



DIGITAL BOOK

ERASMUS + PROJECT

Science is all around

2019-1-ES01-KA229-064155_4

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Chapter 1: Project summary, participants and goals

In the last few years, teachers from Escuela Profesional La Salle, Paterna (Spain) realized in their schools that the number of students studying experimental sciences was decreasing year after year. Students did not choose scientific options up to the point that biology could not be taught in 4th grade ESO (Compulsory Secondary Education) during the school year 2006-2007 due to the lack of registered students. Concerned about the problem, the school's department of experimental sciences began to analyze the possible causes and soon realized it was a global phenomenon. The same problem was taking place both in Spain and Europe. The usual teaching of physics and chemistry focuses on the quantitative and operational aspects, ignoring some features of science which, according to the research in didactics, could contribute to increase the interest towards those subjects as a more qualitative, experimental and contextualized treatment, showing its contributions to solve human problems and needs. And it is here, in this last sentence, where we found the leitmotif of the present project.

As the main objective, we want to achieve that students, under equal conditions, show more interest in the study of STEM as a result of methodological changes. That is, by increasing the qualitative nature of the scientific subjects in the different participating schools, we will also increase the interest of the students in them, since the contents will be more contextualized and their implementation will predominate. Consequently, it is expected that the project can reduce school dropout, hence it is not only aimed at students with good academic results, but also at students with special educational needs or students at risk of dropping out of school. Last but not least, this project aims to make women feel attracted to STEM subjects as an opportunity, as any other, to get a foothold in society.

To assess the impact and potential of the project, three surveys are planned to be carried out on students and families involved in the project to discover their interest in STEM, and how this evolves during the course of the project. In addition, as a main result of the project, this digital book plans to gather the description of each congress, the laboratory practices carried out, the posters resulting from each congress, the lesson plans, the mention of scientists women and the talks of participating scientists. Digital publishing of all project's products will allow to

prolong in time the use of practices and teaching units. Likewise, the fact that they are easily accessible will allow many teachers and therefore, many students to take advantage of those practices. Finally, by way of dissemination, social networks will be used and the following website of the project created: <https://siaa-erasmus.com/>.

A total of 5 countries are participating in the preparation and development of this project:

- Spain (coordinating partner), Escuela Profesional La Salle, Paterna, Valencia
- Belgium, Campus ZAVO Groenstraat, Zaventem
- Italy, Istituto d'Istruzione Superiore, Castelnovo ne'Monti
- Latvia, 3.vidusskola, Daugavpils
- Portugal, Agrupamento de Escolas, Vila Nova da Barquinha

The project reaches a minimum of 600 students (50 in mobilities) aged between 15-19 from low and upper secondary students, and about 60 teachers including STEM teachers and other teachers (from other subjects). A minimum of 600 families is expected to be involved (50 in mobilities), in addition to companies, universities and science museums.

All the mobilities will take the form of a scientific congress with all kinds of details and paraphernalia that surround a real one to make students feel and experience what it is like to be a true scientist. In fact, as detailed below, at the last meeting in Spain they will be able to participate in the Experimenta Fair, a contest where they will compete with other groups and present their experiments to both the jury and the visiting public. The congresses are therefore foreseen to be the core line of the project, but other activities, products and events will be generated before, during and after each one: a keynote lecture led by a scientist of some significance in the host country, an exhibition of science communications, workshops where students carry out the practices, a visit to the school and a presentation of the science curriculum in each country, a training visit to a university or museum and a company related to the congress branch of science, an informal training visit to the school's surroundings and, lastly, a closing ceremony.

Chapter 2: Congresses

2.1 Geology Congress in Portugal

As part of the project "Science is all around" and through the exchange of students and teachers, we intend to discuss different aspects of science, organizing scientific meetings in 5 schools: Belgium (Biology), Italy (Environment), Latvia (Chemistry), Portugal (Geology) and Spain (Physics). Portugal was thus the first to shape this initiative, between January 20th and 24th, 2020.

DAY 1- D. Maria II school families welcome Erasmus students

At 8:15 pm, some families were already waiting at the D. Maria II school to welcome students from Belgium, Latvia and Italy for a week.

These were received in a warm way that smothered the Glória wind for a few moments. After brief presentations, the students went to the comfort of their hosts' homes. Meanwhile, teachers from Belgium, Latvia and Italy, along with coordinating teacher Vasco Lourenço and director Paulo Tavares and two Italian students went to restore their energy to the Tasquinha da Adélia restaurant.

Here the meal was deliciously enjoyed by foreigners and every bite was an explosion of appetizing commentary. Let's not forget that Italian student Federico ended up consuming just six succulent steaks.

It was after 10:15 pm at the Entroncamento station and we were waiting for our partners from Valencia to arrive. After quick introductions and hugs, everyone headed to their quarters, as the night was "gloriously" windy.

DAY 2- Hospitality

In the morning, we attended the welcome ceremony and presentation of all 23 students and 8 foreign teachers and the 6 respective Portuguese students selected for mobility to Belgium.

Then the group went to CIEC where they became aware of the school space as well as carried out some interactive activities. At 11 am they returned to Escola D. Maria II. where they took a tour of the school, visiting laboratories, library (a space that

does not exist in the schools we host), interacted with classes, watched volcanic activities and finally had lunch in the canteen.

The opening of the international geology congress took place in the auditorium with the presence of the President of the Chamber.

Each partner presented their country's poster on the topic of geology. During the entire afternoon the students carried out the experimental geology activities that were chosen from their national programs:

o Zavo: Limburg Marl-effects of acid rain;

the Daugavpils 3.vidusskola: Geological formation in Latvia;

the Istruzione Superiore Institute, Castelnovo ne' Monti: Total calcium in rocks;

the Vila Nova da Barquinha School Group: Crustal Deformation Processes: Folding and Faulting;

o Escuela Profesional La Salle: Crystallize monoammonium phosphate crystals ($\text{NH}_4\text{H}_2\text{PO}_4$).



DAY 3 - An extraordinary beauty, thank you very much

At Carsoscopia, at Centro Ciência Viva do Alviela, they visited the interactive exhibitions, visited the source of Olhos d'Água and walked through several places of geological interest in the Serra de Aire Natural Park. They were all delighted with such beauty



DAY 4 - The importance of Geosciences for modern society

The excitement in the morning foresaw a remarkable experience for this big day. Today the students were presented with a spectacular cave - the Algar do Pena. After a 45m descent, they were able to observe geological formations in a space of rare beauty. In the end, they were able to easily identify the stalactites and stalagmites and even heard curiosities about caves around the world. On the way out, they were given a piece of calcite that they could bring back as a souvenir.



After this visit, the best way to continue our journey was to take a break for a comforting lunch and recharge at a restaurant in Videla.

Then we visit the Natural Monument of Dinosaur Footprints, which is about 175 million years old. Following a 1000-meter walking route, they also visited the Jurassic garden.



In the middle of the afternoon we went to the Filstone quarry, which in the 80's was already one of the biggest references in the stone industry in central Portugal. We were received in a very affectionate way by the public relations and the administrator who welcomed us. We visited the extraction site and learned that most of the blocks are for export to Eastern countries. At the end we were offered a snack and a box with a sweet surprise. We say goodbye with a big thanks and immense joy for the reception.

DAY 5 - a little culture

Practical activities "Forensic Geology" and "Stone and Fire".



This fifth day of activities began with a lecture by Professor Amélia Dionísio (IST) whose central approach was again the importance of geology in society, along with experimental activities with the students.

After lunch we traveled to the Convent of Christ, which was very much appreciated by the foreign teachers. On their way out, they had the opportunity to observe the restoration of some pieces in the stone laboratory.

At the end of the day, the students also got to know the Polytechnic Institute of Tomar, its courses and laboratories.

At the farewell dinner, parents, teachers and students sang happy birthday to Elien, were toasted with the voice of the fado singer Rita Inácio, listened to the anthem of Europe, danced... There were intense moments!



DAY 6 - the longing

The last day of activities started with a visit to the Almourol Castle and the Templar Interpretation Center of Almourol (CITA). At 12:30, it was time to say goodbye through the closing ceremony with the delivery of participation certificates and other souvenirs, by the Mayor - Fernando Freire.



Between hugs and tears among the students, an emotional disorder was installed. Strong emotions remained, such as the nostalgia that the Portuguese tried to explain to the group and the Spaniards, Italians and Latvians left.

But the Belgians stayed for one more night in families so they could have the afternoon free to walk with their guests. There were trips to the Railway Museum and not only...

It was an extremely rich week for everyone involved.



2.2 Chemistry Congress in Latvia

From October 4 to 8, Daugavpils Secondary School No. 3 hosted the participants of the International Chemistry Congress. Unforgettable impressions on everyone were left by wonderful choirs, participating in the Open ceremony.

On the first day, all guests were warmly greeted by Juris Soms, the Dean of the Faculty of Natural Sciences and Mathematics of Daugavpils University. In his lecture, the professor noted the importance of chemistry in human life from ancient times to the present day and the role of the younger generation in new discoveries. Evans Griškjāns, a 12th grade student of our school, has demonstrated the operation of chemical laws in practice. The professor himself and the staff of various laboratories introduced us to the exciting equipment and work of researchers. At Daugavpils Innovation Centre, students and teachers enthusiastically experimented with determining banana DNA and tried out the laws of physics on various interactive exhibits.



An important chemistry congress was held on Tuesday, where students were given the opportunity to feel like real scientists. All countries produced and presented posters on "Chemistry around us" and led experiments prepared for the congress: production of glue from skimmed milk (Spain), determination of titratable acidity in milk (Italy), preparation of elephant toothpaste (Belgium), effect of flame on various surfaces (Portugal), glowing stick reaction (Latvia). Each participant had the opportunity to take part in these exciting chemical experiments.



Wednesday's theme was getting acquainted with Latvian culture and traditions. The participants of the Erasmus + project visited the unique Preili Doll Museum, where they looked with interest at well-known film and cartoon characters, as well as admired other works of the talented artist. With great joy the students and teachers were transferred to another age, trying on the wonderful costumes of princes and princesses, court ladies and musketeers. At the Aglona Bread Museum, guests enjoyed Latvian cuisine and got acquainted with national traditions. Vivid memories of the trip will be remembered for a long time.



Thursday was the last day of the project participants' stay in Daugavpils. In the morning, they visited the Mark Rothko Art Centre and learned about the history of Dinaburg Fortress, and in the afternoon took part in an interactive chemistry show organized by the Chucha chacha kids club. An international team of teachers summarized the results of the congress and planned the work for the near future. In the evening, the cake with the project logo became a pleasant surprise, and students from different countries who had been friends for a few days did not want to part with each other.



On Friday morning, the international delegation went to Koknese, where everyone had the opportunity to make a souvenir with Latvian symbols in the trade centre "Mazā kāpa". At the Pharmacy Museum in Riga, students and teachers followed with interest the development of pharmacies for several centuries, visited the laboratory of an alchemist, the house of a traditional healer and the garden of medicinal plants. The last day of the project ended with a tour of the old town of our country's capital.



It was an unforgettable and valuable experience for the students of our school who chose medicine and languages as their future profession:

A wonderful, exciting week has passed, which gave me a lot of experience. What I enjoyed most was contacting students from other countries, getting to know their culture and learning something new. I also enjoyed the day of the congress, where each country showed experiments. For example, I learned how to make a glowing liquid or how to change the colour of a flame. (Nellija Osmane)

Foreign students proved to be very good and pleasant to talk to. We were all afraid to start talking to each other, at times we didn't understand each other, but we became very close, which was sad at the thought that we would all soon part. The project gave me new impressions for a lifetime. (Karina Vaidere)

This week was unforgettable. I met new friends and different cultures. I really enjoyed our trip to Aglona, the Bread museum, when we, as one big family, sat at the table

and tasted Latvian dishes. Also, I really enjoyed our school disco. Hope this was not our last meeting and we will keep in touch! (Ksenija Petunova)

Convinced of my experience, I can safely say: it is much easier than it seems to do the program and communicate with foreign guests. The most difficult thing in this case - to move from a simple desire to real action. These days were undeniably the best time of my life. (Valērija Prihodko)

I liked our trip to Riga the most, especially the pharmacy museum. There was a lot of new and interesting information and exhibits. It was also very nice to go by bus with other project participants, because we exchanged our news and facts about our countries. (Daria Malysheva)



2.3 Biology Congress in Belgium

The Belgian congress was supposed to take place in november 2021. However, at the time Belgium was experiencing a worrying increase in covid-19 cases and our government decided to implement regulations to deal with the situation. An unfortunate side-effect of these regulations was that we could no longer host the congress on biology as traveling was highly discouraged and schools were no longer allowed to welcome guests. Fortunately, our Italian colleagues were gracious enough to host not only their own congress but also combine it with that of biology. We, therefore, recommend to continue reading and enjoy the explorations in Italy we have all enjoyed.

2.4 Environmental Sciences in Italy

From March 21 to 25, the participants of the International Biology and Environmental Science Congress have been hosted in Castelnovo ne' Monti. An intense week of cooperation, mutual learning and bright weather has characterized the time spent together.

On the first day, all guests were warmly greeted at the welcoming ceremony by Sara Ferrari, the Erasmus Project coordinator, in the various sections of the school, with the help of students and teachers from all the courses of study. All the guests visited the kitchen lab where students learn to cook, the practical tools students use in the mechanic sections and finally, they went to the greenhouse of the school to see how agricultural techniques are being used to produce crops, to cultivate plants and guests were invited to ride the school horses, to ride the school tractor and were offered a taste of the typical Balsamic Vinegar together with Parmigiano Reggiano and honey. After that, participants were invited to show their own videos that they recorded to introduce themselves, their school and their country. Then all together they had lunch prepared by the school before having a free afternoon.



On Tuesday participants were welcomed at City Hall by deputy mayor and after started some biology and environmental science activities and observations in some magnificent places of the Apennine Park: Lago del Ventasso (Lago Calamone), where biologists Arianna Garofolin and Maria Chiara Contini had prepared a speech and showed pictures about claws, wolves and forest therapy. The impact with the beauties of nature is incredible in these places. Nevertheless, these places are not inhabited by many people; that's why the lunch was held in Succiso, where after tasting typical dishes, Oreste Torri explained what a community cooperative is: he described all the activities aimed at repopulating the area and showed us the farm with rabbits, cows and calves.



The biology and environmental science congresses were held on Wednesday, where students were given the opportunity to show their friends their trials. All countries produced and presented posters and led experiments prepared for the congress. For Biology, they had: Water and temperature (Spain), Observation of vegetal tissues (Italy), Chromatography on chloroplasts (Belgium), Investigating the upward transport of xylem sap (Portugal), Calculating biorhythms (Latvia). For environmental sciences they had: Effect of CO₂ in air and water (Spain), Determination of nitrites in water through rapid determination (Italy), The influence of acid rain on vascular and non-vascular plants (Belgium), greenhouse effect determination (Portugal), Natural PH indicators (Latvia). Each student has learned something from these didactic experiments.



On Thursday it was time to enjoy some scientific but also cultural visits: the first place was the dairy factory “Carnola”, where partners attended the whole process of cheesemaking of Parmigiano Reggiano. Students Leonardo and Stefano from

the Agricultural course explained all the steps, from cooking the milk to the seasoning. A taste of Parmisan was offered to everyone and a “formaggiera” to all the teachers. After that, it was time to climb up to the Pietra di Bismantova, where our Science teacher Massimo Monti explained the origin and formation of our symbol and where we could enjoy one of the most memorable views! Then at night we had an unforgettable final dinner with pizza, cake and certificates.



On Friday it was time to head to Reggio Emilia for the last scientific and cultural visit: in the morning Musei Civici in the sections of Geology, Biology, Anatomy and Chemistry as well as Tricolore museum with the history of the Italian flag; in the afternoon the visit to Theatre Valli before saying goodbye and finally meeting in Spain for the last congress.



2.5 Physics Congress in Spain

The last meeting of this project was hosted by Spain, the coordinating partners, from April 6 to 10. During that week, several activities related to science and the native culture of Valencia were carried out, as described below.

On the first day, all the participants were received at the Escuela Profesional La Salle, in Paterna. The opening ceremony was carried out by the project coordinator and the headmaster of the coordinating center. A group of school students also participated in it, performing two short theater performances related to Spanish stereotypes. Another group of students took charge after showing and telling the educational offer of the school through a tour. To end the morning, the students played a presentation game, while the teachers compared the physics curriculum of the different participating countries. After having lunch all together, we visited the town hall of Paterna, where we were received by the festivities and education councilors, and we explored “les coves” and the tower of Paterna.



The second day, we went to the University of Valencia. There, three different workshops were held throughout the morning: granulometry, museum of natural sciences and astronomy. We had lunch in the university campus and in the afternoon we visited the IFIC (The Institute of Corpuscular Physics), where we attended the talk by Dr. Alberto Aparici and discovered different physics laboratories.



The third day was purely culture: we visited the beach and sailed by boat through the Albufera. During the journey we learned how rice is grown and later they also taught us how to cook paella, the quintessential typical dish of Valencia. Finally, we visit a Valencian “barraca” (old typical rural houses).



On the fourth day, we went to the City of Arts and Sciences museum in Valencia. We participated in a workshop called “vacuum horror” and also in a theater called “high voltage”. We also had time to get lost among the infinite experiments proposed by the museum. In the afternoon, we visited the oceanographic (the largest in Europe) and we went to the city center of Valencia.

The last day was undoubtedly the most significant of the entire project, as the students participated in the Experimenta Fair in Valencia and presented their physics experiments to the competition jury and to the general public who came to visit us. The format of this congress was not the same as that of those held in other mobilities, but the students proved to be up to the task, and not even the language

barrier kept visitors away from our stands. In the evening, we hold the closing ceremony. We all had dinner together and received the certificates of participation.



Chapter 3: Posters

3.1 Geology Congress in Portugal

Portugal



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Science is all around





CONGRESS OF GEOLOGY

20th to 26th January 2020
Vila Nova da Barquinha, Portugal

MARIA DA CONCEIÇÃO FREITAS – A PORTUGUESE GEOLOGIST



Place and date of birth: Lisbon, 11th, June, 1961

Academic degrees:

- Completed a BSc in Geology at the Faculty of Sciences of the University of Lisbon in 1986.
- On April 12, 1989, completed an MSc in Economic and Applied Geology.
- On March 20, 1996, completed a PhD in Geology, specialization in Geology of the Environment (with distinction).

Present position: Full Professor at the University of Lisbon (since 2012)

Main scientific technical areas of research: Coastal Geology, Geomorphology, Sedimentology, Quaternary Geology, Paleoenvironmental reconstruction, Estuaries and Lagoons.



Recent Projects:

- DETI – Dynamics of Ephemeral Tidal Inlets;
- Coastal Transitions: a comparative approach to the processes of neolithisation in Atlantic Europe.

Other scientific technical areas of interest or activities: Management and Environmental Studies, Impact of Climate Change.

Since the beginning of her professional activity, she has dedicated herself to the study of Coastal Geology, in particular to coastal and estuarial lagoons (including marshlands), although she also participates in research projects relating to beaches, dunes, abrasion platforms and cliffs. Her primary approach focuses on environmental aspects (and their interaction with anthropic activity), as well as morphological, sedimentological, dynamic, evolutionary and planning aspects, across micro to macro temporal scales. Throughout her career she has participated in numerous projects and collaborated on dozens of articles published in national and international scientific journals as well as contributing chapters to scientific text books.



Água de Madeiros Beach – Stratified Sedimentary Rocks (Foto – Ana Salas)



Água de Madeiros Beach – Detail of a Black Rock Series Strata (enriched with organic matter) (Foto – Ana Salas)



Água de Madeiros Beach – Ammonites in Sedimentary Strata (Foto – Ana Salas)







Geology Around Us in Latvia



THE MAJOR NATURAL RESOURCES OF LATVIA

Geographically, much of the country (98%) lies under 656 feet elevation. Latvia was divided into three regions by the ice age: Middle lowland, morainic Eastern upland, and morainic Western upland. Non-metallic mineral resources such as clay, limestone, gypsum, dolomite, peat, and other construction material are some of the important natural resources of Latvia.

SAND

Sand and gravel are mined in quarries. Gravel pit Kurzemē is one of the largest in central and eastern Europe. Sand is used in construction and in Latvia also for glass production.



FUNCTIONAL GLASS DESIGN OBJECTS

Glass art has a rich tradition in Latvia already since the middle ages, when stained glass windows were decorated in Latvia's many beautiful gothic churches. In time, the creation of interior objects made of glass became popular.

Ernest Vītis is the only artist in the Baltic States and amongst the few contemporary artists in the world, working exclusively and professionally with layered technique, offering design objects for everyday practical use with a unique artistic value due to the unique ways glass reflects and distributes light.



LIMESTONE

There are more than 180 million m³ of limestone deposits in Latvia. Limestone is the main raw material for cement of the Broceni Cement Plant - the largest cement plant in Latvia.



LIME - FROM CONCRETE TO FOOD PRODUCTION

Limestone is one of the most valuable minerals in Latvia, the most widely used in the national economy. In construction - no house is built without lime. In agriculture, the soil can be fruitful for a long time and not deteriorate even with intensive agriculture if lime is applied. In animal husbandry, calcium is essential for animal health and productivity - for both cattle and chickens. In the food and hygiene industry - creams, vitamins and even cakes on the table.

GYPSUM

Latvia is the only Baltic country where gypsum is mined. There is a gypsum cave on the bank of the river Memele. Gypsum is mainly used for fabrication of finishing and acoustic panels, floor and partition panels, as well as in sculpture and medicine.



DOLOMITE



Dolomite is one of the main sources of mechanically resistant stone materials in Latvia. It is used for building blocks and slabs, crushed stone; dolomite sand and dolomite flour are used for liming soil. Dolomite chips are used for road construction, manufacture of finishing elements, as well as production of dolomite flour and mineral wool.

PEAT

Peat is one of the greatest resources of Latvia and is of immense significance in the preservation of the country's beauty. Peatlands cover about 10% of the territory of Latvia. Peat is used in energy industry, agriculture and horticulture, animal husbandry and veterinary, medicine and pharmacy, cellulose and paper industry.



LATVIAN AMBER

Latvians put it in their brooches, beads, textiles and song lyrics. They do occasionally call the Baltic Sea the Amber Sea. And they do not hesitate to name their brands or even children after it, either. Dintars or Dzintra (meaning amber) are among the few given names of Latvian origin. Latvian scientists and entrepreneurs have thought of innovative application elsewhere. As an organic material, it absorbs the body heat and is easy to work with. Equally ancient is the use of amber for medicinal purposes. Amber oil and varnish are used to make high quality paints and varnishes. Amber varnish is essential for restoring the gilded roofs of architectural monuments. Amber, particularly pressed amber or amberoid, is used as an insulator in electrical equipment. Such amber cores were also used in the equipment that measured radiation levels after the Chernobyl nuclear disaster. These facts just add up to the importance Latvians have always attributed to amber.



CLAY

Clay is the most widely used for the production of building and insulation materials, as well as household utensils, for art objects and for sculpture. Latvia produces bricks for building, clay dishes from clay.

LATVIAN POTTERY

Pottery is the process of forming vessels and other objects with clay and other ceramic materials, which are fired at high temperatures to give them a hard, durable form. Latvian pottery is one of the country's oldest art forms. Some Latvian pottery wares are food-related: pots for cooking, storing honey, fruit preserves, milk, soured cream, oil; a bowl, a jug or mug, most often for beer or milk. Others include a bird-shaped whistle toy, candlestick and decorative plates and ashtrays.



RED BRICK BUILDINGS IN DAUGAVPILS

Bricks are good for house construction as the most of them are durable, since there are brick walls, foundations, pillars, and road surfaces constructed thousands of years ago that are still intact. Normally, bricks contain sand, clay and lime. Daugavpils is exceptionally rich in red brick buildings of the 19th century. Daugavpils fortress is a unique cultural and historical architectural monument of national importance. It is also considered as the last bastion-type fortress in the world that has been preserved without any significant alterations since the early 19th century. It is supposed that 85% of the all fortifications remained in its initial condition till nowadays. All these aspects make the Daugavpils fortress the one of the most popular tourist attractions in Daugavpils.



Austra Stinkule and her son Ģirts Stinkulis, also a geologist

LATVIAN GEOLOGIST AUSTRA STINKULE

Latvian Doctor of Geology Austra Stinkule was born on July 27, 1936 in Riga. She was three years old when the World War II began. After finishing school in 1954 she decided to study chemistry at the State University of Latvia, specializing in silicate technology. Since the studies were completed with excellence, she was immediately offered the work in the laboratory of the Institute of Geology of the Latvian Academy of Sciences. In 1959 Austra started her career as an engineer. She also gradually got acquainted with the field of geology, worked on publications, and in 1967 received a degree in Geology and Mineralogy. She practically spent her entire life at the Institute of Geology as a senior researcher. She was also a lecturer at the University of Latvia and led courses in mineralogy and geochemistry.

Austra Stinkule is the author of several books on different types of mineral resources in Latvia and on all minerals in general. Austra Stinkule's lifetime work is Latvian clay - its formation, distribution, quality and practical use. She sees herself as a chemist, though, of course, much more has been done in the field of geology than in her original specialty.



Co-funded by the
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European Union Erasmus+ Programme KA219
School Exchange Partnerships project
"Science is All Around" (SIAM)
No. 2019-1-ES01-KA229-064155_4
Congress of Geology in Vila Nova da Raparizinha,
Portugal on 28th to 24th January 2020

GEOLOGY AND ITS ROCKY SOILS



Erasmus+

Science is all around

2019-1-ES01-KA229-064155



Congress of Geology

20th - 24th January 2020

Portugal - Vila Nova da Barquinha

Geology importance in everyday's life

The role of geology is fundamental in a lot of aspects of our daily existence; in Italy, in the last few years, the Italian Geological Society has promoted a document with the aim of raising awareness of the public opinion and of the political authorities to the importance of geosciences in the sustainable use of water, mining and energy resources, as well as a planning of the territory to prevent or mitigate the risk of catastrophic events of natural origin. Geology also contributes to the conservation of paleontological heritage. If we think about the soil, we can also find its origin in the branch of pedology. Thanks to scientific studies which relate to pedology, we can determine that the process which formed soils and its material is chemical, physical and biological and therefore also linked to geology. If we determine the composition of soils measuring the content of calcium carbonate we can also identify the variety of plants that can be cultivated in different areas.

Italian geologist Alessandra Curotti: a continuous commitment to her territory

- Born in 1967 and qualification as a Geologist in 1993;
- Work experience aimed at the protection of the environment at local, regional and national level, with functions related to the enhancement and the sustainability of the National Park of the Tuscan - Emilian Appennines;
- Collaboration with the Province of Reggio Emilia: project dealing with the dissemination of the places of geological interest in the territory with meetings, excursions, seminars and a final conference entitled "The Geology of the Appennines: risk and resource";
- "Earth education" course in 2002



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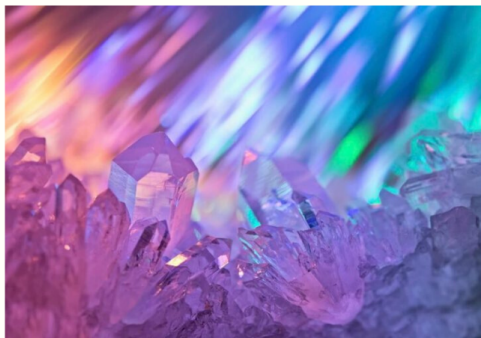
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GEOEARTH

Science is all around.

Project No: 2019-1-ES01-KA229-064155.
Portugal Geology Congress. Vila nova Da Barquinha.
19th-25th January 2020.



Dr. Duna C. Roda Boluda

Biography of a geologist woman.

This woman is a teacher and geologist from Picanya. She has been awarded in the local category "Dona Científica Valenciana Awards" (Valencian Scientist Woman Awards), in Picanya (Valencia) City Council



She was awarded a very prestigious Marie Curie scholarship, offered by the European Union to encourage the training of the most promising young people.
Now, with the Marie Curie grant, Duna is among the elite of European scientific research.



NEWS ABOUT GEOLOGY.

TRAPPED BY THE DUNES

The dunes of Tarifa invade the entrance road and leave tourists trapped in it.



CRYSTALS EVERYWHERE

There are crystals in makeup, chocolate, ice cream, clothes... Impossible a world without them



WHAT THE CRYSTALS HIDE

Crystals influence many aspects of our lives, although the world of crystallography is a field without much development.
Crystals are much more important than you think



PRACTICE: CRYSTALLISATION

Is a chemical process by which, from a gas, a liquid or a solution, ions, atoms or molecules establish bonds to form a crystal lattice, the basic unit of a crystal.



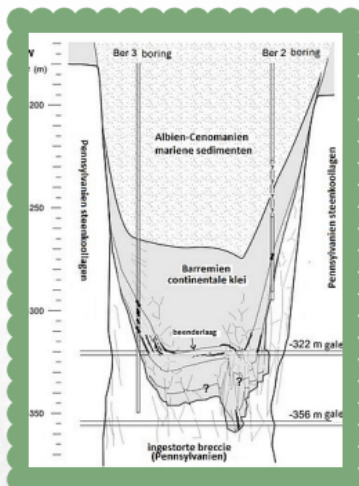
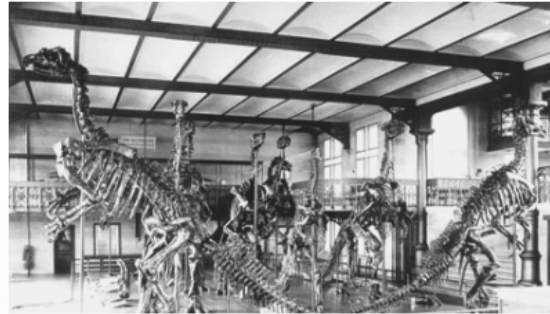
Belgium



THE IGUANODONS OF BERNISSART

An extraordinary discovery

In 1878 a complete iguanodon skeleton has been found in a Belgian coal mine in Bernissart. Over the following three years around 30 Iguanodon skeletons were uncovered, of which many were relatively complete. The fossils were transported to Brussels covered in plaster for protection to be reassembled and fitted with iron frames. For the first time, scientists were able to see what a complete dinosaur might have looked like.



Time scale

The Iguanodons lived in our regions in the early Cretaceous, the geological period between 145 and 66 million B.C., also known as the Jurassic period. The dinosaurs were originally buried in the Barremian, an earth layer dating from 125 million years ago. Because of sedimentological activity the skeletons gradually slipped in a sinkhole. Thus the fossils ended up in the Carbon (± 350 - 300 million years ago).

"THE DISCOVERY OF THE REMAINS OF IGUANODONS IN THE 1820'S WERE ONE OF THE FIRST FINDINGS OF DINOSAURS. AT THAT TIME, THE MAJORITY OF THE WORLD WAS UNAWARE OF THESE LARGE CREATURES WHO LIVED IN THE JURA AND CRETACEOUS GEOLOGICAL TIME PERIODS."

Elise François, geologist



was a Belgian paleontologist who contributed on the excavation in Bernissart. The rest of his life he documented the information about his catch in the Royal Belgian Institute of Natural Sciences and published articles.

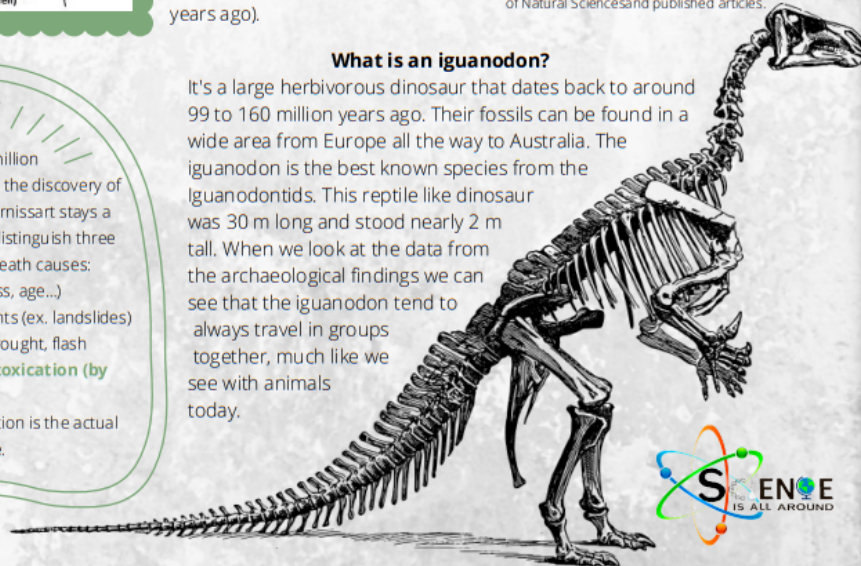
What is an iguanodon?

It's a large herbivorous dinosaur that dates back to around 99 to 160 million years ago. Their fossils can be found in a wide area from Europe all the way to Australia. The iguanodon is the best known species from the Iguanodontids. This reptile like dinosaur was 30 m long and stood nearly 2 m tall. When we look at the data from the archaeological findings we can see that the iguanodon tend to always travel in groups together, much like we see with animals today.

Even 125 million years after their death, the discovery of the Iguanodons in Bernissart stays a mysterious case. We distinguish three types of possible death causes:

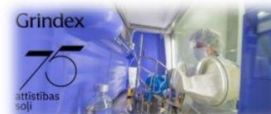
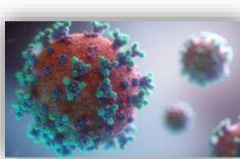
1. Natural death (sickness, age...)
2. Sedimentological events (ex. landslides)
3. External factors ex. drought, flash floods, serial killer, **Intoxication (by hydrogen sulfide...)**

Most likely this last option is the actual death cause.



3.2 Chemistry Congress in Latvia

Latvia

 CHEMISTRY AROUND US IN LATVIA	
NO EVERYDAY LIFE WITHOUT CHEMISTRY	
MĀDARA Limited Company MĀDARA Cosmetics is a Latvian manufacturer of organic skin care, hair care and baby care products. The company produces over 80 different cosmetic products, including face and body care products made from herbs and flowers harvested in the Baltic region according to organic farming principles. 	Grindeks Grindeks (a joint stock company) is the largest pharmaceutical company in the Baltic States. Grindeks manufactures world class quality products and provides services to the European pharmaceutical industry. It is recognised as a high technology company that has developed its scientific potential, exporting products to at least 37 countries around the world, including the other Baltic States, Europe, Japan, USA and Russia.  The company manufactures more than 100 products – tablets, capsules, injectables, syrups, ointments and active pharmaceutical ingredients. Grindeks is especially proud of its branded products – cardiovascular preparation Mildronate and anticancer preparation Ftorafur.
SPODRIBA Joint Stock Company SPODRIBA is the largest manufacturer of household chemicals and cosmetics in Latvia. The Company has accrued more than 90 years of experience and successfully created products which take an important role in many customers' homes. 	OlainFarm OlainFarm is one of the largest chemical-pharmaceutical manufacturers in the Baltic region. The company manufactures more than 80 finished products and 40 active pharmaceutical ingredients, as well as a number of intermediates and speciality chemicals. Fine organic synthesis of active ingredients is the priority direction the company has set. The company possesses great experience in working with highly dangerous chemicals. The products manufactured at OlainFarm meet the requirements of the highest quality standards listed in international Pharmacopoeias in terms both of chemical and physical parameters, and in levels of microbiological purity. 
BIOLAR BIOLAR company specializes in experimental developments in the field of chemistry, production of technologically complex chemical products, intermediate products for the paint and varnish industry, and also produces finished paints and varnishes for various purposes, construction, automotive and household chemicals. 	PharmIdeas PharmIdeas Ltd is a pharmaceutical company dedicated to the research, development and commercialization of hospital, women health and anti-cancer drugs with main R&D and production competence in sterile formulations. It develops, manufactures and sells sterile pharmaceutical forms in more than 50 international export markets. PharmIdeas is the only company in Latvia, providing sterile and freeze-dried drugs manufacturing at a world class quality, which is granted by the GMP certificate and various successfully passed international quality inspections. 
CHEMICAL SCIENTIST IVETA PUGAJEVA  For Women in Science FOUNDATION L'ORÉAL Dr. Chem. Ivetā Pugajeva is the leading scientist at the Institute of Food Safety, Animal Health and Environment BIOR and the head of the Chromatography Group of the Chemical Laboratory. Ivetā has been working in the chemical industry for 16 years, is the author of more than 50 scientific publications and she has launched an unprecedented Baltic-wide study to develop a new wastewater research methodology for a better understanding of public health. Ivetā works on wastewater-based epidemiology – an innovative approach to research various contaminants in samples of waste water that characterize, for example, the food and alcohol consumption habits of the population, in order to develop a new methodology for public health assessment. The data obtained in the research will provide useful epidemiological information on the lifestyle, dietary habits and public health of the Latvian population. In 2020 she received the L'ORÉAL Baltic Prize for Women in Science. Ivetā is honored to be noticed by the scientific community, and for her this award is a great encouragement for the future. She believes that everyone has different gifts and everybody should never give up.  	
 European Union Erasmus+ Programme KA219 School Exchange Partnerships project "Science Is All Around" (SIAA) Nr. 2019-1-ES01-KA229-064155_4 Congress on Chemistry in Daugavpils, Latvia on ...  Co-funded by the Erasmus+ Programme of the European Union 	

Portugal

SCIENCE IS ALL AROUND

4 / 11 - 8 / 11

CONGRESS OF CHEMISTRY Daugavpils

ISABEL FERREIRA

Considered one of the most influential Portuguese researchers worldwide, Isabel Ferreira has a degree in biochemistry from the Faculty of Sciences of the University of Porto and a PhD in Chemistry from Faculty of Sciences of the University of Minho, and has dedicated herself to a line of research that consists of how to replace synthetic components in the food industry, by studying species of mushrooms and plants from the northeast of Trás-os-Montes to identify new molecules.

