approaches to study the variation of metabolism both within human populations and between different species. Our goal is to uncover the signatures of natural selection acting on human metabolism and thereby increase our understanding of healthy and diseased states.

For more details, see *www.brc.hu/sysbiol/*.

TECHNIQUES AVAILABLE IN THE LAB

Basic bioinformatics and chemoinformatics methods, phylogenetics and comparative genomics methods, computational metabolomics, experimental metabolomics, R statistical programming language, Matlab programming language, Perl programming language, statistical methods, machine learning.

SELECTED PUBLICATIONS

Zampieri, M.*, Szappanos, B.*, Buchieri, M.V., Trauner, A., Piazza, I., Picotti, P., Gagneux, S., Borrell, S., Gicquel, B., Lelievre, J., **Papp, B.**, Sauer, U. (2018) High-throughput metabolomic analysis predicts mode of action of uncharacterized antimicrobial compounds. **Sci Transl Med 10:** eaal 3973.

Notebaart, R.A., Szappanos, B., Kintses, B., Pál, F., Györkei, A., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Ruppin, E., Pál, C., **Papp, B.** (2014) Network-level architecture and the evolutionary potential of underground metabolism. **Proc Natl Acad Sci U S A 111:** 11762-11767.

Szappanos, B., Kovács, K., Szamecz, B., Honti, F., Costanzo, F., Baryshnikova, A., Gelius-Dietrich, G., Lercher, M.J., Jelasity, M., Myers, C.L., Andrews, B.J., Boone, C., Oliver, S.G., Pál, C., **Papp, B.** (2011) An integrated approach to characterize genetic interaction networks in yeast metabolism. **Nat Genet 43:** 656-62.

Papp, B., Pál, C., Hurst, L.D. (2004) Metabolic network analysis of the causes and evolution of enzyme dispensability in yeast. **Nature 429:** 661-4.

FERENC PETÁK

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RESEARCH AREA

The cardiopulmonary research laboratory performs scientific activities in various fields of cardiopulmonary physiology and pathophysiology by using translational animal models of lung diseases and performing assessments in clinical environment. A research area is focusing on the involvement of the pulmonary hemodynamics and lung vasculature in various respiratory diseases. We clarify the mechanisms responsible for the lung function deteriorations with a particular focus on the cardiopulmonary interactions. Further research focuses on the characterization of the pulmonary consequences of general anesthesia in various animal models and in clinical environment. Improvement of patient monitoring is essential for the optimization of patient management in anesthesia and intensive care settings. Analyses of the expired gases has great importance in respiratory patient monitoring. Thus we analyze the within-breath dynamics of CO_2 exhalation by using capnography to gain insights into the ventilation-perfusion matching. Further research focuses on the pulmonary manifestations of type-2 diabetes mellitus (T2DM) that presents major public health concerns. We characterize the changes in airway function and clarify the deteriorations in the viscoelastic properties of the pulmonary parenchyma, which may be a consequence of lung volume loss, interstitial edema, proliferation, and the effect of advanced glycation endproducts and their interaction with receptors.

TECHNIQUES AVAILABLE IN THE LAB

- Measurement methodologies for the assessment of lung mechanics in animal models and in clinical environment involving spontaneously breathing subjects and anaesthetized mechanically ventilated patients.
- Techniques for circulatory and respiratory monitoring.
- Models of airway hyperresponsiveness.
- Inhalation of airborne nanoparticles: exposition and measurement methods.
- Analyses of expired gases, evaluation of the dynamics of expired CO_2 concentration with capnography, oxygraphy.
- Assessment of pulmonary consequences of diabetes mellitus in animal models and patients.
- Near infrared spectroscopy for the assessment of cerebral tissue oxygen saturation.
- Assessment of perioperative hemostasis.

SELECTED PUBLICATIONS

Fodor, G.H., Bayat, S., Babik, B., Habre, W., **Petak, F.** (2018) Reversing Cholinergic Bronchoconstriction by Common Inotropic Agents: A Randomized Experimental Trial on Isolated Perfused Rat Lungs. **Anesth Analg 129:** 745-752.

Babik, B., Balogh, A.L., Sudy, R., Ivankovitsne-Kiss, O., Fodor, G.H., **Petak, F.** (2017) Levosimendan prevents bronchoconstriction and adverse respiratory tissue mechanical changes in rabbits. **Am J Physiol Lung Cell Mol Physiol 313:** L950-L956.

Petak, F., Fodor, G.H., Babik, B., Habre, W. (2016) Airway mechanics and lung tissue viscoelasticity: effects of altered blood hematocrit in the pulmonary circulation. **J Appl Physiol 121:** 261-7.

Filep, Á., Fodor, G.H., Kun-Szabó, F., Tiszlavicz, L., Rázga, Z., Bozsó, G., Bozóki, Z., Szabó, G., **Petak, F.** (2016) Exposure to urban PM1 in rats: development of bronchial inflammation and airway hyperresponsiveness. **Respir Res 17:** 26.

Fodor, G.H., Babik, B., Czövek, D., Doras, C., Balogh, Á.L., Bayat, S., Habre, W., **Petak, F**. (2016) Fluid replacement and respiratory function: comparison of whole blood with colloid and crystalloid: A randomised animal study. **Eur J Anaesthesiol 33:** 34-41.

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RESEARCH AREA

The saying originating from the US at the beginning of the previous century *"A picture is worth a thousand words"* is particularly adequate for the description of the complexity of the brain. A new discipline, called geometrical statistics, is used now by micro-anatomical photography to derive unbiased data characterizing the number, size, specified surface portions, etc. of nerve cells by using tiny samples from an enormously high population (≈ 200 billion) of neurons constituting the brain.

The results of such investigations either may contribute to the interpretation of the industrial amount of data coming from (sometimes) automated molecular biology instruments, or may substitute those, when variations of biological functions should be attributed to distributional instead of quantitative changes in e.g. gene expression. The development of biological micro-structural investigations is undoubtedly motivated by a typical human desire expressed by *"seeing is believing"*. This is most obvious in the regular need of seeking the structural correlates of the results obtained by another cutting edge technology, electrophysiology.

Our micro-anatomical research is aimed to derive quantitative data characterizing nerve cells in healthy conditions, during disease and ageing, which are also suitable to measure the effect of treatments aimed to halt or reverse disease progression.

TECHNIQUES AVAILABLE IN THE LAB

Basic methods in structural investigations (light, fluorescent, and electron microscopic techniques), sample preparation methods for biological structural research, labeling techniques for molecular imaging, statistical basis of sampling for unbiased quantitative microscopy, derivation of biological relevant three-dimensional parameters from biological tissue, interactive and automatic computer assisted image analysis, image analysis programming languages.

SELECTED PUBLICATIONS

Patai, R., Nógrádi, B., Obál, I., Engelhardt, J.I., **Siklós, L.** (2017) Calcium in the pathomechanism of amyotrophic lateral sclerosis – taking center stage? **Biochem Biophys Res Comm 483:** 1031-1039.

Adalbert, R., Morreale, G., Paizs, M., Conforti L., Walker, S.A., Roderick, H.L., Bootman, M.D., **Siklós, L.**, Coleman, M.P. (2012) Intra-axonal calcium changes after axotomy in wild-type and slow Wallerian degeneration axons. **Neuroscience 225:** 44-54.

Paizs, M., Tortarolo, M., Bendotti, C., **Siklós, L.** (2011) Talampanel reduces the level of motoneuronal calcium in transgenic mutant SOD1 mice only if applied presymptomatically. **Amyotroph Lateral Scler 12:** 340-344.

Paizs, M., Engelhardt, J.I., Katarova, Z., **Siklós, L.** (2010) Hypoglossal motor neurons display reduced calcium increase after axotomy in mice with upregulated parvalbumin. **Comp Neurol 518:** 1946-1961.

Paizs, M., Engelhardt, J.I., **Siklós, L.** (2009) Quantitative assessment of relative changes of immunohistochemical staining by light microscopy in specified anatomical regions. **Microscopy (Oxford) 234:** 103-112.

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RESEARCH AREA

The genome programs of the past decades have provided an enormous amount of information about the human genome and how this information is translated to the "language of life". This knowledge is essential for understanding the pathogenesis of human diseases at the molecular level and, in fact, is currently being used to develop novel diagnostics and therapeutic modalities. Our workgroup identifi es novel pathogenic mutations that result in rare monogenic human diseases. By performing functional analyses of these mutations, we attempt to understand how their mode of action leads to human disease. In another project, we investigate the genetics and molecular susceptibility factors of multifactorial human skin diseases, with a primary focus on psoriasis. We are also engaged in the investigation of non-coding RNAs. In particular, we analyze the role of the PRINS mRNA-like non-coding RNA, which was previously identifi ed by our workgroup, in cellular stress responses and in various human diseases. In the last few years our research group has joined the Hungarian Brain Research Program (NAP Project) and as the member of the clinical branch we are engaged in the identification of genetic factors in neurodegenerative human diseases. This work has already yielded several new results for the field.

TECHNIQUES AVAILABLE IN THE LAB

After identifying mutations using the polymerase chain reaction (PCR) and sequencing methods, various bioinformatics tools are used for sequence analysis. For our functional analyses, we employ *in vitro* DNA and cloning techniques as well as specifi c gene-silencing methods. Gene and protein expression is assessed using real-time reverse transcriptase PCR, western blot analysis, immunohistochemistry and immunocytochemistry. In the last few years we have introduced next generation sequencing (NGS) into our laboratory and we apply it routinly in our research work. Data provided by NGS are analized by various bioinformatics tools.

SELECTED PUBLICATIONS

Tripolszki, K., Csányi, B., Nagy, D., Ratti, A., Tiloca, C., Silani, V., Kereszty, É., Török, N., Vécsei, L., Engelhardt, J.I., Klivényi, P.(5), Nagy, N., **Széll, M.** (2017) Genetic analysis of the SOD1 and C9ORF72 genes in Hungarian patients with amyotrophic lateral sclerosis. **Neurobiol Aging 53:** 195.e1-195.e5.

Szell, M., Danis, J., Bata-Csorgo, Z., Kemeny, L. (2016) PRINS, a primate-specific long non-coding RNA, plays a role in the keratinocyte stress response and psoriasis pathogenesis. **Pflugers Archiv 468:** 935-943.

Szell, M., Bata-Csorgo, Z., Kemeny, L. (2008) The enigmatic world of mRNA-like ncRNAs: Their role in human evolution and in human diseases. **Semin Cancer Biol 18:** 141-148.

Sonkoly, E., Bata-Csorgo, Z., Pivarcsi, A., Polyanka, H., Kenderessy, Szabo, A., Molnar, G., Szentpali, K., Bari, L., Megyeri, K., Mandi, Y., Dobozy, A., Kemeny, L., **Szell, M.** (2005) Identifi cation and characterization of a novel, psoriasis susceptibility-related noncoding RNA gene, PRINS. **J Biol Chem 280:** 24159-24167.

Széll, M., Bata-Csorgo, Z., Koreckm, A., Pivarcsim, A., Polyánkam, H., Szeg, C., Gaál, M., Dobozy, A., Kemény, L. (2004) Proliferating keratinocytes are putative sources of the psoriasis susceptibility related EDA+ oncofoeltal fibronectin. **J Investigat Dermotol 123:** 537-546.

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RESEARCH AREA

Our research is characterized by a combination of technically challenging electrophysiology, molecular biology, imaging and anatomy in pursuit of the function of cell types and their synapses in the human and rodent cerebral cortex. We discovered the cellular source (neurogliaform cells) of slow, GABAB receptor mediated inhibition in the cerebral cortex. Subsequently, we discovered the mechanism of this slow inhibition as single neuron driven nonsynaptic or volume transmission of the neurotransmitter GABA. In addition, our experiments assigned a new, excitatory role to axo-axonic cells, which were considered as the most specific inhibitory neurons of the cortex. Our commitment to cutting edge methodology recently resulted in recordings from identified interneurons in completely unaesthetized, freely behaving rodents and identified the first ripple-like oscillatory events in the neocortex and their cellular structure. We initiated a research program in 2004 for multiple patch clamp recordings in slices taken from the human cerebral cortex leading to the first recordings of human synaptic interactions and showing the existence of Hebbian networks in the human cerebral cortex.

TECHNIQUES AVAILABLE IN THE LAB

In vivo juxtacellular recordings from neurons of the cerebral cortex in freely behaving rodents, *in vivo* patch clamp electrophysiology, human *in vitro* brain slice patch clamp electrophysiology, *in vivo* and *in vitro* multiphoton imaging (acustooptical and resonant scanning), CARS microscopy in brain slices, transmission electron microscopy, 3D neuron reconstruction with Neurolucida, single digital PCR, single and oligocellular next generation sequencing.

SELECTED PUBLICATIONS

Averkin, R., Szemenyei, V., Borde, S., **Tamas, G.** (2016) Identified cellular correlates of neocortical ripple and high-gamma oscillations during spindles of natural sleep. **Neuron 92:** 916-92.

Molnar, G., Rozsa, M., Baka, J., Holderith, N., Barzo, P., Nusser, Z., **Tamas, G.** (2016) Human pyramidal to interneuron synapses are mediated by multi-vesicular release and multiple docked vesicles. **Elife 5:** e18167.

Olah, S., Fule, M., Komlosi, G., Varga, C., Baldi, R., Barzo, P. **Tamas, G.** (2009) Regulation of cortical microcircuits by unitary GABA-mediated volume transmission. **Nature 461:** 1278-81.

Szabadics, J., Varga, C., Molnar, G., Olah, S., Barzo, P., **Tamas, G.** (2006) Excitatory effect of GABAergic axo-axonic cells in cortical microcircuits. **Science 311:** 233-5.

Tamas, G., Lorincz, A., Simon, A., Szabadics, J. (2003) Identified sources and targets of slow inhibition in the neocortex. **Science 299:** 1902-1905.

GYULA TIMINSZKY

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RESEARCH AREA

Genome integrity is crucial for all living organisms. If damaged DNA is not promptly repaired, the mutations ultimately lead to the development of cancer. Defective repair can also cause immunodeficiency, neurodegenerative disorders and premature ageing. The range of DNA lesions require diverse signaling and repair pathways to shape the DNA damage response. This involves changes in nuclear dynamics including alterations in chromatin structure, nucleocytoplasmic transport and protein activities.

ADP-ribosylation is one of the earliest post-translational modifications appearing upon DNA damage. Its effects are numerous. One of its functions is to relax chromatin at the sites of DNA damage, facilitating the access of DNA repair processes to the lesions. Our findings indicate that nuclear dynamics, mRNA metabolism and chromosome organization strongly depend on nuclear ADP-ribosylation reactions and their crosstalk with other signaling pathways. Its deregulation impairs DNA repair and is implicated in cancer. At the bedside, the inhibition of ADP-ribosylation by drugs is used to treat cancer with certain gene mutations.

Our research goal is to characterize novel molecular mechanisms that regulate the DNA damage response, including nucleocytoplasmic transport, mRNA metabolism and chromatin architecture. We study novel cancer relevant mutations that are sensitive to ADP-ribosylation inhibitors, which could be potentially used to treat tumors carrying such mutations. Furthermore, we investigate the molecular basis of a novel DNA damage-induced nuclear export mechanism that regulates ADP-ribose metabolism.

TECHNIQUES AVAILABLE IN THE LAB

Molecular biology techniques for DNA, RNA and protein production, isolation and measurement, PCR, qPCR, cloning, sequencing, *in vitro* mutagenesis, Western blot, immunohistochemistry, cell culture methods, cell-based reporter assays to measure DNA repair, ADP-ribosylation, chromatin structure or protein-protein interaction, confocal microscopy, live cell imaging of fluorescently tagged proteins, knocking out or silencing genes in human cells, CRISPR-based whole genome knockout screening.

SELECTED PUBLICATIONS

Smith, R., Sellou, H., Chapuis, C., Huet, S., **Timinszky, G.** (2018) CHD3 and CHD4 recruitment and chromatin remodeling activity at DNA breaks is promoted by early poly(ADP-ribose)-dependent chromatin relaxation. **Nucleic Acids Res 46:** 6087-6098.

Singh, H.R., Nardozza, A.P., Möller, I.R., Knobloch, G., Kistemaker, H.A.V., Hassler, M., Harrer, N., Blessing, C., Eustermann, S., Kotthoff, C., Huet, S., Mueller-Planitz, F., Filippov, D.V., **Timinszky, G.**, Rand, K.D., Ladurner, A.G. (2017) A Poly-ADP-Ribose Trigger Releases the Auto-Inhibition of a Chromatin Remodeling Oncogene. **Mol Cell 68:** 860-871.

Golia, B., Moeller, G.K., Jankevicius, G., Schmidt, A., Hegele, A., Preißer, J., Tran, M.L., Imhof, A., **Timinszky, G.** (2017) ATM induces MacroD2 nuclear export upon DNA damage. **Nucleic Acids Res 45:** 244-254.

Czarna, A., Berndt, A., Singh, H.R., Grudziecki, A., Ladurner, A.G., **Timinszky, G.,** Kramer, A., Wolf, E. (2013) Crystal structures of Drosophila Cryptochrome and mouse. Cryptochrome1: insights into circadian function. **Cell 153:** 1394-405.

Jankevicius, G., Hassler, M., Golia, B., Rybin, V., Zacharias, M., **Timinszky, G.**, Ladurner, A.G. (2013) A family of macrodomain proteins reverses cellular mono-ADP-ribosylation. **Nat Struct Mol Biol 20:** 508-14.

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RESEARCH AREA

Sudden cardiac death is among the leading causes of mortality worldwide. Therefore to better understand the mechanisms of sudden cardiac death and consequently to introduce effective preventive measures represent extremely important issues in the field of public health care. Sudden cardiac death may occur due to cardiac ischaemia, adverse reaction following drug treatment is associated with diseases like heart failure, congenital diseases or can develop in top athletes due to excessive exercise and/or doping. These cases can manifest due to electrophysiological malfunctions of the heart as a consequence of disturbances in cardiac transmembrane ion channel function including various types of potassium channels. Our research team focuses on investigations on the physiology and pathophysiology of these ion channels including pharmacological modulation and possible prevention of cardiac arrhythmias in general, achieving international attention worldwide.

TECHNIQUES AVAILABLE IN THE LAB

Basic cardiac electrophysiological and molecular biological methods, such as *in vivo* arrhythmia models, cellular action potential measurements, patch-clamp techniques, epifluorescent Ca^{2+} signal detection, gene transfer, PCR and Western Blot techniques.

SELECTED PUBLICATIONS

Varró A., Tomek J., Nagy N., Virág L., Passini E., Rodriguez B., Baczkó I. (2021) Cardiac transmembrane ion channels and action potentials: cellular physiology and arrhythmogenic behavior. **Physiol Rev 101:**1083-1176.

Jost, N., Virág, L., Comtois, P., Ördög, Ö., Szűts, V., Seprényi, Gy., Bitay, M., Kohajda, Zs., Koncz, I., Nagy, N., Szél, T., Magyar, J., Kovács, M., Puskás, LG., Lengyel, Cs., Wettwer, E., Ravens, U., Nánási, PP., Papp, JGy., **Varró, A.,** Nattel, S. (2013) Ionic mechanisms limiting cardiac repolarization-reserve in humans compared to dogs. **J Physiol 591:** 4189-4206.

Jost, N., Nagy, N., Corici, C., Kohajda, Zs., Horváth, A., Acsai, K., Biliczki, P., Levijoki, J., Pollesello, P., Koskelainen, T., Otsomaa, L., Tóth, A., Papp, J.Gy., **Varró, A.,** Virág, L. (2013) ORM-10103, a novel specific inhibitor of the sodium/calcium exchanger, decreases early and delayed afterdepolarization in the canine heart. **Brit J Pharmacol 170:** 768-778.

Nagy, N., Acsai, K., Kormos, A., Sebők, Zs., Farkas, A.S., Jost, N., Nánási, P.P., Papp, J.Gy., **Varró, A.,** Tóth, A. (2013) $[Ca^{2+}]$ i-induced augmentation of the inward rectifier potassium current (IK1) in canine and human ventricular myocardium. **Pflügers Arch Eur J Physiol 465:** 1621-35.

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Varró, A., Baláti, B., Iost, N., Takács, J., Virág, L., Lathrop, D.A., Lengyel, C., Tálosi, L., Papp, J.Gy. (2000) The role of IKs in dog ventricular muscle and Purkinje fibre repolarisation. **J Physiol (London) 523:** 67-81.

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RESEARCH AREA

Our main research interest is the experimental and clinical investigation of the pathomechanism and possible therapeutic targets of neurological diseases. With the aid of MR imaging and electrophysiological recordings we search for the characteristic features of multiple sclerosis, Alzheimer's disease, Parkinson's disease and given headache disorders. From cerebrospinal fluid and from blood samples we determine biomarkers, which could help the diagnosis confirmation and provide details about the course of the diseases. In genetic studies, we investigate the genetic background of multiple sclerosis and Parkinson's' disease. The foundation of these experiments is our Biobank of human tissue samples, which we collect continuously.

In our animal models we examine the molecular background of neurological disorders, particularly the protective effects of kynurenic acid derivatives. The kynurenine system is our main research target, which is involved in the patho-mechanism of numerous neurological disorders due to the modulatory effects on glutamatergic neurotransmission. In previous experiments, these molecules were effective in the experimental models of headache, Huntington's disease, epilepsy and stroke. Our aim is to further elucidate the mechanisms of effect and potential therapeutic value of this molecules.

TECHNIQUES AVAILABLE IN THE LAB

MR imaging and data processing, clinical electro-physiological recordings, transcranial direct/alternating current stimulation, RNA and DNA isolation, different PCR and ELISA methods, immunohistochemistry, Western blotting, behavioral experiments on animals, HPLC.

SELECTED PUBLICATIONS

Molnár, K., Lőrinczi, B., Fazakas, C., Szatmári, I., Fülöp, F., Kmetykó, N., Berkecz, R., Ilisz, I., Krizbai, I.A., Wilhelm, I., **Vécsei, L.** (2021) SZR-104, a Novel Kynurenic Acid Analogue with High Permeability through the Blood-Brain Barrier. **Pharmaceutics 13:** 61

Tanaka, M., Török, N., V**écsei, L.** (2021) Are 5-HT 1 receptor agonists effective anti-migraine drugs? **Expert Opin Pharmacother 22:** 1221-1225.

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Boros, FA., Klivényi, P., Toldi, J., **Vécsei, L.** (2019) Indoleamine 2,3-dioxygenase as a novel therapeutic target for Huntington's disease. E**xpert Opin Ther Targets 23:** 39-51.

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Vécsei, L., Lukács, M., Tajti, J., Fülöp, F., Toldi, J., Edvinsson, L. (2018) The therapeutic impact of new migraine discoveries. **Curr Med Chem 26:** 6261-6281.

Boros, F.A., Bohár, Z., **Vécsei, L.** (2018) Genetic alterations affecting the genes encoding the enzymes of the kynurenine pathway and their association with human diseases. **Mutat Res 776:** 32-45.

Edvinsson, L., Tajti, J., Szalárdy, L., **Vécsei, L.** (2018) PACAP and its role in primary headaches. **J Headache Pain 19:** 21.

See: PUBMED Vecsei L

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RESEARCH AREA

As a "central dogma" earlier it was suggested that stress-induced protein denaturation serves as a major stress-sensing machinery, which triggers the expression of the molecular chaperone heat shock proteins (HSPs). We have introduced a new but not exclusive cellular "membrane thermosensor" model, which predicts the existence of membrane-associated stress sensing and signaling mechanisms. It proposes that changes in the physical state and composition of lipid molecular species with the concomitant destabilization/reorganization of membrane microdomains ("rafts") can serve also as "molecular switches" to operate "cellular thermometers". Using mammalian cells and the fission yeast *(S.pombe)* as models we intend to elucidate the mechanism of membrane-associated stress sensors, signaling pathways and the interplay and networking of potential cellular stress survival strategies. Since HSPs play a fundamental role in the pathology of several human diseases, understanding the mechanism whereby mammalian cells can elicit a stress response may also be of paramount importance for the design of novel drug molecules.

TECHNIQUES AVAILABLE IN THE LAB

Classical biochemical and molecular biology methods. Membrane biophysics: spectroscopy, Langmuir monolayers, ultrasensitive fluorescence microscopy, single molecule tracking, image analysis. Lipidomic analysis: chromatographic and mass spectrometry techniques. Multidimensional data analysis, statistical methods.

SELECTED PUBLICATIONS

Escribá, P.V., Busquets, X., Inokuchi, J.I., Balogh, G., Török, Z., Horváth, I., Harwood, J.L., **Vigh, L.** (2015) Membrane lipid therapy: Modulation of the cell membrane composition and structure as a molecular base for drug discovery and new disease treatment. **Prog Lipid Res 59:** 38-53.

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Vigh, L., Horváth, I., Maresca, B., Harwood, J.L. (2007) Can the stress protein response be controlled by ‚membrane-lipid therapy'? **Trends Biochem Sci 32:** 357-363.

