PROJECT ABSTRACTS – CONTEST 2007

Austria

1. Synthesis of a Linker Molecule for Self-Assembled Monolayers (SAM)

SAM formers are special molecules with an almost unique property that makes them similar to the formative components of animal or plant cell membranes – self-assembly in the form of precisely defined and arranged single layers. These molecules represent the technological basis for many applications from the world of micro and nanotechnology, ranging from special sensors to building elements in the sub-micro sector.
Not satisfied with the efficiency of the conventional way of producing such molecules, we looked for alternative state-of-the-art methods at the university and also found them. Following extensive research we developed new ways of synthesis in theory to begin with and then also proved these in subsequent practical tests.
The project resulted in two new ways of synthesis being created. The particular advantages of both new approaches compared to the synthesis methods used to date are the considerably greater yield and higher purity of the product produced.

2. Salt Crystals as a New Energy Storage Technology

An ambitious energy storage project at the HTL Braunau technical college shows how we can take a further step in the direction of independency from fossil raw materials in the supplying of energy. Solar energy stands out through its unlimited availability but is hindered considerably in its use by the still unresolved problem of long-term energy storage.
Inspired by pocket-size heated cushions in winter, the team of students from HTL Braunau addressed the storage issue and developed a very promising solution based on salt crystals. The team produced a prototype of a latent heat storage device in extensive tests. The device must be able to receive heat generated by surplus energy, store it in a hidden, i.e. latent form over a longer period and then make it available again at a later point in time.
Thanks to the modular build of the heat storage device the heat release process can be adapted to match individual requirements.
The elaborated tests carried out by the students were successful; the test results indicate that a technical solution to the heat storage problem is within reach.

3. Energy from Maize Straw

This project focuses on maize straw and its possible uses in generating energy. Every year large quantities of maize straw are left over on farms without there being any effective use for it. The high fibre and cellulose content in particular make it difficult to generate energy from it, something that calls for an appropriate process. The reason is that bacteria attack the maize straw only slowly, which in turn slows down the conversion to methane. This is precisely where this research comes in, with the aim of developing a new treatment process for materials rich in cellulose.
A simple test unit was built to begin with to optimise the energy generation process. Then two pre-treatment methods which both enable more efficient generation of biogas were developed. The test results show quite clearly that the pre-treatment of biogenic materials has a positive effect on the gas yield in biogas production.

Belarus

1. Stop a Moment

In our research we have carried out the analysis of some features of the stroboscopic effects arising during the observation of the periodic phenomena against the background of the screen of CRT. We have carried out a series of experimental observations of which we proposed the original technique of the description of the stroboscopic effects arising during the observation of the periodic phenomena against the background of the screen of the CRT.
Having done this work we have come to the following conclusions:
TV allows us to observe stroboscopic effects in more difficult variants; it is offered to use the given phenomenon for studying spatial periodic processes.
We created a technique for describing the image of moving subject against the background of the TV screen, which gave us good conformity between the results of the calculations and the real figures observed in the experiment.
We have shown the opportunity of the formation of complex images, which don't correspond to the real form of the subject that requires additional research.

2. Geometry in the Bounded Spaces

"Space/plane" is the bounded space/plane if it is a closed connected set of points (a determinative set) with a bound and with traditional concepts of point, figure and distance between points. The border of the bounded plane/space is supposed to be the bound of a respective determinative set. A straight line in a bounded space is usually defined as a straight line until it meets the border; at the border of the space the line reflects from the edge of the bounded plane according to the law "The angle of incidence is equal to the angle of scattering" to be inside the space.
The objectives of this research are:

- to explore the behavior of different lines in bounded spaces (beginning for square as bounded space);
- to study such factors as cyclicity and self-intersection of lines in bounded spaces, and to introduce our own directions of analysis of the problem.

We found the following results for lines in bounded spaces: the necessary and sufficient conditions of the line cyclicity; the length of the cycle; the number of segments; symmetry of lines; analytic representation of line and range of other interesting properties of lines.
The results can be applied in optics, data transfer theory, theory of games.

3. Almost Central Symmetry

The initial idea for our research is based on the following problem:
Let M0 be a finite point set in the space. Let point O be called the "almost center of symmetry" of the set M0 if one point can be excluded from M0 in such a way that point O will be the center of symmetry of the remaining set.
The objective of our work is the formulation of the theory of «almost» transformations and the combination of results which have been based on new models.
We have formulated the following problems based on this idea:

1. To describe a possible structure of the point set (number of points, their layout etc).
2. To formulate in common form definition of almost transformations.
3. To find (or to formulate) some interesting problems which can be easily and beautifully solved by the theory of almost transformations.
4. To find the application of our theory to other mathematical objects.

In this research we have found results relevant to the above formulated problems. Besides, we have found the application of this theory to other sections of mathematics. So, we have developed a basis to build the general theory of almost transformations.

Bulgaria

1. GMOs - Enthusiasm or Fear

GMOs, one of the most debated and controversial issues for the past years, is a topic that concerns each and every one of us. The results from the survey on GMOs I conducted among students in Bulgaria showed me how poorly informed about the essence of the issue today's youth is. The project was made in a way that it offers a basis for profound deliberation on the pros and cons of GMOs and due to its gradual transition from theoretical to experimental it can be used as a supplemental material in biological education at high schools. The three main steps we showed are: 1) extraction and purification of DNA, 2) setting up a PCR and, finally, 3) visualization of pcr products by agarose gel electrophoresis. The results showed amplification of 123 base pairs fragment of the 35S promoter only in the positive control and the tested sample, which proves the presence of transformation event in it and the successful conduction of the experiment, as well. The project is an example of how (complicated) science can turn out to be quite captivating and thus easy to perceive.

2. Irreducibility of Polynomials

This project explores the proof of irreducibility of polynomials of one variable with integer coefficients and its wide application in problem solving. Its aim is to present the criteria and some other strategies as a "powerful weapon" when solving problems of irreducibility.
The direct exploration of irreducibility is used for problem solving. Two of the problems are standard but the rest of them require more sophisticated reasoning and one of them has a particular role in more abstract mathematical fields. Afterwards the reduction criterion, Perron's criterion and a generalized version of Eisenstein's criterion, which have the major role in the article, are proved.
A number of problems, some of which of generalizing nature, are solved using these criteria.
The research ends with alternative solutions of Olympiad problems, some of which are then generalized. The next step would be additional development of generalizing ideas and a better knowledge of relation between irreducible polynomials and prime numbers.

3. Possibilities for People with Hearing Loss to Perceive Sounds

Millions of people live in isolation and feel constant discomfort while communicating, studying, and working in their private life. By using different ways for perceiving sounds they will be able to gain access to every single scope of life. Thus, their adequate integration in society will become possible.
This project describes how speech and sounds can be „understoud" by using vibrations and ultrasounds. The project contains a system for elementary music education, which is very beneficial for children with hearing disorder. The system gives access to information in an attractive and approachable way, aiming at perceiving and realizing sound pitches and values by the use of vibrations.
The basis of the proposed system for primary musical education is the sense of touch. Thus, in the case of the people with hearing loss one of the senses – the hearing, may be substituted to great extend by another sense – the sense of touch. The system is user-friendly; it is elaborated in electronic version in ppt format.

Czech Republic

1. Generalization of the Method of Tiling in Triangular and Hexagonal Grid

This project generalizes tiles as diamonds, polyominoes and polyplets to triangular and hexagonal grid. Then it generalizes methods of tiling to these grids. The main generalized method by James

Propp is based on the parallel of two cities. In the framework of its generalization, I discovered and described the most important tiles – those with zero signed area in the second city. Their number is greater than one. In the last part I compare the properties of tiling of triangular or hexagonal grid with the square one, which is the result of the count of tiles with zero signed area in the second city.

