

Welcome Note .....	3
Inspector's Note .....	4
Guest Speakers .....	6
Judging Panel .....	8
Assessment Criteria and Running of the Competition .....	13
Symposium Program .....	17
Opening Ceremony .....	19
Closing Ceremony .....	20
Junior projects participating from the different schools .....	21
Senior projects participating from the different schools .....	22
Junior Projects .....	23
Senior Projects .....	61
Acknowledgements .....	75



A warm welcome to all participants of the 16<sup>th</sup> European **S**chool **S**cience Symposium taking place in ESMOL.

*The mission of the European schools is to provide all pupils with multilingual broad education of high quality and to equip upper secondary students for adult life and form a basis for further learning.*

To bring this mission into practice, the European school system has put in place a range of inter-school activities that allow students to learn and grow, not only in the safe surroundings of their own classroom and school but also in exchanging experiences with fellow students from other schools. The European School Science Symposium is one of these activities where students present their work and have the opportunity to be inspired by the work of others.

We at ES Mol are very proud to host this event. Participating students this year may well go on to be the scientists of the future. A lot of challenges we face today depend on scientific research for solutions; climate change, pollution, renewable energy, space exploration, treatment for diseases, the list is endless. The science symposium combines critical thinking, experimenting, scientific research and presenting projects. A jury of scientists will evaluate the work presented and give valuable feedback to inspire students to further develop their scientific skills.

During the Symposium, ES Mol will open its gate to students, accompanying teachers and to renowned and valued scientists of our privileged partners JRC (Joint research Centre) and SCK-Cen (Belgian Nuclear Research Centre). We will take this opportunity to expose all our pupils from primary as well as secondary to this exciting science event.

A special thanks to the team of colleagues here in Mol that have organised the event and made it a success, to the scientists that were part of the jury and/or led scientific workshops and to our partners for supporting the event in different ways.

The best of luck to all participants. We have no doubt that the ESSS 2019 at ESMOL will be an unforgettable experience for all those involved.

Tinne Van Opstal  
Acting Director  
European School Mol



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



Cette 16<sup>ième</sup> 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 31 mars au 3 avril 2019 à l'EE de Mol pour présenter leurs projets scientifiques.

Je dois mon respect à vous les élèves qui vous vous êtes engagés, de manière exemplaire, bien avant d'arriver ici à Mol. Mon respect parce que vous étiez prêt à fournir un travail supplémentaire, à vous investir.

Lors de ce concours votre créativité est stimulée. Vous étiez obligés de travailler de manière efficace et ciblée, de communiquer et de collaborer. Pour développer vos projets il fallait avoir l'esprit d'initiative, de l'imagination, être en mesure de résoudre des problèmes tout en restant critique par rapport à sa propre démarche.

Quand on jette un coup d'œil sur les projets qui ont été soumis au Symposium on peut se rendre compte d'une imagination et d'une créativité insatiables. Vous avez travaillé sur des sujets et thématiques qui sont d'actualité et qui vous ont interpellés.

Est-ce que ce ne sont pas de telles initiatives, comme ce symposium, qui permettent de développer les compétences du 21<sup>ème</sup> siècle chez nos jeunes, à savoir créativité, esprit critique, entrepreneuriat, résolution de problèmes, innovation pour n'en citer que quelques-unes.

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 réciproquement. Mais dans tout cela n'oubliez jamais de chercher une manière de vous évader, pour trouver un domaine que vous adorez et qui vous passionne

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 de l'Ecole hôte, l'association des parents ainsi qu'à toute l'équipe organisatrice (Sonia Mohan, Pieter Somers, Christophe Melzassard, Guillaume Martel, Marleen Van Asbroeck, Mersiha Teskeredzic, Pieter Hermans pour leur travail insatiable tout au long des deux dernières années.

L'équipe qui remportera l'ESSS ira représenter les EE au prestigieux **EUCYS** (*European Union Contest for Young Scientists*), qui aura lieu du 20 au 25 septembre 2019 à Sofia (Bulgarie). Ce concours est la vitrine des meilleures performances scientifiques des élèves. Il s'agit d'une initiative de la Commission Européenne lancée pour promouvoir la coopération et l'échange entre jeunes scientifiques. 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. Les écoles européennes ont œuvré dans ce sens en publiant de nouveaux Syllabai de Sciences pour la rentrée 2019-2020.

Pour le moment il me reste de féliciter tous les participants au symposium. Bravo pour votre engagement et vos travaux. Beaucoup de plaisirs avec les sciences et à l'année prochaine à l'école européenne de Karlsruhe!

Max Wolff

Inspecteur des Écoles européennes





Vladimir Pletser earned a Master of Engineering in Mechanics in 1979, a Master of Sciences in Geophysics in 1980 and a Ph.D. in Astrophysics in 1990 from the University of Louvain, Belgium.

He is currently Director of Space Training Operations at Blue Abyss, a company based in UK, proposing a new approach for astronaut training.

From 2016 to 2018, he was Visiting Professor – Scientific Adviser at the Technology and Engineering Centre for Space Utilization of the Chinese Academy of Sciences in Beijing, China, supporting the preparation and development of microgravity research instrumentation for parabolic flights and for the future Chinese Space Station.

Previously, he worked for 30 years as Senior Physicist – Engineer at the European Space Research and Technology Centre (ESTEC) of the European Space Agency (ESA), developing scientific instruments for microgravity research in fluid physics, crystallisation of proteins and zeolites and on dexterous manipulation on board the International Space Station.

He was also responsible of the ESA aircraft parabolic flight programme. He logged more than 7350 parabolas, representing more than 39h 30m of weightlessness, equivalent to 26 Earth orbits, and 53 min and 50 min at Mars and Moon g levels, during which he participated in several hundred experiments in physical and life sciences. He holds the official Guinness World Record for the number of airplanes (14) on which he flew parabolas. He served as Flight instructor for public Discovery Parabolic Flights.

Astronaut Candidate for Belgium since 1991, he was Payload Specialist candidate for several Spacelab missions, including Spacelab LMS for which he spent two months in training at NASA-JSC, Houston, in 1995. He was Astronaut Training Instructor for Parabolic Flights with ESA astronauts and for NASA and DLR astronauts for several Spacelab missions.

Selected in 2001 by *The Mars Society*, a private organisation promoting the human exploration of Mars, he participated in three international simulation campaigns of Mars missions in the Arctic Circle in 2001 and in the Desert of Utah in 2002 and as Crew Commander in 2009.

He is visiting Professor in 20 universities in Europe, USA, Canada, Africa, Israel, and China. He has more than 600 publications, including 16 books or chapter in books, 60 articles in refereed journals and 132 articles in international conferences proceedings.

He is member of the *International Astronautical Academy* and of several other academies and scientific organizations.





### Biography

Dr Anklam is Director of the JRC-Geel site and of JRC-Directorate F: Health, Consumers and Reference Materials (comprising staff in Geel and Ispra) following a JRC-reorganisation in 2016. The JRC is the European Commission's science and knowledge service. The working topics of JRC-Directorate F are related to life sciences and include public health matters such as cancer and rare diseases registries and quality assurance for cancer screening, nutrition, nanotechnology and medical devices, alternative-to-animal-testing toxicological methods, food and feed safety and quality, including combating fraud, and reference materials for quality control of analytical measurements. JRC-Directorate F carries out regulatory science to serve EU policies in the areas of public health and health technologies, single European market for goods and services, safety of food, feed and chemicals and fraud detection and prevention to ensure that EU citizens are protected when they buy products or receive a service.

Dr Anklam studied chemistry at the Universities of Muenster and Hamburg (Germany), and received her PhD in organic chemistry from the University of Hamburg, with a focus on food, organic-, photo-, and radiation chemistry. After completing her PhD, she received a grant from the Alexander von Humboldt Foundation to spend a very exciting year (1985) as Feodor-Lynen Grantholder in the research group of Prof. Lehn who was awarded the Nobel Prize in Chemistry in 1987. She was a recipient of yet another German grant to work at the former Hahn-Meitner-Institute in Berlin (Germany) until 1989 where she led a small team in the area of synthetic and radiation chemistry. She witnessed the fall of the Berlin wall before taking up a new career as a Teaching Professor in the Applied University of Fulda (Germany), focusing on food chemistry and chemistry.

In mid-1991, she left Germany and moved from Fulda to Ispra in Italy where she began a new career by joining the European Commission's Joint Research Centre (JRC). Since then, she has been enjoying the exciting work of providing scientific and technical expertise and advice to EU policymakers. During her first years in Ispra, she served as Head of Unit of the, then, relatively new activities on food sciences. In 2002, she moved to the JRC-Geel site in Belgium, transferring with her a significant part of her food and feed safety and quality work before being assigned in 2006 as Director of the former JRC Institute for Health and Consumer Protection located at the JRC-Ispra site. Following the JRC re-organisation, she relocated back to Geel in 2013 to become Director of the defunct Institute for Reference Materials and Measurements, now JRC-Geel site. It was with much pride and honour that she became the first woman to be awarded the Joseph-Koenig commemorative coin by the German Chemical Society in 2013.

**Andrea HELD**

I am German, and I have been living in Belgium (with few interruptions) since 1994. I have a son of 7 years, who is attending the European School in Mol.

I went to school in Duisburg, Germany. I hold a degree in chemistry from the University in Dortmund, Germany. I worked on my diploma thesis in the field of analytical chemistry at the University of Antwerp, supported by a fellowship of the ERASMUS programme. During this first stay in Belgium I came into contact with the JRC in Geel, and successfully obtained a "Human Capital and Mobility" grant of the EU to carry out the practical work for my PhD thesis, entitled "A contribution to metrology in chemistry: Measurement of traceable platinum and zirconium amount contents in a car catalytic converter material to be used as certified test samples", at the JRC in Geel. The international working environ-

ment at the JRC encouraged me to take on several temporary positions at the JRC Geel, dealing with topics such as organising laboratory intercomparisons to evaluate performance of analytical laboratories and the development and preparation of uranium isotopic reference materials for environmental analysis.

Since 2003 I have a permanent position at the JRC, initially working on Certified Reference Materials (CRMs) for environmental analysis, especially soil and water. I gradually took over more topic areas, such as CRMs for food analysis, nanomaterials and industrial applications. I am currently team leader of a team of scientists, developing CRMs for engineering, food and environmental analysis and also providing targeted input to policy developments in the EU on these topics■

**Dr. Eric OPSOMER**

Born in 1987 in East Belgium, obtained his Master's degree in Mathematics in 2009 at the University of Liege (ULiege).

The same year, he started a PhD Thesis in Soft-Matter Physics in the GRASP (Group for Research and Applications in Statistical Physics - ULiege) under the supervision of Prof. Nicolas Vandewalle. His Thesis focused on the dynamics of granular materials in microgravity conditions, and was realized within the frame of a European Space Agency project. Given the need for low gravity conditions, his studies were realized thanks to intensive computer simulations and experiments in parabolic flights. Since his Post-Doc on pattern formation in magnetic granular materials at the University of Paris 7, Dr. Eric Opsomer has been working at the University of Liege where he recently obtained a position as Assistant Professor. Currently his research interests lie in the fields of complex fluids, cohesive granular systems and active matter. Moreover, he is developing a section for Numerical Physics at the University of Liege and organizes several courses and laboratories for Bachelor and Master students■

**Marcel BROHEE**

I graduated in Biology with speciality in Oceanology from the University of Liège. I am a self-made man and have had a lot of different working experiences before being hired by the European Commission in 2003. I now work as a senior scientist, responsible for the ELISA lab in the Unit F5 JRC-Geel. My responsibilities include the production of research material to validate new methods of analysis for allergens with mass spectrometry and help in creating new reference material for allergens. I also host the students of the 6<sup>th</sup> year Biology 4 every year for a hands-on session with Elisa kit and my colleagues from the Unit explain different techniques of analysis such as Mass-



## Dr. Ursula VINCENT

EC-JRC-Geel, Directorate for Health, Consumers and Reference Materials



Ursula Vincent joined the European Commission Directorate General Joint Research

Centre in 1997. Her first task was to develop and validate a method for the analysis of oxidative hair dyes (cosmetics field). Today Ursula is the Team Leader of the European Union Reference Laboratory (EURL) for Feed Additives Control, one of the two pillars of the EURL for Feed Additives, hosted at the Joint Research Centre (in Geel, Belgium); her main activities are to design, supervise and coordinate projects related to additives, contaminants and residues analysis in food and feed matrices as well as to contribute to the harmonisation of analytical methods used by the EU Member States for the control and monitoring of the food chain in EU. For the last years Ursula has been carrying out projects focusing on feed additives (regulated substances) such as coccidiostats (last anti-bacterial substances authorized as feed additives in EU), carotenoids (e.g. colouring eggs or fish flesh) and vitamins.

As a senior scientist with more than 15 years of experience in the development and the validation of analytical methods, Ursula also participated in several EU projects where she was the leader or co-leader for parts of the projects. Her areas of expertise are on methods development, validation and standardisation, chromatographic techniques, mass spectrometry and spectrophotometric detection. Ursula graduated in Paris, France, in 1991 with a scientific and technical master in biochemical and biological engineering followed by a specialisation diploma in analytical chemistry in 1992 also obtained at Paris VI. In 1996 she successfully defended (with honours) a PhD thesis in chemistry with a specialisation in analytical chemistry. The title of her thesis was "Analysis of double-stranded DNA fragments and of polynucleotides by capillary electrophoresis – Application to biological samples".■

## Vincent MASSAUT

Deputy Director « Business Development » at the Belgian



MSc in Engineering, electro-mechanics, with a specialty in nuclear engineering, from the University of Liège (in 1982), I spent most of my career at the SCK•CEN in Mol (Belgian Nuclear Research Center).

After a few years spent on technology research for fusion energy, I took over in 1990 the BR3 decommissioning project, a PWR reactor of 11 MWe which was selected as European pilot decommissioning project by the EC; I directed this project during almost 15 years. Nominated Chairman of the WPDD within the OECD/NEA, I have also been member of various international expert committees and of a dedicated working group from the US Academy of Science on R&D in decommissioning. I am still member of the European JRC-D&WM international expert group giving advice on the dismantling of nuclear facilities in the 4 JRCenters of the Commission. I am also, since 1999, member of the "Groupe Permanent Usines", which gives advice to the French regulatory authority ASN.

After 2 years at the EFDA in Garching near Munich, I took over in 2007 the direction of the fusion technology studies at SCK•CEN. In 2014 I was nominated as Deputy Director in charge of the Business Development activities at the SCK-CEN.