Török, Z., Tsvetkova, N.M., Balogh, G., Horváth, I., Nagy, E., Pénzes, Z., Hargitai, J., Bensaude, O., Csermely, P., Crowe, J.H., Maresca, B., **Vigh, L.** (2003) Heat shock protein coinducers with no effect on protein denaturation specifically modulate the membrane lipid phase. **Proc Natl Acad Sci USA 100:** 3131-3136.

Vigh, L., Literáti, P.N., Horváth, I., Török, Z., Balogh, G., Glatz, A., Kovács, E., Boros, I., Ferdinándy, P., Farkas, B., Jaszlits, L., Jednákovits, A., Korányi, L., Maresca, B. (1997) Bimoclomol: a nontoxic, hydroxylamine derivative with stress protein-inducing activity and cytoprotective effects. **Nat Med 3:** 1150-1154.

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RESEARCH AREA

Homeostasis and proper functioning of the central nervous system are largely determined by the coordinated action of cells of the neurovascular unit. Formed by microvascular endothelial cells, pericytes, glial cells and neurons, the neurovascular unit controls the traffic of solutes and cells between the circulation and the brain (blood-brain barrier function) and regulates cerebral blood flow in response to local neural activity (neurovascular coupling). The neurovascular unit is involved in several pathologies of the brain, including cerebral metastases and small vessel ischemic disease. Recently, we have shown that a poorly characterized cell type, namely cerebral pericytes possess significant pro-metastatic features, especially in triple negative breast cancer. In addition, we observed constriction of capillaries in the vicinity of metastatic cells and also cerebral microinfarcts, which seems to be mediated by pericytes. Therefore, on the one hand, we aim to evaluate the role of capillary pericytes in the regulation of blood supply, which is a highly debated scientific question. On the other hand, we focus on the effects of cancer cells on pericytes and other cells of the brain, to understand the mechanisms of tumour cell-induced shaping of the metastatic niche.

TECHNIQUES AVAILABLE IN THE LAB

Classical biochemistry and molecular biology techniques (real-time PCR, western-blot), isolation of primary cells, culture of cerebral and tumour cells, construction of complex in vitro models, gene silencing, impedance measurements, measurement of transendothelial electrical resistance and permeability, exosome isolation, transgenic animal models, injection of tumour cells into the carotid artery, preparation of cranial window, immunofluorescence and confocal microscopy, advanced microscopy (two-photon, superresolution).

SELECTED PUBLICATIONS

Molnár, K., Mészáros, Á., Fazakas, C., Kozma, M., Győri, F., Reisz, Z., Tiszlavicz, L., Farkas, A.E., Nyúl-Tóth, Á., Haskó, J., Krizbai, I.A., **Wilhelm, I.** (2020) Pericyte-secreted IGF2 promotes breast cancer brain metastasis formation. **Mol Oncol 14:** 2040-2057.

Haskó, J., Fazakas, C., Molnár, K., Mészáros, Á., Patai, R., Szabó, G., Erdélyi, F., Nyúl-Tóth, Á., Győri, F., Kozma, M., Farkas, A.E., Krizbai, I.A., **Wilhelm, I.** (2019) Response of the neurovascular unit to brain metastatic breast cancer cells. **Acta Neuropathol Commun 7:** 133.

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Wilhelm, I., Fazakas, C., Molnár, K., Végh, A.G., Haskó, J., Krizbai, I.A. (2018) Foe or friend? Janus-faces of the neurovascular unit in the formation of brain metastases. **J Cereb Blood Flow Metab 38:** 563-587.

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RESEARCH AREA

Proteins are polypeptide chains characterized by unique amino acid sequences (primary structures) and specific secondary and tertiary three dimensional structures. They are the key players in many biophysical, biochemical and physiological processes. (*Nota bene,* many intrinsically disordered proteins have recently been discovered whose functional form lacks any defined 3D structure…). In many cases the presence of non-amino-acid cofactors is also essential for the protein's function. Typical examples are the proteins excited by visible light (e.g. in visual perception and light sensing), or certain electron transport – so called redox – proteins, such as the cytochromes, that are also colored. In our research group we study such "colorful" proteins, their properties, function, physiological roles, taking advantage of the fact that the structural changes accompanying their function can usually be followed by measuring their color changes using static or kinetic (rapid time-resolved) absorption spectroscopy. The colored (possessing chromophores) or the redox proteins may exhibit interesting or useful properties not only in their natural physiological environment but also in very different artificial environments. One can envisage biophotonics or bioelectronics applications from the appropriate interfacing of certain proteins with photonic crystals or semiconductor materials. Hence we also study the interactions of porous silicon based photonic crystals (periodic structures commensurate with the wavelength of light) and select proteins.

TECHNIQUES AVAILABLE IN THE LAB

Expression and purification of proteins, static and kinetic spectroscopies, electrochemical technique (voltammetry), preparation and functionalization of porous silicon photonic samples, control of pulsed laser laboratory, Matlab programming language.

SELECTED PUBLICATIONS

Hajdu, K., Gergely, C., Martin, M., Cloitre, T., **Zimányi, L.,** Tenger, K., Khoroshyy, P., Palestino, G., Agarwal, V., Hernádi, K., Németh, Z., Nagy, L. (2012) Porous silicon / photosynthetic reaction center hybrid nanostructure. **Langmuir 28:** 11866-11873.

Levantino, M., Cupane, A., **Zimányi, L.**, Ormos, P. (2004) Different relaxations in myoglobin after photolysis. **Proc Natl Acad Sci USA 101:** 14402-14407.

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Dér, A., Oroszi, L., Kulcsár, Á., **Zimányi, L.**, Tóth-Boconádi, R., Keszthelyi, L., Stoeckenius, W., Ormos, P. (1999) Interpretation of the spatial charge displacements in bacteriorhodopsin in terms of structural changes during the photocycle. **Proc Natl Acad Sci USA 96:** 2776-2781.

ISTVÁN ZUPKÓ

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RESEARCH AREA

In spite of the impressive achievements in the treatment possibilities of malignant disorders, cancers still have leading roles in mortality statistics worldwide indicating the need for novel anticancer agents. Natural products and their analogs are inexhaustible source of drugs candidates. The main aims of our group are to identify potential lead molecules by screening isolated and synthetic compounds for their anticancer properties. *In vitro* cell culture based studies are performed in order to characterize the cancer selectivity and the mechanism of the action of the most promising hits.

TECHNIQUES AVAILABLE IN THE LAB

Determination of antiproliferative action against cancer cells, cell cycle analysis by flow cytometry, fluorescent microscopy, tubulin polymerization assay, apoptosis detection (measurement of activities of caspases), cell-based assays for hormonal activity, Western blot analysis, RT-PCR.

SELECTED PUBLICATIONS

Bózsity, N., Minorics, R., Szabó, J., Mernyák, E., Schneider, G., Wölfling, J., Wang, H.C., Wu, C.C., Ocsovszki, I., **Zupkó, I.** (2017) Mechanism of antiproliferative action of a new d-secoestrone-triazole derivative in cervical cancer cells and its effect on cancer cell motility. **J Steroid Biochem Mol Biol 165:** 247-57.

Molnár, J., Szebeni, J.G., Csupor-Löffler, B., Hajdú, Z., Szekeres, T., Saiko, P., Ocsovszki, I., Puskás, G.L., Hohmann, J., **Zupkó, I.** (2016) Investigation of the antiproliferative properties of natural sesquiterpenes from Artemisia asiatica and Onopordum acanthium on HL-60 cells *in vitro*. **Int J Mol Sci 17:** 83.

Molnár, J., Frank, É., Minorics, R., Kádár, Z., Ocsovszki, I., Schönecker, B., Wölfling, J., **Zupkó, I.** (2015) A click approach to novel D-ring-substituted 16α-triazolylestrone derivatives and characterization of their antiproliferative properties. **PLOS ONE 10:** e0118104.

Mernyák, E., Kovács, I., Minorics, R., Sere, P., Czégány, D., Sinka, I., Wölfling, J., Schneider, G., Újfaludi, Z., Boros, I., Ocsovszki, I., Varga, M., **Zupkó, I.** (2015) Synthesis of trans-16-triazolyl-13α-methyl-17-estradiol diastereomers and the effects of structural modifications on their *in vitro* antiproliferative activities. **J Steroid Biochem Mol Biol 150:** 123-34.

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SZENT-GYÖRGYI JUNIOR MENTORS

"Science is built on the premise that Nature answers intelligent questions intelligently; so if no answer exists, there must be something wrong with the question."

Albert Szent-Györgyi

Szent-Györgyi Mentors have the opportunity to appoint a young talented researcher working in his/her laboratory who becomes the *Szent-Györgyi Junior Mentor* of the *Szent-Györgyi Student* and takes part in the Student's education actively.

Their main tasks are
taking active part in the Student's education
taking part in the Meeting of Nobel Laureates and Talented Students organized twice a year

The work of the 44 *Szent-Györgyi Mentors* is assisted by the 25 *Szent-Györgyi Junior Mentors* who are all scientists of the University of Szeged or the Biological Research Center.

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RESEARCH AREA

Transition from simple to complex multicellularity was a giant evolutionary innovation in the history of life. Mushroom-forming fungi are ideal model organisms of complex multicellularity: they start their lifecycle as unicellular spores thus developing multicellular filaments followed by formation of a complex fruiting body structures with various fungal tissues in the sexual cycle. Complex multicellularity appeared multiple times independently (convergent origins) in the fungal kingdom via unique mechanisms. In contrast, yeasts are secondarily simplified organisms with multicellular ancestors. They spend most of their life cycle as unicellular organisms but retain the genes for multicellular complexity. The potential for yeast-like growth (i.e. genetic toolkit) evolved early in fungal evolution but the transitions to yeast-like lifestyle happened much later multiple times and yeast-like growth became dominant independently in distantly related clades. To gain deeper insight into such evolutionary innovations we examine genome-evolution, differences in gene expression and reconstruct gene regulatory networks with comparative genomics and -transcriptomics and lab experiments. Investigating the genetic and molecular background of fungal plant cell wall degradation is also among our research interests. Lignocellulose decomposition is one of the most industrially exploited fungal traits (e.g. in bioethanol production). Our goal is to reconstruct gene regulatory networks that underlie plant biomass degrading fungal extracellular enzyme biosynthesis.

TECHNIQUES AVAILABLE IN THE LAB

Coprinopsis cinerea is our primary model system, however, several members of Basidiomycota and Ascomycota are also involved in these experiments. In addition to basic microbiological techniques, we also use state-of-the-art methods of genetics, molecular biology and bioinformatics. Of those I would like to highlight the followings: cultivation of fungi and induction of fruiting body formation, microscopy imaging techniques, DNA and RNA isolation, genome- and transcriptome (RNA-Seq) sequencing and data-analysis, protein-DNA interaction assays (identification of DNA binding sites of transcription factors with Chip-Seq, DAP-Seq and CUT&RUN), gene cloning, CRISPR/Cas9-based genome editing, heterologous protein expression, protein purification and Western-blot, phylogenetic reconstruction.

SELECTED PUBLICATIONS

Nagy, L.G., Varga, T., **Csernetics, Á.**, Virágh, M. (2020) Fungi took a unique evolutionary route to multicellularity: Seven key challenges for fungal multicellular life. **Fungal Biol Rev 34:** 151-169.

Nagy, G., Vaz, A.G., Szebenyi, Cs., Takó, M., Tóth, E.J., **Csernetics, Á.**, Bencsik, O., Szekeres, A., Homa, M., Ayaydin, F., Galgóczy, L., Vágvölgyi, Cs., Papp, T. (2019) CRISPR-Cas9-mediated disruption of the HMG-CoA reductase genes of Mucor circinelloides and subcellular localization of the encoded enzymes. **Fungal Genet Biol 129:** 30-39.

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Csernetics, Á., Nagy, G., Iturriaga, E.A., Szekeres, A., Eslava, A.P., Vágvölgyi, Cs. and Papp, T. (2011) Expression of three isoprenoid biosynthesis genes and their effects on the carotenoid production of the zygomycete Mucor circinelloides. **Fungal Genet Biol 48:** 696-703.

TÍMEA GONDA

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RESEARCH AREA

Cancer is the second leading death cause globally, and is responsible for nearly 10 million deaths in 2018. The application of conventional anti-cancer drugs is often limited by their excessive undesirable side-effects. One of the biggest unresolved challenges in cancer therapy is to maximize damage on cancer cells while minimizing toxicity in normal cells. A recently emerged potential solution would be the selective inhibition of ATR kinase, a protein crucial for the survival of cancer cells. Our research group aims to contribute to the state-of-art knowledge in this research area with the synthesis of structurally diverse compound libraries potentially exerting ATR kinase inhibitor activity. Investigation of the antitumor activity of the prepared compounds is performed in collaboration, followed by the assessment of structure-activity relationships and the optimization of the compound structures.

TECHNIQUES AVAILABLE IN THE LAB

A wide array of synthetic organic chemistry and spectroscopic analytical methods (NMR, MS) are available. The reactions are followed by thin layer chromatography and analytical HPLC, while for the purification of the prepared compounds diverse separation techniques are available: preparative HPLC, supercritical fluid chromatography, flash chromatography, column chromatography, rotational planar chromatography and centrifugal partition chromatography.

SELECTED PUBLICATIONS

Latif, A. D, **Gonda, T.**, Vágvölgyi, M., Kúsz, N., Kulmány, Á., Ocsovszki, I., Zomborszki, Z. P., Zupkó, I., Hunyadi, A. (2019) Synthesis and in vitro antitumor activity of naringenin oxime and oxime ether derivatives. **Int J Mol Sci 20:** 2184-2196.

Gonda, T., Bérdi, P., Zupkó, I., Fülöp, F., Szakonyi, Zs. (2018) Stereoselective synthesis, synthetic and pharmacological application of monoterpene-based 1,2,4- and 1,3,4-oxadiazoles. **Int J Mol Sci 19:** 81-92.

Gonda, T., Balázs, A., Tóth, G., Fülöp, F., Szakonyi, Zs. (2017) Stereoselective synthesis and transformations of pinane-based 1,3-diaminoalcohols. **Tetrahedron 73:** 2638-2648.

Gonda, T., Szakonyi, Zs., Csámpai, A., Haukka, M, Fülöp, F. (2016) Stereoselective synthesis and application of tridentate aminodiols derived from (-)-pulegone. **Tetrahedron: Asymmetry 27:** 480-486.

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RESEARCH AREA

The SARS-CoV-2 pandemic gives a high priority to the elucidation of the coronavirus replication mechanism. MERS-CoV, SARS-CoV and SARS-CoV-2, belonging to the betacoronavirus genus, induce the formation of double membrane vesicles (DMV) in infected cells, which function as the sites of action of the viral replication-transcription complex. The key proteins in autophagy processes, the mammalian Atg8 homologues (LC3 and GABARAP), play an important role in the formation of DMVs; the non-lipidated form of these proteins covers the surface of such vesicles. In our study, we analyse the interactions between viral proteins and human Atg8 homologues, using a computer-based method to determine the LIR (LC3-interacting region) motifs (responsible for the interaction) in viral proteins. The identified LIR motif-containing proteins are expressed in an N-terminally EGFP-tagged form in MCF-7 cells, investigate the morphology of the changes that occur and their co-localization with mCherry-tagged human Atg8 homologues by fluorescence microscopy. This research will also provide an opportunity to test drug candidates to suppress the development of DMVs.

TECHNIQUES AVAILABLE IN THE LAB

Molecular biology techniques: cloning, DNA/RNA preparation and quantitation (DeNovix spectrophoto/fluorometer), different PCR techniques. Recombinant protein expression and purification. Western blot analysis with Li-Cor ODYSSEY Blot Imager using Image Studio 5.2 software. Cell culture techniques, cell transfection, immunocytochemistry, fluorescent microscopy, confocal microscopy.

SELECTED PUBLICATIONS

Jipa, A., Vedelek, V., Merényi, Zs., Ürmösi, A., Takáts, Sz., Kovács, A.L., **Horváth, G.V.**, Sinka, R., Juhász, G. (2021) Analysis of Drosophila Atg8 proteins reveals multiple lipidation-independent roles. **Autophagy 1-11.**

Leviczky, T., Molnár, E., Papdi, Cs., Őszi, E., **Horváth, G.V.**, Vizler, Cs., Nagy, V., Pauk, J., Bögre, L., Magyar, Z. (2019) E2FA and E2FB transcription factors coordinate cell proliferation with seed maturation. **Development 146:** 179333.

Takáts, S., Glatz, G., Szenci, G., Boda, A., **Horváth, G.V.**, Hegedűs, K., Kovács, A.L., Juhász, G. (2018) Non-canonical role of the SNARE protein Ykt6 in autophagosome-lysosome fusion. **PLoS Genet 14:** e1007359.

Aleksza, D., **Horváth, G.V.**, Sándor, G., Szabados, L. (2017) Proline accumulation is regulated by transcription factors associated with phosphate starvation. **Plant Physiol 175:** 555-567.

Ábrahám, E., Yu, P., Farkas, I., Darula, Zs., Varga, E., Lukács, N., Ayaydin, F., Medzihradszky, K.F., Dombrádi, V., Dudits, D., **Horváth, G.V.** (2015) The B" regulatory subunit of protein phosphatase 2A mediates the dephosphorylation of rice retinoblastoma-related protein-1. **Plant Mol Biol 87:** 125-141.

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RESEARCH AREA

"1) *In vitro* measurements

The transplanted organ (graft) undergoes warm and cold ischemic periods during surgical removal from the donor and the cell damage during storage is further exacerbated by reperfusion injury during the reestablishment of the circulation. During ischemia the oxidative phosphorylation is inhibited due to lack of oxygen and the Ca^{2+} overload results in a reduction of the efficiency of the mitochondrial electron transport and the formation of reactive free radicals. In the clinical practice static and dynamic preservation techniques are used and our goal is to increase the efficiency of transplant solutions by using biological active gases which may contribute to better graft survival and improved recovery of function. Methane (CH_4) is widely considered to be biologically inert, but many recent studies have shown that exogenous CH_4 affects cell pathways involved in oxidative and nitrosative stress responses. To date, the effect of CH_4 on the outcome of organ transplantation and graft damage has not been studied, and the effect of CH_4 on graft survival or other postoperative effects is unknown.

2) *In vivo* measurements

Behavioural studies provide important information for modelling various human neurological pathologies, various forms of cognitive impairment, including postoperative sepsis-associated encephalopathy and for testing the efficacy of therapies in the experimental phase. One group includes methods and tests that examine the animal's spontaneous, self-produced behavior. The other large group consists of methods for studying learning / memory. Our laboratory has widely accepted non-invasive, repeatable, "real-time" data tools for testing the cognitive functions of rodents. Spatial memory, spontaneous discovery activity, coordination, sense of balance, anxiety, and depression are examined using a variety of tests.

TECHNIQUES AVAILABLE IN THE LAB

Participation in animal experimental work, acquisition of surgical techniques (surgical and microsurgical techniques) in anesthetized rats. Professional application of the use and evaluation of behavioral test methods and the drawing of conclusions. Functional testing of isolated organs *in vitro* (in an organ bath). *Ex vivo* monitoring and analysis of cell and mitochondrial respiration using a high-resolution respirometer. Measurement of the activity of several inflammatory biochemical markers and enzymes. Methods of data processing, statistical analysis of data.

SELECTED PUBLICATIONS

Horváth, T., Jász, D.K., Baráth, B., Poles, M.Z., Boros, M., Hartmann, P. (2021) Mitochondrial Consequences of Organ Preservation Techniques During Liver Transplantation. **Int J Mol Sci 22:** 2816.

Horváth, T., Hanák, L., Hegyi, P., Butt, E., Solymár, M., Szűcs, Á., Varga, O., Thien, B.Q., Szakács, Zs., Csonka, E. et al. (2020) Hydroxyapatite-coated implants provide better fixation in total knee arthroplasty. A meta-analysis of randomized controlled trials. **PLoS One 15:** e0232378.

Papp, A., **Horváth, T.**, Igaz, N., Gopisetty, M.K., Kiricsi, M., Berkesi, D.S., Kozma, G., Kónya, Z., Wilhelm, I., Patai, R. et al. (2020) Presence of Titanium and Toxic Effects Observed in Rat Lungs, Kidneys, and Central Nervous System in vivo and in Cultured Astrocytes in vitro on Exposure by Titanium Dioxide Nanorods. **Int J Nanomedicine 15:** 9939-9960.

Horváth, T., Papp, A., Igaz, N., Kovács, D., Kozma, G., Trenka, V., Tiszlavicz, L, Rázga, Zs., Kónya, Z, Kiricsi, M. et al. (2018) Pulmonary impact of titanium dioxide nanorods: examination of nanorod-exposed rat lungs and human alveolar cells. **Int J Nanomedicine 13:** 7061-7077.

Horváth, T., Vezér, T., Kozma, G., Papp, A.(2018) Functional neurotoxicity and tissue metal levels in rats exposed subacutely to titanium dioxide nanoparticles via the airways. **Clinical Neuroscience 71:** 35-42.

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RESEARCH AREA

Metal nanoparticles have a great potential in cancer treatment due to a broad spectrum of anti-cancer activities. Nano-sized materials are able to accumulate in the tumor tissue owing to the fenestrated endothel of the tumor blood vessels. Moreover, the large specific surface of nanoparticles can be functionalized with tumor-specific ligands to achieve active tumor targeting. Among metal nanomaterials, silver and gold nanoparticles are the most promising entities for oncotherapeutic applications. Silver nanoparticles induce apoptosis in tumor cells by triggering the production of reactive oxygen species, whereas gold nanoparticles potentiate the efficacy of ionizing radiation, thus possess radiosensitizing activity on tumor cells. Metal nanoparticles are also excellent combinational partners of chemotherapeutic agents and of different treatment modalities. Besides the tumor-targeting activity of nanoparticles, nano-sized materials can be used to modulate the cancer promoting activity of other cell types such as cancer-associated fibroblasts and tumor-associated macrophages in the tumor microenvironment, thus we examine how metal nanoparticles affect the paracrine cross-talk between cells in the tumor tissue in order to attenuate tumor progression, invasion and dissemination.

TECHNIQUES AVAILABLE IN THE LAB

Maintaining *in vitro* human cell cultures, detection of cell proliferation, *in vitro* toxicity measurements, detection of cell migration by scratch assay, invasion assays, gelatin zymography, Western blot analysis, conventional PCR, Real-time PCR, immunocytochemistry, fluorescence microscopy, isolation of primary cells, toxicity measurements on 3D cell cultures, clonogenic assay to detect the colonyforming capabilities of tumor cells.

SELECTED PUBLICATIONS

Igaz, N., Szőke, K., Kovács, D., Buhala, A., Varga, Z., Bélteky, P., Rázga, Z., Tiszlavicz, L, Vizler, C., Hideghéty, K., Kónya, Z., Kiricsi, M. (2020) Synergistic radiosensitization by gold nanoparticles and the histone deacetylase inhibitor SAHA in 2D and 3D cancer cell cultures. **Nanomaterials 10:** 158.

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Szerencsés, B., **Igaz, N.**, Tóbiás, Á., Prucsi, Z., Rónavári, A., Bélteky, P., Madarász, D., Papp, C., Makra, I., Vágvölgyi, C., Kónya, Z., Pfeiffer, I., Kiricsi, M. (2020) Size-dependent activity of silver nanoparticles on the morphological switch and biofilm formation of opportunistic pathogenic yeasts. **BMC Microbiol 20:** 176.

Gopisetty, M. K., Kovács, D., **Igaz, N.**, Rónavári, A., Bélteky, P., Rázga, Z., Venglovecz, V., Csoboz, B., Boros, I., Kónya, Z., Kiricsi, M. (2019) Endoplasmic reticulum stress: major player in size-dependent inhibition of P-glycoprotein by silver nanoparticles in multidrug-resistant breast cancer cells. **J Nanobiotechnology 17:** 9.

Rónavári, A., Kovács, D., **Igaz, N.**, Vágvölgyi, C., Boros, I., Kónya, Z., Pfeiffer, I., Kiricsi, M., (2017) Biological activity of green-synthesized silver nanoparticles depends on the applied natural extracts: a comprehensive study. **Int J Nanomedicine 12:** 871-883.

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RESEARCH AREA

Functional and morphological changes within mitochondria and their altered interaction with other organelles are suggested to play a critical role in the pathogenesis of various diseases associated with life-threatening organ dysfunction. Some of them, such as sepsis and ischaemia/reperfusion-induced injury (I/R) have more recently become an intensively developing field of basic research. Our main purpose is to investigate the underlying mitochondrial and cellular mechanisms involved in the corresponding animal model of diseases.

TECHNIQUES AVAILABLE IN THE LAB

Preparation of intact mitochondria/tissue homogenates from various tissues/organs of laboratory animals (e.g., liver, small intestine, kidney and brain), evaluation of cellular respiratory function and states using high-resolution respirometry (OROBOROS O2k), simultaneous monitoring of changes in mitochondrial membrane potential (safranin fluorescence), mitochondrial reactive oxygen species (HRP/Amplex UltraRed assay) and calcium-flux (Calcium Green-5N fluorescence). Assesement of oxidative and nitrosative stress markers.

