X PROJECT: WICH ONE IS THE MUTANT?

This protocol is based on the EDVOTEK® protocol "Wich one is the mutant?".

10 groups of students

1. EXPERIMENT OBJETIVE

Students will plant **Quick Plant™** seeds to compare and observe the plants as they grow to investigate the meaning of "mutant" in genetics.

2. EXPERIMENT COMPONENTS for 10 groups of students

COMPONENTS	Store
A. Pack of Wild type **Quick Plant™** Seeds (75 seeds)	Refrigerator
B. Pack of Dwarf type **Quick Plant™** Seeds (75 seeds)	Refrigerator
C. Pack of Pale type **Quick Plant™** Seeds (75 seeds)	Refrigerator
D. Seed gel	Refrigerator
30 peat pellets	Room Temperature
Crowth containers (3)	
Tooth picks	
10 rules	
5 magnifying glasses	

NOTE: Store entire experiment in the refrigerator upon receipt.

NOTE: No human material is used in this practice.

NOTE: All components are intended for educational research only. They are not to be used for diagnostic or drug purposes, nor administered to or consumed by humans or animals.

2.1 Requeriments

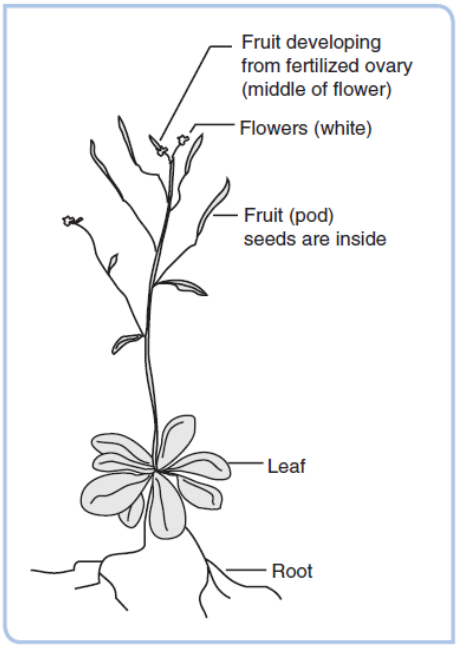
- Fluorescent plant growth lights recommended for optimal growth.

3. BACKGROUND INFORMATION

Quick Plants™ are plants that belong to the mustard family. Some relatives of **Quick Plants™** are cabbage, broccoli, water cress and mustard. The size and short life cycle of **Quick Plants™** make them a popular choice for genetics and biotechnology. Thousands of these plants can be grown in a small space in a research lab or classroom and inheritance in the plant over many generations can be studied in a relatively short time.

Quick Plants™ normally grow as a rosette of leaves out of which a tall inflorescence develops. This form of growth resembles that of cabbage. An obvious difference between the two plants is that cabbage is usually harvested before it has the opportunity to produce flowers. That is why we don't see a tall stem coming up out of the head. Cabbage has also been selected by plant breeders to produce a rosette with tightly overlapping leaves that form a head. The rosette of Quick Plants™ does not do this. The plant is self-pollinating. This means that it is not necessary for you to pollinate the plants in order that they produce seeds.

The three types of seeds supplied with the kit include normal (wild type) plants, dwarf plants whose full adult size is shorter than normal, and some plants that produce lower amounts of chlorophyll. Compared with the wild type, plants that cannot produce a normal level of chlorophyll will have some different physical features.



4. EXPERIMENT PROCEDURES

Students will plant **Quick Plant™** seeds to compare and observe the plants as they grow to investigate the meaning of "mutant" in genetics.

4.1 Laboratory Safety

1. Gloves and safety goggles should be worn at all times as good laboratory practice.

2. NOT PIPETTE WITH THE MOUTH, use appropriate devices.

3. Exercise caution when working with equipment using together heat and mix of reagents.

4. Wash hands with soap and water after working in the laboratory or after using biological reagents and materials.

5. Exercise caution when using any electrical equipment in the laboratory.

4.2 Prelab Preparations

Notes preparations teacher practice

The class size, length of classes of practices and equipment availability are factors that must be considered in the planning and implementation of this practice with their students. These guidelines can be adapted to fit your specific circumstances.

Laboratory Notebooks

Scientists document everything that happens during an experiment, including experimental conditions, thoughts and observations while conducting the experiment, and, of course, any data collected. Today, you'll be documenting your experiment in a laboratory notebook or on a separate worksheet.

Before starting the Experiment:

- Carefully read the introduction and the protocol. Use this information to form a hypothesis for this experiment.
- Predict the results of your experiment.

During the Experiment:

- Record your observations.

After the Experiment:

- Interpret the results – does your data support or contradict your hypothesis?
- If you repeated this experiment, what would you change? Revise your hypothesis to reflect this change.

Preparations before the practice

PreLab Preparations:

- Before beginning the experiment, be sure your classroom maintains a constant temperature at night and over the weekend. Temperatures above 28°C and below 18°C will affect growth and development.

