



Identifying Biotechnology

Middle School Food and Agricultural Literacy Curriculum

Precepts

- C. Vision
- C1. Contemplate the future

National Standards

- BS.01.01.01.a. Define biotechnology and explore the historical impact it has had on agriculture.
- BS.01.01.02.a. Investigate current applications of biotechnology in agriculture.
- NL-ENG.K-12.4 – Communication Skills
- NL-ENG.K-12.12 – Applying Language Skills
- NS.5-8.3 – Life Science
- NS.5-8.5 – Science and Technology
- NS.5-8.6 – Science in Personal and Social Perspectives
- NT.K-12.2 – Social, Ethical, and Human Issues

Student Learning Objectives

- As a result of this **unit** the students will...
- Discuss concepts and issues related to biotechnology
- As a result of this **lesson** the students will...
- Define **biotechnology**.
- Identify five examples of agriculture-related **biotechnology**.

Content Outline

- I. **Define biotechnology**
 - A. Biotechnology: Using living organisms to make products useful to humans.
- II. **Identify five examples of agriculture-related biotechnology**
 - A. Describe the four categories of biotechnology
 - 1. Plant
 - a. Crops resistant to plant diseases.
 - b. Crops resistant to insect pests.
 - c. Making the food we eat more nutritious.

Time

Instruction time for this lesson: 45 minutes.

Resources

Frequently Asked Questions about Biotechnology. (2008). Retrieved August, 09, 2009, from United State Department of Agriculture: Official Web site: <http://www.usda.gov/wps/portal?navid=BIOTECH> — Herren, Ray. (2005). Introduction to agriculture: an agriculture revolution. Clifton Park, New York: Delmar Learning. — National FFA Organization. (2009). LifeKnowledge Online. Retrieved July 9, 2009, from <http://agedlearning.org> — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success.

Tools, Equipment, and Supplies

Overhead projector/transparencies
MS.AST.3.1.TM.A – one per teacher
MS.AST.3.1.TM.B – one per teacher
MS.AST.3.1.TM.C – one per teacher
MS.AST.3.1.TM.D – one per teacher
Post-it Notes – one per student
MS.AST.3.1.AS.A – one per student
MS.AST.3.1.AS.A-Key – one per teacher
MS.AST.3.1.AS.B – one per teacher
MS.AST.3.1.ASSESS.A – one per student

Key Terms

The following terms are presented in this lesson and appear in **bold italics**:

biotechnology

- d. Helps make our food last longer.
- e. Increases disease-fighting nutrients in plants.
- 2. Animal
 - a. Produces new animal vaccines.
 - b. Helped developed artificial insemination.
 - c. Transfers embryos, or fertilized eggs, from one cow to multiple cows.
 - d. Allows livestock producers to pick the sex of their animals.
 - e. Researchers are locating genes that cause genetic diseases, such as Down's syndrome.
- 3. Medical
 - a. Pharming is used to produce organisms to use them in pharmaceuticals.
 - b. Using pigs to produce organs for human organ transplants.



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- c. Using bananas as an edible food vaccine.
- d. Created "golden rice" to help people fight vitamin A and iron deficiencies.
- e. Reduce allergens in food.
- 4. Environmental
 - a. Using plants and animals to detect pollutants in our environment.
 - b. Develop oil-eating bacteria to help clean up oil spills.
 - c. Increase the yield from crops instead of tearing down forests to create more farmland.
 - d. Develop crops that can withstand harsh temperatures, such as extreme heat or cold.
 - e. Finding a way to develop biodiesel in a way that is cheaper than fossil diesel.

Interest Approach

Using **MS.AST.3.1.TM.A, B, C, and D**, show students the four pictures. Ask them what the connection is between all these pictures. It may be helpful to them if you give them a short description of what the picture is actually showing them.

It's great to see everyone in class again today. Let's start things off with a few pictures. On the screen we can see four pictures. These pictures all have something in common. As I read a short description of each picture, take a look and try to figure out the connection.