The study of healthy alternatives and the study of molecules with bioactive interest have captured the attention of other scientists worldwide.

Isabel Ferreira is seen as the scientist who "is exploring one of the most dynamic areas in agri-food research".



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Erasmus+



Project code:
2019-1-ES01-KA229-064155

Italy

NOTHING IS LOST, NOTHING IS CREATED, EVERYTHING IS TRANSFORMED



**Science is
all around**



2019-1-ES01-KA229-064155

Congress of Chemistry

October 2021 Latvia



Silvia Marchesan

Associate Professor of Organic Chemistry at the Department of Pharmaceutical Chemistry in Trieste, where she manages the university's laboratory, she works on molecules and superstructures in the search for bio-sustainable materials. She has developed a self-assembling protein hydrogel useful for repairing body tissues. She studied in London, Finland and Australia. It is worth hearing once more what she has to say about work-family reconciliation in our country.

Did you know...?

The only letter not appearing on the periodic table is J



By the time you feel thirsty, you've already lost about 1% of your body's water.



Mars is red because its surface contains a lot of iron oxide or rust.



Co-funded by the
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LA SALLE NEWSLETTER

Confirmed: Chemistry has a big impact in our lives



Chemistry makes people's lives easier thanks to its many applications, like: Paper and ink, photographs, films.. Chemistry is important in everyday life because everything is made of chemicals, and many of the changes you observe in the world around you are caused by chemical reactions. Knowing some chemistry can help you make day to day decisions that affect your life.



Pilar Mateo Herrero, is a Valencian recognized scientist in the field of chemistry. She is listed in the top 10 most prestigious women scientists in Spain. She has focused her scientific activity on the development of high-tech products with his own polymer microencapsulation technique. She has carried out several projects to improve the quality of life of the most vulnerable communities.

He firmly believes that "Science must be at the service of society". He has focused his professional activity on the development and application of new technologies to eradicate deadly diseases that spread due to poverty. She has received numerous national and international awards, among which are: Ashoka Fellow 2011, Professional Woman of the Year 2012 (FEDEPE).

By Ángel Cano, Silvia Moreno, Eva Sánchez,
Elisabet Serer and Alba Segovia 2º ESO



A ballon to study the stratosphere

Students from Adolfo Suárez Secondary School in Paracuellos de Jarama (Madrid, Spain) have launched a balloon probe to study the stratosphere for the project ERASMUS+



A cell-based medicine developed in Spain could reduce mortality from COVID-19 by 98%

The medicine produces a generalized radiological improvement. It reduces inflammation, coagulation and tissue damage, but does not lower the lymphocyte count.



Infinitely Recyclable plastic

It is the latest innovation from a group of scientists at Berkeley Lab, USA.

In a study they have described how they have developed a new material: PDK. A plastic that can be broken down and decomposed at the molecular level. Thus creating a new plastic from it, infinitely.



Chemistry Congress Latvia, Daugavpils (DATES)



LA SALLE NEWSLETTER

Belgium



Co-funded by the
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FLUORINE

VERONIQUE GOUVERNEUR

WHO IS VERONIQUE?

Veronique was born in Geel, Belgium in 1964.
She holds a master's degree in chemistry and a doctorate from the Université catholique de Louvain.
She joined the faculty of chemistry in Oxford in 1998 and became a professor.
She chose to study fluorine.

9 18.998

F

Fluorine

[He] 2s²2p⁵

Halogens

RESEARCH

Some hydrogens in hydrocarbon molecules are replaced with fluorine to form the organofluorine molecules.

Veronique Gouverneur's research helped with the findings of new synthetic ways of making organofluorine molecules and the fluorination catalyst.

APPLICATIONS

Medicine:
Medication: Used in sleep medication, cancer medication, to fight fungi or yeasts, ...
The bond is generally metabolically stable and the fluorine atom is a bioisostere of the hydrogen atom.

Scanning: PET scans.

Refrigerant:
Used in large cooling systems. Harmful for the ozonlayer.

Catalyst:
To speed up other reactions. Fluorine is the most electronegative atom.

AWARDS

AstraZeneca:
for organic chemistry
- 2005

Royal Society of Chemistry's Bader award:
Synthetic organofluorine
- 2008

Royal Wolfson Research Merit Award:
for her work in the Oxford university
- 2013

ACS Award:
for Creative Work in Fluorine Chemistry
- 2015







3.3 Biology Congress in Belgium

Italy

**Science is
all around**

**The miracle of
life into Biology**





Erasmus+

Congress of Biology

2019-1-ES01-KA229-064155

November 2021 Belgium

An insight into living organisms



MICROORGANISMS

A micro-organism is a living organism of such dimensions that it cannot be seen with the naked eye, essentially unicellular beings belonging to the kingdoms of protists, moners and fungi; viruses and viroids are also considered micro-organisms, as they contain DNA or RNA.



PLANTS

a living organism of the kind exemplified by trees, shrubs, herbs, grasses, ferns, and mosses, typically growing in a permanent site, absorbing water and inorganic substances through its roots, and synthesizing nutrients in its leaves by photosynthesis using the green pigment chlorophyll.



ANIMALS

a living organism that feeds on organic matter, typically having specialized sense organs and nervous system and able to respond rapidly to stimuli. They have evolved independently from the unicellular eukaryotes.

Elena Cattaneo: the new Rita Levi Montalcini?

Biologist, pharmacologist and science communicator, Elena Cattaneo is the Italian woman of stem cells.

In fact, her career led her to work for many years at MIT in Boston, where she began her long journey of research into stem cells and Huntington's Korea, a neurodegenerative genetic disease.



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Spain

Why Biology is all around us?

Zaventem (Belgium) 21/ 26 of November
Marta, María, Rebeka, Aracely, Victoria and Angelica

Biology and Food

Food provides the energy, which living things need to carry out their daily life activities.

Biology and health

www.

Biology has made many contributions in this sense. Biology is also important in the development of new vaccines.

María Blasco Marhuenda

María Blasco was born in 1965 in Alicante. She is one of the most internationally renowned Spanish scientists. Throughout her scientific career

María Blasco has worked about:

- Generation of the first telomerase-expressing mouse
- Discovery of telomeric RNAs
- Demonstration that telomerase activity determines the regenerative capacity of cells.
- Discovery that telomeres rejuvenate after nuclear reprogramming
- Discovery that telomeric protein can act both as a tumour suppressor and as a factor in the prevention of ageing

Biology and climate change

Nowadays, there are many climatic phenomena that have been explained by biology.

Biology and Hygiene

Controls the elements of daily life, such as: bathing, hand washing... Furthermore, based on these considerations, products

Co-funded by the Erasmus+ Programme of the European Union

Project number 2019-1-ES01-KA229-064155_1

Belgium







SCIENCE IS ALL AROUND

CONGRES ON BIOLOGY

CHRISTINE VAN BROECKHOVEN

She is born on 9 april 1953 in Antwerp. Today she is best known for her breakthrough in the research of neurodegenerative dementia that has been recognized and awarded several times nationally and internationally. She is since 1999 a professor in molecular biology and genetics.



DEMENTIA

Dementia is an overall term for conditions and diseases that decline language, memory, problem solving and other thinking problems that affect a person's everyday activities. Alzheimer's is the most common cause of dementia.

ALZHEIMER

Alzheimer's disease is an irreversible, progressive brain disorder that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest tasks. The disease is named after Dr. Alois Alzheimer. In 1906, Dr. Alzheimer noticed changes in the brain tissue of a woman who had died of an unusual mental illness. Her symptoms included memory loss, language problems, and unpredictable behavior.

AWARDS

The American Potamkin prize in 1993 for her work on the Alzheimer genetics

In 1995 with the 5 yearly prize for her scientific oeuvre at the National Fonds for scientific research

Prize for woman in science form L'Oréal/UNESCO in 2006

the European Inventor Award for research in 2017

MetLife Award for Medical Research, USA

And a lot of other scientific prizes in Belgium





BIOLOGY AROUND US IN LATVIA

THE HUMAN AS A BIOLOGICAL SYSTEM

The human is an open biological system representing exchanges of matter, energy or information with the surrounding environment

Eyes: The visual system, which comprises the sensory organ (the eye) and parts of the central nervous system, gives the sense of sight.

Nose: Olfaction, or the sense of smell, is the special sense through which smells are perceived.

Mouth: The gustatory system, or the sense of taste, is the sensory system that is partially responsible for the perception of taste.

Muscles perform the following functions: they support the body and internal organs, enable the body to move, and protect the internal organs.

Metabolism is the process by which the body produces and expends energy (calories) for its vital functions.

Love is a strong and deep affection and aspiration for another person or object, a feeling of deep sympathy.



CELLS

IVF RIGA STEM CELL CENTRE

Umbilical cord blood stem cells, which are collected during childbirth, are securely stored in the First National Stem Cell Bank in Latvia. Nowadays umbilical cord blood stem cells are gently obtained during childbirth, and they can be used to successfully treat more than 80 different types of diseases, including some types of cancer, blood diseases and immunodeficiency.



MICROBIOLOGY & HEALTH CARE

PHARMACEUTICALS INVENTED IN LATVIA



Meldonium, a metabolic agent known in medicine as Mildronate, was developed in 1970 by Ivars Kalviņš at the Latvian Institute of Organic Synthesis, and now manufactured by the Latvian pharmaceutical company Grindeks and several generic manufacturers.

This cardioprotective drug normalizes the functioning of cells exposed to hypoxia (oxygen deficiency) or nutritional deficiency. It has a stimulating effect on the body. Mildronate improves intracellular metabolism and is often prescribed to treat heart diseases.



Rimantadine is an orally administered antiviral drug used to treat, and in rare cases prevent, influenza virus A infection. Rimantadine is 70–90% effective in preventing illness in healthy adults and, if taken within one to two days of developing symptoms, can reduce flu symptoms and shorten the duration of the illness by 1–2 days.

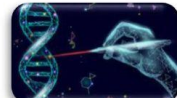
Scientists from the Academy of Sciences of Latvia were engaged in research on Rimantadine and in 1969 Janis Polis and Ilze Grava received a patent for the original method of the drug.

GENETICS

IVF RIGA GENETIC CENTRE

In 2014, the first Genetic Centre in the Baltic States and Northern Europe was opened in Latvia with a modern equipped laboratory and wide possibilities to carry out in-depth genetic examinations. Today, they keep the leading position and develop our specialization in the following fields:

- Infertility diagnostics and complicated pregnancies/miscarriages;
- Genetic testing of hereditary tumours;
- Lifestyle genetic tests Viva Genomics.



LATVIAN IMMUNOLOGIST AINA MUCENIECE

(23 March 1924 – 14 February 2010) was a Latvian immunologist, inventor of RIGVIR, who discovered that an echovirus might be a useful treatment for melanoma.

She finished school in 1941 and worked as a nurse during World War II. After the war, she studied medicine at the Latvian State University, where she earned a doctor's degree in 1974.

Muceniece's scientific career began at the Institute of Microbiology, Latvian Academy of Sciences. Muceniece's laboratory started to study enteroviruses in the 1960s, and the research led to the identification of an echovirus that had possible use to treat melanoma, which became RIGVIR.

Muceniece also worked at the Pauls Stradiņš Hospital and the National Oncology Center as an immunology consultant.

In 2002 she was made an honorary member of the Latvian Association of Oncologists. In 2005 Muceniece received the Cross of Recognition for meritorious service to the Republic of Latvia.

Before she died in 2010 at the age of 85, she published 190 papers and three monographs.





European Union Erasmus+ Programme KA219 School Exchange Partnerships project "Science Is All Around"
(SIAA) Nr. 2019-1-ES01-KA229-064155_4
Congress on Biology in Zaventem, Belgium on ...



Co-funded by the Erasmus+ Programme of the European Union



Portugal



Congress of Environmental Sciences



ALEXANDRA MONTEIRO- Environmental Investigator

19-26 March, 2022 Castelnovo ne' Monti



Academic degrees

- 2007 PhD in Science Applied to Environment, University of Aveiro, Portugal
- 2003 Master in Atmospheric pollution, University of Aveiro, Portugal
- 1996 Degree on Chemical Engineering, Faculty of Engineering of the University of Porto, Portugal





Research interests

- Air quality
- Atmospheric emissions
- Air quality modeling
- Climate change
- Air quality integrated assessment



Projects in Progress:

- FIREURISK
- SmokeStorm
- ATLACE
- EMERGE







FIREURISK:

The FEURISK project that Alexandra Monteiro is participating as a researcher will develop, evaluate and disseminate a science-based integrated strategy to expand current wildland fire risk assessment systems, produce effective measures to reduce current fire risk conditions, and adapt management strategies to expected future climate and socio-economic changes, approaching all wildfire types.

Projects concluded:

- ARTUR
- DOUROZONE
- FUTURAR
- AIRSHIP



AIRSHIP Project

Intercomparing and improving shipping emissions

3.4 Environmental Sciences Congress in Italy

Italy

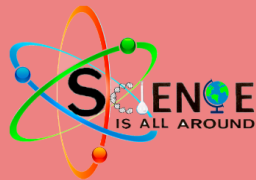
**Science is
all around**

Congress of Environmental Sciences

Man and Biosphere Reserve

 **Erasmus+**

2019-1-ES01-KA229-064155




March 2022 Italy

"Environmental scientists study subjects like the understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management, and the effects of global warming and climate change. Environmental issues almost always include an interaction of physical, chemical, and biological processes."



TWO SIDES, TWICE THE BIODIVERSITY

This orientation gives the Park two distinct climate zones and dramatic diversity. There are olive trees, holly oaks, and vineyards and early, warm springs on the southern side in Lunigiana and Garfagnana

On the border between Europe and the Mediterranean Sea The Tuscan-Emilian Apennine National Park (TEA Park) consists of a striking stretch of the Apennine Mountains surrounded by forests, in an extraordinary geographical position





ANCIENT AND PRECIOUS FARMLAND

A small scale, mountain agriculture which has reached very high quality and has created some of the highest quality products in Italy including international favorites such as Parmigiano Reggiano and Prosciutto di Parma. Both products originated in the Tuscan Emilian Apennine National Park

Mia Canestrini



Naturalist, Zoologist, Researcher and Television Host
 Born in 1982, Zoologist, she graduated in Natural Sciences and specialized in Conservation of Animal Biodiversity. Conductor for the naturalistic content of the broadcast L'Italia never finishes Rai1.
 For more than 10 years she has dedicated herself to the study of wolves between the Casentino Forest National Park and the Tuscan-Emilian Apennines National Park, where she worked as a wildlife technician on two LIFE projects for the conservation of wolves. Author of the book La ragazza dei lupi, Piemme 2019,
 She holds conferences and seminars throughout Italy.




 Co-funded by the Erasmus+ Programme of the European Union

Spain

ERASMUS + ENVIRONMENTAL SCIENCES CONGRESS

NEWS ON ENVIRONMENTAL SCIENCES



Stannah helps take care of the environment with its ECO range of refurbished solutions

Large methane emissions detected in Madrid landfills





Plastics are found in all marine habitats analyzed in Valencia and Mallorca in low season. In total, there are a dozen sites rich in biodiversity that combine different types of habitats

Global warming increases and if we don't reduce greenhouse gas emissions, it will be impossible to meet the Paris Agreement goals of limiting the temperature increase to 1.5 °C or even 2 °C





Ecological restoration is not just planting trees. In 2021, the theme chosen for World Environment Day is ecosystem restoration and it will precisely mark the beginning of the United Nations Decade on Ecosystem Restoration

How the environmental sciences act in our day to day

Environmental sciences are beginning to play a growing role in our society. UNESCO recommends that environmental education should be an irreplaceable part of the students training

Marga Gual Soler



PhD in biomedical sciences, she actively works with governments, universities and NGOs promoting science as an instrument to tackle climate change

She has worked in the United Nations investigating the role of science in sustainable development to achieve the Millennium Goals



Environmental Science Congress 21th to 25th March 2022 **Castellnovo ne' Monti, Italy**



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Erasmus+
Enriching lives, opening minds.



Latvia

**ENVIRONMENTAL SCIENCES
AROUND US IN LATVIA**



BIODIVERSITY

THE COLEOPTEROLOGICAL RESEARCH CENTRE

The Coleopterological Research Centre at Daugavpils University researches the systematics, taxonomy, morphology, fauna and biogeography of beetles (Coleoptera). Daugavpils is a mecca for flying beetles and a world-class treadmill research centre. Every year Daugavpils entomologists discover and describe several new species from different countries of the world. A beetle researcher, Professor, Dr. biol., Full Member of Latvian Academy of Sciences Arvids Barševskis was pleasantly surprised that a Spanish colleague named a newly discovered beetle species after him. Arvid Barschevskis was awarded this high honour, as he is considered the largest researcher in the field of beetle research in Eastern Europe.



A new beetle species was discovered on May 5, 2010, in the Torcal de Antequera National Park in the province of Malaga (southern Spain), at an altitude of 1,200 meters. The naming of the new species *Platyderus barsevskisi* in the name of a Latvian scientist is a great contribution to the promotion of Latvia and its scientists.

ECOLOGY

LATVIAN SCIENTIST

Ilze Dimanta, Dr. biol., a researcher at University of Latvia, Scientific and Regulatory Affairs Manager, For Women In Science programme Manager for Baltic countries, L'Oréal Poland Baltic HUB

Born: 1st September 1986, Riga

Studied: Riga Centre Language School, University of Latvia, for a long time studied in Denmark, Austria and Iceland

Languages: English and French

Scientific interests: renewable energy technologies; hydrogen energy; creation of hydrogen energy on basis of biology sources



She discovered a bacterium that can work out biological hydrogen from lactose and milk serum. It is a source of clean energy that can be used in transport and for heating.

ENVIRONMENTAL SAFETY AND SUSTAINABILITY

GETLIŅI EKO



SIA Getliņi EKO is the largest municipal solid waste landfill in the Baltic States and one of the most modern landfills in Europe; at the moment, it is created and developed as a modern and safe waste recycling centre. Since the opening of the sorting plant in the territory of SIA Getliņi EKO on 26 October 2015, biodegradable waste has been used for the production of biogas, meanwhile, materials and metal products useful for processing have been delivered to companies engaged in the recovery and recycling of these materials.

Unrecyclable waste is stored in secure, environmentally sealed biodegradation cells protected from exposure to air or rainwater. The landfill gas produced in the cells is transferred to the Getliņi power unit, then burned in six internal combustion engines and converted into energy – electricity and heat. The electricity is sold to AS Latvenergo, and the heat is used in SIA Getliņi EKO greenhouses, where Getliņi tomatoes, cucumbers and hanging flowers are grown.

All wastewater (infiltrates) is collected and cleaned, so the environmental impact of the waste is reduced to a minimum.





Getliņi is a company open to the public. The daily free excursions provided by Getliņi are visited by kindergartens, schools, company teams and groups of friends, entrepreneurs and foreign guests to participate in environmental education activities and gain some new knowledge.



European Union Erasmus+ Programme KA219 School Exchange Partnerships project “Science Is All Around” (SIAA)

Nr. 2019-1-ES01-KA229-064155_4

Congress on Environmental Sciences in Castelnovo ne’ Monti, Italy

21st to 25th March 2022



Co-funded by the Erasmus+ Programme of the European Union



Portugal




CONGRESS OF BIOLOGY

22 - 26 NOVEMBER, 2021 - ZAVENTEM, BELGIUM

ANA HILÁRIO - A PORTUGUESE BIOLOGIST







Academic Degrees:

- 2001 - completed first degree in Aquatic Sciences Institute for Biomedical Science Abel Salazar, University of Porto, Portugal.
- 2005 - completed a PhD in Ocean and Earth Science National Oceanography Centre, University of Southampton, UK.



Present position: Biologist of the Centre for Environmental and Marine Studies

Recent projects:

- Challenger 150
- Horizon 2020

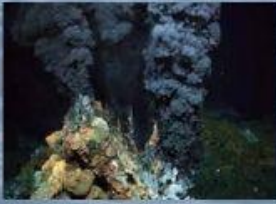


Polychaete

Research interests: Ecology of deep-sea ecosystems; Life-story traits and reproductive ecology of deep-sea invertebrates; Population connectivity in deep-sea ecosystems and its implications for biogeography and conservation; Evolution, phylogeny and taxonomy of deep-sea invertebrates, in particular polychaetes of the family Siboglinidae.

Participation in scientific networks:

- INDEEP: International network for scientific investigation of deep-sea ecosystems
- DOSI: Deep-Ocean Stewardship Initiative

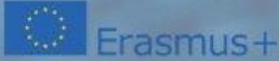


Hydrothermal vents

The Challenger 150 program that Ana Hilário and Kerry Howell began to develop, wants to find out what we do not yet know about the deep sea, that is, the area between 200 and 11,000 meters below the surface of the ocean. One of the great objectives of Challenger 150 is the empowerment and increase of diversity within the scientific community.




"Challenger 150"-
coordinated by Ana Hilário and another biologist.




Belgium



Virginie Pierre

Prices

- the Yves Rocher Foundation.
- First Prize (Ex Aequo) Terre De Femmes Awards Yves Rocher 2021 with 'Cueilleuses de Miel'.

Who is Virginie?

She is born in Luik, Belgium, and is a real businesswoman. She works with bees over the whole world. She wants to show beekeepers that you can grow honey without the use of fire or harmful chemicals.

Application

The locals use it for treatments, balms, elixirs, propolis and honey...

Co-funded by the
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of the European Union

3.5 Physics Congress in Spain

Spain

Escuela Profesional La Salle

WATER'S SURFACE TENSION

Physics Congress 6th to 10th April 2022 **Paterna (Valencia) Spain**

WHAT IS IT?

The surface tension is the property of the surface of a liquid that allows it to resist an external force. The stronger the links between molecules are the bigger is the surface tension. And can be calculated with this formula: $\gamma = F/l$ (N/m). The surface tension force (F) is proportional to the water's sheet outline and not to the sheet surface.

GOALS

With this project we try to visualise the surface tension that exists between water's molecules and how it changes if we modify the liquid or the material we attach to the surface of it.

- Calculate in an experimental and approximate the surface tension of the water, the ethyl alcohol (maybe olive oil too).
- Compare both pieces of information between them, with the bibliography and deduce conclusions.
- Verify experimentally how the active tensions (like detergent) affect the surface tension.

M^a DEL CARMEN MUÑOZ ROCA

She is a researcher at the Center of Physical Technologies and deputy director of the Applied Physics Department at the UPV. Her mainly research activities focuses on the correlation structure- magnetic and photo-changeable metal organic molecular materials that are a source of first-order phase transitions.

PROCEDURES

To show this, we built a weighing scale with plastic plates in both ends. We will put one of them in contact with the water, this one will stick due to the surface tension. On the other side, we will add one gram masses until the force of them is capable to drop the stucked plate.

RESULTS

We will try to calculate that the surface tension of water is $\gamma = 72 \cdot 10^{-3} \text{ N/m}$ at 293 K, so a force of $72 \cdot 10^{-3} \text{ N}$ would be necessary to break a film of water with a perimeter of 1 m. But if we use surfactants (we find them above all in detergents), we will calculate that the necessary force will be less, since the detergent causes the surface tension to decrease and the slide to be separated more easily. We will qualitatively compare the differences with the surface tension of alcohol and olive oil.

CONCLUSIONS

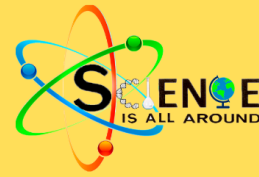
Finally, we learn that this curious force that water has, even though we can't see it, maintains a material on top of itself without the necessity of effort, because of the polarity and the molecules' union doesn't allow it passage. Because of this, every time we see an insect walking on water we will remember this physics elements. We also see the soap's action on the water's surface tension just like that every liquid has their own surface tension

VERA AGUSTI, MIGUEL LUJÁN AND MERITXELL VALLS

**Science is
all around**

Congress of Physics

**"Measure what can be
measured, and make
measurable what cannot be
measured."**



Erasmus+

2019-1-ES01-KA229-064155

April 2022 Spain

The centre of gravity of the bodies

We intend to make the relationship between the body and the position of its centre of gravity identifiable. It is known that a suspended or leaned body is in stable equilibrium if and only if the position of its centre of gravity is vertically aligned with the position of the point of attachment or once its minimum possible height has been reached

The aim is to prove the above theories by means of devices and/or systems made using commonly used materials (cardboard, toothpicks, cork stoppers, glue, forks, wood, small metal objects).

Below are the photos reproducing some of the demonstration prototypes.



A body is in stable equilibrium if, by shifting it slightly from its equilibrium position, it naturally tends to return to it. In fact, when all the forces acting on a body cancel each other out, the body is in equilibrium. To understand how the balance of a body works it is necessary to know its weight and its point of application, where the weight of a body indicates the force with which the body is pushed down (force of gravity).

Each prototype will return to its original stable equilibrium conditions and will continue there until an external condition (external force) acts again which will change the equilibrium of the prototype and its position. Therefore, some prototypes will oscillate in search of the equilibrium position, others will rotate until they reach it.

The principle that regulates the centre of gravity of the body finds considerable applications in the field of technology, everything that is made by man has a centre of gravity: for example, the comfort with which you hold a smartphone is simulated by carefully evaluating the position of its centre of gravity, its vibration system works thanks to the rapid movement of an eccentric mass in the centre of gravity.

Gabriella Greison: the rockstar of Physics

Gabriella Greison, 47 years old, Genoese of Scottish origin, graduated in Nuclear Physics from the University of Milan, two years working in Paris at the École Polytechnique, has made the dissemination of quantum physics her mission, discovering her vocation as a writer, as well as a teacher. She has written 9 books, the result of studies and comparisons with other scholars. Her latest effort is "Quantum Guide for Nonconformists. A journey into physics that Newton would not approve of."



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IIS
Nelson Mandela

Belgium

SOUND WAVES AND THE TUNING OF INSTRUMENTS

Tuning: the experiment ! – What do we need?



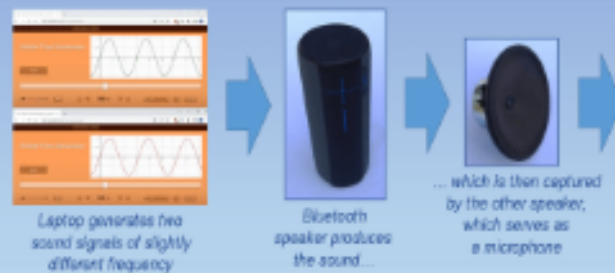
Periodic movement

- Waves
- Sound
- Longitudinal
- Mechanical

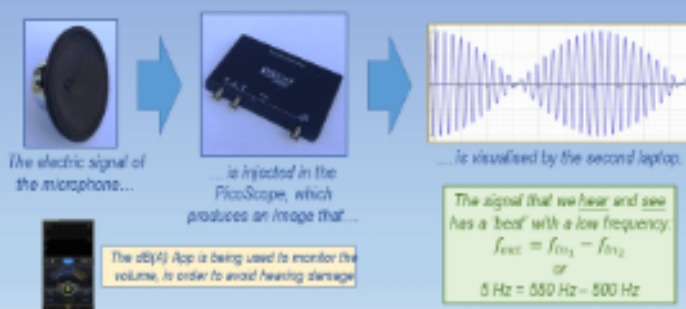
Hearing Sound

- Pressure wave
- Eardrums
- Signal to brain
- Interpretation

Setup of the experiment



Setup of the experiment



Instruments are "in tune" when the beat becomes zero.



PHYSICS AROUND US IN LATVIA

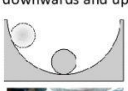
CENTRE OF GRAVITY AND POTENTIAL ENERGY



In what direction is the water flowing? Of course, from top to bottom. This is understandable even to the smallest child. It is known that in a lot of regions excursion buses take tourists to mountainous regions where guides, using the features of the relief, demonstrate how the water poured out of a bottle “flows” uphill. Does this mean that water can flow both downwards and upwards? There is a problem that needs to be explained.



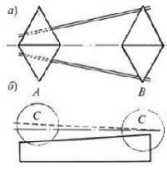
Why does the ball roll down the mountain? What makes it move this way and not otherwise? Consider the movement of a cylinder from an improvised slide. It also rolls off of it. Does this mean that the motion of all other bodies will be the same?



Let's try to put a double cone on the improvised slide. And it starts moving up! Did a miracle happen?



To explain this experiment, let us turn to the figure, which shows a top view (a) and a side view (b) of this experiment. The thing is that the guides along which the cone rolls are located at a certain angle to each other. Therefore, in the “lower” position A, the cone rests on them near its middle, and in the “upper” position B, with its ends. The slope of the guides concerning the horizontal surface of the table is chosen in such a way that the centre of gravity of the cone C in position A is higher than in position B. Then the cone, moving as if “from bottom to top”, actually rolls down from top to bottom, under the laws of classical mechanics.



Any body always tends to take such a position that the centre of gravity of the body takes the lowest position. In this case, the energy of the body will be minimal.



Thus, it has been proven that tourists are misled by guides who do not know physics very well. Water poured from a bottle does not flow uphill, but downhill. Tourists are shown an illusion (visual effect). All bodies tend to take a position in which their energy will be minimal. Therefore, in this case, the smallest potential energy will correspond to the lowest location of the centre of gravity of the body.

Why does not a roly-poly toy fall when pushed?



The centre of mass of a tilting doll is located in its weighted spherical base. When a tumbler is tilted, the height of the centre of mass relative to the support increases, as a result of which a weighted doll tends to take its original position.

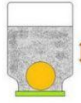


ARCHIMEDES' PRINCIPLE IN BULK SOLIDS AND INERTIA



It is known that stones “crawl out” to the surface of the earth and every year agricultural workers have to remove them before ploughing. There is a problem that can be explained by applying the concept of Archimedes' principle. If you put a tennis ball in a jar, fill it with sand, and create a slight vibration (lightly shake the jar up and down), then the friction force between the grains of sand will decrease, they will become mobile and the ball will float to the surface after some time under the action of the physical law of buoyancy, discovered by Archimedes.

Robert Hooke, a famous contemporary and compatriot of Newton, wrote about experiments of this kind: “You cannot bury a light body in the sand (subject to frequent shaking), for example, a piece of cork: it will immediately “float” to the surface of the sand; on the contrary, a heavy body immediately digs into it and falls to the bottom of the vessel.”



If you pour sand into a plastic bottle together with metal and plastic balls, place the bottle horizontally and move the bottle in a horizontal direction from side to side, then the metal balls will sink in the sand, and the plastic balls will float to the surface. This happens because the density of the metal is greater than the density of sand, and the plastic is less than the density of sand, that is, in full accordance with the conditions for floating bodies.



Then how do the stones “crawl out” to the surface of the earth? The buoyant force cannot lift them! We put a large metal ball on the bottom of the bottle and fill it with sand on top. With a sharp movement, we move the bottle down, the ball appears on the surface. If it does not work once, repeat it several times. As a result, a more inert body - the ball - changes speed slowly, but the sand does it much faster. Therefore, the ball, as it were, remains in place, and the sand moves down. This is how inertia manifests itself.



LATVIAN PHYSICIST ELZA KRAULIŅA



Elza Krauliņa (1920 - 2002) was a Latvian scientist, the first physicist in Latvia to defend her doctoral dissertation in physics, the first female doctor of optics in the Baltic States, and Dean of the Faculty of Mathematics, initiator, and head of the Laboratory of Spectroscopy Problems.

From early childhood, Elza was interested in science. At school, she was interested in math, chemistry, physics, as well as poetry, and literature. She entered the Faculty of Mathematics and Natural Sciences of the University of Latvia in 1939 to study physics, but in June 1941 the war stopped her studies. During World War II she worked in the editorial office of newspapers as the executive secretary. She graduated from the University of Latvia in 1947. From 1949 to 1952 she studied postgraduate studies at the St. Petersburg State University, where in 1954 she defended her dissertation on the role of the second type of collisions in the fluorescence of mercury and sodium vapour.

After returning to Latvia, Elza continued her research in spectroscopy. In her dissertation, she studied the spectral lines of sodium, which were in the visible part of the spectrum. The idea was also to study areas of the ultraviolet spectrum. She organized the Laboratory of Spectroscopy Problems at the University of Latvia. In 1971, she managed a large contract with the Latvian Ministry of Health for the construction of a scanning spectrophotometer to study the cells. In 1978, she actively participated in the organization of an international conference on nuclear physics in Riga. In 1979, she resigned from the position of the head of the laboratory and continued to work as a scientific consultant. For more than 30 years, Elza Krauliņa chaired the Scientific Council of Spectroscopy (since 1958) at the Latvian Academy of Sciences. Once a month, lectures were organized for factory laboratory staff on the latest developments in spectral analysis in 32 factories of the Republic.

Professor E. Krauliņa is the author of more than 100 scientific publications, and was the editor of 15 collections of scientific articles. She participated with reports in many international conferences, earned true respect and authority at the university, and was well known in the society of foreign physicists.





European Union Erasmus+ Programme KA219 School Exchange Partnerships project
“Science Is All Around” (SIAA) Nr. 2019-1-ES01-KA229-064155_4
Congress on Physics in Paterna, Spain from 5 to 10 April 2022



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2019-1-ES01-KA229-064155_4

Chapter 4: Laboratory Practices

4.1 Geology

4.1.1 Portuguese laboratory protocol

Crustal Deformation Processes: Folding and Faulting

Students used several crustal models to predict Folding and Faulting.



4.1.2 Latvian laboratory protocol

Karst Processes

Experimental procedure:

1. Take a piece of paper and make a tube from it.
2. Put the paper tube into a box.
3. Fill the paper tube with soda (which substitutes limestone) and the box with sand.



4. Put a piece of chalk near the paper tube.
5. Pour vinegar on the soda in the paper tube and on the piece of chalk.



6. Watch the formation of a sinkhole.

7. Put the paper tube away and observe the collapse of the sand.



Expected results:

As you see, there is the chemical dissolution of carbonate rock (soda). The surface layer can stand for a short time, but if the sand collapses (because there is no longer support from the rock), a sinkhole forms.

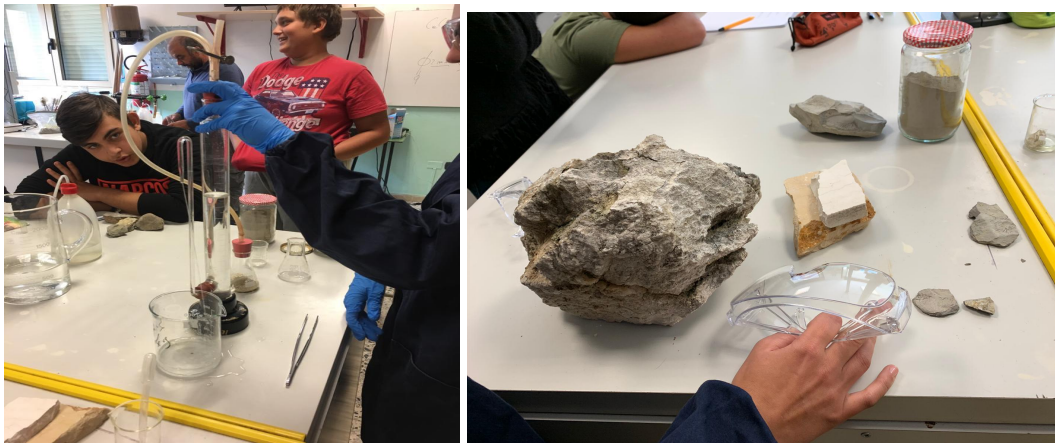
Limestone (a piece of chalk) does not dissolve very quickly, as it takes a lot of time.

