Project description

To motivate young people at the age of 16 till 18 for studying modern life sciences or engineering, a project-like, action-oriented and experimental teaching is an imperative. The enthusiasm for experimentation is extremely motivating and is proved to promote future interest of students in natural sciences and engineering studies. Therefore it`s necessary to provide a motivating science curriculum and learning methods to sustain students’ interest in the subject and desire to achieve a good education.

As a part of modern science in the project, we will develop together **action-oriented teaching modules** on the innovative production **methods of renewable energy and biodegradable polymers** by biotechnology. The development of sustainability by biotechnological promises to have an immense value-creating potential with secure jobs in Europe. With this project the participating schools try to foster their STEM competences.

The global energy hunger of the industrial nations has the consequence of a great dependency on fossil raw materials like oil, gas and coal. But those fossil raw materials are coming slowly to the end and getting so more and more expensive. Furthermore, we know by using fossil raw materials, the climate change is fostered. The EU reaction to this problem is the Strategy Program 2020. 20 percent of the final energy consumption has to be provided by renewable sources by 2020. A great target compared to the share of 12.5 percent we have today.

One possible alternative for a future sustainability in Europe energy and polymers e.g. plastic production should be realized by biotechnology. By using renewable raw sources in sustainable production processes, the produced bioenergy in case of biohydrogen in a fermentation process, bioelectricity in a fuel cell by yeast and saving fossil oil by using biopolymers could help to reach the aims of the EU Program 2020. In addition, the use of sustainable raw sources is more or less carbondioxid neutral and helps to decrease the emission of climate gases. In comparison to other renewable energies like solar and wind power, biohydrogen has the advantage that it can be stored.

Europe is the global leader in the field of sustainable energy production. In order to keep this position in the world, strong efforts are necessary. In schools, the young generation must be sensitized for sustainability and the environmental aims of Europe. Using agricultural products as resources for the bioenergy production is not uncontroversial. So it`s necessary to select agricultural resources for a sustainable bioenergy production in a smart way. In an ethical discussion we try to figure out a sustainable and possible energy mix for future consumption.

Furthermore, Europe should be a pioneer in developing new innovative and sustainable production procedures e.g. in biodegradable polymers to substitute plastic. Plastic waste in the oceans coming into food chain is a huge risk for all living organisms. To substitute fossil raw materials in plastic production requires, however, a considerable joint effort to raise awareness in young, internationally acting and thinking people about these issues and thus to strengthen European business position in this area.

The project will foster the innovation and creativity of the participating students by finding project solutions. In addition, during the project we create high quality learning activities to develop students’ research and practical skills, alongside skills such as problem solving, team work, effective communication and professionalism. Students will be trained to become knowledgeable mentors in this field of biotechnology. They will share their knowledge with the audience of participants as lecturers during experimental laboratory workshops that will serve the evaluation of the developed teaching modules. To ensure the evaluation of the project results international tandem student groups are formed. This strengthens the awareness of being a member of the EU.

At the same time they will continue with the implementation of the modules in the classroom at their home schools. By this way, the students will be sensitized and motivated towards these issues and take relevant professions in order to strengthen European biotechnology business position in this area. In addition, foreign language skills are promoted by using English as work language in the project. All these activities will improve students life chances.

What´s more, the international profile of the participating schools will be fostered. The project meetings will increase the interest in other work systems, mentalities and cultures. Furthermore, the aim of the partner schools in this project will be to develop into competence centers in the field of sustainability by biotechnology. The partner schools start to enlist support from new and existing employer contacts in their surrounding to share expertise and get specialist experiences and access to commercial facilities.

The innovative aspect of the project is that all partners intend to create innovative examples for best practices in the field of sustainability by biotechnology. The created innovative experiments are mapped to schools curriculum and offers opportunity for specialist technical training. The innovative character of the project might also be derived from the scientific questions that are dealt with and the sharing of these results through dissemination activities within the communities.

