

Growing Herbicide Resistant GMO



Introduction

In this lab activity, students will investigate how biotechnology has been used to create plants that are herbicide resistant. Since the beginning of agriculture, weeds have been a problem for farmers. Herbicides have been used for many years to control problematic weeds, but on some occasions they can be toxic and harmful to the crops themselves. However, through the use of biotechnology, several varieties of crops have been created that are resistant to specific herbicides. This allows farmers to apply herbicides that target problematic weeds but cause no damage to the desired crop



Grade Level: 9-12

Time Needed: Portions of 6-7 class periods

Learning Objectives

After completing this lesson, students will be able to:

1. Observe and document the effects of an herbicide on herbicide-resistant GMOs and control plants
2. Describe how herbicide-resistant traits allow farmers to utilize herbicides effectively without damaging their crops

Materials (per group)

- (4) medium flower pots
- Potting Soil
- Safety Goggles
- Rubber Gloves
- Apron
- Masking tape
- Marker
- Round-up Ready Seeds (corn or soybean)
- Weed seeds (can be any other seeds, like marigolds, wildflowers, etc.)
- Non-GMO seeds (corn or soybeans)
- Roundup Herbicide (Roundup Weed and Grass Killer – 2% glyphosate will work and can be purchased at Lowe's, Home Depot, or a local hardware store)
- (1) micropipette per group
- (5) micropipettes per group

Next Generation Science Standards (NGSS)

As a result of activities for grades 9-12, all students will learn content in these areas:

Topic

- **LS2:** Inheritance & Variation of Traits
- **LS5:** Natural Selection & Evolution

Performance Expectations

- **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- **HS-LS4-3:** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking the trait.
- **HS-LS4-5:** Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Dimensions

Practices:

- Developing & Using Models
- Planning & Carrying out Investigations
- Analyzing & Interpreting Data
- Constructing Explanations

Disciplinary Core Ideas:

- **LS3.B:** Variation of Traits
- **LS4.B:** Natural Selection
- **LS4.C:** Adaptation

Cross-cutting concepts:

- Stability & Change
- Cause & Effect
- Patterns
- Scale, Proportion & Quantity



Instructional Process

DAY 1 – PLANTING DAY

1. Set up stations around the room where students can go to prepare both the control plants and the herbicide-resistant plants. Roundup Ready seeds can be purchased at a local cooperative. Other types of seed can be purchased at a local cooperative or garden shop.
2. Divide the class into groups of 3-4 students.
3. Allow each group about 30 minutes to plant the herbicide-resistant and control groups.
4. Have student place their flower pots under a grow light or near a window where it can receive natural light.

Follow-up Days

1. Allow students time to monitor their pots every other day. Ask them to carefully water them as needed and observe them for signs of germination
2. When the students' plants have sprouted their first true leaves, ask them to document their growth by describing their appearance, relative growth and height.
3. Once they have documented the plants' appearance, ask students to move their potted plants to an outside area designated by you. The areas should be at least 30 yards from the school and be free of any vegetation.
4. Ask students to put on their goggles, aprons, and gloves. Even though Roundup is a relatively safe product, students should wear this protective gear the entire time they are handling the herbicide and plants
5. Have students carefully apply the Roundup herbicide to all of the plants in each pot according to the directions on the spray bottle.
6. Leave the pots outside until the Roundup has dried. Then, return them to their original locations.
7. Tell students to observe the growth of the plants in all of the pots over the next 3-4 days and document any changes in their appearance or height.
8. Ask students to prepare a five-minute presentation detailing their findings.

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Student Sheet

In this lab activity, students will investigate how biotechnology has been used to create plants that are herbicide resistant. Since the beginning of agriculture, weeds have been a problem for farmers. Herbicides have been used for many years to control problematic weeds, but on some occasions they can be toxic and harmful to the crops themselves. However, through the use of biotechnology, several varieties of crops have been created that are resistant to specific herbicides. This allows farmers to apply herbicides that target problematic weeds but cause no damage to the desired crop

Materials (per group)

- (4) medium flower pots
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- Round-up Ready Seeds (corn or soybean)
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- Roundup Herbicide (Roundup Weed and Grass Killer – 2% glyphosate will work and can be purchased at Lowe’s, Home Depot, or a local hardware store)
- (1) micropipette per group
- (5) micropipettes per group

Procedure

1. Fill four flowerpots about $\frac{1}{2}$ to $\frac{3}{4}$ full of potting soil.
2. Using the masking tape and marker, label two of the flowerpots as Roundup Ready Seeds – Herbicide Resistant. Label the other two as Control Seeds – No Herbicide Resistance.
3. Obtain several weed seeds from your instructor and plant 6-8 seeds in each of the four flower pots. Plant each seed approximately one inch from the top of the soil.
4. Obtain the Roundup Ready seeds from your teacher and plant 3-4 seeds in each of the flower pots labelled Roundup Ready Seeds- Herbicide Resistant. Plant each seed approximately one inch from the top of the soil.
5. Obtain the traditional seeds from your teacher and plant 3-4 seeds in each of the flowerpots labeled Control – No Herbicide Resistance. Plant each seed approximately one inch from the top of the flower pot.
6. Water each of your pots until they are moist and place them under a glow light or near a sunny window.



Follow-up Days

1. Monitor your pots every other day. Carefully water them as needed and observe them for signs of germination.
2. When the plants have sprouted their first true leaves, document their growth by describing their appearance, relative growth and height.
3. Move their potted plants to an outside area designated by the teacher. The areas should be at least 30 yards from the school and be free of any vegetation.
4. Put on your goggles, aprons, and gloves. Even though Roundup is a relatively safe product, you should wear this protective gear the entire time you are handling the herbicide and plants
5. Carefully apply the Roundup herbicide to all of the plants in each pot according to the directions on the spray bottle.
6. Leave the pots outside until the Roundup has dried. Then, return them to their original locations.
7. Observe the growth of the plants in all of the pots over the next 3-4 days and document any changes in their appearance or height.
8. Prepare a five-minute presentation detailing their findings.

Follow-Up Questions

1. Based upon your lab results what percent of the genetically modified plants were better adapted to the round up than the unmodified plants?
2. Why is having a seed selection that is round up ready an advantage to both the plant and the environment?
3. Explain a situation, other than round up ready plants, where a genetically modified organism has been beneficial.
4. Describe a situation when it would be more advantageous to use a genetically modified plant over a non-modified plant. How would you measure the success rate of the population of plants in this scenario?