4.1.3 Italian laboratory protocol

Determination of total limestone (total calcium and magnesium carbonate) in soil

Experimental procedure:

1. Weigh 1 gram of fine soil
2. Fill the lime meter cylinder with H₂O, taking care to eliminate any air present and to position the beaker intended to collect the exhaust H₂O
3. Introduce fine soil into the flask
4. Take 2 ml of HCl with the pipette and place it in the small tube attached to the calcimeter itself.
5. Place the test tube in the flask, taking care not to spill HCl.
6. Connect the flask to the calcimeter by means of the appropriate ducts and plugs, taking care to bleed the air from the circuit.
7. After hermetically sealing the calcimeter, shake the Erlenmeyer flask causing the reaction between the HCl contained in the tube and the soil.
8. The HCl reacting with the calcium and magnesium carbonates present in the soil sample produces the formation of gaseous CO₂ that exerts a pressure on the H₂O column of the central cylinder of the calcium meter.
9. CO₂ pressure causes water to escape through the drain pipe.
10. Reading on the graduated scale present in the cylinder of the calcium meter, the total percentage of calcium and magnesium carbonates present in the soil sample is obtained.



Expected results:

Calcium carbonate influences phosphoric nutrition by insolubilising phosphorus, and the higher its content in the soil, the lower the pH must be for better plant nutrition.

4.1.4 Spanish laboratory protocol

Practice Crystallization

Introduction:

Crystallization is the simplest and most effective technique for purifying solid compounds. It consists of dissolving an impure solid in the smallest possible amount of the appropriate solvent and heat. Under these conditions, a saturated solution is generated which, on cooling, becomes supersaturated and crystallization occurs. The crystallization process is a dynamic process, so that the molecules that are in solution are in equilibrium with those that are part of the crystal lattice. The high degree of arrangement of a crystal lattice excludes the participation of impurities in it. Therefore, it is desirable that the cooling process take place slowly so that crystals form slowly and the slow growth of the crystal lattice excludes impurities. If the cooling of the solution is very fast, the impurities can be trapped in the crystal lattice.

Objective:

Obtain crystals of ADP (ammonium dihydrogen phosphate), also called monoammonium phosphate (MAP).

ADP is highly soluble in water and crystallizes in the tetragonal system, forming square-based prisms terminated in pyramids.

Materials used

Commercial crystallizers ¹ ,	Beaker
Bunsen burner	Rod
Scales	Thermometer
Spatula	Tripod
Pipette	Rack
Petri dishes	

1 along with other ones (containers where the temperature of the solution remains stable for as long as possible)

Process

Step 1:

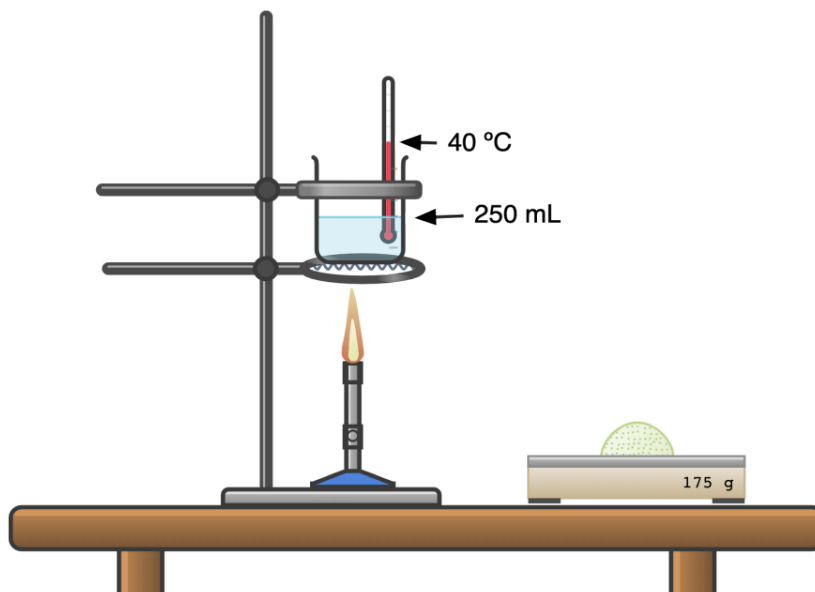
Make an assembly like the one in the image, using a tripod, a grid and a heating plate



Step 2:

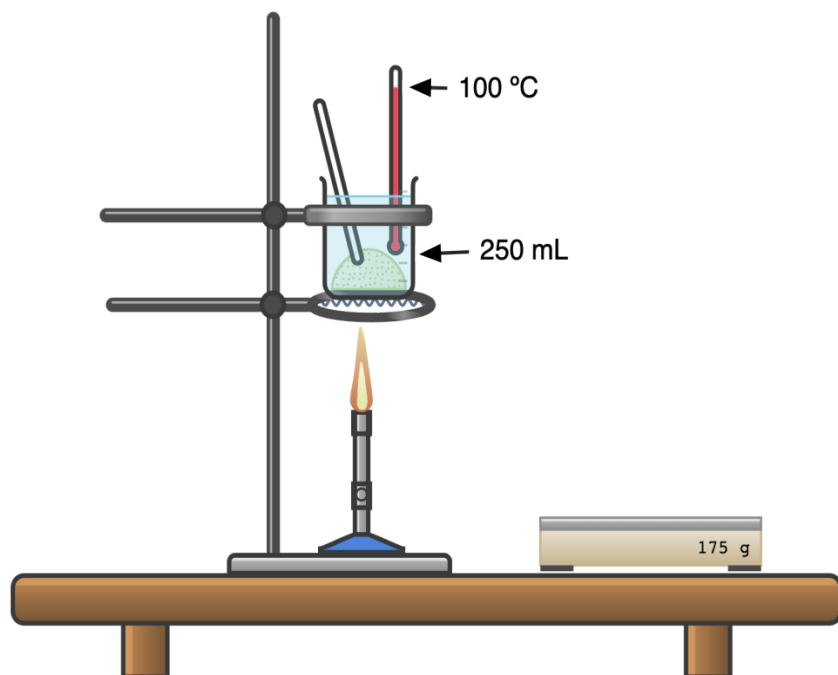
In a cylinder, measure 250ml of distilled water and placed it in a 500 ml beaker.

Weigh 175 g of ADP.



Step 3:

Heat the water in the baker to about 40-60 °C. The ADP should be added once the water is hot, stirring constantly the rod Heat



Step 4:

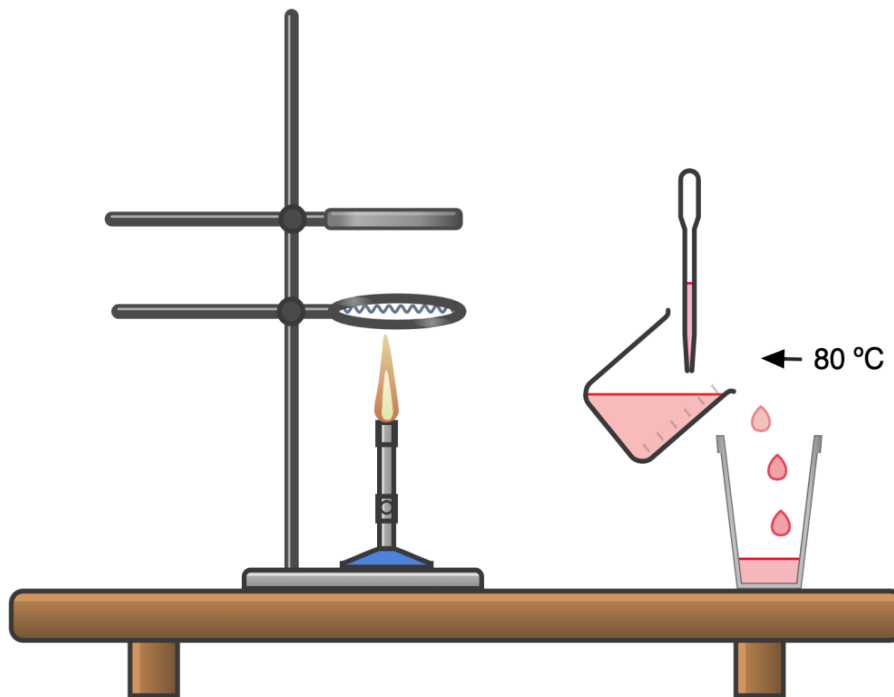
Add the food colour and stir with the rod

Step 5:

Wait until the temperature reaches 80°-90°C so that all the ADP dissolves.

Step 6:

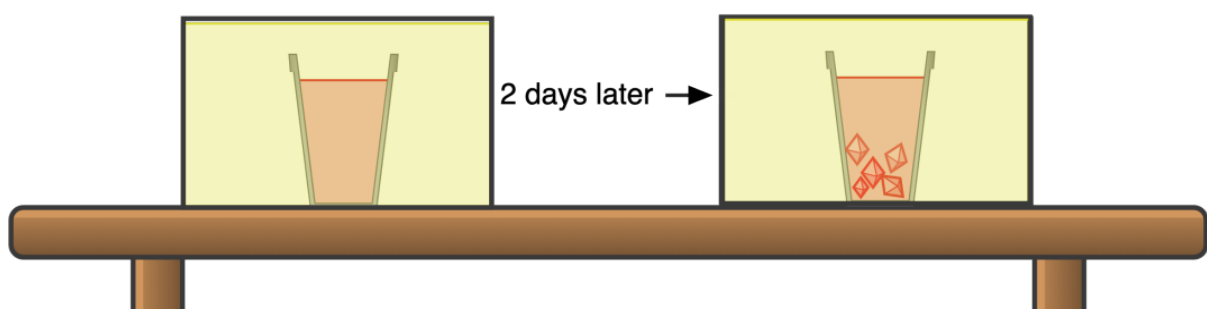
Subsequently, place the solution in a plastic container with a lid and put it into the crystallizer.



Step 7:

Finally, leave the crystallizer in a place where nobody can disturb it (if not the whole process is destabilized).

After 2-3 days when you remove the excess liquid you will find a beautiful crystal.



Calculations

Weight 70gr of ADP for every 100 ml of distilled water.

70gr-----100ml

x gr-----250

x = 175gr of ADP

Results

Different coloured crystals



Questions

1. What does the success of the experiment depend on? On the crystallization temperature
2. What is the supersaturated zone? The one where the ADP begins to crystallize

Conclusions

For nucleation to begin, it is necessary to reach the so-called supersaturated zone. This zone is reached by increasing the temperature as the solubility of ADP increases.

Personal comments

In this practice, crystallized ADP and water can be recycled.

4.1.5 Belgian laboratory protocol

The influence of acid rain on Limburg marl



Introduction:

Limburg marl is a type of chalkstone, indigenous to Dutch and Belgian Limburg. Geologically speaking it is not marl per sé. Most marl is a combination of chalk and clay whereas Limburg marl is about 98% carbonated chalk and 2% other materials. Its name comes from the latin 'marga' under which Romans categorized all non-hardened lime sediments.

Limburg marl is often used by sculptors and was once a favorite stone in building. The stone is rather soft but under the right circumstances it can be strong. However, modern technology (cars, etc) have proven to be a challenge for buildings made up out of Limburg marl.

Hypothesis:

Limburg marl will suffer decay under the influence of acid rain.

Procedure and safety:

Necessary equipment:

- 2 pieces of Limburg marl
- safety goggles
- 2 measuring cups
- ½ liter of acid rain
- ½ liter of normal water



Steps:

1. fill out both measuring cups with either acid rain and one with normal water
2. make a similar mark on both pieces of Limburg marl
3. place both pieces in said measuring cups
4. make sure both are submerged to the same degree
5. time the exposure
6. remove both pieces and compare the pieces to see if any decay is visible



Outcome:

An unexpected outcome occurred when the acid rain was absorbed into the piece of Limburg marl while the normal water was not. Since both pieces were from the same slab of Limburg marl we were not able to provide a sufficient explanation for this occurrence.

4.2 Chemistry

4.2.1 Latvian laboratory protocol

Glow stick reaction

<https://youtu.be/0f25hjsv5-l>

Experimental procedure:

- 1) Add TCPO powder to the test tube with a screw cap.
- 2) Add dye, followed by sodium acetate and ethyl acetate.
- 3) Close test tube with a screw cap and shake it gently for a few seconds.
- 4) Add hydrogen peroxide solution to the mixture, close test tube and shake it again.

Precautions:

Hydrogen peroxide is corrosive and can cause skin burns. Ethyl acetate is moderately toxic and can be absorbed through the skin and respiratory organs. TCPO can irritate skin and eyes.

Use all safety equipment (lab goggles, protective gloves, lab coats).

Expected results:

Participants have learned how to recreate reactions used in glow sticks and know general mechanisms according to which the reaction proceeds.

Resources:

<https://www.goldbio.com/articles/article/the-science-and-history-of-glow-sticks>

<https://www.thoughtco.com/how-do-lightsticks-work-607878>

https://www.youtube.com/watch?v=w_CYwd6cHUA

4.2.2 Portuguese laboratory protocol

Flame test

Introduction:

Just as a fingerprint is unique to each person, the color light emitted by metals heated in a flame is unique to each metal. When atoms of elements are heated or electrified, some give off visible colored light. For example, the familiar red glow of a neon sign is caused by neon atoms excited by electricity. Fireworks displays of bright lavender, red, green and yellow are the result of excited metal atoms. In fact, the kind of color given off by each atom is so exact that it can be used to identify that atom. You will test various metal salt solutions in a hot flame to learn the expected color given off by each excited atom.

Atoms have two kinds of states; a ground state and an excited state. The ground state is the state in which the electrons in the atom are in their lowest energy levels (orbitals) possible. Atoms naturally are in the ground state, so electrons need a source of energy to jump up to a higher energy level. In the ground state, electrons have the lowest possible values for "n" the principal quantum number.

Specific quantized amounts of energy are needed to excite an electron in an atom and produce an excited state. The excited electron is still "in" the atom even in an excited state. The valence electron will only escape the atom if the electron is given an amount of energy equal to the ionization energy for that atom.

When an element is burned, the electrons will be excited. Then as these electrons fall back from one energy level to another, they release energy and will emit photons of light. These photons will have different colors depending on the element and its discrete energy levels. That is, different wavelengths of light (colors) will be emitted when the electrons of different elements go down the step(s) between their energy level(s). Each element will have its own set of steps, therefore each will have its own color or set of colors.

Objective:

Small amounts of different salts are burned in the flame of a Bunsen burner. The characteristic color associated with each metallic ion will be observed and used to identify an unknown salt mixture.

Materials used:

Various elemental salts - 1g

Beaker

Bunsen Burner or Lamp Alcohol Burner

Water

Nichrome Wire or paper clip

8 little Beakers or Watch Glasses (to contain 1 g)

BaCl ₂	Barium Chloride	KCl	Potassium Chloride
CaCl ₂	Calcium Chloride	NaCl	Sodium Chloride
CuCl ₂	Copper (II) Chloride	SrCl ₂	Strontium Chloride
LiCl	Lithium Chloride	Unknown	<i>mix</i>

Safety: Do not touch any of the solid chemicals

Process

1. Dip the nichrome wire (or paper clip) into the water and then hold it in the flame until red hot.
2. Dip the nichrome wire into the water again and then take the wire and scrape one of the element salts onto the wire. You will test only one salt at a time.
3. Place the wire into the Bunsen burner flame and observe.

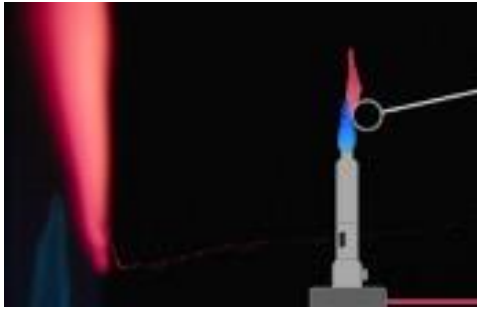
4. Repeat steps 1-3 once again for other salts.
5. Record your observation onto your data table: Flame color

Results

Fill in the data table below.

Data Table:

sample	Name of solid/ salt	Metal symbol	Color of Flame
A	Barium Chloride		<i>yellow</i>
B	Calcium Chloride		<i>Orange red</i>
C	Copper (II) Chloride		<i>Blue green</i>
D	Lithium Chloride		<i>Deep cherry red</i>
E	Potassium Chloride		<i>Purple pink</i>
F	Sodium Chloride		<i>Bright orange</i>
G	Strontium Chloride		<i>Red orange</i>
H	Unknown		<i>Blue green, yellow & red orange</i>



4.2.3 Italian laboratory protocol

Determination of titratable acidity in milk

Experimental procedure:

1. Comply with safety measures.
2. Shake the milk sample to homogenize it.
3. Take 50 ml of milk, with pipette and pro pipette.
4. Place the milk sample in a beaker with a capacity of 100 ml.
5. Add 1 ml of phenolphthalein.
6. Titrate drop by drop, keeping the milk stirring, with NaOH until the milk turns a persistent pale pink for 15 to 20 seconds.

Expected results:

The milliliters of NaOH used represent the titratable acidity value of the milk expressed in °SH50

The normal value of titratable acidity in milk in °SH 50 is around 3. 5; with such, the milk is suitable for consumption and cheese making.

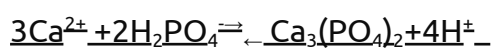
Values below 3. 2 are an indication of disease in the cow (mastitis), milk unsuitable for consumption and cheesemaking.

Values greater than 3. 7 may indicate colostrum or soured milk (e. g. , a sour milk). for poor preservation). Milk unfit for consumption and cheesemaking.

Multiplying by 2 the value obtained we obtain the °SH degrees referred to 100 ml.

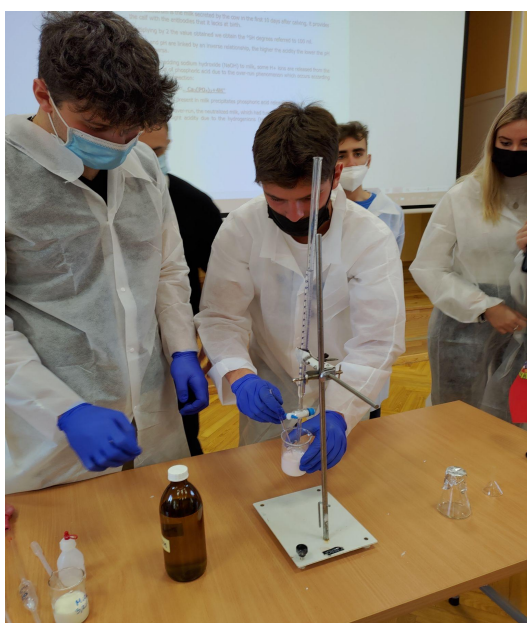
Acidity and pH are linked by an inverse relationship, the higher the acidity the lower the pH and vice versa.

Remark: by adding sodium hydroxide (NaOH) to milk, some H⁺ ions are released from the third function of phosphoric acid due to the over-run phenomenon which occurs according to the following reaction:



Calcium (Ca²⁺) present in milk precipitates phosphoric acid releasing H⁺ ions.

Because of the over-run, the neutralized milk, which had turned pink, slowly returns to white and a very slight acidity due to the hydrogenions (H⁺ ions) released by the previous reaction.



4.2.4 Spanish laboratory protocol

Making glue

Introduction

Chemistry has always used food to obtain other substances to improve our lives. For example, substances like sea salt, steel and glucose, or medicinal products such as food supplements and other products based on natural products to prevent hair loss (aloe vera, almond oil, etc.) or against insomnia (valerian, melatonin, camomile and different vitamins).

Chemistry is essential for life.

Knowing that plastics are organic materials produced from raw materials such as cellulose, carbon, etc., we think that, just as some resins from some trees are used as glue, we can state our hypothesis.

Hypothesis

We believe you could also get glue from a milk protein, called casein, because the solid particles are so small and they do not sediment and remain in suspension. These particles are called micelles; they are precipitate when they come into contact with an acid such as vinegar.

Objective

We will separate the casein from the milk and make a white glue.

3.MATERIALS USED

- Beaker 250 ml
- Glass agitator
- Funnel and filter paper
- Graduated cylinder

4.PRODUCTS USED

- Skimmed milk
- Vinegar
- Sodium bicarbonate

Process

Step 1: Put 125 ml of milk into the 250 ml beaker.



Step 2: Add 25 ml of vinegar (acid solution)



Step 3: Heat the mix slowly and shake it often until it starts to form small lumps



Step 4: Stop the heating and continue shaking until more lumps appear

Step 5: Wait for the lumps to seat themselves

Step 6: Filter by gravity



Step 7: Gently press the filter paper to drain the liquid

Step 8: Return the solid material to the empty beaker



Step 9: Add 30 mL of water and shake

Step 10: Add ½ teaspoon of baking soda to neutralize the excess vinegar. Note the gas bubbles that appear. If necessary, add more bicarbonate until no more bubbles form.

Results

Milk protein coagulates due to the effect of acidity and heating. The casein is presented in the form of lumps or precipitate.

The excess vinegar is neutralised by the action of the sodium bicarbonate, producing carbon dioxide bubbles



Questions

1. What is a plastic? It is an organic material produced with natural products.
2. What is the function of vinegar? Vinegar causes proteins, called caseins, to stick together, turning into little balls, called clumps.

Conclusions

Thanks to this practice we can demonstrate that it is possible to separate the casein from the milk to get a homemade glue, as we suggest in the hypothesis.

Personal comments

It is possible to manufacture plastics that are not petrochemical and thus avoid environmental damage.

References

This practice and experiment are taken from:
https://servicios.educarm.es/templates/portal/images/ficheros/etapasEducativas/secundaria/5/secciones/513/contenidos/10263/experimentos_de_quimica.pdf

(Pages 51, 52, 53 Experiment 16)

Photo 1: <https://www.youtube.com/watch?v=vAkLAe5jOw4>

Photo2: <http://206a1-danielitzaes-tenorio-gutierrez.blogspot.com/2011/05/pegamento-con-leche.html>

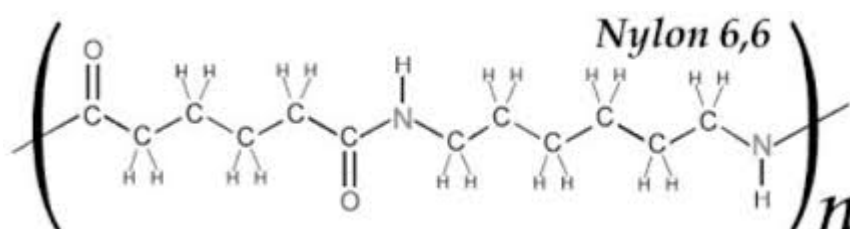
Photo 3: <https://www.youtube.com/watch?v=PQTdNDzcYow>

4.2.5 Belgian laboratory protocol

Introduction

We will focus on Nylon, a very strong polymer with exceptional flexibility and very strong strength against stretching, which is why it is widely used in cords, threads and especially in the textile industry.

This is a nylon monomer:



Research question

How long can you make the nylon wire with a given amount of chemical products?

Hypothesis

Nylon is a polymer. It means that the wire you are going to make is a sequence of identical molecules called monomers. You will need 2 or more materials to have a chemical reaction. After you combine those materials, you will have precipitation. If you grab the precipitation with tongs and you pull it out of the erlenmeyer flask, you will have a nylon wire.

Requirements

- 1,6- diaminohexane
- water
- sebacoylchloride (Instead of decanedioyl dichloride (sebacoyl chloride) one can also use hexanedioyl dichloride (adipoyl chloride), this gives you nylon-6,6 instead of nylon-6,10.)
- heptane
- sodium hydroxide
- graduated cylinders
- measuring cup
- tweezers

Safety

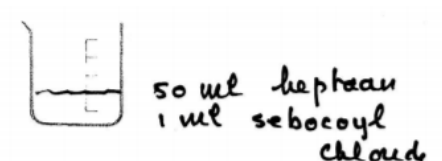
1,6- diaminohexane	Hazard	302: Harmful when you swallow it 312: Harmful after contact with your skin 314: Causes serious burning wounds and eye injuries 335: May cause irritation of the airway
	Precaution	280.1+3: Wear protective clothing 301+330+331: After swallow → rinse your mouth. Do not induce vomiting.

		302+352: After contact with your skin, wash with a lot of water and soap 305+351+338: After contact with your eyes, keep rinsing for a few minutes. Remove contact lenses, if possible. Keep rinsing
sebacoylchloride	Hazard	302: Harmful when you swallow it 314: Causes serious burning wounds and eye injuries
	Precaution	280.1+3: Wear protective clothing 301+330+331: After swallow → rinse your mouth. Do not induce vomiting. 305+351+338: After contact with your eyes, keep rinsing for a few minutes. Remove contact lenses, if possible. Keep rinsing
heptane	Hazard	225: Highly flammable liquid and vapor 304: May be fatal if swallowed and enters airways 315: Causes skin irritation. 336: May cause drowsiness or dizziness. 410: Very toxic to aquatic life with long lasting effects.
	Precaution	210: Keep away from heat / sparks / open flames / hot surfaces and other ignition sources. - Do not smoke. 273: Avoid release into the environment. 301+310: IF SWALLOWED: "→ Immediately call a poison control center or a doctor 331: DO NOT induce vomiting 302+352: IF ON SKIN: Wash with plenty of soap and water. 403+235: Keep in a well-ventilated place. Keep

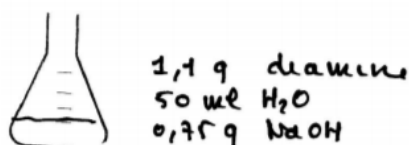
		cool.
sodium hydroxide	Hazard	314: Causes serious burning wounds and eye injuries
	Precaution	280.1+3: Wear protective clothing 301+330+331: After swallow → rinse your mouth. Do not induce vomiting. 305+351+338: After contact with your eyes, keep rinsing for a few minutes. Remove contact lenses, if possible. Keep rinsing

Method

1. Place 50 ml of heptane in a small beaker and dissolve 1 ml of sebacyl chloride in it

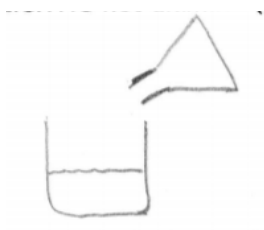


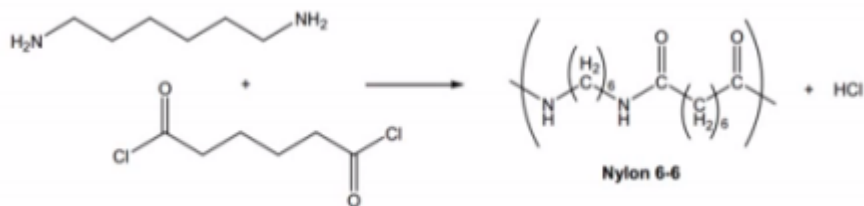
2. Place 50 ml of water in an erlenmeyer flask and add 0.75 g of sodium hydroxide and 1.1 g of diamine



3. Carefully add the contents of the Erlenmeyer flask to the beaker

Pay attention: wear gloves as this substance is corrosive





We see that HCl gas is formed by cleavage of Cl at the sebacoylchloride and H with 1,6-hexanediamine. The NH group of 1,6-hexanediamine then joins one bond to the C = O bond of sebacoylchloride. This creates the peptide bonds.

4.3 Biology

4.3.1 Italian laboratory protocol

Photosynthesis and observation of vegetal tissues

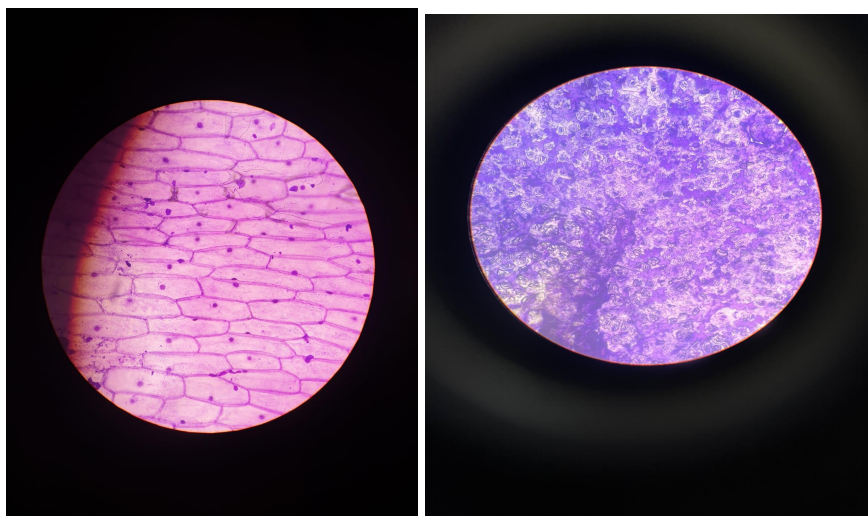
Experimental procedure:

1. Pour some water into the beaker and add a few drops of gentian violet (the solution must not be too colored) and mix
2. Cut the onion and leaf through the bulb, take a fragment of the film present on the inside of the leaves of the bulb.
3. Place the sample on the slide and add a drop of solution taken from a small beaker, cover with the coverslip and press lightly with absorbent paper
4. Place the slide on the microscope slide and observe starting from the lower magnification and then moving on to the higher ones

Expected results:

The cell wall made up of cellulose is observed. Cellulose is a complex glucose polymer with a structural function in plants.

The cell nucleus is observed: it contains the genetic material (DNA and RNA) of the species (and variety).



4.3.2 Spanish laboratory protocol

Introduction

Biology is the science which studies all living beings and their vital processes; it is of great importance since from it we can understand what happens with living organisms, from bacteria to larger organisms.

Yeasts are single-celled, microscopic fungi. They feed on sugars from which they obtain energy in a process called fermentation. Fermentation takes place without the presence of gaseous oxygen.

In this experiment, the results of alcoholic fermentation carried out by yeasts will be verified. As a result of this process, carbon dioxide and ethanol are released, products that are used in the production of bread and alcoholic beverages, such as wine and beer.

Objective

Check that biological yeast consists of live microorganisms with a metabolism.

Our hypothesis is that in very hot water the yeast, a living microorganism, will die and will not carry out fermentation

Materials

- Beaker
- Plastic bags
- Spatula

Products

- Yeast
- Water
- Sugar

Process

Step 1: Put 125 ml of water into the 250 ml beaker and prepare:

-25 ml of cold water with ice, more or less 4 or 5 degrees centigrade.

-25 ml of warm water at about 35-45 degrees, more or less

-25 ml of hot water, more or less 65-75 degrees

Step 2: Add 2 gr of sugar to each beaker containing water

Step 3: The yeast is then added and, with the help of the spatula, it dissolves,



Step 4: Next, the yeast mixture is placed in three plastic bags and they are tightly tied, taking care not to leave any air inside the bags.



Step 5: Wait about five minutes, and we can observe how carbon dioxide begins to accumulate in the bags.

Results

In the first bag we observe some foam produced by carbon dioxide, although the reaction is slower.

In the second bag, after a few minutes, a large amount of foam is produced by the carbon dioxide

In the third bag, with very hot water , the yeasts die and for that reason no carbon dioxide is produced



Questions

1. What is fermentation? A biochemical process by which an organic substance is transformed into another, by the action of a ferment.
2. What is the function of the plastic bag? By closing the plastic bag without leaving air, we allow the yeast to begin to ferment.
3. What does yeast use for energy? Due to the lack of oxygen it uses the sugar to produce energy.
4. What products are produced in yeast fermentation? Carbon dioxide

Conclusion

Thanks to this practice we can demonstrate that yeast is a living being. If this were a simple chemical reaction, the beaker of hot water should show the same results,

even faster. However, since the hot water has killed the yeast, the dead microorganisms fall to the bottom.

Our hypothesis was correct.

9. PERSONAL COMMENTS

Yeast is not a chemical product, but is made up of single-celled microorganisms. If they have enough food and a comfortable room temperature they will produce the gas bubbles that make bread fluffy.

REFERENCES

<https://www.yeastexperiments.com/yeast-fermentation-experiment/>

4.3.3 Belgian laboratory protocol

The influence of acid rain on vascular and non-vascular plants



Necessary equipment:

- 2 measuring cups
- 1 vascular plant (fern, seed plant or similar)
- 1 non-vascular plant (moss, liverworts, hornworts or similar)
- 2 shallow bowls or pots to hold the plants
- ph test strips
- ½ liter of fresh water

- small bottle of vinegar
- safety goggles
- latex gloves
- (if possible) lab coats

Safety measures:

- wear goggles at all times
- wear latex gloves when handling materials

Procedure:

- measure the ph-value of both plants using the test strips and note the value in the first column
- take a picture of both plants
- divide the fresh water equally into both measuring cups
- mix a small amount of vinegar in both measuring cups, make sure to use the exact same amount both times
- measure the ph-value in both cups and note the value in the second column
- water each plant with the same amount of the prepared 'acid rain'
- wait 20 minutes
- measure the ph-value of both plants using the test strips and note the value in the third column
- take a new picture of both plants from the same angle as the first time
- compare the first and third column and compare the first and second picture of both plants
- form conclusion

4.3.4 Latvian laboratory protocol

Measuring our biorhythm cycles

Experimental procedure

1. Count the number of days you have lived!
2. Calculate a current day for each cycle. (23-day physical cycle, 28-day emotional cycle, and 33-day intellectual cycle).
3. Create your sinusoid for each cycle.

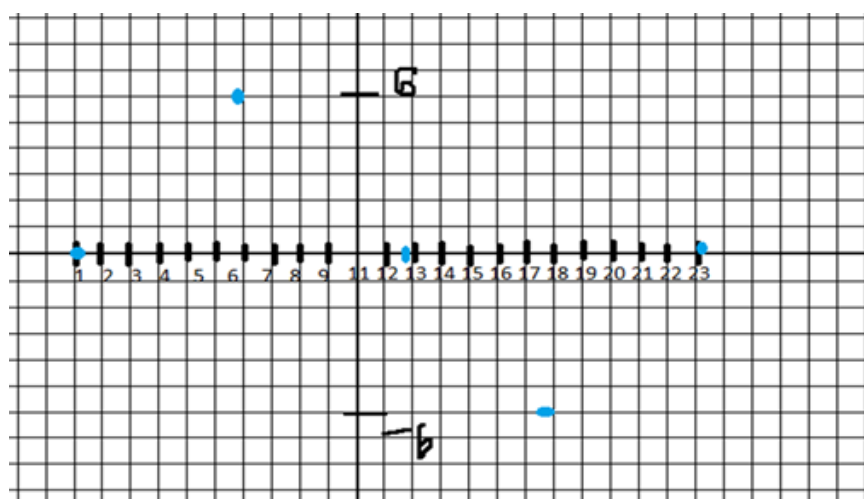
23-DAY PHYSICAL CYCLE

Let's start by calculating a current day for the 23-day cycle.

- Firstly, determine the number of days that have passed since the day of your birth using "Eternal calendar" on the Internet: 6313
- Next, divide the number of days lived by 23: $6313 : 23 = 274,4$ - Leave the resulting number in whole, without rounding: 274 - *Thus, we get the number of complete lived cycles.*
- Secondly, from the number of days lived, we subtract the multiplication of the resulting number of full lived cycles by 23: $6313 - (274 \times 23) = 11$ - *Thus, we get the number of today's day from the beginning of the cycle.*

Then, let's move on to drawing a graph – creating a sinusoid.