SELECTED PUBLICATIONS

Juhász, L., Rutai, A., Fejes, R.,Tallósy, S.P., Poles, M.Z., Szabó, A., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Kaszaki, J. (2020) Divergent effects of the N-methyl-D-aspartate receptor antagonist kynurenic acid and the synthetic analog SZR-72 on microcirculatory and mitochondrial dysfunction in experimental sepsis. **Front Med 7:** 566582.

Nászai, A., Terhes, E., Kaszaki, J., Boros, M., **Juhász, L.** (2019) Ca(2+)N it be measured? Detection of extramitochondrial calcium movement with high-resolution fluorespirometry. **Sci Rep 9:** 19229.

Poles, M.Z., **Juhász, L.**, Boros, M. (2019) Methane and inflammation - A review (Fight fire with fire). I**ntensive Care Med Exp 7:** 68.

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Kiss, A., **Juhász, L.**, Seprényi, G., Kupai, K., Kaszaki, J., Végh, Á. (2010) The role of nitric oxide, superoxide and peroxynitrite in the anti-arrhytmic effects of preconditioning and peroxynitrite infusion in anaesthetized dogs. **Br J Pharmacol 160:** 1263-1272.

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RESEARCH AREA

DNA double-strand breaks (DSBs) are among the most severe types of genomic damage threatening cellular viability. They can be repaired by two major pathways: canonical non-homologous end-joining (c-NHEJ) and homologous recombination (HR).

One of the earliest events upon DNA damage is the recruitment and activation of poly(ADP-ribose) polymerase 1 (PARP1), a key regulator of the DNA damage response. PARP1 is a DNA damage sensor and signal transducer that synthesizes negatively charged, branched poly(ADP-ribose) chains (PARylation) on target proteins. PARylation facilitates the recruitment of DNA repair factors and chromatin remodeling enzymes around damaged DNA. A little over a decade ago, it was discovered that BRCA1 and BRCA2 defective tumors can be specifically killed by PARP inhibitors (PARPi). This synthetic lethality had great premise in oncology because carriers of deleterious heterozygous germline mutations in the BRCA1 or BRCA2 genes have a high risk of developing breast and ovarian cancers. Regulatory bodies including FDA and EMA have recently accepted PARPi to be used in ovarian cancer patients with BRCA1 or BRCA2 mutations. Today, more than one PARP inhibitor is approved for cancer therapy.

PARP inhibitors drive synthetic lethality in two, not necessarily exclusive ways: interfering with DNA damage repair or trapping PARP on DNA. Both PARP1 and BRCAs play an important role in restarting stalled replication forks. Furthermore, the loss of 53BP1 in BRCA1 mutant cells alleviates hypersensitivity to PARP inhibitors and restores HR suggesting a role for PARP1 in regulating the choice between HR and NHEJ DNA repair pathways. Activated PARP1 strongly PARylates itself, which facilitates its own release from the damaged DNA, hence, the release of drug-inhibited PARP1 is hindered. In our studies we identify new factors that can modulate the PARPi-mediated synthetic lethality in human cells. We characterize these factors in classical molecular biology assays that can provide data to extend the therapeutic spectrum of PARP inhibitor treatment.

TECHNIQUES AVAILABLE IN THE LAB

Techniques for vertebrate cell lines including generation of KO cell lines with CRISPR, Western blot, co-immunoprecipitation assay, Southern blot, chromosome preparation, chromatin fractionation, immunostaining, laser microirradiation assay, micropore irradiation assay, SNAP-system for protein repopulation, measuring of the DNA repair kinetics, live cell imaging of fluorescently tagged proteins. In vitro techniques including recombinant DNA technology, protein purification and pull-down assays.

SELECTED PUBLICATIONS

Smith, R., Lebeaupin, T., **Juhász, S.**, Chapuis, C., D'Augustin, O., Dutertre, S., Burkovics, P., Biertümpfel, C., Timinszky, G., Huet, S. (2019) Poly(ADP-ribose)-dependent chromatin unfolding facilitates the association of DNA-binding proteins with DNA at sites of damage. **Nucleic Acids Res 47:** 11250.

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Juhász, S., Elbakry, A., Mathes, A., Löbrich, M. (2018) ATRX Promotes DNA Repair Synthesis and Sister Chromatid Exchange during Homologous Recombination. **Mol Cell 71:** 11.

Biehs, R., Steinlage, M., Barton, O., **Juhász, S.**, Künzel, J., Spies, J., Shibata, A., Jeggo, P.A., Löbrich, M. (2017) DNA Double-Strand Break Resection Occurs during Non-homologous End Joining in G1 but Is Distinct from Resection during Homologous Recombination. **Mol Cell 65:** 671.

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RESEARCH AREA

Skeletal muscle is a highly dynamic tissue that can undergo successful regeneration upon injury, and change in size in response to exercise, aging or due to diseases (e.g. cancer cachexia, immobilization, or denervation). The muscle stem cells, satellite cells are stimulated by local damage to proliferate extensively and form myoblasts that will subsequently migrate, differentiate and fuse to form muscle fibers. Our research aims are to study (i) the signaling pathways and mechanisms in myoblast migration, differentiation, and fusion (ii) the role of exosomes in cell migration, (iii) the biology of satellite cells. Moreover, we investigate the molecular mechanisms regulating skeletal muscle mass, and we aimed to find new nanotechnological approaches for the local treatment of muscle atrophy. Skeletal muscle has an important role in whole-body metabolism, it accounts for 40% of adult human body weight, and about 90% of insulin-stimulated glucose uptake occurs in skeletal muscle. The vesicular transport of GLUT4 glucose transporters is impaired in cases of insulin resistance and type-2 diabetes mellitus leading to decreased glucose uptake of skeletal muscle and increased blood glucose level. Our further aim is to study this mechanism and to find new signaling pathways regulating glucose uptake of skeletal muscle. Our work is mainly basic research and we have strong scientific collaborations with clinicians.

TECHNIQUES AVAILABLE IN THE LAB

Mammalian tissue culture techniques, *in vivo* animal models, primary cell isolation, single myofiber and satellite cell isolation, immunocytochemistry, immunohistochemistry, fluorescent microscopy techniques, image analysis, analysis of cell migration, flow cytometry, cell cycle analysis, cell proliferation assays, spectrophotometry (measurement of enzyme activities, metabolites), PCR, co-immunoprecipitation, GTP-ase activity assays, Western blotting, glucose tolerance test, insulin tolerance test.

SELECTED PUBLICATIONS

Becsky, D., Gyulai-Nagy, S., Balind, A., Horvath, P., Dux, L., **Keller-Pinter, A.** (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823.

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RESEARCH AREA

The immune system has to differentiate between harmful and non-harmful agents. Inadequate immune recognition can lead to infectious diseases, allergy, autoimmunity and cancer.

We examine the adaptive immune recognition and its role in different diseases. We are focusing on MHC molecules, which are essential elements of this process by presenting short peptide fragments to immune cells. The genes encoding these molecules show extreme genetic variability, which means that two individuals rarely carry the same MHC variants.

During our work, we analyze large datasets to reveal general features of MHC molecules, which make people susceptible to different diseases.

TECHNIQUES AVAILABLE IN THE LAB

Programming in "R" language; big data analysis; modern statistics; database processing, data visualization.

SELECTED PUBLICATIONS

Manczinger, M., Koncz, B., Balogh, G. M., Papp, B. T., Asztalos, L., Kemény, L., Papp, B. & Pál, C. (2021) Negative trade-off between neoantigen repertoire breadth and the specificity of HLA-I molecules shapes antitumor immunity. **Nat Cancer 2:** 950-961.

Manczinger, M., Boross, G., Kemény, L., Müller, V., Lenz, T. L., Papp, B., Pál, C. (2019) Pathogen diversity drives the evolution of generalist MHC-II alleles in human populations. **PLoS Biol 17:** e3000131.

Manczinger, M., Kemény, L. (2018) Peptide presentation by HLA-DQ molecules is associated with the development of immune tolerance. **PeerJ 6:** e5118.

Manczinger, M., Bodnár, V., Papp, B. T., Bolla, B. Sz., Szabó, K.,Balázs, B., Csányi, E., Szél, E., Erős, G.,Kemény, L. (2018) Drug repurposing by simulating flow through protein – protein interaction networks. **Clin Pharmacol Ther 103:** 511-520.

Manczinger, M., Kemény, L. (2013) Novel factors in the pathogenesis of psoriasis and potential drug candidates are found with systems biology approach. **PLoS One 8:** e80751.

Manczinger, M., Szabó, E.Z., Göblös, A., Kemény, L., Lakatos, L. (2012) Switching on RNA silencing suppressor activity by restoring argonaute binding to a viral protein. **J Virol 86:** 8324-7.

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RESEARCH AREA

Organelles of eukaryotic cells represent an intricate network the members of which are connected with each other either via vesicular transport processes or permanent physical contacts. Significance of the latter type of organellar communication (the so-called membrane contact sites) has only been recognized in the last decade. The complex, dynamic endomembrane system plays a pivotal role in normal cell physiology and its proper function requires the concerted action of several proteins. Main research focus of our group is the investigation of genes and proteins involved in vesicular trafficking routes chanelling to the lysosomes, the central degradative organelles of cells. Members of the Sorting nexin (Snx) protein family play important roles in numerous points of the endolysosomal system. All Snx proteins contain the lipid-binding PX-domain that enables them to associate with organellar membranes where they utilize other protein domains to take part in versatile molecular events. However, exact cellular functions of many Snx proteins are currently unknown, and importantly, some of these proteins are involved in the pathogenesis of human diseases. Most of the Sorting nexins are evolutionarily conserved, offering the possibility to investigate their functions in model organisms. We use various fruitfly tissues to study the molecular functions of the less well-characterized Snx proteins in the endolysosomal system. Our current focus is on the investigation of the function of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease. Our results show that the mutation of the fruitfly counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. However, the exact mechanism of this phenomenon is currently not known.

TECHNIQUES AVAILABLE IN THE LAB

To explore Sorting nexin functions in the endolysosomal system, we primarily use light-microscopy techniques (fluorescent immunohistochemistry and other labeling methods). In our research we exploit the genetic and cell biology toolkit of the fruitfly (*Drosophila melanogaster*), the model organism with a history of more than a hundred years. Beside larval nephrocytes, we use other fruitfly tissues (e.g. larval fat body and salivary gland) as well to analyze the endolysosomal network. Routine molecular biology approaches (cloning and protein detection methodsbetc.) are also used mainly in order to generate new genetic tools (mutant and transgenic animals).

SELECTED PUBLICATIONS

Kiss, V., Jipa, A., Varga, K., Takáts, S., **Maruzs, T.**, Lőrincz, P., ... & Tóth, D. (2019). Drosophila Atg9 regulates the actin cytoskeleton via interactions with profilin and Ena. **Cell Death Differ 27:** 1677-1692.

Maruzs, T., Simon-Vecsei, Z., Kiss, V., Csizmadia, T., & Juhász, G. (2019). On the fly: recent progress on autophagy and aging in Drosophila. **Front Cell Dev Biol 7:** 140.

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RESEARCH AREA

Since the beginning of modern neuroscience it is a primary desire to understand the human cerebral cortex. How neurons build up networks and how they are able to serve higher brain functions such as cognition, complex perception, decision-making or language is still a mystery yet to be solved. The research of human brain mainly approached with noninvasive low resolution brain-imaging technologies or scalp electrode based techniques. We still are missing the information on the intricate organization of human neuronal networks. To date substantial data have been acquired from animal models investigating the physiological mechanisms. However, research on human neural circuits are more challenging due to lack of suitable tissue. Human neurons are not "scaled-up" versions of rodent or primate neurons, but have unique structural and functional properties. Our results, apart from deepening our understanding of basic features and mechanisms neuronal circuits and connections, can also provide a basis for development of proper therapies for neurodegenerations.

TECHNIQUES AVAILABLE IN THE LAB

We are using cutting edge neurophysiological and imaging techniques e.g. in vivo patch clamp electrophysiology, human *in vitro* brain slice patch clamp electrophysiology, *in vivo* and i*n vitro* multiphoton imaging (acustooptical and resonant scanning), CARS microscopy in brain slices, transmission electron microscopy, 3D neuron reconstruction with Neurolucida, image processing, coding and statistics.

SELECTED PUBLICATIONS

Cserep, C., Posfai, B., Lenart, N., Fekete, R., Laszlo, Z.I., Lele, Z., Orsolits, B., **Molnar, G.**, Heindl, S., Schwarcz, A.D., Ujvari, K., Kornyei, Z., Toth, K., Szabadits, E., Sperlagh, B., Baranyi, M., Csiba, L., Hortobagyi, T., Magloczky, Z., Martinecz, B., Szabo, G., Erdelyi, F., Szipocs, R., Tamkun, M.M., Gesierich, B., Duering, M., Katona, I., Liesz, A., Tamas, G., Denes, A. (2020) Microglia monitor and protect neuronal function through specialized somatic purinergic junctions **Science 367:** 528-537.

Molnar, G., Rozsa, M., Baka, J., Holderith, N., Barzo, P., Nusser, Z., Tamas, G. (2016) Human pyramidal to inteiencerneuron synapses are mediated by multi-vesicular release and multiple docked vesicles. **ELife 5:** e18167.

Molnar, G., Farago, N., Kocsis, A.K., Rozsa, M., Lovas, S., Boldog, E., Baldi, R., Csajbok, E., Gardi, J., Puskas, L.G. , Tamas, G. (2014) GABAergic neurogliaform cells represent local sources of insulin in the cerebral cortex. **J Neurosci 34:** 1133-1137.

Molnar, G., Olah, S., Komlosi, G., Fule, M., Szabadics, J., Varga, C., Barzo, P., Tamas, G. (2008) Complex events initiated by individual spikes in the human cerebral cortex. **PLoS Biol 6:** e222.

Szabadics, J.*, Varga, C.*, **Molnar, G.***, Olah, S., Barzo, P., Tamas, G. (2006) Excitatory effect of GABAergic axo-axonic cells in cortical microcircuits. **Science 311:** 233-5. *joint first authors

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RESEARCH AREA

The cardiac electrophysiology investigates the electrical changes of heart, implying both the physiological and pathological functions as well as novel pharmacological interventions. The cardiovascular diseases, and especially the arrhythmias are leading cause of mortality. The arrhythmias have a complex underlying mechanism where the intracellular Ca^{2+} handling play a critical role. Therefore, the main aim of our laboratory is the investigation of the physiological function of the cardiac Ca^{2+} handling, its role in different arrhythmias, and possible pharmacological interventions.

A novel antiarrhythmic strategy could be the selective inhibition of the cardiac Na^{+}/ Ca^{2+} exchanger that may decrease the excessive Ca^{2+} load of the cell, furthermore may have positive inotropic effect.

The sinus-node as a primary rhythm generator of the heart has an extremely complex electrophysiological mechanism, at the same time, it could be involved in several types of arrhythmias. Our further aim is the investigation of the Ca^{2+} handling in sinus-node cells under normal as well as during pathological condition (e.g.: metabolic syndrome).

It is well-known that physical activity is healthy and significantly contributes to the normal physiology of the cardiovascular system. Still, several times sudden cardiac death of competitive athletes was observed where organic disease of the heart was not found. The underlying mechanism of sudden death could be the abrupt disturbance of the normal electrophysiological function of heart, however the arrhythmia mechanism is unknown. Therefore, further aim of our Institute is to develop a reliable "athlete's heart" animal model that provide data regarding the electrophysiological changes during physical activity.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of cardiac myocytes. Measurement of action potentials from cardiac tissue with standard microelectrode technique. Combined ionic current and Ca2+ movement measurement by patch-clamp technique associated with fluorescent optical method from isolated ventricular and sinus node cells. Analysis and interpretation of the data.

SELECTED PUBLICATIONS

Szlovák, J., Tomek, J., Zhou, X., Tóth, N., Veress, R., Horváth, B., Szentandrássy, N., Levijoki, J., Papp, J.G., Herring, N., Varró, A., Eisner, D.A., Rodriguez, B., **Nagy, N.** (2021) Blockade of sodium-calcium exchanger via ORM-10962 attenuates cardiac alternans. **J Mol Cell Cardiol 153:** 111-122.

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Gazdag, P., Oravecz, K., Acsai, K., Demeter-Haludka, V., Ördög, B., Szlovák, J., Kohajda, Z., Polyák, A., Barta, B.A., Oláh, A., Radovits, T., Merkely, B., Papp, J.G., Baczkó, I., Varró, A., **Nagy, N.** & Prorok, J. (2020) Increased Ca^{2+} content of the sarcoplasmic reticulum provides arrhythmogenic trigger source in swimming-induced rat athlete's heart model. **Sci Rep 10:** 19596.

Varró, A., Tomek, J., **Nagy, N.**, Virag, L., Passini, E., Rodriguez, B., Baczkó, I. (2020) Cardiac Transmembrane Ion Channels and Action Potentials: Cellular Physiology and Arrhythmogenic Behavior. **Physiol Rev 101:** 1083-1176.

Oravecz, K., Kormos, A., Gruber, A., Márton, Z., Kohajda, Z., Mirzaei, L., Jost, N., Levijoki, J., Pollesello, P., Koskelainen, T., Otsomaa, L., Tóth, A., Papp, J.G., Nánási, P.P., Antoons, G., Varró, A., Acsai, K., **Nagy, N.** (2018) Inotropic effect of NCX inhibition depends on the relative activity of the reverse NCX assessed by a novel inhibitor ORM-10962 on canine ventricular myocytes. **Eur J Pharmacol 818:** 278-286.

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RESEARCH AREA

Our research group's aim is to identify the genomic causes of rare genetic disorders. Rare disease affects a small percentage of the population; its prevalence is less than 1:2000. However, taking all rare diseases together, many individuals and families are affected. To date, there are more thousands of known rare disease. They cause a large health burden to the individuals and families. 80% of rare diseases have genetic component and they are very diverse. Our research group mainly focuses on genodermatoses, neurodegenerative diseases, cardiovascular diseases, rare inheritable eye diseases, inherited hearing loss and congenital developmental abnormalities. Our findings help to understand the genetic background of rare genetic disorders and to expand human mutational databases related to human inherited diseases. This knowledge is essential for understanding the pathogenesis of human diseases at the molecular level and it can be also useful to develop novel diagnostics and therapeutic modalities. Our results may provide a good basis to develop Hungarian population-specific test panels in different inherited diseases.

TECHNIQUES AVAILABLE IN THE LAB

We apply a wide range of laboratory methods, including classical and new ones. The regularly used methods are the following: polymerase chain reaction (PCR) and sequencing methods combined with various bioinformatics tools for sequence analysis. DNA extraction from blood and tissue samples, DNA quantitation, primer design, different PCR techniques such as standard, Repeat-Primed PCR, Real-Time PCR, Digital Droplet PCR, agarose gel electrophoresis, Sanger sequencing and amplicon fragment length analysis, next generation sequencing (gene panel and whole exome sequencing) and bioinformatics analysis of these data. We use clinical and mutational databases and *in silico* variant predictions for variant interpretation and also provide genotype-phenotype comparison.

SELECTED PUBLICATIONS

Rusz, O., **Pal, M.**, Szilagyi, E., Rovo, L., Varga, Z., Tomisa, B., Fabian, G., Kovacs, L., Nagy, O., Mozes, P., Reisz, Z., Tiszlavicz, L., Deak, P., Kahan, Zs. (2017) The Expression of Checkpoint and DNA Repair Genes in Head and Neck Cancer as Possible Predictive Factors. **Pathol Oncol Res 23:** 253-264.

Kovács, L., Nagy, Á., **Pál, M.**, Deák, P. (2020) Usp14 is required for spermatogenesis and ubiquitin stress responses in Drosophila melanogaster. **J Cell Sci 133:** 2.

Nagy, A., Kovacs, L., Lipinszki, Z., **Pal, M.**, Deak, P. (2018) Developmental- and tissue-specific changes of ubiquitin forms in Drosophila melanogaster. **PLoS One 13:** 12.

Nagy, O., **Pal, M.**, Udvardy, A., Shirras, CAM., Boros, I., Shirras, A.D., Deak, P. (2012) lemmingA encodes the Apc11 subunit of the APC/C in Drosophila melanogaster that forms a ternary complex with the E2-C type ubiquitin conjugating enzyme, Vihar and Morula/Apc2 **Cell Div 7:** 9.

Pal, M., Nagy, O., Menesi, D., Udvardy, A., Deak, P. (2007) Structurally Related Tpr Subunits Contribute Differently to The Function of The Anaphase-promoting Complex in Drosophila Melanogaster. **J Cell Sci** 120: 3238-3248.

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RESEARCH AREA

The saying originating from the US at the beginning of the previous century "*A picture is worth a thousand words*" is particularly adequate for the description of the complexity of the brain. A new discipline, called geometrical statistics, is used now by micro-anatomical photography to derive unbiased data characterizing the number, size, specified surface portions, etc. of nerve cells by using tiny samples from an enormously high population (≈ 200 billion) of neurons constituting the brain.

The results of such investigations either may contribute to the interpretation of the industrial amount of data coming from (sometimes) automated molecular biology instruments, or may substitute those, when variations of biological functions should be attributed to distributional instead of quantitative changes in e.g. gene expression. The development of biological microstructural investigations is undoubtedly motivated by a typical human desire expressed by *"seeing is believing"*. This is most obvious in the regular need of seeking the structural correlates of the results obtained by another cutting edge technology, electrophysiology.

Our micro-anatomical research is aimed to derive quantitative data characterizing nerve cells in healthy conditions, during disease and ageing, which are also suitable to measure the effect of treatments aimed to halt or reverse disease progression.

TECHNIQUES AVAILABLE IN THE LAB

Microsurgical methods to induce acute neurodegeneration in experimental animals. Basic methods in structural investigations (light, fluorescent, confocal and electron microscopic and electron tomography techniques) and chemical element determination (energy-dispersive X-ray microanalysis, chemical elemental mapping), sample preparation methods for biological structural research, labeling techniques for molecular imaging and statistical basis of sampling for unbiased quantitative microscopy, derivation of biological relevant three-dimensional parameters from biological tissue, interactive and automatic computer assisted image analysis, image analysis programming languages.

SELECTED PUBLICATIONS

Nógrádi B., Nyúl-Tóth, A., Kozma M., Molnár K., **Patai R.,** Siklós L., Wilhelm I., Krizbai I.A. (2020) Upregulation of Nucleotide-Binding Oligomerization Domain-, LRR- and Pyrin Domain-Containing Protein 3 in Motoneurons Following Peripheral Nerve Injury in Mice. **Front Pharmacol 11**: 584184.

Meszlényi V., **Patai R.**, Polgár T.F., Nógrádi B., Körmöczy L., Kristóf R., Spisák K., Tripolszki K., Széll M., Obál I., Engelhardt J.I., Siklós L. (2020) Passive Transfer of Sera from ALS Patients with Identified Mutations Evokes an Increased Synaptic Vesicle Number and Elevation of Calcium Levels in Motor Axon Terminals, Similar to Sera from Sporadic Patients. **Int J Mol Sci 21**: 5566.

Nógrádi B., Meszlényi V., **Patai R.,** Polgár T.F., Spisák K., Kristóf R., Siklós L. (2020) Diazoxide blocks or reduces microgliosis when applied prior or subsequent to motor neuron injury in mice. **Brain Res 1741**: 146875.

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Patai, R., Paizs, M., Tortarolo, M., Bendotti, C., Obál, I., Engelhardt, J.I., Siklós, L. (2017) Presymptomatically applied AMPA receptor antagonist prevents calcium increase in vulnerable type of motor axon terminals of mice modeling amyotrophic lateral sclerosis. **Biochim Biophys Acta 1863**: 1739–1748.

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Paizs, M., **Patai, R.**, Engelhardt, J.I., Katarova, Z., Obál, I., Siklós, L. (2017) Axotomy leads to reduced calcium increase and earlier termination of CCL2 release in spinal motoneurons with upregulated parvalbumin followed by decreased neighboring microglial activation. **CNS Neur Disord Drug Targets 16**: 356–367.

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RESEARCH AREA

The consequence of ischemia or hypoxia is the emergence of a reductive stress (proton accumulation) in an intracellular level. The following reperfusion or reoxygenation indicates the formation of high amounts of reactive oxygen- (ROS) and nitrogen species (RNS). The onset of oxidative and nitrosative stress aggravates the damages caused by ischemia and reperfusion thereafter. Thus there is a clear interest in developing novel anti-inflammatory therapeutic agents which can specifically attenuate the damages caused by the processes mentioned before in a molecular and cellular level. We have demonstrated the anti-inflammatory effects of inhaled methane (CH_4) however there are many unanswered questions remained of its mechanism of action. Our aim is to investigate the protective role of CH_4 inhalation on various damaged organs of systemic or local hypoxia and inflammatory processes such as sepsis.