I have regularly been giving lessons and large public conferences on the future fusion energy and its current developments and also on the dismantling of nuclear power plants, both based on my practical experience in the fields.■

**Dr. Marta DABRIO****EC-JRC-Geel, Directorate for Health, Consumers and Reference Materials**

I have a background as chemist with a specialisation in analytical chemistry. Before joining the European Project fifteen years ago, I spent some time completing my studies and getting to know different European Member States. First in Belgium, where I did my PhD to contribute to the characterisation of small proteins known as metallothioneins using different analytical techniques. These are very interesting molecules that take part in metal storage and detoxification routes in our bodies. Later on, in Sweden, the work continued with post-doctoral studies of the same proteins from a more biological perspective. Back in Spain, where I come from, I also experienced working in the private sector, this time by

supporting different laboratories to develop analytical applications in diverse areas using mass spectrometric techniques. This background brought me back again to Belgium and to the Joint Research Centre of the European Commission where, for many years, I am heading the Organic Analysis Laboratory and leading projects for the production of Certified Reference Materials (CRM) for food analysis. In that field, the CRMs play a pivotal role to make sure laboratories analyse their food samples correctly, whether it is for the specific food composition (reflected in product labelling at the supermarkets) or to detect the presence of any harmful contaminants (to prevent such foodstuffs from entering the market). In this respect our work at the JRC is contributing to make sure that we, as EU citizens, are protected in our daily lives and can enjoy safer food. ■

My name is Nikolay and my background is social science and economics with specialization in international trade. I am from Bulgaria and I completed my studies between Bulgaria, Germany and the UK.

After graduating I enthusiastically entered the world of international sales. This was a great opportunity to earn my living – I travelled around the world, met unique people and explored interesting cultures. I worked in Spain and Germany but in reality, I was virtually and literally all around the world... unfortunately mainly on airports, hotels and business meetings.

I speak 6 languages which helped me open many doors in numerous countries. I specialized in market development, sales forecast and customer relations. My most important assets were intercultural understanding and flexibility. Another important element for my job, and I would say for everyday life, was my interest in behavioural economics and psychology. In this respect I

**Nikolay DENIN**

strongly recommend the book “Thinking, Fast and Slow” from the Nobel laureate Daniel Kahneman.

After years of being on the go I finally settled in Belgium. I currently work for the Joint Research Centre of the European Commission which feels like a blessing! I am surrounded by excellent colleagues working on very exciting projects and all in the name of making Europeans healthier and improving their wellbeing. Moreover, my work gave me the opportunity to be part of this wonderful initiative of European Schools Science Symposium and witness first-hand the promising future of European science! Looking forward to seeing you all and your wonderful ideas! ■

**Geert VAN DEN EYNDE**

I am the head of the Expert Group "Nuclear Systems Physics" at the Belgian Nuclear Research Center, SCK\*CEN. I combine my education as a computer science engineer and nuclear engineer in the simulation of nuclear systems ranging from nuclear reactors to nuclear chemistry labs. My team is responsible for the calculations supporting the safe and efficient operation of the BR1 and VENUS research reactors at SCK\*CEN as well as the core and safety analysis of the MYRRHA Accelerator Driven System under development at SCK\*CEN. My main interests are, of

course, in reactor physics but also in applied mathematics: "How do I compute this? How do I simulate this on a computer?".

I was born in 1975, and am happily married to Katrien and have three teenage boys.

I also am an active member of the SCK\*CEN Academy for Nuclear Science and Technology and teach reactor physics and reactor engineering at levels ranging from high-school students to nuclear engineering students. I am also a guest lecturer on reactor technology at Hasselt University since a few years.

In my spare time, I like to read (Terry Pratchett and Haruki Murakami, two of my favorite authors) and I practice Goju-ryu karate■

**Dr. Laura BROHEE**

Dr. Laura Brohee pursued her secondary studies in the "European school of Mol" located in Belgium. Directly after she joined the University of Liège where she obtained a Bachelor's Degree in Biology. Afterward, she continued her studies in the field of molecular biology and obtained a Master's degree in "Molecular biology and biochemistry" in the same University. Fellow of the FRS-FNRS (Télévie) she carried on her doctoral thesis on the theme of cancer research under the supervision of Dr. Deroanne. During four years she investigated the impact of the enzymes involved in lipid metabolism on cancer phenotype and the targeting of these enzymes for cancer treatment. Since end of 2017 Dr. Laura Brohee is a Postdoctoral fellow at the "Max Planck Institute for Biology of Ageing" in the laboratory of Dr. Demetriades. Dr. Brohee current research focuses on how cells sense environmental conditions, such as stresses and starvation of specific metabolites, and respond adapting their growth and survival. These mechanisms are of great importance as dysregulation of cell growth can lead to threatening effects like ageing and cancer■

**Dr. Andrew DOBNEY**

I studied Chemistry with Analytical Chemistry and Toxicology as an undergraduate at Hull University, UK. After completing my PhD in electroanalytical chemistry (also at Hull University) I moved to Belgium where I have lived for more than 20 years. During this time I worked as a post-doctoral researcher at the European Commission Joint Research Centre laboratory in Geel on isotope dilution mass spectrometry, at DSM Research in Geleen (NL) on inductively coupled plasma mass spectrometry (ICP-MS) and laser ablation, and at the Netherlands Forensic Institute near Den Haag where I also continued to specialize in inductively coupled plasma mass spectrometry (ICP-MS) and laser ablation. I therefore became very specialized in inorganic mass spectrometry and elemental analysis. Since 2005 I have worked at the Belgian Nuclear Research Centre in Mol where I am responsible for an instrumental analysis group that operates several laboratories perform inorganic analysis on samples originating from the nuclear fuel cycle. These laboratories also support internal research projects unrelated to the nuclear fuel cycle. We therefore analyse non-radioactive samples as well as highly radioactive samples. My specific interests include thermal ionization mass spectrometry, elemental analysis in general, measurement uncertainty and chemical metrology■





## Jordi VIVES I BATLLE

Jordi Vives i Batlle is a research scientist who works at the Belgian Nuclear Research Centre (SCK•CEN). He specialises in radioecology, the science that studies the fate, transport and biological uptake of radionuclides in the environment. Jordi has devoted his career to investigating the impact of radiation in wildlife and ecosystems, with the goal of establishing a mathematical foundation for radioecology based on physics, ecology and biology. Jordi's research goal is to uncover the hidden mathematics of nature, using them to develop realistic mathematical models of the environment and of life, capable of describing the spread of radioactive

contamination.

Jordi has a long track record of 30 years working for universities, government and industry in Catalonia (where he was born), Ireland, USA, UK and Belgium, having some 150 scientific publications on radioecology and radiation protection subjects. During his 5-years doing a PhD on marine radioecology at University College Dublin, Jordi fell in love with the marine environment and has continued his interest through a 2-year postdoc at the University of Pittsburgh (USA), 15-years at the Westlakes Research Institute (UK) and (since 2010) the Biosphere Impact Studies group of SCK•CEN. He is very active on studies of the impact of the Fukushima accident in the oceans, and participates regularly in international projects within the EU as well as the IAEA and ICRP. In 2010, he was awarded a professorship of Environmental and Radia-

## Anneli NY



I am from the north of Sweden and studied chemistry and biology for a bachelor's degree at Umeå University (Sweden). During my studies I had the opportunity to participate in an exchange program and spent two terms at University of Sussex (UK). I attended courses in medicinal chemistry that interested me in specializing within this field. I therefore completed a PhD at the Department of Medicinal Biochemistry and Biophysics (Umeå University) where I spent five years studying proteolytic enzymes and their role in degrading extracellular matrix. The results of my thesis gave us new fundamental understanding on mechanisms involved in female fertility. I left for Belgium and University of Leuven (KU

Leuven) to join world leading scientists in the field of cancer. The first couple of years I focussed on establishing *Xenopus* (frog) as a novel model to study how cancer can spread. Since then I have also developed tools and animal models for mimicking human disease with the aim of finding better and safer drugs for epilepsy, autism, kidney fibrosis and viral infections. Since 2016 I am the Innovation Manager at the Laboratory for Molecular Biodiscovery where my main responsibility is to manage a zebrafish platform making experiments for both discovering and assessing the safety of potential medicines, and to closely interact and collaborate with industry as well as academia■

- Each school can submit **3 projects plus 1 reserve**.
- Projects will be grouped according to pupils' year level:  
Junior Projects: **years 2 - 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.

### 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 as a scientist you should be concise and very precise in what you write, i.e. LESS is MORE, don't use more words than you really need. Don't be satisfied with a first draft. You can write your report in any language but you will need to provide a translation in English, French, or German for the judges.



## SCORING SHEET – REPORT WORK

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

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

Number of the project: \_\_\_\_\_

### Motivation and Originality:

/10

Motivation and ultimate aim

Originality

### The Process

/20

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

Presentation of data

Achievement of aims / Answering of research question

Drawing of conclusion

### Significance

/5

Global significance

Short comments on the project if it is applicable:

**Total points: /50 points**

Signature of the jury member: \_\_\_\_\_

### 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. However, 10 points (10% of the total point) will be given by the jury (a panel of judges composed of two experts) concerning the readability of the project through the poster. They are available to provide you additional information on their project work and answer questions. The oral presentation will be maximum 10 minutes and the panel of judges will be invited to pose questions for a max of 5 minutes.

The jury members evaluate the oral presentation by giving the rest 50% of the total preliminary points.

#### SCORING SHEET – ORAL PRESENTATION

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

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

Number of the project: \_\_\_\_\_

#### Evaluation of the oral presentation

/40

How easily did student(s) express themselves? (15)

Using of supports (slideshow and/or poster and/or equipment)

Has been done clearly and explain the aim of the project? (10)

How clear were the answers? (15)

#### Evaluation of the poster

/10

How well planned and organized was the poster? (2)

How well does the poster describe the aim of the project? (4)

How well were experiments/data/statistics presented? (2)

Level of creativity (2)

Short comments on the project if it is applicable:

**Total points: /50 points**

Signature of the jury member: \_\_\_\_\_

The scores of the written and oral 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 make its common decision.

## **(2) Final round – plenary stage presentation**

### **(3)**

The very best 5 junior and 5 senior projects (selected in preliminary rounds) will be invited to present their work on stage for a maximum of 10 minutes. Audience and jury will be invited to pose questions for a maximum of 5 minutes.

The stage manager will indicate when the final minute of the presentation/questions-answers starts. The timing must strictly be kept for all participants.

Previous points and rankings are disregarded for the final round.

The jury will give rankings for the projects. They will take into account of the following characteristics of the projects:

- 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?
- Presentation – how well is your project communicated? Do you demonstrate understanding and reason clearly? Is your final report of the high quality?
- Significance – what is the wider impact of your project?

Final rankings for each category will be added, the lower the rankings, the better the score. In the event that projects have identical ranking scores, the panel of judges will arbitrate to reach a final common decision.

The three best entrants in each category (junior and senior) of the competition (according to the above mentioned criteria) will be received the 'ESSS 2019 prize' (1st 2nd 3rd) . the 4th and 5th places will be rewarded with a 'finalist certificate of ESSS 2019'.

The winner of the senior project of ESSS 2019 will be selected for the **European Contest for young scientists (euCys 2019)**.

**the awarding ceremony will take place on the final day of the ESSS 2019 (3rd).**

### **Day 1: Sunday 31<sup>st</sup> March 2019**

- 14:00-16:30 : Arrival participants to ES Mol-Registration
  - 16:30-17:30: Set-up posters
  - 17:30-19:30: Opening Ceremony
  - 19:30-20h00: Bus transfer to de Linde Hostel
  - 20h00-21:00: Dinner at De Linde Hostel
- 

### **Day 2 : Monday 01<sup>st</sup> April 2019**

- 7:30-8:30: Breakfast at de Linde Hostel
- 8:30-9:00: Bus transfer to ES Mol
- 9:00-10:30: Individual presentations project to judges and poster presentation
- 10:30-10:45: Coffee-Tea Break (Jury)
- 10:45-12h30: Individual presentations project to judges and poster presentation
- 12h30-13h30: Lunch at ES Mol
- 13h30-14:00: Transfer to activity sites by bus or on foot depending on the group
- 14:00-17:00: Scientific Workshops on JRC site or SCK-CEN site
- 17:00-17:30: Transfer to ES Mol by bus or on foot depending on the group
- 17:30-18:30: Presentation of the visit of the port of Antwerp
- 18:30-19:30: Dinner at ES Mol
- 20:00-21:30: Escape room game at ES Mol
- 21:30-22:00: Bus transfer to de Linde Hostel

### **Day 3 : Tuesday 02<sup>nd</sup> April 2019**

- 7:30-8:30: Breakfast at de Linde Hostel
  - 8:30-9:00: Bus transfer to JRC Geel
  - 9:00-10:30: Presentations of five best Junior projects
  - 10:30-10:45: Break
  - 10:45-12h30: Presentations of five best Senior projects
  - 12h30-13h30: Lunch at ES Mol
  - 13h45-15:00: Transfer to the Port of Antwerp
  - 15:30-18:00: Visit Port of Antwerp by boat
  - 18:00-19:00: Bus transfer to de Linde Hostel
  - 19:00-120:00: Dinner at De Linde Hostel
- 

### **Day 4: Wednesday 03<sup>rd</sup> 2019**

- 7:15-8:00: Breakfast at de Linde Hostel
- 8:00-8:30: Bus transfer to ES Mol
- 8:30-9:00: Removing posters
- 9:00-10:15: Closing ceremony
- 10:15-12:00: Award Ceremony



**SUNDAY 31<sup>st</sup> MARCH 2019**

**17:30-Musical introduction**

*L.V. Beethoven « Ode to Joy »*

**17:45-Speech of the acting Director of the European School of Mol, Ms Tinne VAN OPSTAL**

**18:00-Speech of the Secondary School Inspector of European Schools, Mr Max WOLFF**

**18:15-Musical interlude**

*Manccini « The pink panther »*

**18:25: Speech of the Jury Président**

**18:35: Speech of Prof. Sarah BAATOUT SCK-CEN**

**18:45: Scientific presentation of Guest speaker**

**Mr Vladimir PLETZER**

**19:30-Musical interlude**

*W.A.Mozart « Eine kleine Nachtmusic » 1<sup>st</sup> movement*

**WEDNESDAY 03RD APRIL 2019**

**9:00-Speech of the acting Director of the European School of Mol, Ms. Tinne VAN OPSTAL**

**9:15-Speech of the General Secretary of European Schools, Mr .Giancarlo MARCHEGGIANO**

**9:30: Speech of the President of Parent Association**

**9:40: Scientific presentation of the guest speaker**

**Dr. Elke ANKLAM , Director of JRC**

**"Education in Science: Important as Ever!"**

**10h15: Award Ceremony**

*Distribution of awards to participants and winners by Mrs. Tinne VAN OPSTAL*

## JUNIOR PROJECT LIST



SCHOOL	PROJECT N°	TITLE OF PROJECT
Alicante	1	The Perfect Timetable
Alicante	2	How does the use of influence students academic results?
Culham	3	It's Plastastic
Culham	4	Food-Waste futures
Culham	5	BreathXlite
Frankfurt	6	The use of plastic waste in costruction
Frankfurt	7	The effect of Wi-Fi radioation on living Organisms
Frankfurt	8	Oxy-hydrogen (hgo) generator
Frankfurt	9	Students and phones:are we already addicted?
The Hague	10	Our Hovercraft
The Hague	11	What is in the darkness?
Ixelles (EEB3)	12	Testing the bacterial colonization of EEB3
Karlsruhe	13	Managing the moisture content in indoor plants from a central control
Karlsruhe	14	How can blind people be helped by using a <b>device that can recognize colors?</b>
Luxembourg 1	15	Cpu visualiser
Luxembourg 1	16	Luxembourg nature explorer
Luxembourg 1	17	Smartcap
Luxembourg 1	18	The symbiose of the ants and the fungus
Luxembourg 2	19	Robot de surveillance solaire
Luxembourg 2	20	The autonomous greenhouse
Mol	21	Can cooler
München	22	Menschenerkenner
Parma	23	chester
Parma	24	Newton can save the cristal !
Parma	25	Lost in translation
Rhein/Main	26	Energiespar tastatur
Rhein/Main	27	Killer für tintenkiller
Rhein/Main	28	Shamprush
Uccle (EEB1)	29	Study of privacy in social media
Uccle (EEB1)	30	Le hamster vs le minotaure ou le test de mémoire