- Today's day (November 23) is exactly in the middle of the coordinates. *The beginning of my physical cycle is 11 days earlier.*
- To draw the first graph, divide 23 by 4: $23 : 4 = 5.75$ (6 + 6 + 6 + 5) - *Each phase of this cycle lasts 6/5 days.*



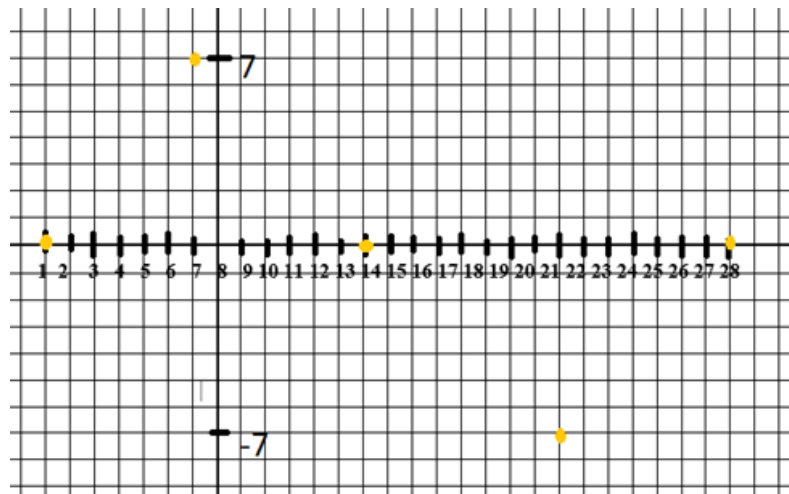
Thus, we get that from the first day of our cycle in about 6 days the graph will reach its maximum peak, after another 6 days it will cross the axis, after the next 6 days it will reach the smallest value, and finally, after the last 5 days of the cycle, it will cross the axis again, completing one cycle. After that, we can repeat the same cycle.

- The amplitude of this graph at which the function deviates from the x-axis as much as possible, is also 6.
- When you have placed all the points, you can draw a graph. *Thus, we have created the first sinusoid, which shows your best and worst physical condition on different days.*

After that, repeat the same steps for 28-day and 33-day cycles.

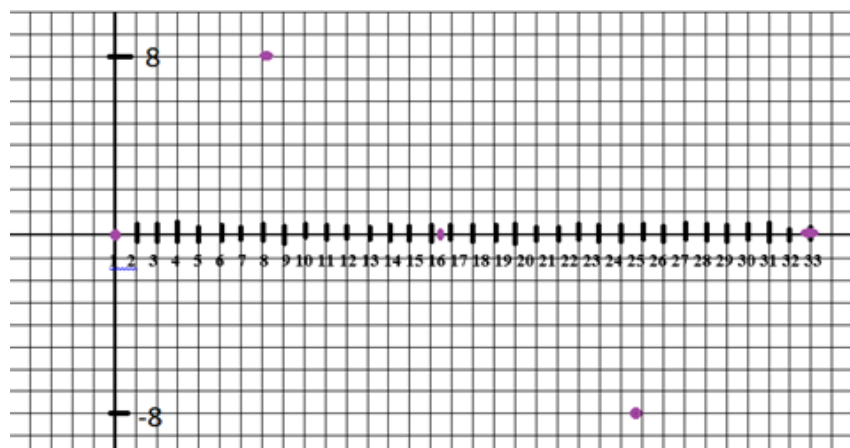
28-DAY EMOTIONAL CYCLE

1. $6313 : 28 = 225,46$
2. $6313 - (225 \times 28) = 13$ - *The beginning of this cycle is 13 days earlier than today's day.*
3. $28 : 4 = 7$ ($7 + 7 + 7 + 7$) - *Each phase of this cycle lasts 7 days.*



33-DAY INTELLECTUAL CYCLE

4. $6313 : 33 = 191,3$
5. $6313 - (191 \times 33) = 10$ - The beginning of this cycle is 10 days earlier than today's day.
6. $33 : 4 = 8 (8 + 8 + 8 + 8)$ - Each phase of this cycle lasts 8 days.



4. Analyze the obtained results!

4.3.4 Portuguese laboratory protocol

Investigating the upward transport of xylem sap

Introduction

The xylem is the vascular tissue responsible for the upward conduction of water and mineral ions from the roots. Xylem sap (mainly water and mineral ions) circulate through specialized tissues - conductive vessels - from the root, through the stem, to the leaves, fruits and flowers, regardless of the inclination of the branches, generally counteracting the force of gravity.

Objective

Check the ascent of the xylem sap, along the stem, to the flowers, against the force of gravity.

Materials used:

- 2 white flowers (e.g. carnations);
- 2 X 250 ml Erlenmeyer flasks;
- Vital dye (methylene blue, neutral red) or a food coloring;
- Water;
- Forceps and scalpel;
- Acetate marker;
- Binocular magnifying glass

Process:

1. Place 200 ml of tap water or mineral water in each Erlenmeyer flask.
2. Put a few drops of dye in one of them, until the solution is visibly colored.
3. Cut the end of each of the flowers petioles; immediately place each one of them in one of the Erlenmeyer flasks.
4. Mark the water level of the Erlenmeyer flasks with the aid of an acetate marker.

5. Leave the assembly in a ventilated and well-lit place.
6. Observe daily – color of leaves and flowers and water level.
7. When the color of the dye on the leaves/flowers becomes visible, remove them from the water and cut a cross section of the petiole, a little away from the final region.
8. Observe with the magnifying glass.
9. Record observations using a photo or diagram.

Results:

(Photograph of the flower colored with the color of the dye; water levels; diagram of the stem cross section)

Discussion of results

1. What hypothesis would be suitable for this protocol?
2. Which is the control group?
3. How is the bluish tone of the flowers explained?

Conclusions:

(The results confirm the hypothesis).

4.4 Environmental Sciences

4.4.1 Italian laboratory protocol

Determination of nitrites in water through rapid determination

Experimental procedure:

1. Respect security measures.
2. Shake the sample to homogenise.
3. Rinse the syringe (or pipette) and tubes with the water to be analysed and withdraw 5 ml of water to be analysed using the syringe (or pipette) and place it in each of the two tubes.
4. Place a test tube (blank test) in the left hole of the comparator.
5. Place the comparator on the colour scale with the coloured fields under the blank test piece.
6. In the second test tube add 8 drops of reagent A and shake well.
7. After 10 min, place the test tube with the reagents in the right hole of the comparator.
8. Observe from above, slide comparator until you find the colour of the sample.
9. Read the corresponding value, indicated by the comparator arrow.
10. If the concentration is high, dilute the sample and determine the value taking into account the dilutions.

Expected results:

The presence of nitrates determines the colouring of the sample. The colour scale is used to determine the value of nitrites present expressed in parts per million (ppm) or milligrams per litre (mg/l). The more coloured the sample, the higher the nitrite content in the water. Values above 0.5 mg/l indicate waters with nitrogen pollution problems.



4.4.2 Spanish laboratory protocol

CO₂ in our lives

Introduction

Carbon dioxide is a gas that pollutes the environment and it is the one that increases the greenhouse effect the most. In other words, it increases the retention of heat in the atmosphere and it generates global warming.

Carbon dioxide is not toxic to living beings because it is a gas that we exhale, but in high concentrations, more than 30.000 ppm, it can produce suffocation. In plants, a high concentration of carbon dioxide causes a reduction in photosynthesis.

Objectives

We have four experiments to carry out:

1. CO₂: For all the following experiments we need CO₂ and we are going to produce it using vinegar and bicarbonate; the greater the quantity of vinegar and bicarbonate the greater will be the concentration of CO₂.
2. SEA AND OCEANS: First, we thought about simulating a sea or an ocean with a high concentration of CO₂. in order to do this we must confirm whether or not the CO₂ changes the acidity of the water using bromothymol blue. The hypothesis is: the yellower the water is, the more acidic it will be. Finally, if the beaker that has water with CO₂ is yellow this means that some marine species cannot survive and they will become extinct in the future.
3. AIR: We want to see if a large amount of CO₂ can warm up the air of the planet and therefore explain the melting of the Earth's Poles, despite the

differences in the North and South Poles. The hypothesis is: the more carbon dioxide the air has, the quicker the atmosphere will warm up.

4. PLANTS: Additionally, like the solutions to the previous problems, we are going to recreate the reaction of aquatic plants with a high concentration of carbon dioxide. Plants are the solution because during daytime via photosynthesis they change CO₂ to oxygen, whereas at night they change oxygen to CO₂. We have chosen aquatic plants because in the water we can easily see the oxygen bubbles and the hypothesis here is that the more carbon dioxide the plant consumes, the more oxygen it will produce.

Materials

CO₂

- 1 plastic bottle with the cap (125ml)
- Scissors
- 2 latex tubes, one longer than the other
- Scales
- Petri dish
- Test tube
- Funnel

SEA AND OCEAN

- 2 beakers
- Scales
- Petri dish

CO₂

- Vinegar (80ml/50ml)
- Bicarbonate (20g/50g)

SEA AND OCEANS

- Tablespoon

AIR

- 2 bottles
- 2 thermometers
- Sticky tape
- Foil

PLANTS

- Large transparent pot
- Aquatic plant
- Paper
- Scales
- Petri dish

Products

- CO₂ (80ml and 50g) in one beaker
- 3 drops of bromothymol blue in each beaker
- 100ml water in each beaker

- 5g salt in each beaker

AIR

- CO₂ (50ml and 20g)

- CO₂ (80ml and 50g)

- Water

- 18g bicarbonate

PLANTS

Experimental procedure

CO₂

1. Measure 80ml or 50ml of vinegar in a test tube.
2. Measure 50g or 20g of bicarbonate with the scales and a petri dish.
3. Drill into the cap of the plastic bottle with the scissors and put one end of the latex tube in the hole.
4. Put the bicarbonate inside the plastic bottle using the funnel.
5. Quickly add the vinegar and close the bottle.
6. Put the other end of the latex tube wherever necessary
7. Repeat this for each experiment.

SEA AND OCEAN

1. Put 100ml of water in each beaker.
2. Measure 5g of salt and put it in each beaker.
3. Dissolve the salt in each beaker
4. In one of them put CO₂ (80ml, 50g and use the short latex tube).
5. Add 3 drops of bromothymol blue to each beaker.
6. Observe the colour of each beaker and the difference.

AIR

1. Use 2 glass bottles.
2. In one of them add CO₂ (50ml, 20g).
3. Cover both bottles with foil and stick it down with sticky tape.
4. In each bottle, pierce the paper with a thermometer.
5. Put both bottles in the sun and wait.

6. Then observe the air temperature of the bottles. Which one is hotter than the other?

PLANTS

1. Put the aquatic plant in the large transparent pot.
2. Fill the pot with enough water to cover the plant.
3. Add the CO₂ (80ml, 50g using the longer latex tube) to the water .
4. Measure 18g of bicarbonate with the scales and the petri dish.
5. Add the 18g of bicarbonate to the pot .
6. Cover the pot with the paper.
7. Put the plant in the sun.
8. Wait and see if photosynthesis occurs and look for oxygen bubbles under the water.

Results

CO₂

We got a high concentration of CO₂ from the latex tube; and the reaction is effective immediately.

SEA AND OCEANS

We had one beaker that represented typical seas and oceans without a high quantity of CO₂ and this was blue, meaning it is basic..However, The other beaker, with a lot of CO₂, is yellower meaning it is more acidic.

AIR

In this experiment we had 2 bottles, one of them with CO₂ and the other without. At first the T bottle without CO₂ was hotter than the other one, but, as time passed, the bottle with CO₂ became hotter than the other one.

PLANTS

After some time had passed we could see small oxygen bubbles around the plant, meaning that photosynthesis had taken place and the CO₂ was changing to oxygen.

Conclusions

Finally ,we arrived at the conclusion that all the hypotheses are right and CO₂ pollution is causing some marine species to become extinct because it changes the acidity of the water. Also, it can cause the melting of the Earth Poles because we have seen that the CO₂ increases water temperature. The solution is plants; they can change the concentrations of CO₂ to oxygen. However, people are looking for other more complicated solutions, and they are ignoring this easy solution.

Questions

Why do vinegar and bicarbonate cause CO₂?

Because a chemical reaction takes place.

Vinegar is an acid (called acetic acid), and baking soda is a base.

When an acid and a base come together, a chemical reaction occurs. Some may explode, but in this case the reaction is not as violent.

Is this one: vinegar + sodium bicarbonate → sodium acetate + water + CO₂

Why is the air without CO₂ hotter than the other air at first, but then the air with CO₂ ends up being hotter than the other air?

How does bromothymol blue work?

Below pH7, the indicator is yellow, but if the pH becomes basic, the -OH groups deprotonate and a C=O double bond can form.

As a result, the molecule's conjugate system (that of all its resonant double bonds) changes enough so that the electrons no longer absorb the same photons, and the solution turns from yellow to bluish.

If, on the other hand, the pH is much below 7, the colour of the indicator changes from yellow to red. The change in the conjugate system is due to the protonation of the -OH groups to -OH₂⁺.

4.4.3 Latvian laboratory protocol

Natural pH indicators

<https://www.youtube.com/watch?v=svLqBIOsPU>

Objectives: To learn how to prepare and use natural pH indicators for the examination of the pH of solutions.

Equipment and reagents:

1. red cabbage, hibiscus tea, red onion peel and/or red beets
2. a small pot for making decoctions
3. 4 glass beakers 250 ml
4. Pasteur pipettes (7-10 pcs)
5. 9 test tubes
6. test tube rack
7. vinegar (aqueous 9 % acetic acid solution) or any other acidic solution
8. alkaline household cleaner or aqueous NaOH solution

Experimental procedure:

1. Decoction of red cabbage, hibiscus tea, red onion peel - pieces of vegetable material cooked ≈5 minutes in a small amount of water, then allow the decoction to cool without pouring it down!
2. If blueberry juice or red beet is used, no decoction shall be made, but juice diluted in water shall be used.
3. Dilute an alkaline household cleaner in one of the glass jars!
4. Pour equal volumes of prepared decoction into three test tubes!
5. Add table vinegar to the contents of one test tube, dilute alkali to the other, and leave the third for comparison!

6. Observe the colour change!
7. Repeat the experiment with another decoction or berry juice!
8. Create a table independently and mark the observations in it!
9. Conclude the discoloration of plant materials depending on the solution environment!

Precautions:

Acids and bases are chemicals that can easily damage your skin and eyes. The severity of the hazard depends on how strong the chemical is, how long contact is maintained and what actions you take after contact is made. Use personal protective equipment (PPE) as required.

4.4.4 Portuguese laboratory protocol

Investigating the greenhouse effect

Introduction

Anthropogenic action has led to an increase in the greenhouse effect and a change in the surface albedo, which alters the Earth's thermal balance and causes global warming and significant climate change.

The greenhouse effect is a process that occurs when energy from a planet's sun goes through its atmosphere and warms the planet's surface, but the atmosphere prevents the heat from returning directly to space, resulting in a warmer planet. Light arriving from our Sun passes through Earth's atmosphere and warms its surface. The warmed surface then radiates heat, which is absorbed by greenhouse gases such as carbon dioxide. Without the natural greenhouse effect, Earth's average temperature would be well below freezing. Current human-caused increases in greenhouse gases trap greater amounts of heat, causing the Earth to grow warmer over time

Albedo is the fraction or amount of sunlight reflected by a surface or object. It is often expressed as a percentage and is related to the colour of a surface or object. For example, snow-covered surfaces or deserts reflect a large fraction of sunlight and therefore have a high albedo. In turn, vegetation covered surfaces and oceans

reflect a small fraction of sunlight and have low albedo. Changes in the Earth's surface albedo affect the energy balance of the planet. If there is extensive snow melt, more energy will be absorbed, leading to more surface heating and more snow melt. On a large scale, this has implications for our climate.

Objective:

Recreate the greenhouse effect in a container;

Understand the influence of albedo on surface temperature.

Materials used:

Acetate marker

1 Clear glass container (or a transparent plastic bag)

4 small thermometers – for ambient temperature

2 incandescent lamp lamps

1 black and 1 white A4 cardstock

Process:

1. Identify the thermometers with the numbers 1, 2, 3 e 4.
2. Place the thermometers 1 and 2 under the light of a lamp with an incandescent lamp and wait two minutes.
3. Write down the value of the temperature registered on thermometers 1 and 2 and the initial time.
4. Place the container on top of thermometer 2(if the thermometer is too large, it can be placed vertically).
5. Every two minutes, for ten minutes, record the temperature value on thermometers 1 and 2.
6. Build a graphic with the data obtained.

7. Place the thermometers 3 and 4 under the light of a lamp with an incandescent lamp and wait two minutes.
8. Write down the value of the temperature registered on thermometers 3 and 4 and the initial time.
9. Place thermometer 3 inside the white cardboard previously folded in half and thermometer 4 inside the black cardboard, also folded in half.
10. After 5 and 10 minutes register the value of the temperature on the thermometers 3 and 4.

Thermometer 1 and 2



Thermometer 3 and 4



Results:

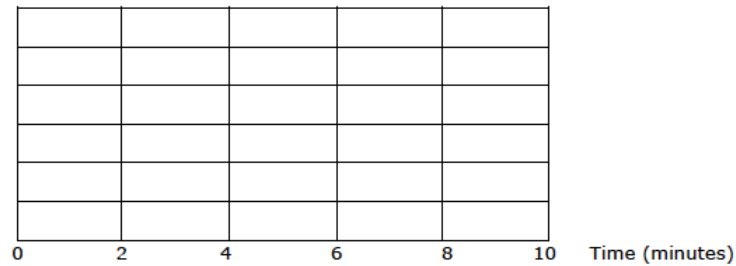
Thermometer 1 e 2

Initial temperature:

Thermometer 1-____

Thermometer 2-____

Temperature(°C)



Thermometers 3 and 4

Thermometer	Initial temperature	Temperature at 5 minutes	Temperature at 10 minutes
3			
4			

Discussion of results

1. Indicate the function of thermometer 1.
2. Explain what the glass container represents.
3. Which one of the thermometers 1 or 2 registered the highest increase of temperature. Justify your answer.
4. The increase in the amount of greenhouse gases in the Earth's atmosphere has the same effect as that observed in the glass container. What are its consequences?
5. Which thermometer 3 or 4 registered the highest increase of temperature. Justify your answer.
6. What phenomenon was intended to represent with thermometers 3 and 4?
7. What is the importance of vegetation cover in maintaining the average temperatures in cities?

Conclusions:

(Answers to question 4 and 7).

4.4.5 Belgian laboratory protocol

Experiment : Chromatography of chloroplasts

1. Introduction

Chromatography is used when separating a mixture into its base components. In this experiment, we'll be using chromatography to separate the different pigments in chlorophyll.

Chromatography process : we start by adding a dot or a line on a piece of paper (see figure). The bottom of the paper is submerged in a suitable solvent (the carrier liquid). The carrier liquid is absorbed by the paper and dissolves the line of the mixture into its components as the liquid passes through it.

Some components stick to the carrier liquid more than others, because they either dissolve into it easier or there's less interaction with the molecules in the paper.

2. Materials

- spinach leaves
- mortar and pestle
- scissors
- acetone
- diethyl ether
- paperclip
- chromatography paper (or fine filter paper)
- 1 beaker with a volume of 100 ml (can be slightly bigger)
- 1 test tube

3. Chemical compounds

Name H-sentences P-sentences

Acetone

Diethyl ether

4. How it works

- take your spinach leaves and use the scissors to cut them in small pieces
- grind the pieces down using the pestle and mortar
- drip a few mls of acetone on the crushed leaves and wait 2-3 minutes
- cut a piece out of the chromatography paper (or the filter paper) of about 1 cm wide. Make sure it is slightly longer than the length of your test tube.
- draw a pencil line about 3.5 cms above the bottom line
- use the paperclip to add a dot of the green liquid to the pencil line
- do this 10 times in total, adding dots to the horizontal line
- prepare the mixture of 10 mls of acetone and 1 ml diethyl ether in the beaker
- pour this mixture in the test tube, until it's filled to the 2.5 cm line. Dip the paper with the chlorophyll in the mixture. Make sure it doesn't touch the bottom of the test tube and that the chlorophyll is about 1 cm above the liquid. Fold the excess paper over the border of the test tube, to make sure the paper doesn't slip down.
- put the test tube in a dark area, the closet is an option
- wait at least 15 minutes

5. Observations

- a) what lines do you observe? Take a photo.
- b) measure the distance from the pencil line with the chlorophyll up to every other line
- c) measure the distance that carrier liquid moved, starting from the pencil line

7. Conclusion

Write down the conclusion you can draw from those observations.

4.5 Physics

4.5.1 Spanish laboratory protocol

Introduction

This project deals with surface tension of water. A property shared by all kinds of liquids giving them a singular behavior of the surface: it seems like a thin elastic layer. The surface tension forces works all along the contact point between the surface and the liquid. That's the reason why the insects can walk over the water without sinking. They can't break the union between water molecules.

Objectives

Our goal is to visualize and measure the surface tension of water and maybe other liquids. We will build a balance with two Petri dishes in both extremes of the balance. The first dish will be in contact with water, and enhanced with her. In the second dish, we will put several little 1 gram masses. That's the way we can measure the force of the surface tension. When the first dish leaves the water, the mass of the other dish will give us the force of the surface tension (we must multiply the mass in Kg for 9,8 in order to calculate the force in Newton). We will repeat the experience with alcohol. Then we can compare the differences between liquids.

We will check the effects of soap in surface tension. Usually, soap reduces the surface tension of liquids

We will invite the visitors to play with liquids, masses and soap effects in liquids. We also offer them to check the surface effects by putting water drops with a dropper in a coin, defying to guess the number of drops they can put on the coin's surface before the water spills.

Materials and products

2 Petri dishes

Fishing line

Water

25 ct coins

alcohol

Several wooden plates

Water and ethyl alcohol

4 Pasteur pipette

Soap

1 g Masses

Wools sticks

Experimental procedure

Surface tension is the manifestation of the attractive forces between molecules of liquids. Water has a tension of $\gamma = 72,75 \cdot 10^{-3} \text{ N/m}$. The polar nature of water molecules (composed of an Oxygen atom and two of hydrogen) is the reason of the dipole that increases the cohesion forces and the largest surface tension in water than other liquids (Olive oil $32 \cdot 10^{-3} \text{ N/m}$; Alcohol $22,3 \cdot 10^{-3} \text{ N/m}$; Benzine $28,9 \cdot 10^{-3} \text{ N/m}$; Glycerin $63,1 \cdot 10^{-3} \text{ N/m}$). The force (F) of surface tension is proportional to the perimeter of the object, not to its area. The coefficient of tension is $\gamma = F/l$ (N/m).

*All values are for 293K.

Surface tension is altered by soap action that breaks the surface tension by attracting water molecules and reducing the cohesion forces.

In this experiment we will see:

1. The force of water will keep, by cohesion forces, the dish linked to water.
2. We will put, in the other dish, 1 g masses.
3. While weight in the second dish will not overcome surface tension in the other dish, this one will be linked to water.

We will repeat the experiment with alcohol and olive oil to compare the different tension surface of each liquid, showing that surface tension is a specific property of liquids.

We also will show surface tension with other elements like needles, rings and other small objects.

In a second moment we will dissolve a little bit of soap in water to reduce the surface tension and achieve the action of soap over the surface tension of water.

Results

We will prove that the surface tension of water is $\gamma=72$ dynes/cm ($72 \cdot 10^{-3}$ N/m) at 25°C . It's necessary a $72 \cdot 10^{-3}$ N (72 din) force to break the water layer 1 meter long (remember: it depends on the perimeter of surface). If we use surfactants, the surface tension will be reduced.

Conclusions

Finally, we learn about this invisible and curious force of water that keeping a material adhered over water without effort is possible because of the polarity of water molecules and the enhance forces between them. Therefore, when we see an insect walking on the water, we will remember this theory..

We also see the action of surfactants on these specific properties, specifics to each liquid.

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4.5.2 Italian laboratory protocol

Introduction

The easiest way to get a student to learn a concept is to turn it into an experience, that is, an experiment. If the experiment turns into a game to do with classmates or friends, it is even better. In the realization of this project, we set ourselves the objective of demonstrating the concept of balance of bodies.

Objectives

Through the use of simple experimental prototypes, we intend to make the relationship between the body and the position of its centre of gravity identifiable. It is known that a suspended or leaned body is in stable equilibrium if and only if the position of its centre of gravity is vertically aligned with the position of the point of attachment or once its minimum possible height has been reached. We thought to present some simple “homemade” demonstration prototypes that allow us to identify this property and analyse its functioning. Students, therefore, will be invited to participate in the realization of simple experiments, through which to acquire naturally the concept of the centre of gravity.

Materials and products

The aim is to prove the above theories by means of devices and/or systems made using commonly used materials (cardboard, toothpicks, cork stoppers, glue, forks, wood, small metal objects). Easy access to the materials used will allow students to easily create experimental prototypes even in a completely autonomous way, for example at home or at school. This will promote, through a self-made methodology, the understanding of the physical principle as well as the pleasure of discovery.

Below are the photos reproducing some of the demonstration prototypes.



Experimental procedure

A body is in stable equilibrium if, by shifting it slightly from its equilibrium position, it naturally tends to return to it. In fact, when all the forces acting on a body cancel each other out, the body is in equilibrium. To understand how the balance of a body works it is necessary to know its weight and its point of application, where the weight of a body indicates the force with which the body is pushed down (force of gravity).

The demonstration prototypes involved in the experiment will be free to move and through their observation it will be understood that whenever an unstabilizing activity (temporary external force) is exerted on them, they will tend to return to their stable equilibrium position, which is the position for the body with the lowest potential energy expenditure.

Results

Let's look at the case of a ship sailing on the sea, it moves safely because it has a centre of gravity and the force that will keep it in stable equilibrium will be applied. Every prototype has a centre of gravity. On the basis of this hypothesis, simulations will be carried out in which it will be possible to test that, even starting from

different conditions, e. g. starting positions imposed by an external operator, each prototype will return to its original stable equilibrium conditions and will continue there until an external condition (external force) act again which will change the equilibrium of the prototype and its position. Therefore, some prototypes will oscillate in search of the equilibrium position, others will rotate until they reach it.

Conclusion

All bodies have a natural tendency to seek the condition of stable equilibrium. Prototypes stimulate children's intuition to understand equivalences in existing systems. For example, the prototype made with the two forks is equivalent to a two-arm scale or a construction crane, a ship oscillates on the sea as does the eccentric wooden disc until it reaches the equilibrium position. The principle that regulates the centre of gravity of the body finds considerable applications in the field of technology, everything that is made by man has a centre of gravity; for example, the comfort with which you hold a smartphone is simulated by carefully evaluating the position of its centre of gravity, its vibration system works thanks to the rapid movement of an eccentric mass in the centre of gravity.

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4.5.3 Belgian laboratory protocol

1. Brief summary of the project and aims

In this project we will demonstrate in a first experiment how resonance has an effect on the harmony of the sound we perceive. In the second part we will prove that a sound wave in physics can be described from a pure scientific point of view while the sound we hear is an interpretation by our brain.

2. Material and assembly (including some medium-low resolution figures, diagrams or photographs)

We don't need much material. 2 laptops to demonstrate resonance. The necessary software for frequency and amplitude regulation. We will show figures and diagrams notably of the sound waves on the laptop screens. We will bring all the necessary materials with us: Laptop x 2, oscilloscope, bluetooth speaker, microphone, cables, DB(A) meters.

3. Justification:

Physical principles involved and their relation to technological applications. We intend to observe the following phenomena:

- a. The resonance between the two laptops when they emit sound with the same frequency. This will be linked to pianos and to the fact that sound is a wave. We will also demonstrate that this resonance is only possible at certain phase-differences. We intend to observe the interference of waves of slightly different frequencies and thus establish the observation of interference giving rise to standing waves.
- b. Ultrasound and infrasound: this is in interaction with the public: we will start at a frequency too low to be heard by the human ear and continue to a frequency too high to be heard.
- c. We will produce sound waves with the same amplitude but different frequencies. This gives an idea of the interaction between purely sound physics and interpretation by the human ear/brain

4. Performance and Results: Observations and Measurements

a) the qualitative measurement is the resonance as such, the quantitative is the frequency of the resonance. We will observe the frequency of the “la” used to tune a piano

b) interaction with the public leads to quantitative results “which frequencies are heard” and we can compare girls with boys, older adults (like the teachers) with young adults (the pupils)

c) demonstration of how our brain deceives us. Sound with the same amplitude but a higher frequency is conceived as louder. On the screen of the laptop we will see that it isn’t.

The screen on the laptop will give quantitative data. Our ears will give us only qualitative (and intrinsically false) data.

5. Conclusions

a) Harmonic sound is important and can be measured in a physical experiment. What we consider “nice” when we hear it can be reduced to certain sound waves with the right frequency and in the right phase.

b) Not all sound waves can be heard. And those that can be heard, differ by age, gender,

c) Physics and biology do not always give the same result.

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4.5.4 Latvian laboratory protocol

Centre of gravity and potential energy

<https://www.youtube.com/watch?v=PKU97VfoJ74>

1. Look at pictures 1 and 2 and mark the correct answer.



1.

I see the water flowing from ...

A) top to bottom

B) bottom to top

2.

I see the water flowing from ...

A) top to bottom

B) bottom to top

2. Experiment.

Put the cylinder in the middle of the makeshift slide and let go of your hands. Mark the correct answer.



The cylinder is rolling from ...

A) top to bottom

B) bottom to top

Repeat the experiment with the ball. Put it in the middle of a makeshift slide and let go of your hands.

The ball is rolling from ...

A) top to bottom

B) bottom to top

3. Measure the height of the centre of gravity with a ruler.

The height of the centre of gravity of the cylinder in the middle of the slide is ... cm

The height of the centre of gravity of the cylinder at the bottom of the slide is ... cm

The height of the centre of gravity of the ball in the middle of the slide cm

The height of the centre of gravity of the ball at the top of the slide ... cm

Conclusion:

when the cylinder moves, the height of the centre of gravity ... (decreases/increases)

Conclusion:

when the ball moves, the height of the centre of gravity ... (decreases/increases)

4. Can movement occur spontaneously with an increase in the height of the centre of gravity (i.e. with an increase in potential energy)?

A) yes

B) no

5. Consider Figure 2 again.

The water flows in such a way that the potential energy decreases. And what we see in the figure is an illusion that is created by the terrain.

Archimedes' principle in bulk solids and inertia

[Link video](#)

1. Read the text and look at the pictures.

In many regions of the world, stones “crawl out” to the surface of the earth and agricultural workers have to remove them every year before ploughing or other agricultural work.



2. Conduct experiments.

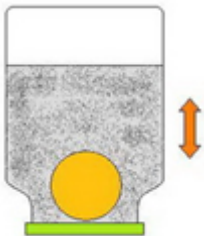
Put a tennis ball in a plastic bottle and fill it with sand. Create a slight vibration (lightly shake the plastic bottle up and down)!

3. What happens to the tennis ball?

The tennis ball ...

A) stays in its place

B) moves up



Pour sand into a plastic bottle along with metal and plastic balls. Place the bottle horizontally and move the bottle in a horizontal direction from side to side.

The metal balls ...

A) stay in their places

B) move up

C) move down

The plastic balls ...

A) stay in their places

B) move up

C) move down

It happens due to the density of metal being... (greater / less) than the density of sand, and plastic is ... (greater / less) than the density of sand. That is in full accordance with the conditions of navigation of bodies.

4. Then how do the stones “crawl out” to the surface of the earth? The buoyant force cannot lift them.

Put a large metal ball on the bottom of the glass and fill the top with sand. With a sharp movement to move the glass down, the ball appears on the surface.

A more inert body - the ball - changes speed ... (slowly / fast) and the sand significantly ... (faster / slower).

Therefore, the ball, as it were, remains in place, and the sand moves down. This is how inertia manifests itself.

4.5.5 Portuguese laboratory protocol

Free fall with MakeyMakey

Main objective:

The object of this experiment is to determine the value of the acceleration of gravity by measuring the time of a freely falling object using MakeyMakey and Scratch to get the falling time.

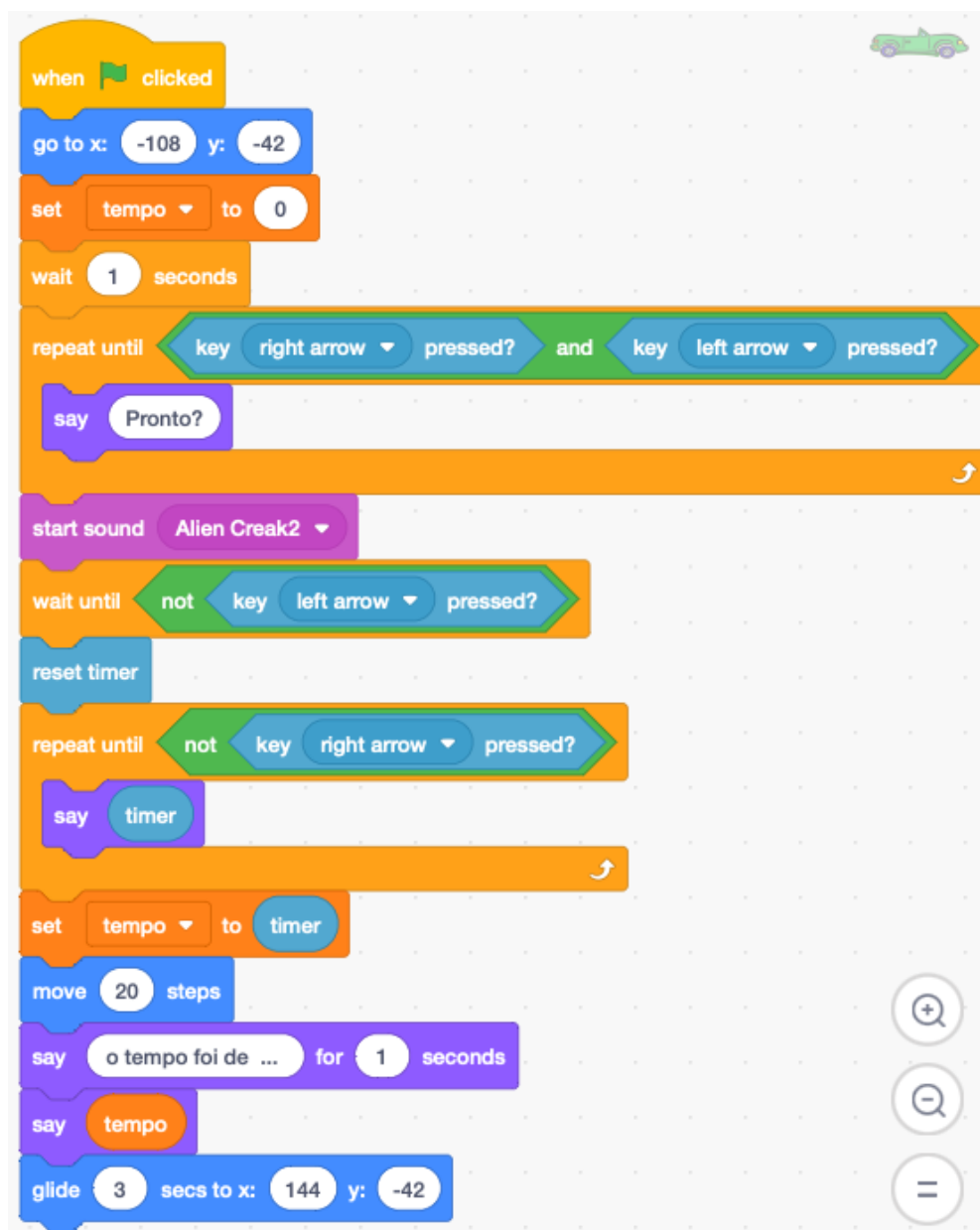


Material

Makey-makey, electric cables, laptop or notebook with Scratch, rubber/ball (falling object), ruler, holders of 2 m (for cables), aluminum foil or copper cables.

Introduction

An object dropped near the earth's surface will accelerate uniformly with the acceleration due to gravity (g) toward the earth. Thus, according to the equation describing motion for a uniformly accelerated object, its position y as a function of time t is $y = \frac{1}{2}gt^2$. If we graph distance fallen vs. time squared the data should yield a linear graph similar to the one shown below.



