

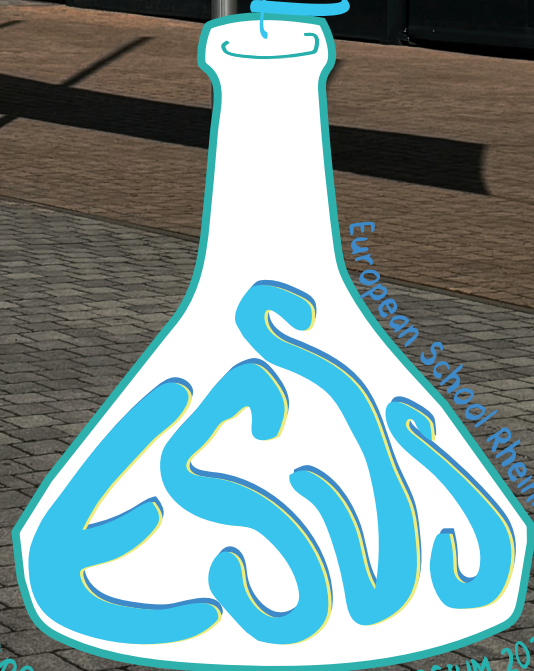
# ESSS 2024 @ ESRM Booklet



## TABLE of CONTENTS

Welcome to ESSS 2024	2-4
General ESSS 2024 Program	5
Keynote Speakers	6
Judging Panel	7-11
Assessment Criteria and Competition Rounds	12-13
List of Junior Projects	14
List of Senior Projects	15
Junior Projects Abstracts	16-35
Senior Projects Abstracts	36-55

*European School  
Table of*



*European School RheinMain  
EUROPEAN SCHOOLS SCIENCE SYMPOSIUM 2024*



# WELCOME

## To ESSS 2024



A colourful parade of European genius

What a pleasure it is to be looking forward to having you all together with us on our wonderful campus for the occasion of the European Schools Science Symposium.

A keynote of this year's event is the potential source of powerful innovation as a result of scientific education and research. Society needs you, young exploring scientists. Without you the world is more or less powerless with regard to finding adequate solutions for the major issues of our time such as energy, healthcare, safety, sustainability. In order to achieve this it is of crucial interest that continuously new generations of young academics stand up and take up the torch of researching and experimenting and that is exactly what we will experience during the three days to come, here in Hessen, here in Bad Vilbel. Amaze the world with your imagination and your collaboration within the multilingual framework of our unique school system. Let us witness the fruits of your creativity and inventiveness, accompanied and perhaps steered by your talent to share and to cooperate.

Dear students from all over Europe, I want to thank you all for being with us, with your wonderful enthusiasm and your stirring and inspiring personalities. I thank your teachers for giving you all their support and expertise. I wish to thank you, external experts as well; without your generous participation this Symposium could not exist at

all. And: I need to take off my hat to the local crew in Bad Vilbel; indefatigable and full of

motivation.

Finally, probably a bit unexpected on this occasion, I want to thank the European Schools, as an entity, as a whole, for offering all these high-quality events in the areas of sports, culture, politics and society. Probably we all tend to take these things for granted, but we should surely not. Let us embrace the thought that European Schools, individually and as a whole, are something highly unique, not only from an academic point of view, but undoubtedly where it concerns the joy and the pride of belonging together to this community of heartfelt Europeans.

**L' Europe, notre patrie.**





Chers élèves, chers jeunes scientifiques,  
Chers participants aux Symposium des Sciences  
des Écoles européennes,

Cette 19e édition du Symposium des Sciences  
des Écoles européennes promet d'être à nouveau  
un grand succès. Des élèves et enseignants d'un  
nombre croissant d'écoles européennes vont se  
rassembler du 21 au 24 avril 2024 à l'EEA de Rhein-  
Main à Bad Vilbel pour présenter leurs projets  
scientifiques.

Cet événement témoigne de l'importance de  
l'enseignement des sciences et permet aux élèves  
de présenter leurs découvertes, leurs idées et  
projets de recherche. En partageant leurs travaux,  
les élèves ont pu développer leurs compétences  
de collaboration, de communication et d'échange  
d'idées, autant de compétences cruciales pour  
tout scientifique.

En participant à ce symposium, les élèves ont pu  
développer une série d'aptitudes et de compé-  
tences, telles que la pensée critique, la résolution  
de problèmes et la créativité. Les jeunes peuvent  
démontrer qu'ils sont capables d'aborder des  
questions complexes afin de trouver des solutions  
innovantes, des compétences essentielles pour  
réussir au 21e siècle.

Continuez à travailler avec passion, et vous allez  
constater que beaucoup de filières vous ouvriront  
leurs portes. N'ayez pas peur d'approcher d'autres  
personnes, d'échanger vos idées et d'apprendre  
des autres. Entourez-vous de mentors plus âgés  
et plus expérimentés. Soutenez-vous réciproque-  
ment. Mais dans tout cela, n'oubliez jamais de  
chercher une manière de vous évader, pour trouver  
un domaine que vous adorez et qui vous passion-  
ne.

J'aimerais aussi remercier les enseignants qui ont  
consacré leur temps libre afin de guider les élèves  
dans leurs démarches. Sans leur engagement de  
telles initiatives ne pourraient pas avoir lieu.

Un très grand merci à la direction d'École hôte, à  
l'association des parents ainsi qu'à toute l'équipe  
organisatrice (Maria José Penuelas, Dr. Anne Sam-  
land, Dr. Jens Hafke, Dr. Ilka Emig, Ute Arias) pour

leur travail insatiable tout au long de l'année.

Mes remerciements vont aussi à tous toutes les in-  
stitutions et autorités qui contribuent au succès de  
cet événement phare des écoles européennes, le  
bureau du secrétaire général des Écoles européen-  
nes, les JRC ainsi que l'EPO pour leurs soutiens  
financiers et matériels.

L'équipe qui remportera l'ESSS ira représenter les  
EE au prestigieux EUCYS (European Union Contest  
for Young Scientists), qui aura lieu en septembre  
2024 à Katowice en Pologne (<https://us.edu.pl/en/eucys-2024-europejski-konkurs-dla-ambitnych-uczniow-pasjonujacych-sie-nauka/>). Ce concours  
est la vitrine des meilleures performances scien-  
tifiques des élèves. Il s'agit d'une initiative de la  
Commission européenne lancée pour promouvoir  
la coopération et l'échange entre jeunes scientifi-  
ques. Profitez de cette occasion unique pour entrer  
en contact et vous échanger avec des jeunes du  
même âge, venus des quatre coins de l'Europe.  
Or le but de l'ESSS n'est pas de pouvoir envoyer  
une minorité d'élèves à l'étranger, mais d'éveiller  
l'intérêt pour les sciences chez une majorité de nos  
jeunes. Ce sont bel et bien de telles initiatives qui  
permettent de transmettre une image positive des  
sciences. L'enseignement scientifique doit rester  
une priorité dans notre système éducatif.  
Pour le moment il me reste de féliciter tous les par-  
ticipants au symposium. Bravo pour votre engage-  
ment et vos travaux. Beaucoup de plaisirs avec les  
sciences et à l'année prochaine pour la prochaine  
édition de du symposium des sciences !

**Max Wolff**

Inspecteur des Écoles européennes





**Dr. Daniella Schmitt** – Deputy Director Secondary  
AES RheinMain

What is science? Science represents a never-ending exploration and quest for truth. Science attempts to answer the questions that we do not have an answer to. What better platform to solve some of the global issues and problems we face today than a European Schools Science Symposium (ESSS)? ESSS represents an arena for the most ambitious young minds to exchange critical ideas and fresh perspectives on different areas of science with the final goal of making this world a better place.

The European School RheinMain is extremely grateful to be able to host the European Schools Science Symposium in 2024. More than 200 young minds aged 12-17 and their teachers will visit RheinMain to explore new dimensions of scientific paradigms, theories, and explo-

rations. Students will prove and disprove new or existing hypotheses and bring further knowledge and enlightenment not only to the world scientific community, but to the entire European Union.

For science to prosper and scientific ideas to develop further, collaboration and cross-disciplinary work is pivotal. The European Schools Science Symposium offers a platform for young minds to collaborate, exchange ideas and initiate progress. Students in the competition come not only from the traditional fields of natural sciences, but also from the fields of economics and informatics. With three special prizes for sustainability, innovation, and creativity, ESSS this year wants to ensure that as many individual and unique thinking projects are honoured as possible. By engaging in a scientific quest for truth, the young minds of our students will bring new perspectives to the attention of fellow students, teachers, administrators, and the wider scientific community, inspiring even more students to attempt to solve the insolvable and dare to be critical, to explore and be different!

I wish all the participants a fruitful scientific endeavor and an enjoyable stay at our school.





# PROGRAM

## ESSS 2024

### Sunday, 21.04.2024

12:00 Arrival and Project build-up by participants

@ESRM sports hall

16:30-17:30 Opening ceremony @ ESRM Aula

Opening speeches:

Director of ESRM, Tom Zijlstra

Staatsminister, Armin Schwarz

Secretary-General of the European Schools,  
Andreas Beckmann

European School Inspector, Max Wolff

Stadtrat und Staatsminister a.D.,

Dr. h.c. Jörg-Uwe Hahn

Keynote speech:

European Space Agency, Alessandro Ercolani

Moderators: Linda Heiligttag (S6 ENA),

Nicolaos Mitcas (S6 DEA)

Music: Annabelle Niakamal, Rock Band, individual  
student/ teacher musical performances,

Choir (European Anthem)

18:00 Dinner @ ESRM School Restaurant

19:30 Return to Hotel

12:00 Lunch @ ESRM School Restaurant

13:00 Bus transfer ESRM – Frankfurt

13:30 Arrival at ECB - security check

14:30 Scientific Program

Opening and Q&A Session by ECB President  
Christine Lagarde

15:15-18:00 ECB: workshops (Students)

Walk to dinner location

19:00- 20:30 Dinner at Restaurant Oosten, Frankfurt

21:00 Return to Hotel

### Wednesday, 24.04.2024

10:00-11:30 Closing ceremony @ ESRM Aula

Scientific conference and speeches of the Officials

Award ceremony,

announcing the 3 Junior and 3 Senior prizes

Closing Remarks by Dr. Daniella Schmitt,

Deputy Director of Secondary ESRM

Closing Speech by Prof. Dr. Guido Friebe

from Goethe University of Frankfurt

### Monday, 22.04.2024

8:30-10:00 School Tour (Primary Exhibition, Tiny  
Forest, Art exhibition, School grounds)

9:00 Morning Exhibit (part 1) @ ESRM sports hall

11:00 Morning coffee break @ ESRM sports hall  
foyer

11:15 Morning Exhibit (part 2) @ ESRM sports hall

12:15 Lunch @ melomi in ESRM School Restaurant  
in the ESRM Aula

13:00 Bus transfer ESRM - Frankfurt

Anlegestelle Frankfurt Eiserner Steg

13:30 – 15:15 City Tour Frankfurt

15:30 – 18:00 Frankfurt Boat tour

19:00 Dinner @ ESRM – Announcement of Finalists

20:30 Party at ESRM Aula with Rock Band

22:00 Return to Hotel

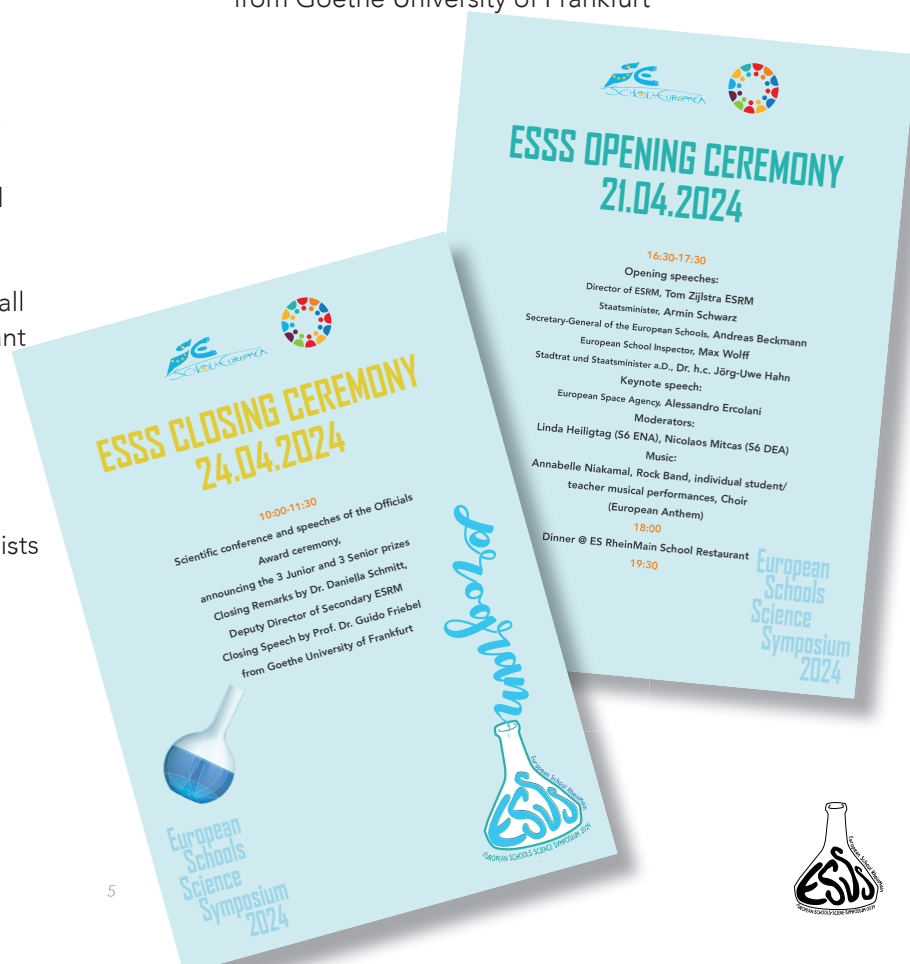
### Tuesday, 23.04.2024

8:00-10:00 Exhibit for finalist @ ESRM Aula

Five best Junior and five best Senior groups

10:00-10:15 Morning coffee break @ ESM Aula

10:15-12:00 Exhibit for finalist @ ESRM Aula



# KEYNOTE

## Speakers



**Dr. Alessandro Ercolani** is a Space Enthusiast, who spent most of his career at the European Space Agency (ESA) in the operations centre (ESOC) in Darmstadt, Germany. He graduated in Software Engineering at the University of Rome Tor Vergata, and was involved in the development of the Mission Control System of the Rosetta mission, the famous ESA's comet chaser. In 2009 he was given the task to lead the section in charge of providing control systems and simulators to all ESA Science Missions, thus developing experience in the coordination and motivation of a team of skilled engineers and managers. In the last 10 years Alessandro developed a strong interest in fostering Space and Science education and outreach, especially directed to younger generations of future explorers. At the end of 2023 he took the decision to focus on this passion, thus stepping down from all previous tasks at ESA and entering early retirement.



**Prof. Dr. Guido Friebe.**

I am Professor of Human Resources at Goethe University in Frankfurt. My main research field is organizational and personnel economics. I carry out randomized controlled trials (RCTs) with and within firms, with a view to increase both productivity and worker welfare and to test important theories. I also analyze observational career and promotion data and write models about careers, communication and talent management. My other main interest is how institutions shape the accumulation and allocation of human capital, focusing on problems of families, gender, and migration.

I am President of the Society for Institutional and Organizational Economics, a fellow at CEPR and IZA, a founding member of the Organizational Economics Committee of the German Economic Association, a member of the Scientific Advisory Board of Sciences Po, and of ConTrust at Goethe University. I am also Scientific Director of CLBO, a project leader at the Rockwool Foundation in Berlin and an Associate at ZEW, Mannheim.

Before joining Goethe, I graduated with a Ph.D. from ULB in Brussels and held positions at the Toulouse School of Economics and at SITE, Stockholm School of Economics.



# JUDGING

## Panel



**Dr. Sabine Bauersachs.** I graduated with a diploma in nutritional science and economics at the Technical University of Munich (TUM). My doctoral thesis covered the investigation of the trace element selenium and Vitamin E on the humoral immunity. My career path started in the pharmaceutical industry where I worked in clinical research as a group leader to perform and coordinate clinical studies in different phases and indications like cancer, immunology, transplantation, rheumatology, urology, cardiology (by the way this was my mega project as a project manager on a global trial with > 12.000 patients enrolled) etc. Companies I worked for where Johnson & Johnson, GSK, Pharmacia later Pfizer and Quintiles, a global provider for clinical services. Development and improvement of medical devices was another topic on my journey with a focus on liver and kidney diseases. I got also involved in business development, investigating patent letters and doing scientific reviews (due diligence) for possible in- and out-licensing deals in a corporate environment at Fresenius.

On the job I completed a degree in „Health Economics“ at the European Business School (ebs). Finally, I decided to found my own company as a „Consultant for Clinical and Medical Affairs and Health Economics“, in order to support pharmaceutical and medical device companies with operational and scientific topics, management issues, project coordination, budgeting, risk-management and regulatory affairs topics for registration purposes. So, I worked for companies like Merck, Baxter, Meda, Hexal, etc. My latest degree is a „Portfoliomanager“ to focus more on financial issues to better „survive“ in the currently challenging economical, political and social environment.

I am also an active member of an array of associations and alumni organisations to stay on top of the huge improvements achieved in the different areas lately. For the TUM I also „worked“ as a Mentor to support young students with all their many questions. With my engagement at „HBA“ the intention

was to encourage women to take responsibility and to start their own career especially in an scientific environment.

Not to forget I am a mum of a former student of European School RheinMain who participated twice in ESSS and now studies Economics, Politics & International Relations in UK and has got the best foundation for an international career.



**Dr. Konstantinos Boboridis** holds a Master's and a doctoral degree in engineering physics from the Graz University of Technology. Since 2007 he has been working at the European Commission's Joint Research Centre in Karlsruhe on high-temperature thermophysical properties of nuclear fuels. In the past he has worked at the US National Institute of Standards and Technology, the Los Alamos National Laboratory, and the University of Cyprus. His main research activities have dealt with high-temperature high-pressure thermophysical materials properties, pulse-heating and shock compression techniques, radiation thermometry, reflectometry, and laser polarimetry. In recent years he has discovered a passion for scuba diving.



**Dr. Mercedes Carrillo Solano** holds a PhD in Materials Engineering from the Technische Universität Darmstadt and a PhD in Physical Chemistry from the Université de Bordeaux. After studying Chemistry in Colombia, a joint pro-



gram within 4 European universities awarding her titles in Physical Chemistry and Material Science. Her curiosity for renewables and new technologies brought her to Darmstadt, Germany.

At the TU Darmstadt she worked on her doctoral thesis focusing on the performance of protective layers for cathode materials in lithium-ion batteries. This was a joint program executed in collaboration with the University of Bordeaux in France.

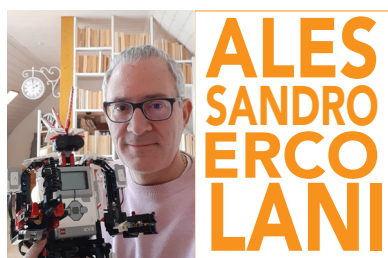
Subsequently she held a postdoctoral position in the Material Science Department at GSI (Helmholtzzentrum für Schwerionenforschung). During this time her work focused on the preparation and study of nanostructures and nanopores employing ion-track technology for sensors and electrical applications.

Her passion for innovation and technology brought her to Merck Innovation Center where she worked in the Ideation pillar coordinating open innovation technology-transfer with industry and academic partners, including for example the European Space Agency. During this time, she completed a Master in Innovation and Entrepreneurship from the University of Barcelona (OBS Business School). She currently works in P&G (Procter & Gamble) as a Products Research Scientist supporting the Oral-B electric toothbrushes.



#### Dr. Xavier Gerard

I have been working as a quantitative researcher and portfolio manager for almost 20 years. My work consists in investing and growing large pools of retirement savings to help people maintain decent lifestyles in old age when most vulnerable. To do that I am using the latest predictive modelling techniques and large amounts of data gathered across thousands of assets while offering optimized investment solutions that consider various trade-offs such as the tolerance of our clients for risk-taking against their desire and need for potentially higher investment returns. But also, aspirational objectives like their desire to hold companies with powerful climate initiatives or that are actively promoting workforce diversity. Consequently, this is an area that requires an inquisitive mind and an eclectic mix of skills ranging from computer science, statistics, mathematics to economics, accounting and even psychology. The pace of change in each subject matter is rapid and while staying on top of the latest academic discoveries is challenging, it is also hugely rewarding intellectually. For instance, recent advances in Machine Learning algorithms and Natural Language Processing as well as the increasing demand for Responsible Investing have already made a large impact on our models. Reflecting on my experience so far, I can honestly say that, since I earned my PhD in Financial Economics from Bayes Business School (formerly Cass) and started working in this industry, there has not been a week when I have not learned something new or developed new skills.



**Dr. Alessandro Ercolani** is a Space Enthusiast, who spent most of his career at the European Space Agency (ESA) in the operations centre (ESOC) in Darmstadt, Germany. He graduated in Software Engineering at the University of Rome Tor Vergata, and was involved in the development of the Mission Control System of the Rosetta mission, the famous ESA's comet chaser. In 2009 he was given the task to lead the section in charge of providing control systems and simulators to all ESA Science Missions, thus developing experience in the coordination and motivation of a team of skilled engineers and managers. In the last 10 years Alessandro developed a strong interest in fostering Space and Science education and outreach, especially directed to younger generations of future explorers. At the end of 2023 he took the decision to focus on this passion, thus stepping down from all previous tasks at ESA and entering early retirement.



**Nils Franke**, born in 1976 in Mainz, went through his educational journey from Alzey through the Gymnasium am Römerkastell to the Diakonenschule Paulinum of the Kreuzwacher Diakonie. In 2006, he completed his studies in Philosophy and Physics at the Christian-Albrechts-University in Kiel, obtaining his first teaching degree. During his studies, he gained insights into medical physics at the Neurology and Forensic Medicine departments of the University of Kiel. Additionally, he was involved in the digital development of telephone devices and worked in the federal administration at the Technical Assistance Service.

After his studies, Mr. Franke worked as a high school teacher at various schools in Germany, including the Homburgisches Gymnasium Nümb-





recht and the European School Karlsruhe. Currently, he leads as the principal at the Evangelical School on Lake Constance - Schloss Gaienhofen, where he teaches Philosophy, Physics, Computer Science, and Mathematics. His interests span Astrophysics, Medical Physics, History of Science, Philosophy of Science, and Epistemology. With great passion, he delves into pre-Socratic texts and engages with works by Kant, Heidegger, Gadamer, Aristotle, and Leibniz. The fascinating world of theoretical physics also strongly captivates him. This broad range of interests is reflected not only in his academic career but also in his teaching approach, influenced by Maria Montessori. During his 8-year tenure at the European School Karlsruhe, Franke actively supported students on their path to the European Baccalaureate. He consistently sparked interest in the European Science Symposium. Franke sees the strategy of emphasizing hands-on science as a crucial step to inspire new scientific talents to actively participate in research and education. For him, research is always interconnected with education, as discourse about acquired knowledge propels further progress. In this spirit, Nils Franke wishes all participants a wonderful experience and much success.



