

# High School Survey

## Information Sheet/ Introduction:

Every year, we come across more and more news of a changing environment. Forest fires in Uttarakhand, floods in Assam and Bihar, lower and lower water tables, swarms of locusts, cyclones at the coast - these are just some of the effects of our Earth's changing environment. But did you know that there may be ways for us to heal it... using biology?

We are a group of students at the Indian Institute of Science Education and Research (IISER), Pune, and we're trying to combat one of these environmental problems (climate change) with a new kind of tool called synthetic biology! We're interested in knowing what you, as school students, think about these ideas. Depending on how much you already know, we will make some materials for you to expand your knowledge of the topic. Do please take our survey and help us out!! It shouldn't take very long - not much more than 5 minutes.

Don't worry about giving away your personal information - we're not even asking for your name! No contact information will be collected. However, we do need just your school's name. Click on submit at the end to finish.

This survey is completely voluntary and you can choose to drop out at any time. Click on 'Next' to continue.

## Section 1: Preliminary information

1. Please enter the name of your school.
2. Please mention the city/town your school is in. (optional)
3. Please select your current grade (standard) in school. (8<sup>th</sup> – 12<sup>th</sup>)

## Section 2: Climate Change

Climate change, as the name suggests, is a change in the expected climate patterns. Climate change can cause an increase in surface temperatures, increase in frequency of storms and droughts, variation in the timing and intensity of rainfall, etc.

4. Please state your level of agreement for the following statements

Statement	Completely disagree	Somewhat disagree	Neutral	Somewhat Agree	Completely Agree
Climate Change is caused mainly by human activities					
Climate Change is a serious threat to people around the world					
Climate Change is a serious threat to my family and me					

5. Which of the following do you think is the biggest contributor to climate change?
  - a. Particulate matter – dust, ash, dirt, etc
  - b. Carbon dioxide
  - c. Pesticides leaking into water bodies
  - d. Hole in the ozone layer
  - e. Poor plastic disposal
  - f. None of the above contribute to climate change

In 2019, about 43.1 billion tons of CO<sub>2</sub> from human activities were emitted into the atmosphere, making it the most important contributor to climate change. These CO<sub>2</sub> emissions are mainly due to burning fossil fuels such as coal, oil and gas and emissions from manufacturing industries, factories and vehicles.

**The best way to combat climate change is to reduce CO<sub>2</sub> concentrations in the atmosphere.**

6. How does increase in carbon dioxide affect the climate?
  - a. It is toxic to plants/trees so it causes deforestation
  - b. It reacts with ozone to cause a hole in the ozone layer
  - c. It traps heat radiated out by the earth
  - d. Reacts with chemicals in the atmosphere and releases heat

7. Have you participated in any of the following in an effort to combat climate change?

	I have	I have not but would like to in the future
Reduce motor transport usage		
Tree planting drives		
Climate protests		
Volunteering with organizations battling climate change		
Reducing household electricity consumption		
Other (text box to elaborate)		

8. What kind of activities has your school organized around climate change?
  - a. Tree plantation drives.
  - b. Art Competitions (Poem writing, poster making, best out of waste etc.)
  - c. Talks by experts on climate change
  - d. Hands on activities to better understand climate change
  - e. Other (text box to elaborate)

9. In your opinion, should there be an increased focus on climate change in your school?
  - a. Yes
  - b. Not sure
  - c. No
10. Do you think we can reduce carbon dioxide in the air by converting it into a valuable and essential product?
  - a. Yes.
  - b. Not sure
  - c. No

### **Section 3: Synthetic Biology and Genetically Modified Organisms**

11. Have you heard of the term Synthetic Biology before?
  - a. Yes
  - b. No

You must have heard of the Covishield vaccine developed to protect against COVID-19! You may even have heard that insulin, a very important drug used to treat diabetes, is produced using 'engineered' bacteria/yeast. These are applications of synthetic biology. Here, technology is used to alter the genetic composition of biological organisms so that they have new specific abilities. These organisms can be used to solve problems of the world.

12. To your knowledge which of the following best describes 'genes'?
  - a. A gene is a type of cell in our body
  - b. Genes help in the transport of information through our body
  - c. Genes hold the information that define traits such as eye colour
  - d. You are not sure
13. Have you heard of the term 'Genetic Engineering' or 'Genetic Manipulation'?
  - a. Heard of it, know what it means
  - b. Heard of it, don't know what it means
  - c. No

Genes are life's way of storing information. Traits such as the shape of a flower, the colour of our eyes, the length of insect antennae - these are all determined by genes, copies of which are found in every cell of our bodies! If we add or remove genes from an organism, we can change these traits.

A good example is that of insulin. It is a hormone produced by us humans to regulate blood sugar. People with diabetes don't have enough insulin. So, we add the human gene for insulin to a bacterium called E coli! The E coli now produce insulin, which we can inject into diabetic patients. This way of changing an organism's genes is called "Genetic Manipulation".

14. Bacteria are the major organisms used in Synthetic Biology applications, why do you think that is the case? (select all that apply)

- a. They cause various diseases, so helps in studying the disease
- b. They cannot be seen with naked eyes
- c. They have simple biology and thus easy to modify and study
- d. They grow very fast
- e. They are similar to humans

Genetically modified organisms such as the insulin producing bacteria can be used in many different fields. For example, we can modify plants to be pest resistant (agriculture) or we can even make fish glow in the dark. Usage of these tools can save millions of lives like in the case of insulin and Covishield. Yet, some people are worried about the use of synthetic biology. For example, people worry about its side effects on human health or even its potential usage in developing bioweapons!

15. Under what conditions do you think Genetically Modified Organisms should be used? (Select all that apply)

- a. Strictly regulated in a laboratory
- b. Administered to humans (vaccines, etc)
- c. Released into the environment (pest resistant plants, etc)
- d. Provided for daily use in households (glow in the dark plants as lamps, etc)

16. In which of the following fields do you think it is ok for Genetically Modified Organisms to be used? (Select all that apply)

- a. Pharmaceuticals
- b. Cosmetics
- c. Agriculture and food industry
- d. Manufacturing chemicals
- e. Data storage and computation
- f. Waste management

17. Would you be interested in learning more about the applications of synthetic biology and genetically modified organisms?

- a. Yes
- b. Not sure
- c. No

18. Do you think more about the applications of synthetic biology and genetically modified organisms should be taught at in your school?

- a. Yes
- b. Not sure
- c. No

One of the largest contributors to the release of carbon dioxide is the chemical industry, responsible for about 18% of industrial carbon dioxide emissions. They produce chemicals from which things like medicines, paints and your nylon clothes are made.

What if you were told that there is a less polluting method to produce these chemicals, using synthetic biology. Even better, this process uses carbon dioxide from the atmosphere, instead of fossil fuels that release CO<sub>2</sub> into the atmosphere. So, a process that releases carbon dioxide could be replaced with one that takes in carbon dioxide.

19.

1: Would you be willing to use paint for your home that...	Yes	Not sure	No
Has been partially made from atmospheric carbon dioxide			
Uses genetically modified bacteria as part of the production process			
2: Would you be willing to eat jam, one of the ingredients for which...	Yes	Not Sure	No
Has been partially made from atmospheric carbon dioxide			
Uses genetically modified bacteria as part of the production process			

20. If your answer for any of the above was no, would you mind briefly describing why you feel this way? (optional)