2. Enterococci Isolated from the Human Urogenital Tract

Enterococci are opportunistic pathogens which are a frequent cause of a wide variety of infections in humans. Enterococci have become firmly established as emerging nosocomial pathogens. The isolation of strains resistant to many antibiotic therapies represents an important public health concern. In the period 2003 – 2006, a total of 197 enterococcal strains were cultivated from clinical specimens from urogenital tract of hospitalized patients of Pardubice County Hospital. All strains were identified using biochemical and serological tests. The aim of the study was to identify and determinate the enterococcal isolates and test their level of resistance to 6 different groups of antibiotics. The study also focusses on the comparison of the biochemical tests used for differentiation of two most frequent species.

3. JTR Dry Slipper Clutch for Ducati and its Racing Use

This project is about new race slipper clutches for Ducati motorcycles and its racing use. We decided to work with Ducati, because this Italian motorcycle brand and the people working with it are very unique and always bring along a lot of passion. We studied the preparation of the new specifications and the testing of it. During our work we got into the fascinating world of racing and cooperated with its main actors. Thanks to that we got very special materials and points of view. Nowadays we use them in our home raceteam, and we are very proud to be part of the achievements of Jakub Smrž who races in the Ducati NCR team.

China

1. Polluting Property and Dispersion Rule of Airborne Allergenic Pollen in Urban Areas

This study, through installing advanced wind vane-type pollen collectors respectively on top of a 10m high building in the outskirts of Beijing and on the top of a 40m high building near to Beijing, conducted the pollen collection and continuous investigation for 39 weeks from March 1, 2004 to November 28, 2004, collecting various pollens near to 40 categories in total.
We investigated the relation between pollen pollution and plant florescence, disclosed, through multi-sample comparison and analysis, the quantitative relationship between airborne pollen dispersion and the meteorological factors like precipitation, relative humidity, and temperature change. Further we explored the onset regularity of pollinosis and pollen dispersion in main seasons. We came to eight important conclusions, by taking into consideration the materials and data of other aspects including different collection places, various meteorological factors, plant florescence investigation and the onset regularity of pollinosis.

2. Pedal Keyboard Input System

Computers have already become a symbol of our civilization and an indispensable tool of modern society. But we should not forget people with disabilities, who also need to work, study, and to communicate daily. They are eager to utilize computers just as much as non-disabled people. For this reason, we have invented the PEDAL Keyboard Input System, which allows people with motor disabilities involving their hands to use their feet to replace their hands in controlling the keyboard. The computer can then be used by these physically challenged individuals in their work, study, and

communication, just as non-disabled people would. Physically-challenged people will be able to enjoy modern science and technology, conveniently, along with the rest of the world.
By means of an accompanying coding system and Windows Pedal Keyboard driver, the Pedal Keyboard Input system maps all the keys on the normal keyboard to a set of numeric keys 1-6 on the pedal, which consists three coding input. Thus the computer is controlled through the pressing of pedal keyboard by foot.

Estonia

1. Synthesizer of Vowels of Estonian Language

Speaking machines have attracted mankind for centuries and speech synthesis is gaining popularity every year. The objective of the current project was to generate a computer programme which is capable of synthesizing vowels based on their acoustic model. In order to achieve that, the spectrum of vowels generated by different persons was recorded and analyzed. In conclusion of this analysis an acoustic model for each vowel was created. Based on these results a computer programme for synthesizing all 9 vocals found in the Estonian alphabet was created.

2. Lesser Redpoll (Carduelis flammea cabaret) – A New Bird Species in Estonia

Redpolls are busy little birds which have several species and subspecies. Common Redpoll (Carduelis flammea flammea) is spread in North–Europe and North–America. Lesser Redpoll (Carduelis flammea cabaret) has a much smaller distribution area that lies completely within Western Europe. According to the literature its spreading area is enlarging and most probably approaching Estonia. In 2004-2006 in the Sõrve Bird Observatory, observations were carried out to find proof of the existence of Lesser Redpoll in Estonia. For that 104 Redpolls were caught using special net and Redpolls song for attraction. All specimens were measured and released. The results of data analysis was that ¼ of the measured birds appeared to be Lesser Redpoll – new species in Estonia. Data and results are forwarded for consideration to the Estonian Rarities Committee.

European School

1. Consequences of the Existence of a Boson for the Gravitational Force

The concept of dark matter has been devised to rationalise certain observations in the universe (e.g. the rotation speed of stars in galaxies), which cannot be explained by other theories. However, dark matter, which is assumed to represent 27% of the universe, makes itself manifest only through gravitation! Since the postulate of its existence is not very satisfactory, as it leaves many parameters undefined, scientists have been seeking alternative theories.
Starting by the observation of an anomalous acceleration of the Pioneer 10 and 11 spacecrafts (which cannot be explained by the presence of dark matter), we have attempted to develop our own theory. We assume the existence of a boson of the gravitational force, the graviton, and show its impact on gravitational law. A very minor change to the latter – resulting from the application of our hypotheses – could well explain the observed acceleration of the Pioneer 10 and 11 spacecraft.
On the scale of the galaxies, our theory could contribute to explaining their curves of rotation.
Validation of our calculations have been carried out by computer-based simulations and experiments by analogy with electricity

France

1. The Hydrogen Boat

In order to find solutions to replace fossil energies, which produce greenhouse gases, we decided to develop a boat using a new energy vector. Indeed, surface transports (cars, trucks…) are known as the most polluting sector of activities. Therefore this seems the best area for developing the hydrogen solution. Thus we adapted a model boat propelled by a two-stroke engine. After many problems and several months of development, we focused our
study on a four-stroke engine driving a handmade hydroplane. A fourstroke engine has the advantage to free us from the problems of lubrication, and H2/O2 mixture composition.
Furthermore, we developed an electronic system using sensors and actuators to acquire information from the boat and to drive it remotely. In addition, the security was always one of our main concerns.

2. Can We Walk on Water?

Can we walk on water? To answer this question, we focused our study on the basilisk lizard, an animal effectively walking on water. A careful video observation gave us crucial information on its movements. We then conducted various experiments to model the lizard motion in order to precise the physical laws governing this phenomenon. Thanks to three experiments, we tried to define the force/speed relation more exactly, which led us to look into Bernoulli's law, which seems to be one of the dominant effects in this study. In order to estimate the accuracy of our deductions, we used the data of an article on the basilisk lizard, and established a parallel between the movement of the lizard and barefoot waterskiing. In addition, we looked into other laws such as viscosity and superficial tension to quantify their importance in our study. Finally we calculated the speed a man should walk, or rather run, on water!

Georgia

1. Osteochondrosis and Overweight: Mechanisms of Weight Action on Vertebral Column

In this project we studied the mechanism of weight action on the vertebral column when the background of developing osteochondrosis (osteochondrosis is in the 4th place among all known diseases) - is overweight. Overweight is another problem of contemporary medicine. We used an archive file of overweight observations (7000) and analysed the physical principle of the mechanism of overweight on the vertebral column. We analysed the "work failure" of the elements of locomotor segments on the physical level and revealed the frequency of osteochondrosis prevalence in overweight patients subdivided into age categories and according to different degrees of overweight. This data indicate that the prevalence of spine diseases increases along with age and degree of overweight. From this analysis we derived an original formula for defining directly the "degree" of overweight.