TECHNIQUES AVAILABLE IN THE LAB

Wide spectrum of performing surgical and microsurgical interventions on anesthetised rats and mice for invasive monitoring (e.g. arterial and venous blood pressure, cardiac output, arterial and venous oxygen levels). *In vivo* monitoring and measuerement of microcirculation of various tissues in various conditions (e.g. hypoxia, inflammation) by imaging techniques such as fluorescent laser-scanning endomicroscopy or intravital microscopy. Monitoring and measurement of gastrointestinal motility by electrogastrography. *Ex vivo* monitoring and analysis of cellular and mitochondrial respiration with high-resolution respirometry. Measurements of various biochemical markers including the measurement of different enzyme activities. Preparing tissue sections with cryostat, or by whole-mount preparation, histochemical and immunohistochemical stainings.

SELECTED PUBLICATIONS

Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., Varga, G., Szűcs, S., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., Kaszaki, J. (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia- reperfusion. **Free Radic Biol Med 120:** 160-169.

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Talapka, P., Nagy, L., Pál, A., **Poles, M.Z.**, Berkó, A., Bagyánszki, M, Puskás, L.G., Fekete, É., Bódi, N. (2014) Alleviated mucosal and neuronal damage in a rat model of Crohn's disease. **World J Gastroenterol 20:** 16690-16697.

[+]Máté, Z., [+]**Poles, M.Z.**, Szabó, G., Bagyánszki, M., Talapka, P., Fekete, É., Bódi, N. (2013) Spatiotemporal expression pattern of DsRedT3/CCK gene construct during postnatal development of myenteric plexus in transgenic mice. **Cell Tissue Res 352**: 199-206. [+]equal first authors

Bódi, N., Talapka, P., **Poles, M.Z.**, Hermesz, E., Jancsó, Zs., Katarova, Z., Izbéki, F., Wittmann, T., Fekete, É., Bagyánszki, M. (2012) Gut region-specific diabetic damage to the capillary endothelium adjacent to the myenteric plexus. **Microcirculation 19:** 316-326.

BALÁZS SZAPPANOS

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RESEARCH AREA

The recent emergence of the field of systems biology brought a new era in the research of evolution. The novel methods and largescale datasets enable the systematic exploration of the elements of biological systems and the interactions between them. Our group is particularly interested in studying the evolution of metabolism. By measuring the intracellular metabolite levels, that is, the metabolome in different yeasts we can assess how fast metabolism evolves and what are the driving forces behind its evolution. We are also studying the evolution of the metabolic network, that is, how can organisms gain novel enzymes and biochemical pathways to better adapt to the environmental conditions. We utilize this knowledge for strain design by discovering genetic modifications that can boost the microbial production of chemicals with industrial importance.

TECHNIQUES AVAILABLE IN THE LAB

Metabolic network modelling, phylogenetic and comparative genomics methods, bioinformatic analysis of metabolomic and transcriptomic data, statistics and machine learning. Programming in R, Python, Perl and Matlab languages.

SELECTED PUBLICATIONS

Zampieri, M., **Szappanos, B.**, Buchieri, M.V., Trauner, A., Piazza, I., Picotti, P., Gagneux, S., Borrell, S., Gicquel, B., Lelievre, J., Papp, B., Sauer, U. (2018) High-throughput metabolomic analysis predicts mode of action of uncharacterized antimicrobial compounds. **Sci Transl Med 10:** eaal3973.

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RESEARCH AREA

Sarcomeres, the basic contractile units of muscles, are composed of three major filament systems: a filamentous actin based thin-filament array, the myosin motor protein based thick filaments, and a titin based elastic filament system. Grounded on classic electron microscopy studies, the sarcomere is defined as a repeating unit of the myofibril bordered by two Z-disks, which serve as anchoring sites for the oppositely oriented thin-filaments of the neighboring units. The midline of the sarcomere is referred as to the M-line flanked by the H-zone corresponding to the central thin filament-free area and to the head-less area of the bipolar thick filaments. The sarcomeres are extremely highly ordered macromolecular assemblies where structural organization is intimately linked to the functionality of these contractile units. Therefore, precise structural description of the sarcomeres is critical to better understand the mechanisms of muscle development and maintenance. We previously established a single-molecule localization microscopy based approach, which can deliver localization maps of multiprotein complexes with very high precision, virtually attaining single protein size resolution. By combining the tools of Drosophila genetics with nanoscopy, we plan to better understand the molecular mechanisms of sarcomere assembly and growth during development.

TECHNIQUES AVAILABLE IN THE LAB

Classical and molecular Drosophila genetics, molecular biology, cell biology, cytoskeleton analysis, immunohistochemistry, the basic methods of biochemistry, confocal and superresolution microscopy, behavioral tests, live imaging, digital image analysis.

SELECTED PUBLICATIONS

Szikora, S., Gajdos, T., Novák, T., Farkas, D., Földi, I., Lenart, P., Erdélyi, M., Mihály, J. (2020) Nanoscopy reveals the layered organization of the sarcomeric H-zone and I-band complexes. **J Cell Biol 219:** 201907026.

Gajdos, T., Cserteg, Z., **Szikora, S.**, Novak, T., Kovacs, B. B. H., Szabo, G., Mihaly, J., and Erdelyi, M. (2019) mmSTORM: Multimodal localization based super-resolution microscopy. **Sci Rep 9:** 798.

Migh, E., Gotz, T., Foldi, I., **Szikora, S.**, Gombos, R., Darula, Z., Medzihradszky, K., Maleth, J., Hegyi, P., Sigrist, S., Mihaly, J. (2018) Microtubule organization in presynaptic boutons relies on the formin Daam. **Development 145:** 158519.

Szikora, S., Foldi, I., Toth, K., Migh, E., Vig, A., Bugyi, B., Maleth, J., Hegyi, P., Kaltenecker, P., Sanchez-Soriano, N., Mihaly, J. (2017) The formin DAAM is required for coordination of the actin and microtubule cytoskeleton in axonal growth cones. **J Cell Sci 130:** 2506–2519.

Teréz Vig, A., Földi, I., **Szikora, S.**, Migh, E., Gombos, R., Ágnes Tóth, M., Huber, T., Pintér, R., Csaba Talián, G., Mihály, J., Bugyi, B. (2017) The activities of the c-terminal regions of the formin protein disheveled-associated activator of morphogenesis (daam) in actin dynamics. **J Biol Chem 292:** 13566–13583.

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RESEARCH AREA

According to the criteria of "Sepsis-3" consensus conference, sepsis is defined as a life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis is still one of the most frequent cause of death in intensive clinical care, so a well-standardized animal model compatible with human symptoms is essential in research. There are many descriptions of the process of sepsis in the related literature, but the microbiological background is a less researched area, despite the fact that sepsis is caused by a polymicrobial infection. Based on the above, only that sepsis model is appropriate, where live microorganisms are used, and for this reason, it is indispensable to describe the microbial profile of the animals, and calculate the initial concentration of the microorganism suspension for the sepsis induction. One of the major problems during sepsis is the disproportion between oxygen transport and use, which necessarily leads to the energy deficiency of the cells, therefore, we the mitochondrial effects of different pharmacons from the therapeutic targets were investigated. In our view, the main target of sepsis can be the supply of oxygen and energy to the body, mitigating the mitochondrial dysfunction, and thus reducing the inflammatory response to severe organ damage. We believe that our therapeutic approaches to mitochondrial dysfunction can improve the condition of septic patients.

TECHNIQUES AVAILABLE IN THE LAB

Our research laboratories are equipped with instruments to identify macro- and microcirculatory changes (hemodynamic computerized data-acquisition and analysis systems, laser-Doppler flowmetry, fluorescence-based intravital microscopy, orthogonal polarisation spectral imaging). Fluorescence confocal laser scanning endomicroscopy technique offers the possibility of acquiring precise in vivo data for histological analysis. A high resolution respirometer is available for examination of mitochondrial function (activities of the components of electron transport chain) and additional laboratory facilities (ELISA) to study inflammatory biomarkers. Animal house and fully-equipped operating theatres are available for surgical intervention of small (rats) and larger animals (minipigs).

SELECTED PUBLICATIONS

Tallósy, S.P., et al. (2014) Investigation of the antibacterial effects of silver-modified TiO2 and ZnO plasmonic photocatalysts embedded in polymer thin films. **Environ Sci Pollut Res 21:** 11155–11167.

Tallósy, S.P., et al. (2016) Adhesion and inactivation of Gram-negative and Gram-positive bacteria on photoreactive TiO2/polymer and Ag–TiO2/polymer nanohybrid films. **Appl Surf Sci 371:** 139–150.

Tallósy, S.P., et al. (2014) LED-light Activated Antibacterial Surfaces Using Silver-modified TiO2 Embedded in Polymer Matrix**. J Adv Oxid Technol 17:** 9-16.

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Janovák, L., et al. (2017) Hydroxyapatite-enhanced structural, photocatalytic and antibacterial properties of photoreactive TiO2/HAp/polyacrylate hybrid thin films. **Surf Coatings Technol 326:** 316–326.

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Samu, G.F., et al. (2017) Photocatalytic, photoelectrochemical, and antibacterial activity of benign-by-design mechano-chemically synthesized metal oxide nanomaterials. **Catal Today 284:** 3–10.

Veres, Á. et al. (2012) Silver and phosphate functionalized reactive TiO2/polymer composite films for destructions of resistent bacteria using visible light. **J Adv Oxid Technol 15:** 205-216.

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RESEARCH AREA

Genomics is the study of the structure and function of genome. The genome sequences of many organisms have now been determined. It has also been described that the mammalian genomes contain approximately 22,000 protein-coding genes, however, they only represent about 1% of the genomes. It has also been demonstrated, that almost the entire genome is transcriptionally active at both DNA strands. More and more results show that the non-protein coding RNAs have a very important role on the regulation of gene expression, on various post-transcriptional processes and on the translation. Our research projects focus on the analysis of various viruses (e. g., Herpes simplex virus, Varicella Zoster virus, Vaccinia virus, etc.). We examine the gene expression profiles and transcriptional complexity of these viruses, and also use them as model organisms for the study of our Transcriptional Interference Network (TIN) hypothesis, which propose a novel layer of genetic regulation, and is based on the interactions between the gene activities via the mechanisms of transcriptional read-through between convergent, divergent and parallel gene pairs. For these, we apply state-of-the-art sequencing and bioinformatics techniques, as well as other cutting edge technologies such as the CrispR-Cas9/dCas9 techniques, with which we generate genetically modified viruses or inducible gene expression. Our group also has bacterial-fungal- and human genomics projects (analysis of the genetic background of major depression, Alzheimer's Disease) by applying exome-, transcriptome-, methyl- and ChIP-seq techniques.

TECHNIQUES AVAILABLE IN THE LAB

We apply a wide variety of standard molecular biological methods and the most modern genomic approaches: DNA and RNA purification, propagation and maintaining various cell cultures, propagation of viruses, molecular cloning (homologous recombination and CrispR technique), PCR, quantitative (q)PCR, digital (d)PCR, Northern- and Western-blot, fluorescent and confocal microscopy. Next- and third generation sequencing (Illumina MiSeq, Oxford Nanopore MinION): genome-, transcriptome-, small RNA sequencing, analysis of epigenetic changes, preparation of sequencing libraries, bioinformatics and statistics. Pacific Biosciences RSII and Sequel data analysis and bioinformatics.

SELECTED PUBLICATIONS

Boldogkői, Z., Moldován. N., Balázs. Z., Snyder, M., **Tombácz, D.** (2019) Long-Read Sequencing - A Powerful Tool in Viral Transcriptome Research. **Trends Microbiol 27:** 578-592.

Tombácz, D., Prazsák, I., Szűcs, A., Dénes, B., Snyder, M., Boldogkői, Z. (2018) Dynamic transcriptome profiling dataset of vaccinia virus obtained from long-read sequencing techniques. **Gigascience 7:** giy139.

Tombácz, D., Sharon, D., Szűcs, A., Moldován, N., Snyder, M., Boldogkői, Z. (2018) Transcriptome-wide survey of pseudorabies virus using next- and third-generation sequencing platforms. **Sci Data 5:** 180119.

Tombácz, D., Maróti, Z., Kalmár, T., Csabai, Z., Balázs, Z., Takahashi, S., Palkovits, M., Snyder, M., Boldogkői Z. (2017) High-Coverage Whole-Exome Sequencing Identifies Candidate Genes for Suicide in Victims with Major Depressive Disorder. **Sci Rep 7:** 7106.

Boldogkői, Z., Balint. K., Awatramani. G.B., Balya, D., Busskamp,V., Viney, T.J., Lagali, P.S., Duebel, J., Pásti, E., **Tombácz, D.**, Tóth, J.S., Takács, I.F., Scherf, B.G., Roska, B. (2009) Genetically timed, activity-sensor and rainbow transsynaptic viral tools. **Nat Methods 6:** 127-30.

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RESEARCH AREA

Dysfunction of epithelial ion transport has a crucial role in the development of several diseases such as acute pancreatitis or cystic fibrosis. Acute pancreatitis is among the most common gastrointestinal disorders worldwide. The disease is generally mild, however, the mortality rate in its severe form is high. Researchers have shown that altered ion transport could be responsible for the pathomechanism of inflammatory pancreatic diseases, however, the exact mechanism is unknown. At present, there is no specific treatment. The aim of my research work is to find new molecular and cellular therapeutic targets and to study the ion transport mechanisms of pancreas related diseases such as acute pancretitis or cystic fibrosis.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of pancreatic ductal or acinar epithelial cells, establishment of cells cultures, microsurgery techniques, patch clamp. Fluorescent and confocal microscopy. Molecular biology methods as immunfluorescence staining, PCR, RT-PCR, ELISA. Induction of acute and chronic pancreatitis in different animal models in vivo; mice, ferrets, pigs, guinea pigs, enzymatic assays, histological analysis.

SELECTED PUBLICATIONS

Tóth, E., Maléth, J., Závogyán, N., Fanczal, J., Grassalkovich, A., Erdős, R., Pallagi, P., Horváth, G., Tretter, L., Bálint, E.R., Rakonczay, Jr., Z., Venglovecz, V., Hegyi, P., (2019) Novel mitochondrial transition pore inhibitor N-methyl-4-isoleucine cyclosporin is a new therapeutic option in acute pancreatitis. **J Physiol 597:** 5879-5898.

Rumbus*, Z., **Toth*, E.**, Poto, L., Vincze, A., Veres, G., Czako, L., Olah, E., Marta, K., Miko, A., Rakonczay, Jr., Z., Balla, Zs., Kaszaki, J., Foldesi, I., Maleth, J., Hegyi▪, P., and Garami, A.,▪ Bidirectional Relationship Between Reduced Blood pH and Acute Pancreatitis: A Translational Study of Their Noxious Combination (2018) **Front Physiol 9:** 1360.
*Authors share a co-authorship of this article, ▪Authors share a co- last authorship of this article

Venglovecz, V., Pallagi, P., Kemény, V., J., Balázs, A., Balla, Zs., Becskeházi, E., Gál, E., **Tóth, E.**, Zvara, Á., Puskás, G.L., Borka, K., Sendler, M., Lerch, M.M., Mayerle, J., Kühn, J.-P., Rakonczay, Jr.Z., Hegyi, P. (2018) The Importance of Aquaporin 1 in Pancreatitis and Its Relation to the CFTR Cl- Channel. **Front Physiol 9:** 854.

Fanczal, J., Pallagi, P., Görög, M., Diszházi, Gy., Almássy, J., Madácsy, T., Varga, Á., Csernay-Biró, P., Katona, X., **Tóth, E.**, Molnár, R., Rakonczay, Jr. Z., Hegyi, P., Maléth, P. (2020) TRPM2-mediated extracellular Ca^{2+} entry promotes acinar cell necrosis in biliary acute pancreatitis **J Physiol 598:** 1253-1270.

Szentesi, A., **Tóth, E.**, Bálint, E., Fanczal, J., Madácsy, T., Laczkó, D., Ignáth, I., Balázs, A., Pallagi, P., Maléth, J., Rakonczay, Jr. Z., Kui, B., Illés, D., Márta, K., Blaskó, A., Demcsák, A., Párniczky, A., Pár, G., Gódi, Sz., Mosztbacher, D., Szücs, Á., Halász, A., Izbéki, F., Farkas, N., Hegyi, P., and Hungarian Pancreatic Study Group¶ (2016) Analysis of Research Activity in Gastroenterology: Pancreatitis Is in Real Danger. **Plos One 11:** e0165244.

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RESEARCH AREA

Besides the bacterial flora, several fungal species are also long-term occupants of the oral microbiota. Among these, *Candida* are the most abundant species. Although the role of the human bacteriota and virome is well characterized, less is known about the composition of the mycobiota, let alone its role in the host. Therefore, one purpose of our project is to examine how do normal oral epithelial cells respond to the presence of commensal *Candida* species. We aim to explore their recognition, the corresponding signal transduction mechanisms and potential effector functions in the presence of various fungal stimuli. Since the last decade, numerous studies report alterations in the diversity of the oral microflora of immunocompromised and cancer patients (e.g. with oral squamous cell carcinoma), allowing the overgrowth of opportunistic pathogenic species (such as *C. albicans* and *C. parapsilosis*). Besides the increased probability of oral candidiasis in these patients, the abnormally altered microbiota might also influence the underlying diseases' progression. In addition to investigating the immune response regulatory effect of normal oral epithelial cells, we further aim to examine the potentially altered immunomodulatory effects of oral squamous cell carcinoma cells and to explore signaling routes that might be associated with tumor progression following fungal stimuli.

TECHNIQUES AVAILABLE IN THE LAB

Establishment/ optimization/ handling of *in vitro* co-infection models to examine fungal infections, using human monocytic, epithelial and murine cell lines and primary cells; phagocytosis and killing experiments; RNA preparation; real-time PCR; ELISA; flow cytometry; metabolic activity; cell adhesion and host cell killing (LDH) assays, live cell imaging. Next-generation sequencing, RNA-seq, micro RNA investigations.

SELECTED PUBLICATIONS

Toth, R., Nosek, J., Mora-Montes, H., Gabaldon, T., Bliss, J.M., Nosanchuk J.D., Turner, S.A., Butler, G., Vagvolgyi, Cs., Gacser, A. (2019) The emergence of *Candida parapsilosis*: from genes to the bedside. **Clin Microbiol Rev 32:** e00111-18.

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Toth, R., Toth, A., Vagvolgyi, Cs., Gacser, A. (2017) *Candida parapsilosis* secreted lipase as an important virulence factor. **Curr Protein Pept Sci 18:** 1043-1049.

Nagy, L.G., **Toth, R.**, Kiss, E., Slot, J., Gacser, A., Kovacs, G.M. (2017) Six Key Traits of Fungi: Their evolutionary origins and genetic bases. **Microbiol Spectr 5**.

Toth, R., Toth, A., Papp, Cs., Jankovics, F., Vagvolgyi, Cs., Alonso, M.F., Bain, J.M., Erwig, L.P., Gacser, A. (2014) Kinetic studies of *Candida parapsilosis* phagocytosis by macrophages and detection of intracellular survival mechanisms. **Front Microbiol 5:** 633.

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RESEARCH AREA

Bioactive natural compounds and their semi-synthetic derivatives represent a highly promising treasury of potential new drugs. Two particularly interesting naturally occurring, pharmacologically active compound groups are ecdysteroids and protoflavonoids.

Ecdysteroids are present both in flora and fauna. In mammals, they are non-toxic compounds that can exert numerous beneficial non-hormonal bioactivities, such as anabolic and adaptogenic effects. Besides, our research group has discovered the particular property of notably less polar ecdysteroid derivatives to sensitize the drug resistance of both multi-drug resistant (MDR) and non-MDR cancer cells towards various chemotherapeutics.

The pharmacological potential of protoflavonoids is also wide-ranging. They are intensively studied for their antitumor effects, which stem from their representatives' cytotoxic nature and their inhibitory effect on specific DNA damage response mechanisms (ATR-dependent signaling), through which they can enhance, e.g., the activity of cisplatin. Besides, considerable evidence has been revealed in recent years (e.g., inhibition of xanthine oxidase enzyme, antiviral activities) suggesting that the pharmacology of protoflavonoids might exceed their antitumor potential.

The focus of our research efforts is on the structural optimization of compounds of the outlined groups with therapeutic potential, according to which semi-synthetic modifications are made on the molecules, which may result in the improvement of their chemical-physical parameters, the enhancement of their biological effects and/or the reduction of their potential disadvantageous side effects.

TECHNIQUES AVAILABLE IN THE LAB

Versatile organic synthetic techniques and drug functionalization methods that enhance the *in vivo* efficacy of the compounds (e.g., the preparation of self-assembled nanoparticles of bioactive agents) can be studied in our laboratory. An extensive array of instrumental chromatographic techniques is available for the qualitative analysis and purification of products: high performance liquid chromatography (HPLC), supercritical fluid chromatography (SFC), flash chromatography, rotation planar chromatography, and centrifugal partition chromatography (CPC). In addition to the above, we provide an opportunity to learn about methods used for the structure elucidation of molecules (mass spectrometry, nuclear magnetic resonance spectroscopy).

SELECTED PUBLICATIONS

Vágvölgyi, M., Bélteky, P., Bogdán, D., Nové, M., Spengler, G., Latif, A.D., Zupkó, I., Gáti, T., Tóth, G., Kónya, Z., Hunyadi, A. (2020) Squalenoylated Nanoparticle Pro-Drugs of Adjuvant Antitumor 11α-Hydroxyecdysteroid 2,3-Acetonides Act as Cytoprotective Agents Against Doxorubicin and Paclitaxel. **Front Pharmacol 11**: 552088.

Vágvölgyi, M., Girst, G., Kúsz, N., Ötvös, S.B., Fülöp, F., Hohmann, J., Servais, J-Y., Seguin-Devaux, C., Chang, F-R., Chen, M.S., Chang, L-K., Hunyadi, A. (2019) Less Cytotoxic Protoflavones as Antiviral Agents: Protoapigenone 1′-O-isopropyl ether Shows Improved Selectivity Against the Epstein–Barr Virus Lytic Cycle. **Int J Mol Sci 20:** 6269.

Fumagalli, G., Giorgi, G., **Vágvölgyi, M.**, Colombo, E., Christodoulou, M.S., Collico, V., Prosperi, D., Dosio, F., Hunyadi, A., Montopoli, M., Hyeraci, M., Silvani, A., Lesma, G., Dalla Via, L., Passarella, D. (2018) Heteronanoparticles by Self-Assembly of Ecdysteroid and Doxorubicin Conjugates To Overcome Cancer Resistance. **ACS Med Chem Lett 9:** 468-471.

Vágvölgyi, M., Martins, A., Kulmány, A., Zupkó, I., Gáti, T., Simon, A., Tóth, G., Hunyadi, A. (2018) Nitrogen-containing ecdysteroid derivatives vs. multi-drug resistance in cancer: Preparation and antitumor activity of oximes, oxime ethers and a lactam. **Eur J Med Chem 144:** 730-739.

Ötvös, S.B., **Vágvölgyi, M.**, Girst, G., Kuo, C-Y., Wang, H-C., Fülöp, F., Hunyadi, A. (2018) Synthesis of Nontoxic Protoflavone Derivatives through Selective Continuous-Flow Hydrogenation of the Flavonoid B-Ring. **ChemPlusChem 83:** 72-76.

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RESEARCH AREA

The extracorporeal circulation (ECC) can be lifesaving in conditions, accompanied by severe acute respiratory or circulatory failure, but the ECC related complications limit the application of the technique, and this reduces the group of patients who can benefit from the ECC treatment. Moreover, the complications frequently affect vital organs (kidney, brain, heart) and as a result long lasting aftercare can be necessary or in case of the most severe cases, it might even cause the death of the patient. Our main purpose is to develop and establish animal models, which will be suitable to the examination of inflammatory processes that play critical role in the pathomechanism of the ECC related complications. The other aim is to develop an innovative treatment method, the trans-oxygenator methane administration to moderate ECC associated complications.

TECHNIQUES AVAILABLE IN THE LAB

Learn about small and large animal models of extracorporeal circulation. Participation in animal experimental work, learn about surgical techniques, macro and microhemodynamic measurements. Methods of data processing, statistical analysis of data. Active participation in human studies of the research team.

SELECTED PUBLICATIONS

Szűcs, S., Bari, G., Ugocsai, M., Lashkarivand, R.A., Lajkó, N., Mohácsi, A., Szabó, A., Kaszaki, J., Boros, M., Érces, D., **Varga, G.** (2019) Detection of Intestinal Tissue Perfusion by Real-Time Breath Methane Analysis in Rat and Pig Models of Mesenteric Circulatory Distress. **Crit Care Med 47:** e403-e411.

Bari, G., Érces, D., **Varga, G.**, Szűcs, Sz., Varga, Z., Bogáts, G., Boros, M. (2019) Methane inhalation reduces the systemic inflammatory response in a large animal model of extracorporeal circulation. **Eur J Cardiothorac Surg 56:** 135-142.

Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., **Varga, G.**, Szűcs, Sz., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., Kaszaki, J. (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia-reperfusion. **Free Radic Biol Med 120:** 160-169.

Mészáros, A.T., Büki, T., Fazekas, B., Tuboly, E., Horváth, K., Poles, M.Z., Szucs, S., **Varga, G.**, Kaszaki, J., Boros, M. (2017) Inhalation of methane preserves the epithelial barrier during ischemia and reperfusion in the rat small intestine. **Surgery 161:** 1696-1709.

Boros, M., Ghyczy, M., Erces, D., **Varga, G.**, Tokes, T., Kupai, K., Torday, C., Kaszaki, J. (2012) The anti-inflammatory effects of methane. **Crit Care Med 40:** 1269-1278.

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RESEARCH AREA

Telomeres are nucleoprotein complexes located at the end of chromosomes and their main function is to prevent the erosion and fusion of chromosomes. Cellular stress and the 'end replication problem' both cause progressive degradation of chromosomes. Due to the progressive shortening, elderly individuals possess shorter telomeres. Lifestyle also influences telomere length, since people with a healthier way of living have longer telomeres. Telomere length therefore is often regarded as a clock associated with the aging process. As telomeres are getting shorter by each cell division, a critical limit is reached after which the cells are too 'old' and unable to divide. However, telomere shortening is not the only cause of aging, since those organisms that do not display telomere shortening are also aging. In these species and in the germ and stem cells of most eukaryotes, an enzyme called telomerase is able to elongate the telomeres and compensate for their shortening. Nevertheless, telomere shortening is not necessarily bad, it is also a failsafe mechanism against cancer. As an individual is getting older, more and more genomic mutations accumulate in their cells, which eventually could lead to cancer. However, due to telomere shortening cells stop dividing before the cancer forming mutations are acquired. In 90% of tumours, however, the telomerase is reactivated and provides the possibility of unlimited cell divisions. In our lab, we study the telomere structure, and the mechanisms behind telomerase gene activation in tumours.

TECHNIQUES AVAILABLE IN THE LAB

DNA isolation from different biological samples (bacteria, FFPE tumour samples, urine), agarose gel electrophoresis, cloning methods, enzymatic DNA manipulation techniques, culturing of bacterial or mammalian cells, reporter assay, chromatin immunprecipitation, PCR based techniques (primer design, high fidelity PCR, nested PCR, PCR mutagenesis, KASP, qPCR), heterologous protein expression and protein purification, PAGE, macromolecule interaction studies (gel filtration, immunprecipitation, MST).

SELECTED PUBLICATIONS

Vedelek, B., Maddali; A. K., Davenova N., Vedelek, V., Boros I. M. (2020) TERT promoter alterations could provide a solution for Peto's paradox in rodents. **Sci Rep 10:** 20815.

Henn, L., Szabó A., Imre, L., Román Á., Ábrahám, A., **Vedelek, B.**, Nánási, P., Boros, I. M. (2020) Alternative linker histone permits fast paced nuclear divisions in early Drosophila embryo. **Nucleic Acids Res 48:** 9007-9018.

Sike, A., Nagy, E., **Vedelek, B.**, et al. (2014) mRNA levels of related Abcbgenes change opposite to each other upon histonedeacetylase inhibition in drug-resistant rathepatoma cells. **PLoSOne 9:** e84915.

Vedelek, B., Blastyák, A., Boros, I.M. (2015) Cross-Species Interaction between Rapidly Evolving Telomere-Specific Drosophila Proteins. **PLoSOne 10:** e0142771.

Pahi, Z., Borsos, B.N., **Vedelek, B.**, et al. (2017) TAF10 and TAF10b partially redundant roles during Drosophila melanogastermorphogenesis. **Transcription 8:** 297-306.

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RESEARCH AREA

Stem cells present in the human adult body play a crucial role in the maintaining of homeostasis, and in the regeneration of tissues and organs. The loss or alteration of their function have been shown to have an important role in the pathomechanism of certain diseases. Mesenchymal stem cells (MSCs) can be isolated from many tissues and organs, and can be differentiated under appropriate conditions towards osteoblasts, fat cells, chondrocytes, myoblasts, fibroblasts, epithelium and other tissues as well. The MSC is capable of controlling humoral and cellular immune responses to prevent inflammation, tissue and organ rejection. They have an extremely important role in inducing local immunosuppression, in which both T cells and dendritic cells are affected by MSC. Due to their immunosuppressive capacity and their high potential for differentiation they became the most researched objects of regenerative medicine. As cell therapy product MSC able to regenerate the damaged tissues or organs and inhibit inflammatory processes. Our research mainly focuses on the role of mesenchymal stem cells in tissue regeneration, and immunomodulation under healthy and pathological conditions According this knowledge we create artificial tissues, tissue engineered products using 3D bioprinting from stem cells and bioscaffolds. We characterize the biochemical and immunological properties of these bioprinted tissues as well. We also investigate how MSC can participate in tumor formation and metastasis.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of stem cells and progenitor cells from various tissues, *in vitro* and *ex vivo* cultivation of isolated cells. Phenotype analysis of cells is performed by immunocytochemistry and flow cytometry. Gene expression studies using PCR and high throughput gene arrays. Measurement of *in vitro* differentiation assays, wound healing and migration tests by high content screening microscopy. Detection of proteins, secreted factors by Western blots, ELISA and protein arrays. Three-dimensional cell cultures and 3D bioprinting.

SELECTED PUBLICATIONS

Klusóczki, Á., **Veréb, Z.**, Vámos, A., Fischer-Posovszky, P., Wabitsch, M., Bacso, Z., Fésüs, L., Kristóf, E. (2019) Differentiating SGBS adipocytes respond to PPARγ stimulation, irisin and BMP7 by functional browning and beige characteristics. **Sci Rep 9:** 5823.

Veréb, Z., Póliska, S., Albert, R., Olstad, OK., Boratkó, A., Csortos, C., Moe, MC., Facskó, A., Petrovski G. (2016) Role of Human Corneal Stroma-Derived Mesenchymal-Like Stem Cells in Corneal Immunity and Wound Healing. **Sci Rep 6:** 26227.

Veréb, Z., Albert, R., Póliska, S., Olstad, OK., Akhtar, S., Moe, MC., Petrovski, G. (2013) Comparison of upstream regulators in human ex vivo cultured cornea limbal epithelial stem cells and differentiated corneal epithelial cells. **BMC Genomics 14:** 900.

Veréb, Z., Lumi, X., Andjelic, S., Globocnik-Petrovic, M., Urbancic, M., Hawlina, M., Facskó, A., Petrovski, G. (2013) Functional and molecular characterization of ex vivo cultured epiretinal membrane cells from human proliferative diabetic retinopathy. **Biomed Res Int 2013:** 492376.

Varga, N., **Veréb, Z.**, Rajnavölgyi, E., Német, K., Uher, F., Sarkadi, B., Apáti, A. (2011) Mesenchymal stem cell like (MSCl) cells generated from human embryonic stem cells support pluripotent cell growth. **Biochem Biophys Res Commun 14:** 474-80.

SZILVIA VESZELKA

Biological Research Center
Institute of Biophysics

Address: 6726 Temesvári krt. 62., H-6725 Szeged, Hungary

RESEARCH AREA

Pharmaceutical treatment of most disorders of the central nervous system, including neurodegenerative diseases and brain tumors, is restricted due to the poor penetration of drugs across the *blood-brain barrier*, the major entry route for therapeutic compounds to the central nervous system. The great majority of neuropharmaceutical candidates, hydrophilic molecules, biopharmaceuticals, and efflux transporter ligands have a low permeability across the blood-brain barrier. Biocompatible and biodegradable drug targeting systems, so-called *nanocarriers* hold a great promise. Nanovesicles which can encorporate drug cargos and present on their surfaces ligands for blood-brain barrier endogenous nutrient transporters achieve increased specificity and efficacy for drug delivery across the blood-brain barrier. Combination of such ligands is a novel and innovative idea which could contribute to develop systems for better treatment of central nervous system diseases.

TECHNIQUES AVAILABLE IN THE LAB

In vitro cell culture works, isolation of brain endothelial cells (rat/mouse), toxicity measurements (MTT/LDH tests, double cell nuclei staining, real-time cell monitoring assay), resistance measurement, cell uptake and blood-brain barrier transport experiments, immunohistochemistry, confocal microscopy, scanning electron microscopy, spectrofluorometer measurements. Preparation of nanoparticles, zeta potential and size measurements.

SELECTED PUBLICATIONS

Porkoláb, G; Mészáros, M., Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M., **Veszelka, S.** (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics 12**: 635.

Mészáros, M., Porkoláb, G., Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, M.A., **Veszelka, S.** (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the bloodbrain barrier. **Eur J Pharm Sci 123**: 228-240.

Veszelka, S., Tóth, A., Walter, F.R., Tóth, A.E., Gróf, I., Mészáros, M., Bocsik, A., Hellinger, É., Vastag, M., Rákhely, G., Deli, M.A. (2018) Comparison of a Rat Primary Cell-Based Blood-Brain Barrier Model With Epithelial and Brain Endothelial Cell Lines: Gene Expression and Drug Transport. **Front Mol Neurosci 11**: 166.

Veszelka, S., Meszaros, M., Kiss, L., Kota, Z., Pali, T., Hoyk, Z., Bozso, Z., Fulop, L., Toth, A., Rakhely, G., Deli, M.A. (2017) Biotin and Glutathione Targeting of Solid Nanoparticles to Cross Human Brain Endothelial Cells. **Curr Pharm Des 23**: 4198-4205.

Dithmer, S., Staat, C., Müller, C., Ku, M.C., Pohlmann, A., Niendorf, T., Gehne, N., Fallier-Becker, P., Kittel, Á., Walter, F.R., **Veszelka, S.**, Deli, M.A., Blasig, R., Haseloff, R.F., Blasig, I.E., Winkler, L. (2017) Claudin peptidomimetics modulate tissue barriers for enhanced drug delivery. **Ann N Y Acad Sci 1397:** 169-184.

EDIT WÉBER

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Chemistry

Address: Dóm tér 8., H-6720 Szeged, Hungary

RESEARCH AREA

Protein-protein interactions play an important role in a number of therapeutically relevant pathophysiological processes. These interactions include large protein surfaces; hence their modulation is challenging. While small-molecule drugs cannot effectively decouple macromolecule interactions in general because of their small size, the right sized and often used antibodies have many disadvantages. Thus, proteomimetic compounds and innovative drug development strategies are required.

The aim of our research group is to create new proteomimetic macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein functions by these chemically well-defined substances is a great challenge and holds promise. We utilize foldamers as artificial self-organizing proteomimetics to modulate protein-protein interactions or to develop diagnostic tools.

Our targets are proteins that have a key role in tumour development and progression. We aim to design foldamers that can bind to our target proteins and are able to inhibit their interactions, thereby modulating their function. Our goal is to construct new foldamers which can inhibit tumour growth in cells.

TECHNIQUES AVAILABLE IN THE LAB

Target proteins are produced via bacterial expression systems. Foldamers are synthetized chemically. To detect and analyze protein-ligand interactions, various techniques are applied: pull-down methods with HPLC-MS analysis, protein mass spectrometry, NMR spectrometry methods, isothermal titration calorimetry and various fluorescent techniques.

Structure-based drug design. Foldamer structure design relies on computer modelling. In order to determine the binding site of the foldamers and to characterize the structure of the protein-ligand complexes, NMR spectroscopy is deployed with a special emphasis on protein NMR methods.

SELECTED PUBLICATIONS

Tököli, A., Mag, B., Bartus, É., **Wéber, E.**, Szakonyi, G., Simon, M. A; Czibula, Á., Monostori, É., Nyitray, L., Martinek, T.A. (2020) Proteomimetic surface fragments distinguish targets by function. **Chem Sci 11:** 10390.

Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity profiling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. **Sci Rep 9:** 12801.

Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity profiling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. **Sci Rep 9:** 12801.

Bartus, É., Hegedüs, Z., **Wéber, E.**, Csipak, B., Szakonyi, G., Martinek, T.A. (2017) De Novo Modular Development of a Foldameric Protein-Protein Interaction Inhibitor for Separate Hot Spots: A Dynamic Covalent Assembly Approach. Chemistryopen 6: 236.

HeténYi, A., Németh, L., **Wéber, E.**, Szakonyi, G., Winter, Z., Jósvay, K., Bartus, É., Oláh, Z., Martinek, T.A. (2016) Competitive inhibition of TRPV1 – calmodulin interaction by vanilloids. **FEBS Lett 590:** 2768.

SZENT-GYÖRGYI STUDENTS

"Discovery is seeing what everybody else has seen, and thinking what nobody else has thought."

Albert Szent-Györgyi

Szent-Györgyi Students can become members of the Szeged Scientists Academy after their successful admission. These students have already achieved successes as secondary school pupils at the national OKTV and at various international natural sciences competitions. They are especially interested in medical and health sciences, including medical and biological research, and they hope for a career in the field of scientific activities. They are thoughtful, creative, open-minded people; driven by insatiable academic curiosity.

Szent-Györgyi Students have the opportunity to establish a reliable, internationally recognised and renowned career that rests on a widespread network of international science and research.

Szent-Györgyi Students have the ability to join research groups of domestic and foreign mentors so as to systematically achieve their future goals.

LEÓ ASZTALOS

Szeged Scientists Academy, 4th year

University of Szeged,
Faculty of Faculty of Medicine, 5th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Lajos Kemény

SPECIALIZATION:

dermatology, immunology, bioinformatics

SECONDARY SCHOOL:

Zrenjaninska Gimnazija (Zrenjanin High School)

NAME OF TEACHER:

Angéla Lázár

LANGUAGES:

English/advanced
German/intermediate
Serbian/native speaker

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

In our research, we are currently looking for correlations between the immune recognition of cancer patients and their response to treatments. Human leukocyte antigen (HLA) molecules are outstandingly important in adaptive immunity. These molecules show an exceptional variability, and the different variants can bind a different number of protein-sequences (i.e. different promiscuity). We hypothesize that HLA promiscuity has an effect on response to cancer immunotherapy, and thus could be an important biomarker. In addition to immunotherapy, we also investigate the relation between promiscuity and susceptibility to tumours, autoimmune and infectious diseases. In our laboratory, we analyse large and reliable databases which contain information about thousands of patients. We use up-to-date bioinformatic methods for the statistical analysis of these data.

AMBITIONS AND CAREER GOALS

As a medical student, what I find immensely important is having the most up-to- date information in the field of medicine. The Szent-Györgyi Programme is a great opportunity for me to acquire a deeper insight into the latest research, while also learning to make use of scientific literature and improving my problem solving ability through research work. Additionally, my work can contribute to a deeper understanding of pathophysiological processes and to choosing the most appropriate way of treating them.

HONORS AND PRIZES

2021 - National Scientific Student Research Conference, Szeged, Bioinformatics, special award
2020 - Scientific Student's conference in Szeged, Biochemistry - Bioinformatics , 3rd prize
2019 - National Scientific Student Research Conference, Debrecen, special award
2018 - Scientific Student's conference in Szeged, Cellular biology-immunology, 2nd prize
2018 - XXIV. Korányi Frigyes Scientific Forum, Experimental and clinical immunology - microbiology - genetics, 3rd prize
2018 - Scientific Student's conference in Szeged, Genetics - Cellular biology - Bioinformatics, 2nd prize

PUBLICATIONS

Manczinger, M., Koncz,B., Balogh, G.M., Papp, B.T,. **Asztalos, L.**, Kemény, L., Papp, B., Pál, C. (2021) Negative trade-off between neoantigen repertoire breadth and the specificity of HLA-I molecules shapes antitumor immunity. **Nat Cancer 2:** 950-961.

SZABOLCS BENE

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Science and Informatics,
Biology MSc, 2nd year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Gyula Timinszky

JUNIOR MENTOR:

Szilvia Juhász

SPECIALIZATION:

genetics, molecular biology

SECONDARY SCHOOL:

Secondary School of Economics and Informatics of Cegléd

NAME OF TEACHER:

Ágnes Kotlárné Bíró

LANGUAGES:

English/intermediate
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

ADP-ribosylation is one of the first posttranslational modifications appearing at the site of DNA damage. There, it causes the loosening of the chromatin structure, and has effect on various DNA repair proteins, gene expression and RNAs, too. Small-molecule inhibitors of ADP-ribosylation are now used in the treatment of certain types of cancer. Our goal is to further characterize the role of this posttranslational modification in DNA damage repair. In particular, we focus our research on oncogenic mutations which could be effectively treated with ADP-ribosylation inhibitors. Therefore, new possibilities could be found in the therapy of certain cancer types.

AMBITIONS AND CAREER GOALS

Cancerous diseases are among the main causes of death. Thus, understanding the development of tumours and their functional mechanisms is an important aim of biomedical and molecular biological research. Exploring these questions is necessary for medical treatment. Although I am not a medical student I believe I can participate in the development of this research field as a molecular biologist.

HONORS AND PRIZES

2019 - XXXIV. Student Scientific Conference Biology Section, participant
2018 - Student Scientific Conference, Spring, 3rd place
2016 - National Student Competition Assay, Biology Category I., 16th place

PUBLICATIONS

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GERGŐ BITAY

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Norbert Nagy

SPECIALIZATION:

electrophysiology, farmacology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Béla Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our research group specialises is researching the electrophysiological and pharmacological properties of the heart. We mainly focus on the spontaneous activity of the heart, Ca^{2+} - homeostasis; sudden cardiac arrest related research on athletic heart syndrome models. In our laboratory we conduct research on rabbit and dog models, both on tissue samples (conventional microelectrode technique) and on individual cells (patch-clamp). My main research involves the spontaneous activity of the sinus node: Ca^{2+} - homeostasis, sodium-calcium exchanger, small-conductance calcium-activated potassium (SK) channels. SK channels have a significant role in neurons, and due to the fact that they create a direct connection between the intracellular calcium handling and the repolarisation of the cell membrane, their role in the cardiac tissue could also be important. However, there is no consensus in the literature on the extent of their contribution to cardiac repolarisation. Because both the Ca^{2+} - homeostasis and the repolarisation are related to arrhytmias, SK channels could potentially have a major role pathophysiologically and farmacologically.

AMBITIONS AND CAREER GOALS

My ambition is to become a successful doctor and to continue with research. Furthermore, my goals are to earn a PhD and other degrees. The amount of knowledge given to us by the programme, the publications and the scientific conferences all contribute to achieve these goals.

HONORS AND PRIZES

2019 - XXXIV. OTDK, Medical and Health Section, Theoretical Medicine - Electrophysiology: Special Award
2018 - SZTE ÁOK TDK: Best presentation in the secondary-school section
2017/2018 - Biology OKTV 14th place
2017 - SZTE Szent-Györgyi Competition 3rd place

PUBLICATIONS

Kohajda, Zs., Tóth, N., Szlovák, J., Loewe, A., **Bitay, G.**, Gazdag, P., Prorok, J., Jost, N., Levijoki, J., Pollesello, P., Papp, J.Gy., Varró, A., Nagy, N. (2020) Novel Na+/Ca2+ Exchanger Inhibitor ORM-10962 Supports Coupled Function of Funny-Current and Na+/Ca2+ Exchanger in Pacemaking of Rabbit Sinus Node Tissue. **Front in Pharmacol 10:** 1632.

CSENGE BOCZ

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Pharmacy, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mónika Kiricsi

JUNIOR MENTOR:

Nóra Igaz

SPECIALIZATION:

nanoparticles,
tumor stroma

SECONDARY SCHOOL:

Petőfi Sándor Secondary School, Bonyhád

NAME OF TEACHER:

Andrea Nagy, Csaba Péter

LANGUAGES:

English/advanced
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Nowadays many people are affected by some kind of cancerous disease. Tumorcells are able to change their microenviroment, thereby creating the ideal conditions to multiply, migrate and become malignant. In this process stromal cells have a major role. These are altered functioned, cancer associated fibroblasts and immune cells. Targeting these cells is a potential therapeutic method.
Nanoparticles can be used in the treatment of tumors, and they have several beneficial impacts, in contrast with the traditional cytotoxik molecules.
In our research group we examine the anti-tumor effects of metal nanoparticles on stromal cells. Our goal is to get a better understanding of the communication between the cancer cells and their microenviroment, and recon the cellular and molecular events behind this process. This could provide relevant information in the fields of cancer research, and give the opportunity to develop new diagnostic techniques and treatments.

AMBITIONS AND CAREER GOALS

During my studies I would like to acquire the skills that will be really useful in my future work. I find it important to deepen my knowledge, and get a first-hand experience about what it is like to work in a laboratory and be part of a research group. My primary goal is to become a researcher and take part in the developement of novel therapeutic strategies.

HONORS AND PRIZES

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PUBLICATIONS

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BÁLINT LÁSZLÓ CZAKÓ

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

József Kaszaki

JUNIOR MENTOR

László Juhász

SPECIALIZATION:

circulatory physiology and pathophysiology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Sepsis is a potentially life-threatening multiorgan failure, an uncontrolled, self-harming response of the body to inflammation. This disease is one of the biggest challenges in intensive clinical care, so it is extremely important to develop new organ-protective therapies. In our study, we examined the damage of vital organs, and its underlying mitochondrial function impairment in untreated and methane-inhaled rats with peritonitis induced sepsis. Methane is a biologically active, anti-inflammatory gas that, due to its apolar nature, can pass through membrane systems without hindrance, thus it can offer a promising targeted therapy in sepsis. In our sepsis model, we examine the extent of circulatory and inflammatory parameters, mitochondrial function, and organ damage, which features are expected to improve with methane treatment.

AMBITIONS AND CAREER GOALS

My ambition is to master techniques and gain knowledge while working in the laboratory and to be able to exploit those skills when becoming a doctor. The program and the organised events provide an excellent opportunity to acquire insight into the life of a researcher and to lay down the foundations for my future research career.

HONORS AND PRIZES

2019 - European Union Science Olympiad (EUSO): silver medal
2019 - International Genetically Engineered Machine (iGEM): bronze medal
2020 - Chemistry OKTV: 15th place
2020 - Biology OKTV: 6th place
2020 - International Biology Olympiad (IBO): bronze medal

PUBLICATIONS

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MÁRTON SIMON CZIKKELY

Szeged Scientists Academy, 4th year

University of Szeged,
Faculty of Medicine, 4th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Csaba Pál

SPECIALIZATION:

genetic engineering, experimental evolutionary biology, antibiotic resistance

SECONDARY SCHOOL:

Városmajori High School

NAME OF TEACHER:

Anna Jánossyné Solt

LANGUAGES:

English/advanced
Spanish/advanced
German/intermediate
Latin/intermediate
Persian/beginner

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Pathogens seem invariably to attempt to survive the immune system of the invaded host or the pressures of applied therapies. During this accommodation process, DNA-level changes and mutations occur in the cells. These invisible, but important evolutionary processes lead to one of our biggest clinical challenges: antimicrobial resistance. Thanks to scientific advances of recent decades, it has become possible to manipulate the DNA in a precise manner, which enables a rapid and targeted examination of these very mutations. This approach offers a breakthrough in the investigation of antimicrobial resistance. A technique developed in the laboratory of my mentor, Csaba Pál, makes the rapid examination and manipulation of evolution possible with unprecedented accuracy. In our current work, we use this technique also to predict the most important resistance processes against antibiotics under development.

AMBITIONS AND CAREER GOALS

My aim is to help the fight against antibiotic resistance – a major crisis in medicine – trough the examination of its evolution in clinically important pathogens.

HONORS AND PRIZES

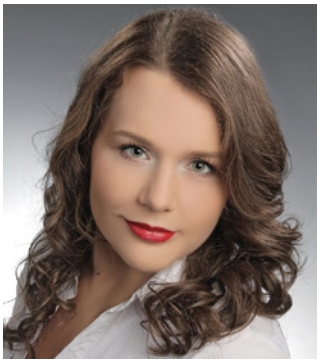
2018/19, 2019/20, 2020/21 - ÚNKP
2018/19, 2019/20, 2020/21 - Municipality of Szeged: University Scholarship
2020/21 - National Higher Educational Scholarship
2020 - University of Szeged: Scientific Students' Associations Conference (TDK)
1. prize in Cell Biology-Microbiology section
2019 - Stephen W. Kuffler Research Scholarship
2019 - University of Szeged: Scientific Students' Associations Conference (TDK)
2. prize in Biochemistry-Microbiology section
2018 - University of Szeged: Scientific Students' Associations Conference (TDK)
1. prize in Genetics and Molecular Biology Section

PUBLICATIONS

Wannier, T. M., Nyerges, A., Kuchwara, H. M., **Czikkely, M.,** Pál, C., Church G. M., et. al. (2020) Improved bacterial recombineering by parallelized protein discovery. **Proc Natl Acad Sci U S A 117:** 13689-13698.

Szili, P.§, .Draskovits§, G., Révész, T.§, **Czikkely, M.,** Pál*, Á. Nyerges, Á.,* et al. (2019) Rapid evolution of reduced susceptibility against a balanced dual-targeting antibiotic through stepping-stone mutations. **Antimicrob Agents Chemother 63:** 00207-19.