**Dr. Tillmann Krahnke** obtained his PhD in Statistics from the University of Dortmund and started his career as a Biostatistician in the pharmaceutical industry in 2002. He is experienced in human drug development, being involved in the design, analysis and interpretation of clinical trials ranging from first-in-human experiments to studies conducted in drugs that are already available on the market. As a Biostatistician, he usually works in larger teams and helps to collect the right information, to interpret study results correctly, and to discuss and communicate them in a meaningful way.

Previously, Tillmann served as a statistical consultant across various industries as diverse as real estate, alimentation, or manufacturing. He also has experience in statistical software development. Currently, Tillmann acts as statistical project lead for multiple drug development programs at Sanofi-Aventis in Frankfurt am Main.



**Prof. Dr. Alison McNamara** is a professor at TH Aschaffenburg, where she earned her degree in Information Technology in 2006. With a focus on software security, she worked in Luxembourg before returning to Ireland to complete her Masters in E-Commerce in 2009. Alison then went onto work in Dublin's tech industry, while simultaneously completing her PhD in 2016.

Her journey continued with a project in Germany, where she worked as a software developer until the end of 2022. Transitioning to academia, Alison assumed the role of Professor of Mobile Applications at TH Aschaffenburg. Her research interests encompass game-based learning, gesture-based technology, and programming. Beyond the classroom, she shares her programming insights on her YouTube channel, „Java with Ali,“ contributing to the wider discourse on programming education.



**Beatriz Mora** is a Computer Engineer with a Master in Science in Software Engineering at the University of Oxford. She joined EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites) in 2006. During her professional career Beatriz has specialised in quality, management and engineering processes applied to Space Software Systems. Beatriz is the Quality Assurance Manager of the department providing scientific and engineering support to EUMETSAT Programmes. Among other responsibilities, Beatriz is in charge of defining the Quality aspects of the EUMETSAT operational Satellite Ground Segment Software Systems.





**Prof. Dr. Steffen Pauls** forscht und lehrt zur Ökologie von Fließgewässern sowie zur Vielfalt von Insekten in Flüssen, Wäldern, und Städten. Er promovierte an der Universität Duisburg-Essen und habilitierte sich im Jahr 2014 an der Freien Universität Berlin im Fach Zoologie. Seit 2010 arbeitet er am Senckenberg Forschungsinstitut und Naturmuseum Frankfurt. Dort leitet er die Abteilung Terrestrische Zoologie und betreut eine wissenschaftliche Forschungssammlung von ~1,3 Mio. Tag- und Nachtfaltern und Köcherfliegen. Seit 2019 ist er zudem Professor für Allgemeine Entomologie an der Justus-Liebig-Universität in Gießen.



**Dr. Gerrit Praefcke** obtained his university degree in biochemistry and a Ph.D. from the Ruhr-University-Bochum. During his scientific career he has worked at the Max-Planck-Institute for Molecular Physiology in Dortmund, at the MRC Laboratory of Molecular Biology in Cambridge, UK and at the University of Cologne. Since 2014 he works at the Paul-Ehrlich-Institut in Langen where he is currently head of section "Product Testing, Haematology, Cell and Gene Therapy" and deputy head of the division. His research interests focus on the regulation of proteins by posttranslational modifications and by interactions with biological membranes. He is also as an expert for the European Directorate for the Quality of Medicines and Healthcare (EDQM) in Strasbourg.



**Prof. Dr. Imke Schmitt** is an evolutionary biologist at Senckenberg Biodiversity and Climate Research Centre, and Goethe University Frankfurt. Her research interests are symbiosis research, biodiversity genomics, and environmental genomics. She studies climate adaptation of the lichen symbiosis, a mutualistic association of fungi



and green algae. With her team she addresses questions such as: Why do lichens in different environments have different partner combinations? What is the impact of climate on genomic and transcriptomic features in the lichen symbiosis? This research helps us understand how organisms respond to the environment at the molecular level. Before she started her position in Frankfurt she was Assistant Professor at the University of Minnesota, conducted postdoctoral research at the Field Museum in Chicago, and at the Leibniz Institute for Natural Product Research in Jena, and obtained her PhD in biology from the University of Duisburg-Essen.



**Prof. Dr.-Ing. Dierk Schoen** has a university degree and a PhD in Electrical Engineering from Darmstadt University of Technology. In 2001, he joined the company "Pepperl + Fuchs" as R&D Engineer. 2006 he has gained comprehensive international expertise within a 3 year full expatriate deployment in Shanghai. After nearly 12 years industrial working experience in national and international positions in Research and Development, Business Development and Product Management, Dierk Schoen joined in 2012 the University of Applied Sciences "Wilhelm Büchner Hochschule" in Darmstadt as Professor for Electrical Engineering. Currently, he is acting as Dean of the Department of Engineering Sciences.



**Prof. Dr. Michael Scholz** obtained his diploma in Physics at RWTH Aachen and then joined the Biophysics Department at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt in 1987, where he finalized his PhD thesis about the characterization of cellular effects of ion radiation in 1992. He later became group leader of the Biophysical Modelling group with a research focus on modelling the increased biological effectiveness of ion beam radiation; this is an important aspect for the application of ion beams in tumor therapy. His research was strongly linked to the clinical studies for ion beam therapy which were performed at GSI in collaboration with the Radiological Clinics Heidelberg, Krebsforschungszentrum Heidelberg and Forschungszentrum Dresden-Rossendorf.



440 patients mainly with head and neck cancer had been successfully treated within this project with carbon ion beams in the years 1997 – 2008, which triggered the subsequent establishment of a dedicated clinical facility, the Heidelberg Ion Beam Therapy Center (HIT).

Michael Scholz supervised many students doing bachelor, master and PhD theses, and he has published about 150 scientific papers in the field of ion beam radiobiology. He also was involved in writing a report of the International Commission on Radiation Units and Measurements (ICRU) on the application of ion beams in tumor therapy. He was awarded the Röntgen-Prize of Justus Liebig University Giessen in 1999 and the Karl-Heinz-Bekurts-Prize in 2003.



**Dr. Hanna Sediri-Schön** is Lab head at the Paul-Ehrlich-Institut. She studied at University Paris 7 Denis Diderot (France) associated with Pasteur Institute and obtained her Master of Infectiology: Immunology, Microbiology and Virology in 2010. She holds a PhD (2015) in Virology from the University of Marburg. In 2015, she joined the Paul-Ehrlich-Institut as researcher involved in the development of a standardized assay for Influenza Neuraminidase antibodies measurement. In 2018, she joined the Viral Vaccine section team as Lab head and is responsible for the OCABR batch release certification.



**Prof. Dr. Gisela Taucher-Scholz** is a senior scientist at the GSI Helmholtzzentrum für Schwerionenforschung (Darmstadt) at the Molecular Radiobiology and Imaging group, the head of which she had been for over 30 years. She holds a degree in biochemistry from the University of Chile (Santiago de Chile), then moved to Germany at the University of Heidelberg where she got a PhD in molecular biology. She is a Professor at the Technical University of Darmstadt, being in charge of the Radiation Biophysics Master course for many years. Her research focus is molecular radiobiology with charged particle radiation, especially DNA damage repair in the context of chromatin using microscopy or live cell imaging of damage response proteins. In this interdisciplinary research field, she has co-authored more than hundred papers in scien-

tific journals as well as book contributions. She has been recognized with various awards and is a board member of expert groups in the radiation research field. In addition, for more than 10 years she has been serving in the judging panel of "Jugend Forscht", a German youth science contest.



**Dr. Claudia Walther** is passionate about supporting young talents and science. She studied biology, chemistry and physics at the Universities in Heidelberg, Germany, and Sussex, UK. In her PhD and postdoctoral research at the Max Planck Institute in Göttingen, Germany, she discovered and studied developmental control genes in mammals. After positions at the German Cancer Research Center and the German Association of Research-Based Pharmaceutical Companies e. V., she joined the Boehringer Ingelheim Fonds (BIF). BIF is a non-profit organisation for the promotion of basic research in biomedicine and mostly known for its fellowships for outstanding international PhD students who pursue ambitious, cutting-edge research projects. She held the position of managing director of BIF for 14 years and in addition became managing director of the Boehringer Ingelheim Foundation, a further organisation for the support of research in medicine, chemistry, pharmacy and biology. In this capacity, she has been responsible for initiating, developing, implementing and evaluating funding strategies and programmes for basic research as well as projects in biology, medicine and chemistry. This included, for example, peer-review-based selections of research awards for internationally renowned scientists and research projects, comprehensive support of junior researchers from some 60 countries and for the founding of an entire new research institute. In an honorary capacity, she has served, for example, on evaluation panels for the Volkswagen Foundation, is a member of the Board of Trustees of a Max Planck Institute and treasurer of an association supporting the contemporary dance company of the State Theater in Rhineland-Palatinate.



# ASSESSMENT

## criteria and competition rounds

Each school can submit 3 projects plus 1 reserve. Projects will be grouped according to pupils' year level:

- Junior Projects: Years 1 - 4
- Senior Projects: Years 5 - 7

Projects may be submitted by an individual or a group of maximum 3 students.

A project will be judged as a senior project if at least one member of the group is in years 5 – 7. Projects should demonstrate that the student(s) has/have undertaken some significant original work. Originality is exceptionally important. Examples must include a practically based experimental investigation carried out by the students, original design of an item or process, or survey based investigations involving the first-hand collection in 2 preliminary rounds to select the five best junior or five best senior projects.

### 1. PRELIMINARY ROUND

#### a) 1st preliminary round: Report work

The student/groups will present their written scientific report of their project. The jury members evaluate these papers by giving 50% of the total preliminary points.

Find below the information given to the participants about guidelines for writing their

#### scientific report:

The final report should be a document which describes the investigation carried out by your group. As a suggestion, you can go through the steps in the scientific process including a detailed description of your work and findings.

There is no minimum or maximum length of the report, but the student(s) should be concise and very precise in what they write. The student(s) should not be satisfied with

a first draft. The report needs to be written in English, French, or German. The report will be

evaluated by the judges according to specific criteria shown in the following table

### SCORING SHEET – REPORT WORK

Name of the jury member: \_\_\_\_\_

Title of the project: \_\_\_\_\_

N° of the project: \_\_\_\_\_

Motivation and Originality: /10 points

- Motivation and ultimate aim
- Originality

The Process /20 points

- Planning and organization
- Quality of the research work
- Use of relevant experiments/data/statistics - Level of innovation and creativity
- Variety of scientific skills used

Data analysis and conclusion /15 points

- Presentation of data
- Achievement of aims / Answering of research question
- Drawing of conclusion

Significance /5 points

- Global significance

Short comments on the project if it is applicable:

Total points: /50 points

**SCORING SHEET - REPORT WORK**  
(Max 50 marks)

JUNIOR Projects European Schools Science Symposium 2024

Please pick your name from the judges panel: \*

Email address: \*

Number and Title of JUNIOR PROJECT: \*

**Motivation and originality: (Max. score 10pts. in total)**

Motivation and ultimate aim: ☐ 35 ☐ 45 ☐ 35 ☐ 25 ☐ 15 ☐ 05

Originality: ☐ 35 ☐ 45 ☐ 35 ☐ 25 ☐ 15 ☐ 05

**The process: (Max. score 20pts. in total)**

Planning and organization: ☐ 44 ☐ 34 ☐ 24 ☐ 14 ☐ 04

Quality of research work: ☐ 44 ☐ 34 ☐ 24 ☐ 14 ☐ 04

Use of relevant experiments/data/statistics: ☐ 44 ☐ 34 ☐ 24 ☐ 14 ☐ 04

Level of innovation and creativity: ☐ 44 ☐ 34 ☐ 24 ☐ 14 ☐ 04

Variety of scientific skills used: ☐ 44 ☐ 34 ☐ 24 ☐ 14 ☐ 04

**Data analysis and Conclusion: (Max. score 15 pts. in total)**





### **b) 2nd preliminary round: Oral presentation**

The student/groups will present their scientific project orally to the jury (a panel of judges composed of two experts). The oral presentation could be supported with a slideshow presentation, and/or any technological equipment that the pupils have developed. A poster will be present in the classroom, which students may or may not wish to use in their oral presentation. Each member of the project groups should be able to provide additional information on their project work and answer questions. The oral presentation will be limited to a maximum of 10 minutes and the panel of judges will be invited to ask questions for a maximum of 5 minutes.

40% of the total preliminary points will be attributed by the jury members to the oral presentation itself. 10% of the total preliminary points will be attributed by the jury concerning the readability of the project through the poster.

The scores of the written and poster presentations will be added and the highest scored projects (5 from each category) will be qualified to participate in the final round. If the final points are equal, the panel of judges will need make to take a decision.

### **SCORING SHEET– POSTER PRESENTATION**

Name of the jury member: \_\_\_\_\_

Title of the project: \_\_\_\_\_

N° of the project: \_\_\_\_\_

Evaluation of the oral presentation /40 points

- How easily did student(s) express themselves? /15 points
- Has the use of supports (slideshow, poster and/or equipment) been done clearly and the aim of the project been explained? /10 points
- How clear were the answers? /15 points
- Evaluation of the poster /10 points
- How well planned and organized was the poster? /2 points
- How well does the poster describe the aim of the project? /4 points
- How well were experiments/data/statistics presented? /2 points
- How high was the students' level of creativity /2 points

Short comments on the project if it is applicable:

**Total points: /50 points**

### **2. FINAL ROUND – PLENARY STAGE PRESENTATION**

The best 5 junior and 5 senior projects (selected in the preliminary rounds) will be invited to present their work on stage in front of a bigger audience for a maximum of 10 minutes.

The audience may be composed of students and teachers, parents of presenters... The jury members will be invited to pose questions for a maximum of 5 minutes after each project presentation.

The stage manager will indicate when the final minute of the presentation/questions/answers starts. The timing must strictly be kept for all participants. Student staff helping in the organisation of the event may be involved in passing the microphones and/or managing the time.

All points and rankings that have been previously attributed are disregarded for the final round.

The jury will attribute rankings to the projects. The projects will be evaluated according to the following criteria:

- The concept – What was the motivation behind your project and what were your aims? How original is your project?
- The process – How well did you plan and organize your work? What research did you do? What experiments did you undertake? Were you innovative or creative in your approach? What skills did you use?
- The outcome – How well did your project achieve its aims? What conclusions did you draw? Personal skills –how well did you deal with any problems or challenges you encountered, individually or as a group?
- The presentation – How well is your project communicated? Do you demonstrate understanding and reason clearly? Is your final report of the high quality?
- The significance – What is the wider impact of your project?
- Final rankings for each category will be added. In the event that projects have identical rankings, the panel of judges will arbitrate to reach a final common decision.
- The three best projects in each category will be attributed the 1st, 2nd or 3rd price.
- The 4th and 5th places will be rewarded with an 'ESSS finalist certificate'.

The winner of the senior project of ESSS 2024 will participate at the European Contest for Young Scientists (EUCYS) and need to be registered by the EUCYS representative.

### **3. PRIZE FOR THE BEST POSTER**

(election by the audience)

During the poster session, the participants and accompanying teachers can choose their preferred junior or senior project. The choice of best project will be based only on the poster. The choice of method by which the vote is carried out is left to organising school (e.g. electronic vote, voting tickets that will be collected during the event in a voting box...).

The vote will be open on days 2 & 3 during which the posters hang out. Each category (junior and senior) will be awarded a "Best Poster Prize". Each project group will need to be present during the morning of day 2 next their poster where they will present their work to the audience, while waiting for their turn for the oral presentation.



# List of Junior Projects ESSS 2024:

J01	Wrist injuries rehabilitation	Pawel Kazmierczak, Jean-Luc Fael Bernabé and Javier Tejedor Granado	ES Alicante
J02	Sustainable mechanized garden	Mireia Orozco Fernandez-Montes and Alba Aracil Pérez	ES Alicante
J03	What is in our Beaches?	Raúl Domínguez González, David Meseguer Carrillo and Elisabet Ruiz Medina	ES Alicante
J04	Do Water Parameters Affect the Population and Distribution of Freshwater Species in Canals?	Arnav Dhole	ES Bergen
J05	Which types of Mediterranean soil dampen seismic activity the best?	Alp Demir	ES Bergen
J06	Burgers Beyond Gravity: Plant-based vs. traditional meat	Eleni Kyratsis, Eleni-Mary Tzima and Myrto Vasileiadou	ES Bergen
J07	Is music the vessel to Mars?	Léontine Summerer, Lisanne de Zutter and Polina Apanas	ES The Hague
J08	Comparing the relative amounts of DNA provide insights into genetic differences	Aagneya Sarkar, Freddie Lee and Sankalp Krishna	ES Luxembourg Clervaux
J09	Can potatoes grow in the air without soil?	Martina Noguerola Peñuelas, Anna Cornelia Maria Wenzel and Eléa Solenne Gross	ES Frankfurt
J10	Screen Guardian: Can we come back from the Digital Trap?	Martha Goodchild and Verónica Jara Gómez	ES Brussels III
J11	Endangered and Threatened Species in the world	Artemis Palamidi	ES Brussels III
J12	Can microalgae also be used as a natural preservative for food?	Ankit Senthil	ES Karlsruhe
J13	First Aid Robot	Vito Pezer, Mael Bartuli and Mateo Escarate-Kruwinus	ES Karlsruhe
J14	Eco-Douche	Timothée Clemence and Maceo Garcin Laceres	ES Brussels IV
J15	Flower Power	Joanna Noirot, Gabriel Mikhailov- Leroy and Emili Rabuzin	ES Brussels IV
J16	Récupération de l'énergie des ventilateurs cheminée	Erik Van de Velde and Igor Vandeputte	ES Brussels IV
J17	Blob vs air pollution: who wins?	Raphaël Newton and Raphaël Sniter	ES Luxembourg I
J18	Une capsule autonome basée sur la lentille d'eau lemna minor	Clémentine Samson Zilliox	ES Luxembourg II
J19	Sustainable Portable Affordable Aquaponics Unit	Stella Schaerf	ES Mol
J20	The effect of propolis on bacteria and fungi	David Hateley and Leon Alink	ES Munich
J21	Pour la paresse du professeur	Milo Falala Frati, Emil Dujardin and Ewan Carlo	ES Parma
J22	Les règles et l'école	Lena Moussaoui Chenot and Anahelle Paima	ES Parma
J23	Empreinte Musicale	Chloé Lapy, Serena Peracchi and Camilla Feuchio	ES Parma
J24	Musiktransport auf einem Laserstrahl	Julius Schlüter	ES RheinMain
J25	Food Waste in Brussels	Maja Limantaitė, Etain O'Mahony and Eliza Slavova	ES Brussels I
J26	How actually clean are these everyday objects? - Testing how clean is our school	Nina Szmytkowska and Maria Pirveli	ES Brussels I
J27	La radiation, guérisseuse de cancers?	Nicolas Fourestié	ES Brussels I
J28	Rainfall changing	Senni Tobia and Consoli Riccardo	ES Varese
J29	Homemade space food experiment	Ayanna Le Boloch' and Cléophee Augendre Della Corte	ES Varese
J30	Fingerprints: Discovering their limits	Apostolou Antonia Zoi	ES Warsaw
J31	Does chewing gum help kill mouth bacteria?	Gintarė Skruodytė and Justė Ilievičiūtė	ES Brussels II





# List of Senior Projects ESSS 2024:

S01	Aerodynamics of different control surfaces for orbital booster landing	Jan Kazimierzczak, Tobias Van Bavel and Oscar Canals Estirado	ES Alicante
S02	Sea-Current: Magnetohydrodynamic Electricity Generation with Seawater	Louisa Carlsson, Matilda James and Aderyn McCurdy-Luksch	ES Bergen
S03	Carbon dioxide to water and electricity convertor	Gustavo Fernández-Balbuena Paredes	ES The Hague
S04	Investigation of atmospheric gasses and their IR absorption inside a city	Aron Visegradi, Cassius Moeller and Theocharis Chalyvidis	ES The Hague
S05	Le Blob et les pesticides : Physarum polycephalum, peut-il être un acteur de dépollution des sols?	Lena Minlend and Sarah Tudose	ES Luxembourg Clervaux
S06	Exploring methods for detecting microplastics in sea fish destined for human consumption	Charlotte Hagon and Nina Hermans	ES Frankfurt
S07	Ear training application for music	Jakub Kranz	ES Frankfurt
S08	ZebraGo	Lauren Holleboom, Leonie Goodchild and Thomas Van den Wyngaert	ES Brussels III
S09	Exploring the Phenomenon of Surface Tension in Various Experiments	Maximilian Montgomery and Sergej Skackov	ES Brussels III
S10	Brain Wave controlled Raspberry Pi car	Manuel Suhrcke and Nurali Rakhmetov	AES Luxembourg Junglinster
S11	WWA – World wide algae: how do these organisms exchange information about climate change.	Miquel Ribas Bonet	ES Karlsruhe
S12	Objectif zéro trainee	Colin Houdet, Ernest Kutzner and Thomas Schneider	ES Karlsruhe
S13	Comment mesurer des masses dans des conditions de microgravité?	Antoine Leopold, Enrico De Rosa and Nicolas Schinas	ES Brussels IV
S14	Trashplit - A huge impact on recycling with a little effort!	Antonio Brunetti, Lorenzo Gobbi and Daniele Grassi	ES Luxembourg II
S15	Protégeons les Océans : La Bioluminescence Bactérienne au Service de la Préservation Marine	Alizée Da Cunha	ES Luxembourg II
S16	Ocean Deacidification	Nicolo Broom and Mariana Waicman Gonçalves	ES Luxembourg II
S17	Automatic Crop Watering System	Arnav Gupta and Matvey Nikonorov	ES Mol
S18	The mechanical frog	Joachim Baetsle and Dries Caers	ES Mol
S19	A study of the relationship between phonemes of European languages and their geographical location	Alban Rauch	ES Munich
S20	BrainSight – EEG AI Analysis	Abhinav Verma, Chiara Ma and Jingsen Yang	ES RheinMain
S21	Can the quality of medical records be improved through portable, long-term storage?	Marta Kotarba	ES RheinMain
S22	Hunde – die besseren Therapeuten	Margareth Eirich and Jule Hochhaus	ES RheinMain
S23	Mauvaises herbes, si mauvaises que ça?	Ela Ramont, Margarita Ramont and Lucilla Manciocchi	ES Strasbourg
S24	Advancing Educational Frontiers: Approaches for Integrating AI Tools in Teaching and Learning Processes	Klim Stepanenko	ES Tallinn
S25	Could Sunscreen Be Used To Treat Fungal Growth?	Karl Padisaar, Lejon Lehtinen and Mia Heath	ES Tallinn
S26	Power Socket Communication	Niklas Ilmari Tikka and Sulo Pietari Hintsala	ES Tallinn
S27	Like two drops of water. Analysis of Brussels water sources.	Helena Domańska	ES Brussels I
S28	Wireless Energy Transmission Through Waves	Maja Stępniać and Sofia Baj	ES Varese
S29	Regrowth of the flora after extreme events: a case study on the Campo Dei Fiori Mountain	Andrea Petrillo, Diego Pirrami and Anton Dente-ner	ES Varese
S30	What happens when an AI has opinions and emotions?	Sebastian Calacean and Mihail – David Staicu	ES Brussels II
S31	Prototype d'une voiture piézoélectrique	Liisa Bourgey, Victoria Santangelo and Olivia Pataki	ES Brussels II



# JUNIOR

## Projects

### J-01 WRIST INJURIES REHABILITATION

*Pawel Kazimierzak (S3ES), Jean-Luc Fael Bernabé (S3ES), Javier Tejedor Granado (S3ES), ES Alicante*

Wrist injuries can cause serious problems, both for athletes and for people who do not play sports regularly. Rehabilitation of an injury, in this case a wrist injury, can be extraordinarily long, uncomfortable and, if not done correctly, can lead to chronic problems.