2. Protection of Georgian Rivers from Sawdust Pollution

Today 25 biological "hot spots" are known all over the world, the Caucasus being among them. Georgia is located in the south-east part of Europe, in south Caucasus.
In the last years, anthropogenic influence on Georgian nature has increased because of different political and socioeconomic factors. Because of a great demand for Georgian woods in the neighboring countries, timber industry has become very attractive and the owners intentionally build sawmills along river shores and gorges. Millions of cubic meters of sawdust are thrown into the water, which is disastrous to our ecology. Our main objective was to find ways of protection of our rivers from sawdust pollution. Therefore, we searched information about all investigated and approved methods of sawdust utilization known in the world. One very important, but less investigated method of sawdust

usage is its utilization as a soil for mushroom growth. Based on the results of our research we can say that sawdust is very good soil for mushrooms to grow. According to our research, we can offer an interesting method of sawdust usage to our people. Hundreds of green-houses will be employed in mushroom cultivation, which will provide a double effect-ecological and economical.

3. Application of Modern Molecular Biology Methods for Resolving Research Problems

Universality of the basic principles of nucleic acids building made it possible to introduce research methods, applicable to any type of organism. In this research we studied two very different issues. 1. Cord blood is used in the treatment of cancer and blood disorders. HBV, HCV, HIV-1 testing is crucial. Multiplex RT-PCR was developed, new primers were designated, RT-PCR was optimized, using standard positive controls. This method saves costs for cord blood testing and donor screening. 2. 46 strains of Y. pestis from the former Soviet Countries (FSC) were examined by PFGE to determine this species' genetic diversity. PCR was applied to screen the isolates for the presence of three major plasmids. In addition, 2 strains were examined by the IS100 analysis to test the applicability of this molecular typing method for Y. pestis. 5 PFGE types were identified among 46 strains examined. The experiments revealed that the plasmid pMT1 was absent in one Georgian strain. The IS100 analysis demonstrated a high discriminatory power in typing of Y. pestis.

Germany

1. Impact Probability of Asteroids on Earth

The lunar surface is coverd with craters of different sizes. They are the relicts of 4.5 billion years of astroid impacts. The impact probability of asteroids on the moon was determined by analysing pictures of the lunar surface and computer simulation. Using another computer simulation, the impact ratio of asteroids on earth and moon was calculated. Merging these results, the impact probability of asteroids on earth was determined

2. Flashing Water Drops

Visiting a stalactite cave last summer, one of us made a strange observation: Every time a drop fell down from the top it seemed as if it would flash at a certain height. We didn't know the explanation for this, so we tried to reproduce the phenomenon at home. Our first idea was to use the drops falling down from the water tap. Quite accidentally we found out, that the effect only occurred when we put a light source in a very special position towards the observer and the falling drop. Fascinated by this mystery we started doing some research on the strange flash in the air. During our work we found out the relevant factors and we can now exactly say, under which conditions these flashes occur. In addition to that we succeeded in describing the phenomenon mathematically and we know now, that the light reflections within a falling droplet change because the droplet itself oscillates. We also found out that this can be observed everywhere a drop detaches from anything like in the shower, at a water tap or raindrops falling down from gutters. With our research we found a completely new phenomenon that, as far as we know, has never been analyzed by anyone else so far.

3. SmartCam – Development of a Universal 3D-Camera

Nature often raises the impulses for technical inventions. Florian Schnös was inspired by the three dimensional human vision. He developed a 3D camera, which does not only provide the colour and image information of a normal picture, but also calculates the distance to every object in the lens coverage. The resulting 3D models can be analysed and used as a basis for autonomous actions in a wide field of application. He attached great importance to the compact and competitive construction. Due to the low material costs the 3D camera can even be used in private applications. The field of

application ranges from autonomous robots over medical engineering to collision avoidance in traffic. To demonstrate the 3D camera's potential in combination with an industrial robot, a futuristic three dimensional derivative of the well known game “Tic Tac Toe” was invented and can now be played against the computer.

Israel

1. Dental Implants

While dental implants have many advantages, one significant drawback outweighs them all – bone loss, resulting from the fully accretion of implant with the jawbone (despite the connecting way of natural tooth). During the chewing the implant and underlying bone are subject to pressure, and over time this pressure causes the bone to wear away.
The aim of our project was to reduce the pressure on the bone by additioning the amortizing properties. The model we recommend has several advantages over existing implant models: first and the most important is the prevention of bone loss, in addition, from a financial point of view, our model will be considerably less expensive because of its simple structure.

2. Towards Scanning a Biological Live Cell with the SNIM (Scanning Near-Field IR Microscope)

The main purpose of my research is to develop a scanning near-field microscope (SNIM) that will make it possible to carry out spectral imaging of biological objects in the mid-IR (3-25μm). The analysis of these images will yield information on chemical morphology of the cells at the sub-cellular level. The ability to analyze a single cell will allow carrying out a direct, sensitive investigation of microorganisms. This kind of microscope will contribute a lot to many disciplines, since the ability to chemically characterize on subwavelength scale is important in medicine, molecular biology, material science, nanotechnology etc. The SNIM is based on IR transmitting fiber, one side of such a fiber will be etched to form a tip of diameter 0.5-3μm and this tip will scan a single cell when it is at a distance of nanometers from the sample

3. Molecular Identification and Characterization of Phytoplasma Bacteria in Grapevines

Phytoplasmas are pathogenic bacteria that cause many diseases in a variety of plant species throughout the world. In grapevines, the bacteria are the predominant cause for yellow disease, which causes an enormous damage to the wine industry in the form of partial, or even total, crop loss. Phytoplasma cannot be cultured in vitro in cell-free media. Consequently, molecular methods were developed to identify and characterize it. In the Golan Heights in Israel, the main cause for yellows diseases was identified as Stolbur (Stol) Phytoplasma. In my attempt to solve the problem using molecular analysis, I found that the cause of yellows disease in a Carignan vineyard was Stolbur Phytoplasma. Furthermore, I discovered a direct correlation between the titer of the pathogen in the plant and the apparent symptoms of the disease. Future research characterizing the class of Phytoplasma that causes yellows diseases in vineyards, both throughout Israel and in other countries as well, will provide a complete description of the bacteria's distribution. Promoting knowledge about Phytoplasma will set the cornerstones for successful dealing with grapevines yellows diseases and reducing economic loss in the wine industry.

Denmark

1. Improved Efficiency and Less Pollution of Two-Stroke Motors

The invention of the two-stroke motor was 100 years old when I was born, and hasn't changed much since. Then and now, the two-stroke motor pollutes like a barrel of oil, with a large hole in it. If you

have ever been in a large city in India or Asia, you have seen the smoky trails of taxis and know how hard it is to breathe. The two-stroke motor is a cheap, simple, and powerful motor, but because of the simplicity, it sprays unburned fuel out in the nature, furthermore, it pollutes with 14 times as many dangerous particles than a normal car per kilometre. Our aim was to burn more of the otherwise unburned gas, to get rid of some of the particles. And we succeeded. By looking on a type of exhaust, normally used for getting more power, we designed one with similarities, and altered it till we had our present model. It pushes the unburned fuel back into the motor, with help from the natural pressure wave in the exhaust. This works so well that we can drive over 17% longer on a litre of fuel! It is cheap to produce and it is going to save lives, money, and nature.

2. Why Drop the Fun – When the Drip Is On?

Imagine a smile on a very sick cancer child. This thought kept me fight to aim the goal, to ease very sick children's stay on a hospital ward. Therefore this project isn't only important to me! But important to many very sick children around the Globe. I visited the National Hospital's pediatric oncology ward for children. After this visit I really wanted to help these children. That's why I asked myself this question: "Is it possible for me to add extra quality to the everyday life of very sick children by making their days just a little easier?" – and the answer to this is: "Yes indeed!" through a lot of research I have found out how children normally react when they get a serious desease, and what there is to do about it. I have put all this research together in one united solution, which is why I've invented a 'toy vehicle', which makes it possible for the children to have a mobile day, when they get their medication, such as chemotherapy. It is possible to ease their stay!