The answer to this question is that they are all connected through biotechnology. Below are some leading questions about each picture to see how much information they already know. Then you can provide students with information as needed. Avoid using the term "biotechnology" as you describe the pictures to the class.

Let's start with picture one! What do you notice about this picture? What do you think is being injected into the tomato?

Show **MS.AST.3.1.TM.A**. This photo represents biotechnology in plants. Talk to them about how this tomato is being altered in some way. Most likely scientists are making it pest resistant or even more nutritious by inserting or removing DNA from the plant.

Now let's examine picture two. Some of these pictures may look familiar. What things do you notice about picture two? What does the object in the center of this photo have to do with the other images? What animal was first to be cloned? What kinds of animals do we clone?

Show **MS.AST.3.1.TM.B**. This photo represents biotechnology in animals – specifically, with the cloning of animals. Help them make the connection of the double helix in the center of the photo to cloning. You may need to prompt them about Dolly the sheep being the first animal cloned.

Let's move on to picture three! What are your thoughts on what this picture represents? Where do you think we get this medicine?

Show **MS.AST.3.1.TM.C**. This photo represents biotechnology in medicine. Most specifically it is a picture that represents insulin. We now can make insulin by genetically altering bacteria to produce it for us. Before this, we actually got our insulin from the pancreas of slaughtered cattle. Remind the students that before scientists made insulin with bacteria, it was much more expensive and couldn't be produced in large quantities.

Now it's time for our last photo! What do you see in this photo? What makes this place a good or bad environment for an organism to live in?

Show **MS.AST.3.1.TM.D**. This photo represents biotechnology in the environment. Scientists are discovering ways that plants and animals can be used to help clean up polluted environments like this river. Right now, certain microorganisms will eat toxins and then convert those toxins into carbon dioxide. Even some plants can help absorb toxins from the soil. This process is called bioremediation.

So now that we have taken a quick look at all four of these pictures, let's hear what you think they may have in common. What connects all of these pictures together?

Answers will vary. Students may talk about how it all had to do with science or scientists. They may bring up genetics or even that all four pictures had dealt with living organisms. Lead them to the conclusions that these four pictures all represent biotechnology in some fashion.

All of these pictures do represent **biotechnology**! As we have seen, **biotechnology** can deal with plants, animals, medicines, and even our environment.



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We have already discovered so much about **biotechnology**, but we haven't really defined it yet. Next, let's discover exactly what **biotechnology** is.

Summary of Content and Teaching Strategies

Objective 1. Define biotechnology.

Students will be conducting the Me-You-Us e-Moment® using post-it notes for this next activity. They will be writing their own definition of what biotechnology means on a post-it note then sticking that post-it on their neighbor and reading their idea. Then students will stick it on the writing surface at the front of the room.

So what do think the word **biotechnology** means? When we hear the word, WRITE, we will have one minute to form a short definition for the word **biotechnology**. Put this definition on one of the post-it notes at your table. Questions? WRITE!

After one minute is up, tell students that they are now going to share their definition with someone near them by sticking their post-it note on their shoulder. Encourage them to ask questions about their neighbor's definition or even to add something to theirs.

Now that we have our definitions, it is time to share them! Hold your definition in the air. Now ever so gently reach behind your neighbor and place that post-it on their shoulder and hold both your hands out in front of you. When you hear the word DISCUSS, you will grab the post-it note from your shoulder and read your partner's definition. Talk to your partner and revise your definitions together. Be prepared to share with the class. Questions? DISCUSS!

Let's bring our discussions to a close in 5,4,3,2, and 1. Who will be the first to share?

Possible responses could be that they combine living things with improving life, or things that make our lives easier by using living things. After four or five students have shared, have them bring their post-it notes to the writing surface.

Thanks for sharing! Let's put all these great definitions in one location. Take your post-it and stick it onto the writing surface in this area. We have 30 seconds!

