INSTITUT NATIONAL DES SCIENCES APPLIQUÉES DE LYON

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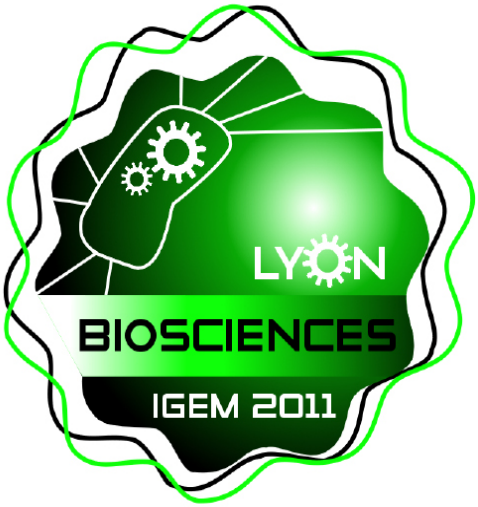
ÉCOLE NORMALE SUPÉRIEURE DE LYON

Two of the best grandes écoles of Lyon join their skills in a synthetic biology competition.

technical file



INSA ADN CONCEPT CLUB

Students' association recognized under the 1901 law aimed to promote synthetic biology by participating in international competitions and by organizing technical conferences within an ethical thinking.

sommaire

The road to a gold medal... Regional Jamboree in Amsterdam and then world in Boston.

1. A cooperation between two prestigious schools

The Ecole Normale Supérieure de Lyon

The Ecole Normale Supérieure de Lyon is a higher education institution which statutes are those of a university with a few special features, in particular regarding the recruitment of students on a national competitive entrance examination and the admission with an auditeur status.

In its current form, this institution is considered as recent, resulting from the merge, on January 1st 2010, of the scientific branch and the arts, humanities and social sciences branch. In fact, it inherits from the Saint-Cloud and the Fontenay-aux-Roses schools founded by Jules Ferry in 1880 and 1882. It is dedicated to teaching, research and the dissemination of knowledge. It is both multidisciplinary and interdisciplinary, from accurate and experimental sciences, to human and social sciences. It gathers 2150 students including 400 PhD students.

The quality of research within the institution puts it on the 100th rank in 2010 among the 604 best universities in the world (among the 9000 identified by the Unesco) and on the 3rd rank in France according to the international ranking published by the Times Higher Education Supplement.

The department of biology offers a general training of high level through a Bachelor's degree in Sciences and technologies (BSc) and a "Biosciences" Mater's degree in partnership with renowned laboratories enabling a close bound between the education and the fundamental research activities. It also prepares students for careers in teaching with a preparation for aggregation of Life Sciences and Sciences of the Earth and the Universe. At the end of their education, around 80% of our students follow a thesis in various fields of Biology.

The Institut National des Sciences Appliquées de Lyon

INSA Lyon is an engineering university founded in 1957. It has overtaken all the other schools with an accessible and plural scientific education opened on the world. This gamble on the human nature enabled this engineering Grande Ecole to be nowadays among the firsts in the race of opening the engineering world to middle social classes.

By the means of its twelve fields of specialisation, at the state-of-the-art, this institution is acknowledged by recruiters as one the best french engineering schools. It is indeed ranked 4th, all categories taken together, in the last ranking of the french magazine l'Usine Nouvelle.

Founded in 1959 under the name of "Biochemistry", the "Biosciences" department has never stopped its evolution in order to offer today multiple skills to its students. Thus, the Bioinformatics and Modeling (BIM) section emerged in 2000. The education provides young graduated students of Biosciences with a knowledge enabling them to both a thesis and an entrance in the industrial world, and therefore to access various positions, from R&D to quality control.

Besides the academic aspect, INSA is marked by a culture of community life: not less than 125 students associations are actively involved on the campus, and enable "Insaliens" to live their passions, to satisfy their desires of investment and development.

Lastly, INSA Lyon is a privileged place to mix with all the cultures in the world. By the means of its international sections during the First Cycle and its exchange programs during the Second Cycle, over 70 different nationalities live together on campus, and over one out of five students is a foreigner.

2. the project

A project anchored at the heart of current concerns

Environment and risks prevention issues are a major stake in our society. The Rhône-Alpes region has understood that very early, especially through the importance of its chemical and nuclear activities.

