Introduction to genetic engineering workshop: teacher guide

Humans have always depended on the plants as a source of fiber and energy. What would be the most common plants you guys eat at home?
We are also dependent on animals to provide us with products such as milk and eggs. As the population grows humans experience a need in greater food production: higher crop yield and more produce.

Metaphor to explain how little of earth is available for food production

1. Imagine that the apple represents the earth. Slice an apple into quarters.
2. Set aside 3 of the quarters, these represent the ocean. The remaining quorter represents the land
3. Slice the ¼ in half : One 1/8 represents the parts of earth that are inhospitable to people: polar regions, deserts, swamps, very high or rocky mountains. What fraction do you have left?
   The other piece is the land area where people live, but do not necessarily grow the foods needed for life.

1. Slice the 1/8 piece into 4 sections. Set aside 3 pieces, which represent the areas too rocky, too wet, too cold, too steep, or with too poor soil to actually produce food. They also contain the cities, suburban sprawl, highways, shopping centers, schools, parks, factories, parking lots, and other places where people live but do not necessarily grow food.
2. Carefully peel the 1/32 slice of the earth - this tiny bit of peeling represents the surface, the very thin skin of the earth's crust upon which mankind depends. It is less than five feet deep and is a quite fixed amount of food-producing land.

How do you guys think we can improve the crops yeild to allow us to produce enough crops to feed the population?

- Fertilizers and chemical and biological controls (modified or artificial environment)
- Process optimization - getting the right equipment, planning ahead for the harvest/growth seasons
- Selective breeding and GE

Who can define selective breeding and GE?

Selective breeding or artificial selection is a process used to develop new organisms with desirable characteristics. Breeders select two parents that have beneficial traits to reproduce, yielding offspring with those desired traits.

Genetic engineering generally refers to the use of tools of modern biotechnology and molecular biology to introduce new genetic material, or delete or alter existing genetic material to introduce intended, new traits or characteristics.

What is a gene and DNA?
DNA—can be seen as a recipe for a living thing. It codes for all the specific characteristics that the organism posses. DNA is what makes the different between a monkey and a human.

Genes are pieces of the DNA that code for a specific trait (characteristic). For example you might have heard of the blue-eye gene or the height gene. Such genetic features are passed on to you from your parents.

Why do we use GE?
General ideas : Promoting human health, fighting diseases, yield increase, research purpose

- It can improve the ability of an organism to do something it already does:
  —>corns ability to be stored can be improved, certain plants can be modified to give higher yield
  —> Canola plants have been previously modified to produce healthier oils
- It can suppress, or stop, an organism from doing something it already does:
  —> the gene that codes for the softening of tomatoes is "turned off" in a genetically engineered tomato variety so the tomatoes do not soften as quickly.
- It can make an organism do something new:
  —>bacteria and yeasts have been genetically engineered to produce insulin hormone for human use
  —> Cows can become resistant to certain diseases.

Add some sort of borders or bottom design?
Add out team's logo?

The 5 main steps of GE:

1. DNA extraction is the first step in the genetic engineering process. In order to work with DNA, scientists must extract it from the organism with desired trait/gene.
2. The second step of the genetic engineering process is gene cloning**.** During DNA extraction, all of the DNA from the organism is extracted at once. Scientists use gene cloning to separate the single gene of interest from the rest of the genes extracted and make thousands of copies of it.
3. Once a gene has been cloned, genetic engineers begin the third step, designing the gene to work once inside a different organism. This is done in a test tube by cutting the gene apart with enzymes and replacing gene regions that have been separated.
4. The modified gene is now ready for the fourth step in the process, transformation or gene insertion. The new gene is inserted into some of the cells using various techniques. Some of the more common methods include the gene gun, agrobacterium, microfibers, and electroporation. The main goal of each of these methods is to transport the new gene(s) and deliver them into the nucleus of a cell without killing it.
5. The fifth and final part of producing a genetically engineered organism is backcross breeding. Transgenic plants are crossed with elite breeding lines using traditional plant breeding methods to combine the desired traits of elite parents and the transgene into a single line. The offspring are repeatedly crossed back to the elite line to obtain a high yielding transgenic line.

Interactive part of the workshop: Strawberry DNA extraction experiment

This experiment is aimed at exploring the first step in the genetic engineering process—DNA extraction.

Materials:

1. Zip bag
2. Strawberry
3. Water
4. Dish-washing liquid
5. Salt
6. Isopropyl alcohol

Instructions:

1. Put a bottle of isopropyl alcohol in a freezer.
2. Measure 6T (90 ml) of water into a small glass container.
3. Add 2 tsp (10 ml) dish soap to the water.
4. Stir in a ¼-tsp salt and mix until the salt dissolves. This is the extraction mixture.
5. Put strawberry into the zip-bag and add extraction mixture to it
6. Remove as much air from the bag as possible and seal it closed. Smash the strawberry so that no big pieces remain
7. Pour the resulting strawberry pulp and extraction mixture through a strainer and into a medium glass bowl or similar container. Use a spoon to press the mashed bits of strawberry against the strainer forcing even more of the mixture into the container. From the container it's in now, pour the extraction mixture into a smaller glass container that holds ¼- to ½-cup (50-100 ml) of fluid. This will help to isolate the DNA on the surface of the mixture.
8. Add 1 tsp (5 ml) of the chilled isopropyl alcohol to the solution and hold the mixture at eye level. You're looking for a separation of material that shows up as a white layer on top—strawberry DNA.

Why do we use strawberry? Strawberry cells contain bigger amount of DNA than other fruits, however it opens the possibility for manipulation of conditions: try extracting DNA from different fruits/produce.
What is the role of dishwashing liquid? It helps to lyse the cells (burst them apart and open)
What is the role of salt? Salt helps to create an environment where the different DNA strands could gather and clump, making it easier for you to see them.
What is the role of alcohol? Alcohol precipitates the DNA out of the liquid.