After students have stuck their definitions on the board and made it back to their seats, reveal the definition for biotechnology and have them capture it in their notes. You can show **MS.AST.3.1.TM.E**.

A. Biotechnology: Using living organisms to make products useful to humans.

As you can see, this definition looks a lot like the definitions we all just shared in class. We are a smart group! Let's figure out how **biotechnology** is used in our lives today.

Objective 2. Identify five examples of agriculture-related biotechnology.

Students will be gathering examples of biotechnology using the Go-Get-It e-Moment. Have the examples from **MS.AST.3.1.AS.B** (pages 1-10) cut up and taped on the walls. Provide the students with **MS.AST.3.1.AS.A** to write down the information as they find it. Ultimately, they will not only be seeing twenty different biotechnology examples, but they will also be categorizing those examples into plants, animals, medicine, and environment.

At the very beginning of class today we saw four pictures of **biotechnology** examples. Many of us probably noticed that these pictures actually represented the four categories of **biotechnology** that we are discussing today. Who will take a guess at those categories?

You can show them the four pictures that you started with again in order to jog their memories.

If you take a look around the room you will see 20 different examples of how **biotechnology** is used in our everyday lives. These 20 examples taped on our walls fit into those four categories of plants, animals, medicine, and environmental **biotechnology**.

Let's take a look at our worksheets. When you hear the word BIOTECH, get out of your seats with your writing utensil in hand and make your way around the room. When you come to a slip of paper decide which category it belongs in. Write it down and move on to the next example. Categorize all 20, and then return to your seat. We will have seven minutes. How many examples will we write? How much time do we have? BIOTECH!



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Provide the students with check points throughout the process. For instance, at two minutes, inform students that they should have classified at least five examples. At the end of seven minutes have them take their seats. If some students finish early have them compare their notes with another student.

Awesome work, class! We just identified 20 different uses of **biotechnology** in agriculture. Let's see how we did!

At this point list the categories on the writing surface so that students can move the examples from the walls to the writing surface. Or you could have a transparency of the student worksheet and write the examples on it. Use the students to volunteer and move their answers to the front writing surface.

As you can see, we have the four categories on the writing surface. Let's take a look at the plant category first. We need five volunteers to go collect one of the examples from around the room that deals with plants and place them at the front. Great, thanks for volunteering!

Using the key to **MS.AST.3.1.AS.A** go through each of the four categories allowing students to correct their charts as needed to match the large chart at the front of the room. This is also an opportunity to talk about how some of their example may overlap areas. For example, using pigs for organ donors can be both medicine and animals.

Many great scientists of our past were very curious about how we were going to feed our world. They were very inquisitive and were constantly thinking about the future of our world. Thanks to them, we no longer consider catching a cold as a fatal illness, and we can go to the grocery store and buy canned foods that can last for years. Just like these scientists thought about the future, we need to always be thinking about our futures. Why would thinking about our futures be important in our own lives?

Answers may sound similar the following: we need to know what job we want to have when we grow up, to help form goals, to help us meet our goals.

So when we think about our future, what do we see? Who will share something they see themselves doing in the future?

Thanks for sharing. Now back to our scientists: as we have seen, there are so many ways that **biotechnology** is affecting or could be affecting our lives in the future. This brings up a question: what do you think our life would be like without **biotechnology**?

Review/Summary

Walk students through a visualization of a life without biotechnology. Go through each of the categories. After they have visualized this, have them write a paragraph reflecting on life without biotechnology.

Utilize the Hole-in-one e-Moment.

Close your eyes for a moment. Think about life without **biotechnology**. What kinds of foods would you eat? How easy is it for everyone in the world to eat this food? What kinds of technology reproduce animals for us to eat? Imagine going to the doctor. What kind of help is the doctor able to give you without the use of **biotechnology**? Now imagine our environment. What does it look like? Open your eyes.

Take five minutes and write a short one-paragraph reflection on life without **biotechnology**. Feel free to use the back of your paper to write your reflection.

