

Lesson Title – What are Common Plant Cloning Techniques?

Length – 44 minutes			
PA Academic Standards and Anchors Addressed –			
<u>Science</u>			
S11.B.2.1.3: Explain the role of selective breeding and biotechnology in changing the genetic makeup of a population.			
<u>Reading and Writing in Science & Technical Subjects</u>			
CC.3.5.9-10.C: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.			
PA Agriculture Standards and Benchmarks –			
<u>Biotechnology-</u>			
Biotechnology in Plant Science			
6.1-Describe the purpose of plant biotechnology.			
6.3-List the requirements for and complete plant cloning/tissue culture techniques in a laboratory setting			
Objectives - Upon completion of the lesson, students will be able to:			
1. List 5 common plant cloning techniques with 100% accuracy.			
2. Demonstrate the following plant cloning techniques—Separation, Division, Root Cutting, Stem Cutting, and Vein Cutting to teacher satisfaction.			
Lesson Type -	Informational	Operational	Managerial
Modalities Addressed -	Visual	Auditory	Kinesthetic
Multiple Intelligences Addressed -	Verbal-Linguistic	Naturalist	Musical Visual-Spatial
	Logical-Mathematical Kinesthetic	Interpersonal	Intrapersonal Bodily-

Essential Vocabulary – “Stem Cutting,” “Vein Cutting,” “Grafting,” “Cloning,”

Need of Lesson – With such a varied definition of cloning, this lesson aims to give students a real-world experience of a cloning technique. Since the definition of a clone is “Any organism that has the exact same genetic material of another,” the procedures demonstrated in this lab activity fit this definition and defy the negative connotation of the word. This lesson was developed for a class of 15 students at the 9th grade level enrolled in an Introduction to Agriculture & Natural Resources course.

Materials –

Interest Approach Materials—

1 pack Twizzlers

1 24-pack of Fruit Roll-Ups

Scalpels

Paper plates

Laboratory Materials—

African Violet or Geranium

Rooting Hormone

Rooting Medium

Garlic Cloves

Potatoes (best if eyes have sprouted)

Small Planting pots

Scalpels

Toothpicks

Masking Tape

Sharpie Marker

Plastic Wrap

Resources (Community, etc)

Herren, Ray V. *Biotechnology: Fundamentals and Applications*. Delmar Publishers: Clifton, New York

Pre-Class Set-Up –

Objectives and Bell Work should be posted so that students can view each upon entering the

classroom. For the interest approach, Twizzlers and Fruit Roll-Ups should be placed at a work bench. Scalpels should be distributed by instructor when students will begin working. All materials for the laboratory materials should be placed on a demonstration table in the Greenhouse or appropriate work area.

Bell Work – Name 3 plant cloning techniques discussed in yesterday’s class. Describe and/or illustrate each technique. (*Students could respond with Root Cutting, Stem Cutting, Layering, Air Layering, Vein Cutting, or Grafting*).

Interest Approach – Yesterday we discussed several plant cloning techniques. In an effort to practice some of these techniques before you actually work with a real plant, we are going to practice with Twizzlers and Fruit Roll-Ups. Everyone can take 2 pieces of Twizzlers and one Fruit Roll-Up from the table.

Vein Cutting

Instruct students to rip a 4-5” piece of their Fruit Roll-Up and place it on the paper plate. Ask students to envision that the Fruit Roll-Up as a leaf. When completing a vein cutting, it is imperative that you do not cut through the entire leaf, but just the upper surface. Demonstrate this technique. You are simply trying to make a slight incision in the top layer of the leaf. Try your best to practice this technique.

Stem Cutting

Instruct students to select one Twizzler and lie it on the paper plate. Ask students to envision that the Twizzler is a stem of a plant. Whenever making a stem cutting, it is imperative to cut at a 45-degree angle. Does anyone know why we don’t cut straight across? We are looking to create more surface area for the stem to sprout from. Take a couple practice runs and I’ll be around to check your progress.