This project aims to carry out correct rehabilitation of wrist injuries. To do this, we have designed a glove attached with an elastic band to a fabric placed on the upper arm. This method allows the patient to easily alter the resistance of the elastic band based on the rehabilitator's suggestions by moving the fabric through the arm.

Most of the materials used in this project are recycled, cheap, and readily available and the use of plastic is minimal. Strengthening all muscles of the wrist can be done by wearing only one glove. The glove is durable so it can be used in multiple rehabilitation processes.

Now, we are testing the functionality of the glove, later we are going to do a statistical study of the data we are collecting, and then we will test if the elastic band is strong enough to cover all the possible necessities.





## J-02 SUSTAINABLE MECHANIZED GARDEN

Mireia Orozco Fernandez-Montes (S3ES), Alba Aracil Pérez (S3ES), **ES Alicante**

We did this project because we know that a lot of fruits and vegetables have to go through a very long journey until they reach to our houses, and that can cause more contamination and an increase of the final costs.

The purpose of this study is to show how effective and economical it is to produce proximity products, with the aid of sensors to control the productivity and quality of the final goods. This is applied at a small-scale garden using mechanized technology. This can also be done at big scale, so you can have your own garden with dif-



ferent products and then have all the benefits from it: The foods would be from a proximity source, and you wouldn't have to buy them. This can also make a considerable difference in climate change.

For this project we have used a lot of different sensors like:

- Water level sensor
- Soil moisture sensor
- Sonar: bit
- OLED Screen
- Rainbow LED
- PIR Sensor
- DHT11 Sensor (Humidity and temperature sensor)
- Micro bit

## J-03 WHAT IS ON OUR BEACHES?

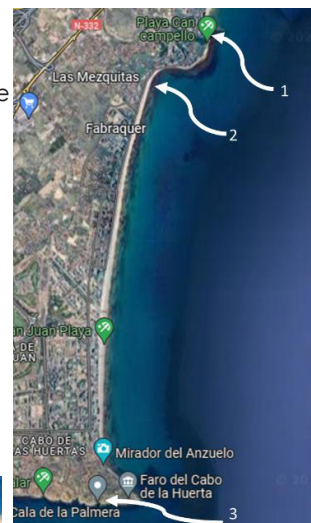
Domínguez González, Raúl (S4es); Meseguer Carrillo, David (S4es); Ruiz Medina, Elisabet (S4es), **ES Alicante**

Plastic is nowadays part of our lives. It is used for endless purposes but, in the process, it always winds up in the same place. Even if we try to recycle and reuse it, it seems that it always tends to go where it is least needed, such as the sea. Plastics from the sea end up on our shores and sometimes we don't even know where it comes from. We have decided to find out and try to discover what kind of plastic reaches our beaches in Alicante.

We went to three beaches, the ones marked in the picture, selected because of their differences. The first one was rocky, the second one was open to the sea and sandy and the third one was a cove. We alternately went to a different area every week: one weekend we went to the first two (from top to bottom) and the next one we went to the third. Once there, we collected all visible rubbish with the help of trash bags, zip bags, gloves and, sometimes, a shovel and a rake. We followed this procedure for a month and a half.

After collection, we took the samples to the laboratory and there we will make a classification to find out where they came from and what type of

plastic they are (PET, HDPE, V, LDPE, PP, PS, etc.). We have observed that plastics remain longer in rocky terrain than in the sand, where it can be blown away or buried. In the coves most of the plastics were embedded in the rocks. We have also seen cases where nature and plastic have lived together: the case of a seaweed rooted to a fishing net. The two were impossible to separate after the algae became entangled with the net.



# DO WATER PARAMETERS AFFECT THE POPULATION AND DISTRIBUTION OF FRESHWATER SPECIES IN CANALS?

Arnav Dhole S4EN, ES Bergen

Canals are a great cultural and historical part of the Netherlands: they have a huge role in controlling the water level (as the government can decide how much water to let in or out from it, working like a dam) and preventing floods. Nevertheless its role, it has a remarkably diverse ecosystem, with species such as the **9 & 3-spined stickleback, tench, and heron**. Invasive species, especially 9 varieties of crayfish, are causing harm to the local flora and fauna.

This experiment aims to find out **how water parameters affect the population and distribution of freshwater species in canals**, as this information **will be necessary** to differentiate the preferred parameters for invasive and native species (my following experiment). This experiment is a long-term project that I will continue till the end of school. The investigation is carried out **at two different canal sites**. Since day 1 in the study, the following

parameters are measured with an aquarium test kit: ammonia, nitrite, nitrate, pH, and the average temperature 1]. of day 1. To record the species found in the canal, a net is placed for 24 hours. Afterwards, the net is removed, and the species are counted as quickly and accurately as possible to avoid causing stress or increasing the risk of mortality for the animals; then, they are gently released back into the canal. All the collected data is recorded in the lab book and on MS Excel for further analysis.

Based on the current findings, nine-spined sticklebacks are more abundant in the "Garden Site" in ammonia-high water (the fish are usually present in greater numbers a week after the ammonia spike). This is possibly caused by water management's halt in water flow, leading to stickleback staying in that area due to not following a current, and therefore also the ammonia and waste building up.

**Table I. Comparison of ammonia to 9-spined Stickleback.**

Garden Site	14.10. 2023	21.10. 2023	28.10. 2023	04.11. 2023	11.11. 2023	19.11. 2023	25.11. 2023	02.12. 2023	10.12. 2023	16.12. 2023	25.12. 2023	31.12. 2023	06.01. 2024	13.01. 2024
NH3/NH4+	0,5	0,5	0,5	1	6	3	3	0,25	6	0,5	1	1	0,25	0,25
9-Spined Stickleback	0	0	0	7	1	31	2	12	10	9	0	1	0	0

Increase	Decrease	Neutral
----------	----------	---------

Resources: [1] <https://www.visualcrossing.com/weather-history/>

# WHICH TYPES OF MEDITERRANEAN SOIL DAMPEN SEISMIC ACTIVITY THE BEST?

Alp Demir S3EN, ES Bergen

The aim of this project is to see which soil type, commonly found in the Mediterranean, dampens seismic activity the best.

The findings of this study will aid in identifying suitable locations for building houses in earthquake-prone areas.

## Materials:

- Model building
- Hot glue gun (For the building)
- Soil 1: Leptosols
- Soil 2: Cambisols or Stagnosols
- Plastic container
  - Vibration motor
  - Voltage adjuster

- Microbit
- Ruler
- Permanent marker

## Independent variable:

- Type of soil and voltage (strength of vibrations).

**Dependent variable:** Whether the model building falls, how long it takes to fall and how much vibration the microbit detects.

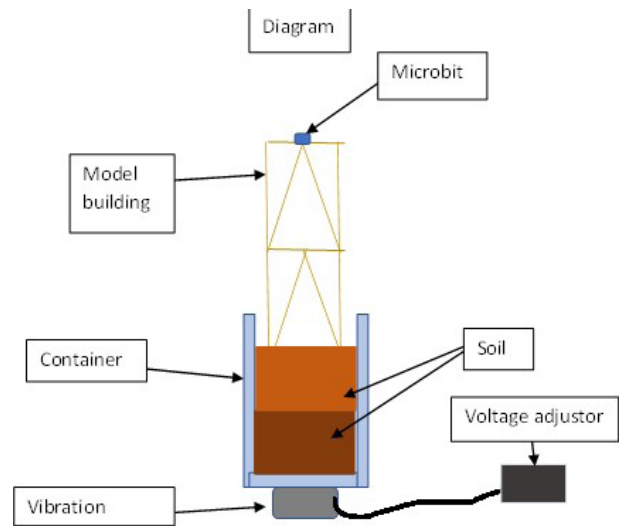
**Control variable:** Container, vibration motor, glue gun and microbit.

## Experimental method:

The method for this experiment is to first place the chosen soil into the plastic container (soil 1 or



soil 2). As in nature, the deeper soil is located at the bottom, while the top layer is at the top. The model building will be placed on top of the soil, 2 cm into the ground, and its depth will be recorded with a marker. Next, once the model building is in place, you put the container on top of the vibration motor. Then, using a voltage adjustor, give 1.5 V to the motor for 2 minutes (equivalent to the length of the earthquake in Turkey in 2023). While the vibration motor is on, the microbit will record the **amount of vibration detected (x, y, z and strength)**, and it will be observed **whether the model building collapses and, if so, the time it takes**. The test will be run three times to ensure the accuracy of the data. The procedure will be repeated for 3, 4.5 and 6 V; obtained data will be represented in tables and graphs and finally statistically compared.



## 90-J-BURGERS BEYOND GRAVITY: PLANT-BASED VS. TRADITIONAL MEAT

Eleni Kyratsis, Eleni-Mary Tzima, Myrto Vasileiadou S3EN, ES Bergen

This project aims to simulate the unique environment that meat would experience during space missions and evaluate the potential benefits of plant-based alternatives for astronauts. Determining **which meat would be better for sustaining the astronauts' health and well-being during long-duration** space missions by researching and evaluating each type of meat's suitability for astronauts in terms of nutritional content, space food suitability and safety and contamination. Finally, considering our results and research, we will also make some future considerations.

**Method:** This experiment is conducted using equal samples (5 g) of each meat (traditional meat and plant-based meat from Beyond Meat). The food samples are cooked at high temperatures and vacuum-sealed in plastic bags. This process simulates how space food is thermostabilised. This helps to eliminate bacteria and other microorganisms. We then placed all our samples in a controlled environment that mimicked the conditions the meals would experience on a space mission. The temperature must be 18.3-26.7°C. The humidity levels must be 40-60%. Finally, the meats would also experience microgravity (89% of the

Earth's gravity). Although it is difficult to replicate microgravity on Earth without access to special equipment, we can place the sealed samples in containers of water. While placing the meat in water won't directly simulate microgravity, it is still a useful method to observe how the meat behaves in a controlled environment. The water creates a buoyancy effect that reduces the impact of gravity, and it also helps us keep the humidity levels from 40-60%. The water is at room temperature (around 25°C), so the meat will be at the right temperature (18.3-26.7°C). Every week, we compare plant-based and traditional meat samples by unsealing three of each to measure and analyse differences in texture, colour, pH and protein content. Finally, for each unsealed individual sample, a microbial control procedure using agar nutrient plates will be carried out, ensuring the absence of any contaminants.



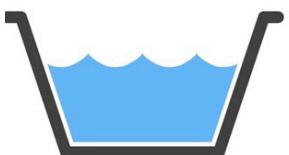
1) Sample's of 5 grams



2) Cook at high temperatures



3) Vacuum seal with plastic bags



4) Place the samples in a container of water

We will repeat this process using multiple samples from each meat (Beyond meat and Plant-based)



5) unseal three samples of each meat, test differences in texture, color, pH and protein content. For each unsealed individual sample, a microbial control procedure using agar nutrient plates is carried out, ensuring the absence of any contaminants.



# J-07 IS MUSIC THE VESSEL TO MARS? WHERE DO THE CHICKEN FIT?

Léontine Summerer S4ENa, Lisanne de Zutter S4ENc, Polina Apanas S4Ena, *ES The Hague*

The goal of our project is to contribute to the project of sending astronauts to Mars. One of the unsolved problems is how the astronauts' mental health will remain in a good condition. This is important as a healthy astronaut is more likely to carry out experiments successfully, to act as a good team player and to stay focussed on the success of the mission. Mental health problems are known to substantially increase the risk of failure of such a mission and the risk of death of the astronauts. Astronauts on a Mars mission need to travel during at least six months to and six months back from Mars in a very tight space. During this time, they will face many dangers and microgravity, they will have little social interaction with other people and be far away from Earth which will not even be visible from the spacecraft.

Music is known to help people in many situations. When researching about it, we have looked at the life and work of Hildegard von Bingen, a composer and doctor from the Middle Ages who used her compositions to cure her patients. She was forgotten and her music remedies were long not investigated further. We have found scientists and musicians who have tested her music on plants, and we would like to see how it affects animals (chickens and mammals), and humans. There are 98 million chickens in The Netherlands and many more in the world. If we can show that they like some type of music, this would be good for the chicken and happy chicken would probably also produce more or better eggs.

We would like to clarify that we design our experiment so that no animal is suffering or be mistreated, and that our experiment not only benefits the project but also the animals.

What we will do:

**1. Work with about 20 free roaming chicken that have 8 boxes there to lay eggs. These chickens are in a small biological farm. The farmer already gave us permission to make this experiment.**

- 4 of these boxes will have music playing while the 4 others do not.
- Every day we will count and record the number of eggs in each box, which will

tell us where most of the chicken lay their eggs.

- We will check whether the chickens have a preference.
- Every week (seven days) we will be changing the music to see if the results change. We have designed the experiment to control for other effects such as the location of the boxes.

We will be using different styles of music including Hildegard's.

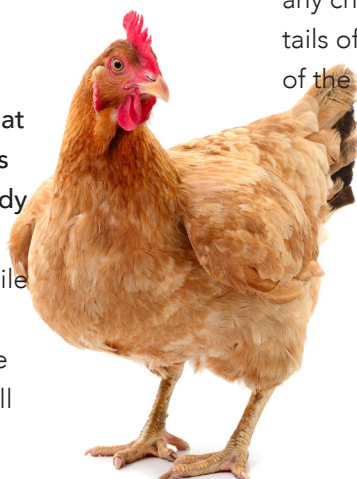
**2. Work in a vet clinic and see if animals are less stressed when checked by the vet.**

- Animals often get stressed when they enter the vet's clinic. We would like to see if their stress level reduces when music is played and compare it without music.
- To not disturb the animals, we will not be there during the experiment. A Raspberry Pi will play it and will film it so that we will be able to see exactly what happened.

**3. Test the reaction of mice with music (they have a similar brain to humans)**

- We would like to capture 2 mice from our kitchen (without harming them)
- We put them in two identical boxes. One with music playing and the other one not.
- We will see if their reaction is different.

After getting the results of the experiments, we would like to have a small interview with an astronaut or an ex-astronaut and ask him about his opinion on music in space and this project, and if our experiment is successful, if there are any chances of testing this in space. The details of the questions will depend on the results of the experiments.



# COMPARING THE RELATIVE AMOUNTS OF DNA PROVIDE INSIGHTS INTO GENETIC DIFFERENCES

Aagneya SARKAR, Freddie LEE, Raphael Branco (all S1) Lycée Edward Steichen Clervaux, Luxembourg, **ES Luxembourg**

## Hypotheses:

- 1) Different mass of DNA can be extracted from the same mass of fruit.
- 2) The masses of DNA extracted from related species - that are close to each other - in evolution are similar.
- 3) DNA from different fruits will exhibit both similarities and differences in terms of quantity.
- 4) Despite the same genetic composition, there are different measurable, visible, comparable differences.

Our group can make a comparison by extracting the DNA contents from an equal mass of different fruits and then we try to analyze some visible and measurable features in other living beings including humans.

The mass of the fruit tissue we start with should ideally be the same for each fruit to ensure this fair comparison. We are using spectrophotometer for the comparison of the extracted DNA contents.

Finally, we would like to find all the answers of our

hypotheses.

After this, we are going to see how different things affect our genetic material on our phenotype (e.g. physical appearance).





# CAN POTATOES GROW IN THE AIR WITHOUT SOIL?

Martina Noguerola Peñuelas, Anna Cornelia Maria Wenzel and Eléa Solenne Gross S1 DEB, ES Frankfurt

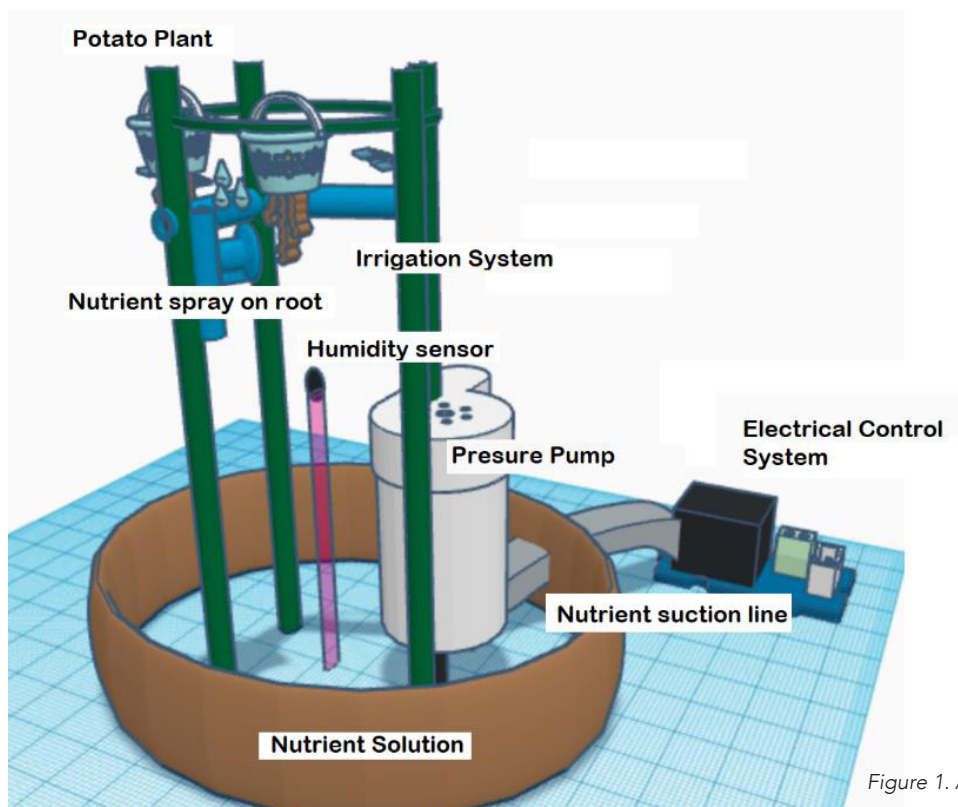


Figure 1. Aeroponic scheme

Aeroponic growing is a new method to cultivate plants in air or mist environment without the use of any substrate. We aim to emulate this technique and assess the distinctions between aeroponic plant growing and traditional methods, studying the advantages and disadvantages of each to determine the better option.

Although the advantages of no needing crop land are evident, as well as the reduction of pest in the aeroponic system, the main challenge in aeroponic farming is the need for constant monitoring and application of a specific nutrient solution to prevent the plant's death. We intend to solve the issue by developing an Arduino program with a humidity and pH sensor to make sure that we apply the correct amount of nutrient solution and water to the plant.

We are doing the experiment using potatoes, suspending them in plastic and including an irrigation system. The irrigation system delivers the nutrients to the hanging potato as well as water and oxygen. Finally, the whole system is covered with black fabric to avoid pests.

After some research, we decided to build a nutrient solution composed of 2.36g  $\text{CaNO}_3$ , 5.04g  $\text{KNO}_3$ , 2.36g  $\text{KH}_2\text{PO}_4$ , and 2g  $\text{MgSO}_4$  each 10 liters.

The hanging system is in the tank with water

and the plant is irrigated automatically following some criteria such as a humidity threshold, a pH of 6.7 and irrigation every 30 minutes in case the sensor was not activated. We are regularly monitoring the potato, documenting its growth progression in a graph and in an excel sheet.



Figure 2. Aeroponic system



# SCREEN GUARDIAN: CAN WE COME BACK FROM THE DIGITAL TRAP?

Martha Goodchild (S2ENA), Verónica Jara Gómez (S4ESB), ES Brussels III

## Summary:

With great power comes great responsibility, and digital media is affecting us in more than one way. In this project, we will perform a series of data-compiling experiments to grasp media usage in EEB3. That way, we will have a better understanding of how aware people are of their media usage and how it affects neurological development. Once our data is compiled and correctly analyzed, we are going to estimate just how much digital media affects the young mind. With this data, we are going to create a media rehabilitation app targeted at teens, ScreenGuardian.

## ScreenGuardian:

It is an app, soon to be available for iOS and Android, where teens are invited to reduce the time, they spend on social media. Inside the app, the students fill out a short inquiry form. After that, an algorithm we have created would tell them how much they should reduce their screen time and propose a plan. The app allows them to reduce their media time in small increments, until they have reached their goal.

Afterwards, the teenagers in question would receive alerts from the app warning them not to return to old habits, if it detects an increase in usage. But how are we going to make teens want to reduce their screen time? With rewards.

## Methodology:

- Survey of a wide range of students from EEB3.
- Memory retrieval, cognitive acuity tests, and reading tests.
- Control groups and experimental groups.
- App and coding softwares.

## Objective:

We want to make teenagers aware of what is happening to their brains when they use digital media, and help them change their lives.



12. Have you recently noticed any changes in your attention span or ability to concentrate?

- ☐ Yes
- ☐ No

13. Have you noticed any changes in your academic or work performance that you attribute to excessive screen time ?

- ☐ Yes
- ☐ No
- ☐ Yes, but I don't know if they have anything to do with screen time

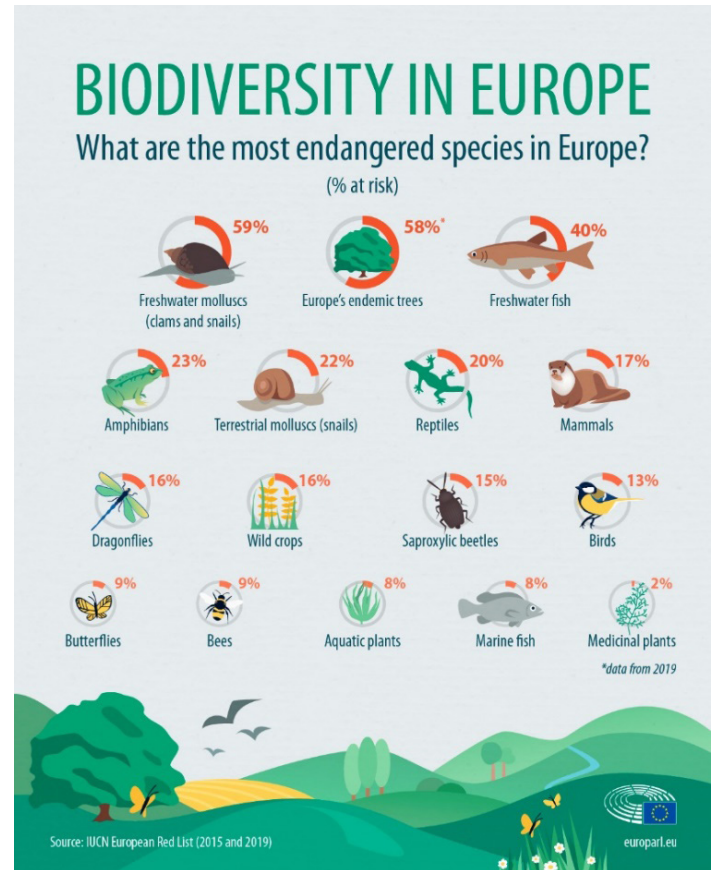
14. Have you ever felt tired or drained after spending a lot of time on screens?

