



UNIT 10: AGRICULTURE TECHNOLOGY

New Plants with Biotechnology

Grade level: Upper primary

Student Learning Objectives

After completing this lesson, students will be able to:

1. Define biotechnology.
2. Define genetic engineering.

Time: 50 minutes

Tools, Equipment and Supplies: Writing surface, some cheese, bread, yogurt, copies of Activity Sheets 31:1 and 31:2 and a classroom set of almanacs/ encyclopedias or the Internet

Key Term(s): Biotechnology
Genetically Modified Organisms

Background Information

The agricultural industry has begun to use more research to help develop new agricultural products. **Biotechnology** has become a popular method to develop new crops and products that are immune to insects or a particular problem. **Biotechnology** is defined as any technological application that uses biological systems and living organisms to make or modify products or processes for specific uses. Agricultural products that are modified by **biotechnology** are called **genetically modified organisms** or GMOs. GMOs are any organism that has been transformed by the insertion of one or more genes to create a new, transgenic version of the original product. Agricultural products such as seedless grapes, navel oranges, tomatoes that stay fresh longer and weed-resistant plants were all created using **biotechnology**.

GMOs will allow farmers to produce more food and help feed a growing population. Genetically modified crops such as corn and cotton have already proved to produce higher yields.

The United States Food and Drug Administration (FDA) helps to protect our nation's food supply by regulating genetically modified products. The FDA only approves products if they meet specific standards and are believed to be safe for human or animal consumption.



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Interest Approach

Before the students arrive to class, divide them into groups of three or four. Use Activity Sheet 31:1 to make an activity packet for each group. (Or you may copy the activity sheet and ask the students to cut out the words and make their own packets.) You may also want to have some cheese, bread, and yogurt on hand for demonstration as you talk about the products.

Cheese, yogurt and bread —yum! These are all foods that I love to eat. They are very tasty. Did you know that these foods are made from various ingredients? Let's see if we can figure out what ingredients are used to create these three food items. Each group is going to receive a packet that has words written on it. The three larger words—cheese, yogurt, and bread—are the products we want to make. The other words are ingredients that are used to make these food products. When I say GO, put the right ingredients under each of the three food items. Ready, set, GO!

Allow the students about 30-45 seconds to place the ingredients under each of the food items.

Awesome! Stop what you are doing; it is okay if all of the ingredients did not find a place. What was surprising about the ingredients you were given to work with?

Solicit answers from the students.

I was surprised to see the ingredients that were used to make these food items, too. Let's review and see if you matched the ingredients with the right foods.

Review the answers with the students:

Cheese = bacteria, curds, and enzymes

Yogurt = fruit, bacteria, sugar, and milk

Bread = yeast, sugar, butter, wheat, honey

OBJECTIVE 1: Define biotechnology.

Great! All of the ingredients that we just reviewed are used to help process bread, yogurt and cheese. Speaking of cheese, who will venture a guess as to how many different varieties of cheese there are?

Solicit answers from the group.



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Those were a lot of great answers! Actually, there are over 650 different varieties. Wow! That is a lot of cheese! All of those varieties of cheese are made through a process called **biotechnology**. Let's take a close look at the word "**biotechnology**" to help us better understand its meaning. The first part of the word is "bio." "Bio" is short for biology, the study of living things. The second word is "technology" which describes scientifically developed tools or techniques that are developed to improve products or processes in order to make life easier. So, a good definition of "**biotechnology**" might be "tools or techniques that use the principles of biology to improve products or processes."

Use an Almanac and Encyclopedia e-Moment® to have students identify how biotechnology is used to make cheese.

OBJECTIVE 2: Define genetic engineering.

We found a lot of good information on how **biotechnology** is used to develop new varieties of cheese. The agriculture industry also uses **biotechnology** to help develop new ways to keep our food fresher, or to create new crops that are resistant to insects and weeds. **Biotechnology** has become very important to agriculture because the new products developed through it help local farmers. Products that scientists develop through **biotechnology** are often called genetically modified organisms or GMOs. Scientists make GMOs by copying a desired gene or trait in one plant or animal and then introducing it into other living things.

How many of you have family or friends who raise a garden? Raise your hands. How many of you have the chance to go out in the garden to pull all the weeds that grow there and take water and nutrients from the vegetable plants? Raise your hands. See? Not many of you like to pull weeds! What if a scientist could develop a seed that would prevent weeds from growing in your garden? How many of you would like that? Raise your hands.

Farmers like that idea, too, so scientists have created a soybean plant that is resistant to weeds. While this plant grows it prevents weeds from growing around it. This makes it easier for farmers to harvest the field and does not require them to use as many herbicides, or chemicals that kill weeds on the field. This is better for the environment and for the farmer's wallet.

These new GMOs do have to meet qualification and standards set by United States Food and Drug Administration before they can be grown and sold to consumers. This ensures that the new plants are safe for humans and animals to consume. GMOs go through a series of steps in the process of becoming a new product. Let's become investigators to see if we can uncover the steps to genetically modifying an organism.