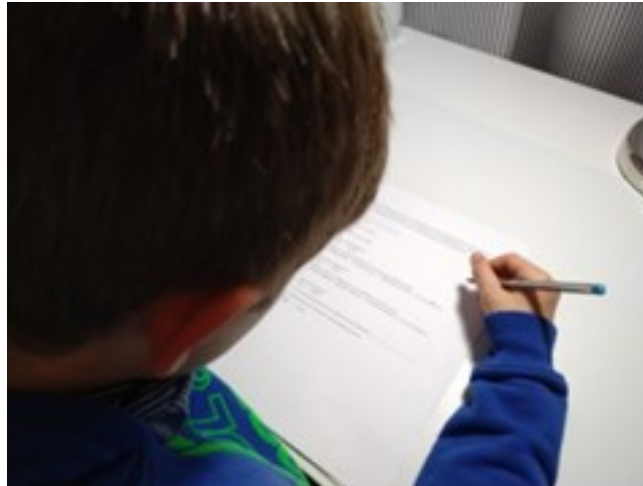
## JUNIOR PROJECT LIST



SCHOOL	PROJECT N°	TITLE OF PROJECT
Uccle (EEB1)	31	Effects of deforestation
Varese	32	The wrong way driver collision prevention module
Varese	33	The effect of different light sources (uv, colors, and odours) on sleep-wake cycle of bug
Varese	34	Salame al cioccolato
Varese	35	Study of privacy in social media
Woluwe (EEB3)	36	What will happen after many years of global warming?
Woluwe (EEB3)	37	ON Which Bread Does Mould Grow the Fastest and in Which Conditions?

## SENIOR PROJECT LIST

Alicante	38	Use of a microbial consortium to improve the performance of a microbial fuel
Alicante	39	Atos
The Hague	40	Nutrient energy value
Ixelles (EEB3)	41	Resonance
Luxembourg 2	42	Home for all
Manosque	43	Plant, Water conservation and Energy Project
Manosque	44	Sea Clean Machine
München	45	Biodiesel
München	46	UVI Wristwatch (UWW)
Strasbourg	47	W.A.V.E.
Strasbourg	48	Finding an alternative way of removing tattoos by studying the phagocytosis of tattoos ink
Uccle (EEB1)	49	EEB1 as a system of multi autonomous agents
Woluwe (EEB2)	50	Redesigning the bicycle frame with generative design
Woluwe (EEB2)	51	Air pollution detector



Attention is one of the most important things affecting our performance in the school. The capacity to hold the attention in class varies between individuals, but there are common factors that can affect it, like the fatigue. For example, the same mathematical lecture on Monday morning or Friday afternoon will probably be differently attended. Similarly, those subjects that need more attention can condition performance in later classes. Based on this intuition, we hypothesize that the order of the class subjects in our timetable conditions our attention. This hypothesis predicts that a perfect timetable, one in which the sequence of subjects optimizes attention, is possible.

To answer this question, we have designed an experiment in which the attention of the students is evaluated with conventional psychological tests at two time points in the day, just at the beginning of the day and before lunch. Testing sessions are organized to get data from all days in the week during a 3 weeks period (from no more than 2 days in the same week). We will repeat this procedure 3 times with one-month interval. Up to 6 different attentional tests will be used to avoid interferences between sampling days. In addition, a four-items questionnaire will be presented to assess the general level of relaxation/stress of the participants. The design allows us to differentiate fatigue along the day and the week from that produced by subject class order. These data and its statistical analysis will verify or falsify our initial hypothesis. In case of a positive result, we will use the obtained knowledge to guide the design of the perfect timetable





The use of a mobile phone occupies great part of the time of teenagers. Often it is used as a tool for researches of contents or to communicate with classmates. Nevertheless, it is a frequent improper use to sail along Internet and chat in the social networks. The result can occupy too much time and to effect the students work.

In this project we are going to analyse the relationship between the frequency, the intensity and the reasons why students use their mobile phone with the academic results in the European School of Alicante.

To see this possible relationship, we are going to evaluate with a questionnaire about the use of the mobile phone and a register of the average grade of each student of secondary. Later we are going to do a statistic study of the data we collected to find results.

Plastic pollution is a pressing issue. Worldwide, 300 million tons of plastic is produced every year, half of it for single use. Recycling reduces plastic waste however it would be better if fewer items were made of plastic. Examples of items that may be unnecessarily made of plastic, are the cutlery and crockery used at events such as festivals, fairs, theatres and concerts. We set out to find a way of replacing plastic with other materials.

Our first challenge was to think of a material that is biodegradable and non-polluting. We thought that food itself could meet those criteria, it is edible, and could be a substitute for plastic. We started considering foods that could be made into materials that are waterproof, heat resistant, sturdy and long lasting. It was difficult to find a single food type with all these qualities. We therefore came up with several ideas that we believe will work: boiled sweets, pasta (e.g. lasagne) and a form of hard biscuit.

Pasta used as a plate is fairly waterproof, sturdy, relatively tasteless when uncooked, could be boiled later (killing bacteria) and eaten for a subsequent meal. A hard biscuit also used as a plate could be eaten as dessert. Boiled sweets could be made into small spoons to put in the lids of ice cream pots and eaten immediately afterwards.

We will attempt to make a pasta plate, a biscuit plate and a boiled sweet spoon. We will then test the plates with a range of foods - hot and cold, dry and wet - to see whether the plates hold their shape without altering the taste of the food being served. The spoon will be tested to see if it is strong enough to scoop ice cream.





Our project is about composting; we aim to find out which food waste makes the most effective compost. We are doing this because it could reduce waste, as people would put their food waste into compost instead of landfill and using compost as fertiliser may help to grow more plants, providing more food.

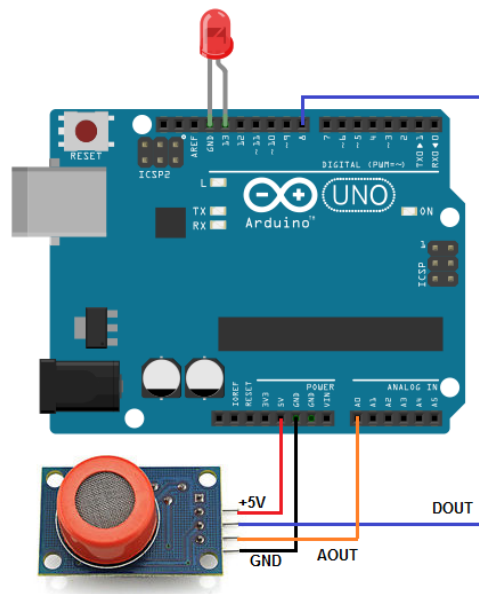
Compost is decayed organic matter which is high in nutrients and is used as fertiliser. Although there are lots of elements in compost, carbon and nitrogen are the most important; in perfect compost you would have thirty parts carbon to one part nitrogen. For our experiment we will find a quick acting compost method, a quick germinating and growing plant, then research the most common food wastes in Europe and what elements they contain. This will help us to predict which compost we think will work best.

Next, we will carry out the experiment. We will make four types of compost using one food type in each and one in normal soil as a control. When the composts are ready, we will get five of the chosen plant and plant them, one in each compost/soil. We will grow them in the same conditions for five weeks, water them every four days, and measure them each week. We will measure germination and number of leaves by eye, and measure height and leaf size using a ruler. Each time we measure we will note it on a spreadsheet.

At the end of the experiment, we will have our results and we can compare them to each other and our control to find out which one worked best. We will then be able to decide which food waste worked best using our data, and also whether there are any parts of our experiment that could be improved for the future.

The purpose of this invention is to hopefully put a stop to drunk driving therefore causing less accidents on the road. The concept is that when you turn on the car and press the stop/start button it activates a breathalyser. If the amount of alcohol in your BAC (Blood Alcohol Concentration) is below the limit the car will start but, if your BAC is above the limit the car will not start but it will give you tips on how to nullify the effects of alcohol I.e.: drink water, have a sleep, give the driving job to someone else, take a taxi.

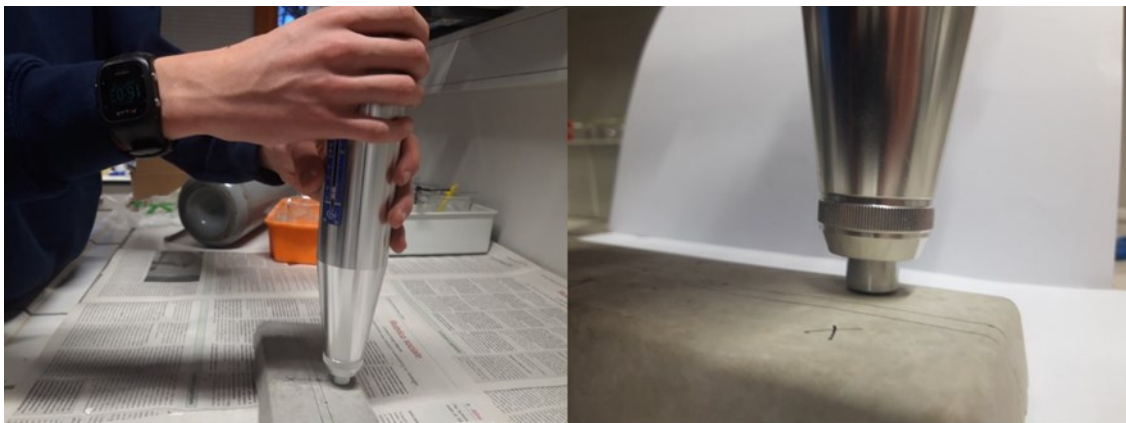
To do this we will be using an Arduino Uno, an ethanol alcohol sensor and a robotic car. We have created a programme to use the sensor to scan your breath (as a breathalyser) and if your BAC is below the limit the Arduino will send electricity to the car, thus starting it. If your BAC is below the limit the car will not start and it will send a message to your phone saying you have drunk too much and will give you tips. Unfortunately, our equipment has not arrived yet so we have not been able to test it. Our prediction is that it should be in full working order in 1-3 weeks.



Plastic waste is an increasing problem in our modern-day world. Areas of thousands of square kilometers in our oceans are littered with all kinds of plastic which pollute our waters and, ultimately end up in our food chain. To partly solve this disastrous problem, we wanted to see if we could use plastic waste as a substitute for sand in concrete.

Global use of sand has increased so much, that among other issues, ecosystems are suffering from loss of habitats and some countries are more likely to flood. For these reasons, we came up with the idea of replacing some of the sand in concrete with the plastic we dispose. This would both decrease the amount of sand used and find an application for waste plastic that would otherwise go to landfill.

We decided to investigate this idea further by preparing and comparing 19 different bricks constructed out of different ratios —cement : sand : plastic : aggregate—. We planned to compare 3 different types of plastic: PVC, HTPE and PET plastic to a brick containing only sand. For each type of plastic we will make six bricks replacing 5%, 10%, 30%, 50%, 100% of the sand. To test its integrity and strength we are using a rebound hammer, which measures elasticity, surface hardness and penetration resistance. Local variation in the sample could cause inaccurate readings. Therefore, we are measuring on six different spots and taking an average.







Our parents are always telling us that it is not healthy to have our mobile phones near at all times. But, is this true? Is the radiation emitted by mobile phones and Wi-Fi routers harmful for humans? This was our original question, but since we could not test it on humans or other mammals, we decided to test the effect of Wi-Fi radiation on plants and invertebrates (mealworms).

Our hypothesis is that Wi-Fi radiation emitted by WLAN routers negatively affects seed germination and plant growth, as well as larvae development. We expect less seeds to germinate, and plants and larvae to grow less or develop slower.

Previous studies claimed to have proved the negative effect of Wi-Fi on cress growth, but failed controlling other factors like temperature. Scientists criticized these experiments saying that the differences observed on the plants growing close to the Wi-Fi router could be due to the heat emitted by the router.

We are running our experiments at home (three different ones), and we have two experiments per house: one next to the Wi-Fi router, another one far from the Wi-Fi router. We are keeping the temperature and other factors similar in both locations to make sure our results are due to the radiation and not to other factors.

Our preliminary results with plants show that less seeds germinated by the Wi-Fi router and that the plants grew less and/or in a different way, producing weaker roots and stems. We will soon start our experiments with invertebrates and cannot wait to see the results.



Are hydrogen cars the future?

If so, how can hydrogen be produced without breaking the bank?

I found out that there is a generator that produces hydrogen, but it is very expensive.

The generator works by using electricity to split water into its respective atoms and collecting the gas.

So, is it possible to make a generator to produce hydrogen that is cheaper than it is sold?

The objective of my project is to make a HHO generator for cheaper than they are sold, so that everyone who has hydrogen powered cars in the future doesn't have to pay that much.

The benefit of this generator would be to produce cheap and clean energy. The only emission of burning the gas is water, so it doesn't pollute.





Over the last couple of years we have observed a substantial increase of the usage of mobile phones by teenagers. What do they use their mobile for? How often they use it for and do they limit themselves or not? We were also curious about whether or not the children could live without their phone.

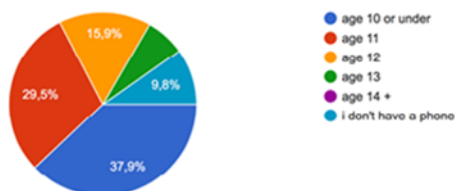
Our main hypothesis is that phones are very commonly used among school students and are mainly used for entertainment purposes rather than education, changing the way students spend their free time at the school. We also hypothesized that the children do not limit the use of their mobile phones, and that they would not be able to live without them for an extended period of time.

To test our hypotheses we conducted a first on-line survey among our school mates from S1-S7 to know how the students use their mobiles. The survey contained questions about habits as regard to usage of the phones and how they affect the children's social life and health. We compared the relative share of the answer options to draw our conclusions. Our preliminary results suggest that most of the children received their first mobile phone by the age of 10. So far, we also found out that the majority do limit the use of their phone, while two-thirds of the students discussed the issue of the use of the phone, most of which with their parents (see graphs below).