If time permits, you may find it helpful to have some students read their paragraphs aloud.



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Application

Extended classroom activity:

Have each student research one of the 20 examples on the Internet. Have them gather five important facts about that example to share with the class.

FFA activity:

Tour a business in the agriculture industry, and specifically ask them to emphasize how they use biotechnology in developing their products.

SAE activity:

Set up an expert in animal reproduction to put on a workshop to help students develop artificial insemination techniques or embryo transfer techniques in their herds.

Evaluation

MS.AST.3.1.ASSESS.A

Answers to Evaluation

Answers will vary. Any of the 20 examples from the activity sheet may be considered correct.











A. Biotechnology: Using living organisms to make products useful to humans.



Categorize the biotechnology examples in one of the four categories. Write the example in the proper box.

Plant Biotechnology 1. _____ _____ 2. _____ _____ 3. _____ _____ 4. _____ _____ 5. _____ _____	Animal Biotechnology 1. _____ _____ 2. _____ _____ 3. _____ _____ 4. _____ _____ 5. _____ _____
Medicine Biotechnology 1. _____ _____ 2. _____ _____ 3. _____ _____ 4. _____ _____ 5. _____ _____	Environmental Biotechnology 1. _____ _____ 2. _____ _____ 3. _____ _____ 4. _____ _____ 5. _____ _____



Categorize the biotechnology examples in one of the four categories. Write the example in the proper box.

Plant Biotechnology 1. Crops resistant to plant diseases 2. Crops resistant to insect pests 3. Making the food we eat more nutritious 4. Helps make our food last longer 5. Increases disease-fighting nutrients in plants	Animal Biotechnology 1. Produces new animal vaccines 2. Helped develop artificial insemination 3. Transfers embryos, or fertilized eggs, from one cow to multiple cows 4. Allows livestock producers to pick the sex of their animals 5. Researchers are locating genes that cause genetic diseases, such as Down's syndrome
Medicine Biotechnology 1. Pharming is used to produce organisms to use them in pharmaceuticals. 2. Using pigs to produce organs for human organ transplants. 3. Using bananas as an edible food vaccine. 4. Created "golden rice" to help people fight vitamin A and iron deficiencies. 5. Reduce allergens in food.	Environmental Biotechnology 1. Using plants and animals to detect pollutants in our environment. 2. Develop oil-eating bacteria to help clean up oil spills. 3. Increase the yield from crops instead of tearing down forests to create more farmland. 4. Develop crops that can withstand harsh temperatures, such as extreme heat or cold. 5. Finding a way to develop biodiesel in a way that is cheaper than fossil diesel.



Using plants and animals
to detect pollutants in our
environment.

Develop oil-eating bacteria to
help clean up oil spills.



Increase the yield from crops instead of tearing down forests to create more farmland.

Develop crops that can withstand harsh temperatures, such as extreme heat or cold.



Finding a way to develop biodiesel in a way that is cheaper than fossil diesel.

“Pharming” is used to produce organisms to use them in pharmaceuticals.



Using pigs to produce organs
for use in human organ
transplants.

Using bananas as an edible
food vaccine.



Created “golden rice” to help people fight vitamin A and iron deficiencies.

Reduces allergens in food.



Produces new animal
vaccines.

Helped develop artificial
insemination to what it is today.



Transfers embryos, or fertilized eggs, from one cow to multiple cows.

Allows livestock producers to pick the sex of their animals.



Researchers are locating genes that cause genetic diseases, such as Down's syndrome, through gene mapping.

Crops resistant to plant diseases.



Crops resistant to insect pests.

Making the food we eat
more nutritious.



Helps make our food last longer.

Increases disease-fighting nutrients in plants.



Name: _____

Directions: Biotechnology in agriculture can be seen in many places. On the space below, write down five ways that we use biotechnology in agriculture.

1. _____
2. _____
3. _____
4. _____
5. _____