Use a Go Get It e-Moment® to help students discover the steps to developing



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a new plant. Prior to the students' arrival, type out the steps for developing a new plant and cut them out or write them on cards. Once the students have collected all of the cards, let them read each of the steps in chronological order and capture them on the board.

REVIEW/SUMMARY

Biotechnology and GMOs are playing a large role in agriculture today. They will continue to influence the way we farm by creating and developing new products that help improve crop yields and the overall quality of the product. The next time you eat cheese, bread, or yogurt think of all the fascinating technologies that were used to create those products. Agriculture and the food we eat are becoming more complex; and we all reap the benefits of genetically altered projects.

REFLECTIVE REVIEW QUESTIONS:

- What exactly is biotechnology?
- Who will explain what GMOs are?
- What type of foods might be GMOs and how do we know they are safe?

APPLICATIONS

APPLICATION 1: Ask students to create a flowchart illustrating the steps to discovering a new plant. Using Activity Sheet 32:2.

APPLICATION 2: Ask students to brainstorm and think of a crop that they would like to improve with genetic modification. Have the students illustrate the steps to developing their new plant.



ACTIVITY SHEET 31:1

Products of Biotechnology

NOTES

BREAD

CHEESE

YOGURT

FRUIT

BACTERIA

MILK

SUGAR

YEAST

SUGAR

WHEAT

HONEY

ENZYMES

BACTERIA

CURD

BUTTER



ACTIVITY SHEET 31:2

Steps to Discover a New Plant

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1. Identify the trait you want.
2. Identify the source of the gene.
3. Isolate the gene from the source.
4. Adjust the gene to confer the desired trait.
5. Transfer gene to plant.
6. Test to see if the trait you want is there.
7. If it is found go on to step 8; if it is not found go back to step 5.
8. Run field trials to: a. make sure there are not bad effects of the gene, and b. to ensure the gene works the way you wanted it to.
9. While you are running the field trial do the initial product safety tests.
10. Submit information as required to regulatory agencies.
11. Wait for regulatory approval, and then market your product.



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Food for America - Demonstration Plan

Unit: Agricultural Technology

Demonstration: Hydroponics (20-30 minutes)

Objective(s):

1. Students will be exposed to new technology in agriculture, specifically hydroponics.

Materials, Supplies, Equipment, References, and Other Resources:

- Seeds (lettuce, tomato, etc.)
- Oasis root cubes
- 5-gallon bucket (dark to prevent algae growth) with lid
- Plastic planter cones
- 5-gallon solution:
- 2 rounded tsp water soluble hydroponic fertilizer 8-15-36
- 1 rounded tsp Epsom Salt (magnesium sulfate)
- 2 rounded tsp calcium nitrate
- Measuring spoon
- Stirring spoon
- Duct tape

Introduction:

Connection to Students – Take a moment and think about what you eat every day. What foods did you come up with? On the board or a sheet of poster paper, capture all of the items students share. What a list! *Pass out small paper cups to each student and fill with water.* Look at that huge list. Take a drink of water. What if you could get all of your nutrients to grow big and strong in this simple glass of water? That is exactly what farmers are doing today, not for humans, but for plants.

Motivation – New technology in agriculture is exciting, amazing, unbelievable, and will change the way we produce food, fiber and natural resources in the future.

Overview – Today we are going to get our hands on some new technology—hydroponics.

***NOTES – There are many resources out there to provide supplies and information. *General Hydroponics* will donate hydroponics products to schools with teachers who use hydroponics in their classrooms or who are considering doing so. Visit www.genhydro.com for more information. This hydroponics set-up is based on information provided by the Hawaii Department of Education www.k12.hi.us.



STEPS (What to Do)

Preparation

Lid

- ## On Lesson Day

Hydroponics allows people like you to grow plants in your home or greenhouse using water instead of soil. They do this by adding nutrients to the water. With hydroponics in the winter you can have plants which would normally grow in summer, and they use less soil and land space.

- Have students circle around hydroponics unit
- Share information about the plant you chose to grow
- Share information about time-line you used, including how long plants have been growing
- Take 1 plant out and let students see each part (roots, root cube, planting cone, and water). Pass plant around class.

As you were checking out this new technology, what questions did you think of? What are you still wondering about? *Create a question list on board of those you don't have an answer for, and have students go home and research the answer.*

- Share background information
- Circle-up and do "Walk-through"
- Give time for questions

- If time allows, students can create their own hydroponics set-up. Bring in seedlings in root cubes and give each student a plastic jug or container. Have students add nutrients and create their own mini-hydroponics unit.

Conclusion – If someone were to ask you “What is hydroponics?” what would you say? (Students share. Fill in any key information they left out.) Great! Hydroponics is just one of many new advancements in agriculture which provide you with a variety of products, while conserving our natural resources. Using hydroponics you could even set up your own garden inside your house!