Grafting

Ask students to tear off another 4-5” piece of Fruit Roll-Up and to lay the other portion of the Twizzler on the plate. We are going to demonstrate a grafting technique. Unfortunately, we don’t have the materials or space in the greenhouse to complete this type of cloning, but this process will replicate the grafting technique. Cut your Twizzler (or tree branch) at a 45-degree angle using the same process that was done for a stem cutting. In grafting, we can take the limb of a young sapling and graft it onto an established tree. Make another 45-degree incision on your second Twizzler. Imagine this is your established tree. Using your Fruit Roll-Up as a binding

agent, graft your limb to the established tree. This is actually the process that is used to graft a new branch (but with specialized tape or binding agents).

Now that we have some practice under our belt, let's transition these skills to 'clone' some other specimens in the Greenhouse.

Transition- Do you think all cloned plants will be successful? What can go wrong? Throughout the coming weeks, you will be able to answer these questions by observing your cloned plants grow and thrive in their new environment. (*Review Objectives with students and transition to Greenhouse or work area*).

Summary of Content and Teaching Strategies –

This lab activity is set up for 5 different cloning techniques. Students can work individually or in a group. Regardless of the set-up, it is best to have at least 2 attempts at each cloning technique.

Allow the students to volunteer for a cloning technique or allow them to pick out of a hat.

Now that everyone has a cloning technique, take a look at the lab procedure for each cloning technique. Each procedure is exactly the same as we practiced with the Twizzlers and Fruit Roll-Ups. Spread out across the work benches and follow your procedure.

Be sure to make your 1st journal entry and take a photo of your project from this week.

Allow students to work with their partner or group to complete each cloning technique. Ask students probing questions about their technique and ask them to evaluate their work and rate it.

The procedure for each technique is listed below.

Procedure A: Cloning by Separation

Introduction: Separation is a method of asexual reproduction in which parts of a plant are separated from the parent plant, and forced to grow into a whole new plant that is an exact genetic copy of its parent. Many plants that produce bulbs and corms (like daffodils, tulips, lilies, onions, amaryllis, garlic, gladiolas, and crocuses can be cloned using this technique.

1. Take your garlic bulb and gently break it apart into its individual cloves. Garlic is actually a corm, which is a type of underground stem. Each clove of garlic has the potential to grow into a mature plant that is a clone of its parent.

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2. Fill a plastic pot with rooting medium and plant one clove of garlic (pointy side up) into the medium. Cover the clove with rooting medium and water it slightly.
3. Label the pot with your name, date, class period, and place it under the growing light.
4. Complete the first line in your "Plant Observation Journal." If you wish to take pictures of the beginning of your experiment, please do so now.

Procedure B: Cloning by Division

Introduction: Division is another method of asexual reproduction in which parts of a plant are divided from the parent plant and forced to grow into an entirely new plant that is a genetic copy of its parents.

1. Take your potato and carefully cut it into 4 pieces. Make sure that your pieces contain a bud.
2. Fill a plastic pot with rooting medium and place one of the pieces into the medium. Cover it with rooting medium and water it just enough to moisten the medium.
3. Label the pot with your name, date, class period, and place it under the growing light.
4. Complete the first line in your “Plant Observation Journal.” If you wish to take pictures of the beginning of your experiment, please do so now.

Procedure C: Cloning by Stem Cutting

Introduction: Stem cutting is another method of asexual reproduction in which a portion of the plant stem is cut from the parent plant and forced to grow into a whole new plant that is an exact genetic copy of its parent.

1. Fill 2 plastic pots with rooting medium. Water the medium just enough to make it moist.
2. From the African Violet plant, select a stem that is at least 3” long. Using a knife, carefully cut the stem from the parent plant at a 45 degree angle at least 2” below the leaf base.
3. Carefully insert the cut end into the rooting hormone and tap off any extra.
4. Carefully insert the cut end into the rooting medium.
5. Label the pot with your name, date, class period, and place it under the growing light.
6. Complete the first line in your “Plant Observation Journal.” If you wish to take pictures of the beginning of your experiment, please do so now.

Procedure D: Cloning by Leaf Vein Cutting

Introduction: Leaf vein cutting is another method of asexual reproduction in which the leaf is cut from the parent plant and forced to grow into a whole new plant that is an exact copy of its parent.