After this first survey, we have planned to do a second questionnaire aimed to a smaller group of students that volunteered to be subjects of our experiment. They will answer a set of questions at the end of 5 days using their mobile phones normally, and after other 5 days without it.

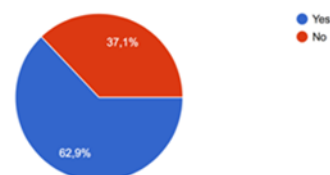
When did you receive your first phone?

132 odpowiedzi



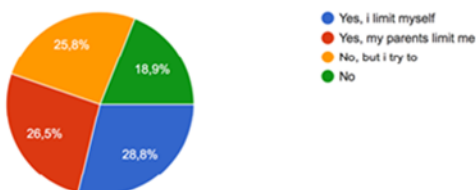
Have you touched on this subject

132 odpowiedzi



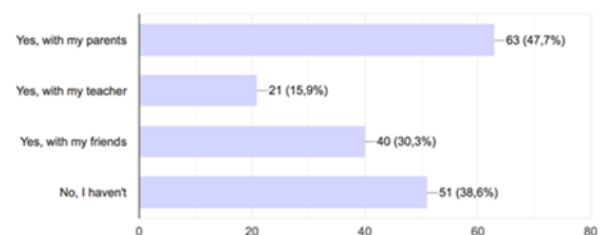
Do you have a limit? (on any mobile device)

132 odpowiedzi



If so, with whom?

132 odpowiedzi



## Our motivation

We would like to build a hovercraft because we think it would be a great experience to join and enter the science symposium. Also, we find engineering, science and math exciting and would love to work on a long-term project involving all three subjects.

## Introduction

A hovercraft is something in between a boat and a plane. Hovercrafts have a great advantage if there is no infrastructure where cars can drive (wet lands) or boats can float (icy lakes). But in traffic they seem to be useless. Maybe one of the reasons that they are not used so much is because they use a lot of fuel compared to an average car. We don't know actually. Or maybe it's because they are difficult to steer. But what if you can make hovercrafts more fuel efficient?

## What we are testing:

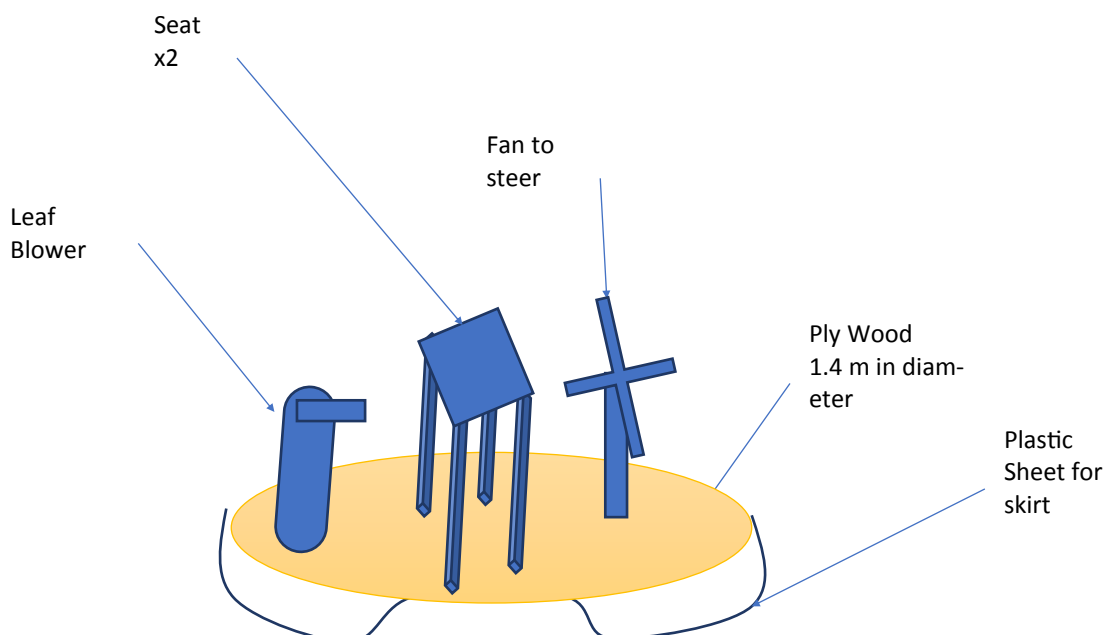
We want to test the efficiency of a 2 person seated hovercraft.

With our test results we hope that we will get ideas for making the hovercraft more fuel efficient.

We hope to come back next year with a new type of hovercraft.

## Background research started

We have already made a small-scale hovercraft using balloons, a CD, a bottle top and tape and would love to make a full-scale version. We have sketched a plan for a full scale version.





### Introduction

We chose this because it is an interesting topic that a German person has investigated and we would like to investigate even more and see if in the darkness the colors are the same as we see them with light, and we will do an experiment.

### Aim

We want to know how colors are actually even though the intensity and position of light changes, we also want to know what is the name of colors in the darkness because if they are not the same then what is the name of it.

### Method

We will search things that can help us on the internet and we will think of some things by ourselves. The problem is that nobody knows what color are things and it could be difficult to investigate. We will go in a room and switch off the light then we will only have one strong light that is pointing to an object in the room and see what shades of black and white the object will be. We



We human beings are constantly surrounded by bacteria from the moment that we are born to the moment we die. Every year, bacteria are responsible for the sicknesses of many children and teachers alike. The identification of bacteria in our surroundings is an important step in minimalizing this risk. Therefore, in my research, I would like to monitor bacterial colonization of EEB3.

The experiment will include taking samples from different places within the school (such as railings, door handles, computers etc.) using sterile cotton swabs, followed by the cultivation of bacteria onto solid media (LB agar, blood agar and MacConkey agar). Representative colonies grown on solid media will be subjected to macroscopic, microscopic and biochemical analysis. Macroscopic evaluation will consider colony size, shape, colour, elevation, margin shape and surface. Microscopic evaluation will focus on the shape of individual bacteria as well as the Gram positivity/negativity after performing the respective staining. Biochemical analysis will include: Voges-Proskauer test, citrate test, indole test, methyl-red test and catalase test.



The expected result will be the identification of the different types of bacteria collected in the interior spaces of EEB3 based on the performed tests and analyses. The relative distribution of pathogenic bacteria will also be noted.

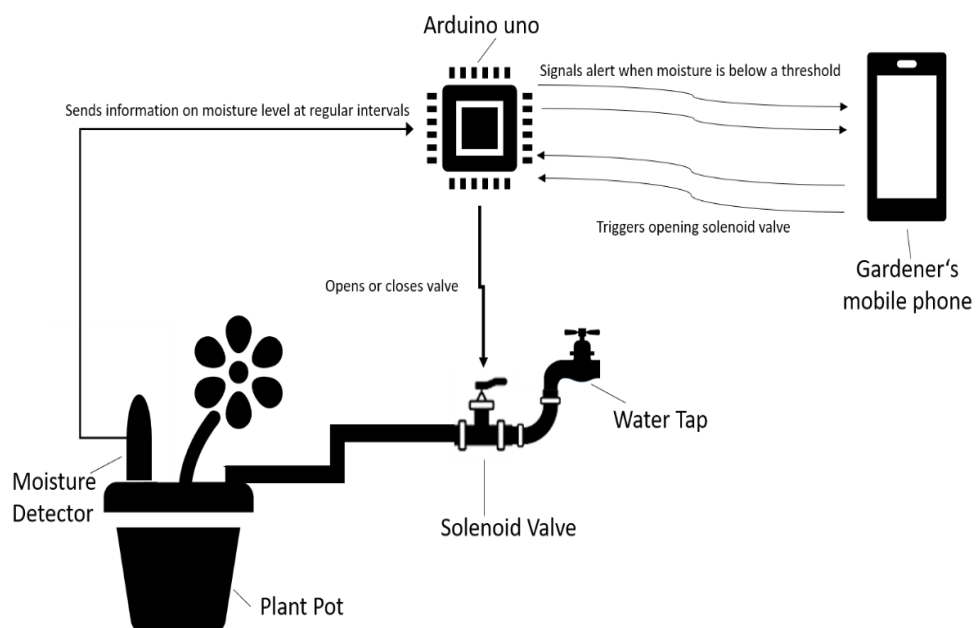
I hope that detailed knowledge about the presence of bacteria in our school, based on the obtained results, could have a beneficial impact on the health of school personnel and students alike.

It is a tedious task to physically monitor the moisture levels in potted plants, even if a water level indicator is available in them. Additional to this, is the challenge of watering the plants when needed. The idea is to monitor the moisture levels in the individual pots and where necessary, to water them to reach the required moisture levels, via remote action.

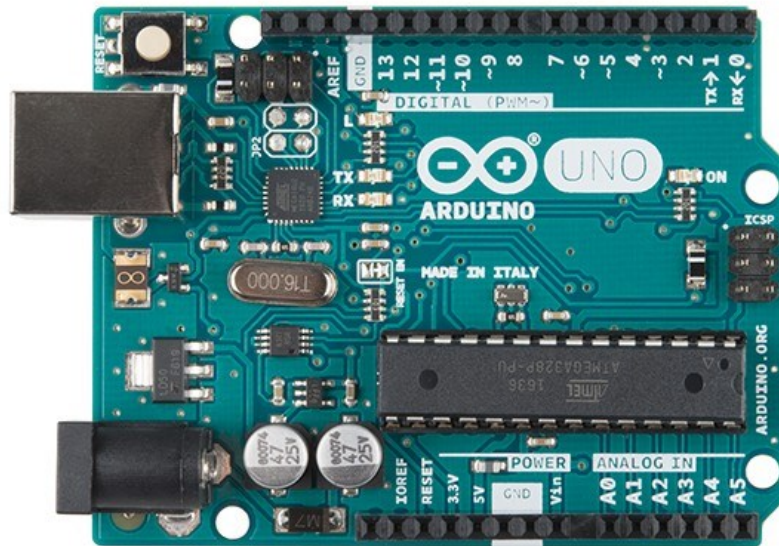
A moisture sensor is used for each plant. When the moisture level in the soil drops below a defined point, an indication is triggered and seen on a central display, informing the controller that the plant needs water. The monitoring is done by using a central monitoring system app that can be installed in the mobile device (phone/tablet) of whoever is responsible for maintaining the plants. Once this person gets a notification on his/her mobile device, he/she can directly ac-

Here's how it works: Arduino is attached to an ethernet shield to allow communication through the internet. An app TouchOSC is installed in the mobile device to receive and send data from/to Arduino. The soil moisture sensor(s) is connected to Arduino and Arduino is programmed to measure the dryness of the soil at regular intervals. If the dryness measured is above a certain threshold, a message is sent to the mobile device. This appears as a notification in TouchOSC. Using TouchOSC and the controller can trigger an action to Arduino, to open the solenoid valve. Arduino opens the valve and the plant gets watered. As soon as the soil dryness falls below the defined thresh-

old,







Arduino Uno

**Key words:** Arduino, Voice control, Color sensor, RFID chips

Our symposium project is directed to the blind, to try to solve one of the many problems that a blind person faces in everyday life. Our device will communicate the color of a piece of clothing to the owner or tell the owner that this clothing would be a good color choice when combining clothing for an outfit.

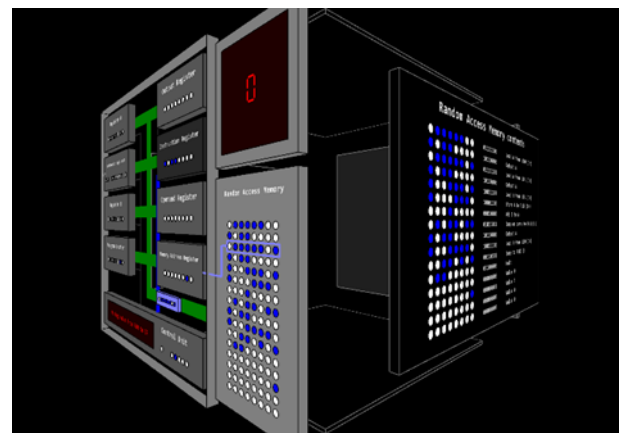
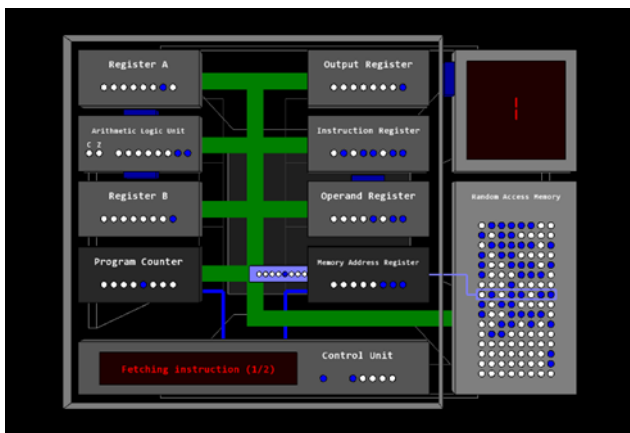
First, we did some research about the topic to find out the devices that work or are similar to our project. Now we are working to develop our device so that it can recognize different colors using a color sensor connected to an Arduino. Our device will be able to talk to the user, by using a mp3 SD card reader communicating in different languages (e.g. English, German and French). We hope that our device will be cheaper than the ones currently commercially available.

In advanced steps, we will develop our device further using RFID chips embedded in clothing. Clothing could be tagged with chips, which would be read by our device. The information about the color, textile composition communicated to the user via speech control would then be useful when choosing clothing combinations. The chips would also help to sort colors and textiles when doing laundry. We plan to challenge the chips for both washing and tumble drying.



This year I have concentrated on studying algorithms and cyber security. In addition to that, I have also been teaching programming to younger children in various events during the last few years. I have noted that in all three of these cases, regardless of it being me or someone else learning these things, if some complex piece of information is presented in a very simple or visualised form, it can suddenly become not-so-complex and much easier to learn and/or understand.

In this project, I wanted to combine these observations and make a simplified, but still precise and correct visualisation tool. My project is an 8-bit Central Processing Unit (CPU) visualisation tool, which simulates a simplified version of a computer processor and how data moves inside a computer, while it is in operation. The tool is built with the Processing 3 programming language, which is basically Java combined with OpenGL. The user interface is a three-dimensional cube,



The processor architecture present in this visualisation tool is the Von Neumann architecture. This means that the program itself and the data the processor handles are stored in the same memory. The different sides of the cube contain the processor itself and a display, the explanation the contents of the Random-Access Memory (RAM), the explanation of the different components inside the processor and a configuration page. From the configuration page, the system can be sped up or slowed down. Different programs to be executed can also be selected, such as an algorithm to calculate numbers from the Fibonacci sequence.