Scratch code

Chapter 5: Lesson Plan

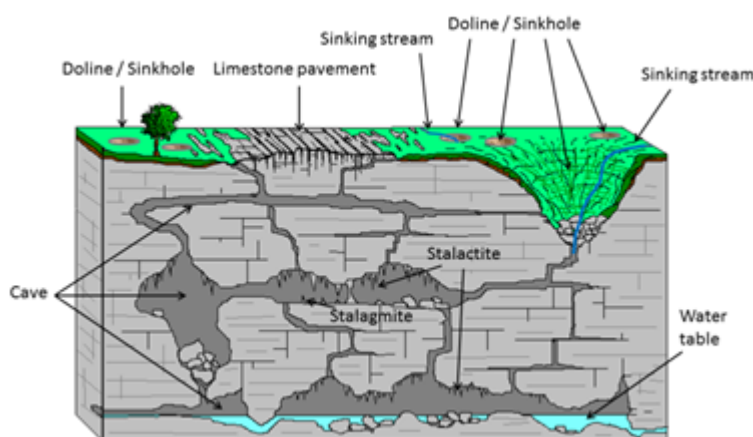
5.1 Geology

5.1.1 Latvian lesson plan

Karst processes

Introduction

Karst is a special type of landscape that is formed by the dissolution of soluble rocks, such as limestone, dolomite and gypsum. A karst process requires soluble, waterproof rocks and underground water. In addition, the water must be in motion, it must circulate in underground strata. It is characterized by underground drainage systems (such as karst aquifers) with deep sinkholes and even caves, which no one in Latvia has managed to access yet.



Chemical decomposition of the rocks occurs by dissolving and leaching the rocks because of groundwater and surface water. Groundwater serves as a development agent for the karst process and as it develops, geological risk increases, as well as the protection of groundwater from surface contaminants decreases. The carbonic acid that causes karstic features is formed as rain passes through Earth's atmosphere picking up carbon dioxide (CO_2), which dissolves in the water. Once the rain reaches the ground, it may pass through soil that can provide much more CO_2 to form a weak carbonic acid solution, which dissolves calcium carbonate.

In Latvia karst processes are caused by infiltration of meteoric water, therefore it is most abundant in areas with no or thin Quaternary cover. In some areas surface features of karst processes such as sinkholes, karst shafts, land subsidence, lakes and dolines are present.



A sinkhole or doline is a depression or hole in the ground caused by some form of collapse of the surface layer. These sinkholes can be dramatic, because the surface land usually stays intact until the underground spaces just get too big. A sudden collapse of the land surface can occur if there is not enough support for the land above the spaces.

Karst processes in Latvia take place in rocks about 50 meters deep, making sinkholes in excess of even 10-meter depth. The karst process is slow. It takes dozens and hundreds of years. Therefore, it is almost impossible to forecast the development of this process.

Objectives:

To observe the process of the formation of a sinkhole, a surface karst feature

To raise awareness about the processes underground and their impact on the earth transformation

Materials: a plastic box, a piece of paper, 200 ml sand, 2-3 tablespoons soda, 50 ml vinegar and a piece of chalk

Products: a sinkhole in the surface layer

Experimental procedure:

1. Take a piece of paper and make a tube from it.

2. Put the paper tube into a box.
3. Fill the paper tube with soda (which substitutes limestone) and the box with sand.
4. Put a piece of chalk near the paper tube.
5. Pour vinegar on the soda in the paper tube and on the piece of chalk.
6. Watch the formation of a sinkhole.
7. Put the paper tube away and observe the collapse of the sand.

Expected results:

As you see, there is the chemical dissolution of carbonate rock (soda). The surface layer can stand for a short time, but if the sand collapses (because there is no longer support from the rock), a sinkhole forms.

Limestone (a piece of chalk) does not dissolve very quickly, as it takes a lot of time.

5.1.2 Italian lesson plan

Determination of total limestone (total calcium and magnesium carbonate) in soil

1. Introduction

The soil takes its origin from the processes of alteration of rocks, which can be both chemical, physical and biological. According to the original rocky material, soil characteristics can be different. From these characteristics we can also identify the process of plant growth. One fundamental parameter which influences the characteristics of a type of soil is its calcium carbonate content. The percentage of calcium influences the plant availability of various nutritional elements, especially phosphorus, iron and magnesium, as it influences the pH of soil. Soils containing calcium have a basic pH (major than 7,2).

2. Objectives

These parameters are therefore useful to determine which variety of plant it is possible to cultivate in a specific type of land. Neutral soils are those with a pH close to 7. Neutral soils are the most suitable for agricultural use as most agricultural species adapt optimally to pH values between 6.5 and 7.5. In acidic soils the pH drops to values that compromise the mineral nutrition of the plants. On the contrary, the alkalinity of the soil is sensitive to pH values above 7.8-8.

3. Materials

-Astis Calcimeter

-1 gram of fine soil (obtained by sieving a sample of crushed soil in a mill at 2mm)

-50% hydrochloric acid solution

-Precision balance

-Flask

-Dropper pipettes

-Becker

4. Products

The chemical reaction which takes place is the following:



Calcium carbonate react with hydrogen chloride to produce calcium chloride, carbon dioxide and water.

5. Experimental procedure

1. Weigh 1 gram of fine soil
2. Fill the lime meter cylinder with H₂O, taking care to eliminate any air present and to position the beaker intended to collect the exhaust H₂O
3. Introduce fine soil into the flask
4. Take 2 ml of Hcl with the pipette and place it in the small tube attached to the calcimeter itself.
5. Place the test tube in the flask, taking care not to spill Hcl.
6. Connect the flask to the calcimeter by means of the appropriate ducts and plugs, taking care to bleed the air from the circuit.
7. After hermetically sealing the calcimeter, shake the Erlenmeyer flask causing the reaction between the Hcl contained in the tube and the soil.
8. The Hcl reacting with the calcium and magnesium carbonates present in the soil sample produces the formation of gaseous CO₂ that exerts a pressure on the H₂O column of the central cylinder of the calcium meter.
9. CO₂ pressure causes water to escape through the drain pipe.
10. Reading on the graduated scale present in the cylinder of the calcium meter, the total percentage of calcium and magnesium carbonates present in the soil sample is obtained.

6. Expected results

Calcium carbonate influences phosphoric nutrition by insolubilising phosphorus, and the higher its content in the soil, the lower the pH must be for better plant nutrition.

Calcium carbonate valuation	
Useful	<5%
Tolerated	5-15%
Volumetric footprint	16-50%
Causes sterility	>50%

Agronomic evaluation of Calcium carbonate	
Absent	0%
Traces	<1%
Slightly chalky	1-10%
Averagely chalky	11-25%
Very chalky	26-50%
Excessively chalky	>50%

5.1.3 Spanish lesson plan

Crystallography

1. PURPOSES

- Get students started in geology through crystals
- Get a closer look at different types of crystals
- Learn the fundamental concepts and notions of internal and external crystallography.

2. OBJECTIVES

- Understand the concept of a crystal and its relationship to minerals
- Understand the structure of crystals
- Understand that crystallography is a science

3. CONTENTS

- Introduction to crystallography

Crystallography is the science that studies crystals. Crystals are formed from a solution when the solvent evaporates.

The study of crystalline solids allows us to understand that matter is composed of atoms. A crystal has a structure called a unit cell.

We find crystalline solids in nature, such as minerals and rocks. We also find them in metals, such as steel or aluminum, in this way we can relate it to chemistry.

The size and perfection of the crystals depends on the conditions in which they have been formed. Slow cooling causes the crystals to grow little by little to ensure that the crystal is more perfect, while rapid cooling results in small and imperfect crystals.

- Difference between mineral and crystal.

Crystal: Homogeneous solid crystal with a defined chemical composition and an ordered internal structure.

Mineral: Homogeneous, natural and inorganic solid mineral, with a defined chemical composition and ordered internal structure. A mineral can be formed by small crystals or thick and long. If it does not have crystals, it is amorphous.

- Saturated solution

In a saturated solution, the maximum amount of solute is dissolved in a volume of solvent. Solutes and solvents are the components of a solution. A solute is the substance that dissolves in the solvent.

4. ACTIVITIES

- Perform the solubility curve

Performing a solubility curve, consists of gradually heating the solute in the solvent and then allowing it to cool.

- Crystal formation (nucleation)

Growth of very small solid bodies in a supersaturated fluid phase.

- Crystal growth

Incorporation of new molecules into the already formed and stable nucleus.

EXAMPLES

It is not easy to recognize the crystals around us. Let's look for some examples:

- Analgesic aspirin: formed by tiny crystals which format it.
- In the human body: bones and teeth have a crystalline structure. Both are made up of hydroxyapatite crystals.
- In food we can distinguish several cases:
 - Salt is a crystal in which the chlorine and sodium atoms form a cubic lattice,
 - Sugar also has crystalline forms,
 - Chocolate, since cocoa butter crystallizes in different ways.

- Crystallography techniques which have revealed the structure of different materials such as lysosomes, ribosomes, viruses and DNA.

5.1.4 Belgian lesson plan

1. Objectives of the lesson

- to understand the impact of climate change on everyday society
- to find the relationship between corrosion of certain types of rocks and climate change
- to investigate the how and why of said relationship
- to develop the scientific method
- to develop a sense for scientific debate

2. Scenario of the lesson

- introducing the the type of rock and its background to the class
 - location
 - composition
 - history
 - importance in modern society
- questioning the existence of acid rain
 - history
 - composition
 - known impact of nature
 - questioning impact on buildings and sculptures
- testing the theory: researching the impact of acid rain on Limburg Marl
 - explaining the experiment
 - researching what procedure fits best with the test
 - preparing the test (2 students per experiment)
 - executing the experiment
 - observing and noting the results
- Conclusion:
 - sharing results
 - discussing possible differences between experiments

- forming conclusion on the subject

5.1.5 Portuguese lesson plan

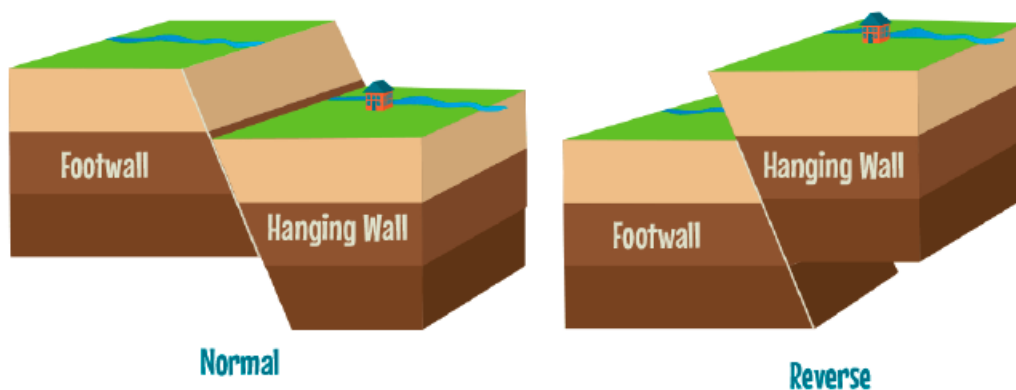
Compressive and Distensive Forces

Objective: Represent the way that compressive and distensive forces act in nature.

Introduction: Tectonic forces are those which cause movement of the lithosphere and alter its configuration. They are originated by the convection currents in the asthenosphere, which are the circulations of its material (lighter, warm material rises while heavier, cool material sinks). There are 3 types of tectonic forces: compressive (in which there is a pushing of rocks) (A), tensional (which cause stress on rocks, pulling them apart) (B), these 2 are the most common ones; however, there are also shearing forces (C).

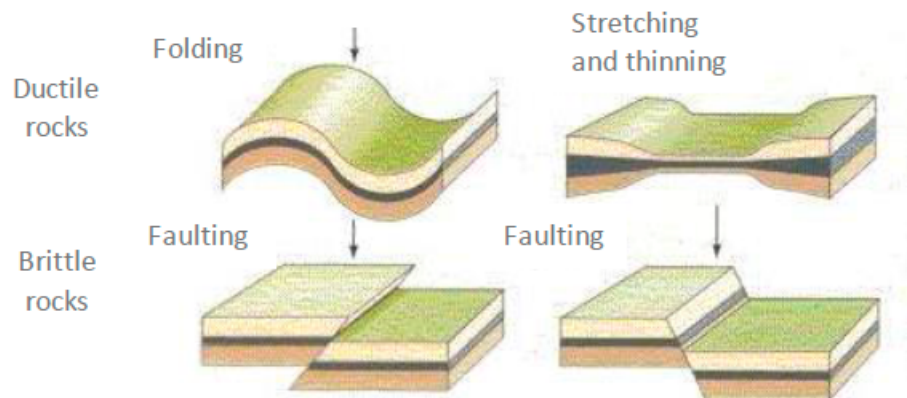
These movements may create faults and folds. Faults are fractures that occur in brittle rocks; there are the normal faults (caused by distensile forces, leading to the lowering of the hanging wall) and reverse ones (caused by compressive stresses, leading to the rise of the hanging wall).

Folds occur when a ductile block bends or curves resulting in permanent deformation.



Activity A: Convection Currents

- In this experiment, try to observe the convection currents in the Lava Lamp's mechanism.



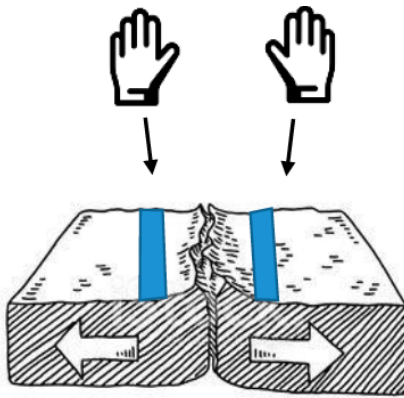
Activity B: Oceanic Crust Expansion

- In this Experiment we have a model that explains how the oceanic crust expands and the age of the geologic blocks.
- To explain this process, we are going to use labels to demonstrate the age of the blocks and the formation of newer layers near the rift.

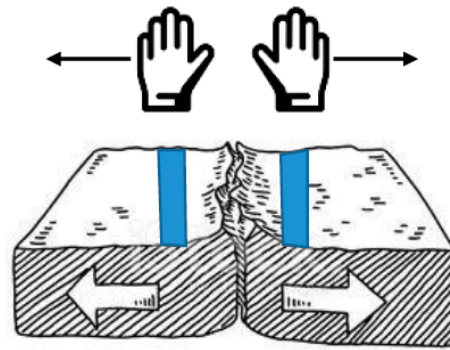
Step 1: Place your hands on the blue straps;

Step 2: Move them apart at the same rate;

Step 3: Try and guess how old the spot A and B are after they



Step 1



Step 2

Activity C: Reverse and Normal Faults using Soap Bars

In this Experiment, we are going to use a bar of soap to represent the 2 types of faults, normal and reverse, and see how they work.

Materials:

- 1 bar of soap
- 4 wood sticks
- Water
- 1 tray

Step 1: Fill the tray with water and sink the bar of soap where the 2 parts meet to lubricate.

Step 2: To represent reverse faults, compress the 2 wood sticks together so that the hanging wall rises, and the footwall remains.



Step 2



Step 3



Activity D: Tectonics/soil layer experiment model

In this experiment we pretend to demonstrate how the layers of sediments are disposed before and after convergent movements.

Materials:

- Flour
- Yellow Sugar
- Tectodidac model
- Powdered Chocolate
- Breadcrumbs

Step 1: Put a good amount of flour inside the box and press it to smooth it out.

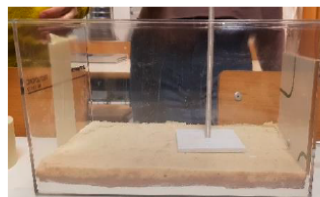
Step 2: Repeat the Step 1 with powdered chocolate, yellow sugar and breadcrumbs until you have the box half filled.

Step 3: Push one iron bar very slowly and watch how the layers act during convergent movements.

Step 1



Step 2



Step 3



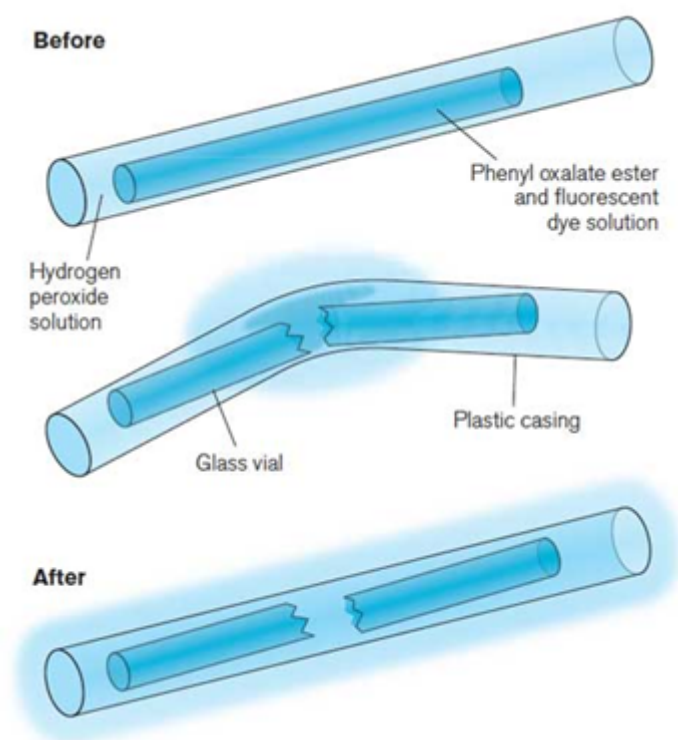
5.2 Chemistry

5.2.1 Latvian lesson plan

Glow stick reaction

Introduction

Glow sticks have wide recreational use, but they were originally patented as a signaling device. This function is different from molecular chemical signaling – glow sticks were intended as emergency flares minus the open flame. Their reliable light source could be deployed in an emergency or by first responder services. Military personnel, divers, police and firefighters were equipped with glow sticks to illuminate their fields of operation.



Some chemical reactions release energy; the chemical reaction in a glowstick releases energy in the form of light. The light produced by this chemical reaction is called chemiluminescence.

There are three components of a glowstick. There need to be two chemicals that interact to release energy and a fluorescent dye to accept this energy and convert

it into light. Although there is more than one recipe for a glowstick, a common commercial glow stick uses a solution of hydrogen peroxide that is kept separate from a solution of a phenyl oxalate ester together with a fluorescent dye. The colour of the fluorescent dye is what determines the resulting colour of the glowstick when the chemical solutions are mixed.

Specifically, the chemical reaction works like this: The hydrogen peroxide oxidizes the phenyl oxalate ester, to form phenol and an unstable peroxyacid ester. The unstable peroxyacid ester decomposes, resulting in phenol and a cyclic peroxy compound. The cyclic peroxy compound decomposes to carbon dioxide. This decomposition reaction releases the energy that excites the dye.

Objectives: To recreate reactions used in commercially available glow sticks and learn the mechanism of chemiluminescent processes.

Equipment:

1. $\approx$ 5 ml Glass Bottle with a Screw Cap
2. 3 ml Polystyrene Pipets

Reagents:

1. Ethyl acetate, 5 ml
2. Hydrogen peroxide (35% water solution), 2 ml
3. TCPO, 100 mg
4. Dye, 2 mg (Rhodamine 6G; 9,10-diphenylanthracene; Rubrene)

Experimental procedure:

- 1) Add TCPO powder to the test tube with a screw cap.
- 2) Add dye, followed by sodium acetate and ethyl acetate.
- 3) Close test tube with a screw cap and shake it gently for a few seconds.
- 4) Add hydrogen peroxide solution to the mixture, close test tube and shake it again.

Precautions:

Hydrogen peroxide is corrosive and can cause skin burns. Ethyl acetate is moderately toxic and can absorb through the skin and respiratory organs. TCPO can irritate skin and eyes.

Use all safety equipment (lab goggles, protective gloves, lab coats).

Expected results:

Participants have learned how to recreate reaction used in glow sticks and know general mechanisms according to which the reaction proceeds.



Resources:

<https://www.goldbio.com/articles/article/the-science-and-history-of-glow-sticks>

<https://www.thoughtco.com/how-do-lightsticks-work-607878>

https://www.youtube.com/watch?v=w_CYwd6cHUA

5.2.2 Italian lesson plan

Determination of titratable acidity in milk

Introduction

The pH of milk normally varies between 6.5 and 6.7 so it has a slightly acidic reaction.

pH values below 6.5 indicate acidic milk.

Values above 6.8 indicate mastitic milk.

Milk contains organic acids, in particular citric acid, and inorganic, carbonic and phosphoric acids and others linked to the micelles of casein (the main protein of milk).

The titrated acidity of milk is an important parameter to identify different criticalities, e.g. the state of preservation, the possible presence of breast diseases (mastitis), suitability for cheese making.

It is expressed in degrees °SH (Soxlet-Henkel) determined on 100 ml of milk, or 50 ml if SH 50 is taken into account. The Soxlet-Henkel grades represent the ml of sodium hydroxide needed to neutralize 100 ml of milk, or 50 ml of milk in the case of °SH 50.

Normally, for convenience, 50 ml are used and the value is expressed in °SH50.

Mastitis: inflammation of the udder due to biotic agents, mainly bacteria, or to factors such as incorrect nutrition, as a result of mastitis the characteristics of the milk are altered.

Objectives

The main objective is to determine the titratable acidity of the milk and to express an opinion on the quality characteristics of the milk accordingly.

Materials

- Gloves and personal protective equipment
- Burette graduated in ml 50 ml pipette with pro pipette (if not available use other capacity)
- Becker 100 ml magnetic stirrer with relative anchor (otherwise glass stirring rod)
- Sodium hydroxide (NaOH) solution normalquarto0,25N (N/4) (or 0,25 Molar (0,25M))

note: normality and molarity are methods to define the concentration of solutions

(0. 25N and 0. 25M are two identical expressions because in sodium hydroxide the normal solution and the molar solution are equivalent)

-1% phenolphthalein alcohol solution (this is the indicator that turning pink gives the end point of the titration and of the neutralization reaction)

Products

Acid-base neutralization reaction between the acids, mainly organic, present in the milk and the sodium hydroxide used in the titration.

5. Experimental procedure

1. Comply with safety measures.
2. Shake the milk sample to homogenize it.
3. Take 50 ml of milk, with pipette and pro pipette.
4. Place the milk sample in a beaker with a capacity of 100 ml.
5. Add 1ml of phenolphthalein.
6. Titrate drop by drop, keeping the milk stirring, with NaOH until the milk turns a persistent pale pink for 15 to 20 seconds.

6. Expected results

The millilitres of NaOH used represent the titratable acidity value of the milk expressed in °SH50.

The normal value of titratable acidity in milk in °SH 50 is around 3. 5; with such, the milk is suitable for consumption and cheese making.

Values below 3. 2 are an indication of disease in the cow (mastitis), milk unsuitable for consumption and cheesemaking.

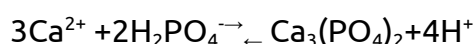
Values greater than 3.7 may indicate colostrum or soured milk (e.g. sour milk for poor preservation). Milk unfit for consumption and cheesemaking.

Note: Colostrum is the milk secreted by the cow in the first 10 days after calving, it provides the calf with the antibodies that it lacks at birth.

Multiplying by 2 the value obtained we obtain the °SH degrees referred to 100 ml.

Acidity and pH are linked by an inverse relationship, the higher the acidity the lower the pH and vice versa.

Remark: by adding sodium hydroxide (NaOH) to milk, some H⁺ ions are released from the third function of phosphoric acid due to the over-run phenomenon which occurs according to the following reaction:



Calcium (Ca²⁺) present in milk precipitates phosphoric acid releasing H⁺ ions.

Because of the over-run, the neutralized milk, which had turned pink, slowly returns to white and a very slight acidity due to the hydrogenions (H⁺ ions) released by the previous reaction.

5.2.3 Spanish lesson plan

Purposes

- Establish elementary and clear ideas about chemistry
- Establish the experimental activity and reflect on this activity
- Investigate events that surprise students
- Communicate the results of this research

Objectives

- Consolidate the scientific method based on observation
- Make scientific models from intuitive models
- Encourage students to ask questions
- Approach everything around from a "chemical point of view"

Contents

- Introduction to chemistry

Chemistry is the science that studies matter, energy and their changes.

The purpose of chemistry is to create materials.

Relationship of chemistry with other experimental sciences such as physics and biology.

- Branches of chemistry

Biochemical. Chemistry-physics. Industrial chemistry. Analytical chemistry. Applied chemistry. Organic chemistry. Inorganic chemistry

- Scientific method

Methodology to obtain new knowledge.

Steps: observation, problem, investigation, hypothesis, experimentation, results, data analysis and conclusion.

- Relationship of environment and chemistry

Chemistry makes it possible to use the natural resources of our planet in a rational way. Chemistry allows us to live in a sustainable way.

- Chemical reactions

Thermodynamic processes in which two or more substances, called reactants, are transformed into other substances, called products.

Activities

- Apply the scientific method
- Observe a problem and seek a solution
- Learn basic laboratory techniques
- Use laboratory equipment
- Perform simple chemical reactions
- Learn simple reactions with everyday products
- Learn to draw conclusions
- Take a full lab

Examples

- Chemistry can be found everywhere, since it is part of our day-to-day lives. Some examples of chemistry in everyday life are:
 - Living beings; Crying when peeling onions, digestion.
 - Plants: Photosynthesis, cellular respiration.
 - Objects: Iron rusting, wood burning.
 - Compounds: sodium chloride, sucrose.

5.2.4 Belgian lesson plan

As this is a lab-class, students are expected to adhere to the general rules of a practicum and are each responsible for their wellbeing and safe conduct during the experiment they are to perform.

The objective of this class is to create a better understanding of polymers and more specific nylon. How long can we make a nylon wire with a given amount of material?

step 1: students form a hypothesis based on previous experience with polymers (both practical and theoretical).

step 2: the safety procedures for the experiment are discussed in class

step 3: students prepare the experiment with the regulations for safe experiments in mind

step 4: students begin the experiment

step 5: students 'compete' (all within safety regulations) to see who can extract the longest nylon wire

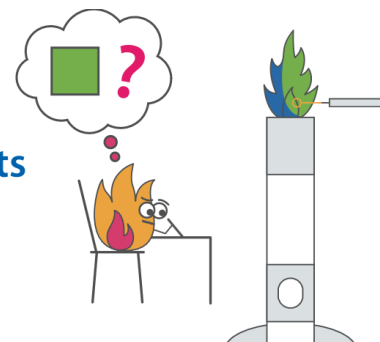
5.2.5 Portuguese lesson plan

Objectives

By the end of this demonstration, students should be able to

- Use flame tests to identify a metal or metallic salt by the color that it produces when it is put into a flame.
- Calculate the frequency of light given its wavelength.
- Calculate the wavelength of light given its frequency.
- Identify an unknown metal by the color it emits when passed through a flame.

Flame Tests



Chemistry Topics

This lesson supports students' understanding of

- Energy
- Electromagnetic Spectrum
- Atomic structure
- Atomic spectra
- Electrons
- Visible light spectrum



Safety

- Barium chloride is highly toxic. Do not ingest the salt or solution.
- Students should wear proper safety gear during chemistry demonstrations. Safety goggles and lab apron are required.
- Wear proper personal protective equipment when preparing and working with solutions.

- Always use caution around open flames. Keep flames away from flammable substances.
- Always be aware of an open flame. Open flames can cause burns. Do not reach over it, tie back hair, and secure loose clothing.
- Wash hands after handling materials used to prepare for or perform this experiment.

Materials

- 7, 100 mL beakers
- Wooden splints (number depends upon how many times the demo will be performed)
- 1 Bunsen burner
- 1 Striker
- 50 mL of 1.0M Barium Chloride (BaCl_2) - Note: Barium chloride is highly toxic. Do not ingest the salt or solution.
- 50 mL of 1.0M Calcium Chloride (CaCl_2)
- 50 mL of 1.0M Copper Chloride (CuCl_2)
- 50 mL of 1.0M Lithium Chloride (LiCl)
- 50 mL of 1.0M Potassium Chloride (KCl)
- 50 mL of 1.0M Sodium Chloride (NaCl)
- 50 mL of 1.0M Strontium Chloride (SrCl_2)

5.3 Biology

5.3.1 Italian lesson plan

Observation of onion and vegetal tissues with microscope

Introduction

The bulb is an underground shoot with a more or less ovate globular shape. It consists of a very short stem surrounded by modified, fleshy leaves, which have the function of storing reserve nutrients. In the lower part the roots are visible. It is typical of biennial plants such as onion.

Once the plant has sprouted, the first year of life it enlarges the bulb, while the second year it uses the accumulated substances to flower. (This is why onions are harvested in the first year). The bulb is also a vegetative (agamic) propagation organ of the plant.

Goals

To observe the cells of the onion by visualizing in particular the cell the wall and the nucleus.

Materials

- 1) An onion bulb
- 2) Microscope
- 3) Microscope slides and coverslips
- 4) Violet dye of gentian
- 5) Distilled water
- 6) A small beaker
- 7) Dropper
- 8) Scalpel

9) Tweezers

10) Glass rods

11) Absorbent paper

12) Latex gloves

Products

Slides on which to observe the onion cells

Procedure

- 1) Pour some water into the beaker and add a few drops of gentian violet (the solution must not be too colored) and mix
- 2) Cut the onion and leaf through the bulb, take a fragment of the film present on the inside of the leaves of the bulb.
- 3) place the sample on the slide and add a drop of solution taken from a small beaker, cover with the coverslip and press lightly with absorbent paper
- 4) Place the slide on the microscope slide and observe starting from the lower magnification and then moving on to the higher ones

Observations

The cell wall made up of cellulose is observed. Cellulose is a complex glucose polymer with a structural function in plants.

The cell nucleus is observed: it contains the genetic material (DNA and RNA) of the species (and variety)

The nucleus can be found in the central area of the cell or near the wall.

A great part of the cell can be occupied by the vacuole which contains various organic and inorganic substances.

5.3.2 Spanish lesson plan

Purposes

- Develop an interest in scientific research
- Understand the importance of biology as the basis for the future of living beings.
- Participate actively and responsibly in the advance of biology.

Objectives

- Understand the difference between biological and chemical processes.
- Develop the ability to design and participate in applied research projects in the fields of Biology.
- Acquire sufficient skills for the oral, written and multimedia dissemination of biological knowledge.

Contents

- Scientific methodology and development of research projects
- Living beings: composition and function
- The evolution of life
- Health and sickness

Activities

- Perform practices in the laboratory
- Go out into the field to observe and collect samples.
- Perform multimedia practices
- Conduct workshops with living beings

Examples

Biology is important in our lives for several reasons:

- Food: Organic food is intended to contribute to a more natural and nutritious diet.
- Health: Biology helps understand the cellular and molecular process origin of numerous biological processes and of various diseases and pathologies that are of particular interest in Health Sciences.
- Environment: Biology provides great solutions for the conservation and preservation of the environment, with the intention of minimizing the factors that intervene in the existence of living beings.
- Hygiene: Study of pathogens and diseases and healthy habits.

5.3.3 Latvian lesson plan

Measuring our biorhythm cycles

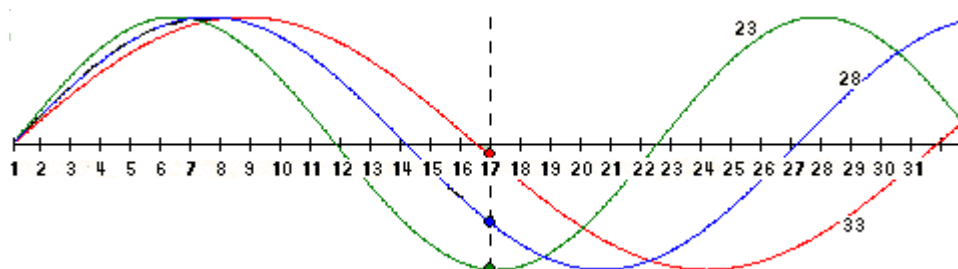
Introduction

Day and night biorhythms - periodic fluctuations in the body's functions - have been seriously studied in both physiological and psychological aspects. Along with the periodic changes of day and night, there are longer periodic cycles of bodily functions:

- 1) a 23-day cycle describes a person's physical condition, energy, and receptivity;
- 2) a 28-day cycle is the emotional cycle, which determines the intensity of a person's creative potential in the emotional, and spiritual life;
- 3) a 33-day cycle manages spiritual intellectual forces and high concentration.

It is believed that the three periodic biorhythms are programmed at birth and their further development can be represented as a sinus curve with a corresponding period of days. The highest abilities concerning the field of life and activity of the person are manifested at higher curve values, the lower, even negative ones - curves in negative areas. At the transition points - critical days – it is necessary to be especially careful. Potentially high capacity are in cases where the positive areas of the curves coincide, low ones - if the negative areas coincide.

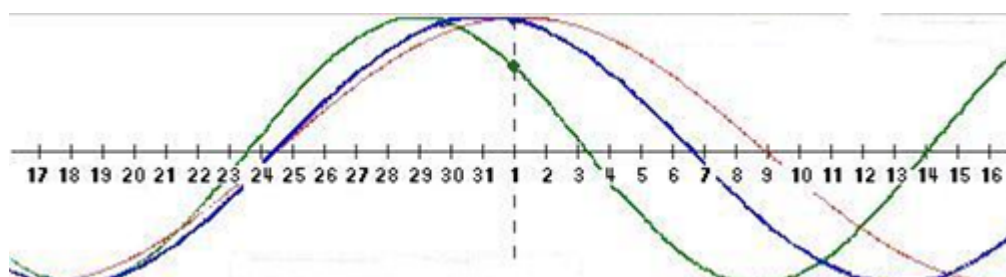
Plotting these curves on the calendar day axis will give Figure 1. The image starts on the first day, but if you want to create your own biorhythm image, you need to determine how many days have passed since the birth and start creating the biorhythm curve for the time you want to embed it.



Let's look at a specific example. The student was born on July 20, 1987. He wants to portray the biorhythm scene from October 1, 2002. $2002 - 1987 = 15$ (years) have passed since the birth of the student. Of these, the long years are 1988, 1992, 1996, 2000, and 2004. In full years the number of days is $365 * 15 + 5 = 5480$ days. Add the difference from July 20 to October 1 - 72 days. Then a total of 5,552 days have passed since the birth.

Divide this number by 23. Let's get 241 full periods and 9 days left. This means that when constructing the 23-day biorhythm from October 1, the 23-day sinusoid has already passed 9 days. We calculate the situation for the 28-day rhythm and the 33-day rhythm analogously. The 28-day rhythm has 198 full periods and 8 days since the start of the rhythm. 168 full periods have elapsed for the 33-day rhythm and also 8 days since the beginning of the rhythm.

Figure 2 shows the biorhythm curves (for a child born on July 20, 1987) from October 1, 2002.



Scientists dispute the dependence of these rhythms on the date of birth because there are very serious crises in a person's life, equivalent to a new rebirth, such as waking up from general anesthesia after a major operation, from a coma, severe mental trauma, and so on.

However, the periodicity of 23-day, 28-day, and 33-day biorhythms exists in human life. Maybe not everyone starts from the date of birth. You can observe yourself on a daily basis and periodically note the maximum influx of your physical strength and energy. You can also mark the periodic cyclical ups and downs of emotional

days, and it is especially convenient to mark the peaks of spiritual intellect because everyone knows that there are days when spiritual work is not going at all, but there is also an influx of spiritual faculties. You can construct biorhythms from your own personal observations.

One should not believe them unequivocally, just as one should not believe rather contradictory published horoscopes in the mass media.

Objectives

Students determine their biorhythms.

Materials

Calendar (if students independently count the number of days lived) or Internet connection with "Eternal calendar" (if it is done online), calculator.

Products

Students will create personal biorhythms for themselves.

Experimental procedure

1. Students count the number of days they have lived.
2. Calculate the current day for each cycle.
3. Create cycle curves.
4. Expected results

Students will be able to predict their abilities in the near future using the obtained curves.

5.3.4 Portuguese lesson plan

Objectives

Students will be able to:

1. recognize that carbon is an extremely common element and can be found in many forms, in both living

and non-living things.

2. recognize that carbon moves between the Earth's four spheres.

3. articulate some ways that carbon impacts us and the earth.

Materials

What Contains Carbon? worksheet (1 per student)

seashell

piece of wood

plastic

fabric

carbonated beverage

cup of water

Teacher Prep

1. Collect the materials as a class set.

2. Print out one worksheet for each student.

Introduction

1. Assess students' prior knowledge of carbon via a class discussion or word map.

2. As you explain its status as an element, highlight diamonds and graphite in their pencils as examples of

pure carbon with vastly different properties.