1. Select a healthy leaf from the African Violet. Using a knife, cut the leaf from the plant about halfway down the petiole.
2. Fill 2 pots with rooting medium and water it slightly to make it moist.
3. Carefully use a knife to make 4 to 6 small cuts along different veins in the leaf. Use a toothpick to gently dust a small amount of rooting hormone onto each cut.
4. Carefully place the leaf (shiny side up) onto the rooting medium and press it gently downward. Hold the leaf down on the soil by using toothpick halves to keep it flat.
5. Insert 3 or 4 toothpicks around the edges of the pot and cover the pot with plastic wrap making a small tent. This will help to keep the leaf moist and increase the success of a leaf clone.
6. Label the pot with your name, date, class period, and place it under the growing light.
7. Complete the first line in your “Plant Observation Journal.” If you wish to take pictures of the beginning of your experiment, please do so now.

Procedure E: Cloning by Root Cuttings

Introduction: Root cutting is another method of asexual reproduction in which the root is cut from the parent plant and forced to grow into a whole new plant that is an exact copy of its parent.

1. Fill 2 cups with water.
2. Gently root around the bottom of the African Violet to locate a root. Using a knife, cut two pieces of the root from the original root.
3. Using a toothpick, dust rooting hormone onto the cut roots.
4. Using toothpicks, prop the cut root directly over the top of the cup. The root should be just above the surface of the water.
6. Label the pot with your name, date, class period, and place it under the growing light.
7. Complete the first line in your “Plant Observation Journal.” If you wish to take pictures of the beginning of your experiment, please do so now.

Learning Assessment- Students will be observing the progress of each cloning technique over the next 5 weeks. Students will take photographs of their plant growth at least once a week and then provide an analysis of the plant cloning project. The analysis will include (1) evaluation of each technique used in the lab, (2) suggestions for improving the project, and (3) measurement of plant growth.

Cognitive Connect –

Yesterday – What are Common Plant Cloning Techniques?

Today – How Do I Perform Common Plant Cloning Techniques?

Tomorrow – How Does Animal Clone Differ from Plant Cloning?

Adaptations/Accommodations for Special Needs -

Students with special needs will be accommodated based on their individual IEP. Guided notes, modified quizzes & tests, and other instructional aids will be available. Preferential seating will be available for students who need it. Various teaching methods and aids will be utilized to accommodate a wide variety of learners. I plan to work with the IEP teams as necessary to adapt to the learner's needs.

Total Ag Program –

Extended Classroom- Students could seek out articles in current agricultural research periodicals to see if any current research is dealing with plant cloning.

FFA – Students could compete in the Floriculture CDE or Nursery/Landscape CDE. Knowledge gained from today's lab activity would be essential to the exam portion of each contest.

SAE – Students could conduct an Agriscience research project comparing the effectiveness of various rooting hormones, rooting mediums, or plants.

Lesson Summary

Which component(s) in your lesson plan are your “flex” item(s), i.e., can be lengthened or shortened to accommodate time? Explain how the component(s) can be “flexed”.

The flex item in this lesson is completing the Plant Observation Journal. If students do not have enough time remaining to complete this portion of the lesson, they can complete this observation at the beginning of tomorrow’s class. If students finish early, they can assist other groups in completing their cloning technique and begin to clean up the work space.

Describe any adaptations and accommodations for learners with special needs that can be made in this lesson plan (see Methods chapter 12).

Students with special needs will be accommodated based on their individual IEP. Guided notes, modified quizzes & tests, and other instructional aids will be available. Preferential seating will be available for students who need it. Various teaching methods and aids will be utilized to accommodate a wide variety of learners. I plan to work with the IEP teams as necessary to adapt to the learner’s needs.

We learn in three modalities. Where in this lesson plan are your specific evidences of accommodating learners’ modalities?

Visual-Students will see an example of the cloning techniques during the Twizzlers and Fruit Roll-Up interest approach.

Auditory-Students will hear instructions during the practice session for the cloning techniques.

Kinesthetic-Each student will have the opportunity to complete at least one cloning technique with a live plant.

What is the highest level of cognition according to Bloom’s Taxonomy that students reach in this lesson plan? Describe this occurrence.

The highest level reached is Evaluation. This occurs as students are reflecting upon the success of their plant clone and proposing new ideas to improve the project.