3. More Efficient and Cheaper Methods for Bioethanol Production

Ethanol produced from inexpensive biological waste like straw has the potential to alleviate the imminent energy crisis but currently is not an economically viable process. Our goal in this project was to reduce the running costs and investigate both enzyme driven hydrolysis and microbial fermentation. Our project consists of two phases of practical research in the laboratory; one focusing on a characterization of the total process and the other focusing on minimizing the amount of enzymes needed. We have carried out an array of experiments determining the effect of temperature on fermentation; how reactor time influences the yield for both hydrolysis and fermentation; and different enzyme mixtures effect on the yield when used before or after the fermentation. We found that one could decrease the concentration of the most expensive enzyme added by 33% without compromising the final ethanol yield. This research will help produce a more economically competitive bioethanol to replace crude oil.

Ireland

1. An Extension of Wiener's Attack on RSA Encryption

In 1990 Wiener showed that if RSA is used with a small decryption exponent it can be successfully attacked. He based his attack on the properties of continued fractions, in particular on a very well-known theorem of Legendre concerning the approximation of irrational numbers by simple continued fractions. In 2004 Hinek proved that if a very large decryption exponent is used, the RSA system can be successfully attacked. Using a small decryption exponent, d, has the advantage of allowing rapid decipherment. It might be thought that this advantage could be retained by increasing d just beyond the range vulnerable to Wiener's attack. In attacks of the Wiener and Hinek types the condition must be obeyed for the success of the attack to be guaranteed. I shall refer to this condition as the "$n^{\frac{1}{4}}$ barrier". In this project I investigate attacks beyond the $n^{\frac{1}{4}}$ barrier. My project builds on Dujella's work. I generalise Dujella's inequality and I prove a number of theorems related to his extension of

Legendre's theorem that form the mathematical basis for efficient Wiener and Hinek-type attacks beyond the $n^{\frac{1}{4}}$ barrier.

Iceland

1. Ice-Gripping System

The purpose of this project was to develop a device that is helpful in increasing the tire grip on a slippery surface, such as icy roads which are common in all northern Europe. Such a device can be crucial in avoiding accidents, or at least minimize damage to people and vehicles.
A lot of trials and experiments were necessary to find out which design and ideas worked best to accomplish the goals we set us and the final project uses vacuum as a means to eject the best suited material for the gripping. Sand turned out to be the best material, it works immediately and doesn't pollute and is inexpensive.
We made our prototype of the sand ejector out of steel and it works on the same principle as the common aerosol can that is air creates sub pressure which draws the sand out of a container towards the tires thus creating the anti slippery function.
This solution to a problem that motorists face in all countries where snow and ice occur, is in our opinion both practical and useful and can without doubt be developed further.

Finland

1. Effects of Nicotine on a Primary Lipid of Lung Surfactant

The aim of this investigation was to find out how nicotine, present in tobacco, affects structurally the lung surfactant in the alveoli of our lungs. Further, pH and ion strength were varied to see how the effect of nicotine changes. The method for the investigation, the Langmuir-Wilhelmy method, is based on the idea that the normal surface tension reducing functioning of the surfactant changes when contaminants interact with it. The extent that the parameters in the yielded surface pressure–area isotherms met criteria required for normal surfactant functioning was ranked from a scale of 1-10. The average rankings for different solutions thus gave the comparative stability and efficiency of the surfactant. Interactions were analyzed in order to explain the differences in the rankings of the surfactants exposed to different solutions, and recognize trends. The results showed that nicotine and pH 10 generally have a negative impact on the surfactant. Nicotine in solutions of sodium chloride and calcium chloride in pH 7.4 seemed to give a risk of the respiratory diseases, emphysema and edema.

2. Finding Optimal Tactics with a Genetic Algorithm

Discovering optimal tactics for different games and situations is generally a hard problem that needs a different approach for every game analyzed. My work presents a generic approach based on genetic algorithms. The method is stochastic and heuristic, that is, inherently random and produces only near-optimal solutions, but even this is better than what can be easily analytically achieved in such problems. However even a with genetic algorithm one needs to work out some game-specific implementation details. This should however generally be easier than a systematic analysis of the game itself. As an example we will apply the proposed methodology to a stochastic combat simulator.

Hungary

1. Examination of the Plants' Self-Defence Against Pests

Some plants, especially members of the mint family can defend themselves against their pests on a special manner: they emit scents that attract natural predators of the pests. This phenomenon was studied by biologists and chemists, but a contradiction remained unnoticed: chemicals that are held responsible directly for this effect cannot evaporate. My project was aimed at finding the reaction pathways taking place in the plant during an attack to convert the furanoterpenoides (chemicals responsible for self-defence) into volatile compounds. Experiments were made with plant extracts which mainly involved chromatographic methods to discover possible pathways. The experiment based effect mechanism model of furanoterpenoids can explain the rapid reaction of the plant to an attack despite of the fact that furanoterpenoide is produced very slowly. By discovering more details of floral self-defence, more environment-friendly pesticides may be developed.

2. Recognition of Movement Patterns Through the Use of Computer

This project is based on the idea that we want to protect information from people who we don't want to get it. I therefore developed a new recognition method, based on the recognition of movement patterns. This recognition method guarantees that only those people get the "secret" who have a real access.
Using the recognition of movement patterns with a pattern and information of the description (for example the speed) we can identify people. We can use it with a touch pad, so this method is easy to build up.
The program consists of three parts: user creater and deleter methods and a recognition test method.
As a conclusion, we can say the new technology is cheap and easy to use in a wide range.

3. SmartDiff

At the very end of my high-school time, I experienced, that some of my classmates had difficulties with understanding the differential calculus. I found out that the major problem was caused by the lack of the practical exercise books.
For this reason I developed the SmartDiff which is a differential calculus teaching method.

Italy

1. ASTRO Water Purification. Active Sludge Treatments for Water Purification

The present project aims at the validation of a new depuration process. The proposed plant has three lines of depuration: the physical (to remove particulates and oils), the biological and the sludge ones. The sludge depuration line involves an anaerobic digestion that produces bio-gas to supply the plant energy. The sludge is dried (thickened) and used as a fertilizer.
The depuration process is the following: an anaerobic tank is placed before the four aerobic ones and an anoxic tank follows; after that, a tank for re-aeration is placed to facilitate the sludge sedimentation and to regenerate the bacterial mass; eventually, a disinfection phase follows to prevent the presence of pathogens. There is also a sludge re-circulation, which flows from the sedimentation tank to the start of the plant, thus mixing the entering sludge (physically treated) with the final sludge.
Finally, the efficiency of the system has been checked throughout a chemical analysis and a two-step biological analysis. First, the aerobic-tank micro fauna was analyzed and the SBI, determining their efficiency calculated. Then, the effluent was analyzed, using a crustacean (Dafnia Magna) that is extremely sensitive to pollutants. The presence of these crustaceans in a water sample after 48 hours proves the plant efficiency.

2. Water Rockets

How can the variation of mass due to the variation of pressure in the rocket's tank be studied?
In a water rocket both air and water are kept in a tank (obtained from a PET bottle), and air is forced in the tank under pressure.
This is in order to assure that when the rocket is freed from the ground, the air will start expanding, pushing water out from the tank. As the water flows out from the tank, a thrust is produced, because of the third principle of dynamics. When the velocity is equal to zero, the rocket inverts its direction, and begins a naturally accelerated motion until it hits the ground.
The point of zero velocity is called rocket's apogee, and represents the maximum height reachable from the rocket. The main evolution of the project in the future could be the generalization of the conclusions.

