







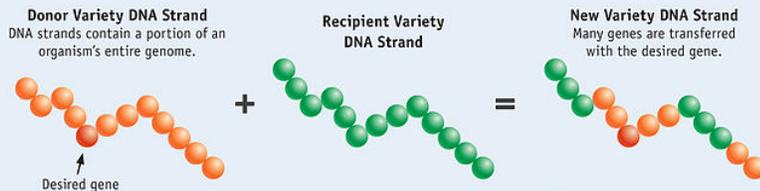
# AG EXPLORER

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## Methods of Plant Breeding

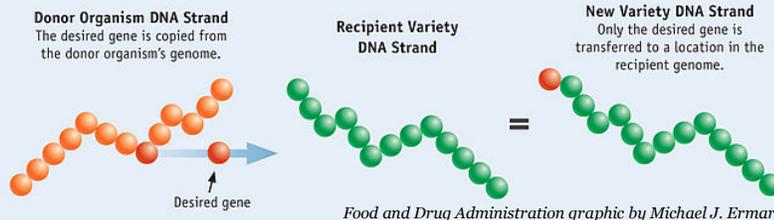
### Traditional

The traditional plant breeding process introduces a number of genes into the plant. These genes may include the gene responsible for the desired characteristic, as well as genes responsible for unwanted characteristics.



### Genetic Engineering

Genetic engineering enables the introduction into the plant of the specific gene or genes responsible for the characteristic(s) of interest. By narrowing the introduction to one or a few identified genes, scientists can introduce the desired characteristic without also introducing genes responsible for unwanted characteristics.



*Describe the process for conventional (traditional) breeding using the picture on the left:*

*Describe the process for Genetic Engineering using the picture on the left:*

*Evaluate genetic engineering using the information above. What advantages does this technology have as a strategy to improve crop yields?*

### Activity #1

Biotechnology is often used to genetically engineer or modify plants to create recombinant DNA. The diagram in the previous section showed a simple model of this process. Biotechnology uses a lot of vocabulary though that can be confusing. *Read the definitions below before analyzing the diagram depicting the process of genetic engineering.*

### Vocabulary Review

<b>Biotechnology</b>	A range of technologies that use biological processes or organisms to create a product.
<b>Genetic Engineering or Genetically modified</b>	A process that includes the direct manipulation of an organism's genome through Biotechnology. Genetically modified organisms (like crops), or GMOs, are plants whose DNA is altered by humans to produce a desired trait. This includes using DNA from one species that is inserted into another.
<b>Gene editing</b>	Changing an organism's DNA by inserting, deleting or changing genes.
<b>Recombinant DNA</b>	DNA comprised of genes from different organisms.

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As you analyze the diagram below, write a description of what happens during each step of the genetic engineering process.

**Step #1 Description:**

**Step #2 Description:**

**Step #3 Description:**

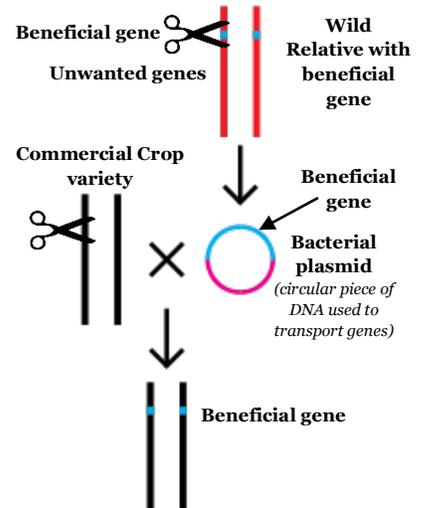
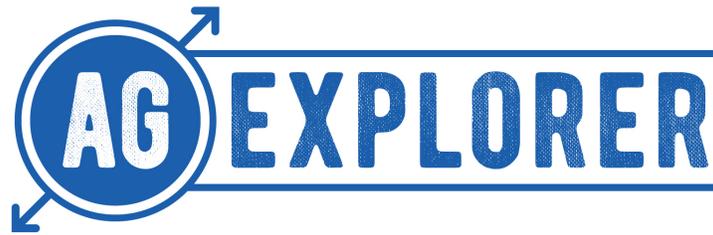


Diagram by Smartse [GFDL (<http://www.gnu.org/copyleft/fdl.html>)] with modification.