SZUZINA FAZEKAS



Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Medicine, 5th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Anikó Keller-Pintér

SPECIALIZATION:

skeletal muscle regeneration, cell migration, exosomes

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Ádám Zoltán Seres
Tamás Mező
Gábor Ábrahám
István Tigyi

LANGUAGES:

English/advanced
Spanish/intermediate
Russian/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

I have always been interested in Natural Sciences, I knew from the start that I wanted to do research later. I have always been amazed by the complexity and mystery of the human body: understanding how it works from the smallest parts to the whole is one of the most interesting questions I know.
The Szent-Györgyi Research Program gave me an opportunity to join the skeletal muscle adaptation research group of the Department of Biochemistry. The institute follows the muscle research traditions of the Szent-Györgyi school. The aim is to understand the molecular mechanisms of the skeletal muscle regeneration and adaptation, and our findings could have clinical applicability later.

AMBITIONS AND CAREER GOALS

During my medical career my primary aim is to become a good doctor and meet the highest scientific expectations. While researching, I am eager to use my obtained knowledge and also widen my scientific perspective. I believe it is desirable to begin the scientists' and doctors' lifelong learning as early as possible.

HONORS AND PRIZES

2021 - National Scientific Students' Associations Conference (OTDK), Special prize
2020 - Scientific Students' Associations Conference (TDK), Szeged, 2nd prize
2019 - National Scientific Students' Associations Conference (OTDK), Special prize
2019 - Scientific Students' Associations Conference (TDK), Szeged, 1st prize
2018 - XXV. Scientific Students' Associations Conference (TDK), Targu Mures, Special award
2018 - Korányi Frigyes Scientific Forum, 1st prize
2017 - Scientific Student Conference, Szeged, 1st prize
2016 - OKTV Biology, 37th place

PUBLICATIONS

Becsky, D., Szabo, K., **Gyulai-Nagy, S.**, Gajdos, T., Bartos, Z., Balind, A., Dux, L., Horvath, P., Erdelyi, M., Homolya, L., Keller-Pinter, A. (2020) Syndecan-4 Modulates Cell Polarity and Migration by Influencing Centrosome Positioning and Intracellular Calcium Distribution. **Front Cell Dev Biol 8:** 575227.

Becsky, D.*, **Gyulai-Nagy, S.*,** Balind, A., Horvath, P., Dux, L., Keller-Pinter, A. (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823. *társ-elsőszerzők

Keller-Pinter, A., **Gyulai-Nagy, S.**, Becsky, D., Dux , L., Rovo, L. (2021) Syndecan-4 in Tumor Cell Motility. **Cancers 13:** 3322.

ROLAND FEJES

Szeged Scientists Academy, 6th year

University of Szeged,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

József Kaszaki

JUNIOR MENTOR

Szabolcs Péter Tallósy

SPECIALIZATION:

pathophysiology of circulation, sepsis

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Béla Gál

LANGUAGES:

German/advanced
English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Sepsis is one of the biggest challenges in medicine because of its rapidly proliferating nature. On account of the complexity of its pathomechanism, sepsis is hard to diagnose, and amongst the countless therapeutic possibilities used, there is no perfect solution yet. A common feature of septic multiorgan failure (MOF) is microcirculatory dysfunction, which leads to tissue hypoperfusion, mitochondrial dysfunction and necrosis. Thus, microcirculatory-mitochondrial resuscitation seems to be a promising therapeutic target. In our previous studies we have shown that the selective modulation of the endothelin-1 (ET-1) receptors – the most potent vasoactive agent of the body – can be a therapeutic solution for sepsis on macrohemodynamics, microcirculation and mitochondrial respiration too. Nevertheless, it is unknown if the proven mechanism is a direct or indirect effect on mitochondria and if it has any advantages compared to the today used inotropic therapies.

AMBITIONS AND CAREER GOALS

In this project my first goal is to learn in vivo techniques which I can perform on rodents and minipigs. I am interested in the technique of high-resolution respirometry (Oroboros O2k), which is a useful tool to investigate mitochondrial functions. I would like to expand both my theoretical and practical knowledge, which I will be able to use either in medical research or in medical practice.

HONORS AND PRIZES

2019 - 54th Congress of European Society of Surgical Research, Geneva, Walter Brendel Award
2018/19 - Scholarship of New National Excellence Program
2018 - Student Scientific Conference, Pharmacology section, 1st prize
2017 - Student Scientific Conference, Pharmacology section, 1st prize
2017 - Student Scientific Conference, Operative Research section, 3rd prize

PUBLICATIONS

Rutai, A., **Fejes, R.**, Juhász, L., Tallósy, Sz.P., Poles, M.Z., Földesi, I., Mészáros, A.T., Szabó, A., Boros, M., Kaszaki, J. (2019) Endothelin A and B receptors: Potential pargets for microcirculatory-mitochondrial therapy in experimental sepsis. **Shock 54:** 87-95.

ANNA TÁCIA FÜLÖP

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Science and Informatics,
Molecular Bionics Engineer Program, 2nd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Csaba Pál

JUNIOR MENTOR

Máté Manczinger

SPECIALIZATION:

immunology,
bioinformatics, bionics

SECONDARY SCHOOL:

Fazekas Mihaly Primary and Secondary Grammar School, Budapest

NAME OF TEACHER:

Zsolt Erős-Honti

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

HLA molecules are essential in immune recognition, because they present short peptides to T cells. HLA-encoding genes are the most variable ones in the human genome. Using bioinformatics, we investigate the possible relationships between the peptide binding properties of different HLA variants and certain diseases (e.g. different tumours). We also aim to explain the molecular background of these associations.

AMBITIONS AND CAREER GOALS

After the current Bachelor's degree, I would like to continue my Master's degree and then to obtain a PhD degree. After graduating, I would like to join an international research team at a Hungarian university or research institute.

HONORS AND PRIZES

2019 - OKTV Biology, 1st prize
2019 - Dr. Árokszállásy Zoltán Biology Competition, 1st prize
2018 - OKTV Biology, 2nd prize
2018 - International Linguistics Olympiad, Prague, contestant

PUBLICATIONS

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TAMÁS PÉTER FÜZESI

Szeged Scientists Academy, 3rd year

University of Szeged,
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Tamás Martinek

SPECIALIZATION:

molecular biology, genetics

SECONDARY SCHOOL:

Bethlen Gábor
Református Gimnázium
és Szathmáry Kollégium,
Hódmezővásárhely

NAME OF TEACHER:

Henriett Jóriné Csölle

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

There is a pressing need for opening up ways for therapeutic macromolecules to the intracellular targets. Certain viral and bacterial proteins are readily internalized in functional form through caveolar endocytosis, but mimicking this process with protein cargos at therapeutically relevant concentrations is a great challenge. Our research group's goal is to target certain gangliosides, as key receptors triggering endocytosis in the caveolar pits, which can internalize large cargos in functional form without degradation. Previously, we identified a pentapeptide sequence that specifically captured the glycan moiety of a ganglioside. The peptide-tag facilitated caveolar endocytosis of proteins so that the cargo-loaded caveosomes did not fuse with lysosomes. An immunoglobulin G complex (580 kDa) was successfully delivered into live HeLa cells at a low nanomolar extracellular concentration, and the escape of the functional cargo protein to the cytosol was observed. Our current work focuses on the intracellular delivery of proteins with a specific function into knock-out cell lines, restoring cell phsyiology. Instead of fluorescent detection, we express the protein, decorate it with our peptide-tag, then we perform functional tests on the human cells.

AMBITIONS AND CAREER GOALS

During my work I would like to learn as many molecular biological methods as possible especially the techniques with DNA and proteins which are the keystones of molecular biological researches. Furthermore, our research group's aim is to develop a drug delivery technology which can be a milestone in the application of protein-based drugs. My personal aim in the Scientists Academy is to acquire significant theoretical and practical knowledge which can not be learnt elsewhere and become a professional who is effective in clinical work and science alike.

HONORS AND PRIZES

2021 - OTDK, participation
2020 - TDK, 1st place
2018 - OKTV Biology, 32nd place

PUBLICATIONS

–

ANNA GRASSALKOVICH

Szeged Scientists Academy, 6th year

University of Szeged,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Péter Hegyi

JUNIOR MENTOR

Emese Tóth

SPECIALIZATION:

gastroenterology

SECONDARY SCHOOL:

Berze Nagy János Secondary School, Gyöngyös

NAME OF TEACHER:

Katalin Molnárné Borbás

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Acute pancreatitis is one of the most frequent gastrointestinal diseases that calls for an acute treatment in a hospital, and its mortality rate in serious cases may reach 30-60%. Despite this, a specific treatment still has not been found, which makes the identification of new drug targets urgent. In an earlier study we showed that the damaged function of the cystic fibrosis transmembrane conductance regulator (CFTR) chloride channel decreases pancreatic ductal bicarbonate secretion. We also suggested that decreased secretion significantly increases the severity of pancreatic inflammation. In my present research my aim is to correct the function of the CFTR channel during acute pancreatitis, which might later prove to be a special treatment option in curing AP.

AMBITIONS AND CAREER GOALS

During my research carrier I would like to focus on the identification of basic mechanisms that can be used in clinical practice. With my results I would like to improve the effectiveness of clinical treatments and the life quality of patients suffering from inflammatory diseases.

HONORS AND PRIZES

2019 - University of Szeged, Faculty of Medicine TDK Conference, 2nd prize
2019 - National Scientific Students' Associations Conference, 2nd prize
2018 - University of Szeged, Faculty of Medicine TDK Conference, 2nd prize
2017 - University of Szeged, Faculty of Medicine TDK Conference, 3rd prize

PUBLICATIONS

Tóth, E., Maléth, J., Závogyán, N., Fanczal, J., **Grassalkovich, A.**, Erdős, R., Pallagi, P., Horváth, G., Tretter, L., Bálint, E., Rakonczay, Z. Jr., Venglovecz, V., Hegyi, P. (2019) Novel mitochondrial transition pore inhibitor N-methyl-4-isoleucine cyclosporin is a new therapeutic option in acute pancreatitis. **J Physiol 597:** 5879-5898.

ÁKOS HARANGOZÓ

Szeged Scientists Academy, 3rd year

University of Szeged,
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Zsolt Endre Boldogkői

JUNIOR MENTOR:

Dóra Tombácz

SPECIALIZATION:

genomics and
gene technology

SECONDARY SCHOOL:

Radnóti Miklós
Experimental Grammar
School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

With modern sequencing technologies we are able to make structural and functional examination of living organisms and viruses, thus we can understand better the role of the present genes and non-coding sequences and their effect on each other. The main focus of our research group includes the genomic analysis of various human and non-human pathogenic viruses by using state of the art genome- and transcriptome sequencing methods (long- and short-read sequencing approaches). The gained genomic data is processed with the help of bioinformatical programs. Also we generate genetically modified viruses by using the CrispR-cas9/dCas9 - which is a state of the art genome editing technology capable of making very precise changes - methods for the evaluation of the effect of the gene modification on the global transcriptome.
Our major goal is to describe the static and dynamic transcriptome profiles of these viruses, and to apply them as model organisms for the study of the Transcriptional Interference Network (TIN) hypothesis proposed by our group.

AMBITIONS AND CAREER GOALS

As a medical doctor I want perform medical practice and research side by side, for which this program gives the best bases. My goal with my research is to gain theoretical knowledge and practical experience which will help me in my career which hopefully will lead me to be able to help others. During my career besides finishing medical university, I also want to reach academic degree in which the Szent-Györgyi program provides help.

HONORS AND PRIZES

2016 - EUSO Tartu, silver medal
2017 - EUSO Copenhagen, golden medal
2017/2018 - Biology OKTV II. category, 30th place
2016/2017 - Biology OKTV II. category, 18th place

PUBLICATIONS

–

MÁRK HARANGOZÓ

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Medicine, 5th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Antal Berényi

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Anxiety and depression are responsible for one of the largest societal and individual burdens amongst neuropsychiatric disorders, and in many cases drug treatments cannot maintain an asymptomatic state. Former investigations have shown that the mechanism of the transformation of concrete fear reactions into generalized anxiety is similar to that of learning, although the exact neuronal mechanisms in the background are still unknown. Successful animal experiments and clinical investigations have proven that depression and anxiety can be made asymptomatic by means of electrical stimulation. This effect is rather diffuse, though. The aim of my work is to explore the neuronal networks and cell-type specific chokepoints which are responsible for the efficacy of electrical therapies.
In our experiments we use different transgenic animal models in which cell-type specific optoproteins are expressed, making their selective excitation or inhibition feasible. Fear reactions are evoked by using lege artis electrical footshock, and we attempt to prevent their generalization into anxiety with optical stimulation. The efficacy of the stimulation is evaluated by measuring the level of anxiety after re-exposure to a similar environment with standard psychophysiological methods (e.g. freezing). The long-term goal of my work is to develop non-pharmaceutical methods to treat drug-resistant anxiety and post-traumatic stress disorder.

AMBITIONS AND CAREER GOALS

After obtaining my medical degree, I would like to become an internationally recognized physician and researcher. Naturally, I intend to earn a PhD and a postdoctoral degree, too. In order to acquire some professional experience, I hope to be able to work abroad as a member of an international team, possibly in the US or the UK.

HONORS AND PRIZES

2015 - EUSO, silver medal (as the member of the Hungarian team)
2014 - iGEM HS division, Best Experimental Measurement (as the member of team HUNGENIOUS)

PUBLICATIONS

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BARNABÁS HEGEDŰS

Szeged Scientists Academy, 3rd year

University of Szeged,
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

1995

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Balázs Papp

JUNIOR MENTOR:

Balázs Szappanos

SPECIALIZATION:

metabolomics,
computational biology

SECONDARY SCHOOL:

Radnóti Miklós
Experimental Grammar
School, Szeged

NAME OF TEACHER:

Viktória Gál,
Sándor Bán

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Studying the human metabolome is necessary for the future of medicine. By understanding it, we can identify new biomarkers, find key molecules in the pathophysiology of diseases and even understand the healthy human body better. As the mapping of the human metabolome only started in the last couple of years we have not yet understood this system in details. We do not know what polymorphisms the healthy human metabolome shows on the population level. We do not know which metabolic alterations are eliminated by natural selection. Furthermore, we do not know the relation of these to disease conditions. In our project we compare pre-existing dataset from previous publications in order to answer the questions above and to understand the mechanisms and evolution of the human metabolome better.

AMBITIONS AND CAREER GOALS

I aim to study the fields of data science, statistics and computational biology further in order to participate in international research projects which contribute to the development of evidence based medicine.

HONORS AND PRIZES

2016 - Wellcome Trust Biomedical Vacation Scholarship
2015 - Scholarship of the Prime Minister of Hungary
2014 - 25th International Biology Olympiad, Indonesia, Bronze Medal
2014 - Hungarian Biology Olympiad: 9th place
2014 - Hungarian Chemistry Olympiad: 16th place)
2013 - Hungarian Biology Olympiad: 21st place

PUBLICATIONS

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ANNA HEGYI

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mária Deli

JUNIOR MENTOR:

Szilvia Veszelka

SPECIALIZATION:

cell biology, pharmacology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

In several diseases the targeted delivery of large protein cargo at therapeutically relevant concentrations is difficult due to their poor penetration across biological barriers. These barriers protect organisms from damaging agents and create homeostasis for physiological functions. The Biological Barriers Research group has an expertise in modelling and studying the epithelium of the intestinal or respiratory systems and the endothelium of blood vessels. The goal of our team is to investigate different peptide constructs to enhance the penetration of high molecular weight drugs across different biological barriers using co-culture models. In these experiments, we study the viability of the cells, the integrity and the barrier functions of the cell layers, the morphological changes of tight junction proteins and the penetration of fluorescently labeled peptide constructs. In our latest studies, we got promising results with a pentapeptide sequence which can deliver large proteins into different cell types via endocytosis. Our aim is to achieve specific targeting of biological barriers with a short, easily applied and nontoxic peptide tag which can not only facilitate the endocytosis of the protein cargo in a carrier/receptor triggered manner but also act as a shuttle for biopharmaceutics.

AMBITIONS AND CAREER GOALS

In my research, I would investigate methods by which I can broaden my knowledge about drug delivery trough barriers, thereby contributing to more effective treatment of various diseases. I consider it important to be able to align scientific research with clinical practice throughout my career because I believe both are essential areas for my future results.

HONORS AND PRIZES

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PUBLICATIONS

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MIKSA MÁTÉ HENKRICH

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Science and Informatics, Biology 2nd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsolt Endre Boldogkői

JUNIOR MENTOR:

Dóra Tombácz

SPECIALIZATION:

Microbiomics

SECONDARY SCHOOL:

Városmajori Grammar School, Budapest

NAME OF TEACHER:

András Vizkievicz

LANGUAGES:

English/advanced
Spanish/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Obesity and comorbidities like insulin resistance and type 2 diabetes, cardiovascular disease and depression are serious healthcare issues for first world as well as developing countries, Hungary is among the most obese OECD nations. Obesity and comorbidities are mainly lifestyle-related, triggered by an incorrect diet and sedentary lifestyle. Based on recent scientific advances we can confirm that the gut microbiome plays a key role in the onset and sustenance of health and disease states - obesity, similarly to other diseases like depression comes with an alteration of the gut flora, however, whether the microbial pattern shift is a cause or an effect of the diseased state is yet to be elucidated. Over the course of our research project we observe the effect of different diet and lifestyle programs on the composition of the microbiome, on microbial and host gene expression and on host gut epithelial methylome based on the sequencing and analysis of human fecal samples. Parallel to that we investigate the heritability and relation to diet of the canine microbiome in purebred Pumi dogs. After obtaining sufficient data we intend to research the effects of probiotic complexes and interactions of members of the microbiome within the community. Our results will mean valuable information about the effect of lifestyle on the microbiome and health state, and can be used to elaborate prevention and intervention strategies - such as probiotic therapies, fecal microbiota transplantation, precision nutrition - aiming to treat obesity and comorbidities.

AMBITIONS AND CAREER GOALS

Throughout my career I want to investigate complex systems of the human body amplifying our knowledge in the fields of microbiomics, nutromics and biological psychology. Using the knowledge obtained and a multidisciplinary approach, I want to work on the development of mainly natural prevention and disease treatment strategies that can provide an answer to the challenge of chronic civilization ailments - I am most interested in metabolic and psychiatric disorders - and can drastically reduce the costs and secondary effects of healthcare intervention. I can see myself working in public health nutrition or food production contributing to an up-to-date, that is to say healthy and sustainable public food provision.

HONORS AND PRIZES

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PUBLICATIONS

–

ZSÓFIA RITA HERNÁDI

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Pharmacy, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

István Krizbai

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Nagy Lajos Grammar School of the Cistercian Order

NAME OF TEACHER:

Zsolt Nyisztor

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

For the physiological functioning of the central nervous system it is inevitable to maintain a constant internal environment in which the so-called neurovascular unit plays a pivotal role. Damage to this defence system can lead to the development of or can aggravate various serious diseases affecting the central nervous system. Pericytes have been attributed a prominent role in the pathophysiology of age-related brain pathologies including ischemic stroke, particularly in the production of abnormal vasoconstriction, which may impede the maintenance of normal cerebral circulation.
As there is currently no clear evidence that pericytes are responsible for pathological vasoconstriction, in the research group we set out to investigate the structural changes and molecular mechanisms that may be involved in this process using in vivo two-photon microscopy imaging and ex vivo techniques. Our expected results may shed new light on the active role of blood-brain barrier elements, particularly the pericytes, in the pathomechanism of age related brain diseases, and may lead to the discovery of new therapeutic targets in the future.

AMBITIONS AND CAREER GOALS

As a Pharmacy student, I feel that the Szent-Györgyi program offers a unique opportunity to master both research and pharmacy skills. After graduating from the University, I would like to join a doctoral school and obtain a PhD while also working as a scholarship holder at famous foreign laboratories. Finally, I would like to use my experience in independent research projects as a neuroscientist.

HONORS AND PRIZES

2021- XXXV. National Scientific Student's Associations Conference (OTDK) - Physiology-Pathophysiology Section – 2nd Prize
2020 - Scientific Student's Associations Conference (TDK) Szeged – Special Prize
2019 - National Research Student Conference (TUDOK), Health Science Section, First Prize
2019 - Conference of Scientific Students' Associations (TDK) Medical School of the University of Pécs, High School Section, First Prize; Audience award
2019/2020 - New National Excellence Programme (UNKP) scholarship

PUBLICATIONS

Mészáros, Á., Molnár, K., Nógrádi, B, **Hernádi, Z.** Nyúl-Tóth, Á., Wilhelm, I., Krizbai, I. A. (2020) Neurovascular Inflammaging in Health and Disease. **Cells 9:**1614.

MÁRTON HORVÁTH

Szeged Scientists Academy, 4th year

University of Szeged,
Faculty of Science and Informatics,
Molecular Bionics Engineer, 4th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Gácser

JUNIOR MENTOR:

Renáta Tóth

SPECIALIZATION:

microbiology

SECONDARY SCHOOL:

Bilingual Secondary Grammar School of Balatonalmadi

NAME OF TEACHER:

Anna Várkuti

LANGUAGES:

English/advanced
German/intermediate
Italian/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Throughout the last few decades, invasive fungal infection has been posing a growing threat to patients with a suppressed immune status in hospital environments. Species from the genus *Candida* are frequently isolated from such infections, and among them it is *Candida* parapsilosis that threatens neonates most and is thus in the centre of our attention. In our research we aim to better understand the interaction between fungal cells and the host by investigating immune responses. We intend to examine pathogen recognition and potentially activated signal transduction pathways in a healthy mucosal environment during *C. parapsilosis* interaction by using various approaches. These include the investigation of the role of pattern recognition receptors (PRRs) in the immunological recognition of *C. parapsilosis* as well as the activated signal transduction pathways, which lead to the development of immunological tolerance. Our further ambitions include finding yet undiscovered mechanism involved in the discrimination between elimination and tolerogenic responses induced by fungal species as we hypothesize that these mechanisms might contribute to the progression of other, non-microbial diseases as well.

AMBITIONS AND CAREER GOALS

During my scientific career I aspire to acquire a deeper insight into immunology in order to fully understand the bases of fundamental immune responses, for which the understanding of host-pathogen interactions is absolutely necessary. As a member of the Candida research group, my long-term goal is to contribute to the expansion of our current knowledge on commensal and pathogen microbe-induced immune responses.

HONORS AND PRIZES

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PUBLICATIONS

–

GÁBOR JUHÁSZ

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Gábor Juhász

JUNIOR MENTOR:

Tamás Maruzs

SPECIALIZATION:

endosomal system, membrane contact sites, drosophila genetics

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Béla Gál

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The existence of membrane contact sites, i.e. permanent physical contacts between organelles of eukaryotic cells has been known for a long time, however, understanding their functions has just begun during the last decade. The most well-characterized function of these contacts is enabling lipid transport between the contacting organelles. Interestingly, recent studies shed light on the direct role of such contacts in the endosomal system as well. During our work, we aim to investigate the function of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease, a distinctive type of spinocerebellar ataxia. Our results show that the mutation of the fruit fly (Drosophila melanogaster) counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. As the exact mechanism of this phenomenon is currently not known, we aim to decipher the role of the Drosophila Snx25 protein in endosomal maturation using genetics and light-microscopy and our self-maintained fruit fly stocks' nephrocytes as an experimental model system.

AMBITIONS AND CAREER GOALS

My primary aim is to match the medical and scientific work. In my opinion through knowledge in all natural sciences, especially in regards to modern biology is essential to understand and discover the most effective therapies. In the near future I would like to work in the fields of genetics and cell biology. Later I intend to continue this work during my PhD study, and my task in inland and foreign laboratories in addition to my medical studies.

HONORS AND PRIZES

2019 - National Biology Competition: 11th place
2019 - National Chemistry Competition: 13th place
2018 - Dr. Árokszállásy Zoltán Biology Competition: 9th place
2018 - National Biology Competition: 14th place
2017 - Szent-Györgyi Albert Competition: 3rd place

PUBLICATIONS

–

FLÓRA KAPTÁS

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Péter Horváth

JUNIOR MENTOR:

-

SPECIALIZATION:

bioinformatics

SECONDARY SCHOOL:

Bányai Júlia Secondary School, Kecskemét

NAME OF TEACHER:

Zsuzsanna Korsósné Jávorka

LANGUAGES:

English/intermediate
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Thanks to the automation and acceleration of imaging, such new techniques have been created over the past decades which opened new doors in the field of biological research. This has increased the need for automated analytical methods. The aim is the extraction of biologically relevant information from pictorial data and the interpretation of them with machines. After cardiovascular diseases, the leading causes of death are the cancer diseases. Because of these, it is important to understand the cellular functioning of tumors and their effects on cell growth. Our goal is to detect cell division and its steps in tumor tissue with the help of deep learning and then to develop an effective pipeline for this task. Further on our goal is as well the extension of this to more tumor types in general.