- ☐ Yes
- ☐ No

# ENDANGERED AND THREATENED SPECIES IN THE WORLD

Artemis Palamidi S1 ELB, ES Brussels III

One out of eight million species in the world are at risk of extinction. In this work we will present which species of animals are under extinction and where in the world they are located. We will gather and combine data from international organizations such as the EU or the UN. We will refer to factors that lead to this threat and we will propose ways to deal with it. We will focus on specific species, and we will present the evolution of their population over the years. This list will contain mammals, birds, amphibians, sea animals and others. Finally, we will refer to cases where specific actions caused the recovery of populations, saving an entire species, and allowing humanity to look to the future with optimism.



# CAN MICROALGAE ALSO BE USED AS A NATURAL PRESERVATIVE FOR FOOD?

Ankit Senthil (S2 ENA), ES Karlsruhe

## Idea:

Antibiotics act on microorganisms by inhibiting their growth or causing their destruction, therefore they are widely used in food industry to prevent diseases in livestock. However, their overuse has raised concerns about antibiotic resistance and the potential impact on human health. Efforts are being made to reduce the unnecessary use of antibiotics in agriculture to safeguard both animal and human well-being. Recently, extracts of microalgae have been investigated for their potential antimicrobial effects. It has been shown so far that extracts of Spirulina and Chlorella can reduce the growth of fungi and viruses but their effects on bacterial growth have so far not been analysed.

## Material:

- 1) Meat from supermarket
- 2) Q-Tips
- 3) Agar plates
- 4) Incubators
- 5) Shaker
- 6) Chlorella and Spirulina powder

## Main method:

Take a swab sample of meat (chicken and pork) from the supermarket as sample and cultivate the bacteria on agar plates. Then perform tests with different concentrations of extracts of Spirulina and Chlorella. If possible, we would like to compare them to commonly used antibiotics. The results will be evaluated by counting colonies on the agar plates and determining halo size.

# FIRST AID ROBOT

Vito Pezer, Mael Bartuli und Mateo Escarate-Kruwinus (alle S2 DEA), ES Karlsruhe

## Idee:

Cette recherche se concentre sur l'évaluation de l'efficacité des drones de sauvetage, pour livrer des biens vitaux et du matériel de première aide dans des zones isolées, en se basant sur le GPS. L'expérience vise à déterminer la faisabilité de cette approche et son application potentielle dans des situations d'urgence à évaluer.

## Matériel:

- Un drone abordable (pour notre but, il est important que les drones soient abordables, afin qu'ils puissent être utilisés dans différentes situations à faible coût).
- Une petite station météorologique portable.
- Des téléphones pour mesurer le temps de voyage et le GPS.
- Un petit kit de première aide ou un modèle avec le poids et le volume appropriés.

## Méthodes:

**Méthode1:** Sélection des zones de test (différentes zones et niveaux de difficulté. Montagne, Champ et Mer).

**Méthode2:** Équipement et configuration du drone: Le drone est équipé d'un défibrillateur, d'un kit d'urgence allergique et d'autres équipements de sauvetage. Le drone est configuré pour le transport de biens d'urgence et du matériel de première aide. Le drone nécessite un système GPS.

## Comment ça marche:

On laisse le drone voler dans les zones de test avec l'aide des coordonnées GPS.

On documente le temps de vol, la distance, la précision de l'atterrissage et les conditions météorologiques. Les vols doivent être répétés dans différentes conditions pour maintenir une base de données fiable. Ces données, que nous collectons, analysons pour l'efficacité et la précision.

## Motivation:

On veut aider les personnes en détresse et se trouver dans un terrain difficile, une aide rapide et simple. Selon nos recherches, il n'y a pas de drones qui puissent être utilisés pour un tel but.

# ECO-DOUCHE

CLEMENCE Timothée (S3FRD) et GARCIN LACERES Maceo (S3FRC), ES Brussels IV

Comment sensibiliser efficacement à la consommation raisonnée d'eau et d'énergie lors des douches?

Notre projet, consiste en la réalisation d'un prototype capable de mesurer le volume et la température de l'eau lors d'une douche, de calculer l'énergie nécessaire pour chauffer cette eau et d'afficher en temps réel le volume d'eau et l'énergie consommée sur un autre dispositif (à l'abri des gouttes...)

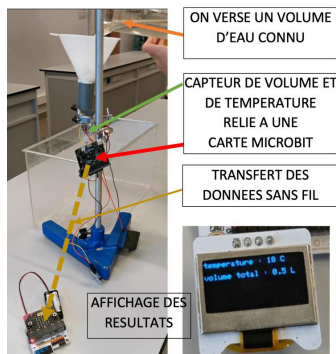
Quelques mots clé de notre projet

EXPERIMENTATION – PROGRAMMATION – ECONOMIE – EAU – ENERGIE

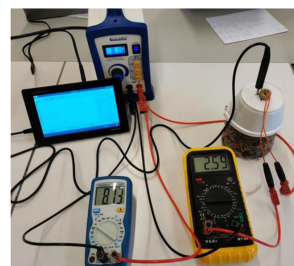
Nous avons déjà bien avancé les expériences et les recherches.

Notre démarche est la suivante :

- Recherches sur les consommations moyennes d'eau et d'énergie lors d'une douche (à approfondir)



EXPERIENCE PERMETTANT DE MONTRER QU'IL FAUT APPORTER  $C_{eau} = 4180 J$  POUR RECHAUFFER 1,0 kg D'EAU DE 1°C

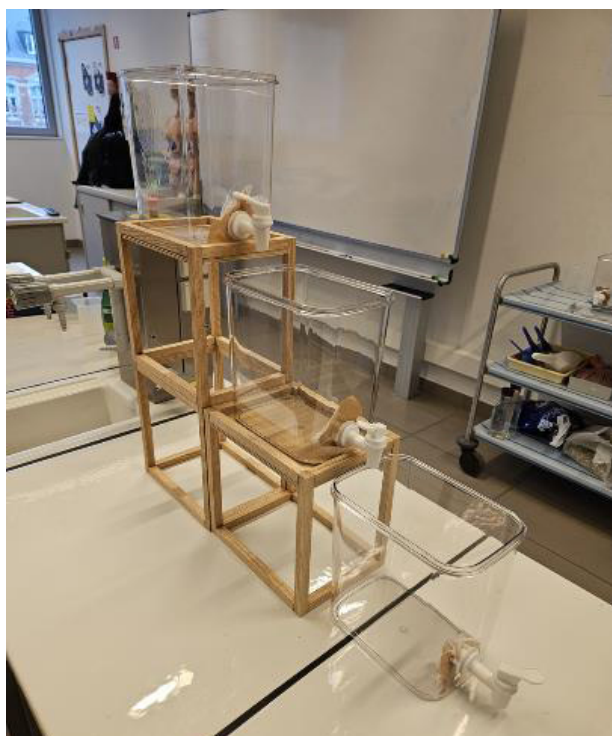


fondir)

- Expérience pour comprendre le fonctionnement du capteur de volume (à effet Hall) (fait)
- Programmer le Microbit pour calculer et afficher le volume consommé (fait)
- Exploiter un capteur de température avec un Microbit (fait)
- Expérimenter pour comprendre comment déduire l'énergie thermique consommée en exploitant la température et le volume d'eau mesurés (fait)
- Transmettre des données d'un Microbit émetteur à un Microbit récepteur (fait)
- Créer un menu qui permet d'afficher et enregistrer VOLUME ET ENERGIE de chaque douche pour chaque utilisateur et attribuer un Eco-score (à faire)
- Faire une application pour téléphone (à faire si nous avons du temps)







Montage en cascade

## Problématique:

Nous avons remarqué que les rivières, les canaux, les étangs et les mares sont souvent contaminés par les polluants suivants: pesticides, hydrocarbures, plastifiants, médicaments, engrais chimiques. Les causes de cette pollution sont principalement liées à l'agriculture conventionnelle et au traitement des eaux usagées.

Avec notre équipe nous avons décidé d'y remédier en créant une mini-station d'épuration!

## Hypothèse:

Avec notre mini-station d'épuration, nous allons chercher à comprendre comment le système de phyto-épuration (ou lagunage) composé de plantes de marais ou plantes d'eau (par exemple: le carex, la massette, l'iris des marais, la menthe aquatique...) ainsi qu'un filtre à gravité peuvent filtrer l'eau et la purifier.

## Expérimentation:

L'expérience consiste en un double système avec un filtre à gravité et des plantes d'eau. Le système de filtre à gravité sert à filtrer l'eau polluée à l'aide de la gravité. Il fonctionne ainsi : l'eau passe par plusieurs couches constituées de gravier (fin et plus épais), de charbon et de sable selon un ordre précis (visible sur la photo: gravier, charbon, sable, gravier, sable et gravier). Ces couches filtrent l'eau en absorbant les polluants.

Pour la phyto-épuration, nous avons utilisé du sable et du terreau en y mettant les plantes (Cyperus et Carex à épi). Nous avons arrosé ses plantes d'une eau polluée composée de  $\text{KNO}_3$  à minimum 90 mg/L de  $\text{NO}_3$  et de  $\text{KH}_2\text{PO}_4$  à minimum 15mg/L de  $\text{PO}_4$ . Nous avons arrosé avec la même composition le filtre à gravité.

## Perspectives:

En appliquant ces deux manières de filtration (lagunage et filtre à gravité) nous espérons pouvoir améliorer la qualité de l'eau et la rendre utilisable en tant qu'eau technique et de savoir quelle méthode est la plus efficace.

Composition des bacs d'épuration



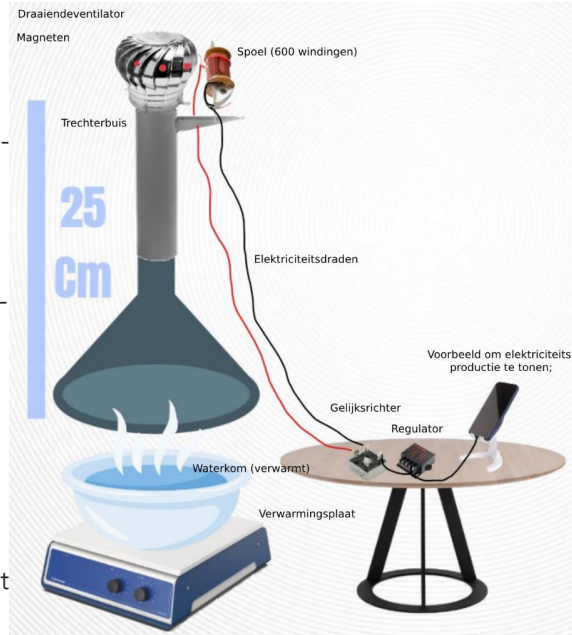
Filtre à gravité



# RÉCUPÉRATION DE L'ÉNERGIE DES VENTILATEURS CHEMINÉE

Erik Van de Velde et Igor Vandeputte, *ES Brussels IV*

Nous aimerions démontrer qu'il est possible de produire de l'électricité sans nuire à l'objectif initial de notre ventilateur de cheminée. Le vent permet d'actionner un ventilateur qui déplace des aimants devant une bobine. Celle-ci produit de l'électricité en fonction du vent. Cela implique donc que la production d'électricité sera variable. Lorsque le vent est fort, ce ventilateur extérieur fait également office d'aérateur et assure en même temps la



ventilation.

Une plaque à induction chauffant l'eau représentant l'air à l'intérieur de la hotte. Cette vapeur est recueillie dans un tube qui mène à la hotte rotative à laquelle sont attachés des aimants. La hotte tourne sous l'influence du vent extérieur. Les aimants passent devant la bobine, générant un courant électrique qui est ensuite acheminé vers un redresseur et un régulateur.

Nous nous attendons à ce que cela fonctionne sans avoir d'effet sur l'objectif initial, à savoir la production d'électricité.

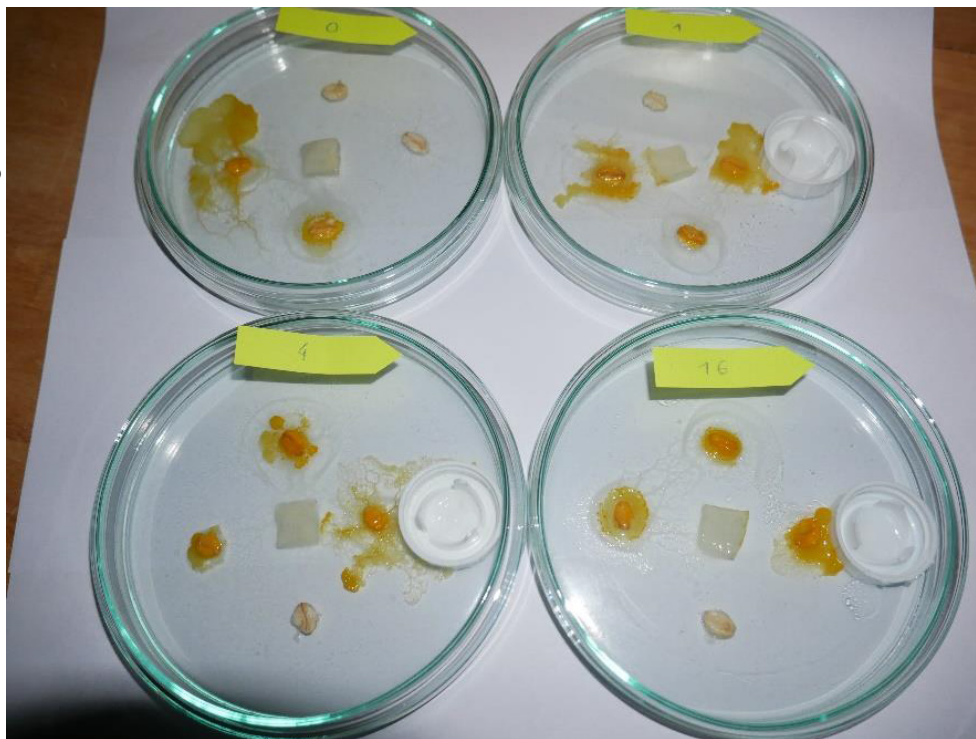
# BLOB VS AIR POLLUTION: WHO WINS?

Raphaël Newton and Raphaël Sniter (LUX 1, S1FRD class), *ES Luxembourg I*

Air pollution has devastating and wide-ranging effects on our planet. It causes more than 300 000 deaths per year in the EU. The European Environment Agency also found negative effects on the environment, pointing to damages to biodiversity. We are conducting experiments to identify and measure the impacts of various air pollutants on *Physarum polycephalum*, also known as the "blob". This unicellular myxomycete is often used as a model organism for research. We will test common pollutants, such as particulate matter (originating from combustions) and VOCs (Volatile Organic Compounds) more common in our interiors. We will compare, using time lapse video recording, the growth of the blob in a polluted environment to the growth of a blob in a normal environment. We will test whether any negative effects are long lasting or reversible. We will conduct our experiments on various types of blobs.

To see our first results with low quantities of alcohol at 70°C, click here ([https://eursc-my.sharepoint.com/:v/g/personal/snitterra\\_student\\_eursc\\_eu/](https://eursc-my.sharepoint.com/:v/g/personal/snitterra_student_eursc_eu/))

[EeSpKnnHZNIJmW2o7kaO6QBJ3-dOOYd0Y-44wu8dYBsZXg?nav=eyJyZWZlcnJhbEluZm8i-OnsicmVmZXJyYWxBcHAiOiJPbmVEcmI2ZUZvck-J1c2luZXNzliwicmVmZXJyYWxBcHBQbGF0Zm9yb-Sl6lIdYiIsInJlZmVycmFsTW9kZSI6InZpZXciLC-JyZWZlcnJhbFZpZXciOiJNeUZpbGVzTGlua0NvcH-kifX0&e=w0l9oQ](https://eursc-my.sharepoint.com/:v/g/personal/snitterra_student_eursc_eu/?e=SpKnnHZNIJmW2o7kaO6QBJ3-dOOYd0Y-44wu8dYBsZXg?nav=eyJyZWZlcnJhbEluZm8i-OnsicmVmZXJyYWxBcHAiOiJPbmVEcmI2ZUZvck-J1c2luZXNzliwicmVmZXJyYWxBcHBQbGF0Zm9yb-Sl6lIdYiIsInJlZmVycmFsTW9kZSI6InZpZXciLC-JyZWZlcnJhbFZpZXciOiJNeUZpbGVzTGlua0NvcH-kifX0&e=w0l9oQ)





# UNE CAPSULE AUTONOME BASÉE SUR LA LENTILLE D'EAU *LEMNA MINOR*

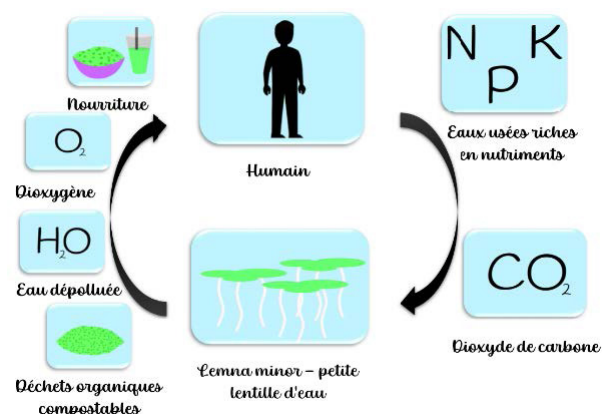
Clémentine SAMSON ZILLIOX – S4frc, ES Luxembourg II (Mamer)

L'autonomie humaine a toujours été un gros problème, surtout dans les lieux inhospitaliers et non fertiles comme l'espace ou les déserts. J'ai donc fait quelques recherches sur les plantes qui pourraient permettre de régler ce problème et je suis tombée sur une plante incroyable : la petite lentille d'eau (*lemna minor*). Le potentiel de la petite lentille d'eau est large ; elle est comestible et contient énormément de protéines (de 15 à 40% de la matière sèche<sup>1</sup>), elle pousse très vite (dans des conditions optimales, elle double de masse en 48h) et filtre efficacement les composés organiques ainsi que les métaux lourds. Elle est déjà utilisée en aquaponie, dans l'alimentation des poissons d'élevage et de nombreuses expériences concernant le traitement des eaux usées ont déjà eu lieu.

Mon but est de concevoir un modèle de capsule autonome dont le seul apport externe est l'énergie solaire. L'écosystème de cette capsule est basé sur la lentille d'eau et l'être humain, ainsi que plusieurs autres plantes nécessaires à l'alimentation humaine. Les humains apportent aux lentilles d'eau les nutriments comme les composés azotés, le phosphore et le potassium via l'urine et les eaux usées et du dioxyde de carbone par l'air expiré. Les lentilles d'eau apportent du dioxygène, de la nourriture et des déchets organiques compostables utilisables pour faire pousser les autres plantes, mais surtout, avec l'aide de bactéries, purifient les eaux usées des composés azotés.

Dans le cadre de mon projet, je teste actuellement

dans divers milieux la filtration d'une eau saturée de différents composés azotés et métaux par les lentilles d'eau et leurs bactéries associées. J'évalue aussi leur capacité à absorber du dioxyde de carbone. Ces résultats me permettront de déterminer le volume d'eau, la surface d'exposition au soleil et la quantité de plantes autres que la lentille d'eau nécessaires à la survie de quatre humains dans la capsule, ainsi que sa taille minimum.



1 J. Xu et al. (2021): Duckweed (Lemnaceae) for potentially nutritious human food: A review, Food Reviews International, DOI: 10.1080/87559129.2021.2012800

2 Iqbal J, Javed A, Baig MA. Growth and nutrient removal efficiency of duckweed (*lemna minor*) from synthetic and dumpsite leachate under artificial and natural conditions. PLoS One. 2019 Aug 27;14(8):e0221755. doi: 10.1371/journal.pone.0221755. PMID: 31454381; PMCID: PMC6711526.

# SUSTAINABLE PORTABLE AFFORDABLE AQUAPONICS UNIT

Stella Schaerf S4ENA, ES Mol

## Purpose and Humanitarian Relevance:

This project's purpose was to address the problems of malnutrition, poverty, lack of access to clean water, medical care and electricity in Africa. Also, climate change worsens water-related hazards and water scarcity and calls for sustainable solutions in developmental and drought-ridden countries. The above-named issues and the wish to improve traditional aquaponic designs

inspired the design of a multifunctional aquaponics unit for developmental countries that is affordable, portable and sustainable. Its goal is also to improve nutrition, have medical remedies available and gain independence from non-renewable energy sources by using solar power. The portability of the unit makes it conducive to maximization of solar power and use of limited space in impoverished areas. The project strives to build the unit with





materials available in developing countries and include a water purification station built from recycled material and available natural resources. Contrary to traditional aquaponic systems with a solely nutritional purpose, this unit aims to combine medicinal and nutritional use by growing medicinal plants.

#### Methods, research, experiments:

Extensive research has been undertaken into current problems of malnutrition, poverty, water scarcity, lack of access to electricity and medical care in Africa, the study of conventional aquaponics systems, water purification, filtering systems and processes, pH testing, African fish, medicinal and nutritional plants, solar energy, the budget comparison between traditional aquaponics and my design as well as research of recyclable



materials for the construction of the unit and their availability in African countries. In various experiments, different natural resources such as sand, charcoal, gravel and cotton were tested for filtering capacity, and a filter was built. A pH scale was developed using cabbage juice and was used to cross-reference against water samples with different pH values.

#### Results:

The various research and experiments resulted in the construction of a sustainable, portable and affordable aquaponics unit with water purification station.

#### Conclusion:

The prototype could be used in other developmental countries with some modification in the use of plants and fish to accommodate indigenous needs and regulations.

## J-20 THE EFFECT OF PROPOLIS ON BACTERIA AND FUNGI

David Hateley (S3DEC) and Leon Alink (S3DEC), ES Munich

Propolis is a resinous mixture produced by honeybees by mixing saliva and beeswax with exudates from trees and flowers. It has been used for centuries to treat respiratory infections in people.