3. Physical Discrete Time Modelling of a Vibrant String to the Synthesis of Sound

One of the main ways to collect information about the surrounding world and to interpret it is the sense of hearing. Through that complex system of mechanical organs which forms the hearing system, it is possible to pick up a wide range of sound signals (from a simple noise to an orchestral symphony; from the roar of the thunder to the light blowing of the wind) and to distinguish a variety of timber, intensity and highness.
The present software can be used by a customer to reproduce a note of a specific highness, with its complete spectrum, produced with a virtual vibrating string, by giving data about the tension applied, the medium of the string and the note. The sound reproduced is that associated to the solution of the wave equation, considering the particular initial conditions, that have been used in its form at the finite variances. This permits to produce infinite highnesses.

Latvia

1. Production of Nano-Architectures by Electronic Methods

Nowadays we cannot imagine our life without various electronic devices. Their operations are based on integral schemes, which are scaled down dense electronic circuits. However, in the near future the further scaling down of integral schemes using existent technologies will be impossible. Therefore new materials are being explored in nanosciences that could be used in the future for the fabrication of integral schemes, however, there is still a lot to be done. Till now, only matrixes of single nanowires and nanotubes have been obtained. However, more perspective in electronics would be dendrite-type nanostructures (forked nanowires) for fabrication detectors and sensors in integrated circuits. Armands suggested such a method, with the help of which dendrite-type nanostructures could be obtained in electrochemical way- Al membrane anodisation of both sides in different electrolytes and Cu electrodeposition in pores. Although improvements and more explorations are still needed, Armands verified that the described new method of obtaining dendrite-structures works.

2. Late Star Spectral Classification in Selected Areas of the Sky

Janis and Reinis in their scientific research have investigated late stars, especially carbon stars, as they are both rare and allow them to look into the structure of our Galaxy. The red light that these stars give out does not disperse as much as blue light in the intergalactic environment and thus more of it reaches the Earth. This work allows the authors to research the evolution processes of carbon stars. It also lets the authors test the efficiency of the new equipment in the Baldone observatory, when observing late stars. This proves that medium sized telescopes can work with weaker objects in the sky that have not yet been investigated.

3. Revision of Ichneumon Wasp (Ichneumonidae, Hymenoptera) Tribus Protichneumonini in Latvia

Forestry pest problems all encountered all over the world. One of solutions to this problem is using parasitic insects, for example ichneumon wasps, which are powerful biological weapons in fight against forestry pests, but they are very poorly studied in Latvia and because of insufficient data it has been hard to evaluate changes of ichneumon wasp populations since the middle of the 20th century. So Ugis set a goal to make a revision of one systematic group of ichneumon wasps. The main tasks were to review all literature data and collection materials and to make an easy usable identification key. As a result 23 species were found 5 out of which are new to fauna of Latvia

Lithuania

1. ACE genotype - Promising Genetic Marker for Heart Diseases

All around the world millions of people suffer from heart diseases. The most crucial risk factor causing ischemic heart disease development is a personal genotype. During two years of study we explored angiotensin I-converting enzyme (ACE) genotype variation, linked to ischemic heart diseases. The goal of this study is to answer the question: whether ACE genotype could serve as a genetic marker for ischemic heart diseases. The ACE genotype and clinical characteristics (total cholesterol, triglyceride, low density lipoprotein, systolic and diastolic blood pressure) were determined and compared between 137 patients with ischemic heart diseases and 40 healthy persons. Our results show that ACE genotype variation differs between patients and healthy people. The genetic tendency to ischemic heart diseases was evaluated for different ACE genotypes. Early determination of personal ACE genotype could serve as a predictor to develop this disease and may help to understand the reasons of its development and to control further progress. Genetic data coupled together with clinical characteristics could help to select proper medication and treatment, before the first symptoms of disease appear.

2. Zinc and Zinc Alloys Galvanic Coatings: Structure Homogeneity Determines Resistance to Corrosion

Have you ever noticed how rusted cars, nails, bridges and many other important steel objects created by human look like? Of course you have tried fighting with rust that came up on their surfaces and had a lot of work. Steel corrosion is one of the most burning problems these days. Practically protecting metals from corrosion galvanic zinc coatings are most widely applied especially zinc. However, zinc alloy with iron subgroup elements (nickel, iron, and
cobalt) highly improve the anticorrosive properties of these coverings. Alloy structure is one of the main factors determining higher corrosive resistance in comparison with pure zinc coatings. We have established a strong correlation between metal covering anticorrosive properties and layer homogeneity as well as number of crystalline structure defects. Improved technologies for electroplating of super-homogeneous coatings could largely help to resolve steel corrosion problems.

3. Lithuanian Youth Interest in Science

The study of the European Commission “Europeans, Science and Technology” published in 2005 states that Lithuanians least of all European countries citizens are interested in science and innovation. The talented youth tends to prefer popular and profitable carreers over a scientific carreer. This appears to be a long term social problem. We tried to find out the particularites of youth interest in science by analyzing their values, abilities and social environment. Altogether, we investigated the attitude towards science and reasons for its formation, such as presentation of science at school and in public. The survey sample consists of 1598 respondents of age 13-30 years. We found out that men

are fonder of science than women, 31% and 21% of respondent groups, respectively. It was very interesting to discover, that respondents whose mothers have higher education are fonder of science. Attitude towards science is most positively influenced by parents and relatives, and most negatively – by politicians. The main reason of science being not attractive (stressed by 66% of respondents) is orientation of teaching at high schools towards marks and exams, and not to the scientific explanation of the world, life, and technologies.

Malta

1. Electrostatic Soot Absorber

Air pollution caused by fume emissions is a health hazard. Tiny soot particles formed when materials or fuels burn, have various negative effects. Soot induces irritation and breathing problems. It also produces harmful black crust deposites on buildings and historical sites. Plants – the key source of life on earth, are damaged when the black material covers their leaves preventing photosynthesis. Moreover soot contributes to worldwide concerns such as climate change. The purpose of this project is to decrease the emissions of soot in air by designing a simple device based on electric principles. Two oppositely charged plates supplied by high voltage attract smoke particles, preventing air pollution. The device can be dismantled and the soot scraped off and deposited in landfills. The reusable apparatus can be adapted and installed in vehicle exhaust pipes and domestic fireplace chimneys, which are major soot emitters. Such an invention gives the users the opportunity to contribute in the creation of a cleaner and healthier environment

Norway

1. Population Models

The object of this project is to find out how well population models can describe the development of the cod stock in the Barents Sea. The mathematical models that were looked at are: exponential growth, the Schaefer model and two Lotka-Volterra models namely the competitive species model and the prey-predator model. I found out that the three models that I managed to compare to the cod stock data, could all describe the general decrease but not the fluctuations. These three models predicted however each a different future outcome: that the cod stock would die out, that it would stabilize at a smaller size than usual or that it would increase to earlier values again. These results did not lead to one conclusion so we still don’t know what will happen to the cod, do we?

2. Do Spices such as Cayenne Pepper, Cumin, Turmeric, Cinnamon and Powdered Cloves Inhibit Fungus Growth on Cooked Rice?

Do spices such as cayenne pepper, turmeric, cumin, cinnamon and powdered cloves inhibit fungus growth on cooked rice?
In Asia, the preservative properties of commonly used spices are well known. The aim of the present study was to assess this property in cayenne pepper, turmeric, cumin, cinnamon and powdered cloves. Cooked rice, mixed with these five spices was prepared, placed in plastic cups and observed for seven days. The extent of fungus growth was used to determine the preservative qualities of these spices and was measured every 12 hours. This study demonstrates that cloves and cinnamon, but not cayenne pepper, cumin and turmeric, have preservative effects.