The website of the Natural History Museum (Musée National d'Histoire Naturelle Luxembourg) has a very interesting part which is called the Data portal and which focuses on biodiversity. It invites users to go further and participate in collecting data on fauna and flora of Luxembourg.

The main problem is that :

- At present data collection is done by desktop computers only (submitting data is not easy) and that
- there is no possibility for on the spot data collection

In our project we would like to build the app in which

- You can mark the animal that you have seen and inform where you found it.
- You can search for some interesting and fascinating animals around you, while on a walk or trail.
- You can easily make a picture and send the info on an animal or plant that you have found and which might be new to you.

To start with, we have to get into contact with the Museum, get their interest and agreement. After we will take the technical decisions: choice of the system (iOS, Android), choice of development platform. The next steps

- The Fauna and the flora part would be tackled one after another.



The aim of this experiment is to develop a solution to ensure safe swimming for swimmers in backstroke.

The purpose of this experiment is to eliminate fear of injury from swimmers when swimming backstroke and safely unleash their full potential. Approximately 2 million high school athletes worldwide suffer from concussions from all sports per year. Of those injured, 500,000 result in doctor's visits and 300,000 land athletes in the hospital. The biggest concerns with concussions are repeated blows and long-term injuries.

- <https://www.jackrabbitclass.com/blog/swimming-and-concussions/>

We plan to use the sensor for detecting walls. To measure the distance between the swimmer and the wall, we needed a proximity sensor. We put the proximity sensor in the swimming cap on top of the of the swimmer's head. We chose this location because when swimmers swim in backstroke, the closest part of their head to the wall is on the top of their head.

To take the Smart Cap from an idea to a working prototype we would need the following equipment: swimming cap, proximity sensor, vibration motor, buzzer.

To make the Smart Cap we will:

Waterproof the sensor in a capsule and attach it to the swimming cap

Program the sensor to activate the vibrator and buzzer

We will use the following pseudo-code to alert the swimmer that they are close to a wall:

*If distance < 200cm*

*Beep + Vibrate*

*Else*

*No beep + No vibrate*

In conclusion, swimmers will be able to have a stress-free swim without worrying about bumping into the wall. Our solution will help approximately tens of thousands high-school athletes



This study consists in the research of the symbiosis of ant's species and the fungus they produce. By using the theory, I expect to observe the ant symbiosis with their fungus: Matching the theory with a careful observation, I will attempt to confirm their symbiosis. First, I will check how they promote the development of the fungus.

Why I am doing this project? Because studying the ant's symbiosis we can eventually learn something on this type of ant, but not only, we can discover some information about the ant's symbiosis and how it happens.

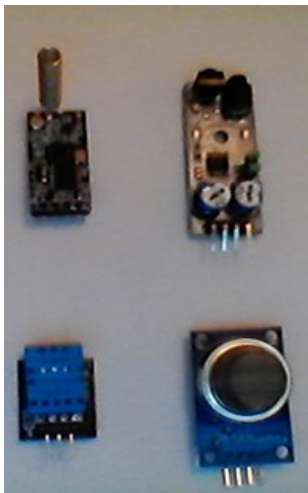
The ants can promote the development of the fungus if they give aliments like dead leaves, corpses of insects, and insects faeces animal. Furthermore, the ants can use some part of the fungus in their diet. They communicate with each other, in order to carry the food to the colony, and bring some information related with the fungus to be fed. When this information arrives to the workers (members of the colony), they will feed the fungus by putting the food (substrate) on the fungus to feed it and making it grow. Some species like the specie *Atta* the "Leaf-cutters ants, produce their own enzyme which they spread over their fungus garden, that the queen and workers sustain. The ant cannot live without the fungus, and the fungus cannot live without the ants.

**Keywords:** fungus; ants; symbiosis;

Nous avons cherché à concevoir un robot autonome mesurant différents paramètres de son environnement et capable de donner l'alerte en fonction de ses mesures. Il est capable de se déplacer de façon autonome et de se recharger à l'aide de son panneau solaire. Il est équipé d'une communication sans fil et de divers senseurs météorologiques ainsi que de capteurs de gaz toxiques. Pour se déplacer, il utilise des steppers et des senseurs infrarouges capables de détecter des obstacles et les éviter.

Nous avons utilisé une plaque en acrylique et une plastique. Comme processeur nous avons utilisé un Arduino Mega et un Nano, ainsi que des Micro chips Attiny85. Pour la communication, nous avons utilisé des émetteurs-récepteurs radios HC-12 (1) pouvant communiquer jusqu'à 1,8 km. Le robot a un senseur à CO et un autre à fumée, gaz inflammables et toxiques (4). Grâce à la simplicité du mécanisme, on peut combiner n'importe quel senseur Arduino. Pour mesurer la température, l'humidité et la pression atmosphérique, nous utilisons un capteur DHT11 (2) et un capteur BMP280. Pour détecter les obstacles, le robot utilise un senseur évitement (3) pour se repérer et des panneaux solaires associés à des batteries pour son alimen-

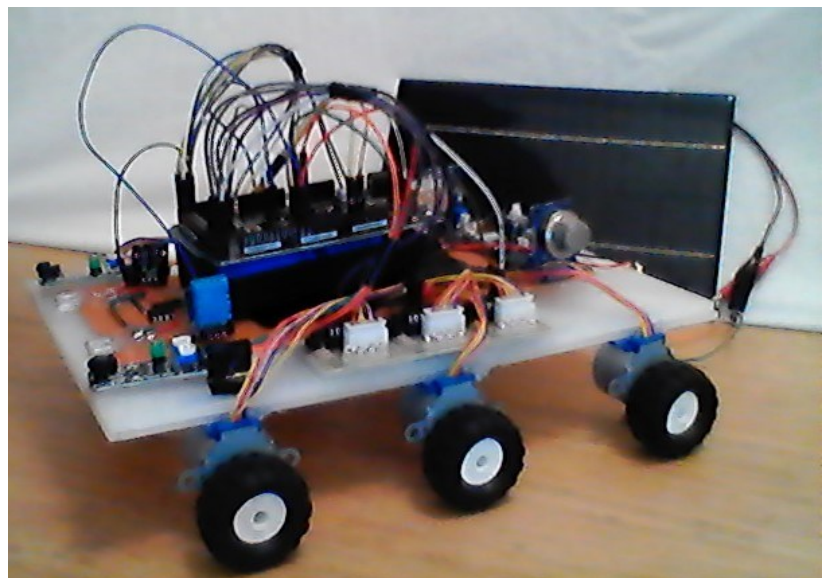
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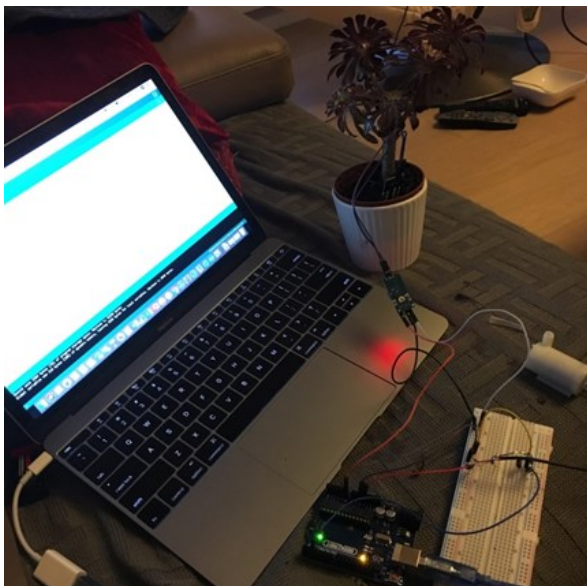
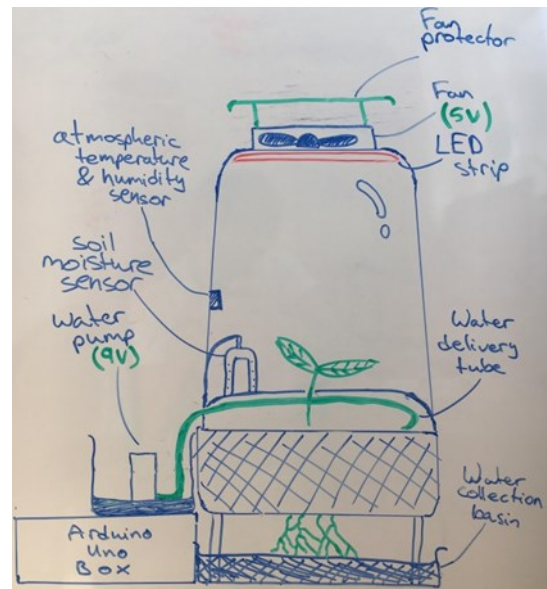
4







Humanity is facing one of its biggest challenges yet: climate change. Activities involving agriculture contribute to more than one third of human pollution; furthermore, around 70% of our water usage goes to agricultural irrigation; moreover, agriculture accounts to 11% of the world's land usage. These problems derive from packaging, carbon footprint due to transportation, or inefficient irrigation and use of land area. As listed above, there are countless problems humanity faces because



I decided to take on the challenge to solve them all. I have developed an autonomous greenhouse which is capable of monitoring and perfecting internal conditions such as temperature, light intensity, and soil humidity. The greenhouse would be placed in a humid basement under a building requiring crops (i.e. a restaurant, a supermarket, a home, etc.) and left untouched until the plant can be harvested. This would eliminate problems such as pollution from packaging and transportation, water loss from inefficient irrigation (i.e. the greenhouse is able to know when to water the plant according to soil humidity, not time) and also save land area because plants could be





Le **CanCooler** est un appareil qui est destiné à refroidir des canettes sans réfrigérateur, sans électricité et en un minimum de temps.

Le principe est simple : on insère la canette dans l'appareil et on vaporise le gaz contenu dans une bombe de froid. Cette bombe contient un gaz comprimé qui crée du froid par un effet de détente lorsqu'il s'échappe de la bombe.

L'appareil a été conçu pour minimiser les pertes de froid et maximiser l'échange de chaleur entre l'enceinte de l'appareil et la canette. La première version du CanCooler ne s'est pas révélée très efficace. Nous avons repensé sa conception et nous avons fabriqué un tout nouveau prototype qui est bien plus performant.



**Material:** Raspberry Pi, Wärmebildkamera, normale Kamera, unsere Köpfe für das Denken

**Nutzung:** Jeden Tag gibt es auf der Erde viele Erdbeben. Dabei werden auch Menschen verschüttet, die nicht schnell genug gefunden werden. Daher kamen wir auf die Idee, ein Tool zu entwickeln, mit dem man diese Menschen finden kann.

Es geht um eine Konstruktion, bei der eine Wärmebildkamera und eine normale Kamera zusammenarbeiten, die Daten mit Hilfe von Raspberry Pi verknüpft werden, und so Menschen gefunden werden können.

Wir haben uns überlegt, dass je ein gleiches Bild pro Kamera fotografiert und zur Raspberry Pi geschickt wird. Der Computer wird die Daten bewerten und falls es sich um ein menschliches Opfer eines Erdbebens handelt, ein Signal geben. Der Computer sollte den Betroffenen auch anhand eines Körperteils erkennen.

Diese Konstruktion aus einer Wärmebildkamera und einer normalen Kamera wäre gut zu gebrauchen, wenn ein Erdbeben ein Haus zerstört. Man könnte sie an einen Roboter oder einer Drohne befestigen, somit riskieren die Helfer kein menschliches Leben. Außerdem kann der Roboter/ die Drohne auch an Orte gelangen, wo kein Lebewesen hinkommt.

#### Arbeitsvorgang:

- In einer eigens gebauten Lego-Konstruktion werden wir den Raspberry Pi und die beiden Kameras platzieren.
- Wir werden einen Menschen in verschiedenen Lagen fotografieren und diese Bilder an den Raspberry Pi weiter senden.
- Wir werden eine Bibliothek anlegen, um die Daten besser auszuwerten.
- Wir werden es so programmieren, dass die Bilder sich übereinander legen, so dass es für den Raspberry Pi einfacher wird sie zu flaggen.
- Die Wärmebildkamera wird so eingestellt, dass sie dem Computer sagen kann, wo sich ein Objekt, dass eine Temperatur zwischen 30 und 40 Grad hat, befindet.
- Der Computer wird durch die vorher gesammelten Daten und den neu gewonnenen Daten der Wärmebildkamera die menschlichen Körperteile finden und flaggen. Der Computer soll nun entscheiden ob es sich um ein menschliches Erdbebenopfer handelt oder ob es ein Fehlalarm war.

Ar-

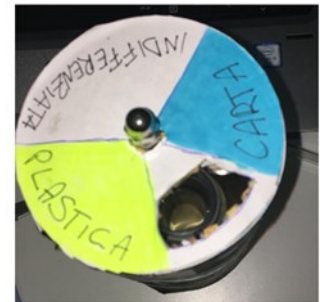
Vorgang	Abgabetermin	Name
Lego-Kasten	Ende November	Nico
Daten sammeln	Ende Schule	Michael
Bilder automatisch übereinander legen	Ende Jahres	Filip
Körperteile automatisch flaggen	Ende Januar	noch nicht vergeben
Körperteile automatisch erkennen	Ende Februar	noch nicht vergeben

beitsaufteilung:

Comme tout le monde, on a entendu parler du réchauffement climatique et des problèmes environnementaux actuels; plusieurs solutions ont été présentées. Nous nous sommes intéressés à la gestion des déchets domestiques.

Nous avons trouvé une nouvelle solution contre la pollution des déchets ( que même en prenant que une petite partie de ce désastre change nos vies de tous les jours), cette solution s'appelle CHESTER. En effet on veut tous faire les choses correctement mais souvent le tri des déchets au quotidien c'est difficile. CHESTER trie pour vous tous vos déchets.

Notre méthode fonctionne grâce à un système de QR code "reading" par notre propre téléphone portable ou le scanner sur la poubelle. On pourra rendre lisible les déchets. Car notre poubelle nous aidera à trier en reconnaissant les déchets par son code [plastique\_papier\_indifférencié] .



Après plusieurs essais on a trouvé la méthode la moins chère et la plus facile à réaliser, mais qui fonctionne.

Si tout le monde utilise Chester, on diminuera une des causes de la pollution : le mauvais triage.



Mon projet prévoit d'utiliser un fluide non newtonien pour trouver un remède à la maladie des os de verre. Cette maladie rend les os extrêmement fragiles à cause du mal fonctionnement des ostéoclastes (cellules qui forment le tissu osseux).

J'ai choisi un fluide non newtonien pour sa viscosité qui change selon la pression qu'on lui applique. L'idée est donc de réaliser une protection qui sera positionnée dans les vêtements qui, en cas de chocs, seront en mesure de durcir et donc d'empêcher la fracture des os.

Le fluide non newtonien sera réalisé en mixant deux ingrédients : de l'eau et de la maïzena. Ce mixe se caractérise du fait que si on y exerce une pression, il devient solide, alors qu'il retrouve sa forme liquide une fois que cette force a cessé d'exister.