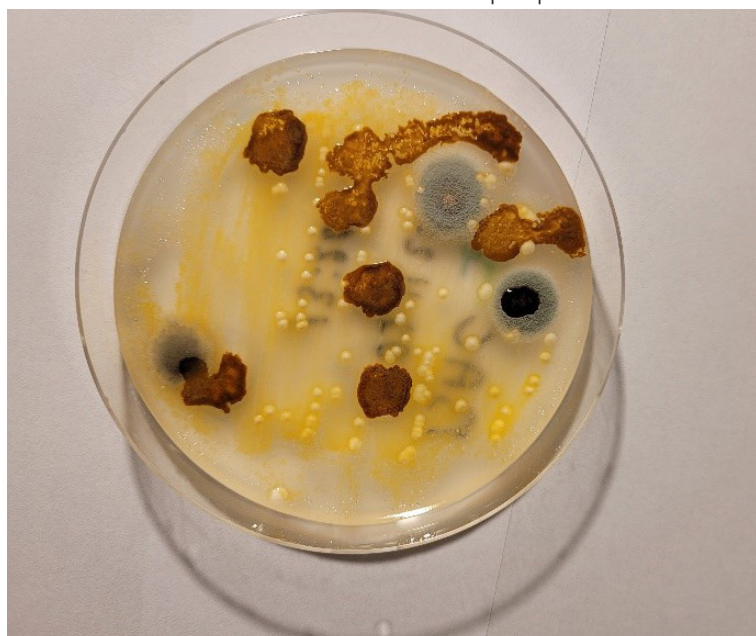
Our question to be answered is how does propolis affect bacteria, fungi and especially mould?

We came to this idea because when people have a

cold, they often use propolis by spraying it in their throat or swallowing drops of it, in order to recover faster.

There are various propolis formulas available: hydro-alcoholic propolis solution, glycolic propolis solution, aqueous propolis solution and pure propolis.

For our experiments we tested propolis extracts on various bacterial and fungal cultures. Initial results suggest a bacteriostatic activity of hydro-alcoholic propolis solutions, as well as an inhibitory effect on mould growth.



## J-21 POUR LA PARESSE DU PROFESSEUR

Milo Falala Frati, Emil Dujardin et Ewan Carlo s3FR, ES Parma

Notre idée pour le symposium est de créer un effaceur automatique qui réussit à effacer un tableau de manière efficace. On a eu l'idée quand on voyait que le tableau n'était pas bien effacé, donc on voulait éviter cela. Pour ceci nous utiliserons une machine munie d'un moteur électrique et d'une batterie, le moteur sera utilisé pour mettre en marche une paire de roues fixées sur des rails en haut et en bas du tableau. Ci-dessous se trouve un schéma pour montrer le principe de notre effaceur.

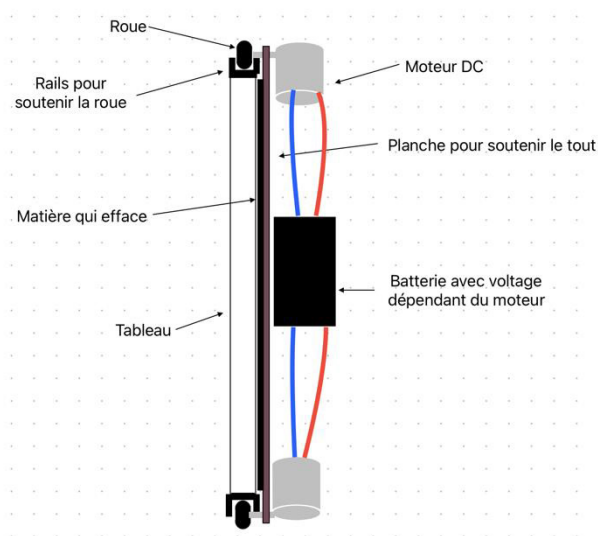
Pour comprendre comment déplacer l'effaceur d'un côté du tableau à l'autre, on a fait des recherches sur le moteur DC. Pour changer la direction du moteur il faut changer la direction du courant dans le circuit électrique. Pour faciliter la construction et le

temps d'effaçage, on a décidé d'effacer toute la longueur en une seule fois sans rajouter un autre mécanisme qui déplacerait l'effaceur du vers le bas vers le haut.

Nous sommes en train de réaliser un prototype avec effaceur à échelle réduite sur un tableau de 30x45 cm comme sur le schéma ci-dessus. Pour

l'effaçage du tableau prototype, on programmera le mouvement pour les allers-retours.

Après avoir assemblé la machine, on exécutera des tests pour valider le fonctionnement et l'efficacité de l'effaceur. On comptera combien d'allers-retours la machine a besoin pour effacer toute la surface du tableau et programmer l'arrêt de la machine.



## J-22 LES RÈGLES ET L'ÉCOLE

Lena Moussaoui Chenot, Anahelle Paima S4FR, ES Parma

### Quelles sont les conséquences des règles dans le milieu scolaire ?

En tant que filles qui souffrons de règles douloureuses, nous avons souvent eu l'impression à l'école d'être désavantagées. Nous sommes toutes concernées par les menstruations mais ne sommes pas toutes égales face à la douleur. Pour certaines d'entre nous la douleur est «handicapante». En particulier, nous ne parvenons pas à nous concentrer toujours de façon optimale ce qui ne nous permet pas toujours d'être au maximum de nos capacités, suivre les cours peut s'avérer un calvaire, nous nous trouvons désavantagées lors de certaines activités voire être parfois absentes en raison de douleurs trop intenses.

Pour notre projet, nous avons tout d'abord effectué des recherches sur le cycle menstruel et les douleurs associées à celui-ci. Nous nous sommes aussi intéressées à la manière dont

ce problème est abordé dans le milieu scolaire. A titre informatif, nous avons également étudié ce sujet dans le cadre professionnel. Pour notre étude de terrain, afin d'avoir des données tangibles, nous avons envoyé un questionnaire aux filles du secondaire de notre établissement afin de nous rendre compte de combien d'entre elles sont touchées par la dysménorrhée et quelle influence cela a sur leur quotidien.

En outre, nous avons pu acquérir les connaissances sur le cycle menstruel en interrogeant le Docteur Galanti, Cheffe de service en gynécologie à l'Ausl / Spazio Giovanni » de Parme, un lieu où les jeunes peuvent bénéficier de consultations gynécologiques.

A partir de l'ensemble de ces données, nous envisageons à l'aide d'un électro simulateur de reproduire une douleur « similaire » pour la pro-



poser aux garçons de notre établissement afin de recueillir leurs impressions. La mise au point de cette expérience prendra en compte la morphologie / constitution différentes des garçons. Cette expérience devrait nous permettre d'avoir ainsi un retour objectif de la part des cobayes que nous

analyserons.

Nous espérons que grâce à ce projet, basé sur des études comptables et scientifiques, nous apporterons des réponses et explications sur ce phénomène récurrent que sont les règles douloureuses.

## J-23 EMPREINTE MUSICALE

Chloé Lapy, Serena Peracchi, Camilla Feuchio s4fr, ES Parma

Nous faisons une étude sur la concentration et l'inspiration que peut apporter un certain genre de musique. Beaucoup de personnes aiment étudier en écoutant de la musique, sans vraiment comprendre si elle les aide. Voilà pourquoi nous avons choisi ce thème.

Nous sommes en train de tester 3 types de musique différents sur un peu plus de 50 étudiants. Les 3 types de musique sont : Instrumental (triste, sans paroles) ; Rock (agressif, avec paroles) ; Classique (joyeux, sans paroles).

Les expériences se déroulent ainsi:

Nous soumettons les étudiants à 3 expériences similaires (une par genre de musique). Chaque expérience se divise en trois activités : un jeu de mémoire, une résolution d'expression mathématique adaptée à leur niveau et une compréhension de texte reprenant les genres littéraires qu'ils étudient actuellement en L1. Ils doivent réaliser ces activités



en écoutant le fond musical.

De plus, nous avons soumis les élèves à deux questionnaires :

- Le premier avant les expériences, pour savoir si les élèves ont l'habitude d'écouter de la musique pendant qu'ils étudient. Si oui, quel genre pour voir si le changement de musique qu'ils écoutent habituellement à un impact.
- Le deuxième à la fin de chaque expérience pour savoir si la musique qu'ils ont entendue, les a aidés à se concentrer, si elle les a déconcentrés ou, si elle ne leur a rien changé.

À la fin de nos expériences, nous essaierons de déduire le genre musical le plus efficace pour la concentration et le plus adapté à l'étude.

Nous avons hâte de vous présenter les résultats obtenus de nos expériences en avril!

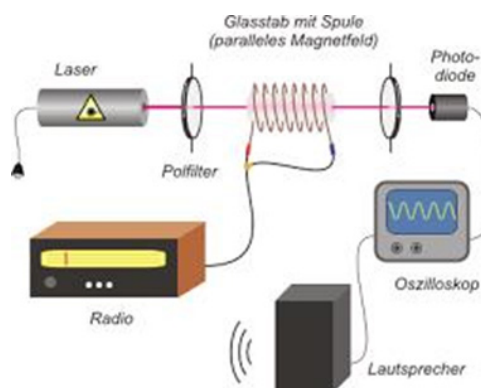
## J-24 MUSIKTRANSPORT AUF EINEM LASERSTRAHL

Julius Schlüter (S3DEB), ES RheinMain

Mein Projekt beschäftigt sich mit dem Problem, wie man Informationen (z.B. Musik, Sprache, usw.) auf einem Laserstrahl über eine längere Strecke transportieren kann.

Grundlage für meinen Versuchsaufbau ist der Faraday-Effekt.

Dieser besagt, dass polarisiertes Laserlicht in einem Medium durch ein Magnetfeld seine Schwingungsrichtung drehen kann. Mit Hilfe eines Polarisationsfilters quer zur Schwingungsrichtung des polarisierten Laserlichts kann erreicht werden, dass normalerweise kein Licht den Filter passieren kann. Mit einer strom-



durchflossenen Spule, die ein Magnetfeld erzeugt, kann die Schwingungsrichtung des Laserlichts gedreht werden, so dass ein geringer Lichtanteil durch den Polarisationsfilter kommt. Wenn man nun Musik auf die Spule gibt, dann gibt es hinter dem Polarisationsfilter geringe Helligkeitsschwankungen im Takt der Musik. Diese werden von einer Fotodiode registriert. Das Signal wird verstärkt und kann mit einem Lautsprecher wieder als Musik hörbar gemacht werden. Der Laser überträgt daher die Musik. Unterbricht man mit der Hand den Laserstrahl, so hört die Musik auf zu spielen.





## FOOD WASTE IN BRUSSELS

Maja Limantaitė (S2ENB), Etain O'Mahony (S2ENB), Eliza Slavova (S2ENA), **ES Brussels I**



Our team has noted one of the most environmentally pressing issues: food waste. It is estimated that worldwide, one third of the food produced for human consumption is wasted or lost.

Food waste adds an estimate of 6%-8% to global warming.

Can we reduce food waste at home and find out how much food the school canteen wastes?

We started by speaking to our (P2-S7) school canteen to find out how much food we waste at

school. We have also emailed some restaurants in Brussels to see how much food they waste and we will continue our research on both of these matters.

Our next task is the 'Sniff and Smell Test'. There is regular confusion between use-by and best-before dates. We have researched that there are some foods which are safe to eat after their best-before date and we want to show that by doing a test.

Our last part is conducting a survey to understand which types of foods are commonly wasted and to see if people are willing to apply the Sniff and Smell Test in everyday life in order to reduce their food waste. We want to raise awareness about how each one of us can play a part in reducing food waste.

We hope you will enjoy our project!

## HOW ACTUALLY CLEAN ARE THESE EVERYDAY OBJECTS? - TESTING HOW CLEAN IS OUR SCHOOL

Nina Szmytkowska and Maria Pirveli, S4PLA, **ES Brussels I**

Have you ever wondered how clean something is?

We all know that trash cans, floors and toilet seats are dirty, so we don't touch them with our hands.

But what about everyday items that often do come in contact with our hands?

That's what we wanted to check - how many bacteria are on these everyday objects. We often don't even realise how unclean they may be. Based on studies, even though bacteria can live up to only two hours on surfaces like door handles, keyboards, and tables, their number doubles every 4 to 20 minutes.

We made this project using sterilized ear buds that were previously soaked in distilled water, followed by the collection of the data from the tested objects. We transferred the samples into petri

dishes by smudging the bacteria onto the gelatine that was previously poured into the dishes. The petri dishes were put in a box in which temperature didn't go over 38 degrees and left to start growing the bacteria.

Our goal is to check which surfaces transmit bacteria the most and bring awareness about our everyday surroundings, their cleanness as well as

how safe they are for our health. We hope that our actions bring positive changes to people's lives, such as developing the habit of trying to keep our environment cleaner.

This topic was chosen because we think it's important to have a clean environment around us. It reduces the risks of illnesses, spreading diseases and overall makes life more comfortable and pleasant.



Le cancer est une des maladies les plus difficiles à soigner au monde et c'est l'une des premières causes de mortalité de nos jours. En Belgique environ 30 000 personnes en meurent chaque année. Alors comment peut-on le soigner ? Il existe plusieurs traitements comme la chimiothérapie, l'hormonothérapie et la radiothérapie. Dans mon projet, je me concentre sur la radiothérapie. Dans une première partie, je présenterai mon travail de recherche visant à expliquer précisément comment fonctionne cette technique de traitement du cancer, et ses trois types principaux : la curiethérapie, la radiothérapie externe et la radiothérapie métabolique.

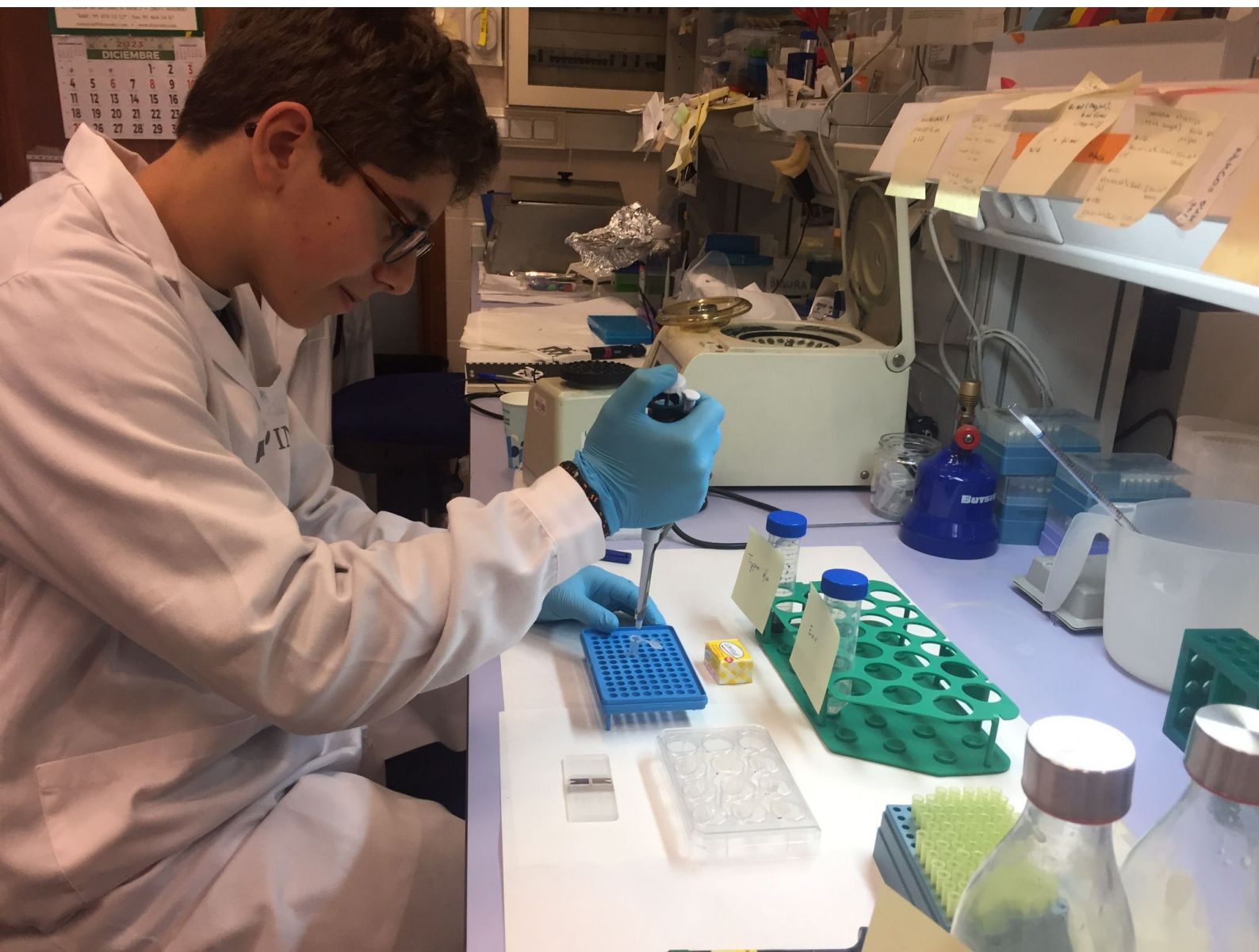
Dans une seconde partie, je présenterai les résultats des expériences que j'ai réalisées pour mieux comprendre la radiothérapie. Faute d'avoir accès à des rayons ionisants et à des cellules cancéreu-

ses, j'ai analysé les effets des microondes sur des cellules vivantes: des levures.

J'ai pu montrer les effets des microondes sur les levures, d'abord d'une manière macroscopique en analysant l'activité des levures (production de gaz carbonique), puis en observant les levures au microscope inversé.

Ces expériences m'ont permis de mieux comprendre l'intérêt de la radiothérapie, mais aussi ses limites et ses dangers.

L'idée de ce projet m'est venue lorsque mon grand-père a commencé à se faire soigner avec la radiothérapie, et j'ai voulu en apprendre davantage.



## RAINFALL CHANGING

Senni Tobia, Consoli Riccardo S3it-a, **ES Varese**

**Key words:** Rainfall strength, low and high precipitations

Our project is a data collection and analysis, to see the evolution of the strength of the rainfall's events in Varese, from 2004 until 2022. We wanted to see if not only the precipitations changes along the years, but also if there are more intense rainfalls.

In this analysis, with data from ArpaLombardia, we discovered that the rainfalls are changing: the low rainfalls (<10 mm/h) are decreasing, while the high are increasing. We have done also a practical experience to see how the rainfalls data are taken: we build a pluviometer 1m x 1m by our selves, unfortunately we haven't have enough data to use it in any method.

## HOMEMADE SPACE FOOD EXPERIMENT

Ayanna Le Boloch' and Cléophee Augendre Della Corte S2 FR, **ES Varese**

Our project aims to experiment the possibility to create a menu adapted to the needs of astronauts in a normal kitchen.

We will analyse the specific needs of their diet, additional calories, vitamin and mineral intake, take into account the importance of the flavour of the dishes, then develop an appropriate menu.

We will therefore have to pay attention to the cooking methods most conducive to the preservation of nutrients:

- Steam / oven / pan / vacuum ...
- Cooking mode / cooking time / temperature

We will take specific care of flavours because astronauts are said to lose taste when they're in space.



Once this phase is completed, we will experiment different preservation techniques for space food:

- Thermostabilization
- Freeze-drying
- Lactofermentation
- Pasteurization
- Vacuum

Finally, we plan to test the quality of our dishes thanks to the school laboratory using instruments like a:

- Refractometer
- Chromatograph
- Spectrophotometer

Ideally, we would also like to be able to define an expiration date on the packaged meals.

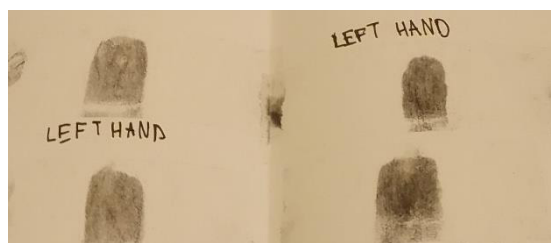
## FINGERPRINTS: DISCOVERING THEIR LIMITS

Apostolou Antonia Zoi S4en, **AES Warsaw**

In forensics, one of the most important scientific procedures is the collection and identification of fingerprints. This type of analysis has been used for more than 100 years. Fingerprints play a very important role in approving the identity of a suspect. Also, it can help identify the victims in disasters.

Fingerprints will be the main focus of this project. More particularly, I am going to study the genetics behind fingerprints, as well as differences depending on the country of origin of

each person and age-related variations. Besides my interest in forensics, I chose this topic because I wanted to investigate if and to what degree fingerprints connect with genetics, age and country of origin of a person.



In order to collect the data, I will use a dark-coloured (charcoal and graphite) powder to trace the fingerprint and then transfer it onto a piece of tape. In addition, I will analyse the collected finger-



prints for the correlation of consecutive patterns and similarities. Last but not least, I will classify my findings.

My hypothesis for this research is that members of the same family will have similar patterns. Mo-

reover, I believe that depending on the age of a person or their country, there will be a certain type of fingerprint that is the most common.

## J-31 DOES CHEWING GUM HELP KILL MOUTH BACTERIA?

Gintarė Skruodytė, Justė Ilievičiūtė S3LTA, ES Brussels II

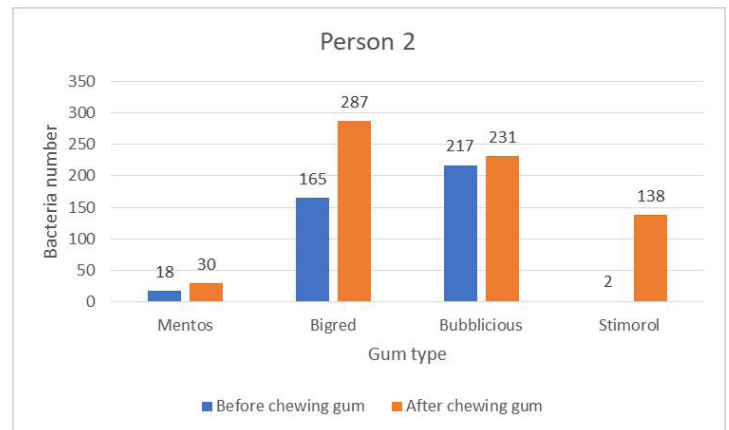
The objective of our experiment was to investigate the potential of gum in killing mouth bacteria and determine if there are variations among different gum types.

The method involved three steps made after lunch:

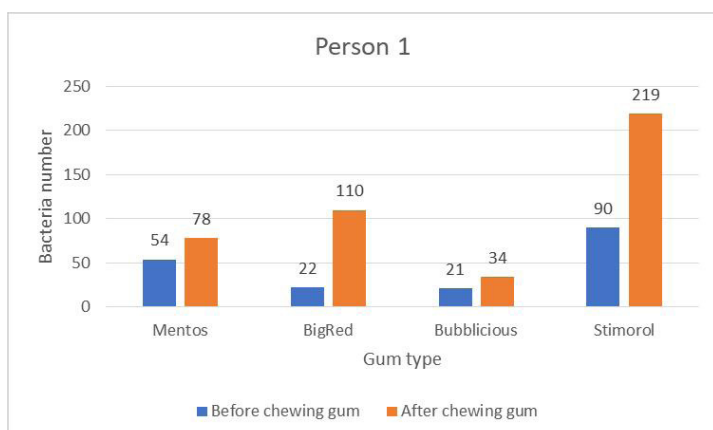
- In the first step, we gathered mouth bacteria using sterilized cotton buds and swabbed it on one side of a petri dish before chewing gum.
- Then, we proceeded to the second step, chewing gum for a period of 5 minutes.
- In the final step, after gum chewing, we collected mouth bacteria once again using sterilized cotton buds, swabbing it on the other side of the petri dish.