- To facilitate even dispersal of seed, add 500 µl of seed gel (component D) to each of the tubes containing the different types of **Quick Plant™** seeds. The tubes will be shared among the class.

- **Quick Plants™** grown in the classroom will normally complete their lifecycles within 5-6 weeks. This means that if you plant seeds today, you will be harvesting the next generation in 6 weeks. As the plants grow, students should be given time to observe them on a regular basis. Routine observations need not take more than a few minutes per day, but planting, measuring, and harvesting activities can be planned as complete lessons.

- The three types of plants provided in this kit can be grown individually, if preferred. In a mixed population, identifying mutant plants will be challenging for students and will illustrate that mutants are simply "genetically different" from the standard type. It is not always obvious which plants are mutants. The student's assessment of mutant plants will depend initially on their observations of the stature and the color of the plants.

- Antes de comenzar el experimento, se debe asegurar que su aula mantenga una temperatura constante durante la noche y durante el fin de semana. Las temperaturas por encima de 28°C y por debajo de 18°C afectarán el crecimiento y el desarrollo de las plantas.

HELPFUL HINTS AND NOTES

Planting the Seeds:

- To help break seed dormancy, refrigerate the seeds for 2-3 days before planting. This "tricks" the seeds into signaling that the cold season is over and that the growing season can begin.
- If not using the included peat pods, students can use a peat-based potting mix. Use light soil mixtures with ample peat moss, and sterilize before planting in order to avoid any pest contamination. Alternatively, use commercially prepared mixes, such as **Metromix 350** or **ProMix BX**. The surface of the soil should be approximately 1 cm from the top of the pot.
- If your classroom is dry, cover the samples with clear plastic wrap to maintain the appropriate humidity for germination. Be sure to perforate the plastic wrap to allow for airflow. Remove the plastic wrap after sprouting is observed.

Temperature:

- The optimal temperature range for germination and growth of **Quick Plants™** is 22- 25°C.
- Before beginning the experiment, be sure your classroom maintains a constant temperature at night and over the weekend. Temperatures above 28°C and below 18°C will affect growth and development.

Lighting:

More than any other factor, light determines how quickly the plants will grow and develop. With proper lighting, germination should occur within seven days. Plants may take another 2-4 weeks to grow to full size.

- Fastest growth is under continuous fluorescent light (no day-night cycle is necessary). We recommend using workshop clamp lights, which are easily and inexpensively configured in a classroom or lab. This lighting condition may produce compact sized plants. See Instructors Guide for directions on creating a plant growth chamber.
- On a bright windowsill, the plants may 1-2 weeks longer to develop, but are larger in size.
- Slowest growth occurs under low light conditions, such as a poorly lit windowsill.

Watering:

Quick Plants™ are amazingly hardy after germination. Water plants as needed to avoid water stress and to prevent fungal growth on the soil surface. If contamination does appear, allow the surface of the pods to dry and scrape the fungus from the soil surface with care.

PREPARATIONS ON THE DAY OF PRACTICE

Preparing to Grow Quick Plants™

1. Before planting the seeds, hydrate the round peat pods in warm water for 30 minutes to several hours. The pellets should expand to approximately 1-1.5 in. (2.5-3.8cm). Drain off any excessive water and place the prepared pods in a shallow plastic tray. Several peat pods can be put together in a small container (e.g. a plastic food container or a small tray).

4.3 Material that should receive each grup

Each practice group should receive the following components before starting the experimental procedure:

Activity One - Planting Quick Plant™ Seeds

For Activity One, each student group should receive:

- Seeds
- Planting medium
- Growth containers
- Toothpick
- Ruler
- Magnifying glass

Wear gloves and safety goggles

5. PRACTICE

Activity One - Planting Quick Plant™ Seeds

Preparing to Grow Quick Plants™

2. Before planting the seeds, hydrate the round peat pods in warm water for 30 minutes to several hours. The pellets should expand to approximately 1-1.5 in. (2.5-3.8cm). Drain off any excessive water and place the prepared pods in a shallow plastic tray. Several peat pods can be put together in a small container (e.g. a plastic food container or a small tray).

3. Using a microscope or a magnifying glass, observe the shape and size of the Quick Plant™ seeds and make a note in your lab notebook. Do the wild type seeds look different from the mutant seeds? (Note: The seeds are suspended in a gel to simplify planting the seeds).

Planting the Quick Plant™ Seeds

1. Use a small transfer pipet to take up some of the wild-type seed mixture. Gently squeeze the bulb to deliver 3-4 drops to the soil surface. Replace the remaining seeds in the pipet back into the container before passing the sample to another group.

2. Repeat step 4 two more times with the seeds for each mutant.

3. Place the seeds directly under fluorescent lights or in direct sunlight from a window. Do not cover the seeds with soil or a lid; the seeds require light for germination.

4. Keep pods/seeds moist and place lights very close to pods while the seeds germinate. This will take approximately 4-7 days.

   NOTE: do not let the seeds dry out.

5. After the seeds germinate, be sure that the peat pods remain moist – the plants will not thrive if the soil mixture is too dry or too wet. For optimal results, mist the plants daily with a dilute (1/4 strength) solution of balanced commercial fertilizer.