Le liquide sera placé dans des pochettes imperméables pour ensuite être positionné à l'intérieur des vêtements. Pour favoriser la circulation de l'air et de la transpiration, une doublure transpirante sera préféré.

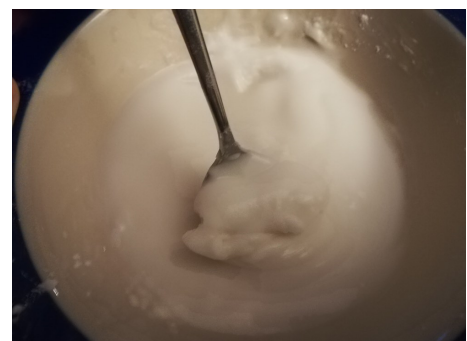
Donc, quand le corps atteint par la maladie subira un choc, cette même force permettra au liquide non newtonien positionné dans les habits de se solidifier et d'empêcher la rupture de ces os si fragiles.

La solution que je me propose d'étudier, pourrait permettre aux personnes atteintes par cette maladie rare de mener une vie normale ou, tout au moins, d'être moins fragiles face au moindre choc et de leur épargner la grande souffrance des milles de fractures causées par la rupture des os.

Voici quelques images d'un liquide non newtonien réalisé avec une certaine quantité d'eau et de maïzena.



© AOI





In the English Section of our school Years 1 – 7 secondary there are 28 SWALS students (Students Without A (mother tongue) Language Section) coming from 6 different language backgrounds. These students are placed in the English section of our school and are required to do the majority of their subjects in English (a language they don't even speak at home). Therefore, our question is 'how much are these students actually understanding and are they actually being understood?'

To test this we are going to use the 'Apple' program 'Siri'. We are going to make the subjects read a range of commonly mis-pronounced/mis-understood English words and sentences to 'Siri' (set on British English since we are in Europe) and see how accurately she interprets them.

The second test will have the students listen to pre-recorded audio of adults, each reading the same short extract, but in different British accents (English, Welsh, Irish and Scottish) because we are in Europe. We will then ask them a range of questions and give them an overall mark for comprehension.

We hope that by conducting these tests we will be able to discover whether or not these students are learning at their full capacity as opposed to their understanding of the English language.



Das Ziel des Projektes ist, dass durch den Piezoeffekt Strom erzeugt wird.

Dieser Strom soll eine Funktastatur ohne Batterie betreiben. Hat man erst einen Prototypen, kann man möglicherweise ein Telefon aufladen.

Die Prototyp - Tastatur wird etwas dicker sein als eine herkömmliche Funktastatur.

In der Zukunft kann daran gearbeitet werden, die Tastatur zu Optimieren und zu verkleinern. Das Piezoelement wird einem Feuerzeug entnommen und der Tastatur hinzugefügt. Ein Kondensator verstärkt den Stromfluss.

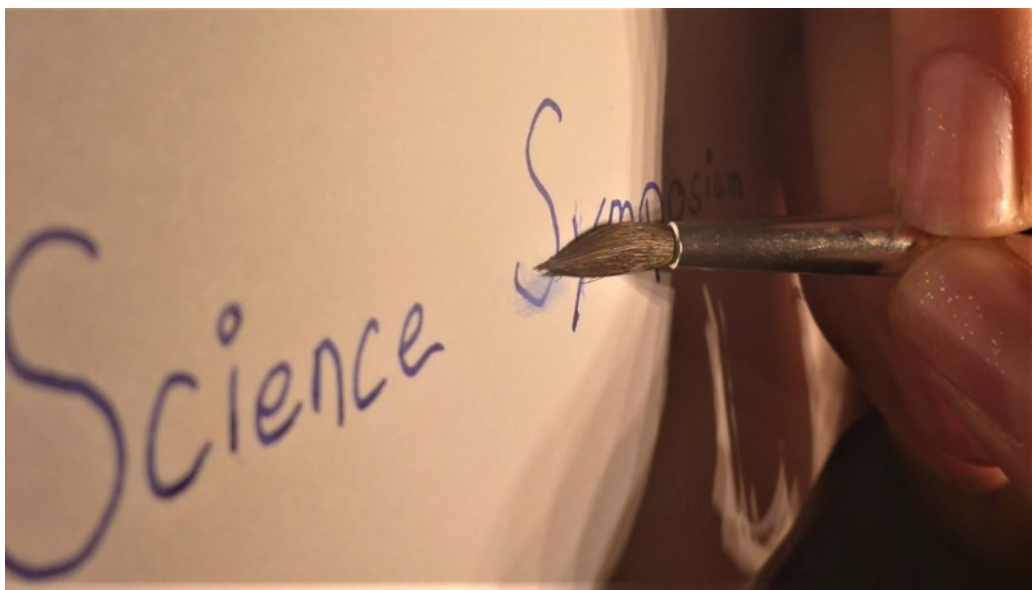




Das Ziel des vorliegenden Projektes ist es, einen Killer herzustellen, der die Schreibtinte von Tintenkiller verschwinden lässt und das davor geschriebene wieder erscheinen lässt. Da man manchmal bemerkt, dass das, was man davor geschrieben hat, doch richtig war und Tipp-Ex® lange braucht, um zu trocknen, wollen wir etwas erfinden, das die Tinte des Tintenkillers löscht und das, was man davor geschrieben hat, wieder sichtbar macht.

Wir haben recherchiert und herausgefunden, dass man mit Säuren und Reduktionsmittel Tinte löschen kann. Daher haben wir verschiedene Stoffe ausprobiert. Doch am besten hat es bisher mit einer Mischung aus Oxalsäure und Zitronensäure in Wasser funktioniert. Wir haben königsblaue Tinte getötet und mit Tintenkiller darüber geschrieben. Danach haben wir die Mischung mit einem Wattestäbchen mehrmals über das mit Tintenkiller Geschriebene gewischt. Die Tinte des Tintenkillers ist teilweise verschwunden und das davor Geschriebene sah man wieder.

Jetzt wollen wir die Zusammensetzung unseres Killers verbessern und herausfinden, wie wir die Tinte des Tintenkillers ganz verschwinden lassen können. Am Ende soll die Killerlösung mit einer Art Pinsel ähnlich wie bei Tipp-Ex® aufgetragen werden können.





The goal of our project is to develop a brush that can wash and brush your hair at the same time. To achieve this we will have dry shampoo in the brush.

There will be little holes where the head meets the brush. We have already researched the most efficient size of the holes. We will use ready made dry shampoo as well as create our own on a powder flour base.

We will have a special disk inside of our brush, so the shampoo doesn't go out all at once. Testing will start soon.



We decided to do this project because we wanted to find out and alert people about the danger that social media entails (especially in Instagram) and how you could try to avoid it.

We wanted to see if privacy was really an important issue for people and check people's experience using them.



We first investigated about privacy and data protection. We also made a little guide with tips to help people improve their privacy.

We created a form to ask people how was their social media privacy and more information about the ways they use Instagram.

We then created 3 instagram accounts to check if people were saying the truth on the form:

An account of a girl our age

An account of a boy our age

An account of an old lady

We chose these different types of accounts because we wanted to see whether people react differently to different types of instagram accounts.

We hope you enjoy our project, it is a big part of our present and for sure of our future.



Mon hamster, Gaya, vous connaissez déjà bien. Cette fois, j'ai décidé de mettre sa mémoire à l'épreuve en lui construisant un labyrinthe.

J'avais beaucoup de problèmes comme le manque totale de coopération de la part de Gaya ou son incompetence que je vous expliquerais avec joie à l'heure de mon exposé, mais finalement j'ai compris comment tirer un maximum de l'environnement et de mes expériences précédentes.

La première étape était de compter son temps après que je lui montre le chemin. Le deuxième, de compter après une nuit, troisième ; deux nuits et quatrième, une semaine. La dernière chose à faire c'était d'examiner quand Gaya oublierait le trajet.

En fin, j'ai fait un calendrier d'essai pour tout mettre en place. Et répondre à ces questions.

Combien de temps elle doit prendre pour qu'elle le retienne ?

Est-ce que cela nous apprend une chose sur les hamsters sauvages ?

Est-ce que cette expérience peut résoudre le problème des rats dans les caves ?

Et bien sûr, à la fin, j'ai fait des beaux tableaux pour vous montrer mes résultats.

Alors, qu'est-ce que nous attendons? Je suis impatiente de vous montrer mes résultats!



31% of the Earth's surface is covered in forests but an area the size of a football pitch is lost every second<sup>1</sup>. This is due to deforestation which is defined as: 'the conversion of forest to other land use or the long-term reduction of the tree canopy cover'<sup>2</sup>. Areas of forest are converted to agriculture, animal grazing, water reservoirs or cities.

My project focusses on the impact of deforestation on the water cycle and floods. My hypothesis is that when trees are cut and roots are removed, rainwater that would normally be absorbed by the soil, stays on the surface and runs off to create floods.

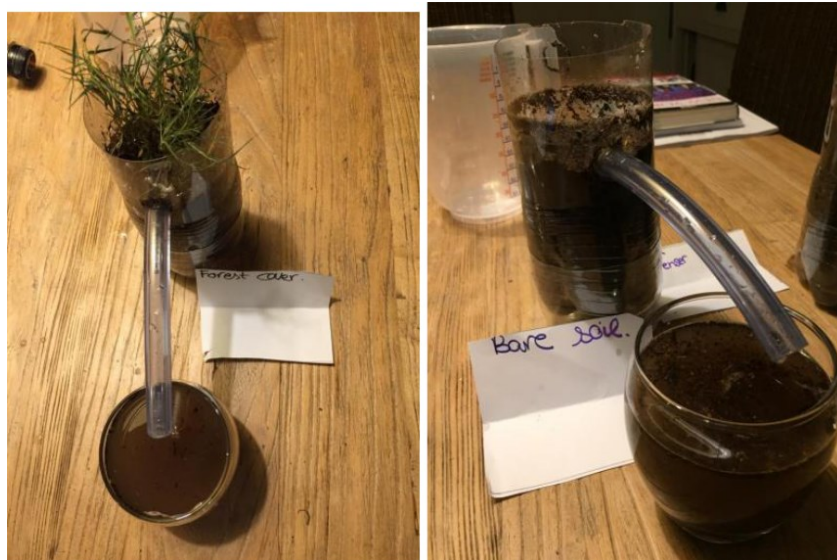


Figure: Test model of my experiment

To test my hypothesis, I set up an experiment that uses two identical containers with a spout to let the water go through. The containers are filled with the same amount of soil. One container has bare soil representing a deforested area. The other contains plants representing the forest. I wet the soil to simulate rain and collect runoff water, which I measure.

I also measure the amount of water that seeps through the soil representing groundwater. I compare the results for both containers.

0.4505 seconds to be precise.

<sup>1</sup>Food and Agriculture Organisation of the UN (FAO), (2010)



Anthony Mammoliti, Sean Krajewski and me (Nicolau Corral Pereira) would like to participate in the science symposium of 2019, using one of the ideas Mr. Popovic had mentioned to us: The Wrong Way Driver Collision Prevention Module (The WWCPM).

Wrong way driving collision are a major mortality cause in many countries around the world. This project could help with its prevention. It will use cheap open source technology and renewable energy, the perfect combination.

The WWCPM will be made of several parts:

- **SOFTWARE:** we will be using the Arduino genuine programming software to program an Arduino MEGA and an app for smart cars or mobile phones for the messages from the WWCPM.
- **HARDWARE:** we will be using optical and geo referencing sensors in order to detect the wrong way driving cars
- **INFRASTRUCTURE:** we will be making a maquette of a road and a blocking bar which will operate with the module. It plan also use solar panels to power itself.

The software interface will be developed using co-design technics by involving potential users.

We hope you like our project.



The goal of this project is to examine in depth my last year project: The effect of odours and light colors on bugs behaviour.

To study in deep my project, I used UV Led lights to monitor sleep-wake cycle behaviour of bugs.

With this I wanted to capture which light color / source facilitate their sleep cycle and what keep them awake.

I decided to do this experiment because I wanted to find an easy and a not aggressive way to repel this kind of bugs which during summer of 2017 and on summer of 2018 have risen in population in northern Italy.

For this experiment I considered Asiatic bugs (halyomorpha) and Green bugs (Nezara Viridula), for the experiment I used 3 Asiatic bugs and 3 Green bugs. This species of bugs are bigger than normal bugs and they multiply very fast, they migrated to Italy approximately in 2007-2010, damaging a lot of fruits and making it uneatable.

Results have shown that the color that both species can't tolerate is blue: infact this color activates them and makes them agitated. The colors that bring them to stay awake is white, maybe because is a strong color, the color that bring them to sleep is purple. The odors that they can't tolerate are mint and marsiglia soap. The result of the effect on uv lights are that Green bugs are attracted (2 of 3), but Asiatic bugs haven't a reaction on them (3 of 3).



Nezara Viridula)



(Halyomorpha)





Per questo esperimento ci siamo basate su un fenomeno che, secondo noi, avviene spesso, cioè che molte persone hanno più fiducia nel senso visivo e da quello che dicono gli altri, anziché nel senso del gusto.

Secondo le nostre ipotesi la maggior parte delle persone, in particolare i ragazzi, si fideranno maggiormente della vista o di quello che dicono gli altri.

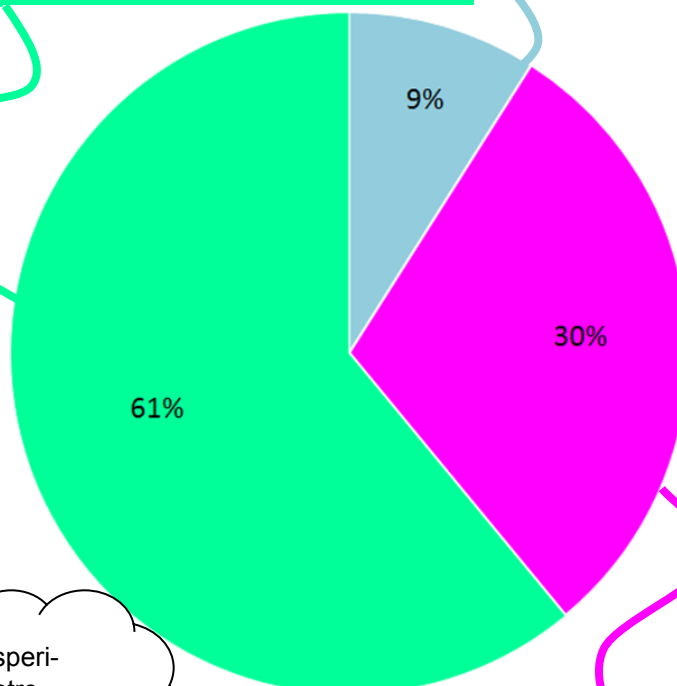
Quindi proporremo a varie persone di assaggiare due pezzetti di salame al cioccolato; il primo (N.1) sarà decorato in modo fine ed elegante e noi diremo che sarà fatto con ingredienti di scarsa qualità, il secondo (N.2), invece, sarà decorato in modo per niente invitante e noi diremo che sarà fatto con ingredienti di ottima qualità.