The gum samples tested included: Mentos, BigRed, Bubblicious, and Stimorol. To obtain the accuracy of our results, the experiment was done by two individuals, so we would have at least two sample comparisons.

In the end, the results were similar, the number of bacteria increased with all the samples. Mentos and Bubblicious had the smallest effect, Stimorol – the biggest. As you can see on the graphs:



In the pictures below you can see the example with the Stimorol gum (1-before chewing gum, 2-after chewing gum), there are two petri dishes because we both did the experiment:



We suspect that glucose or sweeteners might have caused this effect.



# SENIOR Projects

## S-01 AERODYNAMICS OF DIFFERENT CONTROL SURFACES FOR ORBITAL BOOSTER LANDING

Jan Kazimierczak (S6ES), Tobias Van Bavel (S6ES), Oscar Canals Estirado (S6ES), ES Alicante



Recently private companies are striving to make commercial flights possible. It could be done for instance by improving the cost efficiency of orbital flights. The first step is to make boosters reusable. SpaceX was the first to achieve it. After SpaceX's success many companies started taking different approaches for orbital booster recovery. This inspired us to start the project.

The aim of this project is to test and compare the aerodynamics of different types of control surfaces used in landing environments. The most common control surface used for landing are grid fins. Some rockets that use grid fins are SpaceX's Falcon 9 and the Super Heavy. Grid fins are used instead of the conventional planar fins. Grid fins have a

smaller aerodynamic surface than the planar fins. There are various shapes that the grid fins can take. To be able to compare the aerodynamics between different types of control surfaces we first had to build a wind tunnel. We built it 3 meters long and 1 meter tall with the purpose of obtaining results as accurate as possible. The idea is that instead of moving the object at a certain speed, the air moves at the desired velocity. We designed different shapes of grid fins and attached them to a model rocket. With the help of a load cell we calculated the difference in performance of different grid fins.



# SEA-CURRENT: MAGNETOHYDRODYNAMIC ELECTRICITY GENERATION WITH SEAWATER

Louisa Carlsson, Matilda James, and Aderyn McCurdy-Luksch, S6E, ES Bergen

The Sea-Current project aims to develop a new method for the generation of sustainable electricity from seawater using magnetohydrodynamics in conjunction with the Venturi effect.

Magnetohydrodynamics is the principal whereby an electrical current is induced in a conductive fluid as it passes through a magnetic field. The Venturi effect describes the increase in velocity of a fluid as it transitions from a larger to a smaller diameter pipe.

The first project stage proved the interaction between electrical and magnetic fields, demonstrating their capability of creating flow in a conductive fluid. Electrodes connected to a battery were placed on either side of a channel of saltwater, where a magnetic field was applied perpendicularly. The conductivity of the saltwater allowed for a flow of current between the electrodes and the resulting Lorentz force accelerated the ions in the fluid.

The second stage then validated the inverse relationship; utilising fast flowing saltwater in the presence of a perpendicular magnetic field to magnetohydrodynamically induce an electric current between the electrodes. A Venturi will be included to increase the saltwater velocity of a simulated ocean current, which will result in a higher voltage generated.

The third and final stage of the project will be to construct an optimised apparatus, through iterations, in which these principals are applied efficiently. The aim is to increase the produced voltage to the maximum achievable. Variables that will be considered include water velocity and the size of

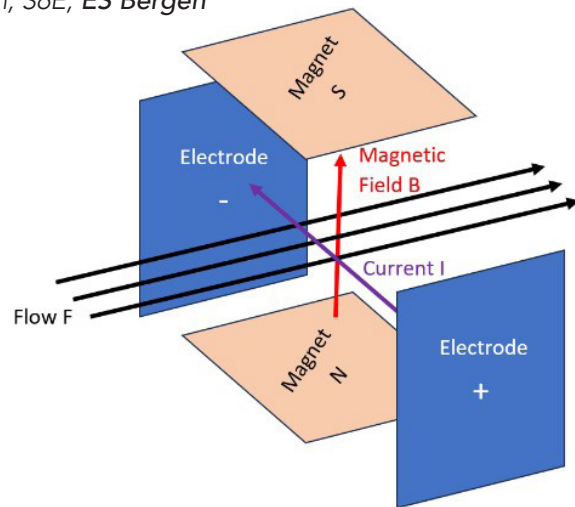


Figure 1. Mechanics of Apparatus

magnetic field. These will be selected based on the project's aim of achieving a report which could help further development of this apparatus.

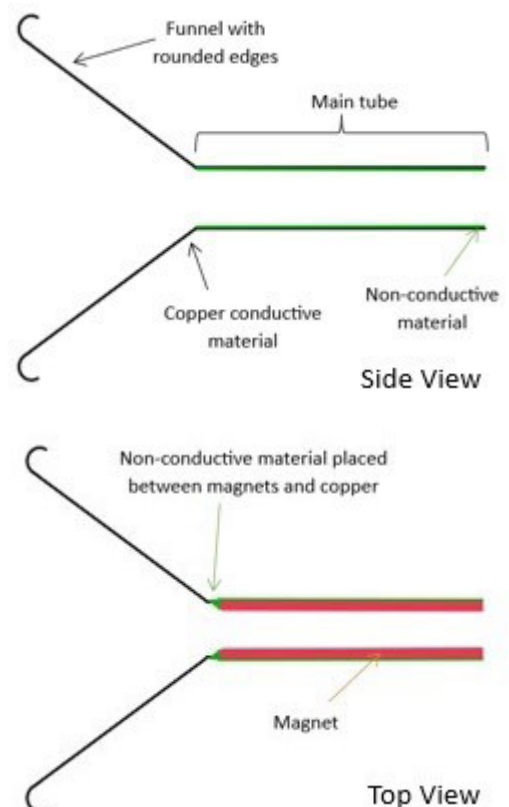


Figure3. Cross section of Apparatus

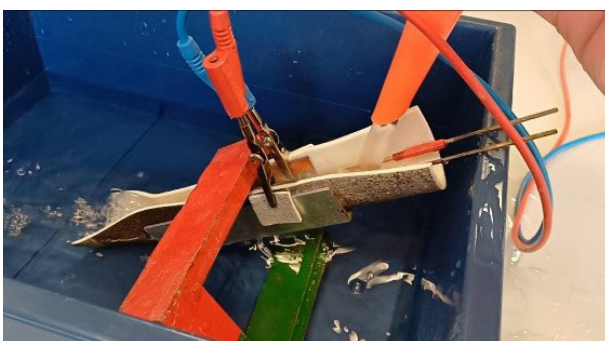


Figure 2. Second Stage of the Project

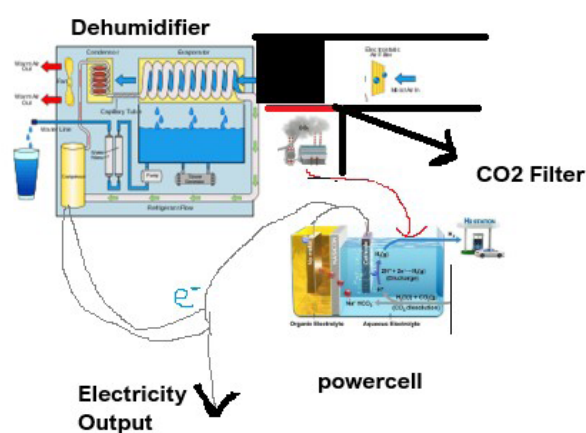


# CARBON DIOXIDE TO WATER AND ELECTRICITY CONVERTOR

Gustavo Fernández-Balbuena Paredes (S6EN\_B), *ES The Hague*

The project aims to create a dual-purpose machine generating water and electricity from CO<sub>2</sub> and air. The research is divided into two parts: a dehumidifier and a battery using an electrochemical cell fuelled by carbonic acid. The dehumidifier comprises an evaporator, condenser, capillary tube, and compressor. These components make a circuit with refrigerant to manipulate air temperature and pressure. This allows the air to reach its dew point, extracting water from the air. The dehumidifier has been built and will be tested in different environments to ensure the most efficiency. Secondly, a battery will be constructed using an electrochemical cell powered by carbonic acid, which can be formed by mixing water with carbon dioxide at a high concentration. The carbon dioxide can be achieved through various methods of carbon capture such as using microorganism like

algae, extracting directly from the source such as factories or in this case it is going to be produced through a chemical reaction of calcium carbonate and vinegar. Then, the carbon dioxide is mixed with water by injecting under pressure the CO<sub>2</sub> in the water to produce carbon dioxide. Then, due to the oxidation of the anode and reduction of the cathode, electrons flow from the anode to the cathode forming the electronic circuit. Early results show promise, with the dehumidifier proving effective, especially in dry conditions. The battery requires further optimization for scalability, focusing on maximizing voltage and battery life through varied cathode and anode configurations. Though not finalized, the project holds significant potential.

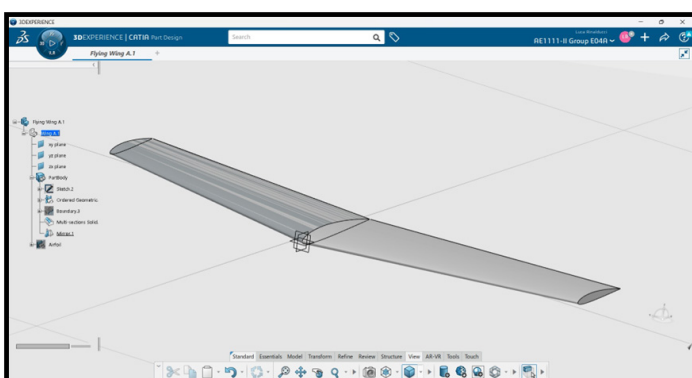


# AERODYNAMIC DESIGN

By Cassius Moeller, Theocharis Chalyvidis, Aron Visegradi (S6), *ES The Hague*

This laboratory report presents an in-depth analysis of aerodynamic designs for a flying wing aircraft conducted by a team led by Theocharis Chalyvidis. The study focuses on parameters crucial for flight performance, including stability, lift to weight ratio, glide ratio, and thrust to weight ratio. Stability is clearly a priority due to the absence of a tail in a flying wing configuration. Detailed assessments are provided for each parameter, considering factors such as aerodynamic centre estimation, centre of gravity computation, and sweep angle optimization. To finalise the report optimal design parameters, including wing geometry, air foil selection (NACA-2412), taper ratio, and sweep angle were determined which aimed at maximizing lift to weight ratio while ensuring stability and manoeuvrability. The methodology used emphasizes parameter prioritization and trade-offs to

achieve the desired performance characteristics. Additionally, a comprehensive assessment of lift to weight ratio indicates the suitability of the proposed design for specific payload requirements. Overall, this report offers valuable insights into the intricacies of aerodynamic design for flying wing aircraft which allows us to further experiment in this field.



# LE BLOB ET LES PESTICIDES : PHYSARUM POLYCEPHALUM, PEUT-IL ÊTRE UN ACTEUR DE DÉPOLLUTION DES SOLS?

Lena Minlend (S6FR1) et Sarah Tudose (S6FR1) International School Edward Steichen LESC, AES Luxembourg

Les produits phytopharmaceutiques, considérés comme pesticides, sont largement utilisés pour protéger les cultures afin de favoriser leur rendement. Néanmoins, une volonté croissante de limiter leur utilisation et stopper tout usage dans le futur est constatée notamment pour ceux contenant une substance active chimique. En effet, le glyphosate, herbicide si controversé et probablement cancérigène, est reconnu pour présenter des risques sanitaires et environnementaux. De même, un déclin des insectes est constaté chez les pollinisateurs dû à une utilisation massive d'insecticides. Ainsi, une augmentation de l'autopollinisation est constatée chez les plantes à fleurs entraînant une perte inquiétante de la biodiversité. Il est ainsi urgent de trouver des solutions pour stopper ces utilisations et éliminer ces substances actives chimiques des sols. Le myxomycète *Fuligo septica* est un organisme unicellulaire macroscopique étudié pour sa capacité de dépollution des



sols notamment des métaux lourds comme le zinc ou le manganèse. Ainsi, connaissant les capacités exceptionnelles du célèbre myxomycète *Physarum polycephalum* nommé le Blob, l'hypothèse d'une

capacité de dépollution des sols par cet être vivant parut intéressante à tester. En effet, pourquoi ce protiste, constitué de milliers de copies de son ADN et capable de régénération, d'apprentissage et de réjuvenation, ne pourrait pas aussi dépolluer les sols en accumulant ces produits chimiques comme le fait *Fuligo* avec les métaux lourds ? Des expériences sont mises en place pour tester si le Blob peut consommer de l'avoine contaminée, à différentes concentrations, par 4 types de pesticides : herbicide, insecticide, bactéricide et fongicide. De même, sa vitesse de déplacement est mesurée en fonction des différentes concentrations en pesticides. Des expériences permettent aussi de tester si le Blob peut apprendre à aimer l'avoine contaminée comme il peut

le faire pour le sel grâce à sa fameuse mémoire cellulaire. Enfin, sera testé si un Blob expérimenté en pesticides peut transmettre cette information à un Blob naïf.

# EXPLORING METHODS FOR DETECTING MICROPLASTICS IN SEA FISH DESTINED FOR HUMAN CONSUMPTION

Charlotte Hagon and Nina Hermans (both S6ENA), ES Frankfurt

The aim of this project is to determine an effective method for detecting microplastics in the digestive system of store bought fish. Plastic waste is a growing issue in our world, especially when it degrades into smaller microplastic particles. According to a



2017 UN report, 51 trillion microplastic particles litter the oceans across the globe. There are filters available that can remove nanoplastics from drinking water. However, there is no practical way to filter the water of oceans. Inevitably, microplastics have entered the food chain. It is therefore crucial to develop

accurate detection techniques.

Initially, our objective was to quantify the risk of microplastic pollution by investigating the presence of microplastics in the digestive organs of a wide range of sea fish destined for human consumption. Our hypothesis was that even wild-caught sea fish will have suffered from having microplastics in their food chain and therefore pose a potential risk to the human food chain. However, we quickly established that it can be difficult to detect micro-

plastic particles in the fish. We decided to focus experimenting with and analysing different methods for detecting and identifying microplastics in sea fish. The aim is to determine a method which works most effectively. Our hypothesis is that a method with finer filtration will yield better results because it will isolate and reveal more microplastics for visual investigation.

## S-07 EAR TRAINING APPLICATION FOR MUSIC

Jakub Kranz (S5 ENB), ES Frankfurt

The goal of this project is to use programming and machine learning to develop a method and software application which allows musicians to gain independence when performing and creating original music. Traditionally, musicians are taught how to play their instruments by memorizing long passages and committing them to memory so that they can execute what they learned in front of a real audience. However, this approach to music is flawed; not only does it rely on a musician's memory to perfectly execute a piece of music, the memory being prone to various slips and errors, but it also limits the musician's ability to improvise and be original when performing music. This study aims to develop both a method and a software application that can be used to enhance the musician's ability to improvise, play by ear, sight read and compose novel pieces.

Discoveries made in this study could have a vast

impact on different styles of music, particularly classical music, which, unlike its rich history and development, has failed to see any recent developments causing a decline in the interest among the public in classical music. In fact, historically, classical music used to be full of improvisation, a practice that was only stopped in the last century. Bringing improvisation and novelty back to classical music could help spark interest in classical music among the masses, which is a good thing, as classical music is a core part of European culture which is being lost to time. This European tradition must be preserved.

Additionally, Jazz music, a style rich in improvisation and exploration, could benefit hugely from discoveries made in this project as the barrier for entry would be lower making it more accessible to wider audiences.

## S-08 ZebraGo: helping individuals with visual impairment to navigate urban environment.

Lauren Holleboom, Leonie Goodchild, Thomas Van den Wyngaert (all S5), ES Brussels

The world is currently undergoing the largest wave of urban growth in history. Due to this, hazardous situations occur increasingly often, especially for individuals with visual impairments. One of the many challenges faced in pedestrian road safety is the crossing of roads. Firstly, locating traffic lights can be tough, as locator tones and tactile indicators are rarely provided. Secondly, depending on auditory cues to decide when to safely cross

is unreliable and dangerous. Auditory cues aren't common everywhere and could become completely inaudible due to surrounding noise pollution. Lastly, during this whole process, individuals are forced to come into contact with crosswalk buttons. This is entirely unhygienic, and contributes to the spread of disease, being especially concerning during the COVID-19 pandemic. We need to prioritise providing accessibility for individuals





with visual impairments in our modern societies, to ensure all citizens remain safe on roads.

To do this, we have created a device (ZebraGo) which notifies users of the state of the pedestrian traffic light (red/green) through vibrations. Coded with Arduino, the device connects to the traffic light via Bluetooth, and alerts the user when it is safe to cross. The original design presents itself as a small portable box, which can be adapted to fit onto a white cane, a belt, a watch, or even be carried in a pocket. It is battery-powered and is activated by the simple push of a button, making it more accessible to people with visual impairment or dexterity issues.

To determine the potential utility of our device, we will conduct two experiments. For „Test A,” we will blindfold subjects and ask them to identify the

state of a simulated traffic light. To test the reliability of our device more accurately, we will play background noise to represent nearby distractions. After collecting results as a pass/fail value and a response time, we will compare our device's performance to that of traditional alternatives mentioned above. Further examination of the potential market for ZebraGo will be done through distributing a questionnaire (Test B) via associations such as Ligue Braille and Brussels Mobility to visually impaired individuals, as well as the general population. With it, we hope to gain perspective on how people might use our device, and how we might improve it.

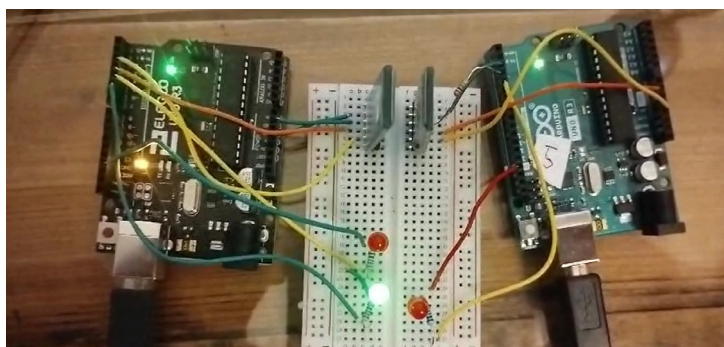


Figure 1. An early version of ZebraGo device

Although we originally designed the device to benefit people with visual impairments, we also envisage a more global use of the device; distracted parents, small children, seniors, headphone users and many other people may also find safety in our innovative device.

## S5 UNVEILING THE DANCE OF MOLECULES: A study of temperature and concentration effects on surface tension.

Maximilian Montgomery and Sergej Skackov (both S5), ES Brussels III

Surface tension is a cohesive force that exists at the interface of a liquid, with significant implications in various scientific disciplines and everyday life. The aim is to gain a deeper understanding of this phenomenon by carefully manipulating and controlling variables to unravel the underlying principles governing surface tension. Through precise

measurements and visual documentation, detailed observations have been captured and data recorded, offering the audience an immersive experience of the world of surface tension.

**Keywords:** Surface tension, cohesive force, liquid interface, variable manipulation, measurements, visual documentation

## S6 BRAIN WAVE CONTROLLED RASPBERRY PI CAR

Manuel Suhrcke and Nurali Rakhmetov (both S6 EN) Lënster Lycée International School, AES Luxembourg

### Introduction to the Study:

The flourishing field of brain-computer interfaces has sparked interest in exploring the capabilities of consumer-grade EEG devices for practical applications. This study, conducted at Lënster Lycée International School, aimed to investigate the potential of using brainwave data, captured through the NeuroSky MindWave headset, to control a Raspberry Pi car.

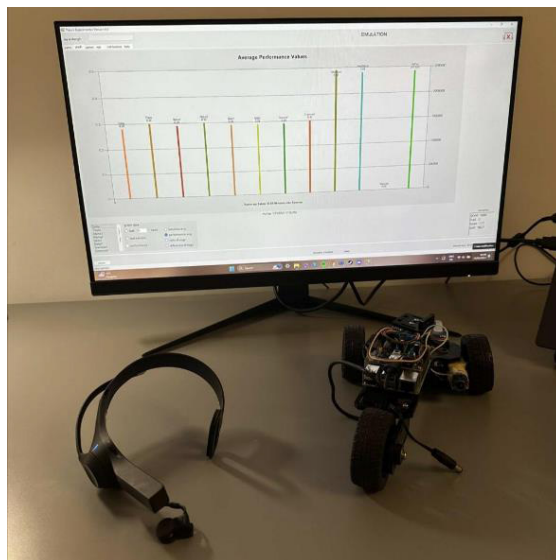
**Experiment Methodology:** The experiment focused on analyzing the EEG patterns of participants while they concentrated on specific mental tasks. These tasks included achieving relaxation through deep breathing and obtaining high levels of attention through playing video games. To control the car, we used the Meditation and Attention values in the Neuro Experimenter software, which change depending on which brain wave



frequencies are achieved. The meditation value reflects the user's level of relaxation or mental calmness, assessed by identifying patterns such as increased Alpha wave activity. In contrast, the Attention value corresponds to the user's level of focus and concentration, seen by increasing Beta wave activity.

#### Preliminary Trials and

**Observations:** Preliminary trials involved real-time monitoring and recording of brainwave frequencies, followed by programming the Raspberry Pi to respond to these specific patterns. Initial observations indicated a visible correlation between con-



centrated mental states and distinct EEG patterns, particularly in the Beta frequency range.

#### Study Findings and Future Implications:

These findings are instrumental in refining the algorithm for the car's responsive movements. The study's findings thus far suggest that specific brainwave patterns can effectively be harnessed to control physical devices, demonstrating the NeuroSky MindWave's potential in interactive technology. While the results are promising, further analysis and development are required to enhance the precision and consistency of the brainwave-controlled car, paving the

way for broader applications in assistive technology and human-machine interaction.

## WWA – WORLD WIDE ALGAE: HOW DO THESE ORGANISMS EXCHANGE INFORMATION ABOUT CLIMATE CHANGE

Ribas Bonet, Miquel (Só DE), ES Karlsruhe

Could the communication among algae hold the key to unlocking new climate change and adaptation strategies?

#### Material :

##### 1. Algae Cultures:

Obtain various species of algae cultures, both single-celled and multicellular, representing different ecological niches.

##### 2. Growth Medium:

Prepare nutrient-rich growth mediums suitable for the selected algae species.

##### 3. Microscopes:

High-resolution microscopes for observing algae at a cellular level.

##### 4. Petri Dishes:

To culture and observe algae.

##### 5. Spectrophotometer:

For quantifying chemical changes in the growth medium.

##### 6. pH meter:

To measure changes in the pH.

