

Cloning! We've been doing it for years!



Introduction

Lesson Introduction

Cloning is defined as a genetically identical copy of some organism. If you look into the history of agriculture, you find that people who moved from one place to another often cut off branches of their favorite tree or bush, wrapped them up in moss and stuffed them into their packs to take to their new home. Once there, they stuck the cuttings in the ground and made sure they stayed watered and not in full sun. Soon they had a new identical version of the large plant they had left behind. In this activity, students will clone plants using stem cuttings and see the affects various concentrations of hormones have on root formation and plant cuttings. As an extention of this lesson students will research natural occuring root hormones and design an expermernt to test their affect on cloning similar plant cuttings.



Time Needed: Activity: two 45 minute periods over 2 days and 1 period once a week over 4-6 weeks

Grade Level: Grades 6-8

Learning Objectives

After completing this lesson, students will be able to:

1. Define cloning
2. Give an example of how hormones affect plants
3. Explain how hormones control cell differentiation
4. Research natural occuring plant hormones and design a controlled experiment to test the affect on root formation of stem cuttings
5. Discuss how cloning has benifited and/or harmed our environmrent and quality of life

Next Generation Science Standards (NGSS)

As a result of activities in grades 6-8, all students should master:

Topic

- **LS2:** Growth, Development, and Reproduction of Organisms

Performance Expectation

- **MS-LS1-5:** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Dimension

Practices:

- Planning and carrying out investigations

Disciplinary Core Ideas:

- **LS1.B:** Growth & Development of Organisms

Cross-Cutting Concepts:

- Cause & Effect



Materials

- Rooting hormone containing Indol-3-butyric acid
- Plant donors; geraniums, tomatoes, mums, poinsettias, or others
- Soilless mix; Perlite, vermiculite, or coarse sand
- Pots and trays to hold them
- Large, clear plastic bag (to hold tray)
- Pruning shears, scalpel, or paring knife
- Baby powder, talcum powder, or corn starch

Vocabulary

Clone – an organism that is a genetically identical copy made from a donor organism. The only difference is their age.

Propagation – starting new plants from seeds, cuttings, layering, or tissue culture.

Plant Hormones – naturally occurring organic molecules that affect plant cell growth and differentiation.

Nodes – the place on the stem of the plant where the leaf is attached.

Internode – the space on the plant stem between nodes.

Sexual reproduction – the process involving the fusion of male and female 1n gametes which produce a fertilized cell that has the same number of chromosomes that the parental regular cells have. This allows for new combinations of genetic material from each parent to be transferred to the offspring resulting in increased genetic diversity.

Asexual reproduction – a process where one parent is involved and is also called vegetative reproduction. Some plants produce structures that are modified stems, rhizomes, bulbs, corms, and tubers. Others grow plantlets on the margin areas of their leaves. Humans often take cuttings or use grafts to reproduce plants with traits they desire. Each of these involves no gametes and all result in offspring that are genetically identical to the original plant.



Instructional Process



1. Prepare the hormone mixtures and gather the lab materials for use around the classroom.
2. Make copies of the Student Lab Sheet and distribute to students.
3. Verbally “walk through” the steps of the lab activity and explain what is happening at each step. Highlight the need to be precise in all steps of the lab activity.
4. Have students complete the lab activity and answer the discussion questions.

Follow up activity (Enrichment)

1. Assign students to work in groups of 4-6. Each group will research:
2. Natural occurring plant materials which encourage rooting in plant cuttings.
3. Design an experiment to test the affect of these substances on the rate of rooting in plant cuttings.
4. Discuss how cloning has benifited and/or harmed our environmrent and quality of life

Supplemental Content – Explanation of the Cloning Process



1. Prepare rooting pots or trays by filling the pot or tray with the rooting mix (perlite, vermiculite, or coarse sand).
2. In five separate 100 ml beakers, (or Dixie cups) mix and label the following:
 - a) Rooting hormone in a 1/3 ratio of filler powder (25%)
 - b) Rooting hormone with equal measure of filler powder (50/50)
 - c) Rooting hormone in a 3/1 ration of filler powder (75/25)
 - d) Rooting hormone at full strength (100%)
 - e) Filler Powder (100%)
3. From a parent plant or plant donors, students will cut a stem section with at least two nodes and cut just below the lower node. If there are many leaves, all but one or two should be carefully removed. If there is a flower, it too should be removed.
4. After the four cuttings have been made, select one to be the control. The control will be placed in a separate pot with a tag indicating that it is the control. The remaining cuttings may be treated with rooting hormone of 25%, 50%, 75% or 100%. To treat them; dip the lower end of the cutting into water and then into the cup with the hormone powder mixture. Gently shake off any excess powder. Place the cutting in the pot labeled with the same treatment.
5. Water the pots by pouring water in the tray the pots sit in and allow the pots to be saturated. Place the entire tray in the clear plastic bag and place in moderate sun or under a plant light. The bag should be inflated to stay off of the clones and tied off with a twist tie. If you have a greenhouse with a misting bench, that can substitute for the plastic bag.
6. After one, two, three, and four or more weeks, take observations by carefully pulling the cutting out of the mix and then carefully replacing it where it was. Students should look for roots and count them, and possibly measure them too. This information should be recorded in a log or data chart.
7. Students will graph their data to communicate their data visually.



Follow Up Questions

1. What week did you first see root formation?
2. Which treatment produced the most roots?
3. What was the observation on the control cutting?
4. How many clones did you get from each donor or parent?
5. What other plants would you like to try this with?
6. What advantages do you see in being able to make clones of plants in this fashion?
7. What other methods are used to clone plants?
8. What is a tissue culture?
9. Can all plants be cloned?



Exstension Activity

1. What natural plant materials can be used as rooting hormones?
2. What is the advantage of using natural occuring rooting hormone materials?
3. What were the variables in your controlled experiment to test the affect of natural occuring rooting hormones?
4. Describe how cloning has benifited and/or harmed our environmrent and quality of life.
5. Other than rooting hormone would another substance allow for the plant to survive and reproduce? If so, what would it be and why would it work?