AMBITIONS AND CAREER GOALS

During my studies and research, my primary goal is to become a good doctor and to learn more practical and theoretical knowledge which can be helpful later. I would like to take advantage of all the opportunities so that I can help many people in the future during my medical practice. This program also provides excellent opportunities for my goals.

HONORS AND PRIZES

2020 - XIII. National Dürer Competition, Category K, 3rd place
2019 - 19th National Conference of Researching Students Tender, International Finals, Category National Instruments and Informatics
2019 - Robot Race, National 2nd place
2018 - VII. Student Symposium, 1st place
2018 - Hlavay József National Environmental Science and Engineering Student Conference, 1st place
2016 - National Robot Programmer Competition, 3rd place

PUBLICATIONS

–

ENDRE KOCSIS

Szeged Scientists Academy, 3rd year

University of Szeged,
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Hunyadi

SPECIALIZATION:

pharmacognosy

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

According to WHO, one in every 6 people's death (a total of 9,6 million deaths in 2018) is due to cancer, making it the second leading cause of death globally. In most cases, the cause of faliure in pharmacotherapy is originated in the tumor's apace development of resistance against cytotoxic agents, which is also called as multidrug resistance (MDR). This issue is unsolved to the present day, which calls for an urgent need for a radically new approach in enhancing our strategies.
Ecdysteroids are analogs of ecdysone, a moulting hormone of arthropods, that are non-toxic and bioactive in mammals. Some of their less polar derivatives combined with a certain chemotherapeutic agent have a strong chemo-sensitizing effect on both drug susceptible and MDR cancer cell lines. The main goals of our research are the identification and semisynthetic chemical modification of new and promising lead molecules (e.g. production of fluorine substituated derivatives and their self-assembling nanostructures), as well as defining their pharmacological potential.

AMBITIONS AND CAREER GOALS

As a medical student I would like to represent the level of quality this profession requires both in my academic studies, and in my research. Apart from improving my cooperating and problem solving ability, research also provides me with an important support in leading me in the scientific literature, which sufficiently supplements my academic knowledge with comprehensive and up-to-date information. I also hope that our work can lead to results that can emerge as useful help in therapy.

HONORS AND PRIZES

2021 - XXXV. National Scientific Students' Associations Conference, 1st prize
2020 - Annual Scientific Students' Associations Conference, University of Szeged, Faculty of Pharmacy, 1st prize
2019 - Annual Scientific Students' Associations Conference, University of Szeged, Faculty of Pharmacy, Special Prize
2017/18 - National High-School Competition in biology, 36th place

PUBLICATIONS

–

ANNA GEORGINA KOPASZ

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Science and Informatics,
Biology MSc, 1st year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Lajos Mátés

SPECIALIZATION:

cancer biology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Nowadays cancer is the leading cause of death in economically developed countries. The contraction of cancer can be considered as an evolutionary process within our bodies. The tumor genome sequence data collected so far show that there are tens or even hundreds of thousands of mutations in each tumor sample, and the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. However, it is this very instability of their genetic material that may allow cancer cells to generate an enormous number of mutations. The long-term objective of our laboratory is to explore genetic alterations fueling malignant transformation by undermining the stability of the genome.

AMBITIONS AND CAREER GOALS

After obtaining my MSc degree, I plan to continue my studies and my research work as a PhD student. By earning my PhD degree, I would like to master a broad range of molecular biological techniques and their biological bases. As a postdoctoral researcher, I hope I will have the chance to spend some years abroad before I can establish my own research group.

HONORS AND PRIZES

2021 - Forum for Young RNA Investigators – Best Presenter Award
2021 - SZTE József Sófi Foundation scholarship, biology MSc category, 1st prize
2020 - 4th National Conference of Young Biotechnologists, Best Presenter Award of the Animal Biotechnology Section, and the Special prize of the Committee on Agricultural Biotechnology of the MTA Section of Agricultural Sciences
2020 - XXIII. Spring Wind Conference, Interdisciplinary Medical Sciences Section, 1st prize
2020 - Annual Scientific Students' Associations Conference, 1st prize
2020/21 - New National Excellence Program fellowship
2020 - SZTE START Master scholarship
2020 - SZTE Talent Scholarship, silver grade
2019 - Annual Scientific Students' Associations Conference, special prize
2019/2020 - New National Excellence Program fellowship
2016 - 16th National Research Student Conference (TUDOK), Medical Sciences Section, 1st prize

PUBLICATIONS

Kopasz, A.G. (2021) RNS interferencia alapú géncsendesítés optimalizálása egy jól kiegyensúlyozottan kétirányú promóter használatával szomatikusan transzgenikus egérmodellben, Forum for Young RNA Investigators, presentation and abstract

Kopasz, A.G. (2020) Establishement of an RNA interference based gene silencing system in a somatically transgenic mouse model, 4th National Conference of Young Biotechnologists, presentation and abstract

ÁKOS KOVÁCS

Szeged Scientists Academy, 3rd year

University of Szeged,
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Imre Miklós Boros

JUNIOR MENTOR:

Balázs Vedelek

SPECIALIZATION:

molecularbiology, genetics

SECONDARY SCHOOL:

Temesvári Pelbárt Franciscan HighSchool, Esztergom

NAME OF TEACHER:

Andrea Keppel Erdős
Katalin Szontagh

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Early recognition is one of the most important factors in successful treatment of cancer, which ideally can be achieved through non-invasive or minimally invasive way. In case of bladder cancer, tumour cells appear in the urine, from which DNA could be purified and analysed to detect mutations specific to cancer. Mutation hotspots are in oncogenes and among them in the promoter of the telomerase reverse transcriptase, which is responsible for DNA elongation at the ends of chromosomes. The telomerase is active in embryonic cells but inactive in somatic cells, therefore the telomeres of the latter are progressively shortening, with each cell division, until they are critically shortened, that results senescence. In tumours, however the telomerase is often re-activated, therefore these cells become immortalised, so they can endlessly divide. In most cases telomerase reactivation is due to mutations at hotspots in its promoter. Our aim is to study telomerase promoter mutations in order to get answers for the following questions: Under what circumstances do the mutations appear? At which stage of carcinogenesis / tumour progression do telomerase promoter mutations appear? Is there any correlation with mutation types, appearance and bladder cancer subtypes? How do the mutations affect the course of the disease? Our long-term goal is to develop a PCR-based, simple and cost-efficient rapid test to detect the presence of potentially cancerous cells from urine targeting telomerase promoter mutation and other tumour markers.

AMBITIONS AND CAREER GOALS

I would like to improve my knowledge continously in order to become as good researcher and physician as I can. With my work I hope to contribute to the advance of society that I consider the most important goal one can aim at.

HONORS AND PRIZES

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PUBLICATIONS

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DORINA KOVÁCS

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Dentistry, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Bálint Kintses

SPECIALIZATION:

antibiotic resistance

SECONDARY SCHOOL:

Grammar School Senta

NAME OF TEACHER:

Mónika Rózsa Sípos

LANGUAGES:

German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Testing resistance evolution with predictive screens is an imperative step of antibiotic development. These screens help to choose the lead molecules for further drug development which are less prone to resistance evolution, and thus may remain effective for years. In the laboratory of my mentor, Bálint Kintses, I'm able to join the development of a platform that accurately predicts which resistance genes will be acquired by disease-causing bacteria via horizontal gene transfer to eradicate the efficacy of a future antibiotic. We would achieve this strategic aim by testing resistance evolution in an experimental system resembling the real-life clinical environment, unlike the current technologies that use oversimplified experimental conditions. The goal is to provide a unique toolset that supports the development of promising antibiotic candidates which may remain effective for years once on the market.

AMBITIONS AND CAREER GOALS

I want to develop my theoretical and practical knowledge by taking advantage of the opportunities offered by the Szent-Györgyi program, and by learning the most possible from my Mentor. My goal is to arrange this acquired competence in the scientific research, thereby being able to cooperate in solving major scientific questions.

HONORS AND PRIZES

2020 - Student of the generation, Grammar School Senta

PUBLICATIONS

–

MÁRTON ATTILA KOVÁCS

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsigmond Tamás Kincses

SPECIALIZATION:

diagnostic imaging, functional MRI

SECONDARY SCHOOL:

Andrássy Gyula Grammar School, Békéscsaba

NAME OF TEACHER:

Klára Stefanik

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

I have been interested in medicine since high school, and have always been keen on the workings of the human body, especially the human brain. Parallel with my university studies, the Szent-Györgyi Program provided an opportunity to participate in research on this topic. By joining the interdisciplinary work of the Neuroimaging Research Group, I have the opportunity to learn about the use of imaging methods in various neurological conditions. The main profile of the lab is using magnetic resonance imaging (MRI) as a biomarker to track the course of disease and to identify underlying pathological processes, employing modern image analysis and statistical methodology. In our current project, we use functional magnetic resonance imaging (fMRI) to characterize hemispheric lateralization via network-based analysis techniques.

AMBITIONS AND CAREER GOALS

During my university studies, I would like to acquire as wide a range of medicine and multidisciplinary knowledge as possible by engaging in as many international scientific projects as possible, where I can acquire practical skills. After finishing my studies, I would like to apply my knowledge both in research and clinical work.

HONORS AND PRIZES

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PUBLICATIONS

-

CSABA KOZMA

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Science and Informatics, Biology, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

József Mihály

JUNIOR MENTOR:

Szilárd Szikora

SPECIALIZATION:

molecular cell biology

SECONDARY SCHOOL:

Petőfi Sándor Secondary School, Bonyhád

NAME OF TEACHER:

Csaba Péter

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Sarcomeres are the basic contractile units of muscles. They are composed of three major filament systems: the filamentous actin based thin filament array, the myosin based thick filaments and the titin based elastic filament system. The structure of sarcomeres has been well characterized, leading to quasi-atomic models of thin and thick filaments. However, the exact spatial arrangement of many of the major muscle proteins remained unknown. In addition, several key aspects of microfilament array formation and dynamics are not yet clarified. Our research group used a Single Molecular Localization Microscopy system to collect imagines of Drosophila melanogaster flight muscle sarcomeres, which are highly similar to the striated muscles of vertebrates. Our group also created a nanoscopic protein localization atlas, which includes 22 muscle proteins. Our studies were so far focused on the muscles of 1 day old adult specimens, however, to obtain developmental insights, it is necessary to examine both earlier and later developmental time points, in order to map the distribution of proteins during the actively elongating phases of sarcomere development, as well as in mature or ageing muscles. Our aim is to better understand how sarcomeres are organized and get assembled during sarcomerogenesis; to determine the position of novel muscle proteins; to test the predictions of our new I-band and H-zone model and to probe the evolutionary conservation of the fruity fly protein distribution data in mouse myofibrils. These pieces of information are indispensable in order to understand the details of sarcomere assembly and function in healthy and in disease conditions.

AMBITIONS AND CAREER GOALS

During my research, I would like to acquire as much methodological and theoretical knowledge as possible, which can be helpful in my further work. I find it important to have a greater insight into the research work during my university years, which will help me make decisions about my long-term plans. After graduating with my MSc degree, I would like to get a PhD degree and then work as a researcher.

HONORS AND PRIZES

2019 - 30th International Biology Olympiad, Hungary, Gold Medal
2019 - Biology OKTV category II, 2nd place
2018 - Biology OKTV category I, 1st place
2018 - SZTE Szent-Györgyi Competition, 1st place
2018 - Richter Gedeon Talent Scholarship
2017 - 15th European Union Science Olympiad, Denmark, Silver Medal
2016 - 13th International Junior Science Olympiad, Indonesia, Silver Medal
2016; 2017; 2018; 2019 - Dr. Árokszállásy Zoltán Biology Competition, 1st place, 2nd place, 1st place, 2nd place

PUBLICATIONS

–

BARNABÁS ÁKOS LAKOS

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Antal Berenyi

SPECIALIZATION:

Neuroscience

SECONDARY SCHOOL:

SZTE Gyakorló Gimnázium és Általános Iskola

NAME OF TEACHER:

István Csigér

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The sharp wave ripple (SWR) oscillations of the hippocampus play a crucial role in the synchronization of healthy brain activities, and in the development of pathological activities. Stimulus tied to the SWRs is shown to influence the development of certain brain disorders (e.g., various forms of anxiety), and may play a role in the treatment of epileptic seizures. Existing studies detected SWRs and delivered stimuli to deep brain areas through penetrating electrodes, limiting human therapeutic applicability.
The aim of our work is to find cortical activity patterns detectable by non-invasive EEG scalp electrodes, which can effectively substitute the hippocampal SWRs in stimulus timing. To achieve this goal, besides of analyzing the signals of specific electrodes (e.g., sleep-spindles, or slow waves) we will also search for distributive patterns in the high-resolution space time representation of the signals of multiple electrodes using the methods of modern data-science and 'big-data' analysis.
We will also explore if the novel transcranial electrical stimulation method (ISP - intersectional short pulse stimulation) developed and patented by our research group can target the desired deep brain target areas and become an alternative to invasive deep brain stimulation electrodes.
We will also search for cortical targets as alternatives to the already identified deep brain targets, making stimulation easier. A possible candidate is the stimulation of the ventromedial prefrontal cortex (or the infralimbic cortex in rodents) instead of the deep brain reward systems (e.g., ventral tegmental area), which can be an important clinical target in the treatment of anxiety-based disorders and posttraumatic stress disorder (PTSD).

AMBITIONS AND CAREER GOALS

During my university years I want to be a useful member of my research group. In two years, I will be responsible for a subtask of the project including the animal experimentation and analysis. After receiving my degree, I want to continue my education in a PhD program. My long-term goal is to become an internationally respected member of the scientific community.

HONORS AND PRIZES

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PUBLICATIONS

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VALÉRIA ÉVA MESZLÉNYI

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1996

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

László Siklós

JUNIOR MENTOR:

Roland Patai

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Petőfi Sándor Secondary School, Bonyhád

NAME OF TEACHER:

Andrea Nagy

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our research group is mainly interested in acute and chronic neurodegeneration. In our current experiments, we have been investigating motor neurons and their neighboring non-neuronal cells, such as Schwann-cells during acute neurodegeneration. In the field of chronic neurodegeneration, we focus on amyotrophic lateral sclerosis and its pathobiology and our main goal is to find possible therapeutic approaches.

AMBITIONS AND CAREER GOALS

In the course of my scientific career I would like to investigate the complex interactions of different factors leading to motor neuronal degeneration. My aim is to gain proper knowledge that can serve the human society and medical science. I hope it will give me a possibility to contribute to the development of novel therapeutic strategies.

HONORS AND PRIZES

2021 - XXXV. National Conference of Scientific Students' Associations, 1st Prize
2020 - Local Conference of Scientific Students' Associations, 1st Prize
2021 - University of Szeged, Sófi József Foundation, Diamond Prize
2020 - Szeged Scientists Academy, Outstanding Student Prize
2020 - Scholarship for Educational Achievements from the City Council of Szeged
2020/21 - New National Excellence Program Scholarship
2020/21 - National Higher Education Scholarship
2020 - University of Szeged, Talent of the Year Scholarship
2020 - University of Szeged, Sófi József Foundation, Gold Prize
2019 - Apáthy István Memorial Prize

PUBLICATIONS

Meszlényi, V., Patai, R., Polgár, T.F., Nógrádi, B., Körmöczy, L., Kristóf, R., Spisák, K., Tripolszki, K., Széll, M., Obál, I., Engelhardt, J.I., Siklós, L. (2020) Passive Transfer of Sera from ALS Patients with Identified Mutations Evokes an Increased Synaptic Vesicle Number and Elevation of Calcium Levels in Motor Axon Terminals, Similar to Sera from Sporadic Patients. **Int J Mol Sci 21:** 5566.

Nógrádi, B., **Meszlényi, V.**, Patai, R., Polgár, T.F., Siklós, L. (2020) Diazoxide blocks or reduces microgliosis when applied prior or subsequent to motor neuron injury in mice. **Brain Res 1741:** 145891.

Obál, I., Nógrádi, B., **Meszlényi, V.**, Patai, R., Ricken, G., Kovacs, G.G., Tripolszki, K., Széll, M., Siklós, L., Engelhardt, J.I. (2019) Experimental Motor Neuron Disease Induced in Mice with Long-Term Repeated Intraperitoneal Injections of Serum from ALS Patients. **Int J Mol Sci 20:** 2573.

GÁBOR MOHÁCSI

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Science and Informatics, Biology, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

András Varró

SPECIALIZATION:

neurophysiology

SECONDARY SCHOOL:

Lutheran Grammar School
Aszód

NAME OF TEACHER:

Bernadett Könczöl
Rita Csörgei

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our aim is to understand of the mechanisms underlying cortical information processing. The two distinct type of processes are excitation and inhibition. The efferent and afferent connections of inhibitory neurons are precise and diverse. We conduct experiments in order to determine the physiologycal significance of the distinct cells. We are recording from identified interneurons in completely unaesthetized freely behaving rodents.The neurogliaform cells play an important role in neuronal inhibiton.

AMBITIONS AND CAREER GOALS

After obtaining my degree I would like to earn a PhD, as well. As a researcher I hope that I can find answers to some important questions. My dream is to develop new methods, which can be applied in clinical environments.

HONORS AND PRIZES

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PUBLICATIONS

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ZSÓFIA FLÓRA NAGY

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Medicine, 5th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Márta Széll

JUNIOR MENTOR:

Margit Pál

SPECIALIZATION:

genetics

SECONDARY SCHOOL:

Városmajori Secondary School, Budapest

NAME OF TEACHER:

Anna Solt Jánossyné

LANGUAGES:

English/advanced
German/advanced
Latin/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Amiotrophic lateral sclerosis (ALS) is a neurodegenerative disorder which cannot be cured efficiently up to this day. ALS significantly decreases the quality of life of the patient and leads to death 3-5 years after the diagnosis. There are two forms of this disorder: familial and sporadic. Through sequencing the genome of patients scientists have been able to detect genetic variants that might be responsible for the development of ALS. The aim of our research is to further investigate the genetic background of amyotrophic lateral sclerosis through the genetic analysis of Hungarian patients affected by ALS. The knowledge of the genetic background of ALS could provide an opportunity to develop efficient diagnostic techniques and personalized therapy.

AMBITIONS AND CAREER GOALS

After finishing medical school, I would like to get my PhD degree. I intend to work overseas or somewhere in Europe, and I wish to pursue a carrier in research as a full-time scientist.

HONORS AND PRIZES

2021 - XXXV. National Student Research Conference (NSRC), Genetics, Genomics section: 2nd prize
2020/21 - National Higher Education Scholarship
2020 - Annual Student Research Conference (ASRC), Genetics Molecular Biology section, 2nd prize
2020 - 27th Student Research Conference in Targu Mures: special prize
2020 - 7th Lublin International Medical Congress, Neurology and Neurosurgery session: II. prize
2019/20 - Municipality of Szeged Scholarship
2019/20 - National Higher Education Scholarship
2019 - XXXIV. NSRC, Genetics, Genomics section, special prize
2019 - ASRC, Genetics Molecular Biology and Bioinformatics section, 1st prize
2018 - ASRC, Genetics and Molecular Biology section, 2nd prize
2018 - 25. International Student Congress of (bio)Medical Sciences (Groningen, Hollandia) Genetics section winner

PUBLICATIONS

Tripolszki, K., Danis, J., Padhi, A.K., Gomes, J., Bozó, R., **Nagy, Z.F.**, Nagy, D., Klivényi, P., Engelhardt, J.I., Széll, M. (2019) Angiogenin mutations in Hungarian patients with amyotrophic lateral sclerosis: Clinical, genetic, computational, and functional analyses. **Brain Behav 9:** 01293.

Tripolszki, K., Gampawar, P., Schmidt, H., **Nagy, Z.F.**, Nagy, D., Klivényi, P., Engelhardt, J.I., Széll, M. (2019) Comprehensive Genetic Analysis of a Hungarian Amyotrophic Lateral Sclerosis Cohort. **Front Genet 10:** 732.

BENCE NAGYMIHÁLY

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Tamás Martinek

JUNIOR MENTOR:

Edit Wéber

SPECIALIZATION:

Molecular biology, protein analysis techniques

SECONDARY SCHOOL:

Szegedi Miklós Radnóti Experimental School

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Protein-protein interactions play a role in a number of pathophysiological processes, the manipulation of which can be therapeutically beneficial. Targeting extensive protein surfaces, however, is difficult with small molecules. For this purpose, artificial agents with higher interaction surface area, e.g. protein mimetics are required. Artificial self-assembling polymers (foldamers) can inhibit protein-protein interactions. The advantages of foldamers are that they have a designable and stable secondary structure, have a larger surface area than small molecule drugs, are resistant to proteases and are less immunogenic than antibodies. We are focusing on PCNA and on Rad6 proteins. PCNA is essential for DNA replication, however, its ubiquitination promotes error-prone DNA replication and allows cancer cells to survive. Rad6 plays a role in the ubiquitination of PCNA. Our goal is to inhibit PCNA ubiquitination with foldamers by blocking the key protein-protein interactions of PCNA and Rad6. We construct the foldamers by linking small-sized, protein surface mimetic building blocks, and innovative optimisation methods, such us dissipative systems are applied. Our compounds could serve as novel anti-tumour agents.

AMBITIONS AND CAREER GOALS

During my work and studies, my aim is to acquire as much theoretical and practical knowledge as possible, so that I can later become an active participant not only in the clinical field, but also in the scientific field. The opportunities provided by the Szeged Scientists Academy will enable me to acquire scientific knowledge on which I can build and guarantee my development in the future. I would like to adopt the concepts and perspectives I have learned here, so that I can later, in my individual work, come up with my own unique ideas to influence the development of the field and use my knowledge to help people beyond the sickbed.

HONORS AND PRIZES

2017 - EUSO: silver medal
2019 - iGEM HS division: bronze medal
2020; 2019; 2018 - Dr. Árokszállásy Zoltán Biology Competition 2nd; 5th; 7th place
2020 - IBO qualifying competition: 5th place
2020 - Bánkúti-prize
2020 - Biology OKTV II. category: 37th place

PUBLICATIONS

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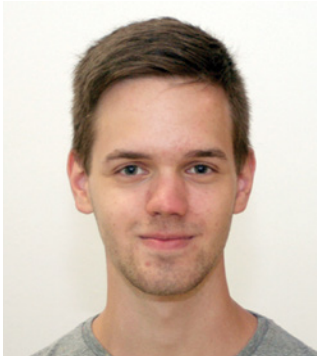
BERNÁT NÓGRÁDI



Szeged Scientists Academy, 6th year

University of Szeged,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

László Siklós

JUNIOR MENTOR:

Roland Patai

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Deák Ferenc Secondary School, Szeged

NAME OF TEACHER:

Jennifer Tusz

LANGUAGES:

German/intermediate
English/advanced
Chinese/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our research group studies the etiology and the complex pathomechanisms of neuronal degeneration and other malicious events which can lead to neuronal death. Amongst degenerative diseases that take place in the central nervous system we focus on amyotrophic lateral sclerosis, one of the most common pathological conditions that can be characterized by the progressive loss of motor neurons. Our aim is to reveal and understand the complex pathological mechanisms from the level of the nervous circuits to the level of a single motor neuron as well as to find possible therapeutic approaches.

AMBITIONS AND CAREER GOALS

As for my scientific approach, I share my mentors' point of view that a scientist must sit down to a microscope and stand next to a patient with the same determination and enthusiasm, because in both cases the most important is to give hope to the people who suffer from the disease.

HONORS AND PRIZES

2020 - University of Szeged Sófi Foundation, Diamond Prize
2019 - University of Szeged Sófi Foundation, Gold Prize
2018-2021 - New National Excellence Program
2018-21 - National Higher Educational Award

PUBLICATIONS

Nógrádi, B.*, Nyúl-Tóth, Á.*, Kozma, M., Molnár, K., Patai, R., Siklós, L., Wilhelm, I., Krizbai, A.I. (2020) Upregulation of nucleotide-binding oligomerization domain-, LRR- and pyrin domain-containing protein 3 in motoneurons following peripheral nerve injury in mice. **Front Pharm 11:** 584184.

Nógrádi, B., Meszlényi, V., Patai, R., Polgár, T.F., Spisák, K., Kristóf, R., Siklós, L. (2020) Diazoxide blocks or reduces microgliosis when applied prior or subsequent to motor neuron injury in mice. **Brain Res 1741:** 146875.

Mészáros, Á., Molnár, K., **Nógrádi, B.**, Hernádi, Zs., Nyúl-Tóth, Á., Wilhelm, I., Krizbai, A.I. (2020) Neurovascular inflammaging in health and disease. **Cells 9:** 1614.

Meszlényi, V., Patai, R., Polgár, T.F., **Nógrádi, B.**, Körmöczy, L., Kristóf, R., Spisák, K., Tripolszki, K., Széll, M., Obál, I., Engelhardt, J.I., Siklós, L. (2020) Passive transfer of sera from ALS patients with identified mutations evokes an increased synaptic vesicle number and elevation of calcium levels in motor axon terminals, similar to sera from sporadic patients. **Int J Mol Sci 21:** 5566.