##### 7. Light source:

Controlled light source to simulate varying environmental conditions.

##### 8. Laboratory Instruments:

Pipets, test tubes, beakers, and other standard lab equipment.

##### 9. Computer and Software:

Data recording and analysis tools.

#### Method:

##### Algae Selections:

We will choose specific algae species relevant to research communication.

##### Culturing:

Cultivate algae in separate Petri dishes with appropriate growth mediums.

##### Environment:

Set up controlled environment with different va-



riables (e.g. temperature, light intensity, pH levels) to simulate various climate change scenarios (also in different time intervals to investigate adaptations).

#### *Observation:*

Regularly monitor algae growth, morphology, and behavior under the varying conditions using microscopes.

#### *Chemical Analysis:*

Use the spectrophotometer and pH meter to measure any changes in the growth medium composition.

#### *Data Collection:*

Record data on growth rates, pigment production, and any observable patterns.

#### *Data Analysis:*

Analyze the collected data to identify potential communication pattern between or responses among the algae.

#### *Comparing the results:*

Compare the communication patterns between different algae species and under different environmental conditions and within the same species for later induced climate variability conditions.

#### **Conclusion:**

Provide valuable insights into algae communication and its potential relevance to climate change adaptation.

#### **How would I like to pursue this experiment:**

In this experiment, we will use three different types of algae: one from the tropics, one from the Mediterranean, and one from freshwater. We hypothesize that algae can adapt to new environments through communication. Specifically, we hypothesize that algae that have already adapted to a new environment can communicate with newly added algae and induce changes that allow them to adapt more quickly.

In the first experiment, we will subject algae to direct stress by placing them in a completely new environment. We will then observe whether the algae survive or adapt to the new environment. If the algae adapt, we will add the same species of

algae to the environment and observe whether they require the same amount of time to adapt. We will compare the time it takes for the algae to adapt in the absence of communication to the time it takes for them to adapt in the presence of communication.

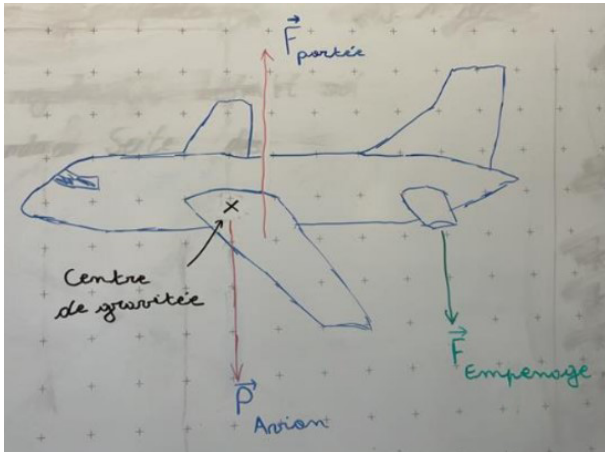
In the second experiment, we will subject algae to gradual stress by changing their environment at regular intervals. We will measure whether the algae have a tolerance for the changes or whether they can adapt to them. After the algae have adapted to the changes, we will return the environment to its original state. We will then add fresh algae and repeat the experiment with shorter intervals between changes. We will compare the tolerance of the algae in the presence of communication to their tolerance in the absence of communication. To both experiments we will add a control group of algae that are not exposed to any stress. This would allow us to compare the performance of the algae that are exposed to communication to the performance of algae that are not exposed to any external factors.

The results of these experiments will provide evidence for or against our hypothesis that algae can adapt to new environments through communication. If our hypothesis is supported, the results could have important implications for the conservation of algae in a changing climate.

Understanding how and how fast this type of adaptation and communication takes place would allow us to envision future use of algae as research organizations for climate change adaptation, giving us insight into whether and how it is possible to control or perhaps speed up the adaptation of life to climatic conditions other than the current ones.

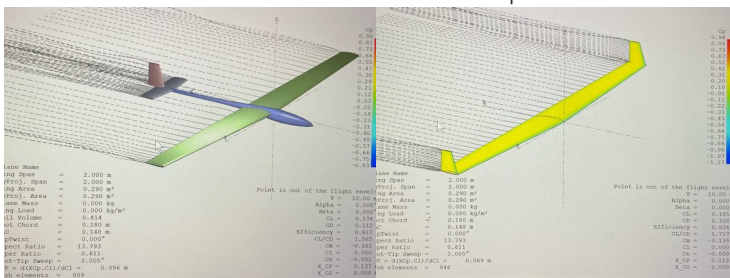






Dans ce projet nous étudions la possibilité de réduire la traînée d'un avion grâce à une aile volante. Le caractère innovant de ce projet est de combiner la traînée réduite d'une aile volante avec un dispositif de gouverne réduisant encore plus la traînée. La raison pour laquelle une aile volante réduit considérablement la traînée est, en partie, à cause de l'absence d'un empennage et d'un fuselage. L'absence d'un empennage réduit la traînée à cause de deux raisons.

La première est, parce qu'il existe deux types de traînées, la traînée induite et la traînée de forme. Donc si on enlève l'empennage, on réduit l'air, qui réduit la traînée. Une autre raison pour la réduction de la traînée à cause de l'absence d'un empennage

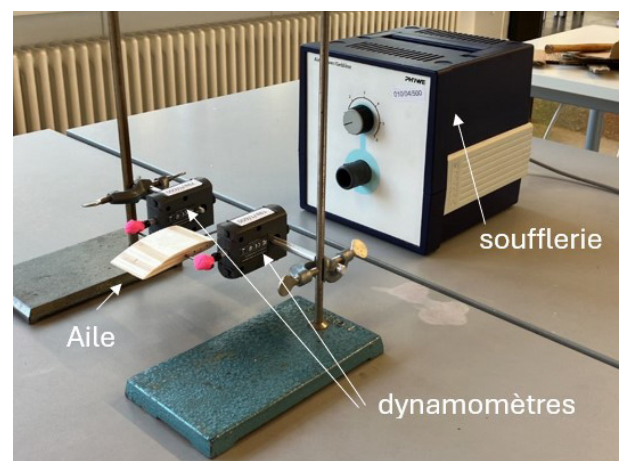


Simulations faites avec XFLR5. Les valeurs de forces de traînée peuvent être lues sur les images ci-contre.

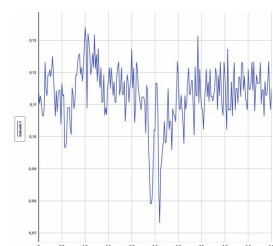
ge est, parce que le centre de gravité d'un avion se situe un peu plus en avant du centre de pression, qui est l'endroit où se situe la résultante de toutes les forces de portance autour d'une aile. Puisque le centre de pression change en fonction de l'incidence de l'aile, l'empennage joue un rôle essentiel pour contrer cet effet.

Cependant la portance de l'empennage ne sert « que » à la stabilité de l'avion, est donc c'est

de l'énergie perdue. Nous allons aussi essayer de calculer la traînée de notre avion en utilisant le logiciel XFLR5, et nous allons comparer les résultats obtenus sur XFLR5 avec nos mesures faites en utilisant la soufflerie et l'aile que nous avons construite.



Mesures de forces de traînée faites avec notre soufflerie et deux dynamomètres Vernier connectés en Bluetooth à notre tablette.



En dernier nous allons faire une aile volante RC, refaire les mesures de traînée pour voir si nos prédictions étaient correctes.

# COMMENT MESURER DES MASSES DANS DES CONDITIONS DE MICROGRAVITÉ?

LEOPOLD Antoine (S7FRD), DE ROSA Enrico (S7FRD) et SCHINAS Nicolas (S7FRC) LAE, ES Brussels IV

Notre projet consiste à réaliser un prototype expérimental de balance qui permettrait de mesurer des masses de l'ordre du milligramme dans des environnements dépourvus de gravité.

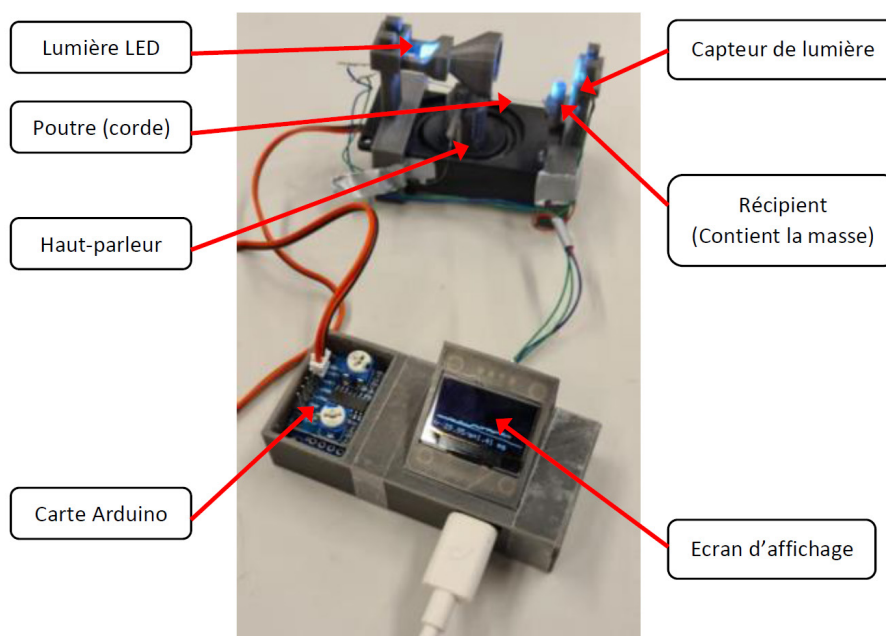
Notre modèle final repose sur des oscillations forcées par un générateur sinusoïdal. La carte Arduino permet leur balayage en fréquences croissantes. La masse, contenue dans un récipient fermé, oscille alors au bout d'une poutre. Ces oscillations sont mesurées par un capteur de lumière. Ainsi, l'amplitude de résonnance est traduite par la fréquence à laquelle l'occultation passe par un

maximum.

En reportant les multiples données expérimentales (masse en fonction de la fréquence de résonnance), nous avons obtenu une relation polynomiale du second degré nous permettant d'exprimer la masse en fonction de cette fréquence à la précision souhaitée.

Notre prototype actuel est fonctionnel et fiable, mais il nous reste encore à étudier l'influence qu'ont la nature et la longueur de la poutre sur la précision.

Diagram or picture of the experimental set-up:



# TRASHPLIT

Antonio BRUNETTI, Lorenzo GOBBI, Daniele GRASSI – S6ITA, ES of Luxembourg II

**"A huge impact on recycling with a little effort!"**

Recycling is a major issue for today's society. Despite great and continuing efforts to involve the population in recycling, the results do not always match expectations. Thus, we decided to check the situation of recycling in our school and try to improve it in a simple way.

First, an inspection of our secondary school premises was carried out to verify the distribution and quality of all the trash bins present. Then, two surveys were administrated: one among the cleaning

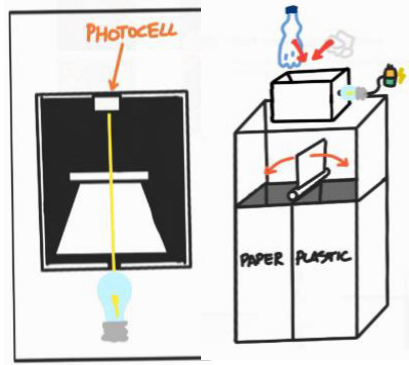
staff and another one among all the students of the secondary grade.

The results of this first actions show that:

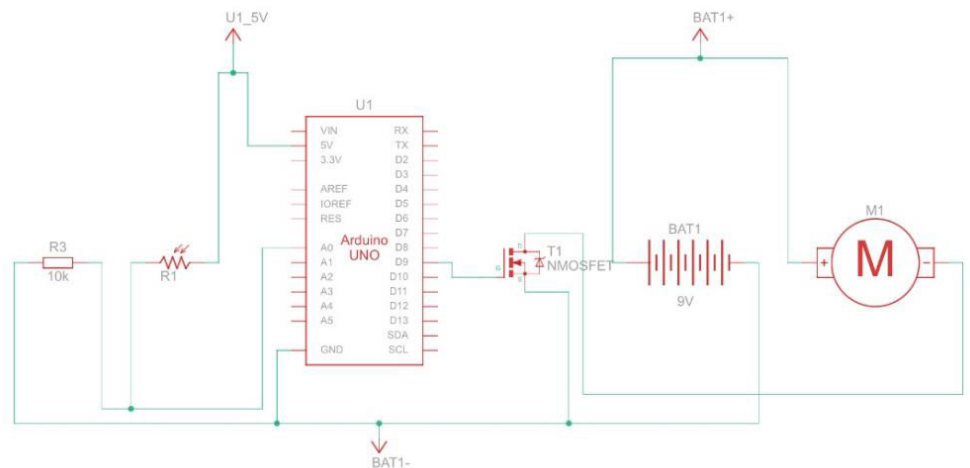
- the litter bins, although present in adequate numbers proportionate to the school population, are not distributed in such a way as to cover the actual need in the critical areas (cafeteria, library and corridors);
- students often do not know where to throw waste due to a lack of clear indications on the bins or because it is difficult to classify the material the waste is made of.



The consequence is that the recycling system does not work efficiently as much as it could be, so we decided to give our contribution, building a new type of bin, named "Trashplit". Trashplit is an automatic bin that distinguishes and separates paper and plastic according to the interaction of these two kinds of material with light. At first sight, it looks like a normal bin, but inside of it, there is a circuit, programmed with Arduino. A white light emitted by a LED bulb is directed onto a photocell fixed inside a darkroom. Plastic and paper waste, when inside it,



will disrupt the light beam differently: plastic does not impede the passage of light, paper does. This different "message of light" activates a rotating plane to the right or left allowing the waste to fall into the correct part of the bin.



S-15

## PROTÉGEONS LES OCÉANS: LA BIOLUMINESCENCE BACTÉRIENNE AU SERVICE DE LA PRÉSERVATION MARINE

Alizée DA CUNHA (S7FRA), ES Luxembourg II

Actuellement, 80 % du monde vit sous un ciel pollué, un taux qui augmente de 6 % chaque année. Cela n'est pas sans conséquence !

Les espèces qui constituent les écosystèmes terrestres et marins sont fortement impactées par cette forme de pollution dont les effets sont trop généralement sous-estimés.

Mon projet vise à la protection des écosystèmes marins grâce à une bactérie : *Vibrio Fischeri*.

Nous pouvons facilement remarquer que l'activité humaine dans les milieux marins a de nombreuses conséquences désastreuses, mais qu'en est-il de la pollution lumineuse ?

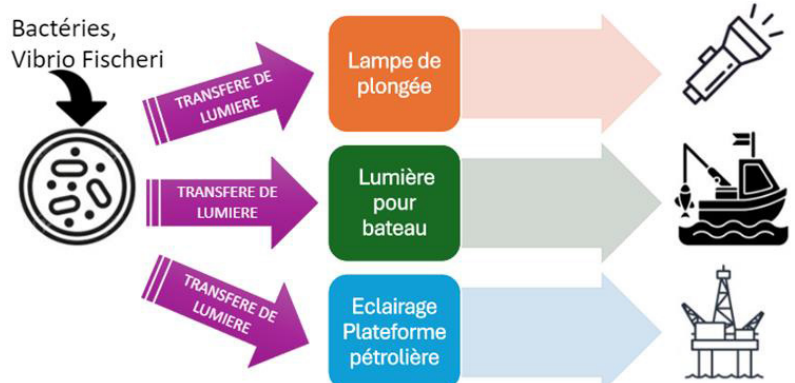
L'éclairage de la pêche en haute mer ou l'éclairage des plateformes pétrolières dérangent grandement la vie dans les milieux marins. Il est prouvé que les rayons solaires ne pénètrent pas plus de 200 m de profondeurs. Or la lumière artificielle pénètre beaucoup plus en profondeur, ce qui dérègle le fonctionnement de la vie marine.

L'objectif de cette étude, réalisée au labora-

toire de l'Ecole Européenne du Luxembourg II, est de détourner la lumière produite par la bactérie *Vibrio Fischeri*, déjà présente dans l'écosystème marin, et de l'utiliser sous forme de lampe étanche. Cela nous permettrait de diminuer notre impact sur les écosystèmes marins et de sauvegarder sa biodiversité.

L'éclairage naturel sera non-polluant, car il utilise la lumière naturellement produite par la *Vibrio Fischeri* et n'empêcherait pas l'activité humaine qui aura un impact mineur sur les écosystèmes.

### La Bioluminescence Bactérienne au Service de la Préservation Marine





The ocean absorbs about 30% of the  $\text{CO}_2$  that is released in the atmosphere, and as levels of atmospheric  $\text{CO}_2$  increase because of the human activity, so do the levels in the ocean. This increase causes the seawater to become more acid with an impact for the sea creatures, that have a shell or coral skeleton but also on the behavior of the non-calcifying organism as well.

Our project is based on the theory that we could save the sea's biodiversity with eggshells. Eggshells are made of calcium carbonate: an element that raises pH.

We've performed different test in different seas (Adriatic Sea, Mediterranean Sea, Atlantic Sea) to see if our theory could be confirmed. We've grinded eggshells and put them in 100 ml of sea water. After 5 minutes we've observed that the pH rises between 1-2 units meaning we can return the ocean's pH to what it used to be. Our observations under the microscope confirmed that the eggshells have no negative impact on the phytoplankton and sea's life will not be negatively affected by this use. To be able to have a future: we need to save the planet and its biodiversity.

Mediterranean Sea



Saltburn, England



Atlantic Ocean

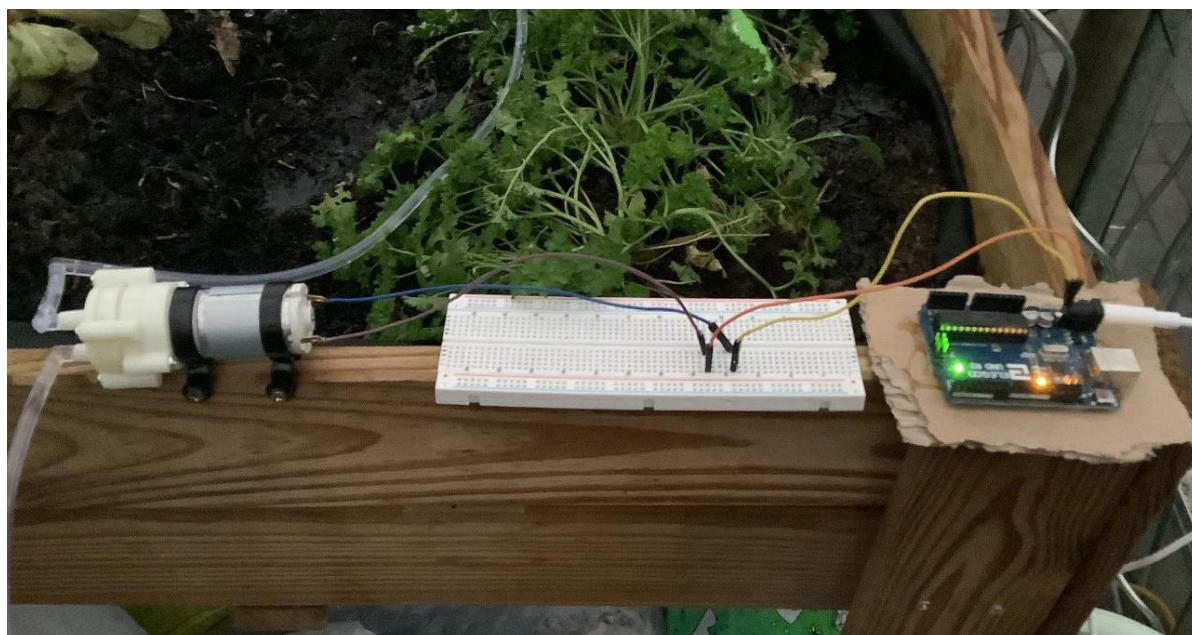
## S-17 AUTOMATIC SENSOR-BASED CROP IRRIGATION SYSTEM

Arnav Gupta S6ENA and Matvey Nikonorov S6ENA, ES Mol

The purpose of our automatic crop watering system is to use water more efficiently in farms and gardens, as well as save farmers and gardeners time and effort, while also keeping the costs and infrastructure at a minimum. Our methods are: a pump that automatically waters multiple plants at once and moisture sensors that sense the soil's

water level and activate the pump when it drops too low.

So far, we have obtained all the necessary parts and made a prototype watering system that does not yet use sensors nor automated response to the water content in the soil.



## S-18 THE PLASTIC HOPPER

Joachim Baetsle (MO - S7NLA), Dries Caers (MO - S7NLA), ES Mol

### Purpose:

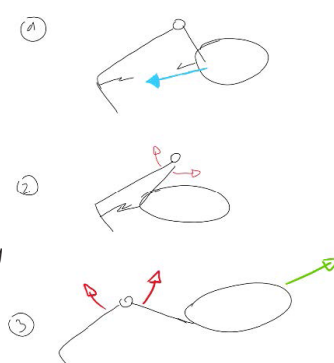
Our research, work, investigations, and experiments aim to eventually construct a jumping robot using compliant mechanisms.

### Summary of Project (Method + Results):

As stated previously, our research objective is to construct a jumping robot using compliant mechanisms. This jumping robot will consist of 3 main parts. A mechanism ( $m_1$ ) which will store all the energy needed to jump, an energy source of some kind that will generate all the energy in that mechanism, and another mechanism ( $m_2$ ) that will let all the stored energy escape all at once. Our jumping robot is based on different animals (grasshoppers, lice, frogs, ...) and their ways of jumping. For the  $m_1$ , which stores all the energy, distinctive designs are still being tested. Different energy sources are also still being tested. These energy sources go from a motor which pulls

the  $m_1$  to using a combination of electromagnets and permanent magnets to store the energy. The compliant components will be 3D printed. To be able to 3D print compliant mechanisms, we had to acquire certain specific materials such as nylon, a semi flexible material, and PETG, which is a little more rigid. We also had to fine-tune the 3D printer at school and experiment with certain slicing programs and settings for size, heat, printing patterns, and shapes.

- 1) The energy is being stored
- 2) All potential energy has been stored, ready to be released
- 3) All energy is being released at once, causing the robot to jump



# A STUDY OF THE RELATIONSHIP BETWEEN PHONETICS OF EUROPEAN LANGUAGES AND THEIR GEOGRAPHICAL LOCATION

Alban Rauch, S7FRA, ES Munich

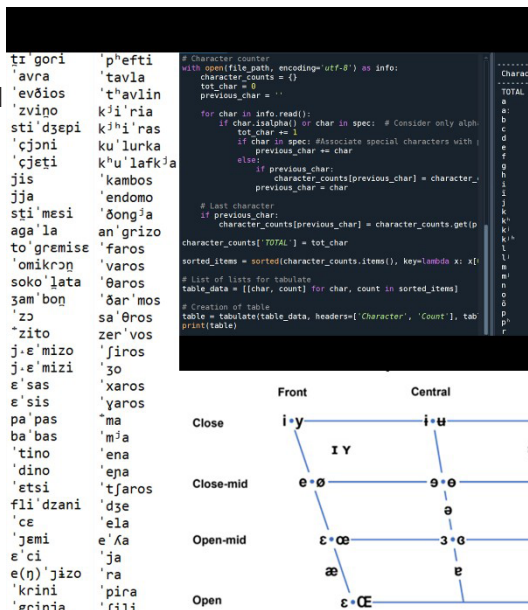
If languages emerge from cultures and populations, they can also be influenced by physical factors related to geographical location. Indeed, phonemes emerge from the ease with which they can be pronounced. For example, at high altitudes the air pressure is lower, making it easier to open the mouth wide. Conversely, in cold or polar environments, vowels that can be pronounced without opening the mouth are more adapted. In addition, while phonemes originate from the place of birth of the language family, pronunciations can also evolve, with some consonants or vowels being pronounced differently to make them more convenient.