3. Explain that carbon combines easily with many other elements to form other substances with different

properties. For example, carbon can combine with oxygen to form carbon dioxide (shake carbonated

beverage or have them breathe out to highlight that it's a gas).

4. Let them know that carbon can be found in both living and non-living things. Today's essential question:

Do these everyday objects contain carbon, or not?

Activity

1. Pass out a What Contains Carbon? worksheet to each student. At first, have students work individually to decide whether they think each object contains carbon or not. Emphasize that they need to provide an explanation for their conclusion.

2. Divide students into six groups and assign each group an object. Have students come to a group conclusion about whether the object contains carbon and their explanation.

3. Have each group report out. If the students don't have a conclusion or the group is split, ask them how they could find out what the answer is.

4. Guide students in understanding how each of the objects contains carbon, drawing from prior knowledge. See the teacher background section for details.

5. Challenge students to look around the classroom from their seats and fill in the last three rows of the worksheet with other carbon-containing items in the classroom that they use on a daily basis.

Quick sort

1. As a class, classify the objects into living and non-living groups, including things that used to be alive as living. (You can classify the seashell and the wood as living and the plastic, fabric, water, and carbonated beverage as non-living.)

2. Discuss man-made objects like plastic, fabric, and the carbonated beverage. Discuss where the carbon in these objects comes from in order to emphasize how carbon can move around. The carbon in fabric may have come from living plants (cotton), petroleum (polyester or acrylic), or animals (wool or silk).

Plastic came from hydrocarbons, which were formed millions of years ago from living things. CO in carbonated beverage is from the atmosphere.

Teacher Tip: For older students, you can introduce the specific terms for the earth's four spheres, found in Carbon Cycle Role-Play, when discussing the movement of carbon.

1. To further emphasize how carbon can move around, discuss how carbon might be released from the objects that you studied and where the carbon will go when you release it.

Burning wood will release CO into the atmosphere.

Shaking the carbonated beverage will release CO into the atmosphere.

Seashell may be ground up into small particles by animals or physical forces and form sediment at bottom of ocean.

Assessment Boundary: If you are working towards Performance Expectations 5-LS2-1 or MS-LS2-3 regarding developing a model to describe the movement of matter among living and non-living parts of an ecosystem, remember that students are not expected to demonstrate understanding of molecular movement or describe the process using chemical reactions.

Discussion

Explain that carbon is necessary for life, but can also have negative consequences. Draw a T-chart on the board and have students generate ideas.

Teacher Tip: An example is below, but don't aim to end with these examples. Consider going back to this chart throughout the unit to engage your students in evaluative argument. How does carbon help the planet?

Carbon is an important element in living things.

Plants need carbon dioxide to photosynthesize and grow.

Carbon dioxide in the atmosphere keeps the planet warm.

5.3.5 Belgian lesson plan

As this is a lab-class students are expected to adhere to the standard rules regarding safety and general conduct in a lab.

1. Introduction

The teacher starts by questioning the students in regards to the present state of their knowledge on the subject and elaborates where necessary. Students are then divided into smaller groups and begin prep work in accordance with the teachers directions.

Chromatography process : we start by adding a dot or a line on a piece of paper (see figure). The bottom of the paper is submerged in a suitable solvent (the carrier liquid). The carrier liquid is absorbed by the paper and dissolves the line of the mixture into its components as the liquid passes through it.

Some components stick to the carrier liquid more than others, because they either dissolve into it easier or there's less interaction with the molecules in the paper.

2. Materials

- spinach leaves
- mortar and pestle
- scissors
- acetone

- diethyl ether
- paperclip
- chromatography paper (or fine filter paper)
- 1 beaker with a volume of 100 ml (can be slightly bigger)
- 1 test tube

3. Chemical compounds

Name H-sentences P-sentences

Acetone

Diethyl ether

4. How it works

- take your spinach leaves and use the scissors to cut them in small pieces
- grind the pieces down using the pestle and mortar
- drip a few mls of acetone on the crushed leaves and wait 2-3 minutes
- cut a piece out of the chromatography paper (or the filter paper) of about 1 cm wide. Make sure it is slightly longer than the length of your test tube.
- draw a pencil line about 3.5 cms above the bottom line
- use the paperclip to add a dot of the green liquid to the pencil line
- do this 10 times in total, adding dots to the horizontal line
- prepare the mixture of 10 mls of acetone and 1 ml diethyl ether in the beaker
- pour this mixture in the test tube, until it's filled to the 2.5 cm line. Dip the paper with the chlorophyll in the mixture. Make sure it doesn't touch the bottom of the test tube and that the chlorophyll is about 1 cm above the liquid. Fold the excess paper over the border of the test tube, to make sure the paper doesn't slip down.

- put the test tube in a dark area, the closet is an option
- wait at least 15 minutes

5. Observations

- a) what lines do you observe? Take a photo.
- b) measure the distance from the pencil line with the chlorophyll up to every other line
- c) measure the distance that carrier liquid moved, starting from the pencil line

7. Conclusion

Write down the conclusion you can draw from those observations.

5.4 Environmental Sciences

5.4.1 Italian lesson plan

Determination of nitrites in the water through rapid determination

Introduction

Nitrogen is one of the macro-elements of fertility, as it is part of the nucleic acids, proteins and other macromolecules necessary for life and is indispensable for the development of plants.

Plants extract nitrogen from the soil through the circulating solution (water + mineral salts) which is absorbed by the roots.

The main reservoir of nitrogen in soil is organic nitrogen (an integral part of soil organic matter), which accounts for about 95% of the total. The process of mineralization of organic matter, carried out by various microorganisms, leads to the release of nitrogen in various forms, ammoniacal (NH_4^+), nitrous (NO_2^-) and nitric (NO_3^-)

Plants absorb nitrogen from the soil predominantly as nitric NO_3^- and alternatively ammoniacal NH_4^+ . Nitric nitrogen is free in the circulating solution and its assimilability is much greater than that of ammoniacal nitrogen which is adsorbed on the exchange complex (soil colloids, clays and organic matter) and is poorly washable.

Nitrate (NO_3^-) is naturally found in the environment and is the most mobile and susceptible to leaching. Leakage can be as high as 99% of the nitrates present, so it can become a source of groundwater and surface water pollution. The loss of nitrates by leaching depends on the NO_3^- concentration in the soil, the volume of water drained, the texture and structure of the soil and climatic factors.

The nitrite (NO_2^-) is generally not present at significant concentrations, except in a reducing environment, since nitrate is the most stable oxidation state. It can be formed by microbial reduction of nitrate by microorganisms in the soil.

The extent of the forms of mineral nitrogen present in the soil, represented by nitrites (NO_2^-), nitrates (NO_3^-) and ammonium ion (NH_4^+), depend on the biochemical activities taking place in it.

Nitrate is mainly used in inorganic fertilizers; it is also used as an oxidizing agent, in the manufacture of explosives, in the manufacture of glass. Sodium nitrite is used as a preservative, especially for salted meat.

Nitrogenic substances, and in particular nitrates, can cause adverse environmental impacts on rivers, lakes and coastal waters because, together with phosphorus, they promote eutrophication, i. e. the uncontrolled proliferation of aquatic plants, algae in particular, because of the abundance of nutrients present and leading to a reduction in the quality of these environments. The large amount of biomass produced by decomposing causes sharp decreases in the amount of oxygen in the water, causing e. g. fish deaths

In 1991, the European Union issued a directive, 91/676/EEC, better known as the “nitrates directive”, which indicated to member states the actions to be taken to identify areas vulnerable to nitrates of agricultural origin on their territory and the limits on the amount of nitrogen that can be distributed by fertilisers in these areas.

The content of nitrates and nitrites in water is an important parameter for determining water quality and for identifying possible sources of pollution. These nitrogen compounds may result from industrial, civil and agricultural discharges, in particular due to the excessive or incorrect use of nitrogenous fertilizers. They may be released into the environment as such or may result from the degradation of other substances such as organic substances.

The maximum concentration of nitrates and nitrites in drinking water is defined by law. Directive 98/83CE and its transposition into Legislative Decree 31/2001, set a parameter value of 50 mg/L for nitrate (as ion) and 0.5 mg/L for nitrite (as ion).

The risks from nitrates are primarily environmental. The danger to human health lies not so much in their relatively low toxicity as in their transformation into nitrites which, when combined with other substances in the body, can give rise to

potentially carcinogenic compounds. Hemoglobin and its ability to carry oxygen into the blood (methaemoglobinaemia).

Objectives

Determine the presence of nitrites in water samples

Materials

Gloves and personal protective equipment

Kit for the determination of nitrite

2 Tubes per sample of water

Water samples

5 ml syringe or pipette

Reaction

Measurement of the intensity of the red-fuchsia colour formed by reaction of nitrous ion with sulphanilic acid and naphthylamine in an acidic environment.

Procedure

Respect security measures.

Shake the sample to homogenise.

Rinse the syringe (or pipette) and tubes with the water to be analysed.

Withdraw 5 ml of water to be analysed using the syringe (or pipette) and place it in each of the two tubes.

Place a test tube (blank test) in the left hole of the comparator.

Place the comparator on the colour scale with the coloured fields under the blank test piece.

In the second test tube add 8 drops of reagent A and shake well.

After 10 minutes, place the test tube with the reagents in the right hole of the comparator.

Observe from above and slide the comparator until you find the colour of the sample.

Read the corresponding value, indicated by the comparator arrow.

If the concentration is high dilute the sample and determine the value taking into account the dilutions

Expected results

The presence of nitrates determines the colouring of the sample

The colour scale is used to determine the value of nitrites present expressed in parts per million (ppm) or milligrams per litre (mg/l).

The more coloured the sample, the higher the nitrite content in the water.

Values above 0.5 mg/l indicate waters with nitrogen pollution problems.

5.4.2 Spanish lesson plan

Purposes

- Promote interest in ecology, the Earth and the environment.
- Understand the problems that humans cause in nature.
- Propose solutions to environmental problems.
- Try to obtain tools to develop sustainable systems.

Objectives

- Study environmental problems.
- Study environmental resources.
- Carry out environmental action.
- Take care of the environment.

Contents

- Environmental transversality
- Relationship with scientific subjects: Biology, Chemistry and Physics.
- Relationship with other subjects such as Social Sciences and Business studies, to deal with the social and economic issue.
- Relationship with languages to communicate and connect environmental problems globally.
- Relationships with manual subjects such as the Arts, Technology and Computer Science to carry out the advertising study.
- Relationship with other subjects such as Religious Education, Music, Physical Education and Tutoring to take care of the mind, culture, body and environment.
- Earth dynamic
- Role of the ozone layer
- Formation and destruction of ozone.
- The Greenhouse effect: causes and effect
- The hydrosphere as a climate regulator

- Atmospheric phenomena: storms, anticyclones, etc.
- Contamination
- Effects of human action
- Air pollution
- Water pollution
- Soil contamination
- Management and sustainable development
- Differences between uncontrolled and sustainable development
- Types of waste
- Consequences of waste production
- Assess the protection of natural spaces
- Understand the main organisms in environmental matters.

Activities

Carry out a transversal project for the third year of secondary school:

-Sciences:

- Use of lunch boxes instead of plastic cling film for lunches
- Classroom cleaning
- Cleaning of natural spaces

-Social and business:

- Simulation with money
- Nearby companies dedicated to recycling.

-Languages:

- Contact NGOs and the City Council to carry out specific actions.

-Art, Technology and Computing:

- Create a corporate image of a TV program
- Make an environmental program and upload it to social networks

-Music, Physical Education, Religious Education and Tutoring:

- Prepare the theme tune of the TV program
- Sustainable hygiene habits
- Study the situation of the Amazon according to the Church
- Coordinate the project.

Examples

The environment conditions our quality of life, so we will provide some examples:

- Food: climate change affects crops. With sustainable food, waste food and resources can be avoided.
- Inadequate management of solid plastic waste produces soil and water contamination and the proliferation of harmful fauna that transmit diseases.
- Emissions of gases such as carbon dioxide which are one of the main causes of global warming.
- Loss of biodiversity due to overexploitation of species by human activity.
- Deforestation of jungles and forests such as the Amazon to expand crops.

5.4.3 Belgian lesson plan

1. Objective of the lesson:
 - a) to understand the negative impact and consequences of acid rain on our ecosystem
 - b) to differentiate in impact between different types of plants
2. course of the lesson:
 - a) students are introduced to the subject by way of a movie/documentary on the subject
 - b) students are requested to give their opinion on the matter (short discussion between students)
 - c) students are divided into groups who will, each conduct 1 experiment; half of the groups will conduct the experiment on an vascular plant, the other half on a non-vascular plant
 - d) the safety procedures are discussed with the class
 - e) the students prepare and execute the experiment
 - f) students from the same type of experiment discuss their results
 - g) students from different type of experiment compare their results and discussion possible reasons for differences in results

5.4.4 Latvian lesson plan

Natural pH indicators

Introduction

pH indicators exist as liquid dyes and dye-infused paper strips. They are added to various solutions to determine the pH values of those solutions. Whereas the liquid form of pH indicators is usually added directly to solutions, the paper form is dipped into solutions and then removed for comparison against a colour/pH key. A substance with a pH of 7 (like distilled water) is neutral. A substance with a pH of less than 7 is an acid. The closer the number gets to zero, the stronger the acid is. A substance with a pH of more than 7 is a base. The closer the number is to 14, the stronger the base is.



There are many common household products and garden plants that can be used as pH indicators. Most plants contain pH-sensitive anthocyanins, making them perfect for testing acid and base levels. Many of these natural pH indicators exhibit a broad range of colours.

Since most naturally occurring organic compounds are weak electrolytes, such as carboxylic acids and amines, pH indicators find many applications in biology and analytical chemistry. Moreover, pH indicators form one of the three main types of indicator compounds used in chemical analysis. For the quantitative analysis of metal cations, the use of complexometric indicators is preferred, whereas the third compound class, the redox indicators, are used in redox titrations (titrations involving one or more redox reactions as the basis of chemical analysis).

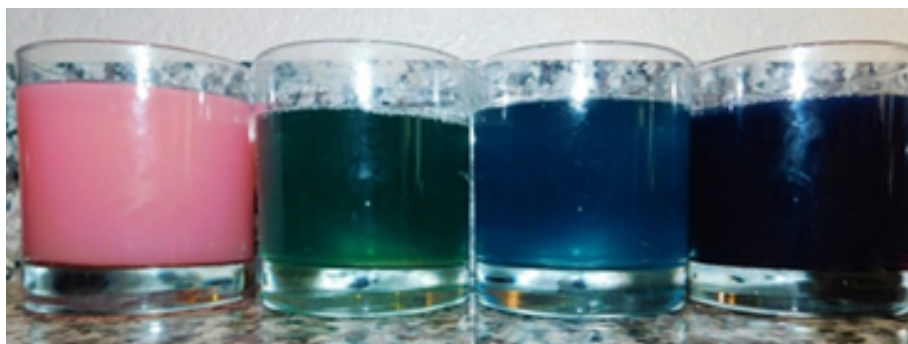
Objectives: To learn how to prepare and use natural pH indicators for the examination of the pH of solutions.

Equipment and reagents:

1. red cabbage, hibiscus tea, red onion peel and/or red beets
2. a small pot for making decoctions
3. 4 glass beakers 250 ml
4. Pasteur pipettes (7-10 pcs)
5. 9 test tubes
6. test tube rack
7. vinegar (aqueous 9 % acetic acid solution) or any other acidic solution
8. alkaline household cleaner or aqueous NaOH solution

Experimental procedure:

1. Decoction of red cabbage, hibiscus tea, red onion peel - pieces of vegetable material cooked ≈ 5 minutes in a small amount of water, then allow the decoction to cool without pouring it down!
2. If blueberry juice or red beet is used, no decoction shall be made, but juice diluted in water shall be used.
3. Dilute an alkaline household cleaner in one of the glass jars!
4. Pour equal volumes of prepared decoction into three test tubes!
5. Add table vinegar to the contents of one test tube, dilute alkali to the other, and leave the third for comparison!
6. Observe the colour change!
7. Repeat the experiment with another decoction or berry juice!
8. Create a table independently and mark the observations in it!
9. Conclude the discoloration of plant materials depending on the solution environment!



Precautions:

Acids and bases are chemicals that can easily damage your skin and eyes. The severity of the hazard depends on how strong the chemical is, how long contact is maintained and what actions you take after contact is made. Use personal protective equipment (PPE) as required.

Expected results:

Participants have learned how to prepare and use natural pH indicators to examine the pH of solutions.

Resources:

<https://chem.libretexts.org/>

<https://t3.ftcdn.net/>

5.4.5 Portuguese lesson plan

Learning Objectives

Students will

1. Explore several issues surrounding our current food system, including food waste, food deserts, agricultural land use, and the environmental impacts of diet choices.
2. Learn more about how food sustainability and environmental issues are impacting people and habitats around the world.

Terms for Students

Sustainability: the ability of a system to last or endure; meeting current human needs without endangering our descendants

Land footprint: the total amount of land required to produce something (e.g., to grow crops, to raise farm animals, or to mine minerals)

Food system: all of the steps a food goes through from being grown to being consumed, including packaging, transporting, and selling.

Materials

Computer with Internet access

Projector

Flipside Science video: The Environmental Impact of Feeding the World

A computer lab with at least one computer for every 2 students

(for Day 2 only)

The Environmental Impact of Feeding the World Journal (1 per student, also available in Spanish, Simplified Chinese, and Traditional Chinese)

A few (2-3) very misshapen fruits or vegetables (e.g., from a local farmer's market)

A few (2-3) empty restaurant take-out containers

A few (2-3) packaged food items with 'expired' sell-by dates (but that are not spoiled)

Examples of processed and packaged convenience store food items (like cheese puffs, candy, bottle of soda)

DAY 1: Teacher Prep

1. Print out one The Environmental Impact of Feeding the World Journal per student

2. Set up stations around your classroom with the following materials:

Food Waste Station: Misshapen fruits/vegetables, empty take-out containers, packaged food items with expired sell-by dates

Food Deserts Station: Examples of processed and packaged convenience store food items

Part I: Introduction to food sustainability and environmental issues (15 min.)

1. Introduce your students to food sustainability and environmental issues by showing them the Flipside

Science: The Environmental Impact of Feeding the World video.

2. Ask for volunteers to talk about one or two things they learned from the video, and make a list of these things on the board. Explain that the youth in the video are talking about some important environmental and sustainability issues related to food. Check that students have an understanding of what 'sustainability' means.

3. Replay the video for students a second time.

4. Working in pairs, students will dive deeper into two of the food sustainability and environmental issues introduced in the video (they will explore the other two issues during the following class period or hour).

Part II: Exploring examples (30 min.)

1. Divide students as appropriate among the stations so small groups can explore the materials up close. It may be best to have students pair up with a single thinking buddy as they complete their journal.
2. Give students 15 minutes at each station, and then have them switch.
3. After students have completed the two activities, bring everyone back together as a class.

Part III: Day 1 Reflection (15 min.)

1. Ask students to share some of their thoughts from the food waste station activity. After you have heard from several students, tell the class that all of the food items at that station are edible and unspoiled. Why do you think people don't like to eat produce that isn't perfectly shaped? How could you inspire or encourage people to embrace misshapen fruits and vegetables? What do you think the 'sell by' date on a food package actually means if it isn't the date the food is no longer edible? Why do the producers put this date on there?
2. Ask students to share some of their thoughts from the food deserts station activity.

5.5 Physics

5.5.1 Spanish lesson plan

Purposes

- Establish elementary and clear ideas about physics
- Establish the experimental activity and reflect on this activity
- Communicate the results of this research in a fair.
- Relate physical and biological concepts.

Objectives

- Consolidate the scientific method based on observation
- Determining physical concepts such as surface tension intuitively
- Encourage students to physically explain to everyone
- Know how surface tension acts in different liquids.

Contents

- Introduction to surface tension
 - Volume concept
 - Surface forces
 - Surface tension and LaPlace's law
 - Liquid properties
 - Capillarity
- Scientific method
 - Methodology to obtain new knowledge.

- Steps: observation, problem, investigation, hypothesis, experimentation, results, data analysis, conclusion and communication

Activities

- Apply the scientific method
 - Observe a problem and seek a solution
- Learn basic laboratory techniques
 - Use laboratory equipment
- Learn to draw conclusions
 - Submit the work to a contest
- Learn to communicate results
 - Intervening in an investigation fair

Biological samples

- How do insects walk on water?
- Function of the lung alveoli in mammals
- Rising sap in trees by capillarity

5.5.2 Belgian lesson plan

Course of the lesson:

1. students are introduced to the subject
 - a. student revise previous learned knowledge on sound waves and their impact on daily life and technology
 - b. students discussion the importance of tuning instruments and why badly tuned instruments pose a threat to safety
2. students discuss how best to test the theory
3. students prepare the experiment
 - a. students discuss different parts of the set up and why they are important
 - b. students execute the experiment
 - c. students adjust the parameters and observe the changes it causes
 - d. students discuss the reasons of why tuning is important

5.5.3 Latvian lesson plan

The force of gravity and its manifestation

Introduction

In what direction is the water flowing? Of course, from top to bottom. This is understandable even to the smallest child.



It is known that in a lot of regions excursion buses take tourists to mountainous regions where guides, using the features of the relief, demonstrate how the water poured out of a bottle “flows” uphill.



There is a problem that needs to be explained. Does this mean that water can flow both downwards and upwards? Therefore, we came up with a construction that will help refute the guides’ story about the gravitational anomaly of such a place.

Why does the ball roll down the mountain? What makes it move this way and not otherwise?



Consider the movement of a cylinder from an improvised slide. It also rolls off of it. Does this mean that the motion of all other bodies will be the same?



Let's try to put a double cone on an improvised slide. And it starts moving up! Did a miracle happen?



Objectives

1. on a specific example to explain to students the features of the manifestation of the force of gravity;
2. to prove that visual perception is not always plausible;
3. to simulate the situation using an experiment.

Materials

For the experiment, two rulers (30 cm), a small rubber ball, a piece of plasticine, and a cylindrical tube of glue are necessary.

Products

Under the influence of the force of gravity, all bodies can move towards the surface of the earth, i.e. down. We will observe the movement of a cylindrical and spherical body from an inclined plane, the sides of which are formed by two rulers located at an angle to each other and raised at one end. At a small angle of divergence of the rulers, both bodies roll down the inclined plane. It is clear to students and does not contradict the way they think about the world around them.

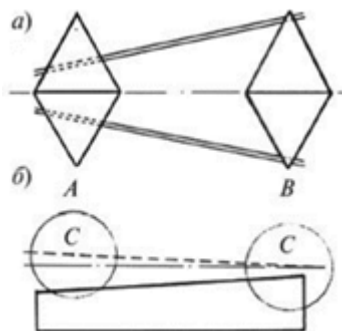
Experimental procedure

To explain this experiment, let us turn to the figure, which shows a top view (a) and a side view (b) of this experiment. The thing is that the guides along which the cone

rolls are located at a certain angle to each other. Therefore, in the “lower” position A, the cone rests on them near its middle, and in the “upper” position B, with its ends. The slope of the guides concerning the horizontal surface of the table is chosen in such a way that the centre of gravity of the cone C in position A is higher than in position B. Then the cone, moving as if “from bottom to top”, actually rolls down from top to bottom, under the laws of classical mechanics.

Any body always tends to take such a position that the centre of gravity of the body takes the lowest position. In this case, the energy of the body will be minimal.

We begin to change the angle between the rulers. The movement of the cylindrical tube occurs from top to bottom, like the first time. However, it seems that the movement of the ball refutes the theory of gravitation since the body moves against gravity as if it is not attracted, but repelled from the Earth, i.e. upwards.



Expected results

In fact, any body always tends to take such a position so that the centre of the force of gravity of the body takes the lowest position (see the figure). In this case, the energy of the body will be minimal.

Thus, it has been proven that tourists are misled by guides who do not know physics very well. Water poured from a bottle does not flow uphill, but downhill. Tourists are shown an optical illusion (visual effect). In reality, the centre of gravity moves down. All bodies tend to take a position in which their energy will be minimal. Therefore, in this case, the smallest potential energy will correspond to the lowest location of the centre of gravity of the body.



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Archimedes' principle in bulk solids and inertia

1. Introduction

It is known that stones “crawl out” to the surface of the earth and every year agricultural workers have to remove them before ploughing. There is a problem that can be explained by applying the concept of Archimedes' principle.



Therefore, we came up with a design that will help you see what is really happening.

2. Objectives

1. To explain to students the features of the manifestation of the force of Archimedes on a specific example in bulk materials.
2. To simulate the situation with the help of an experiment.
3. To prove which bodies are affected by the Archimedes force in bulk materials.
4. To find out what happens to stones in loose soil during an earthquake.

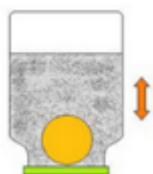
3. Materials

For the experiment, two transparent plastic bottles, sea sand, various metal balls, and light plastic balls are necessary.

4. Products

It is impossible to directly apply Archimedes' principle to bulk solids since the particles of such bodies are subject to friction, which is negligible in liquids. However, if a bulk solid is placed in conditions under which the freedom of movement of particles is not constrained by their friction against each other, then Archimedes' principle turns out to be quite applicable. Dry sand, subjected to frequent shaking, which helps the grains of sand to move, subject to the action of gravity, is an example of such a state.

Robert Hooke, a famous contemporary and compatriot of Newton, wrote about experiments of this kind: "You cannot bury a light body in the sand (subject to frequent shaking), for example, a piece of cork: it will immediately "float" to the surface of the sand; on the contrary, a heavy body immediately digs into it and falls to the bottom of a vessel".



5. Experimental procedure

The essence of the experiment is as follows: pour sand into a plastic bottle along with metal balls and plastic balls. Place the bottle horizontally and move the bottle horizontally from side to side. Metal balls will sink in the sand; plastic balls will float to the surface. It happens because the density of metal is greater than the density of sand, and the density of plastic is less than the density of sand. That is in full accordance with the conditions for floating bodies.



Then how do the stones “crawl out” to the surface of the earth? The buoyancy force cannot lift them! We put a large metal ball on the bottom of the bottle and fill it with sand on top. With a sharp movement, we move the bottle down, the ball appears on the surface. If it does not work once, repeat it several times. As a result, a more inert body - the ball - changes its speed slowly, but the sand does it much faster. Therefore, the ball, as it were, remains in place, and the sand moves down. This is how inertia manifests itself.



During an earthquake, just such vibrations can occur, and the stones gradually “crawl out” to the surface.

6. Expected results

During the experiment, we learned that Archimedes’ principle also acts in bulk materials. Therefore, light bodies seem to float in the sand, while heavy bodies sink. As a result of underground points, the opposite can happen: heavy objects crawl out to the surface.

Additional Information:

If you live in a region without earthquakes, then the reason for the appearance of stones on the surface is completely different.

Stones “crawl out” to the surface as a result of alternating processes of freezing and thawing of the earth. When the ground freezes, the ice boundary in the soil sinks, and water vapor from the soil percolates up to the ice boundary. If there is a stone on the freezing boundary, then it sinks faster in this place, since the stone conducts heat better than the earth. Therefore, the lower part of the stone cools faster than the surrounding earth. More water will freeze in the lower cold surface

of the stone, and as a result of the expansion of the ice when it freezes, the stone will begin to be pushed upwards more than the adjacent land.

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https://teachmen.csu.ru/others/check_know/o62.html

5.5.4 Italian lesson plan

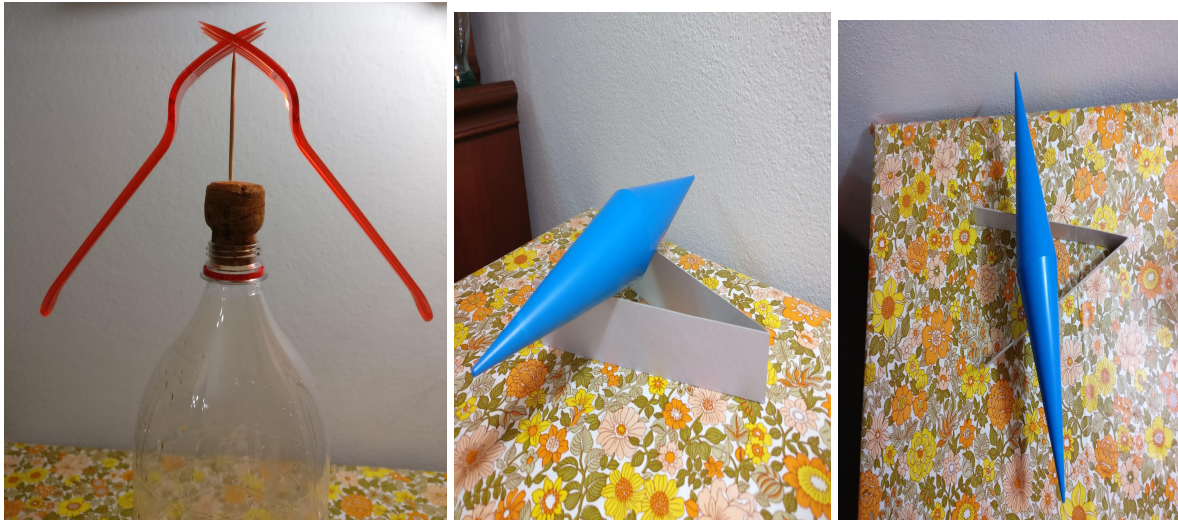
Brief summary of the project and aims

The easiest way to get a student to learn a concept is to turn it into an experience, that is, an experiment. If the experiment turns into a game to do with classmates or friends, it is even better. In the realization of this project, we set ourselves the objective of demonstrating the concept of balance of bodies. Through the use of simple experimental prototypes, we intend to make the relationship between the body and the position of its centre of gravity identifiable. It is known that a suspended or leaned body is in stable equilibrium if and only if the position of its centre of gravity is vertically aligned with the position of the point of attachment or once its minimum possible height has been reached. We thought to present some simple “homemade” demonstration prototypes that allow us to identify this property and analyse its functioning. Students, therefore, will be invited to participate in the realization of simple experiments, through which to acquire naturally the concept of the centre of gravity.

Material and assembly (including some medium-low resolution figures, diagrams or photographs)

The aim is to prove the above theories by means of devices and/or systems made using commonly used materials (cardboard, toothpicks, cork stoppers, glue, forks, wood, small metal objects). Easy access to the materials used will allow students to easily create experimental prototypes even in a completely autonomous way, for example at home or at school. This will promote, through a self-made methodology, the understanding of the physical principle as well as the pleasure of discovery.

Below are the photos reproducing some of the demonstration prototypes.



Justification: Physical principles involved and their relation to technological applications.

A body is in stable equilibrium if, by shifting it slightly from its equilibrium position, it naturally tends to return to it. In fact, when all the forces acting on a body cancel each other out, the body is in equilibrium. To understand how the balance of a body works it is necessary to know its weight and its point of application, where the weight of a body indicates the force with which the body is pushed down (force of gravity).

The demonstration prototypes involved in the experiment will be free to move and through their observation it will be understood that whenever an unstabilizing activity (temporary external force) is exerted on them, they will tend to return to their stable equilibrium position, which is the position for the body with the lowest potential energy expenditure.

Performance and Results: Observations and Measurements

Let's look at the case of a ship sailing on the sea, it moves safely because it has a centre of gravity and the force that will keep it in stable equilibrium will be applied. Every prototype has a centre of gravity. On the basis of this hypothesis, simulations will be carried out in which it will be possible to test that, even starting from different conditions, e. g. starting positions imposed by an external operator, each prototype will return to its original stable equilibrium conditions and will continue there until an external condition (external force) acts again which will change the

equilibrium of the prototype and its position. Therefore, some prototypes will oscillate in search of the equilibrium position, others will rotate until they reach it.

Conclusions

All bodies have a natural tendency to seek the condition of stable equilibrium. Prototypes stimulate children's intuition to understand equivalences in existing systems. For example, the prototype made with the two forks is equivalent to a two-arm scale or a construction crane, a ship oscillates on the sea as does the eccentric wooden disc until it reaches the equilibrium position. The principle that regulates the centre of gravity of the body finds considerable applications in the field of technology, everything that is made by man has a centre of gravity; for example, the comfort with which you hold a smartphone is simulated by carefully evaluating the position of its centre of gravity, its vibration system works thanks to the rapid movement of an eccentric mass in the centre of gravity.

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5.5.5 Portuguese lesson plan

Free fall with MakeyMakey

Main objective:

The object of this experiment is to determine the value of the acceleration of gravity by measuring the time of a freely falling object using MakeyMakey and Scratch to get the falling time.



Material

Makey-makey, electric cables, laptop or notebook, rubber/ball (falling object), ruler, holders of 2 m (for cables), aluminum foil or copper cables.

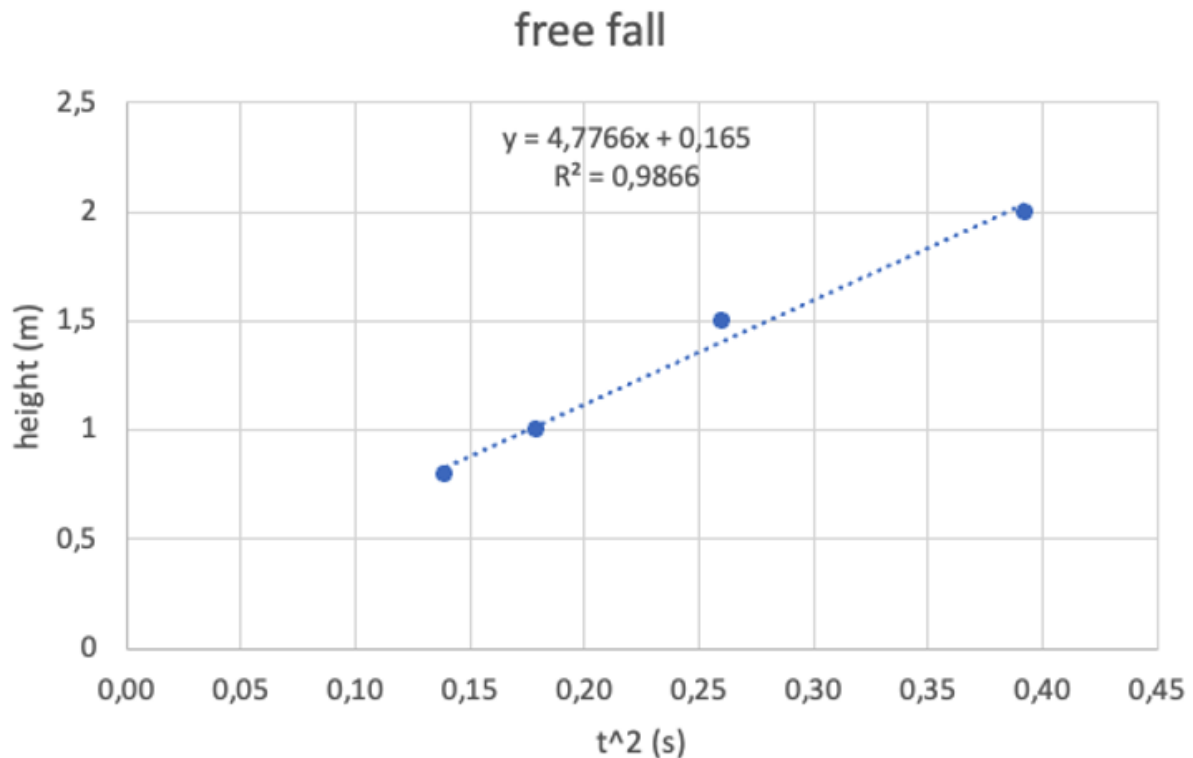
Introduction

An object dropped near the earth's surface will accelerate uniformly with the acceleration due to gravity (g) toward the earth.

Thus, according to the equation describing motion for a uniformly accelerated object, its position y as a function of time t is $y = \frac{1}{2}gt^2$.

If we graph distance fallen vs. time squared the data should yield a linear graph similar to the one shown below.

y-height (m)	x-time(s)	average time (s)
	0,37	0,37
0,80	0,39	
	0,36	
	0,40	0,42
1,00	0,43	
	0,44	
	0,56	0,51
1,50	0,49	
	0,48	
	0,61	0,63
2,00	0,60	
	0,67	



Conclusions

Using equation (start velocity is zero)

$$y = 0.5gt^2$$

We get the slope of 4.777, which returns $g = 9,55 \text{ ms}^{-2}$.