Poland

1. Synthesising and Measuring Superconducting Sodium Cobalt Oxide (NaxCoO2) Crystals

During the last decade Sodium Cobalt Oxide (NaxCoO2) has attracted much attention of the solid state physics community due to its extraordinary properties, including superconductivity below 4.2 K discovered in 2003. Its structure is very similar to the high–temperature superconductors which are of great importance for the future of technology. The research on NaxCoO2 enables better understanding of the mechanism of superconductivity in the compound as well as in high–temperature superconductors. The production of NaxCoO2 crystals is crucial for the research. By now, mostly powder samples have been investigated because of technical difficulties in producing single monocrystals. During his 6-weeks stay at MIT (USA), Radek proposed and successfully tested his own method of obtaining small superconducting crystals from easy to obtain, non–superconducting forms. His method leads to superconductivity much faster than methods previously used for NaxCoO2 crystals and holds out hopes for new applications.

2. Bi-Functional Cross-Linking Reagents as a Means of Establishing Spatial Protein Structure

Recently, much attention has been devoted to the study of the cross-linking of proteins using bi-functional reagents. This method, jointly with enzymatic hydrolysis and analysis of obtained fragments by means of the mass spectrometry technique, may be useful in establishing the spatial protein structure. Dominik and Pawel tested in their project the monodisperse and polidisperse activated polyethylene glycols as cross-linking agents. The employed chemical compounds were similar to each other in terms of chemical character and reactivity but they differed in chain length. Dominik and Pawel explored the possibility of chemical modification of proteins using such reagents, as well as their mixtures, analyzed the obtained conjugates with the mass spectrometry technique through enzymatic hydrolysis. The obtained results can be useful in designing new procedures of measuring intermolecular distances within proteins.

3. Influence of Coal-Fired Power Stations on the Concentration of Radioisotopes in the Environment

Grzegorz has investigated the influence of the coal-fired power plants on radioactive contamination of the environment in the industrial and non-industrial areas and radioactive contamination of Polish soils due to coal-fired power plants and post-Chernobyl radiocesium. He analyzed 47 samples (collected by him) by means of low-background gamma spectrometers in three isotopic laboratories. The results of his research show that there is no significant increase of environmental radioactivity due to conventional coal-fired power stations. Although coal-fired power stations may release radioisotopes to the environment, the amounts emitted do not increase significantly the natural background radiation, provided that modern exhaust treatment systems are fitting. Radioactive contamination of the soils in Poland is due to the Chernobyl NPP accident in 1986 and nuclear weapon tests in the 60ies.

Portugal

1. Anaerobic Reactor UASB

The main goal of this project was to build a UASB - Upflow Anaerobic Sludge Bed reactor - and put it to functioning in mesophyllic conditions (37±1ºC).
The anaerobic digestion is a biochemical process that occurs in several steps, where complex organic compounds are metabolised by microorganisms in the absence of external electron acceptors. The microorganisms use organic matter as energy and carbon source and the products of the anaerobic digestion are methane (CH4), carbon dioxide (CO2), other gases (H2S e NH3) and biomass. So, there are treatment systems, for effluents polluted with organic compounds, based on the activity of anaerobic microorganism.
An important advantage of these systems is the fact that the methane (CH4) produced can be put to use, which leads to a lower use of fossil fuel resources.

From the results obtained through the UASB reactor, in the different operating conditions tested, one can conclude that anaerobic populations can be developed from samples collected in the environment, to inoculate UASB reactors. The results obtained also allowe to conclude that the use of UASB systems to treat effluents is viable.

2. Attitudes Towards Paternity

The concept of family is changing. The way as a child is educated today differs from the way the two previous generations did it. Partly, such changes are consequences of the economic and social shifts that have been changing the profile of families; but according to experts of social psychology, they also result from the new arising attitudes towards paternity and maternity.
The goal of this paper is to study the attitudes towards paternity according to a casual sample of the population that makes up the community of the Secondary School of Nelas

3. Construction of a Water Cooling System for Computer Components

A water cooling system is a method of heat removal from some computer components. In opposition to the traditional Aircooling (used in the majority of the computers that we buy), in watercooling the water is used as heat transmitter, not the air. The advantages of using watercooling over air cooling include water's higher specific heat capacity, density and thermal conductivity. This allows water to transmit heat over greater distances with much less volumetric flow and reduced temperature difference.

Russia

1. Microbiological Pollution of a Personal Computer

Nowadays everybody should know why computer users are suffering from serious illnesses. Microorganisms like coliform bacillus, actinomycetes, which were found in the air around computers, on the surfaces of a "mouse" and a keyboard, are really dangerous to the people. The microorganisms' concentration in the air around a computer is minimal during the use of the equipment because of the electromagnetic radiation produced by the electronic tube. But the microorganisms' concentration in the air grows and can exceed concentration limits at coli-index 2000 times. This fact can cause spreading of the infection through the air. After using the developing system "Computer sticker + Antibacterial solution" on the basis of fitoncides total microorganisms' concentration becomes 20 times less and does not exceed concentration limits. Microorganisms on the surface of the equipment have a stability to surface-active detergents, which testifies on a high probability of the contact infection transfer. The optimal microclimate in a computer room is observed at air humidity of 43% and temperature 24 º C.

2. The Study of Steel Corrosion Inhibitors Synergism

The object of this research is steel corrosion in acid media, corrosion inhibitors interaction and composition of their synergic formula.
The research resulted in finding effective combinations and concentrations of inhibitors with the use of methods of steel corrosion prevention, among which the most inexpensive and highly effective one is the use of inhibitors. The research has resulted in finding effective combinations and concentrations of inhibitors which, due to the phenomenon of synergism, that results in many-fold reciprocal strengthening, decreased corrosion and hydrogen fracturing practically up to zero in both acid and sulphur hydrogen media (in liquid phase) which leads to the possibility of using them in mass production.

3. The Dynamics of the Panic-Stricken Crowd

The main goal of the present research project is to study the behaviour of each person in the crowd that happened to have gathered wherever an emergency situation occurs. When building the physical model, we accepted classical mechanics equations as a basis. Our program written in Delphi monitors the movements of each person in the crowd.
The above model permits to estimate the time of escaping from the facility and to monitor dependency of the time of escape on different parameters. The above model may be considered in order to take into account the influence of any other factors and may be useful when designing facilities where large amounts of people are expected to gather.

Slovak Republic

1. Toxic Influence of Mercury and Cadmium on Artemia Salina Development

The aim of this project was to observe the toxicity of two heavy metals. The most present in our environment and threatening health of animals and people are mercury and cadmium. Their influence was observed on the cysts of Artemia salina during their transformation to nauplii. Experiments were done on their development and the impact of the given substances.
The results of the research done on Artemia salina confirmed toxic influence of both used heavy metals on live organism at the stage of development and at the moment of eggs transformation into nauplius and in the next period of life. Various biotests and their wide - spectrum usage enables us to configure tests on our required degree; therefore we are able to use a different way to perform experiments.

2. The Study of Symbiotic Star BF Cygni

The project is about the author's own visual and CCD data on the BF Cyg star. He used some other visual and CCD data from international databases too. CCD observations have been made by the author using a professional 60cm telescope. The project suggests the improved value of the orbital period, with which he was able to predict the next minimums and maximums of brightness of the star and it describes the behaviour of the star in outburst during August 2006. The project also includes successful observations of brightness of the star. The project is important for stellar astronomy, and shows that there are new parameters for symbiotic binaries.

3. Flowing of Free Surface Liquid and Drop Formation

This project studied the break-up of liquid jet with free surface into drops.
This phenomenon is used in many technological applications. For example in mixing, spraying and chemical processing which leads to applications such as ink-jet printing, fibre spinning and silicon chip technology. In this work we studied the dependence of the smooth length of the jet on the liquid height. We studied liquid flowing down from a hole, using water, aqueous solution and sunflower oil.
For constant high of liquid in a container we found out the smallest length for water and the longest for sunflower oil. We did dependences of length on initial velocity and found out the slope k=0,124s for water, k=0,187s for dilution of detergent and k=0,316s for sunflower oil. We verified and confirmed computer simulations of jet ending. Our results are useful for the development of hydrodynamics.