Obál, I., **Nógrádi, B.**, Meszlényi, V., Patai, R., Ricken, G., Kovács, G.G., Tripolszki, K., Széll, M., Siklós, L., Engelhardt, J.I. (2019) Experimental motor neuron disease induced in mice with long-term repeated intraperitoneal injections of serum from ALS patients. **Int J Mol Sci 20:** 2573.

EMESE KINCSŐ PÁLI

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mária Deli

JUNIOR MENTOR:

Szilvia Veszelka

SPECIALIZATION:

cell biology, pharmacology

SECONDARY SCHOOL:

Újpesti Könyves Kálmán Grammar School

NAME OF TEACHER:

Szulágyiné dr. Segesdi Katalin

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cyclodextrins are versatile sugar molecules that can act both as medicines and as nanocarriers of other active ingredients. Cyclodextrins interact with lipid membranes and can selectively remove lipids from cell membranes. Some cyclodextrins are used as therapeutic drugs, while others are currently tested in clinical studies to treat human neurological diseases, including Alzheimer's disease. It is still a question whether cyclodextrins are able to cross the blood-brain barrier, the gatekeeper and protector of the central nervous system, which blocks the entry of the majority of drug molecules. The Biological Barriers Research group has an expertise in modelling and studying the blood-brain barrier. Our goal is to test different unmodified and modified cyclodextrin molecules on human cell based models of blood-brain barrier. With the help of fluorescent tags we will measure the interaction of cyclodextrins with the cells of the blood-brain barrier, namely, brain endothelial cells, pericytes and astrocytes. We will determine cellular toxicity, the entry of the cyclodextrines to the cells and using a complex model with three cell types the crossing of cyclodextrin across the barrier. These studies will help to determine if cyclodextrins need to cross the blood-brain barrier to act directly on the neuronal cells, or they can exert therapeutic effects without entering the central nervous system. Our results will help in the future therapeutic application of modified cyclodextrins in diseases.

AMBITIONS AND CAREER GOALS

In the course of my work, it is especially essential for me to accomplish activities that are useful and beneficial for society, and I have the opportunity to do so in the Biological Barriers Research Group. Drug delivery research not only has a great future ahead, but its success also promises to make human lives easier. My personal intentions include actively participating in Hungarian scientific life both as a doctor and a researcher. The possibilities provided by the Szeged Scientist Academy open unique gates to reach my goals.

HONORS AND PRIZES

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PUBLICATIONS

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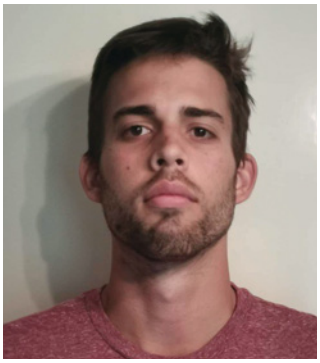
DOMONKOS JÁNOS PERÉNYI



Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Petra Hartmann

JUNIOR MENTOR:

Tamara Illésné Horváth

SPECIALIZATION:

mitochondrial respirational activity

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

German/intermediate
English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The main goal of the usage of profilactic antibiotics is to prevent infections that could occur in connection with surgical interventions. Several studies have proved, that properly applied antibiotical profilaxis plays an important role in the prevention of wound-infections. However, the effect of antibiotics is not confined only to the bacterias. Depending on the concentration of the agent and the duration of the treatment, it can cause different deformities in the tissues and cells, leading to various side-effects. Effects causing mitochondrial disfunction have been proved in cases of several antibiotics, that were followed with increased reactive oxigen species (ROS) production, after which tissue-damage can emerge. To find a proper solution for these problems, we started to experience with some antibiotics that not have been used before. During our research we use the third generational ceftriaxone and the poorly absorbed rifaximine. The goal of our research is to examine the effects of these antibiotics on the mitochondrial respirational activity, and on the coupling of electron transport chain.

AMBITIONS AND CAREER GOALS

Practicing medicine always walked hand in hand with research. That is why I think it is utterly important, to take part in it during my years at the university, and get a broader perspective in disciplines. I see the scholarship of SZTA a one of a kind opportunity to develop myself, from which I hope I can make the most out of.

HONORS AND PRIZES

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PUBLICATIONS

–

BENCE PÓSA

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Zsigmond Tamás Kincses

SPECIALIZATION:

neurology,
migraine

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Magnetic Resonance Imaging (MRI) is a diagnostic tool, which is useful in fundamental research as well. Because it is a non-invasive procedure, it can be used in wide range of cases with only a few exceptions. Beyond the structure of the brain, functional networks could be investigated with MRI. This widely used tool in clinical neuroscience is applied in various diseases such as multiple sclerosis and migraine. Migraine is the most frequent neurological disorder in adults, affecting up to 12% of the general population, primarily women. Its origin and pathomechanism are unknown, but functional and structural differences in migraine patients' brain are detected. This knowledge can be helpful to develop more efficient therapies. Moreover, through understanding of the background of the disease we can get closer to the understanding of the human body's pain processing. The focus of my research project is the alteration of functional networks and their association with clinical data in migraine. This can lead us closer to the understanding of this disease.

AMBITIONS AND CAREER GOALS

During my studies I would like to get to know most fields of medical science and to been able to acquire knowledge which is essential to be a good physician. I would like to gain experience in Hungary as well as abroad to become more effective in my profession. I think it is important not only to care about the present status of medical science but also to build its future as a researcher. For a doctor life-long learning is a really important task, but not only from the books also from the nature.

HONORS AND PRIZES

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PUBLICATIONS

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JOANNA GRACE SANDLE

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Science and Informatics, Biology, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Tamás Gábor

JUNIOR MENTOR:

Molnár Gábor

SPECIALIZATION:

neurobiology,
electrophysiology

SECONDARY SCHOOL:

ELTE Bolyai János Primary and Secondary Grammar School

NAME OF TEACHER:

Katalin Horváth
József Baranyai

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The way we percieve and process information and inputs from our environment is unique to us, humans and still most of the mechanisms which enable us to perform complex and abstract thinking are yet to be discovered. In Tamás Gábor's Research Group for Cortical Microcircuits we seek to unveil the underlying elementary mechanisms of this process on the level of synapses and neural microcircuits and the functions of different cell types in rodent and human cortical cortex. We have the excellent opportunity to compare the functions of the commonly used model animals' brain with ours by performing in vitro patch clamp in non-pathological human brain slices among other electrophysiological techniques. Our primary focus is on the role of inhibitory interneurons in such networks.

AMBITIONS AND CAREER GOALS

I endeavour to exploit the opportunities offered by Szent-Györgyi programme, broaden my understanding and learn new methods. It is of great importance to me to keep up with the developments and findings of neuroscience, and to acquire up-to-date, applicable knowledge not only in the fields of neurobiology and electrophysiology but also in borderline sciences. I want to become a useful member of a research group and be able to contribute to the development of my field of expertise.

HONORS AND PRIZES

OKTV, biology 29th place
OKTV, biology 26th place

PUBLICATIONS

–

BENEDEK SZATHMÁRI

Szeged Scientists Academy, 1st year

University of Szeged,
Faculty of Science and Informatics, Biology, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

László Nagy

JUNIOR MENTOR:

Árpád Csernetics

SPECIALIZATION:

fungal genomics

SECONDARY SCHOOL:

Tóth Árpád Secondary Grammar School, Debrecen

NAME OF TEACHER:

József Gőz

LANGUAGES:

English, written/advanced
English, oral/intermediate
Latin/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

I have been interested in genetics and evolutionary biology since my secondary school studies, and as a member of Fungal Genomics and Evolution Research Group I have the opportunity to get an inside view of these fields through a very interesting taxon, fungi. Our research group investigates the evolutionary biology and developmental genetics of fungi, focusing on the origin of complex multicellularity and lignocellulose degradation. During the work I can learn practical laboratory skills, as well as bioinformatic methods. At present I am working on two projects, one of which is about the density-dependent behaviour of a mould species' conidia, which topic is a part of a larger project in connection with the evolution of yeasts; and I also started to investigate the genetic regulation of fruiting body and basidium formation. Furthermore, I am also interested in Mobilomics and Epigenetics, which fields are also full of interesting questions regarding fungi yet to be explored.

AMBITIONS AND CAREER GOALS

After graduating I intend to take part in PhD and then postdoctoral education. In the long run my aims are to stand my ground in the scientific community, and to become a broad-minded and successful researcher with creative thoughts. Creating a complex scientific world-view built upon scepticism is crucial for me.

HONORS AND PRIZES

2020/21; 2019/20 - Richter Gedeon Talentum Scholarship
2020; 2019; 2018 - Árokszállásy Zoltán Biology Competition 5th; 7th; 4th
2020 - Biology OKTV 37th
2020 - Chemistry OKTV 17th
2020; 2019 - Latin OKTV 9th; 2nd
2020; 2019 - 'Eminence of Debrecen' Award
2020 - Most Successful Student of Tóth Árpád Secondary Grammar School
2019 - Albert Szent-Györgyi Competition 1st
2019; 2017 - Horváth István Károly Latin Competition 3rd; 1st
2019 - International Cicero Competition – participation
2018 - Curie Chemistry Competition 9th

PUBLICATIONS

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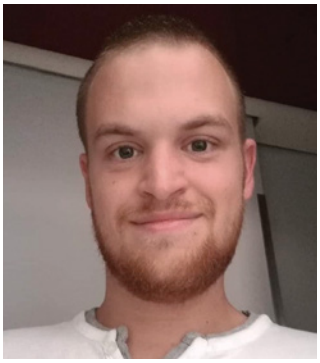
DÁVID TÓTH



Szeged Scientists Academy, 6th year

University of Szeged,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1996

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Gábor Juhász

JUNIOR MENTOR:

Gábor Horváth

SPECIALIZATION:

Atg8 and pathogen proteins, autophagy regulation

SECONDARY SCHOOL:

Táncsics Mihály Secondary School, Orosháza

NAME OF TEACHER:

László Franciszti
László Kiss

LANGUAGES:

English/intermediate
German/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The members of Nidovirales order (MHV, SARS and MERS) form double-membrane vesicles (DMVs) in infected cells and isolate replication-transcription complexes, thus using host cell membranes for their own replication. The mAtg8 is a key protein of DMVs formation. The mAtg8 interactor proteins connect to mAtg8 through LIR motif. Our overarching aim was to identify novel host factors that may interact with SARS-CoV-2 proteins and to understand the biological importance of LIR motifs on SARS-CoV-2 proteins. 10 LIR motif containing SARS-CoV-2 proteins were predicted with databases and software. The predicted proteins were expressed with marked mAtg8 proteins and endogenous mAtg8. Most of the predicted interactions via bioinformatics approaches were experimentally testified with microscopy. One of the coronavirus proteins formed membrane rearrangements (so-called edemosomes). Our analysis characterized the mechanism and regulators of this phenomenon.

AMBITIONS AND CAREER GOALS

My principal goal is to master genetics at the highest level possible and to impart my knowledge to others. I also intend to expand my expertise by working in leading research labs abroad. Also I would like to use my genetics knowledge in the medical oncology field.

HONORS AND PRIZES

2021 - SZTE Talent - silver level
2021 - XXXV. National Scientific Student Conference – Molecular biology - 1st prize
2021 - New National Excellence Program (5 months)
2020 - University of Szeged Faculty of Medicine, Scientific Student Conference, Genetics, molecular biology section - 1st prize
2020 - SZTE Talent – bronze level
2019 - New National Excellence Program (5 months)
2017 - XXXIII. National Scientific Student Conference – 2nd prize
2016 - University of Szeged Faculty of Medicine, Scientific Student Conference, Genetics 1st prize

PUBLICATIONS

Kiss, V., Jipa, A., Varga, K. Takáts, Sz., Lőrincz, P., Simon-Vecsei, Zs., Szikora, Sz., Földi, I., Bajusz, Cs., **Tóth, D.**, Vilmos, P., Gáspár, I., Ronchi, P., Mihály, J., Juhász, G. (2020) Drosophila Atg9 regulates the actin cytoskeleton via interactions with profilin and Ena. **Cell Death Differ 27:** 1677–1692.

Tóth, D., Horváth, G. V., Juhász, G. (2021) The interplay between pathogens and Atg8 family proteins: thousand-faced interactions. **FEBS Open Bio** (under review)

ZSÓFIA EDIT TÓTH

Szeged Scientists Academy, 5th year

University of Szeged,
Faculty of Science and Informatics, Biology MSc, 2nd year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Attila Gácser

JUNIOR MENTOR:

Renáta Tóth

SPECIALIZATION:

immunology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced
Spanish/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Members of the genus *Candida* are the most common opportunistic human pathogenic fungal species that cause nosocomial infections. Although *C. albicans* is the most common cause of candidiasis and thus, the most investigated, the number of infections caused by other *Candida* species is also rising since the last decade. Host responses, enabling an effective clearance of these fungi, originate from the combination of innate and adaptive immune responses. Nowadays, we have a wide range of information about the innate immune system's responses to the presence of *C. albicans* and *C. parapsilosis*. Based on these, the fundamental difference between these two species is that unlike *C. albicans, C. parapsilosis* does not induce strong inflammatory responses. Our laboratory's previous results suggest that *C. parapsilosis*, instead of inducing an inflammatory response, may trigger some kind of tolerogenic reaction. This conclusion was drawn from the fact, that this species' interaction with human mononuclear cells from peripheral blood (PBMCs) resulted in a cytokine response indicating Th2 polarization, instead of Th1 and Th17 differentiation, a response characteristics of fungal infections (especially those caused by *C. albicans*). In our present work, we aim to examine how *C. parapsilosis* influences the adaptive immune response of the host, compared to *C. albicans*. During this process, purified epitopes specific for these species are used to investigate Th1, Th17, Th2 and T-reg polarization of T-cell populations, the induced humoral immune responses and transcriptomic changes in host cells.

AMBITIONS AND CAREER GOALS

After finishing the BsC and Msc programme I would like to get my PhD degree. As a researcher I would like to contribute to the development of medicalbiology and immunology.

HONORS AND PRIZES

2021 - SZTE József Sófi Foundation, prize of Board of Trustees
2020 - New National Excellence Program fellowship
2020 - SZTE József Sófi Foundation, prize of Board of Trustees
2020 - National Higher Educational Scholarship
2019 - XXXIV. National Scientific Students' Associations Conference, 2nd prize
2018 - Talent of Sándorfalva Award
2016 - National Student Competition Assays, 33rd place

PUBLICATIONS

Chakraborty, T., **Tóth, Z.,** Tóth, R., Vágvölgyi, C., Gácser, A. (2020) Iron Metabolism, Pseudohypha Production, and Biofilm Formation through a Multicopper Oxidase in the Human-Pathogenic Fungus Candida parapsilosis. **mSphere 5:** 00227-20.

ZSOMBOR VESZPRÉMI

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Hunyadi

JUNIOR MENTOR:

Kornél Szőri

SPECIALIZATION:

pharmacognosy

SECONDARY SCHOOL:

Radnóti Miklós
Experimental Grammar
School, Szeged

NAME OF TEACHER:

Károly Hancsák
Sándor Bán
Ádám Zoltán Seres

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

In today's developed world there are few diseases for which there is no effective cure. The gravity of tumour related diseases could be characterised by the fact that it is the second leading cause of death globally: approximately every sixth person dies due to cancer. The current treatments damage healthy cells as well in most cases, in contrast, they are usually not efficient enough against tumour cells.
ATR inhibitors may provide a solution to this: recent research has shown that tumour cells exposed to increased replication stress (RS) are very vulnerable to a decrease in ATR protein levels. ATR is one of the key proteins of the DNA damage response (DDR); and it's role is to stabilize the stalled replication fork. In addition to increasing replication stress, ATR inhibitors indirectly force the cell into a premature mitosis that leads to its death.
The aim of my research is the synthesis and examination of previously unknown, expectedly ATR inhibitor antitumor agents. The chemical structure of protoflavones provided the central idea of our work: protoflavones are a rare and special group of natural flavonoids, among which several ATR inhibitors (e.g. protoapigenone) have been found. The impact assesments are not only carried out by the collaborating research groups for ATR inhibition, but for many other impacts. This way we can find other compounds that can be used in several different fields of medicine.
We hope to create a new family of compounds whose most potent members may be well suited for clinical development for tumour therapy and which, in the long term, may lead to the discovery of a first-in-class, effective and safe ATR inhibitor drug.

AMBITIONS AND CAREER GOALS

My goal is to gain as much expertise as possible during my university years and beyond; to help as many people as possible with my research and clinical work. I will strive to improve medicine by developing useful new methods and therapies. Later on, I would love to spend some years abroad to improve my knowledge and gain experience. Besides these, I would like to stay open-minded towards other fields, partially with the help of this programme which offers us first-rate opportunities.

HONORS AND PRIZES

2020 - MOL Talent Support Programme, Arts and Sciences, Topflight
2020 - Scientific Students' Associations Conference (TDK), Pharmaceutical Section, special award
2019 - 53rd International Mendeleev Chemistry Olympiad, bronze medal
2019 - Hungary's Young Talent Scholarship
2019 - Chemistry OKTV II. category, 5th place
2019 - Radnóti-award
2019 - SZTE START Scholarship
2018 - MOL Talent Support Programme, Arts and Sciences
2018 - Chemistry OKTV II. category, 7th place
2018 - Biology OKTV I. category, 15th place
2017 - Szent-Györgyi Academic Competition, 3rd place

NOÉMI VIDA

Szeged Scientists Academy, 2nd year

University of Szeged,
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Mihály Boros

JUNIOR MENTOR:

Gabriella Varga

SPECIALIZATION:

diseases of systemic circulation

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Extra corporal circulation (ECC) is commonly used during several type of heart surgeries and intensive care. During extracorporal membrane oxigenization (ECMO) or cardiopulmonary bypass (CPB) the lungs are excluded from the circulation and the blood is introduced to a considerable amount of heparin. Furthermore the blood contact with the foreign surface of the CPB circuit causes an immediate inflammatory response similar to the septic systemic inflammatory response (SIRS) in which humoral and cellular factors play an essential role. The contact activation leads to intrinsic activation of the coagulation cascade and further activation of pro-inflammatory cascades, triggering a wide variety of cellular systems. If these cascade activations are dysregulated due to prolonged ECC time and further metabolic changes, significant tissue and organ damage can occur in sensitive organs such as the kidneys and intestines. *In vivo* animal models are used to explore the mechanisms behind these reactions, therefore in the Institute for Surgical Research, University of Szeged, a clinically relevant large animal model is used to monitor inflammatory responses during ECC. Our aim is to investigate the exact mechanism behind the ECC-induced inflammatory reactions along with the development of novel therapeutic strategies to reduce post-ECC inflammatory damage.

AMBITIONS AND CAREER GOALS

As a medical student clinical knowledge and skills are exeptionally important, however I find keeping up with scientific research and integrating them into practice is just as cruical. By working in this laboratory, I would like to deepen my knowledge in the pathophysiology of post-surgical inflammatory response and obtain surgical skills, which I will benefit from later as a practicioner.

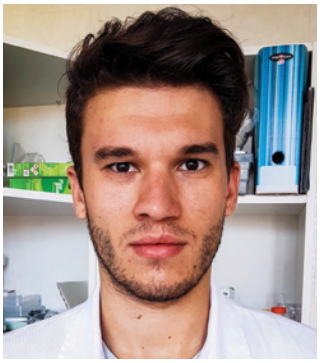
HONORS AND PRIZES

2020 - Scientific Students' Associations Conference (TDK) Szeged, 1st prize in Physiology, Patophysiology and Morphology
2019 - XXXIV. National Student Scientific Conference - Surgical Researcher Prize
2019 - Hungarian Research Student Association Conference, Conference of Life Sciences in the Carpathian Region - Grand Prize
2019/20 - Student researcher Scholarship of the New National Excellence Program
2019 - Dr. Árokszállásy Zoltán National Biology Competition, 17th place
2017 - Dr. Árokszállásy Zoltán National Biology Competition, 13-14th place
2016 - Dr. Árokszállásy Zoltán National Biology Competition, 20th place

PUBLICATIONS

Bársony, A., **Vida, N.,** Gajda, Á., Rutai, A., Mohácsi, Á., Szabó, A., Boros, M., Varga, G., Érces, D. (2020) Methane Exhalation Can Monitor the Microcirculatory Changes of the Intestinal Mucosa in a Large Animal Model of Hemorrhage and Fluid Resuscitation. **Front Med (Lausanne) 7:** 567260.

DÁNIEL LÁSZLÓ VIDÁCS



Szeged Scientists Academy, 4th year

University of Szeged,
Faculty of Medicine, 5th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsuzsanna Bata-Csörgő

JUNIOR MENTOR:

Zoltán János Veréb

SPECIALIZATION:

dermatology

SECONDARY SCHOOL:

Radnóti Miklós
Experimental Grammar
School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced
Spanish/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Psoriasis is a multifactorial skin disease affecting about 2-3% of the population worldwide although it is more prevalent in the Caucasian race. The most common form is the plaque type psoriasis, called Psoriasis vulgaris. Psoriatic lesional tissue is characterized by epidermal hyperplasia, abnormal keratinocyte differentiation, intensified and abnormal angiogenesis and inflammatory cell infiltration. The research focus of my group in our laboratory is the pathomechanism of psoriasis. I am involved in investigating the contribution of the extracellular matrix (ECM) components to the development of psoriatic skin pathology. We aim to examine the regulation of ECM genes by using Real-time RT-PCR technology and the expression of ECM proteins with immunocytochemistry and Flow cytometry in a 3D skin model.

AMBITIONS AND CAREER GOALS

By working in this laboratory, I want to learn basic techniques in biomedical research so that later on I can contribute finding new methods in the therapy of inflammatory skin diseases. There are several medicines that cure psoriasis, but many of them are merely symptomatic therapies. A better understanding of the pathomechanisms may lead to more relevant therapies with longer lasting results.

HONORS AND PRIZES

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PUBLICATIONS

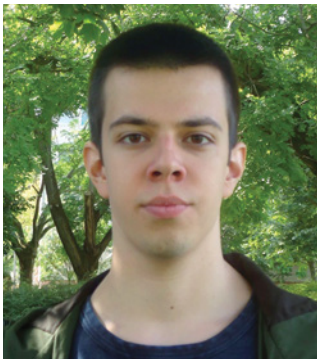
–

SZENT-GYÖRGYI PH.D. STUDENTS

"Raising a good problem, asking a good question is already half the work."

Albert Szent-Györgyi

GERGŐ PORKOLÁB



Szeged Scientists Academy, 1st Ph.D. year

University of Szeged,
Doctoral School of Biology, 1st year

YEAR OF BIRTH:

1996

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mária Deli

RESEARCH INTERESTS:

cell biology, blood-brain barrier

UNIVERSITY DEGREE:

MSc in Biology

AS A SZENT-GYÖRGYI STUDENT:

Former Szent-Györgyi mentor: Mária Deli
Former Szent-Györgyi junior mentor: Szilvia Veszelka

SECONDARY SCHOOL:

Tömörkény István Secondary School

NAME OF TEACHER:

Ildikó Vadászné Horváth

LANGUAGES:

English/advanced

BACKGROUND, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The main goal of our research is to develop a novel drug delivery system that is capable of transporting therapeutics across the blood-brain barrier (BBB). We load the drugs into nanoparticles, which are targeted to the BBB by special molecules on their surfaces. These targeting molecules are recognised by the BBB and the drug-loaded nanoparticles – like „molecular Trojan horses – are able to enter the brain. We are also interested in developing novel, human cell-based models that enable us to investigate the interactions of nanoparticles with the BBB, as well as the healthy and diseased brain.

AMBITIONS AND CAREER GOALS

As a researcher, I would like to focus on and find solutions to relevant basic scientific problems that can potentially improve people's lives in the future.

HONORS AND PRIZES

2020 - New National Excellence Program scholarship for the academic year of 2020/21
2020 - Excellent Student of the Faculty Prize, Faculty of Science and Informatics, University of Szeged
2020 - SZTE József Sófi Foundation Scholarship, „Whole University" category – grand prize
2019 - Student of the Year Prize, Szeged Scientists Academy
2019 - New National Excellence Program scholarship for the academic year of 2019/20
2019 - Stephen W. Kuffler Research Fellowship
2019 - SZTE József Sófi Foundation Scholarship, Biology MSc category – 1st prize

PUBLICATIONS

Topal, G.R, Mészáros, M., **Porkoláb, G.**, Szecskó, A., Polgár, T.F, Siklós, L., Deli, M.A, Veszelka, S., Bozkir, A. (2020) ApoE-Targeting Increases the Transfer of Solid Lipid Nanoparticles with Donepezil Cargo across a Culture Model of the Blood-Brain Barrier. **Pharmaceutics 13:** 38.

Porkoláb, G., Mészáros, M., Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M.A., Veszelka, S. (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics 12:** 635.

Mészáros, M., **Porkoláb, G.**, Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, MA., Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci 123:** 228-240.

Imprint

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