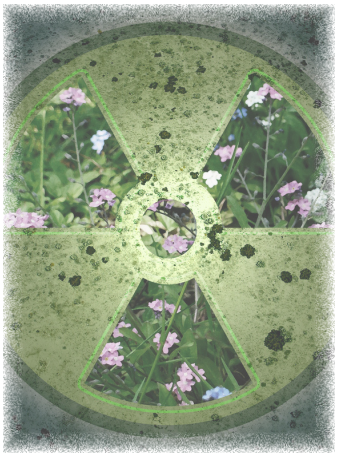
Industrial wastewater treatment permits their reuse in industrial use and improve their quality, enabling compliance with discharge standards. Various processes are currently implemented to clear the wastewater from its contaminants (e.g. biological, membrane liquid-solid separation, physical, chemical and thermal processes). One of them is bioremediation.

It embraces processes that use microorganism metabolism to remove pollutants from a contaminated environment. This rather new approach, the less expensive to put in place, is especially interesting in the treatment of poorly contaminated effluents. However, these microorganisms must respect a few criteria:

- harmlessness towards the environment and human nature,
- easiness of cultivation,
- tolerance to treated pollutant(s),
- ability to be separated from the treated effluent.

It is in compliance with this latter requirement that lies our project. In fact, the immobilization of bacteria on a solid support makes it possible to retrieve more easily the residue in treated wastewater.

The activity of modern nuclear power plants with pressurized water reactors generates radioactive effluents that contain among other things radioactive cobalt. The tubing of the cooling circuit is made of a steel alloy rich in stable cobalt (59Co). Undergoing neutron bombardment coming from the reactor, this stable cobalt changes into its radioactive isotope, cobalt 60 (60Co).



The capture of this metal is interesting on a sanitary point of view, because it represents a danger under both its radioactive and stable forms (carcinogenic). It also represents an advantage on an environmental point of view, in order to avoid contamination of waters, soil and groundwater. Even with a short half life, cobalt 60 emits high intensity gamma rays, and decays to nickel, which is stable but polluting.

Controlled immobilization of radioactive cobalt is both an important sanitary and environmental issue, which we intend to solve with an innovative and economical response.

A current project on solid foundations

Currently, there are several methods to extract the dissolved form of radioactive cobalt:

- Use of chelating agents,
- Use of ion-exchange polymers,
- Use of activated charcoal,
- Nanofiltration techniques.

Some German and Indian researchers are also trying to immobilize radioactive cobalt in polymers which have cobalt ion-like shape holes, in order to enable its fixation, but no industrial exploitation has been established yet.

The bacterium Escherichia coli K12 (E.coli) meets the criteria of non virulence. Moreover, it is possible to modify it, so that its growing would exclusively be subjected to the presence of an external element, and so limiting its random diffusion in the environment.

A researcher from the Lyon INSA-ENS team, Agnès Rodrigues, has recently constructed a E.coli strain able to eliminate 85% of radioactive cobalt (60Co), initially present as traces in a simulated nuclear effluent made up of a mix of heavy metals, in only twice one-hour incubation (Appl Microbio Biotechnol 2009 81:571-578).

The process that was developed by Agnès Rodrigues' team ensures the decontamination of cobalt up to 0,5 ppm (8 nM in 100 000L) with only 4kg of bacteria as against 50kg with an unmodified bacterium or 8,000kg of an ion-exchange polymer. This kind of process with modified bacteria will be a good value because the production of bacteria in a bioreactor is rather economical. However, one issue remained unsolved at the end of this study, that is the separation of cobalt-fixing bacteria.

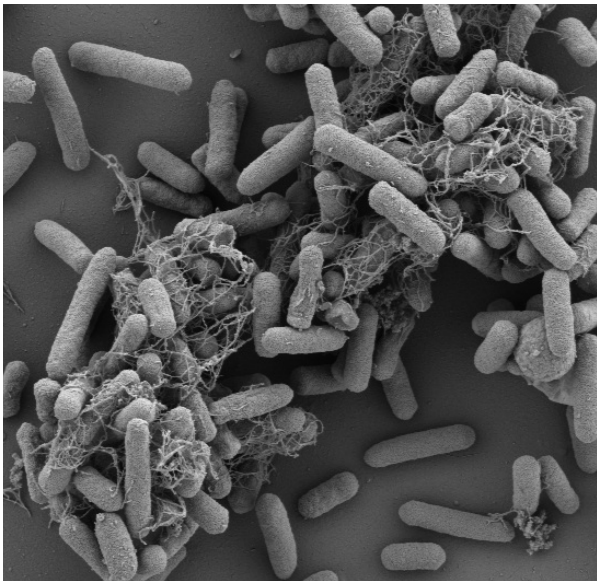
The first objective of our project is, with the most recent genetic engineering techniques, to induce the fixation of optimized bacteria for the cobalt capture and retention in response to the presence of contaminants in the effluent to be treated.