Slovenia

1. Collection of Minerals and Rocks in Ljubljana

The International Mineralogical Association in 1995 adopted a new definition for mineral: A mineral is an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes. There are currently more than 4000 known minerals, according to the International Mineralogical Association, which is responsible for the approval of and naming of new mineral species found in nature. Of these, perhaps 150 can be called common, 50 are occasional, and the rest are rare to extremely rare. The main aim of the project was to classify more than 470 samples of minerals and rocks, a collection which is possessed by Upper Secondary School of Electrical and Computer Engineering in Ljubljana, and is being supplemented every year. In the project I considered the Strunz classification, named after famous German mineralogist Karl Hugo Strunz (1910−2006), who devised a modern mineral classification (1941), made of nine primary groups. Strunz groupings are a means of classifying minerals by the anion groups that they contain.

2. The Effects of Substrate Density on Pit Building Decision and Pit Size in the Antlion Larvae (Euroleon nostras)

Antlions are a group of insects belonging to the order Neuroptera. Antlion larvae dig a shallow cone-shaped pit in dry sand and wait at the bottom for an ant or other small prey to slip on the loose sand and fall in. The aim of my investigation is to answer the question what kind of substrate is the most appropriate for the antlion larvae to build pits. In my experiments the chosen substrates and their densities were brown forest soil 530 g/l, sugar 881 g/l, natural habitat 1074 g/l and the quartz sand 1492 g/l. I suspected that the substrate with the lowest density will be the most frequently chosen. To test this hypothesis the antlion larvae were put separately into boxes filled with four substrates which differed according to their density so that the preferred one could be chosen. The most frequently chosen substrate was that with the lowest density, i.e. brown forest soil. In that substrate the antlion larvae built pits with the largest diameter.

Spain

1. The Pantheon: A Building, a Universe. The Pantheon and its Relation with the Sun

The Pantheon is a building which is dedicated to all the gods but its real purpose is to praise the Emperor. From the exterior square, where we find a circular square of the same diameter as the Pantheon roundabout, we observe the door, similar to most well-known Greek temples. Through two triumphal arches you get a totally different temple to the ones built formerly.. This study tries to unite two different sciences, historical and technological, in order to arrive to conclusions that would bring together the way of thinking of the civilization that built the Pantheon. Through this project we discovered how this building was a way to show the power of the emperor to the people, what the function of this building exactly was and how and when it was built. By generalizing these conclusions we could determinate the way of thinking of a civilization that justified their habits and tradition, something which continues to be reflected in our present society.

2. The 607: Antiretroviral Compound. QSAR Study of TIBO Molecules

The accomplishment of a theoretical study to predict the properties of a drug or a molecule before the experimental development in the laboratory can be very useful, since this means a considerable economic saving. Of all the existing methods, this research has used a mathematical study denominated QSAR, that relates the structure of molecules to their properties. It has worked with Anti-AIDS known molecules, concretely with tetrahydroimidazo [4,5,1-jk] [1.4] benzodiazepinonas (TIBO),

and anti-AIDS activities of these were predicted, in order to compare them with its experimental values and to demonstrate the effectiveness of this system. Then, thousands of new compounds with similar structures to well-known compounds were generated. We than, went about discarding those of less activity until arriving at a new anti-AIDS compound, with better activity than the initial molecules. This one was baptized the “607”, in honour of Paul Ehrlich, who synthesized the first “magical bullet”, the 606.

3. Simple Games Language Compiler. A Novel Toolbox Designed to Solve Mathematical Problems Related to Game Theory

SGLC is a novel toolbox designed to analyse and solve mathematical problems related to game theory, being able to correctly simulate games or models concerning real problems in biology or economy, focusing on complete information, on competitive games. It consists in a specific and simple programming language in which games are naturally defined and its compiler which executes the resolution of the programmed games. We have also optimized the method of processing data to make its running time accessible to usual desktop computers and studied the behaviour of the tool under different games to improve its performance. A manual of the language is also available, with examples.

Sweden

1. Iron Oxidizing Bacteria in a New Environment

We had three questions at issue: What are the differences between Äspö Hard Rock Laboratory in Sweden and a hot spring in Grenada, a small island north of Venezuela? Are there living, active populations of the iron oxidizing and stalkforming betaproteobacteria Gallionella ferruginea in the hot spring? And do minerals congregate in the BIOS (bacteriogenic iron oxide), if you compare it to the rest of the water? We took a lot of different mineral- and DNA-samples from the spring to be able to prove the existence of Gallionella, and to tell if minerals congregate in the BIOS. Through DNA-sequencing we discovered that Gallionella ferrigunea didn’t exist in all of the spring, but bacteria that had 97% of the bases in common with Gallionella ferruginea had started to grow on the surfaces that we had hung up in the water above the inflow. It was found as well that the bacteria had 100 % of the bases in common with an uncultured Gallionella.

2. Rapid Evolution in Bearded Reedling (Panurus biarmicus)

The bearded reedling is a relatively new species in the Swedish fauna. It was first observed in Hammarsjön, Skåne, in june 1965. It is mostly a non migrating bird, but is due to its late colonization of Sweden, not really adapted to the Swedish winter climate (which is somewhat harder than in it’s original breeding areas) and when winters get cold, many bearded reedlings die, causing the Swedish population to fluctuate strongly. My idea was that the winters would strike harder upon individuals less adapted to the Swedish winters, and thereby select for traits that makes them better adapted to the winter. After comparing the population of Tåkern in Sweden, with the population of Kolon in Hungary, I could conclude that the bearded reedlings of Tåkern have more fat stored, weigh more and have longer wings. This indicates that the bearded reedlings have adapted themselves to the Swedish winter, and that a speciation is going on among the bearded reedlings!

3. Construction and Analysis of a Tesla Coil

During the project two tesla coils were constructed. The first is a small replica of the classical tesla coil Nikola Tesla designed. Upon finishing the first tesla coil, it was decided that yet another tesla coil would be constructed. It had shown that Tesla’s tesla coil was considerably dangerous due to one

most troublesome component, and thereby it was not appropriate for exhibition. With this in mind, a brand new kind of tesla coil was developed, which not only was superior to Tesla's construction in that it was safer, but it also had many practical advantages to the old model. This is an ever-evolving project which is still far from reaching its final destination!

Switzerland

1. Spectral Analysis of Electroencephalograms for Classification by Neural Networks

Brain waves are electrical activities of the brain which are manifest as alternating potential differences at the scalp surface and are also known as "electroencephalogram" (EEG). The alternating potential differences encompass a range of typically ±75 microvolt under the condition of quiet wakefulness, while body movements, in particular movements of legs and arms, produce somewhat higher voltages. In our project we aimed at distinguishing between several human body movements by analysing and classifying the underlying brain electrical activities.
Using an experimental design with 7 different types of body movements ("experimental conditions") along with repeated assessments on the same individual at weekly intervals, we were able to quantify brain waves, their within-subject fluctuations and between-subject variations. After a suitable phase of learning, the algorithm yielded a final Neural Network that classified the 7 experimental conditions at rates of 90% correctly classified probes. Our results can well be regarded as a proof of principle, thus stimulating further investigations that involve a much larger and more representative sample of test persons. The program package developed within the scope of this project will greatly facilitate attempts in this direction

2. Simulations on the Sphere: Distribution of Points and Calculations of Energy

Two related properties for a set of n points on a sphere are investigated in this project.
The set has the maximum property if the minimal distance occurring between the points is maximal.
Given a law of repelling forces, the configuration of points can reach equilibrium with (globally or locally) extremal energy.
While it is difficult to verify in general that the maximum property is satisfied, the energy criterion may be approximately checked by numerical simulation. The present investigation uses deterministic and stochastic simulations to find suitable approximations to extremal energy configurations as well as arrangements of points on the sphere enjoying the maximum property. The stochastic simulation mimics Darwinian Evolution. The deterministic one is inspired by Euler's method for the solution of ODE's. The simulations involve programming of geometric algorithms such as finding the convex hull, distance matrices, various invariants of point configurations on the sphere, as well as 3D plots. We discuss examples involving Fullerenes with 24, 60 and 120 points, and a discussion of equilibrium configurations involving only triangles and quadrilaterals.