Answer the questions below using both the provided definitions, as well as the diagram above.

1. The diagram above shows the process of \_\_\_\_\_.
2. The DNA created in step 3 is called \_\_\_\_\_, because \_\_\_\_\_.
3. Steps 1 through 3 show gene editing, because \_\_\_\_\_.
4. This is an example of biotechnology. What is an example of a beneficial gene that may have been inserted into this commercial crop variety? What product would be created? \_\_\_\_\_



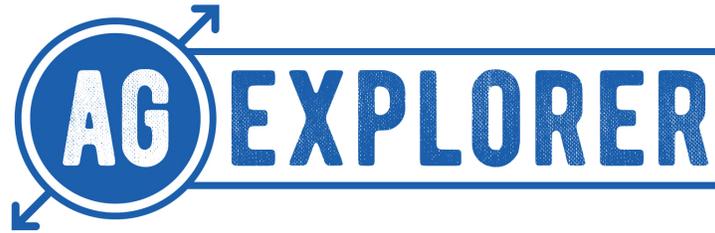
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### **Activity #2**

Innovative techniques, such as gene editing and native trait breeding, can greatly improve crop efficiency. Whether scientists are using conventional breeding or biotechnology, they need to know if their products are successful. How do companies like Syngenta test these new varieties for effectiveness? Advanced solutions require a state-of-the-art testing facility- the Advanced Crop Lab.

Watch the introductory video of the *Advanced Crop Lab at the Syngenta RTP Innovation Center*.

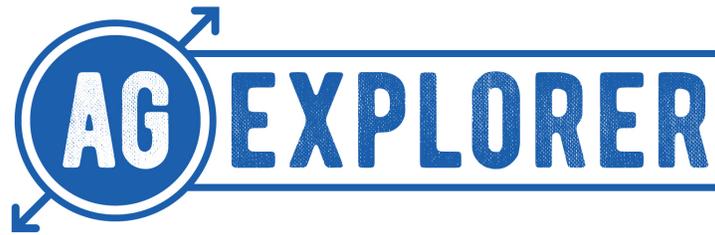
1. What are some variables the lab controls?
2. How does this control allow Syngenta to test new crop varieties?
3. Why is accurately controlling different variables important when evaluating a new crop variety in a scientific study?
4. Pretend you are a scientist at the Advanced Crop Lab. What conditions would you need to set up in a growth room to test new crop varieties for your area?
5. Explain how replicating the growing conditions in your area would help local farmers increase crop yield.
6. During the Virtual Field Trip, you met many different professionals combining biology, chemistry, mathematics, agricultural science, and marketing in a variety of careers. Imagine that you work at the Advanced Crop Lab. Choose one career and consider what role you would play at the Advanced Crop Lab. How can this state of the art facility help you meet the



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challenge of a growing world population? Fill out the Twitter profile below for your career. After you complete your Twitter profile, you will share it with 3 other students who chose a different career.

<b>Name:</b> _____	
<b>Career:</b> _____	
<b>Twitter handle/username:</b> @ _____	
<b>Twitter Bio:</b> _____ _____ _____	
<b>Hashtag that summarizes your career:</b> # _____	
<b>Role at the Advanced Crop Lab:</b> _____ _____ _____ _____ _____ _____	 Find <i>your</i> Future in Agriculture



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7. Create a drawing that communicates a world without genetic engineering in plants. Consider the quantity of crops and global impact as you visually express your thinking and ideas.

A large, empty rectangular box with a thin black border, intended for a student to draw their response to the prompt.