In realtà quello che diremo noi non sarà vero perché noi prepareremo un solo salame al cioccolato, ma diremo quelle frasi per vedere se si fidano più del senso del visivo o da quello che diciamo.

Con questo esperimento vorremmo dimostrare che l'uomo si fa ingannare dall'aspetto visivo e dai discorsi degli altri e quindi non si "fida" delle sue papille gustative.

Rappresenta le persone che hanno detto che il pezzetto di salame al cioccolato "N.1" era più buono. Questa risposta ci conferma che il 61% delle persone che hanno assaggiato si è fidata maggiormente del senso della vista.

Rappresenta il 9% delle persone hanno capito che i due pezzetti di il salame al cioccolato erano uguali



Rappresenta le persone che hanno detto che il pezzetto di salame al cioccolato "N.2" era più buono. Questa risposta ci conferma che il 30% delle persone che hanno assaggiato si è fidata maggiormente di quello che abbiamo detto

Con questo esperimento le nostre ipotesi sono state confermate.



Nowadays we can buy t-shirts that have sensors attached to them.

The purpose of this sensors is to measure some vital parameters related to the performance in sports. Since they are brand new, we don't know which ones are good and exactly for what. In this analysis we plan to compare several sensor shirts available in the market that you can buy in the internet. Our analysis will cover different sports, different type of peoples and different sensor shirts. At the end of the analysis, we will be able to decide which t-shirt is more accurate in measuring particular vital parameters, if that depends on the type of person (boy, girl, short, tall...) and on the sports. We will use basic statistical analysis to draw our conclusions. As a new application of sensor t-shirts, we suggest that they can be used by trainers to help them making changes during games in order to use the best prepared players. Other possible new functions will be rehabilitation of people with heart problems, adapted trainings for elite athletes.

**Motivation for this work:** We are two fans of sports. Actually, we both do sports. We decided, what could make sports into the next level? We are very impressed about the new developing ideas bringing together technology and sports. But the big problem is the price of this technologies. Are the results of this material actually worth it?

**Material:** Several sensor t-shirts

**Method:** Data recording and basic statistical analysis

### Purpose

Visualise the rise of water level caused by melted Earth's ice by:

Measuring and visualising in an aquarium based model the water level rise caused by the melting ice.

Experiment how the temperature of water would influence its volume and the resulting water level rise.

Computer model of the Liberty Island visualising water level rise if one third, half or all the ice melts.

### Method

Based on the amount of all the ice present on Earth, we calculated the amount of water which would flood an area represented by our model: an aquarium with the Pisa tower - scale 1:500. Having this amount, we poured the water into the aquarium observing its rise and flooding of the tower.

We measured whether the increase in water temperature would further significantly increase water level rise. For that, we warmed up 1l of water from 4°C to 50°C and observed its volume.

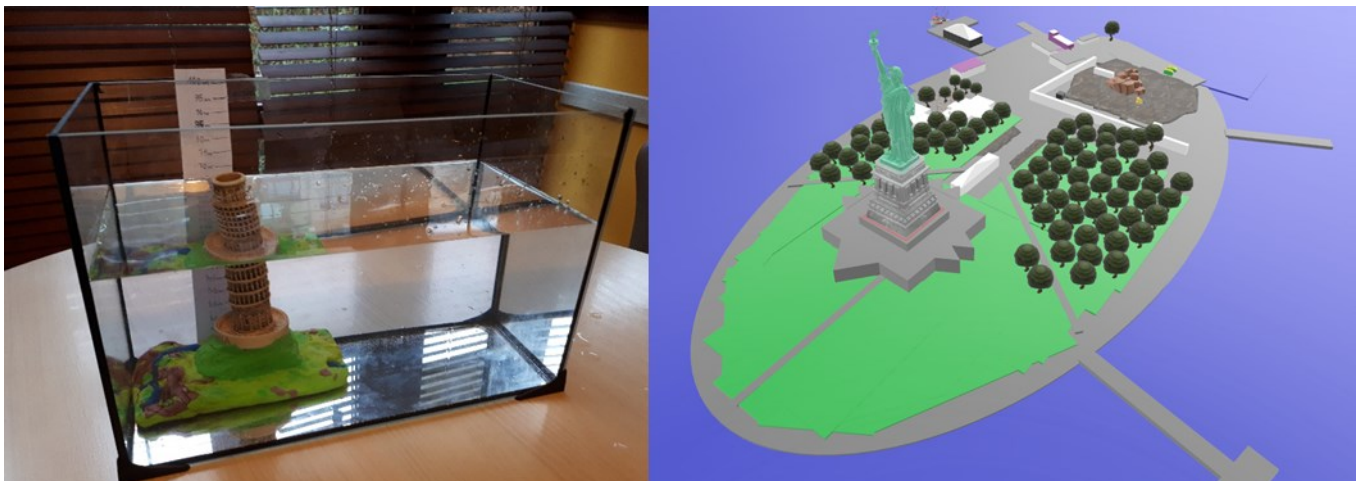
We made a 3D computer model of the Liberty Island and visualised its flooding by raising the water level corresponding to the melting of one third, half and all the ice on Earth.

### Results and conclusion

We observed in an aquarium that in case all Earth's ice melts, the level of water will rise by 65 metres. The Pisa tower would be completely submerged after 90% of the ice had melted.

Although according to scientific research the volume of water rises together with its temperature, our second experiment showed that this raise would not be very significant for the flooding.

In the Liberty Island model we observed that if all the ice melts, only the tip of the Statue of Lib-



## Introduction

People don't realise how fast mould can grow, and in which places mould grows the most often. I want to find out which kind of bread is affected by mould the most. I will be testing out the following types of bread: bread with lots of additives; buns/ rolls; home-made bread (with no additives); sweet bread with raisins and sugar and white bread.

## Method

I have put, each of the above-mentioned types of bread, in five different places to test where the mould grows fastest. The places are: the bathroom (which is humid); by the window (where the mould is exposed to light and dark); the cupboard (where it is always dark); the freezer (where it is cold and dry) and the fridge (where it is cold).

I also added a tablespoon (15 ml) of water to each slice of bread, to dampen the bread and increase the rate of mould growth. I found out that on mould grows faster in places with damp conditions. I found this out by doing a *test-experiment*.

I took photos of each slice of bread every 24 hours, so as to be able to determine when the mould started growing.

## Hypothesis

Before starting the experiment, I hypothesised that the bread with the most additives and was placed in the bathroom, the most humid of the possible locations), would become mouldy the fastest.

## Results

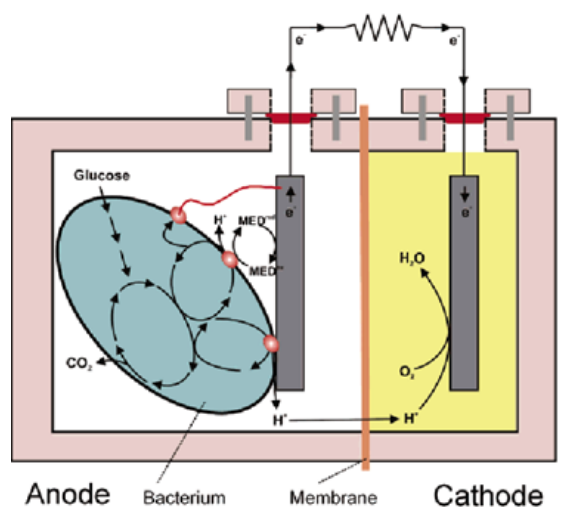
I will show my results in a table which will include: when the mould started growing; what kind of bread it was; in which environment was it placed and a photo of what it will look like at the end of the experiment.

## Criticism

A way to improve my experiment would be to repeat this experiment multiple times. I could have increased the numbers of bread types used and investigated the effect of certain additives on the rate of bread mould. I could have also identified the types of mould growing on each slice of bread rather than merely stating that it was mould. I could have also measured the area of mould grown more precisely







Microbial fuel cells (MFCs) have been proven capable of producing electricity in the treatment of winery wastewater. MFCs are a promising alternative to the traditional wastewater treatment systems, which require a high input of energy and maintenance costs.

*Zygosaccharomyces bailii* has been identified as a suitable microorganism for long-term winery wastewater treatment, given its high resistance to acetic, malic, tartaric, lactic and citric acids usually present in the wine. However, the chemical oxygen removal rate of MFCs using *Z. bailii* as biocatalyst has been shown to be negatively impacted by the production of ethanol as metabolite.

This project aims to test the hypothesis that MFC performance could be improved with the addition of microorganisms capable of degrading excess ethanol. *Acetobacter aceti* and *Pelobacter propionicus* are two possible candidates.

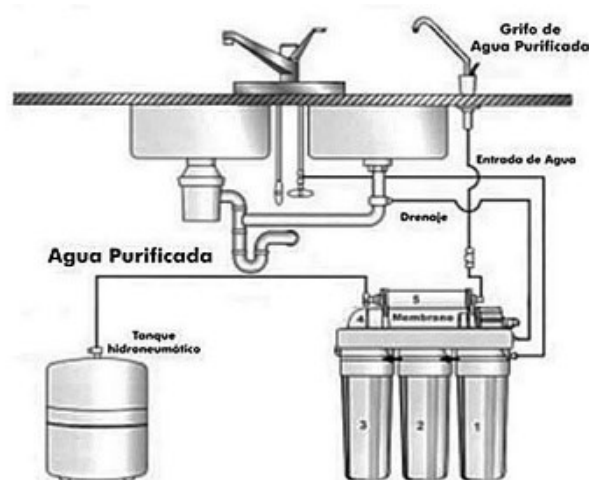
One sample of winery wastewater will be inoculated with *Z. bailii* alone, while another sample will be inoculated with a consortium of *Z. bailii* together with *A. aceti* and/or *P. propionicus*, and the concentration of ethanol after 96 h will be compared.

If the hypothesis is confirmed, then the concentration of ethanol in the second sample will be lower than in the first, thus supporting the likelihood of improved MFC performance.



In some areas, such as the Mediterranean, water is abundant in lime. This poses difficulties when consuming due to its distasteful flavour. Therefore, most families decide either to purchase bottled water or own a system of water purification. Among this last, reverse osmosis, is the most frequent used.

A reverse osmosis is a process that is used to remove chemical compounds and dissolve solids from water. Its sole purpose to provide a healthier, safer and better-tasting water. A quality reverse osmosis system filters up to 99% of contaminants present in water in addition to innocuous disturbances that alter the taste, look, or smell of the water. In addition, it has a small size. All of this, make it a very popular system among families, who live in small houses or flats and do not have a lot space for bigger devices. Furthermore, they are not able to afford installations of



the necessary equipment for the full usage of the greywater (left waters of baths, irrigators, toilets and washing machines only). However, this system has a great disadvantage. A typical system will only be able to reuse about 5 to 15 percent of the water that's being drawn in, leaving up to 85 percent wastewater.

My motivation for this proposal, was because as I have a reverse osmosis, I was worried about this important loss of water. I decided to focus my experiment in creating a system of recycling this water, named ATOS (*Aprovechamiento Total Ósmosis*, in English, full usage of the osmosis). In brief, I have designed a system that recycles the water produced by the reverse osmosis by recycling it through a pipe. This pipe then deposits it into a tank and then serves to give water to the toilet. This system permits to keep a bathroom, with the water that we drink in a day. Moreover, in case there is an excess, it can be storage in a deposit. All the necessities of the usage of cisterns of the toilets are covered and the savings are notable.

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Question/idea: How long a living organism (eukaryotic cell) can survive on different nutrients (sugars, amino acids, nucleic acids) using yeast, and to compare the results with each other.

Why is it important to investigate?

It is important to investigate this topic, because we know that eukaryotic organisms have very similar metabolisms, therefore we could use this information in the future to develop better foods and possibly to (solve the malnutrition problem) eat in such ways that would fit our needs more. We chose to use yeast as a subject since it is well studied model organism that is also easy to obtain and eukaryotic. From our research this experiment has not been done before, but rather similar ones have.

What we've done so far: we have done some research on metabolic pathways for these nutrients and also come up with a method of how we could conduct an experiment to measure this.

Variables:

- Dependent:
  - Length of the survival of the organism (cell) measured by when CO<sub>2</sub> emission drops to or near 0
- Independent:
  - Nutrients 0.1mol
- Controlled:
  - Temperature
  - Solution

Motivation to participate:

We thought that since our contribution during our science classes is highly valued by the teachers in these subjects and the fact that we also like to do experiments and research for it, we thought that we could use this to join the science symposium, since we want to do something that is positive for our future and we may even learn something.

Our project is a scientific experiment aiming at proving that a spring oscillates at its maximum amplitude when its frequency is the resonance frequency. In order to show that, we have set a mechanism, where using a TiNspire and a TiNspire controller, we programmed a servomotor to rotate at a steady speed. A spring that is attached to the servomotor with an axis made by our school's 3D printer



and carries a mass of 50g begins to oscillate after we put the system in motion. We notice that the amplitude of the spring and the frequency of the oscillation are not proportional numbers. After making certain measurements and changing the velocity of the servomotor, we come up with the conclusion that the relationship between the fundamental resonance frequency and the rest of resonance frequencies is that  $F_n = nF_0$ . The amplitude of the oscillation is measured by a distance sensor and its measurements are displayed on a computer in a form of a graph.

When we were first informed about the competition, we knew exactly that we wanted to create something that could make a difference; help people and maybe even solve some of the less fortunate people problems. It was when we heard the news about the refugees living in unprotected and thin-walled tents exposed to the weather between borders that we knew where we wanted to help. Our project is an answer to the unheard cry of all people living in inhumane conditions. Ecological, cheap and sturdy housing for all. We want to invent a house plan adaptable for all scenarios necessary. We want to make these houses out of recycled substances which are neglected and damaging nature but could be turned into gold-mines for creating affordable housing (such as plastics). These houses would have a heating system operated by an individual electric source for each house. All of these ideas will help us build a realistic miniature house that we will be presenting at the science fair.





Water conservation and energy salvation are two of the main aspects of our project. The final product could be used in a third world country to help them conserve their water. If they put in this system not only would it conserve water but it would also let them grow food for themselves. The box that is raised collects the water that can either be put in by a person who has used other means to collect water or by putting it outside to gather rainwater. This water can then be released down into the lower box below the plants. The system used to gather and then release the water all at once is a part of the toilet system found in household toilets. The water is then given to the plants sitting above it. The water then travels up some material in order to collect at the bottom of the soil which is collected by the plants and this allows the plants to feed. The benefit of the water being at the bottom means that the top section lets sunlight through which means that not only do plants get the water they are also getting enough sunlight in order to feed the plants. Finally, we have the two boxes which contain the soil and plants which you may be growing. In the future, we will have the windmill on the side which could either be used to produce energy for temperature control over the plants or stored for later use. We also conducted experiments on soil using percentages of coffee grains in order to determine whether using leftover coffee grains would be better for the plants. As it turns out, 25% coffee grains 75% soil is the best soil-coffee ratio to use hence that's the one we are using.