Activity Two - Hunting for Mutants

1. Keep a careful record of your observations of the plants as they germinate and grow. Pay careful attention to the formation of leaves, flowers, fruit, and seeds. Describe these observations in your notebook. How are the plants alike? How are they different? You may wish to take pictures or make measurements of the plants for your notes.

2. As the plants grow, identify any seedlings that may be mutant.

    a. If you see a plant that you suspect is a mutant, place a colored toothpick next to it as a marker

    b. Watch the plant for the next several days. Is it still different enough from its neighbors to qualify as a mutant?

3. After three weeks have passed, you should be pretty certain which plants are mutant. Remember that we are observing three different types of plants – the normal, or "wild-type" plant, and two different mutants.

4. Describe each mutant in detail in your notes. Compare your notes to other groups. Do you observe the same characteristics?

6. PRACTICE RESULTS

6.1 Practice Results and Analysis

Appearance of Quick Plants™

NOTE: Students observations may vary.

Wild Type:
- Leaf edges slightly serrated.
- Under ideal growing conditions, plants will flower 22 days after planting.
- Average height 12.6 in (32 cm).

Dwarf:
- Reduced size - average 3.4 in (8.6 cm).
- Leaves may be a darker color green.

Pale:
- Leaves may appear white, cream, or light green. The leaves may be variegated (i.e. patches of different color).

6.2 Study Questions

1. When did you begin to notice differences between the plants?

2. Measure the sizes of the plants. Are they all the same? Which are the dwarves? What fraction of the wild type is the height of the dwarf?

3. Do they all have the same intensity of green? Can you distinguish the pale plants? Do they produce more or less chlorophyll than the wild type plants?

4. How would you define "mutant"?

5. What is a phenotype?

Appendix A

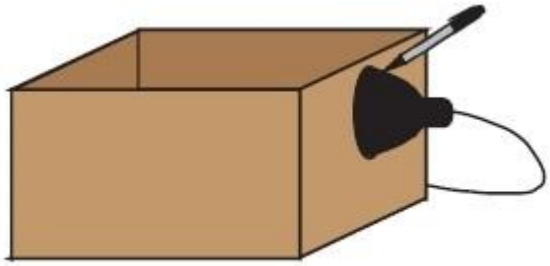
Creating a Plant Growth Chamber

Materials Needed:

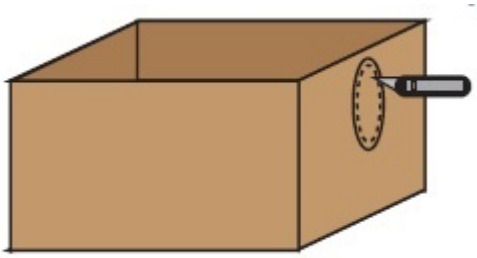
- Open top cardboard box (12x12x12 or similar)
- Marker
- Aluminum foil
- Tape
- Reflector lamp
- 23W Compact Fluorescent bulb (CFL bulb)
- Razor or sharp knife

A plant growth chamber can help ensure success with Module I of this experiment.

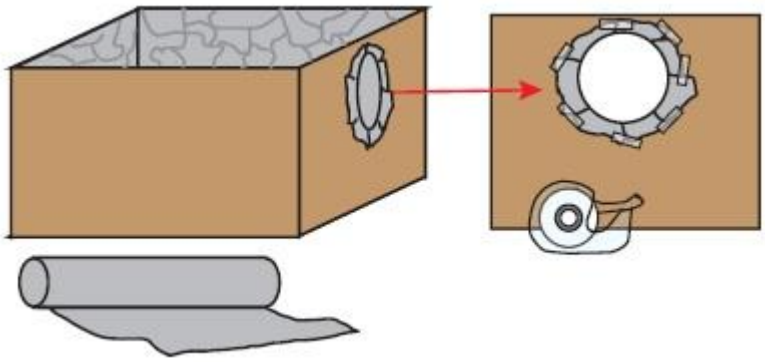
1. Place the reflector lamp on the top center of one of the sides of a small cardboard box. Use a marker or pen to trace a circle around the lamp.



2. Cut a circle 1 cm smaller than the traced circle.

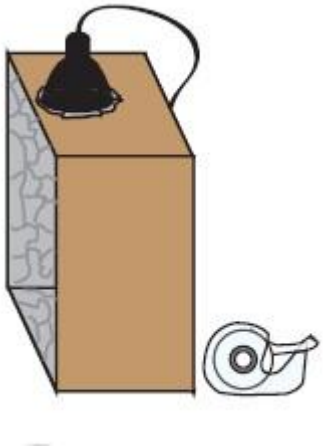


3. Use aluminum foil to line the inside of the box. Use extra pieces to cover the hole. Tape foil in place



4. Screw the CFL bulb into the lamp.

5. Place the lamp over the hole. Secure with tape.



6. The plant growth chamber is ready to go! Use a small box or riser to adjust the proximity of the potted seeds to the light depending on the seed type and the lighting requirements.