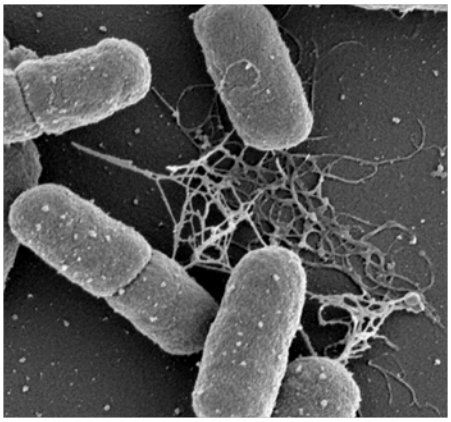
A second objective aims to develop a system to construct custom-built "biofilm inducible" strains. Our goal is to construct captors able to launch the formation of biofilm in response to the presence of various radioactive or not pollutants, and to offer more efficient and cheaper bioremediation processes.

Objective 1: induction of biofilm

The first objective of our project is to induce the fixation of bacteria. This fixation is subjected to the formation of bacteria in a particular structure, called biofilm. The formation of these fixed microorganisms communities will only happen in response to the presence of cobalt in the effluent to be treated. The cobalt-specific biofilter thus formed will ensure the treatment of the effluents of nuclear reactors. Previous work of two researchers from the Lyon-INSA-ENS team (Corinne Dorel and Philippe Lejeune) will be very useful in the achievement of this first phase of the project. Indeed, E.coli is able to adhere to numerous surfaces (glass, sand, PVC, polystyrene...) thanks to the production of a protein polymer called curli.

Some regulating DNA sequences, called promoters, can control the production of these adhesion molecules. Our objective is to launch the "biofilm" response only in the presence of cobalt, by placing the genes necessary for the production of curlis, these adhesion proteins, under the control of a promoter sensitive to this metal.





On the left, detail of a E.coli biofilm
Above, zoom on curlis, adhesion proteins

Objective 2: creation of a "biofilm inducible" strains system.

This more ambitious second objective aims to develop "biofilm inducible" strains specific to an environmental stimulus. The flexibility of the signal transduction systems used by bacteria to sense the modifications of the environment and to adapt to it enables to construct functional chimeric captors that program again the bacterial behaviour.

Our goal is to construct captors able to launch the formation of biofilm in response to the presence of various pollutants or environmental factors, by the use of databases indexing a mass of captors (over 30,000) able to detect chemical or physical parameters such as surface perception (detection of saccharides, amino acids and other metals such as arsenic).

3. Financial aspects

Assessment of year 2010

The first iGEM team from Lyon was created in 2010, within the premises of the Biosciences department of INSA Lyon. The INSA-Lyon 2010 project, absolutely innovative at INSA, had aroused the attention of the bioMérieux group, which had just joined the INSA foundation. Their major financial aid added up to the financial involvement of the Biosciences department of INSA, the Embassy of France, Sanofis Aventis and Altran, and also to the material help of companies such as Ozyme. Thanks to their financial support, we have been able to present our project in Boston, and were rewarded with a silver medal.

Working capital in early 2010 = 0		Working capital in early 2011 = 11 400	
2010 Balance Sheet		**2011 Project Budget**	
iGEM Competition		**iGEM Competition**	
Registration fee	1280	Registration fee	1500
Boston Jamboree (registration and trip)	15360	Amsterdam Jamboree (registration and trip)	6000
		Boston Jamboree	15000
Project:		**Project :**	
Consumables	22640	Consumables	25000
Material purchase/repairing	2660	Material purchase/repairing	2000
Project report-out	750	Communication and insurance	5000
Total	42690	**Total**	54500
INSA foundation (bioMérieux)	40000	INSA (Biosciences) and ENS	10000
Embassy of France in the US	5000	Embassy of France in the US	3000
Sanofi Aventis	3590	IA2C	3590
Altran	5500	Sponsoring	37910
Total	54090	Total	54500
TOTAL	11400	TOTAL	0
		Estimated working capital by the end of 2011	11400

Prospects on year 2011

Thanks to the previous collaborations, we start off this year with a light financial capital. But the road to Boston remains long, with an additive regional qualifying jamboree in Amsterdam.