According to UN Environment Programme, there are more than 51 trillion microplastic particles in the ocean. 500 times more than stars in our galaxy—litter our seas, seriously threatening marine wildlife. This is one of the major problems in the society of today. In order to reduce plastic pollution, we decided to build a device to collect the microplastics.

Starting this project, we measured the drag force of different sized meshes and concluded which sizes would be most efficient in collecting plastic particles while not creating too much drag. We analysed the distribution of floating particles as a vessel passed across the surface. We also explored the size of the frame most capable at plastic collection and the method of maintaining proper orientation. We use a wooden frame on which weights and floats will be added in order to control the depth of the device. We will utilize a series of three nets to collect pollutants of various sizes.

We have created a device which can easily be attached behind a paddle board, canoe, kayak, or any water vehicle. This device can filter the water using a series of nets to catch and remove microplastics from water, cleaning up the oceans and making improvements to save the environment.







Our goal is to make Biodiesel from algae-oil (extracted from microalgae in the form of powder)

The idea first came to us when we discovered biofuel as an alternative to fossil fuels. We were, however, aware that the plants used for this process are usually being planted in the rainforest (e.g. rapeseed and oil palms) and contributing to deforestation. Algae, however, produce around 50% of the world's Oxygen, are easy to grow and contain enough oil to make an extraction of it possible while still being sustainable.

First, we extract the lipids from the microalgae powder a Soxhlet distillation with hexane. Hexane is nonpolar like lipids, so the lipids will mix with the hexane and while at the same time being separated from the polar substances of the algae. At the end, we get a solution of lipids which is dissolved in the hexane and the polar components.

Then we filtrate it to get rid of the polar substances, like amino acids. Some amino acids (and components other than the lipids) are nonpolar too and will therefore be dissolved in the hexane, but it shouldn't affect the experiment.

After that, we distill the lipids from the hexane; hexane has a lower boiling temperature than oil, so it will vaporize first and coagulate to be used again for another extraction later.

The oil is then saponificated with Sodium hydroxide to separate the glycerin from the oils. The saponification process will be reversed later on by an addition of methanol.

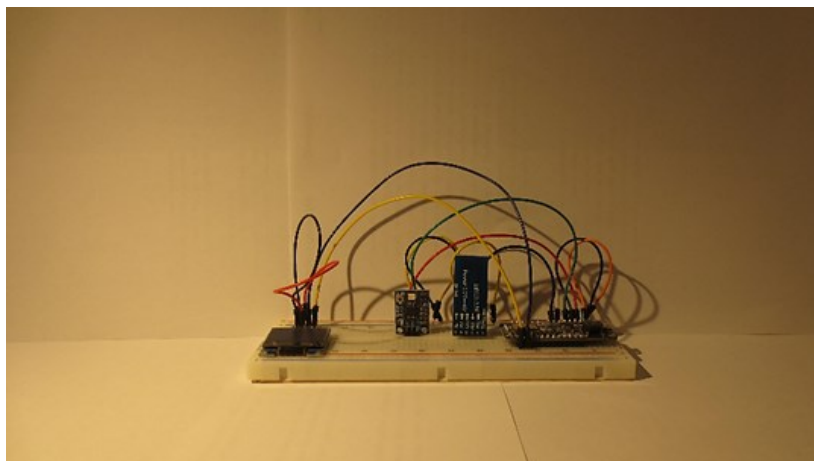
If the experiment succeeds, we will late demonstrate the results using a candle or small Stir-

Der ultraviolette Anteil des Sonnenlichts (Wellenlänge: 100 bis 380nm) kann die menschliche Haut je nach Bestrahlungsstärke durch Sonnenbrand schädigen. Ein international normiertes Maß für die sonnenbrandwirksame Bestrahlungsstärke ist der UV-Index (UVI).

Je höher der UVI-Wert ist, desto schneller können Sonnenbrände auftreten. Für Personen, die dem Sonnenlicht stark ausgesetzt sind (Strandtouristen, Segler, Bergwanderer), wäre es nützlich, den aktuellen UVI-Wert zu kennen, um einen Sonnenbrand vermeiden zu können. Eine Armbanduhr, die zusätzlich ein UVI-Sensor enthält könnte die Träger kontinuierlich über die sonnenbrandwirksame Bestrahlungsstärke informieren und sie so vor Sonnenbrand schützen.

Da es bislang noch keine derartige Armbanduhr gibt, hat sich dieses ESSS-Projekt das Ziel gesetzt, mittels Arduino-Komponenten und einer Android-App eine erste UVI Wristwatch (UWW) zu realisieren.

Im ersten Schritt wurde zunächst auf einem herkömmlich großen Arduino-Board mit angeschlossenem Minidisplays die Funktionalität einer Uhr mit Datumsanzeige realisiert. Dieses Board wurde dann in einem zweiten Schritt mit einem Sensor erweitert, der die Intensität des UV-Lichts im Wellenlängenbereich 200 bis 370nm misst. Der Sensor gibt die Intensität des UV-Lichts als skalierten Spannungswert aus, der dann auf dem Arduino-Board mit einer Open Source Software in einen UVI-Wert umgerechnet wird. In einem dritten Schritt wurde das Board noch um ein Bluetooth-Modul erweitert, damit es von einem Smartphone mittels einer Android-App gesteuert und ausgelesen werden kann. Abschließend wurde dann die App programmiert. Sie übernimmt den UVI-Wert vom Board und stellt ihn auf dem Smartphone-Display als Benachrichtigung dar. Über die App lassen sich außerdem Uhrzeit und Datum des Boards zurücksetzen.



Unser Projekt ist ein grünes Energiegewinnungssystem.

Unser Ziel ist es aus Regenwasser genügend Strom zugewinnen um kleine Systeme, wie zum Beispiel das bewässern von Tomaten autonom ermöglichen zu können. Wir hatten die Idee, als wir in der Kantine bemerkt haben, dass es dort sehr große Waschbecken zum Reinigen des Bestecks gibt. Sie sind meistens sehr voll und das Wasser wird mehrmals am Tag ausgewechselt. Wir haben uns überlegt, dass man all das Wasser nutzen könnte um Strom zu gewinnen. Dies kann ermöglicht werden indem man ein kleines Rad einbaut. Beim Planen dieses Projekts ist uns jedoch aufgefallen, dass immer wieder kleine Abfallreste in den Rohren landen, die unser Rad blockieren könnten. Aus diesem Grund haben wir entschieden, dass man das Rad auch in eine Regenrinne einsetzen könnte. Unsere Idee besteht daraus ein kleines Rad in eine Regenrinne einzusetzen. Dieses Rad ist mit einem Dynamo verbunden, welcher die gewonnene Energie in Strom umwandelt. Man soll auf das System auch Zugriff haben, weshalb wir eine Klappe in die Regenrinne einbauen werden. Zum jetzigen Zeitpunkt sind wir in der Lage einem kleinen Licht genügend Strom zu geben um zu leuchten. Wir haben festgestellt, dass wir die Reibung verringern müssen um genügend Energie/Strom zu gewinnen. Wir erhoffen uns die Reibung soweit verringern zu können um ein kleines System, wie ein Bewässerung System autonom betreiben zu können.



Our project is based on the recent study of Baranska et al. (2018) : “Unveiling skin macrophage dynamics explains both tattoo persistence and strenuous removal”. This group of researchers discovered how dermal macrophages absorb tattoo ink that remains permanently in them. Under normal conditions, macrophages perform a process called phagocytosis when coming in contact with bacteria, viruses, fungi, etc. A phagosome is formed around the target and enzymes are released by lysosomes which destroy the particle. The waste exits the macrophage and is removed by the immediate immune response.

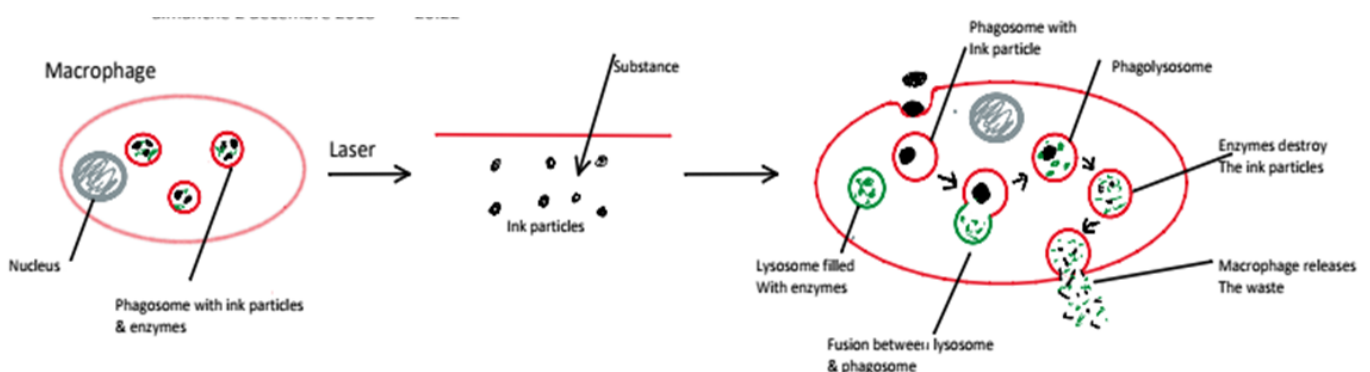
The tattoo ink particles have a chemical composition that prevents the macrophages to perform phagocytosis. When the macrophages ‘die’ the ink is absorbed by new macrophages. This is why laser treatment is rarely effective. We must keep in mind that this problem also occurs when skin and bone marrow transplants have been done.

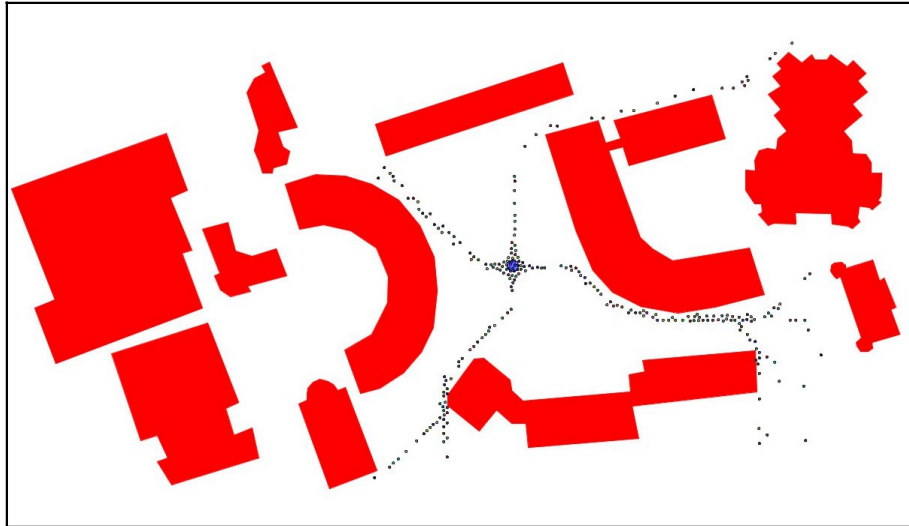
Our project consists of changing the chemical composition of the ink particles which will make phagocytosis possible.

The following steps will guide us once we have obtained enough results:

1. Destroy the macrophages that contain the tattoo ink particles
2. Inject a substance, which changes the chemistry composition of the ink, to the free ink particles
3. Wait for new macrophages to absorb the modified ink particles
4. We will see whether phagocytosis works or not and if the tattoo ink is removed by the immediate immune response.

So far, we are in the research stage as our project is based off theory, but we will start the work in the laboratory rapidly.





In his book: “Vehicles: Experiments in Synthetic Psychology”, Valentino Braitenberg creates the concept of a Braitenberg vehicle. He demonstrates human feelings such as fear and aggression on autonomous vehicles equipped with different sensors. This concept is the foundation of artificial intelligence and is the basis of this work, along with Reynolds’ behaviors. Called after their inventor, Craig Reynolds, they provide an effective way of coding behaviors such as cohesion, alignment and separation.

Imagine there is a fire in a school. Specifically, our school, the EEB1. What would happen? Well, probably nothing too bad. But that’s because of the security procedures. What if such measures wouldn’t be taken? We, students, would act intuitively. Just as a Braitenberg vehicle would. As an animal would. We fix a target- probably the exit gates, and flee as fast as we can. This target is our stimulation, it attracts us. We want to get there the fastest possible, so we fix the shortest path. Another factor that we would have to take into account are obstacles. The buildings are our obstacles, what we are afraid of. But so are other students. We don’t want to run over ourselves either, do we? How fast do we flee? Well, as fast as we can but not so that we hit each other.

This reality has been transferred to Processing IDE and coded in Java. Using the computing power, it is possible to create a life-like ecosystem and possibly seek for improvements in the school infrastructure.



Since the introduction of the “safety bicycle” in the late 1880s, the diamond frame consisting of two triangles has ruled the cycling world. This standard shape has been cemented through UCI (Union Cycliste International) regulations on frame shape, tube dimensions etc. These regulations provide an even playing field for competing athletes, however have significantly hindered new innovations within the cycling world.

We decided to strip ourselves from these regulations and see how far we could push the design of the bicycle frame, and which improvements, if any could be made on the current frame designs. To best achieve this, we decided to use a technology emerging due to increased computing power, generative design. Generative design is an iterative design process using a computer program or artificial intelligence to mimic the evolutionary process, in our case designing a bicycle frame based around certain pre-set constraints.

To determine the pre-set constraints, one needs to find the contact points and corresponding forces on the contact points of a bicycle frame. This is best achieved through a series of measurements using newton meters and load cells. Once the forces acting upon the frame can be found, we will model them within the CAD program Fusion 360, which supports a generative design function, outputting a series of different models of bicycle frames for different materials.





The world has suffered a lot from global warming, due to pollutant gases that damage the ozone layer. And this whole problem raises one question - How polluted is the air around us?

The idea of our project is to find out if there is a big difference between the air pollution in cities and in the country side; at different times of the day.

To do so, we will measure the levels of different polluting gases with an “Air Pollution Detector”. We will measure gases like  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{NO}_2$ ,  $\text{CH}_4$ , etc.

Our short-term plan is to build this detector, using *Arduino*, and apply the different gas sensors. Then we will gather the data, analyse it and finally publish it online.

Our long-term is to have several detectors working at the same time in different locations, sending information to our data base. To do it we would need to present the project to municipalities and try to engage in a more active data based pollution control. With this people can have information about the air pollution at their location in real time. This projects is also intended to help people realize the current air pollution situation on an area of residence/work, change people's behaviors towards a better and greener quality of life.

THANKS FOR SUPPORTING OUR SYMPOSIUM



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*Marcel Cars*



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...ET VIVE KARLSRUHE 2020