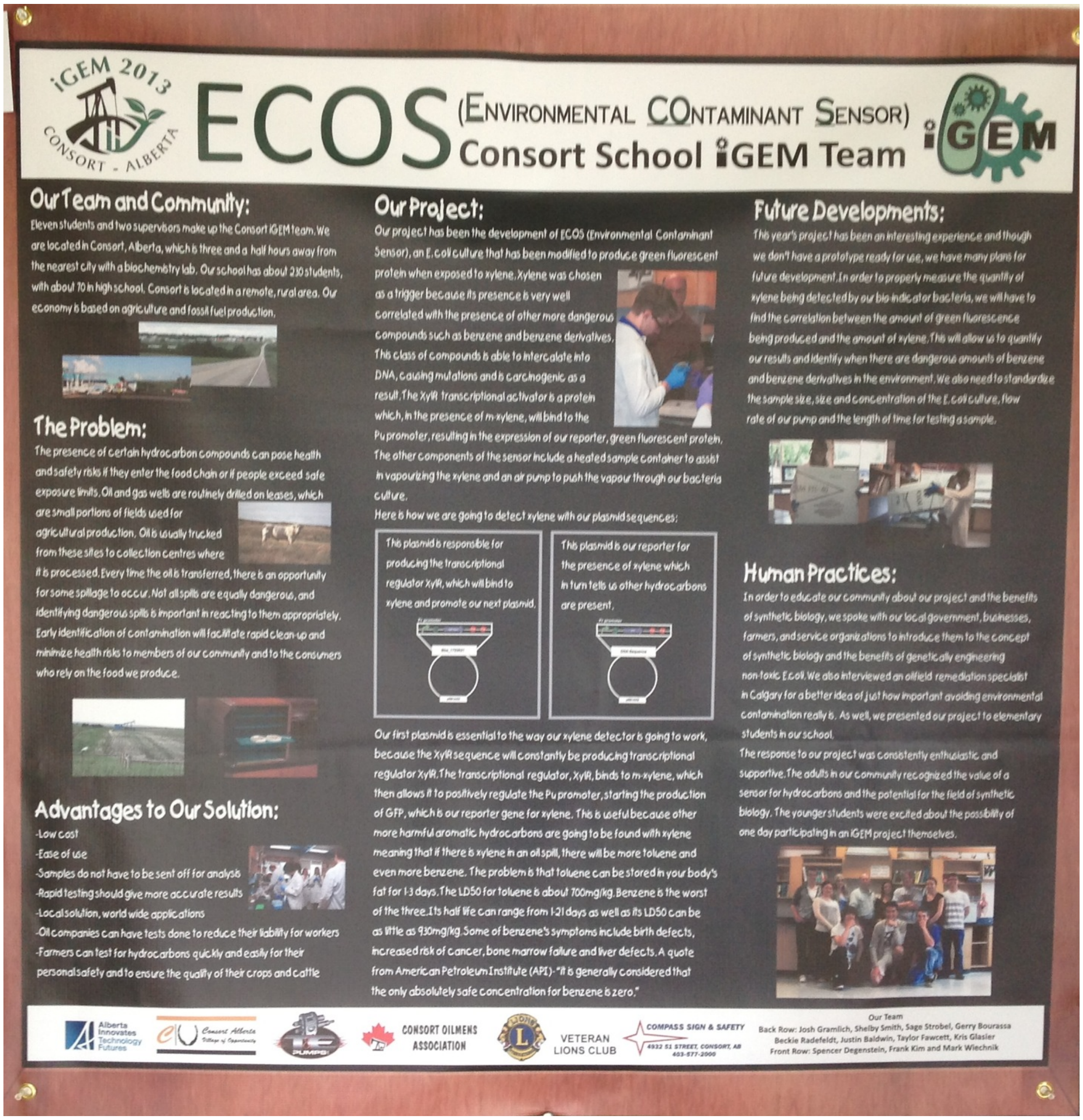
iGEM 2013
CONSORT - ALBERTA
ECOS (Environmental COntaminant Sensor)
Consort School iGEM Team
iGEM
Our Team and Community:
Eleven students and two supervisors make up the Consort iGEM team. We are located in Consort, Alberta, which is three and a half hours away from the nearest city with a biochemistry lab. Our school has about 230 students, with about 70 in high school. Consort is located in a remote, rural area. Our economy is based on agriculture and fossil fuel production.