3. Neural Networks – Simulation and Application in Strategy Games

The aim of our project was to understand more about artificial neural networks and to explore the limits of this technology. Artificial neural networks are self-learning algorithms that are inspired by the way biological nervous systems, such as the brain, process information. They are suitable for solving complex problems in an efficient way; they do not necessarily find the perfect solution. This has to be taken into consideration when problems are chosen. The advantages of artificial neural networks are their adaptability, learning aptitude, robustness and the possibility of generalisation. We tested the limits of artificial neural networks by developing a program that learns to win a board game (The Settlers of Catan) involving sophisticated strategies and complex rules.
The results of our work are encouraging. We managed to train several networks to the point that they were able to play well against each other. Playing against human opponents turned out to be very difficult because the behaviour of the "neuronal" player is incomprehensible to humans. Improving

performance would require further research into several open issues, which are described in the last chapter of our paper. The final chapter also includes suggestions for future work with the goal of reaching or even exceeding human playing ability.

Turkey

1. The Integer Values of Algebraic Expressions and Some New Properties of Binomial Coefficients

In this project we first examined the integer values of algebraic expressions given in terms of *n*, and refined both solution techniques for problems and methods for creating new problems. In addition, in the final section we deduce a new interpretation of the theory of "Reduced Pascal's Triangle in a given prime modulus".
The aims of this project are:

i. To examine the integer values of an algebraic expression given in terms of *n*.

ii. To find the necessary and sufficient conditions for a given geometric sequence to be equivalent, in a given modulo, to a polynomial.

iii. To prove a new property of binomial coefficients and to apply this property in the construction of Pascal's Triangle according to a given prime modulus.

2. Gaining Lithium and Cobalt by Recycling Lithium and Cobalt Batteries and Prevent Environmental Effects

In this project, to prevent their environmental effect two different methods to recycle lithium and cobalt batteries were developed. The cobalt and nickel in the waste batteries were recovered using two different methods. In the first method, crashed battery material was treated with HNO_3. After heating the mixture for two hours, it was filtered. NaOH solution was added to the filtrate until its pH became 6.5. The mixture obtained was filtered again. NaOH was added to the final filtrate until its pH = 10. After filtering the mixture Na_2CO_3 was added to the filtrate to precipitate Li^+ ions. In the second method, crashed battery material was treated with N-methyl pyrolidene. After heating the mixture at 100°C for one hour, it was filtered. The solid collected on the filter paper was transferred into a solution of 4 M HCl solution. The mixture obtained was heated at 80°C for a while and then filtered. NaOH solution was added to the filtrate until all the Co^{+2} ions precipitated as $Co(OH)_2$. After filtering the mixture Na_2CO_3 was added to the filtrate to precipitate Li^+ ions. The metal concentrations in the final filtrate were determined using atomic absorption equipment. In the first method 99.9% of Co and 38.5% of Li; in the second method 99.7%of Co and 33.8% of Li were recovered. In this way, Co and Ni which are dangerous for the environment and human health were recovered and thus saved money.

3. A New Hot Water Source Established with the Environmentally Friendly Zeolite

The most important issue today, as it will be in the future, is providing energy and preventing the pollution of the environment in the process. With the method developed in this project we will have hot water throughout the winter and we will have prevented pollution while obtaining this. We have enabled zeolite to absorb the gas heat by covering the water pipe we passed through the pipe thereby trapping the gasses from the heat source within the substance. With this, we heated the water passing through the pipe. Because of zeolite's property of preserving heat for prolonged periods of time within itself we have secured the availability of hot water source in case of power cuts. Moreover, with this system CO_2, SO_2 and other pollutant gasses are trapped owing to the adsorbent properties of zeolites. There are enough reserves for the zeolites and its cost is quite low. We think that zeolite will be one of the most important raw materials of our century. As a result of this we have taken an important step towards preventing global warming which has become a major problem of our world.

Ukraine

1. Synthesis of Biomaterial Biphase Composite Hydroxyapatite-Beta-Tricalcium Phosphate

Biphase bioactive composite hydroxyapatite-β-tricalcium phosphate (BCP) is used for injured bone repair. It is required BCP with optimum ratio of hydroxyapatite (HA) and β-tricalcium phosphate (β-TCP). In order to synthesize such BCP a simple method is developed. It includes : 1) interaction of aqueous solutions of 0.42 M $Ca(NO_3)_2$ and 0.25 M $(NH_4)_2HPO_4$ at pH 11 that results in suspension creating; 2) treatment of suspension; 3) separation of deposit from the working solution; 4) heat treatment of the deposit. The regulation of temperature and time of deposit maintaining in the working solution allow to receive BCP with required ratio of HA and β-TCP.

UK

1. FSC11 – The Flexible TV Standby Controller

This project aimed to develop a device to solve the TV standby problem by fully and automatically switching off a television and associated equipment such as VCRs, DVD players, etc when not in use – and switching them on again when required, using the television's normal remote control. The two approaches developed involved: learning and recognising signals emitted from the television's remote control; and measuring the power usage of the television. The second approach proved to be successful.

2. Ix, Ypsilon, Z

To encourage innovation, the energy regulator, Ofgem introduced the Innovation Funding Incentive, allowing network operators to spend 0.5% of revenue on research and development. While this encourages investment, reporting requirements are intensive and detract from actual research. An ad-hoc reporting process existed, consisting of manual data collation, which lacked integration and did not facilitate aggregation. The goal was a system for IFI data storage and aggregation. The final system was developed using every day web-browser technologies.

3. Absorption of Ions: Investigation into the Removal of Chromium Ions from Water

A method to remove Cr ions from water involves reducing Cr (VI) to Cr (III) using a metal oxide and photo catalyst, and an alumino silicate to absorb the Cr (III). This project was centred on developing a method to quantify Cr (III) and (VI) in solutions. An electron microscope and EDAX was used to prove the effectiveness of the alumino silicate in absorbing the Chromium, and UV Winlab and Dionex Ion Chromatography was used to design a method to determine unknown quantities of Cr ions.

USA

1. The Secret in Mimosa's Leaf Folding Pattern

Our research has presented the idea of multi patterns of Mimosa's (Mimosa pudica L.) leaf movement when excited by particular mechanical stimuli: touch, wound and heat. To stimulate with touch, we used starch droplets (2.5 g starch/ 100 ml water) as a mechanical stimulus and controlled the force by

varying height at which starch droplets were released. Volume and mass of the droplets were controlled by a plastic tube containing starch solution. We measured the velocity of leaf movement and found that it folded faster when the force is increasing. The speed was fastest when stimulated at tip of leaf. Leaf folding, stimulated by wounding and heating, was faster than the folding, caused by touch, and took longer time for the recovery. Wounding and heating caused sequential folding of leaflets outwardly from stimulated point. In contrast, touch caused two patterns of leaf folding: sequential and simultaneous folding of leaflets. Sequential pattern happens when stimulate Mimosa with low magnitude of force, and simultaneous pattern happens when stimulate Mimosa with high magnitude of force. As an extension, we studied the possibility of using Mimosa as an earthquake sensor, to sense the magnitude of earthquake and direction of epicentre.