The experiment was conducted at sea level of 34m.

$$\text{Difference} = |9,80 - 9,55| \times 100 / 9,80 = 2,6\%$$

The more measures we get, the better approach g we get.

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Chapter 6: Results of surveys

According to the project, three surveys of students and families from all partner countries were carried out before, during and after the duration of the project to discover their interest in STEM. However, due to the change of the coordinating person by the coordinating center and the pandemic, the results of the first survey were lost and due to lack of time (4 mobilities were carried out in the short term of 6 months), only two surveys could be finally carried out.

The questions of these surveys did not change throughout the project, the following being directed to the students:

1. Country
2. Age
3. Gender
4. What is your interest in sciences (Biology, Physics, Chemistry, Geology, Environmental Sciences...)?
5. Have you ever done a practice in a lab?
6. Have you ever participated in a science congress?
7. Would you like to study a scientific career? Yes/No? Why?
8. Do you feel supported by your parents to study a scientific career?
9. Do you think that you can get a good job and earn money having studied science?

The families, for their part, received the survey in their mother tongue with the following questions:

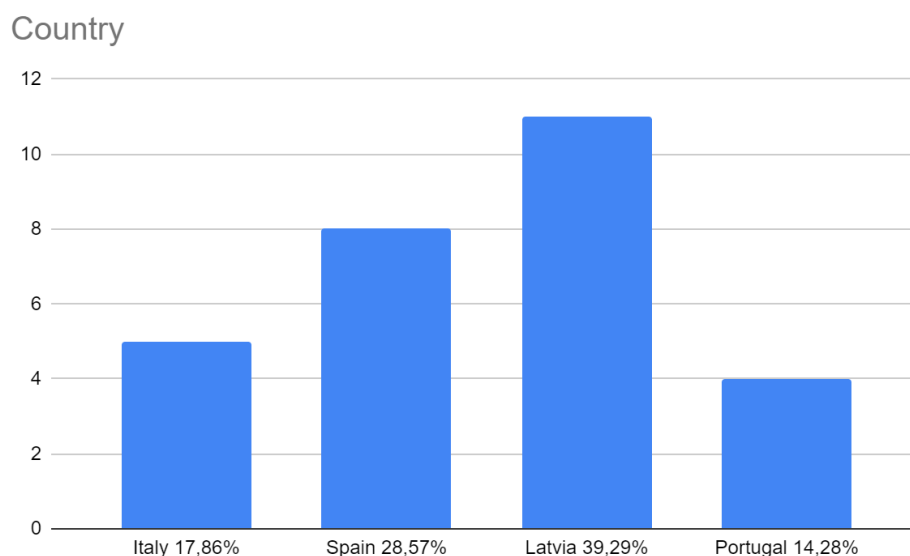
1. Country
2. Do you think science is important in your child's studies?
3. Would you encourage your child to study a science degree?

4. Are you satisfied with the experience? Would you repeat it again? Would you recommend the experience?
5. Did you face any problem?
6. Additional comments

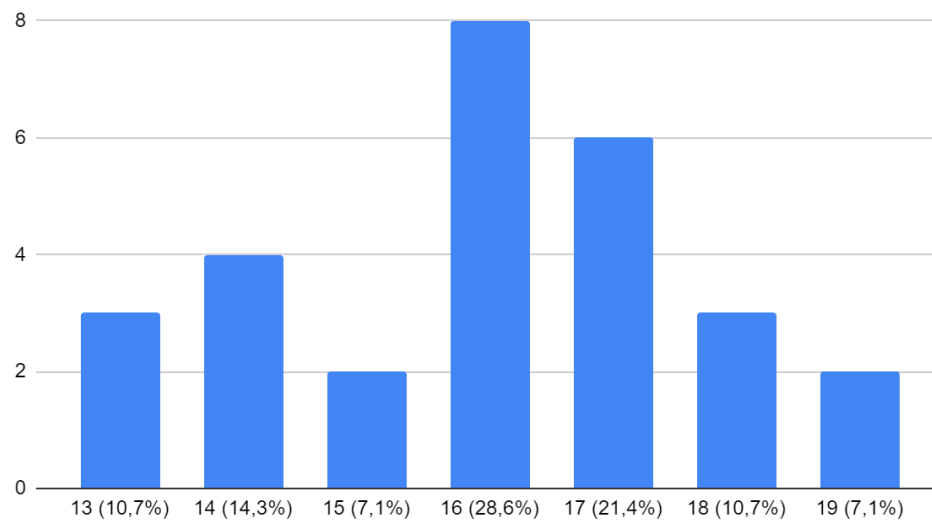
The results of the aforementioned surveys are shown in the following two subsections. Nuances made, deductions drawn, and other comments are found throughout the charts. Hence, it is recommended that you read the information written below in full for its full understanding.

6.1 Mid-project survey, September 2021

The first survey from which data was collected was launched in September 2021, once the pandemic was over. At that time, only the meeting had been held in Portugal, leaving the remaining 4 scheduled for the following 6 months. A total of 28 students responded to this survey, these being the results:

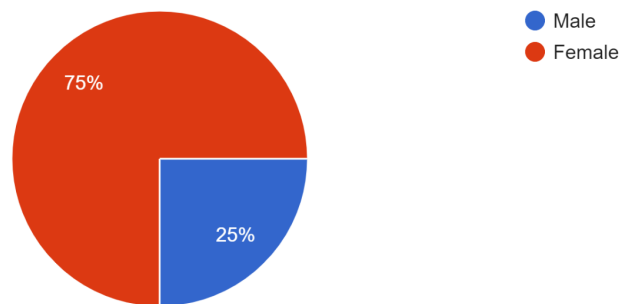


Age



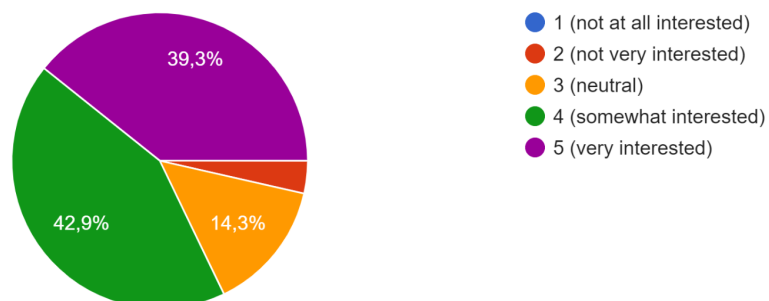
Gender

28 respuestas



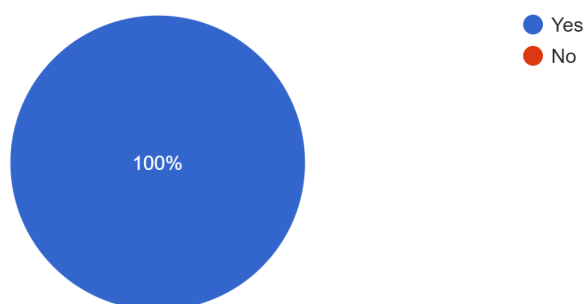
What is your interest on sciences (Biology, Physics, Chemistry, Geology, Environmental Sciences...)?

28 respuestas



Have you ever done a practice in a lab?

28 respuestas

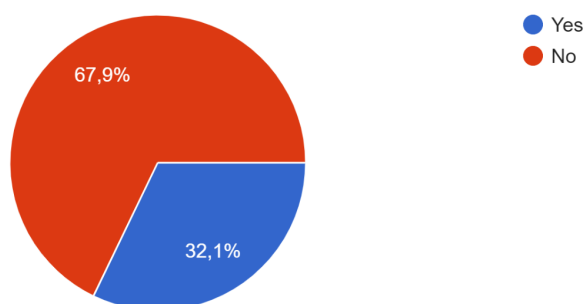


We already anticipated the result of this question, since one of the activities established for all the meetings was a teachers' meeting aimed at comparing the curriculum of the science subjects. We realized that all the schools had a more or less equipped laboratory, but that the hours that each country spent each week using it were completely different. There were countries, such as Spain, that only carried out practices in the laboratory once or twice a quarter, while countries such as Belgium spent an average of 4 hours per week. This is due, in large part, to the approach of each educational system, but age and educational stage may also have had an influence, since following the same example, the Spanish students were 13-14 years old and the Belgians 18, so the level of choice and specialization in the different subjects changes.

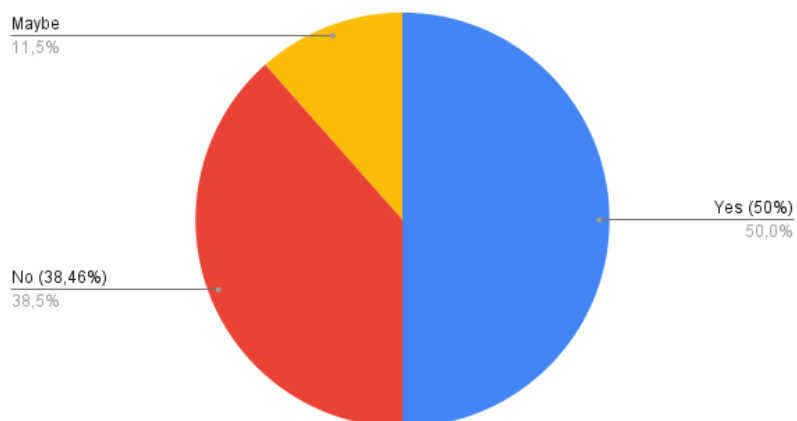
In short, all the students had previously carried out practices in laboratories, but during the congresses the confidence and management of some stood out, compared to the inexperience of others. Furthermore, these teachers' meetings turned out to be key in the change of methodology that this project had as its objective.

Have you ever participated in a science congress?

28 respuestas

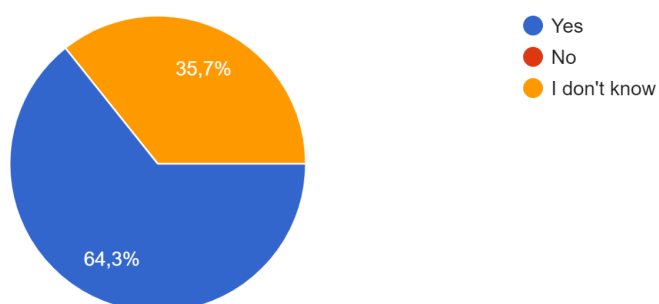


Would you like to study a scientific career? Yes/No? Why?



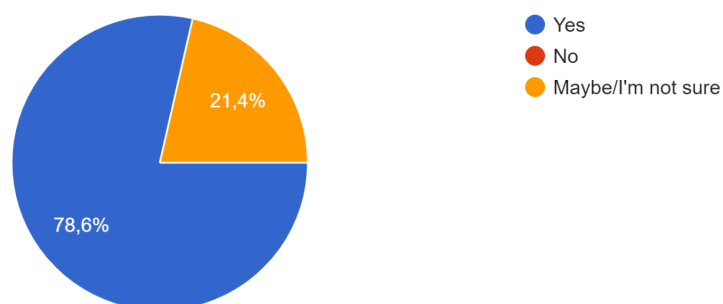
Do you feel supported by your parents to study a scientific career?

28 respuestas



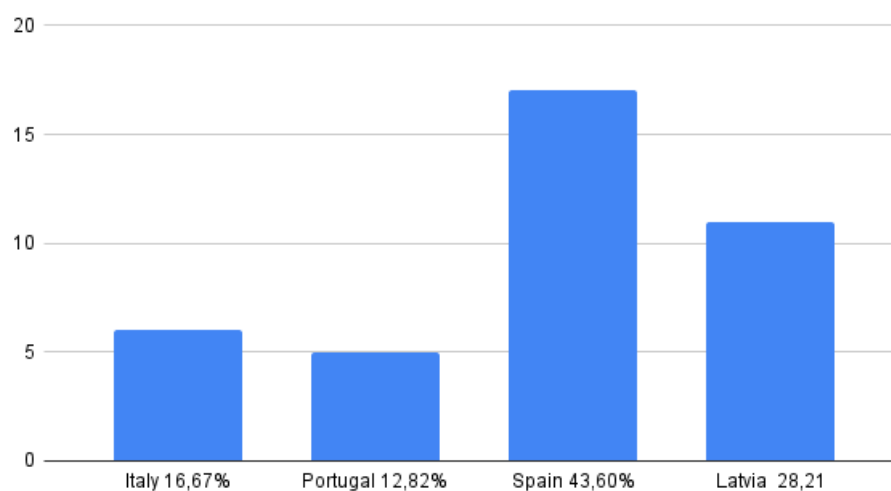
Do you think that you can get a good job and earn money having studied science?

28 respuestas

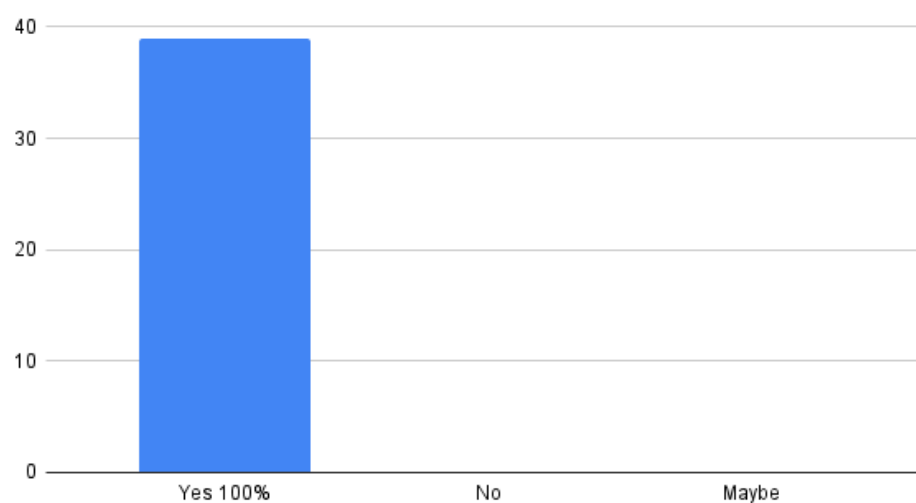


At the same time, the families' survey was also shared. The results are as follows:

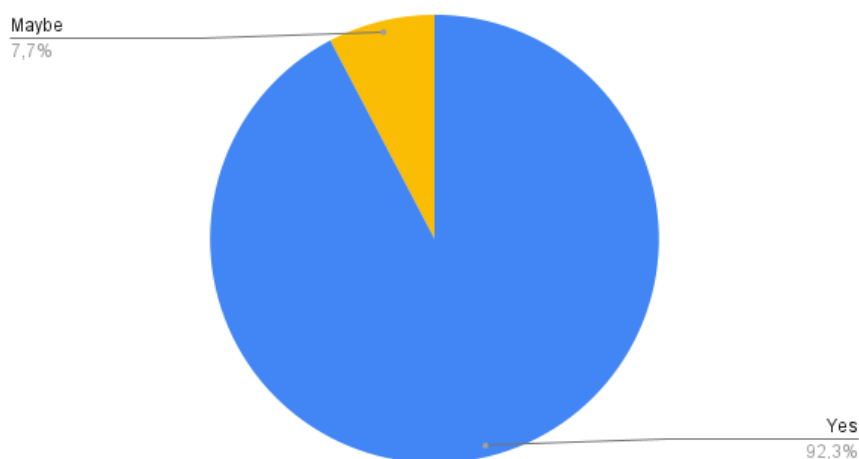
Country



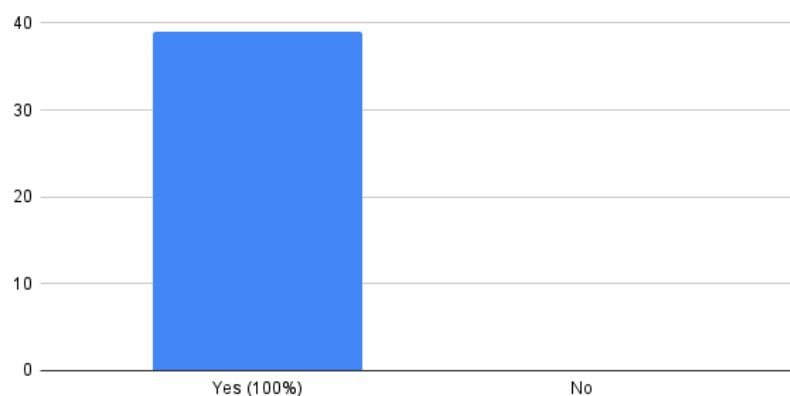
Do you think science is important in your child's studies?



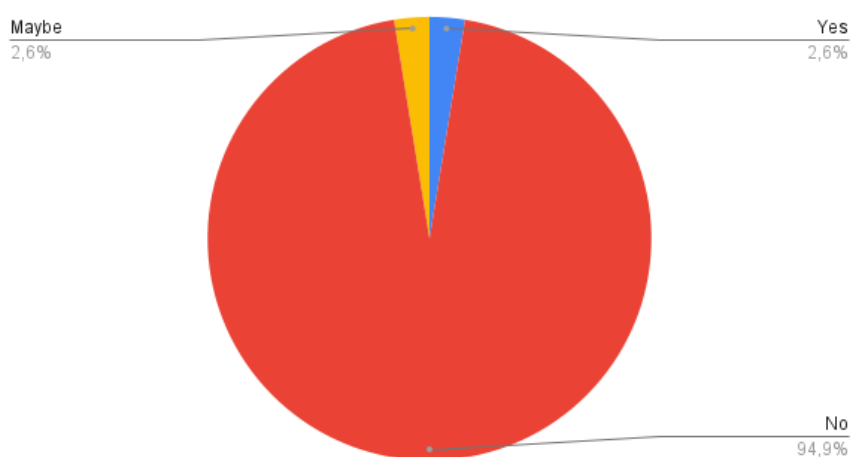
Would you encourage your child to study a science degree?



Are you satisfied with the experience? Would you repeat it again? Would you recommend the experience?



Did you face any problem?

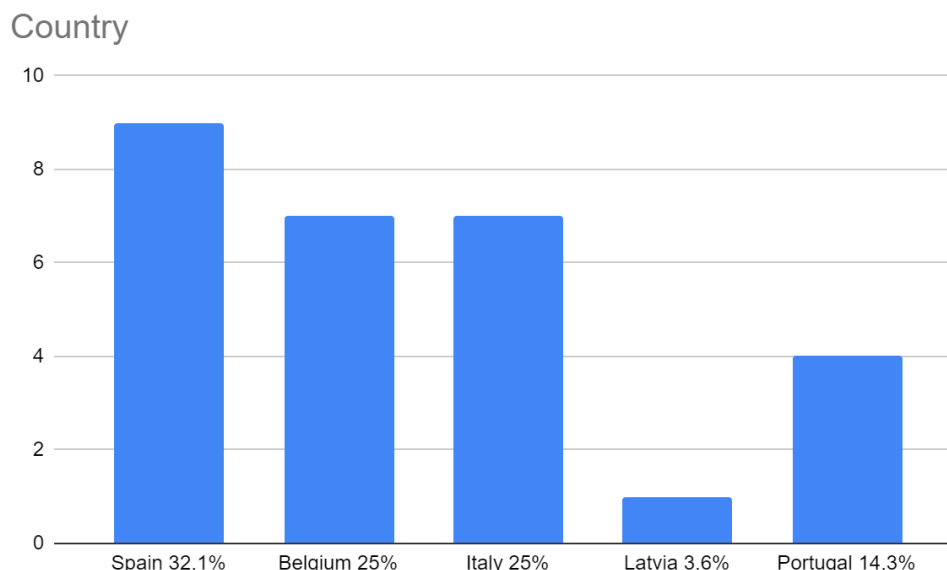


When it comes to the last open question “additional comments”, all families agree that it has been a really fruitful experience for students taking into account not only the educational side, but also the social and personal one. Parents even highlight the work done by teachers and the organization, and hope more Erasmus projects can be carried out in the future.

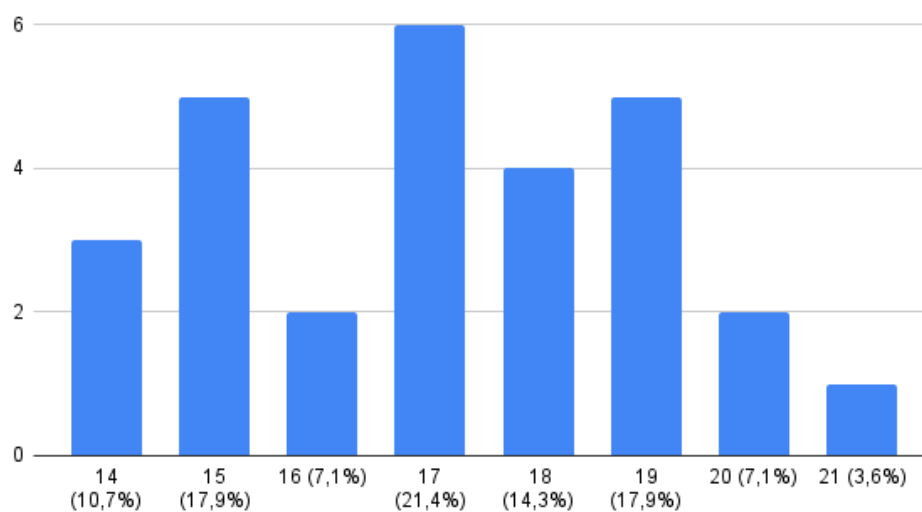
These first statistics from both families and students were undoubtedly positive. The fact that maybe stands out the most is that 75% of the students answering the survey were females, a percentage that also equates to the number of girls taking part in the exchanges. Having in mind that one of the goals of this project is to encourage women to take part in science studies and life, we seem to have fulfilled this objective in the first phase of the project.

6.2 Final survey, June 2022

The second survey was launched once all the mobilities had been completed, that is, in June 2022. The same questions were used as in the previous survey, with the results of the students being as follows:

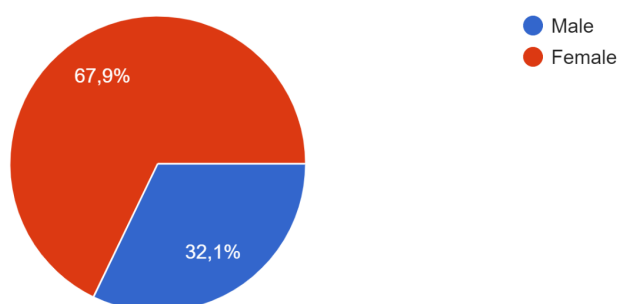


Age



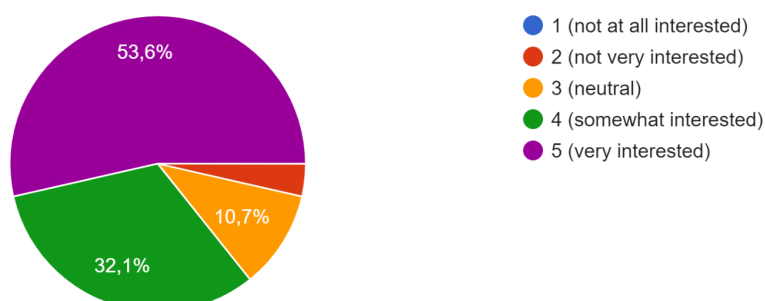
Gender

28 respuestas



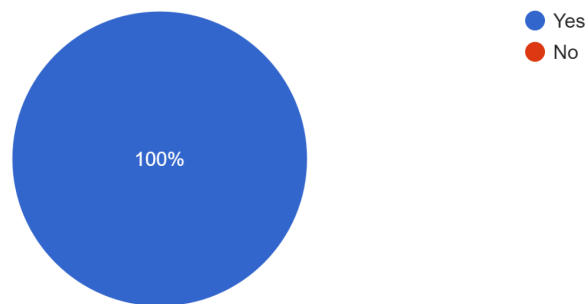
What is your interest on sciences (Biology, Physics, Chemistry, Geology, Environmental Sciences...)?

28 respuestas



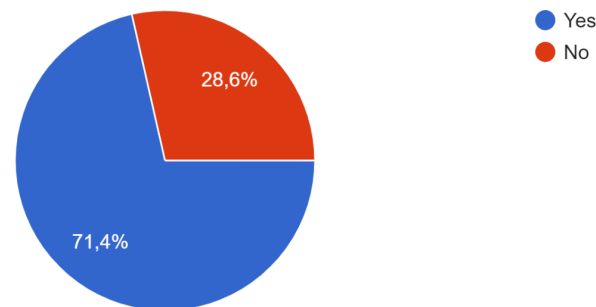
Have you ever done a practice in a lab?

28 respuestas

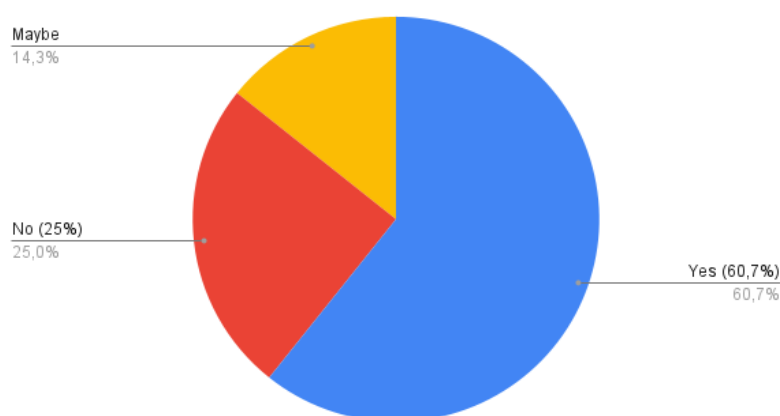


Have you ever participated in a science congress?

28 respuestas



Would you like to study a scientific career? Yes/No? Why?

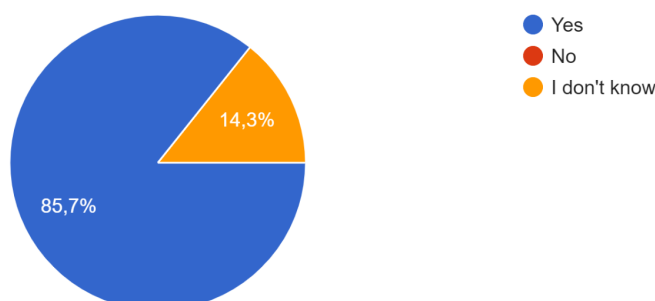


Among the main reasons why our students do not want to study a scientific career is sociability: they prefer to work with the public. Those who do have in mind to choose a scientific career, highlight the usefulness and necessity of this, as they

ensure that our day to day is based and happens thanks to science, as announced by the name of this project.

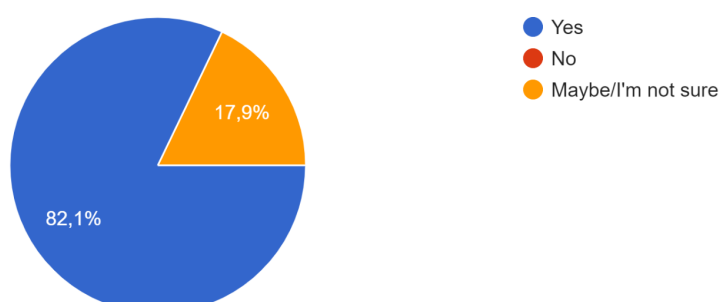
Do you feel supported by your parents to study a scientific career?

28 respuestas



Do you think that you can get a good job and earn money having studied science?

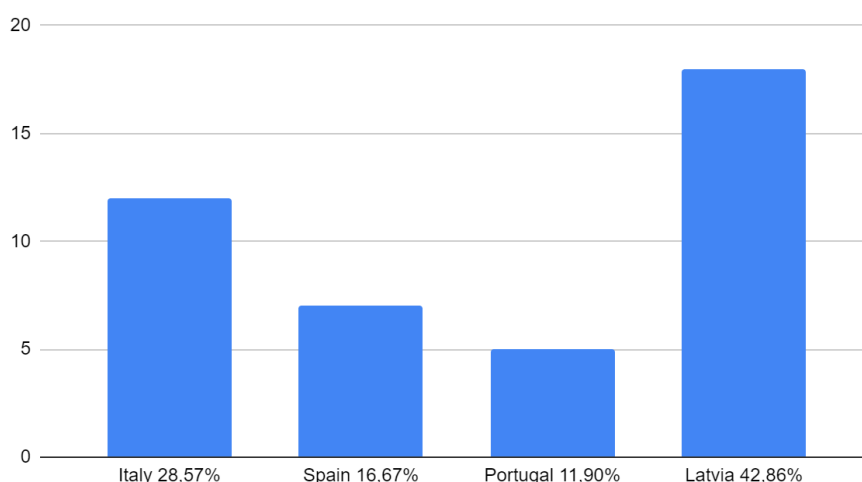
28 respuestas



If we compare the results of the first survey and the second, there are three questions (interest in science, participation in a congress and choice of a scientific career) whose responses are striking. The positive increase in the three cases may be due to the fact that some students (especially from Latvia and Belgium) repeated in several meetings, that is, they participated not only in one mobility. Hence, the interest in science could be greater at the end of the project, the percentage of participation in congresses increased, as well as the desire to study science. If so, we could say that we have fulfilled another of the project's objectives: to increase the attractiveness of STEM subjects.

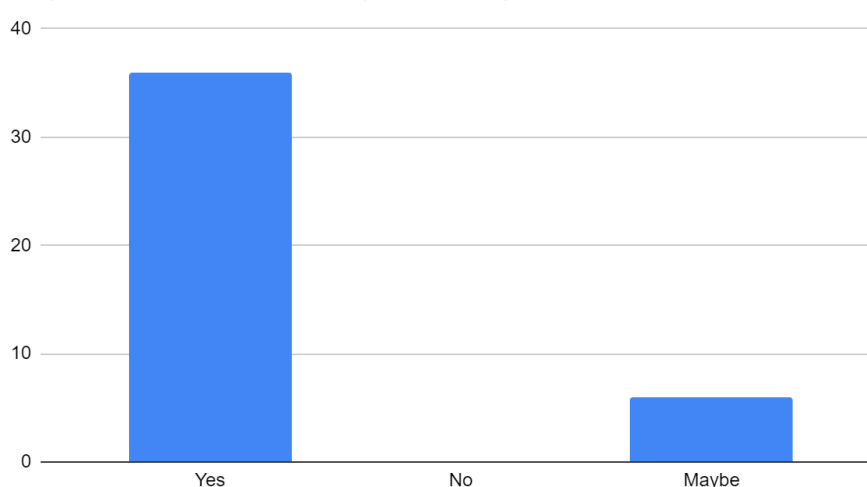
Similarly, families answered the survey for the last time. Here are the results:

Country



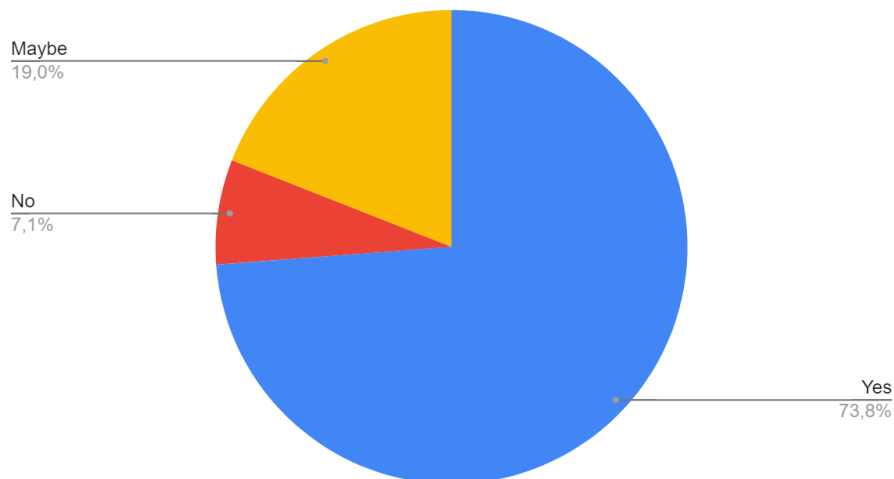
The non-participation of Belgian families both in this survey and in the mid-term survey is largely due to the age of the students involved in the project, since they were already of legal age.

Do you think science is important in your child's studies?



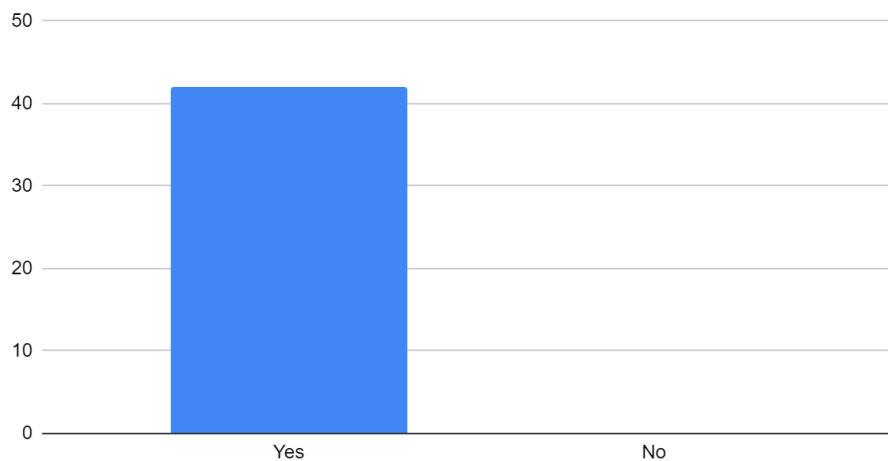
Some families seem to doubt the importance of science, but do not express their thoughts. Among the parents who trust in its usefulness, there are those who emphasize that “In fact, It should be a major concern, because it plays a bigger role in modern societies”, something that pleases us, since this project was born from the same way of understanding the present.

Would you encourage your child to study a science degree?

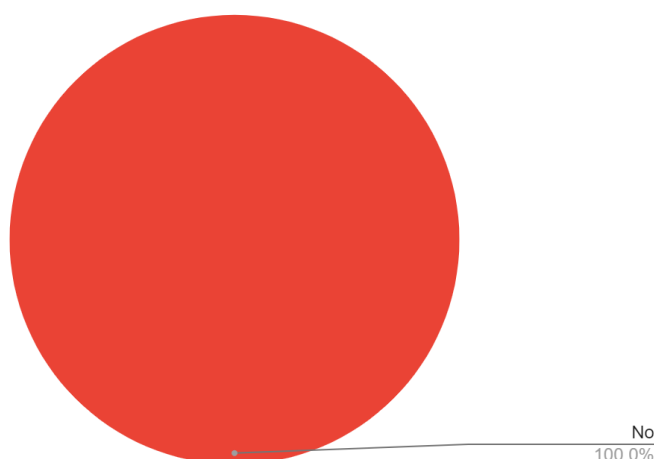


Again the negative response is not accompanied by any explanation. The “maybe” option, for its part, has been chosen both in the previous survey and in this one by both students and families. Perhaps the young age of some participants is the reason why the students have not discussed the option of studying a scientific career at home and the parents have not considered it yet.

Are you satisfied with the experience? Would you repeat it again? Would you recommend the experience?



Did you face any problem?



In the last question “additional comments”, the parents again thank the role of the center and the teachers in the involvement of the project. They also allude to the importance of Erasmus projects for adolescents. And last but not least, there are two families whose comments have been the following: “Science is very interesting and fascinating” and “Science was more fun for my daughter after that”. It is especially this last comment that has filled us with real pride, since apparently we have managed to get a girl student interested in science and share this concern also with those close to her.

Chapter 7: Women Scientists (biography)

7.1 Geology

7.1.1 Latvian geologist Austra Stinkule

Latvian Doctor of Geology Austra Stinkule was born on July 27, 1936 in Riga. She was three years old when World War II began. She studied well at school and after finishing it in 1954 decided to study chemistry at the State University of Latvia, specializing in silicate technology. Since the studies were completed with excellence, she was immediately offered the work in the laboratory of the Institute of Geology of the Latvian Academy of Sciences.

In 1959 Austra started her career as an engineer, in two years she became a junior research fellow at the Institute of Geology and Minerals. There she also gradually got acquainted with the field of geology, worked on publications, and in 1967 received a degree in Geology and Mineralogy. She practically spent her entire life at the Institute of Geology as a senior researcher.