The Problem:
The presence of certain hydrocarbon compounds can pose health and safety risks if they enter the food chain or if people exceed safe exposure limits. Oil and gas wells are routinely drilled on leases, which are small portions of fields used for agricultural production. Oil is usually trucked from these sites to collection centres where it is processed. Every time the oil is transferred, there is an opportunity for some spillage to occur. Not all spills are equally dangerous, and identifying dangerous spills is important in reacting to them appropriately. Early identification of contamination will facilitate rapid clean-up and minimize health risks to members of our community and to the consumers who rely on the food we produce.
Advantages to Our Solution:
-Low cost
-Ease of use
-Samples do not have to be sent off for analysis
-Rapid testing should give more accurate results
-Local solution, world wide applications
-Oil companies can have tests done to reduce their liability for workers
-Farmers can test for hydrocarbons quickly and easily for their personal safety and to ensure the quality of their crops and cattle
Our Project:
Our project has been the development of ECOS (Environmental Contaminant Sensor), an E. coli culture that has been modified to produce green fluorescent protein when exposed to xylene. Xylene was chosen as a trigger because its presence is very well correlated with the presence of other more dangerous compounds such as benzene and benzene derivatives. This class of compounds is able to intercalate into DNA, causing mutations and is carcinogenic as a result. The XylR transcriptional activator is a protein which, in the presence of m-xylene, will bind to the Pu promoter, resulting in the expression of our reporter, green fluorescent protein. The other components of the sensor include a heated sample container to assist in vapourizing the xylene and an air pump to push the vapour through our bacteria culture.
Here is how we are going to detect xylene with our plasmid sequences:
This plasmid is responsible for producing the transcriptional regulator XylR, which will bind to xylene and promote our next plasmid.
This plasmid is our reporter for the presence of xylene which in turn tells us other hydrocarbons are present.
Our first plasmid is essential to the way our xylene detector is going to work, because the XylR sequence will constantly be producing transcriptional regulator XylR. The transcriptional regulator, XylR, binds to m-xylene, which then allows it to positively regulate the Pu promoter, starting the production of GFP, which is our reporter gene for xylene. This is useful because other more harmful aromatic hydrocarbons are going to be found with xylene meaning that if there is xylene in an oil spill, there will be more toluene and even more benzene. The problem is that toluene can be stored in your body's fat for 1-3 days. The LD50 for toluene is about 700mg/kg. Benzene is the worst of the three. Its half life can range from 1-21 days as well as its LD50 can be as little as 930mg/kg. Some of benzene's symptoms include birth defects, increased risk of cancer, bone marrow failure and liver defects. A quote from American Petroleum Institute (API)- "It is generally considered that the only absolutely safe concentration for benzene is zero."
Future Developments:
This year's project has been an interesting experience and though we don't have a prototype ready for use, we have many plans for future development. In order to properly measure the quantity of xylene being detected by our bio indicator bacteria, we will have to find the correlation between the amount of green fluorescence being produced and the amount of xylene. This will allow us to quantify our results and identify when there are dangerous amounts of benzene and benzene derivatives in the environment. We also need to standardize the sample size, size and concentration of the E. coli culture, flow rate of our pump and the length of time for testing a sample.
Human Practices:
In order to educate our community about our project and the benefits of synthetic biology, we spoke with our local government, businesses, farmers, and service organizations to introduce them to the concept of synthetic biology and the benefits of genetically engineering non-toxic E. coli. We also interviewed an oilfield remediation specialist in Calgary for a better idea of just how important avoiding environmental contamination really is. As well, we presented our project to elementary students in our school.
The response to our project was consistently enthusiastic and supportive. The adults in our community recognized the value of a sensor for hydrocarbons and the potential for the field of synthetic biology. The younger students were excited about the possibility of one day participating in an iGEM project themselves.
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