Nevertheless, we can already count on the support of ENS and INSA, the Embassy of France in the US, and also of the Rovaltain business park, which is scheduled for 2013.

4. Why sponsoring us?

Development of innovation within an ambitious project

The iGEM culture represents human values such as sharing, mutual aid, knowledge transmission, within a very demanding science framework. Mixing these two aspects encourages creation, innovation, and offers to our society numerous solutions aimed at the improvement of health, technology or nature conservation.

We are committing ourselves in this competition with ambitions that are both strong and clearly defined. What we have experienced during last year's competition will help us to target our objectives for the best, in order to meet the requirements of iGEM and pass the regional qualifying jamboree, novelty of this year meant to select the top teams for the World Championship jamboree.

We will aim for the gold medal in Boston, by betting on the characterization of one of the biobricks enlisted in the iGEM database by the INSA-Lyon team in 2010. Ethics and mutual aid between teams are also issues that we want to develop. Indeed, apart from the gold medal objective, they represent human sides that make of this competition a real human adventure.

We hope to convince the jury of awarding us with the Best Environmental Project prize, by showing the feasibility of the project, how easily it can be implemented in the industrial world, and also the possibility of developing a flexible activation-specific sensor.

We count on the talents brought together from two of the most prestigious schools of Lyon in order to manage to achieve and maybe even go past those objectives.

An active communication

Several materials have been considered to enable you to associate your corporate image to the Lyon-INSA-ENS team and to iGEM.

Slide show and poster presented during various meetings, website, booklet, t-shirts, advertising gadgets... There are various means, and the impact of your image will be proportional to the level of your participation in our project.

Moreover, this year we have been considering a wider range of communication, through the press and regional broadcast. Participation to conferences organized in the framework of the IA2C association have also been thought of.

We offer you many solutions to enable you to support us throughout the project. By joining forces in this experience, you share values such as team spirit, innovation, nature conservation and beauty of science.

ENS DE LYON

5. the lyon-INSA-ENS

Our instructors: full-time involved teachers

•Corinne Dorel (Associate professor at the Institut National des Sciences Appliquées de Lyon), 2011 project coordinator..

My teaching activities in the Biology and Microbial Genetics mainly take place within the Biosciences department at INSA Lyon, but also at the Ecole Normale Supérieur de Lyon and at the University Claude Bernard Lyon 1.
My research work within the UMR 5240 CNRS-UCBL-INSA-BayerCropScience (Microbiology, Adaptation and Pathogenesis) is based on the understanding of genetic mecanisms involved in the formation of biofilms and the contamination of materials, and gets a major impact on the scientific community (around 97 acknowledgements in the top 10 papers on biofilms). Being the Communications officer for the Biosciences department, my participation in iGEM 2011 is part of a strategy to promote and disseminate knowledge in the field of research in synthetic biology, and more generally in Biological Sciences.

- Dorel C, Lejeune P. Encyclopedia Universalis Paris, France 2005. “Les biofilms.”
- Perrin C, Briandet R, Jubelin G, Lejeune P, Mandrand-Berthelot MA, Rodrigue A, Dorel C. Applied and Environmental Microbiology 2009 75 (6) 1723-33. “Nickel promotes biofilm formation by Escherichia coli K-12 strains that produce curli.”

• Laurent Balvay (Associate professor at the Ecole Normale Supérieure de Lyon)

Graduated from the ENS Cachan, and after a first experience in research at Pasteur Institute in Paris on mRNA alternative splicing, I am currently working at the Human Virology Department (INSERM U758) in Lyon on issues in relation with translational control of viral proteins during an infection, and in particular control of the internal entry of ribosomes in the messenger RNA by RNA sequences called IRES (Internal Ribosome Entry Site). I am also a trainer to the aggregation of Life Sciences and Sciences of the Earth and the Universe. I have always had a passion for biological mechanics, and facing the enthusiasm of students, I have decided to accompany them in this international competition that represents iGEM. Among my recent publications are:

- Balvay, L., M. Lopez Lastra, B. Sargueil, J. L. Darlix and T. Ohlmann (2007). «Translational control of retroviruses.» Nature Review Microbiol 5(2): 128-40.
- Balvay, L., R. Soto Rifo, E. P. Ricci, D. Decimo and T. Ohlmann (2009). «Structural and functional diversity of viral IRESes.» Biochim Biophys Acta 1789(9-10): 542-57.