The modern biotechnology promises in the field of innovative production methods to have an immense value-creating potential with secure jobs. To keep on being the global leader in this topic of biotechnology in the future requires, however, a considerable joint effort to raise awareness in the young generation is necessary.

The project "European Challenges in Sustainable Energy Production" we conducted before was focused only in the production of teaching modules in the field of biogas and bioethanol. Our current application is focused in sustainability which includes other innovative production procedures in bioenergy but includes also the production of biodegradable polymers to avoid plastic accumulation in the environment. In the action-oriented teaching modules, the production of biohydrogen, bioelectricity and biopolymers will be conducted innovatively out of waste materials which are not in concurrence to the food production and don`t increase the prices of food as a consequence of the competition in agricultural areas. The products could decrease the dependancy on fossil raw materials.

Furthermore, we will place a significant emphasis on ‘softer’ skills such as creativity, problem solving, communication, collaboration and emotional maturity in our project. We try to support the transition from study into employment by giving students essential skills required to enter the STEM labour market. Thus the transition from school to a higher education or to work life is facilitated, especially because most partner schools are located in regions with an above-average unemployment rate of young people. Thus we will strengthen European business position in this area by recruiting more students into science subjects to assist in growing the talent pool of the future STEM workforce.

With the creation of the modules for the production of biohydrogen, bioelectricity and biopolymers, the didactical background information as well as the experimental protocols and the engineering items will be worked out. This will be realized with the creative construction of low cost fermenters and self made fuel cells all interested schools could copy without financial investment. Furthermore, the production rate of biohydrogen and biopolymers will be optimized by working with the professional fermenters of the biotechnology high schools of Evreux and Pforzheim. Production rate should be optimized in dependancy on different microorganisms and environmental conditions.

Innovative approaches to achieve the project objectives e.g. to motivate students for a secure job in biotechnology and engineering are:

1. Mentoring concept

Trained mentors work together in international teams during the teacher-student workshops as responsible lecturers and pass on their knowledge of theory and experimental practice to the participants. Mentors who are not on the stage support and assist the mixed teacher-student workgroups and especially in the work groups they support the challenged students. They communicate in the foreign language of English and gain valuable international experience. Through this lecturing activity, the mentors achieve high self-affirmation for their commitment. Additionally, the mentors with their excellent know-how serve the students participating in the workshop as role models. The partner schools set the mentors in the rolling system.

2. “Panel discussions” concept

At the end of the teacher-student lab workshops there will be a review with evaluation of the experimental results from each international work group with discussions. All work groups have to present their results worked out with the different fermenters under different environmental conditions to the audit with the goal to figure out the optimal production process. At these panel discussions, all the students of the countries that did not send any mentors to this lab workshop are encouraged to become actively engaged. These students will be supported and introduced by the mentors who will assist them.

3. Ethical concept

At the end of the project an ethical discussion will take place to evaluate the worked out ethical tools of the former project also led by the participating students. In this way each student is given the opportunity to participate in a highly responsible way in the project meetings.

During the past 12 years JWS conducted 4 EU projects in biotechnology with partly different partner schools. All projects that have been performed up to now were focused in the field of molecular biology and environment protection. Three of our projects were awarded by the EU as star projects. Our fourth project about sustainable energy production is currently in the evaluation process.

By this way all partners developed into competence centers in their countries in biotechnology. All of them have shared aims and would like to improve their experience in the future with this international project of which their students will have a huge benefit.

The most important advantage in this project will be the huge diversity of the partner schools. They are churchly, private, vocational and common high schools. This diversity and their different expertises in science helped a lot to reach the project goals in the past. The advantage of this diversity of partners in future will be the view from different sides to the questions raised up in this project. For example this will be very helpful and productive in the ethical discussion to solve the question which resources could be used for a sustainable energy production and the production of biodegradable polymers.

The diversity of the partners furthermore guarantees that the hands on lab modules we want to develop, will be on the high level of a biotechnology high school with all the professional lab equipment they possess as well as on low cost level with the self made lab items. So it`s ensured that all high schools not only the partner schools depending on their lab equipment and budget can use our project results easily in their lessons.