This research aims to analyse the correlation between phonemes found in different European languages and the geographical location in which

they appeared or developed. Both global and regional languages were studied, with their respective weaknesses: global languages (such as English or French) change a lot and are therefore less reliable, while regional ones (like Finnish and Polish) are more sterile, with less variations. A few selected

languages from different parts of Europe were analysed, including their phonemes and the frequency of these phonemes in the most common words.

To this end, primary sources were used, including lists of common words by language and their respective phonetical transcription, or general pronunciation patterns (Step 1). Python was the main tool for analysis (Step 2), and phonetic studies with mouth morphology helped understand the characteristics of each phoneme (Step 3). Without neglecting the cultural factors behind the languages, we tried to determine to what extent and how geography influences phonetics.



The 3 steps of analysis used in the research

# BRAINSIGHT-MEASURING AND ANALYSING CONCENTRATION LEVELS WITH AN EEG MONITOR

Abhinav Verma, Chiara Ma, Jingsen Yang, S6DE{A/D}, ES RheinMain

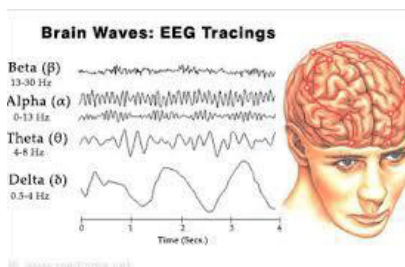
**Introduction:** With the unprecedented advancements in neurotechnology, electroencephalograms (EEG) have begun to transcend their conventional applications in the medical and scientific field. Their usages have been found in various parts of personal life, an unique example being its replacement of gaming controllers. Seeing this, our team aspires to utilise EEGs to compare the brain activity of students during different sensory stimulation so as to help them improve their academic productivity. Our aim is to measure concentration levels by identifying brain waves of different frequencies.

**Methods:** The first phase of our project constitutes the measuring of brain activity on the different parts of the brain, most notably the prefrontal

cortex. If possible, we plan to collect brainwave data, in other words the voltages or frequencies released, by reaching out to experts in the field. We also plan to purchase electrodes with which we will experiment with, on ourselves as subjects.

Having collected the data, we will move on to phase two: Converting it into different formats. In this phase we will develop an algorithm capable of processing, recognising, and interpreting different patterns detected by the EEG. Interpretations include a detailed report of

focus spans and an analysis of when the user is most engaged. In the next couple of months, the bulk of our research and time will be put into coding our algorithm.



\*Figure 1. Varieties of brain waves that we will be analysing <https://www.medindia.net/health/diagnosis/electroencephalogram.htm>





# CAN THE QUALITY OF MEDICAL RECORDS BE IMPROVED IF STORED LONG-TERM IN A STANDARDIZED FORMAT WITH IMPROVED EXCHANGEABILITY

Marta Kotarba, S6enA, ES RheinMain

## Why is the quality of medical records a concern?

Although the existing electronic health record systems do a respectable job of informing health-care providers about the medical background of patients, they are rarely extensive enough to allow doctors to get a full overview of the patient's former conditions or even the medical history of their parents.

Moreover, there is a general lack of continuity regarding the preservation of previous medical data, as can be seen in certain circumstances, for instance: when changing doctors, or moving to a different location, most often the previous medical data is lost and the patient is required to go over and list their previous conditions to the new provider in order for the data to be stored in a new place, independent of where it was previously stored. It can happen that the patient becomes constrained to reside with a single clinic or hospital and has less room for changing where they want to receive their medical care.

This raises concerns about the lack of interchangeability of various medical records. Even with the possibility of transferring old health data to a new medium, there is an absence of standardized formats that would allow for a consistent conservation of data.

As a result, it can be challenging for anyone to track down their old medical records or even dates of important check-ups and their results.

The portability and accessibility of records are crucial for patients to be aware of health conditions and be able to inform their healthcare providers. Many health details are also still stored on paper, as an example, a vaccine pass tends to be encountered in a paper form, and although it is a way of keeping track of records, it is much more prone to damage, or can even be lost by the individual. Retrieving those medical records in such a case is difficult and requires more effort from the person seeking to verify their medical history and might not even be possible under certain conditions. As

a result, such records are often less accessible and portable, requiring more time and

limiting the possibility of exchanging data. The patients themselves do not have immediate access to a clear outline of their medical history, making explaining past health concerns more difficult.

The continuity and conservation of health data is also an important aspect in the identification of potential conditions, e.g. genetic conditions that might have been passed down by parents, but do not emerge until later in life. This is also applicable to the health details collected by the parents for their children as they are growing up and can result in a loss of data from childhood if it is not documented properly.

## How could the storage and accessibility of medical data be improved?

To improve the overall quality of storage of medical data, one of the core elements would be creating a central storage model with different parameters that could be accessed by both the healthcare provider and a patient. This kind of model could exist as an independent database for all the health records recorded to the person. The database could then be accessed by another framework; an app, which would allow for a quicker and simpler acquisition or entry of the data. It would also have the necessary safety precautions due to the need for privacy and security of medical records.

## Research and methods

The main research would include an investigation of existing medical standards, as well as existing medical data formats and tools to further examine the reasons for the absence of an integrated health data system. Alongside research, there would also be questionnaires done to help identify the need for data and gather more information about the experiences of different people with the current system of medical records.

The app made to work with the database would be made with the help of the Python programming language due to its performance with working with data and versatile libraries.



## S-22 HUNDE – DIE BESSEREN THERAPEUTEN

Margareth Eirich & Jule Hochhaus, S5DeB, ES RheinMain

Studien haben gezeigt, dass allein das Streicheln von Hunden Stress abbaut, die Herzfrequenz senkt und glücklich macht.

Das liegt daran, dass der Cortisol-Spiegel sinkt und das Glückshormon Serotonin und Bindungshormon Oxytocin ausgeschüttet werden.

Zudem wirkt sich die Anwesenheit eines Hundes im Unterricht positiv aus. Die Klasse ist ruhiger, konzentrierter und die Lernleistung steigert sich.

Dieses Thema haben wir gewählt, weil es für uns sehr relevant ist. Wir gehen selbst in die 10. Klasse und kennen das Gefühl von Stress vor Prüfungen. Zudem haben wir auch Hunde, die zwar sehr viel Aufmerksamkeit einfordern, aber doch sehr entspannend sind.

Unser Projekt teilt sich in zwei Teile:

Zuerst werden wir mit unserem Schulhund Kalu in



den Unterricht kommen und ein paar Schüler auswählen, die Zeit mit dem Hund verbringen werden. Bei diesen Schülern werden wir vor und nach der 5-minütigen Streicheleinheit mit dem Hund die Herzfrequenz messen, um die physiologischen Auswirkungen zu analysieren und über ihre Stimmung reden, um die psychologischen Effekte zu untersuchen.

Im zweiten Schritt werden wir eine Klasse auswählen und bei allen Schülern die Herzfrequenz messen, bevor sie mit dem Hund spielen. Nach der Stunde messen wir noch einmal die Herzfrequenz.

Der Hund bleibt in der Klasse, während die Schüler weiter lernen.

Danach sprechen wir mit dem Lehrer über den Einfluss des Schulhundes auf das Verhalten der Schüler im Unterricht.

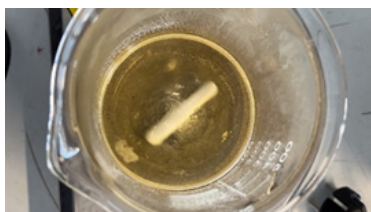
Die Ziele des Experiments sind, die Vorteile von Schulhunden zu erforschen und die Wirkung, die Hunde auf die Psyche, den Schulalltag und das Unterrichtsgeschehen haben zu ermitteln.

## S-23 MAUVAISES HERBES, SI MAUVAISES QUE ÇA?

Ela Ramont, Margarita Ramont et Lucilla Manciocchi S6FR, ES Strasbourg

Les pratiques les plus courantes pour enlever les mauvaises herbes exigent l'utilisation de produits chimiques qui non seulement polluent la terre et les réseaux d'eau mais qui polluent également l'atmosphère car leur production émet du  $\text{CO}_2$ .

Par conséquent, nous avons pensé à créer une alternative au plastique à partir de mauvaises herbes.



Formation de bioplastique

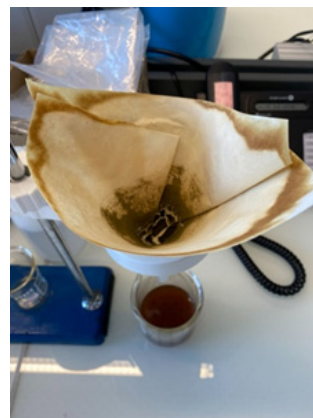
Avec notre projet, non seulement nous réduisons les produits plastiques non-biodégradables mais nous diminuons également les émissions de  $\text{CO}_2$  et l'utilisation de produits chimiques.

Notre démarche sera écologique du début à la fin

du projet.

- Nous extrayons la cellulose des adventices
- Nous la mélangeons avec de l'amidon, du glycérol, du vinaigre et de l'eau, afin de créer un bioplastique biodégradable.

Nous envisageons de poursuivre notre projet en quantifiant la cellulose reçue et en extrayant l'amidon depuis les racines des adventices et pensons également faire une étude physique sur le matériau obtenu.



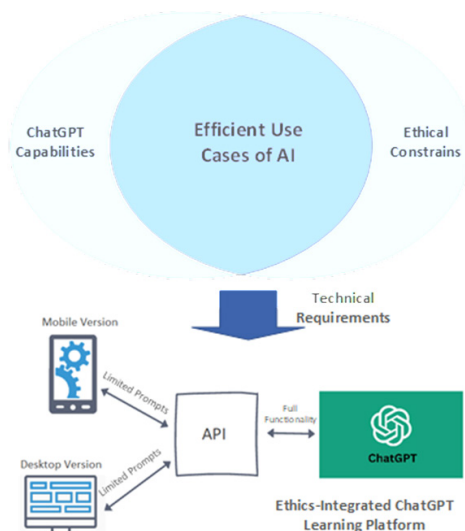
Extraction de la cellulose



# S-24 ADVANCING EDUCATIONAL FRONTIERS: APPROACHES FOR INTEGRATING AI TOOLS IN TEACHING AND LEARNING PROCESSES

Klim Stepanenko, S6EN, ES Tallinn

Recent advancements in generative artificial intelligence (AI) have ignited a surge in research exploring its applications across various domains. This study delves into AI's potential within educational contexts, specifically examining how students and teachers can effectively and ethically leverage AI tools like ChatGPT to support learning. Utilizing a mixed-method approach, the research combines a systematic literature review with qualitative interviews from secondary students and teachers. The analysis of responses from participants reveals innovative use cases of AI in enhancing the learning process. A significant outcome of this study is the development of a strategic framework outlining constraints for ethical AI integration in educational settings. Additionally, the research sets forth technical requirements for the creation of a web-application that incorporates ChatGPT's API, implementing the recommended AI use cases in the learning process. The findings can be used to better understand the role of AI tools in education, offering practical guidance for students and teachers on how to integrate AI in teaching and learning to augment student academic performance and increase the efficiency of the learning.



tegitic framework outlining constraints for ethical AI integration in educational settings. Additionally, the research sets forth technical requirements for the creation of a web-application that incorporates ChatGPT's API, implementing the recommended AI use cases in the learning process. The findings can be used to better understand the role of AI tools in education, offering practical guidance for students and teachers on how to integrate AI in teaching and learning to augment student academic performance and increase the efficiency

of the learning.

**Keywords** – Generative AI in Education, AI-Assisted Learning, Digital Learning Environments and AI, Educational Innovation, ChatGPT.

# S-25 COULD SUNSCREEN BE USED TO TREAT FUNGAL GROWTH?

Karl Padi Saar, Lejon Lehtinen and Mia Heath (all S7), ES Tallinn

Our experiment explores the fields of mycology and nanotechnology, where we have produced yeast culture with the intent to observe the effect of sunscreen with emphasis on nanoparticles. Therefore the aim of our experiment is to test different

concentrations of sunscreen—which would mean different concentrations of zinc oxide nanoparticles—along with UV light, on the fully growth yeast cultures and observe the effect on their growth.

# S-26 POWER SOCKET COMMUNICATION

Niklas Ilmari Tikka & Sulo Pietari Hintsala (all S7), ES Tallinn

Our project is a device that can easily and effectively transmit data through a building's or house's existing power distribution structure. The device can be used to automate tasks in a home, construct smart grids in households or simply transmit data. A multitude of these devices are required to operate within a large building but the system can also work simply with one transmitter and one receiver. The entire system revolves around transmitting data at an undisturbed frequency within the power sockets and cables of a house which is achieved through frequency modulation.

The way this works is by generating frequen-

cies of 300 MHz - 3 GHz that are far above normal electric frequencies of 60 Hz. Then, we simply pack information into these waves with a frequency modulator, and send the signal through the power socket into the power grid of the house. At the receiving power socket these signals can be intercepted and decoded for the information.

This project could have many applications in both households but also smaller industrial and business applications when considering, for example, an office where data transmission between different floors could be difficult, and can save on constructing new ethernet lines, within a building, as the existing infrastructure can be used.





## LIKE TWO DROPS OF WATER. ANALYSIS OF BRUSSELS WATER SOURCES.

Helena Domańska S6 PLA, ES Brussels I

Incredible properties and unique structure due to the molecule's polarity or hydrogen bonds presence makes water one of the most valuable sources on earth. The compound finds use in several nature-linked and mundane actions; it essentially is one of the factors creating life, regulates its' weather phenomena and nourishes all creatures. Therefore, it is important to preserve water sources against exploitation and pollution.

Water in Belgium, Brussels - Capital Region especially is known for having high contents of calcium  $\text{Ca}_2^+$  and magnesium  $\text{Mg}_2^+$  anions dissolved.



Some of the samples used in my project

ved. This causes significant water hardness which can have potential negative impacts on health and livelihood. Dealing with those issues for some time now led me to my research. I wanted to get some more answers about the condition of Brussels water sources as well as figure out which one of them is the safest for consumption.

My project will consist of an extensive water analysis with parameters such as water hardness or chloride  $\text{Cl}^-$  amount. The samples belong to different municipalities (fr. communes) of Brussels and chosen nearby places. After collecting all the data, an infographic or digital map will be created to display the results.

My presentation will be enriched with a photo documentation of the whole process and steps taken.

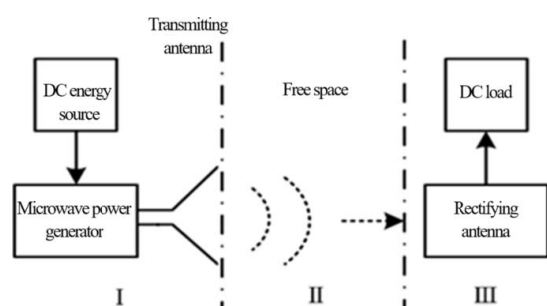
## WIRELESS ENERGY TRANSMISSION THROUGH WAVES

Maja Stępniaik and Sofia Baj (S5 ENA), ES Varese

### Idea

Our original idea was to transmit energy through light waves. After conducting research, we discovered that similar studies are being done with microwaves by the California Institute of Technology's (Caltech) Space Solar Power Project (SSPP).

We decided to test the efficiency of this system with different waves and focalize them as much as possible to limit energy dispersion, therefore studying the affecting factors.



The experiment apparatus is shown on the following diagram: (source: <https://asp-eurasipjournals.springeropen.com/articles/10.1186/s13634-022-00846-7>)

### Phases

#### 1) Microwaves

The first phase of our experiment was to test microwaves, measuring the input and output current when placing the transmitting and receiving antennae at various distances (1 m, 0.5 m, 0.3 m). Starting with a range of short distances on a flat surface, we will proceed with different heights and more important distances, as well as lenses and other factors which will limit energy dispersion and maximise the efficiency.

#### 2) Visible Light (and waves with greater amplitude)

The second phase is repeating the same process with visible light waves of different wavelengths and frequencies. Thanks to visible light, dispersion should be more clearly observed and limited.

#### 3) Demonstration with Mechanical Waves

The third phase is a demonstration of the principle, using mechanical waves in a water tank. The dynamics should be observed in an interesting way and would demonstrate yet another adaptation of this system.



#### 4) Lenses and Other Alterations

Slightly different setups, including lenses to optimise the efficiency of the system, as well as mirrors would be implemented when carrying out the three previous phases, to regulate wave dispersion.

#### Materials

Microwaves	Visible light	Mechanical waves	All
EM wave transmitting and receiving antennae Wooden stick (focalising the waves) Balloon (as a lens)	LED light source Solar panel Lenses, mirrors (?)	Water tank  <i>To Be Determined</i>	Power source (12v, 0.35A) Ampere-meters Light bulb Cables Ruler

#### Conclusion

This system, once a maximum efficiency is reached, will have an array of different life-changing applications in a world where we strive to lower our carbon dioxide emissions and allowing us to fully convert to renewable energy sources.

## REGROWTH OF THE FLORA AFTER EXTREME EVENTS: A CASE STUDY ON THE CAMPO DEI FIORI MOUNTAIN

*Petrillo Andrea, Pirrami Diego and Dentener Anton (S6IT), ES Varese*

In recent years, the frequency of extreme natural events, such as storms and fires, has increased by a lot, with a heavy impact on the vegetation. The area where we live, the Varese Province has also been affected. In particular, on the Campo Dei Fiori Mountain, there have been fires and thunderstorms which heavily impacted the local vegetation.

The goal of our study is to verify and analyse how the woody vegetation is regenerating in the areas where extreme events occurred in the Campo

Dei Fiori Regional Park. For this purpose, we will choose one area among those impacted, on which we will be able to get information from the park authority on the pre-existing vegetation. Afterwards, we are going to carry out surveys on the vegetation to quantify, with linear transects, the coverage of the different species of trees. This will allow us to verify whether the regeneration in the area involves either the same species or other species more suitable to the actual environmental conditions.

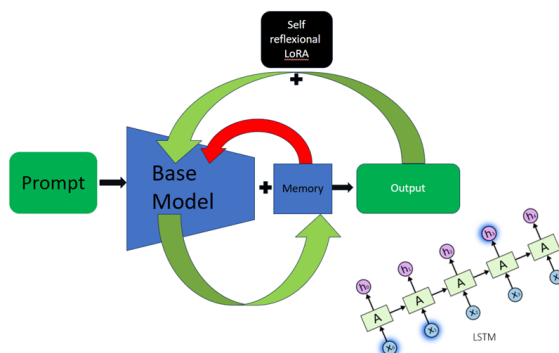


# BIAS AND IDEOLOGICAL SUBVERSION IN LANGUAGE MODELS

Sebastian Calacean and Mihail – David Staicu (both S7FR), ES Brussels II

Large Language Models (LLMs) have revolutionized artificial intelligence (AI), focusing media attention for the past year. However, one of the most debated subjects regarding these AIs are potential dangers and hazards they could present.

In this project, we introduce Eli, an LLM based on the llama-2-7b model that was trained to **resemble human conversation** as much as possible. AI chatbots do not sound very human by design, and by giving the right data, these models can output something very **close to human thought patterns** and conversational capabilities.



We trained several versions of Eli, the biggest one trained on a large collection of internet data scraped from less-known websites and forums and supervised carefully for "social media conversational bias". While testing the AI, we have gathered insights on the inappropriateness of the standard testing data and the results have raised several issues regarding the safety of the models, and of AIs in general, reflecting the extreme nature of the data scraped from the internet and the powerful nature of opinions and their philosophical implications.

# PROTOTYPE D'UNE VOITURE PIÉZOÉLECTRIQUE

Liisa Bourgey, Victoria Santangelo and Olivia Pataki (all S5 FR), ES Brussels II

Parmi les nombreux problèmes qui pèsent sur notre société, il y en a un qui revient souvent en tête : l'émission de  $\text{CO}_2$ . Sachant que 25% de ce danger est dû aux transports, on en a conclu qu'il fallait trouver une solution n'ayant recours à aucune énergie fossile, ni combustion. Nous voudrions créer le prototype d'une voiture indépendante de ces énergies néfastes, en n'utilisant que celles qu'elle produirait par elle-même, plus spécifiquement ses roues.

Nous utiliserions le rotor de la roue avec un brin, qui tournera et touchera la plaque piézoélectrique placée sur un ressort qui se rétractera quand le brin donnera assez de pression, jusqu'à ce que ce brin glisse et recommence le processus. En construisant le générateur piézoélectrique de la voiture, on a constaté que l'énergie produite était très faible, en partie dû à la mauvaise qualité des plaques, donc en considérant les pertes d'énergie lors des conversions d'énergie mécanique et cinétique, on a conclu qu'on avait besoin d'un condensateur. Ce condensateur emmagasinerait l'énergie cinétique créée par la voiture lorsqu'elle aura été

roulée pour accumuler de l'énergie au préalable, ce qui permettra aussi le départ de la voiture et la recharge d'énergie lorsqu'elle s'épuisera à cause des frottements des roues sur le sol.

Nous sommes toujours à la recherche des meilleures plaques piézoélectriques et d'un condensateur adapté à ces plaques. L'efficacité du condensateur devra être testée, nos calculs manquent de données.

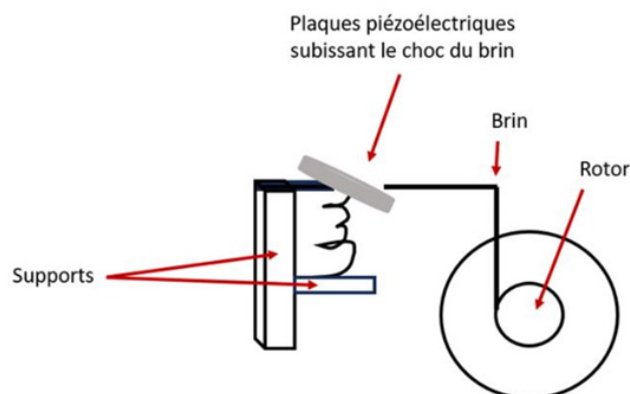


Schéma du dispositif



Thank you to:

Nitsche Gebäude Reinigung

Bäckerei Rumpf

Firma Stamm

Hassia

PPS Sicherheitsdienst

Melomi

Mercury

Oosten