• ***Valérie Desjardin (Associate professor at the Institut National des Sciences Appliquées de Lyon)***

I teach Chemistry classes in the first cycle and also in the Energy Engineering and Environment department where I am responsible of a class dealing with radioactive waste management. During my Master of Advanced Studies in Biochemistry, I have worked on the operon coding for the nickel transportation system in E.coli and then got a thesis in Science and Techniques of waste about the treatment of contaminated effluent with chrome VI through a Streptomyces strain isolated from contaminated soil. My research work at the Laboratory of Civil engineering and Environmental engineering (LGCIE) is currently aimed at the study of biophysicochemical interactions of pollutants in various compounds (soils, sediments, municipal solid waste) using molecular biology tools. I am very excited to take part in the iGEM 2011 project which leads to the development of a synergy, already launched, between the Biosciences department and Environmental sciences.

- V. Desjardin, R. Bayard, P. Lejeune, R. Gourdon, Utilisation of Supernatants of Pure Cultures of *Streptomyces thermocarboxydus* NH50 to Reduce Chromium Toxicity and Mobility in Contaminated Soils, Water, Air, Soil Pollution: Focus, 3 (2003) 153-160.
- A. Ohannessian, V. Desjardin, V. Chatain, P. Germain, Volatile organic silicon compounds: the most undesirable contaminants in biogases, Water Science and Technology, 58 (2008) 1775-1781.

• ***Benoît Drogue (PhD student at the University Claude Bernard in Lyon)***

Graduated from the University Claude Bernard Lyon 1 in 2009 with a Research Master in "Microbiology and Ecology", I am currently doing a PhD financed by the Rhône-Alpes cluster "Quality of plants, agriculture, actors and territories" (2009-2012). My PhD, within the UMR CNRS 5557 Microbial Ecology of Lyon, deals with the understanding of ecosystems, and in particular beneficial interactions between soil bacteria and cereals which they stimulate the growth and yield. Within this framework, I have had the opportunity of supervising several trainees on ecological and bacterial genetics issues. Being mainly interested in ecological issues, my participation in the iGEM 2011 international competition is my own way of sharing skills in microbial genetics and promoting the PhD diploma which I am starting as the vice-president of the association of PhD students of the Evolution Ecosystems Microbiology Modeling school (Association Doc E2M2 Lyon).

6. How to join us?

Contact us!

You are kindly invited to contact us by one of the following means:

Address: Association INSA ADN CONCEPT CLUB, département Biosciences
Batiment Louis Pasteur - 11, avenue Jean Capelle - 69621 Villeurbanne CEDEX.

Telephone: +33 6 65 04 15 30 / +33 4 72 43 62 52

E-mail: lyon.biosciences.igem@gmail.com

Facebook: Lyon Biosciences Igem

Twitter: Lyon_INSA_ENS

We will be pleased to answer any questions you might have after reading this file, and help you through the steps of establishing this sponsorship.
Moreover, you will find under the bank information of the IA2C association, which manages the investment fund for the participation of the iGEM team.

	Banque	Guichet	Numéro de compte	Clé
RIB FRANCE	17806	00377	62239646323	09

IBAN ETRANGER FR76 1780 6003 7762 2396 4632 309 BIC AGRIFRPP878

Domiciliation	Nom et adresse du titulaire
VILLEURB LUIZET (00377)	ASSOC. INSA ADN CONCEPT CLUB
Tél : 0810008812	11 AVENUE JEAN CAPELLE SECRETARIAT DU DPTM BIOSCIENCES
	69621 VILLEURBANNE CEDEX

As soon as an agreement between your company and our team is made, please fill in the following form and send it out with the given envelope.

Sponsorship certificate

I, ..., representing the.....company, certify willing to engage in a sponsorship with the Lyon-INSA-ENS team within the framework of their participation to the iGEM competition, by subscribing to the ..... offer and by paying to the IA2C association the amount of .....euros excl. VAT (or equivalent in consumables/materials).

In return, the Lyon-INSA-ENS team pledges to respect the terms and conditions of the chosen offer, to provide in time the described documents and to honor this sponsorship with the full commitment of all its members.

Date Signature