Austra Stinkule and her son Ģirts Stinkulis, also a geologist

Austra Stinkule is the author of several books on different types of mineral resources in Latvia and on all minerals in general. Participation in another book is not excluded. Austra Stinkule's lifetime work is Latvian clay - its formation, distribution, quality and practical use. Her monograph *Clay in the Depths of Latvian Earth* published in 2014 provides basic information about minerals in the depths of the Earth and their potential uses, as well as their quality characteristics. She also was a lecturer at the University of Latvia and led courses in mineralogy and

geochemistry. She sees herself as a chemist, though, of course, much more has been done in the field of geology than in her original specialty.

7.1.2 Portuguese geologist Maria da Conceição Freitas

Present position, institution, starting date: Full Professor (since 2012), Univ. Lisbon; Head of Geology Department. Main scientific technical area of research Coastal Geology, Geomorphology, Sedimentology, Quaternary Geology, Paleoenvironmental Reconstruction, Estuaries and lagoons Other scientific technical areas of interest or activities Management and Environmental studies, Impact of Climate Change Supervisor or co-supervisor of post graduate students.



7.1.3 Italian geologist Alessandra Curotti

Born in 1967 and qualification as a Geologist in 1993; Work experience aimed at the protection of the environment at local, regional and national level, with functions related to the enhancement and the sustainability of the National Park of the Tuscan - Emilian Appennines; Collaboration with the Province of Reggio Emilia: project dealing with the dissemination of the places of geological interest in the territory with meetings, excursions, seminars and a final conference entitled "The Geology of the Apennines: risk and resource"; "Earth education" course in 2002.



7.1.4 Spanish Geologist Duna Roda Boluda

Dr. Duna C. Roda Boluda

Biografy of a geologist woman.

This woman is a teacher and geologist from Picanya. She has been awarded in the local category "Dona Científica Valenciana Awards" (Valencian Scientist Woman Awards), in Picanya (Valencia) City Council"



She was awarded a very prestigious Marie Curie scholarship, offered by the European Union to encourage the training of the most promising young people.

Now, with the Marie Curie grant, Duna is among the elite of European scientific research.

7.1.5 Belgian geologist Elise François

Elise François is a young and promising geologist who works within the Team of High Temperature Processes and Industrial Ecology within the department of Sustainable Metals Processing and Recycling of the KUL (Catholic University of Louvain). She aids in developing a sustainable future from the perspective of the mining industry. More specifically, how to develop innovative processes in order to transform them towards engineered materials while considering the sustainability of the envisaged process and the fate of metals.

7.2 Chemistry

7.2.1 Latvian chemical scientist Iveta Pugajeva



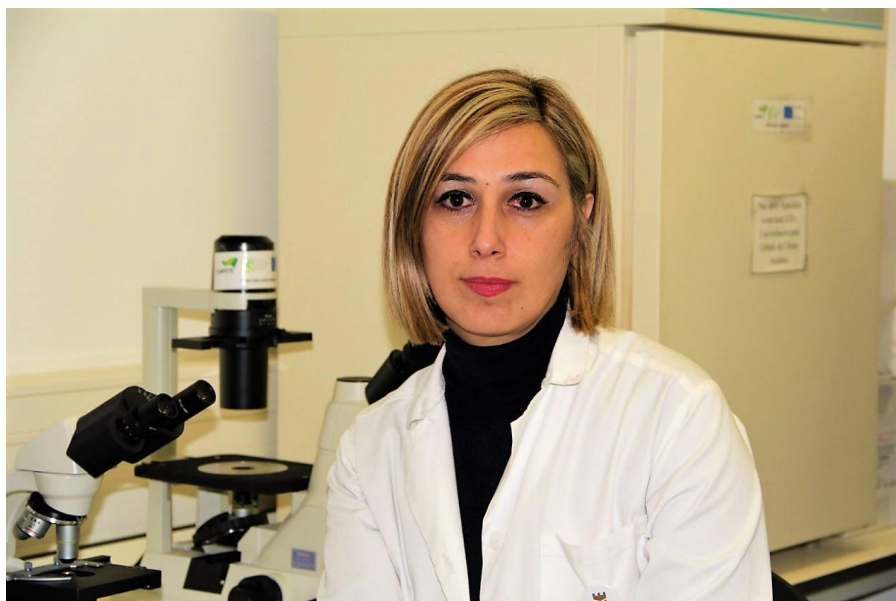
Dr. Chem. Iveta Pugajeva is the leading scientist at the Institute of Food Safety, Animal Health and Environment BIOR and the head of the Chromatography Group of the Chemical Laboratory.

Iveta has been working in the chemical industry for 16 years, is the author of more than 50 scientific publications and she has launched an unprecedented Baltic-wide study to develop a new wastewater research methodology for a better understanding of public health.

Iveta works on wastewater-based epidemiology – an innovative approach to research various contaminants in samples of waste water that characterize, for example, the food and alcohol consumption habits of the population, in order to develop a new methodology for public health assessment. The data obtained in the research will provide useful epidemiological information on the lifestyle, dietary habits and public health of the Latvian population.

In 2020 she received the L'ORÉAL Baltic Prize for Women in Science. Iveta is honored to be noticed by the scientific community, and for her this award is a great encouragement for the future. She believes that everyone has different gifts and everybody should never give up.

7.2.2 Portuguese chemical scientist Isabel Ferreira



Isabel Cristina Fernandes Rodrigues Ferreira (Nampula, Mozambique, 1974) is a Portuguese scientist specializing in agri-food. She has been, since October 26, 2019, Secretary of State for Interior Enhancement in the XXII Constitutional Government.

Considered one of the most influential Portuguese researchers worldwide, Isabel Ferreira has a degree in biochemistry from the Faculty of Sciences of the University of Porto and a PhD in Chemistry from Faculty of Sciences of the University of Minho, and has dedicated herself to a line of research that consists of how to replace synthetic components in the food industry, by studying species of mushrooms and plants from the northeast of Trás-os-Montes to identify new molecules. The study of healthy alternatives and the study of molecules with bioactive interest have captured the attention of other scientists worldwide. Isabel Ferreira is seen as the scientist who "is exploring one of the most dynamic areas in agri-food research.

7.2.3 Italian chemical scientist Silvia Marchesan

Associate Professor of Organic Chemistry at the Department of Pharmaceutical Chemistry in Trieste, where she manages the university's laboratory, she works on molecules and superstructures in the search for bio-sustainable materials. She has developed a self-assembling protein hydrogel useful for repairing body tissues. She studied in London, Finland and Australia. It is worth hearing once more what she has to say about work-family reconciliation in our country.



7.2.4 Spanish chemical scientist Pilar Mateo



Pilar Mateo Herrero, is a Valencian recognized scientist in the field of chemistry. She is listed in the top 10 most prestigious women scientists in Spain. She has focused her scientific activity on the development of high-tech products with his own polymer microencapsulation technique. She has carried out several projects to improve the quality of life of the most vulnerable communities.

He firmly believes that "Science must be at the service of society". He has focused his professional activity on the development and application of new technologies to eradicate deadly diseases that spread due to poverty. She has received numerous national and international awards, among which are: Ashoka Fellow 2011. Professional Woman of the Year 2012 (FEDEPE).

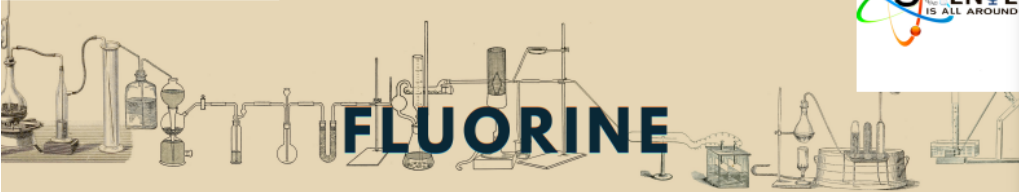


7.2.5 Belgian chemist Veronique Gouverneur



Co-funded by the
Erasmus+ Programme
of the European Union





FLUORINE

VERONIQUE GOUVERNEUR

WHO IS VERONIQUE?

Veronique was born in Geel, Belgium in 1964.
She holds a master's degree in chemistry and a doctorate from the Université catholique de Louvain.
She joined the faculty of chemistry in Oxford in 1998 and became a professor.
She chose to study fluorine.

9 18.998

F

Fluorine
[He] 2s²2p⁵
Halogens

RESEARCH

Some hydrogens in hydrocarbon molecules are replaced with fluorine to form the organofluorine molecules.

Veronique Gouverneur's research helped with the findings of new synthetic ways of making organofluorine molecules and the fluorination catalyst.

APPLICATIONS

Medicine:
Medication: Used in sleep medication, cancer medication, to fight fungi or yeasts, ...
The bond is generally metabolically stable and the fluorine atom is a bioisostere of the hydrogen atom.

Scanning: PET scans.

Refrigerant:
Used in large cooling systems. Harmful for the ozonlayer.

Catalyst:
To speed up other reactions. Fluorine is the most electronegative atom.

AWARDS

AstraZeneca:
for organic chemistry
- 2005

Royal Society of Chemistry's Bader award:
Synthetic organofluorine
- 2008

Royal Wolfson Research Merit Award:
for her work in the Oxford university
- 2013

ACS Award:
for Creative Work in Fluorine Chemistry
- 2015





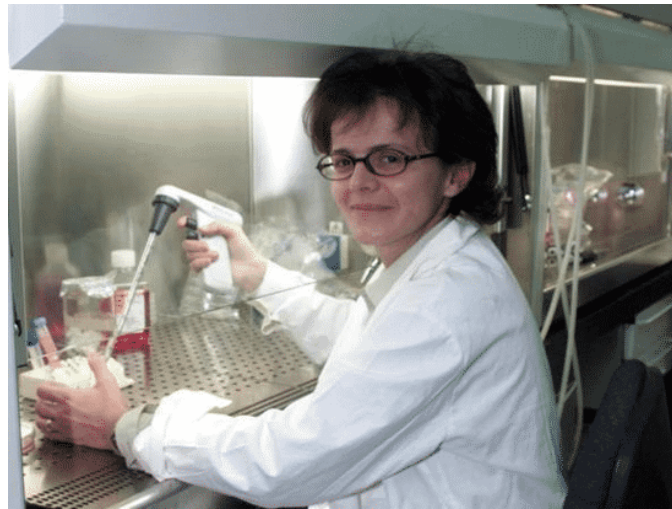




7.3 Biology

7.3.1 Italian biological scientist Elena Cattaneo

Biologist, pharmacologist and science communicator, Elena Cattaneo is the Italian woman of stem cells. In fact, her career led her to work for many years at MIT in Boston, where she began her long journey of research into stem cells and Huntington's Korea, a neurodegenerative genetic disease.



7.3.2 Spanish biological scientist Maria Blasco



María Blasco Marhuenda

Maria Blasco was born in 1965 in Alicante. She is one of the most internationally renowned Spanish scientists. Throughout her scientific career

María Blasco has worked about:

- Generation of the first telomerase-expressing mouse
- Discovery of telomeric RNAs
- Demonstration that telomerase activity determines the regenerative capacity of cells.
- Discovery that telomeres rejuvenate after nuclear reprogramming
- Discovery that telomeric protein can act both as a tumour suppressor and as a factor in the prevention of ageing

7.3.3 Belgian biologist Christine Van Broeckhoven





SCIENCE IS ALL AROUND

CONGRES ON BIOLOGY

CHRISTINE VAN BROECKHOVEN

She is born on 9 april 1953 in Antwerp. Today she is best known for her breakthrough in the research of neurodegenerative dementia that has been recognized and awarded several times nationally and internationally. She is since 1999 a professor in molecular biology and genetics.



DEMENTIA

Dementia is an overall term for conditions and diseases that decline language, memory, problem solving and other thinking problems that affect a person's everyday activities. Alzheimer's is the most common cause of dementia.

ALZHEIMER

Alzheimer's disease is an irreversible, progressive brain disorder that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest tasks. The disease is named after Dr. Alois Alzheimer. In 1906, Dr. Alzheimer noticed changes in the brain tissue of a woman who had died of an unusual mental illness. Her symptoms included memory loss, language problems, and unpredictable behavior.

AWARDS

The American Potomkin prize in 1993 for her work on the Alzheimer genetics

In 1995 with the 5 yearly prize for her scientific oeuvre at the National Fonds for scientific research

Prize for woman in science form L'Oréal/UNESCO in 2006

the European Inventor Award for research in 2011

MetLife Award for Medical Research, USA

And a lot of other scientific prizes in Belgium



7.3.4 Latvian biologist Aina Muceniece

Aina Muceniece (23 March 1924 – 14 February 2010) was a Latvian immunologist, and inventor of RIGVIR who discovered that an echovirus might be a useful treatment for melanoma.



Aina Muceniece was born in Katlakalns, Latvia. She graduated in 1941 from the School of Commerce in Riga and worked as a nurse during World War II. After the war, she studied medicine at the Latvian State University, where she earned a doctor's degree in 1974.

Muceniece's scientific career began at the Institute of Microbiology, Latvian Academy of Sciences, first as a senior laboratory assistant, later as a senior research associate. Muceniece's laboratory started to study enteroviruses in the 1960s, and the research led to the identification of an echovirus that had possible use to treat melanoma, which became RIGVIR (Riga Virus). Production and research were discontinued in 1999 and restarted after national registration in Latvia in 2004.

Muceniece also worked at the Pauls Stradiņš Hospital and the National Oncology Center as an immunology consultant from 1977 to 2003.

In 2002 she was made an honorary member of the Latvian Association of Oncologists. In 2005 Muceniece received the Cross of Recognition, which is awarded to Latvians and foreigners for special services in public, cultural, science, sports, and education, for meritorious service to the Republic of Latvia.

Before she died in 2010 at the age of 85, she published 190 papers and three monographs.

7.3.5 Portuguese biologist Ana Hilário

Ana Hilário is a deep-sea ecologist at Centre for Environmental and Marine Studies of the University of Aveiro (Portugal). Ana holds a BSc in Aquatic Sciences from University of Porto (2001), and PhD in Ocean and Earth Science from Southampton University (2005). Her research focuses on 3 topics in deep-sea biology: 1) biodiversity and biogeography of chemosynthetic ecosystems, 2) reproductive ecology of invertebrates and 3) population connectivity and its implications for conservation and biogeography. Ana has contributed to the policy process by authoring and reviewing the UN Assessment of the State of the Marine Environment and has worked with Portuguese Ministry of the Sea in the design of a national network of MPAs. Currently she co-leads the working groups "Population Connectivity" in INDEEP (International network for scientific investigation of deep-sea ecosystems) and "Decade for Deep-Ocean Science" in DOSI (Deep-Ocean Stewardship Initiative). Ana has participated in 23 oceanographic cruises dedicated to the study of deep-sea ecosystems and has a vast experience in seafloor sampling and in situ experimentation.



7.4 Environmental Sciences

7.4.1 Italian environment scientist Mia Canestrini

Naturalist, Zoologist, Researcher and Television Host. Born in 1982, Zoologist, she graduated in Natural Sciences and specialized in Conservation of Animal Biodiversity. Conductor for the naturalistic content of the broadcast “L’Italia never finishes”, Rai1. For more than 10 years she has dedicated herself to the study of wolves between the Casentino Forest National Park and the Tuscan-Emilian Apennines National Park, where she worked as a wildlife technician on two LIFE projects for the conservation of wolves. Author of the book “La ragazza dei lupi”, Piemme 2019, she holds conferences and seminars throughout Italy.



7.4.2 Latvian environment scientist Ilze Dimanta

Ilze Dimanta, Dr. biol., a researcher at University of Latvia, Scientific and Regulatory Affairs Manager, For Women In Science programme Manager for Baltic countries, L'Oréal Poland Baltic HUB

Born: 1st September 1986, Riga. Studied: Riga Centre Language School, University of Latvia, for a long time studied in Denmark, Austria, and Iceland. Languages: English and French

Scientific interests: renewable energy technologies; hydrogen energy; creation of hydrogen energy on basis of biological sources. In 2016 Latvian scientist Doctor Ilze Dimanta was awarded a L'ORÉAL-UNESCO Latvian Scholarship for Women in Science for providing a new way to extract sustainable energy from bacterial fermentation.



Ilze's research topic – bio-hydrogen research, grew and changed over the years. During her bachelor's studies, Ilze started with the construction of a manual anaerobic box to ensure the fermentation process.

As part of an Erasmus exchange in 2008, Ilze spent six months at the university in Denmark, where she studied the possibility of extracting hydrogen from blue-green algae. She also brought the research methodology of liquid environment micro sensors to the Latvian Institute of Physics.

During her master's studies in biology in 2010, Ilze studied for four months at the School for Renewable Energy Science in Iceland, where she worked on the extraction of hydrogen from thermophilic bacteria.

In Latvia, she continued research to find the most optimal producer of hydrogen from bacterial strains isolated in Latvia, as well as the possibility to process the by-products of industrial production into hydrogen - technical glycerin and whey.

Along with her research work, Ilze regularly participated in the popularization of science - both as an organizer and as a lecturer at the Institute of Solid State Physics of the University of Latvia, schools, children's camps, energy exhibitions in Riga and Hanover, Germany.

For eight years the scientist worked for radio NABA, where she ran the program "In the Name of Science", where listeners could get acquainted with Latvian scientists' research, experiments, and innovations and learn more about their academic and practical daily lives.

7.4.3 Spanish environment scientist Marga Gual Soler



PhD in biomedical sciences, she actively works with governments, universities and NGOs promoting science as an instrument to tackle climate change

She has worked in the United Nations investigating the role of science in sustainable development to achieve the Millennium Goals

7.4.4 Portuguese environment scientist Alexandra Monteiro

Alexandra Monteiro holds a PhD in Environmental Science from the University of Aveiro (2007), a Master in Atmospheric pollution (2003), and a degree on Chemical Engineering, Faculty of Engineering of the University of Porto in 1996. She was Assistant Professor at Universidade de Aveiro since 2008 and is presently (since 2019) a Principal Researcher at this University, belonging to the CESAM - Centre for Environment and Marine Studies - associated laboratory, where she is the coordinator of the research group APM (Atmospheric Process and Modelling) composed by more than 20 researchers. She has more than 65 SCI papers, 12 book chapters, and more than 30 conference proceedings and other papers. She participated in several EU and national funded projects, being the coordinator of two FCT projects (AIRSHIP - <http://airship.web.ua.pt> and ongoing ARTUR) and also the national coordinator of the ongoing H2020 EMERGE project (ID 874990). She is also participating as co-chair of one of the working groups of the FAIRMODE European exercise (Forum for air quality modelling in Europe: <https://fairmode.jrc.ec.europa.eu>) and member of the scientific committee of the COST Action INdUST. She is also a member of the scientific committee of the International Conference on Air pollution (www.wessex.ac.uk) and from several journals. Her main research interests include are related to gaseous and aerosol emission pollutants, air quality modeling (forecasting and assessment purposes) and its impacts on climate and human health.



7.5 Physics

7.5.1 Spanish physics scientist Maria Del Carmen Muñoz Roca



She is a researcher at the Center of Physical Technologies and deputy director of the Applied Physics Department at the UPV.

Her mainly research activities focuses on the correlation structure- magnetic and photo-changeable metal organic molecular materials that are a source of first-order phase transitions.

7.5.2 Belgian physics scientist Erika Vlieghe

PROFESSOR DOCTOR

Erika Vlieghe

Born in 1971,
medical
doctor in
1996.
Personal:
divorced, two
children



Received the
"Gouden
Penning" in 2020.

Chairwoman of the Covid Committee in Belgium.
Head of Staff in the Tropical Institute in Antwerp
National Ebola coördinator

Very active member of
the medicine studies
group. This group makes
the curriculum for all the
med students to keep
high standards for the
doctors-to-be

Specialised in infectious
diseases and in rare
diseases. Did research in
Laos, Cambodja,... is
known for her research
on multiple antibiotica
resistance



Erasmus+





ZAVO

7.5.3 Latvian physics scientist Elza Krauliņa

Elza Krauliņa (1920 - 2002) was a Latvian scientist, the first physicist in Latvia to defend her doctoral dissertation in physics, the first female doctor of optics in the Baltic States, and Dean of the Faculty of Mathematics, initiator, and head of the Laboratory of Spectroscopy Problems.



From early childhood, Elza was interested in science. At school, she was interested in math, chemistry, physics, as well as poetry, and literature. She entered the Faculty of Mathematics and Natural Sciences of the University of Latvia in 1939 to study physics, but in June 1941 the war stopped her studies. During World War II she worked in the editorial office of newspapers as the executive secretary. She graduated from the University of Latvia in 1947. From 1949 to 1952 she studied postgraduate studies at the St. Petersburg State University, where in 1954 she defended her dissertation on the role of the second type of collisions in the fluorescence of mercury and sodium vapor.

After returning to Latvia, Elza continued her research in spectroscopy. In her dissertation, she studied the spectral lines of sodium, which were in the visible part of the spectrum. The idea was also to study areas of the ultraviolet spectrum. She organized the Laboratory of Spectroscopy Problems at the University of Latvia. In 1971, she managed a large contract with the Latvian Ministry of Health for the construction of a scanning spectrophotometer to study the cells.

In 1978, she actively participated in the organization of an international conference on nuclear physics in Riga. In 1979, she resigned from the position of the head of the laboratory and continued to work as a scientific consultant. For more than 30 years, Elza Krauliņa chaired the Scientific Council of Spectroscopy (since 1958) at

the Latvian Academy of Sciences. Once a month, lectures were organized for factory laboratory staff on the latest developments in spectral analysis in 32 factories of the Republic.

Professor E. Krauliņa is the author of more than 100 scientific publications, and was the editor of 15 collections of scientific articles. She participated with reports in many international conferences, earned true respect and authority at the university, and was well known in the society of foreign physicists.

7.5.4 Italian Physics scientist Gabriella Greison

Gabriella Greison, 47 years old, Genoese of Scottish origin, graduated in Nuclear Physics from the University of Milan, two years working in Paris at the École Polytechnique, has made the dissemination of quantum physics her mission, discovering her vocation as a writer, as well as a teacher. She has written 9 books, the result of studies and comparisons with other scholars. Her latest effort is "Quantum Guide for Nonconformists. A journey into physics that Newton would not approve of."



7.5.5 Portuguese Physics scientist Elvira Fortunato

Elvira Fortunato, currently the Minister of Science, Technology and Higher Education of Portugal (30th March 2022-...), was Vice-Rector at Nova University since September 2017-2022, Director of the Materials Research Center (CENIMAT) and the integrated Associate Laboratory i3N, the Institute of Nanostructures, Nanomodeling and Nanofabrication (The only Portuguese research centre (1998-2022) classified as Exceptional in the Advanced Materials and Nanotechnologies area in the last national evaluation); Invited Professor at Universidade Federal de Lavras, Brazil (2013-2022).

She has held other Institutional Responsibilities, such as, Deputy Director of FCT NOVA (2014-17); Coordinator of Research Centers of FCT NOVA (2006-17); Member of the Executive Board of the Materials Science Department (2009-17); Coordinator of the Doctoral Programme in Nanosciences and Nanotechnology, FCT NOVA (2009-18); Member of the Scientific Committee of the PhD Program in Biomaterials (UFLA, Brasil) (2014-2022). Participation in several academic examination referees board (PhD juries in and abroad Portugal).

She has received her Bachelor's degree in Physics and Materials Engineering in 1987, obtaining, in 1995, the PhD in Microelectronics and Optoelectronics.

Elvira Fortunato pioneered European research on transparent electronics, namely thin-film transistors based on oxide semiconductors, demonstrating that oxide materials may be used as true semiconductors. She is co-inventor of the paper electronics concept worldwide: Paper-e®. In 2008 she wins an Advanced Grant from the European Research Council (ERC) for the project "Invisible" and in 2018 she received the second one ERC, with the amount of € 3.5 million. The project is entitled "Multifunctional Digital Materials Platform for Smart Integrated Applications | DIGISMA^{RT}".

Chapter 8: Summary Lesson scientist in opening ceremony

8.1 Portugal: Maria Amélia Alves Rangel Dionísio

Safeguarding Stone-Built Heritage: The contribution of Geosciences

Maria Amélia Alves Rangel Dionísio completed her PhD in Mining Engineering in 2002 (Universidade de Lisboa, Instituto Superior Técnico), with a dissertation on the degradation of stone in historic buildings(the case of Lisbon Cathedral). Her MsC in Georesources was completed in 1998 (Universidade de Lisboa, Instituto Superior Técnico) with a thesis concerning the use of Pedra de Ançã (raw material) in cultural heritage masterpieces. Her Bachelor was attained in 1993 in Mining Engineering (Applied Geology) (Universidade de Lisboa, Instituto Superior Técnico)). She Is Assistant Professor in Instituto Superior Técnico, University of Lisbon.

The professor introduce the congress about the rock commonly known as *Pedra de Ançã* is a white, homogeneous, limestone of the Bajocian-Batonian (lower Jurassic) age corresponding to a particular facies that forms part of the Formation of Ançã (sl) (Barbosa et al., 2008). Due to its unique physical characteristics of resistance (230 kg / cm²), porosity (20%) and water absorption (9.6%) (INETI, sd), among others, is known to have easy workability and was for centuries used in the decoration of built patrimony, mainly in churches, palaces and other monumental constructions, leaving a mark in the unique architecture and sculpture. As a material for sculpture, Pedra de Ançã has a long history of use throughout the central region of the country, having reached its peak in the 16th century with the schools of sculptors João de Ruão and Nicolau Chanterene. Between the period from 1867 to 1927 the exploitation of quarries, mainly for the production of lime, material for masonry, masonry and sculptures as well as for civil construction in general, led to an industrial development in the center of Portugal.

8.2 Latvia: Yuris Soms

On the first day, October 4, 2021, of the Congress on Chemistry in Daugavpils, Latvia, we were warmly greeted by Juris Soms, Dean of the Faculty of Natural Sciences (Biology, Chemistry, Physics) and Mathematics of Daugavpils University, an experienced Doctor with a demonstrated history of working in the higher education industry. Yuris Soms is skilled in ArcGIS Products, Environmental Awareness, Geography, Cartography, and Sustainability. He is a strong research professional with a Dr. Geology focused in Quaternary geology and geomorphology, and the author of many scientific publications.

In his lecture, the professor noted the importance of chemistry in human life from ancient times to the present day and the role of the younger generation in new discoveries. During the professor's lecture Evans Griškjāns, a 12th-grade student at our Daugavpils 3. vidusskola, demonstrated the operation of chemical laws in practice.

Evans Griškjāns tells us, "Craig Charles's quotation "It's evolve or die, really, you have to evolve, you have to move on otherwise it just becomes stagnant" conveys a very important meaning – the meaning of our life. By looking at the start point of human beings, it can be assumed that people were created to discover all universe edges. We have evolved from the lowest form of life to the top of the food chain.

Every century, year, week, and day scientists work on the new, before not explored things and chemistry is not an exception. Comparing 19th and 21st centuries levels of chemistry, humanity did a breath-taking breakthrough in the discovery of novel materials, dyes, drugs, and even reaction principles.

But why does science matter? Have you ever tried to look at the sun through sunglasses? You could clearly see the shape of it or, maybe, even something else. It is very interesting and amazing how science can change our vision and expectations to regular things. Science is like sunglasses – it filters our prejudice and gives us the real sight of life and life mechanics.

The simple experiment of exothermic chemistry is the barking dog reaction, the reaction between carbon disulphide and nitrous oxide, as a result, you can hear a

loud "woof" or "bark" similar to a dog's one. Flashing, fire, rapid burning, flash, explosion, and social excitement are very simple reactions, but very impressive from the side of their mechanism. Consider how this happens: the reaction between the match head and the strip of phosphorus on the matchbox, the burning of the match due to oxidation by oxygen, and finally, the combustion of the combustible mixture, which gives a flash and explosion, stimulating the neurons in our brain and causing them to release dopamine and adrenaline in the synaptic cleft, which makes you feel overwhelmed. This is how science works and this is why science matters."

The professor himself and the staff of various laboratories introduced us to the exciting equipment and work of researchers.

- Ø In the Laboratory of Molecular Biology and Genetics, they use the latest study methods for studying cell stress, cell programmed death passages and cell memory molecular biological, physiological, genetic, and epigenetic processes.
- Ø Animal Ecology and Evolution Laboratory and Laboratory of Genomics and Biotechnology are equipped with modern hardware and use modern laboratory equipment to conduct studies in genetics, biotechnology, molecular biology, molecular systematics, and population genetics.
- Ø Laboratory of Chromatography is engaged in theoretical and applied studies in the field of high-performance liquid chromatography.

To sum up, all the students had an opportunity to imagine their future in science and became aware of the importance of science in the world.

8.3 Belgium

Unfortunately, as stated in chapter 2, we were unable to hold the congress due to covid-19. Therefore, we must once again refer you, dear reader, to Italy.

8.4 Italy: Arianna Garofolin

The LIFE CLAW project, co-financed by the EU, aims to conserve the native river shrimp *Austropotamobius pallipes* in the Apennines northwest, between Emilia-Romagna and Liguria.

Who's that? Why is it endangered? What are the man-made threats against him? What actions are the project partners implementing for its safeguard? The river shrimp is considered an endangered species, it symbolically represents an environmental problem affecting most of the river ecosystems. Particularly stocky and robust carapace, it can reach 11-12 cm of length and 90 g of weight. Males are bigger than females. It lives in streams and streams particularly oxygenated.

It prefers the gravel or sandy beds, but equipped with banks where there are ravines and safe places, often represented by leaves of fallen trees or leaves, to be able to hide and rest. Being a cold-blooded organism, it prefers fresh waters (15 °C) and a range that deviates from a few degrees, with a maximum temperature of 23 °C. It is a typically nocturnal animal. It feeds on everything: from algae to aquatic plants, from worms to molluscs, to insect larvae. It is particularly aggressive in the defence of its territory and in the sexual struggles, as evidenced by the catches of specimens with partially or totally mutilated limbs or claws. The mating takes place mainly in autumn. The female carries on the abdomen for 5-6 months the fecundated eggs (about one hundred), taking care of them, ventilating them and cleaning them continuously.

8.5 Spain: Alberto Aparici

On April 7, 2022, Dr. in Particle Physics Alberto Aparici gave us the opening talk of our Physics congress "Science is all around". Dr. Aparici is a great scientific communicator and collaborates in several radio programs (*La Brújula* and *Más de Uno on Onda Cero*) explaining science to the general public. He also works at the IFIC, which is a joint center of the University of Valencia and the CSIC specialized in particle physics, nuclear physics and cosmology.

His talk focused on explaining to us how science had advanced from the beginnings of chemistry (with Lavoisier or Mendeleev) to physics, in order to explain the world when classical physics ends and how particle physics begins.

For 1 hour he was making us doubt all those theories that, explained in secondary school, seem absolute truths and as knowledge progresses, new truths appear, which will be until someone proves otherwise. It was exciting to see how he delved into particle physics and almost without realizing it we had advanced from Thomson to Rutherford and from there to several dozen particles that we did not know. He brought us closer to the concept of the types of forces: gravitational, electromagnetic, weak nuclear and strong nuclear. We saw how these forces were necessary to understand particles and matter. From there he led us to the appearance of antimatter and its necessity. He told us about Quarks like the neutron, leptons like the electron, bosons and the special case of the Higgs boson.

With great mastery, he left us wanting to know more about the subject, moving towards particle physics for some and the conviction that this world is very complex for others. This is the purpose of these inaugural talks. Approaching worlds beyond the reach of our students' knowledge so that they ask themselves questions and see that basic science solves many of the everyday problems that we face on a day-to-day basis.

After the talk, and the students' questions and doubts, Dr. Aparici took us to see some of the IFIC laboratories:

- ANTARES/KM3NeT is a neutrino astronomy experiment. That is, they observe the sky but using particles.

- ATLAS is one of the LHC experiments at CERN. In this laboratory they work on the silicon detectors of the experiment, so they mainly do electronics design and they have a clean room, a laboratory with filtered air so that it has a low amount of dust, to assemble that electronics.

- In the Nuclear Physics laboratory they are experts in exotic nuclei (unstable nuclei that live for a very short time). What they do is produce these nuclei in experiments and study their properties. Right now they are preparing an experiment that they are going to take to a laboratory in Europe (I don't know if it is CERN or Finland).

- The Grid is the distributed computing network associated with CERN. In Valencia we have a small node with a few thousand CPUs that students will be able to visit. It is quite a peculiar place.

For the students and teachers of the "Science is all around" project, it was an impressive, motivating and clarifying experience of how sciences are united to be able to solve the questions that nature poses to us.

Chapter 9: Photos, videos and links

9.1 Geology congress in Portugal





Erasmus+ KA2 Geology Congress: https://youtu.be/A4qh2x10_98

9.2 Chemistry congress in Latvia







Erasmus+ KA2 Chemistry Congress in Latvia in October 2021:

<https://youtu.be/6b5NiSvSNXU>

9.3 Biology and Environmental Sciences congresses in Italy





9.4 Physics congress in Spain







Chapter 10: Conclusions

The project began on September 1, 2019, with an end date scheduled for August 31, 2021. However, the Covid-19 paralyzed all mobilities (only the one in Portugal could be carried out before the pandemic), forcing us to extend the project 12 more months. This decision allowed us to carry out all the planned activities, although in a short space of approximately 6 months.

During this final stretch of the project, the main problem we faced was the lack of host families. Undoubtedly due to the pandemic, all of us, parents, students and teachers, were more reluctant to share spaces, as we thought it appropriate to form a bubble group among the Erasmus participants and avoid contact with others as much as possible. Therefore, we decided to stay in hotels. In all mobilities we manage to be all the countries housed in the same hotel to continue sharing lunches, dinners and free time. The balance we got was positive, since the bonds of union that were created between the participants were strong. In addition, always advised by the students and teachers of the host country, we try to spend our free time getting to know the culture, environment and gastronomy of the region in which we were, thus compensating for not staying in family homes.

Another incident took place, since, as detailed above, the meeting in Belgium had to be canceled three days before its beginning due to the notorious increase in Covid cases and the measures that the Belgian school was forced to adopt (online/semi-face-to-face modality). The economic losses were not significant in comparison to the preparatory work hours and student displeasure. For this reason, an attempt was made to set another date for its execution, but the different school calendars together with the pending meetings in Italy and Spain prevented it. Consequently, Italy agreed to host both the biology congress planned for Belgium and its own environmental sciences congress.

Nevertheless, apart from the inconveniences that the pandemic caused, the project was carried out with total normality. The objectives established from the beginning were met:

- students with good academic results participated, as well as students at risk of dropping out and with special needs (the latter to a lesser extent),

- interest in STEM subjects increased (as shown by the results of the surveys),
- resulting didactic units managed to enrich the curriculum of all the subjects of all the participating centers at a qualitative, experimental and contextualized level (as contained in this book),
- the place of women in the scientific world was recognized and the majority of the participating students were girls (as shown by the results of the surveys).

The scientific congress format chosen for all the meetings turned out to be key in this change in methodology. In fact, the same participants and organizers saw how each congress surpassed the previous one, both at an organizational and executive level and without neglecting the contents shown and learning obtained. Participation in the Experimenta Fair was the final culmination of this project, and both teachers and students proved to be up to the task of said public competition, even receiving an international mention from the organizing committee. Obviously, not only the congresses, but also the rest of the activities carried out in each mobility (lectures by scientists, scientific workshops, training visits to universities, museums and companies, and closing ceremonies with delivery of participation certificates) propitiated the scientific and real environment.

Regarding the results of the project, the surveys underwent a small quantitative change, but the results were favorable and useful, as described above in the corresponding chapter. The present digital book, for its part, brings together all the information and products resulting from the project. We trust in its usefulness and future source of inspiration for other centers and projects. Finally, the website also contains all the details and products of the project, surely making them more accessible and attractive, and undoubtedly ensuring their longevity and spread. With social networks, however, we were not as persistent and did not use them as much as we would have liked. The project, instead, became more known from the different social networks of each center.

To conclude, the analysis we draw from the project is highly positive. Without a doubt, the benefits have always outweighed the drawbacks and we managed to regain interest in STEM subjects among the participants. We do not know how far the benefits of this project will reach the students; perhaps it is the reason for

choosing a scientific university career, or it represents the first steps of a future scientist, but surely none of the participants and close agents ever forget that *Science is all around*.