

Michigan Farm Bureau Ag in the Classroom – Connections to Michigan Content Standards

5th GRADE LESSON – “Putting it all Together...DNA and Biotechnology”

Michigan Farm Bureau Promotion and Education Committee

This lesson meets the following science content standards for the upper elementary level:

II. Reflect on the Nature, Adequacy and Connections Across Scientific Knowledge

Content Standard 1: All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science.

- 1-3: Describe ways in which technology is used in everyday life.

III. Use Scientific Knowledge from the Life Sciences in Real-world Contexts

Content Standard 1: All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce.

- 1-1: Describe cells as living systems.

Content Standard 3: All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes.

- 3-1: Give evidence that characteristics are passed from parents to young.

“Putting it all Together...DNA and Biotechnology”

Fifth Grade Lesson

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Presented by: Michigan Farm Bureau Volunteers

Introductions / Welcome (2-3 Minutes)

Introduce yourself and give an overview of your farm.

What is biotechnology? (10 minutes)

Show definition poster

Bio: is short for biology or the study of living things.
Technology: is a tool used to apply science using science to make things better i.e. Computer technology – faster computer, Palm Pilots

Then biotechnology is a tool that uses biology to make new things or improve the products we have.

Show soybean, product Poster

For example: Plant biotechnology is a way to make seeds with special qualities – i.e. making them more nutritious or more resistant to disease and pests. How many of you like seedless grades? Biotechnology helped us develop grapes without seeds as well as tomatoes and strawberries that stay fresher longer.

Examples of Biotechnology (10 minutes)

Pass out the cards

Pick up the cards

Use the cell poster

Explanation of Cells (10 minutes)

Usually biotechnology will be used to improve just one part of a product. Many of the products we use are made of many different ingredients. Let's do an activity that looks at these ingredients.

Have students break into six groups. Give each group an envelope containing three large names (lotion, yogurt and bread) and 12 smaller names. Instruct the students to match which materials were used to make each of the three products **(sugar and honey can be used more than once)**.

- a. lotion – lanolin, honey, glycerin, beeswax.
- b. yogurt – fruit, bacteria, sugar, milk
- c. bread – yeast, sugar, butter, wheat, honey

Perhaps there were some ingredients in these products that you didn't know about. Remember scientists might change only one ingredient to make the whole product taste or look better or last longer. ***So, exactly how do scientists change a product using biotechnology? Let's look at the basics of biotechnology.***

Let's start with something you are familiar with: your body is composed of millions of individual units called **Cells** (Use poster as the model to explain the following section).

What is the control center of a cell?

Nucleus

Now it gets a little more complicated, inside the nucleus is a colored body that can only be seen when cells are dividing and only under a microscope What are these called?

These are called - Chromosomes

We have these chromosomes in every cell in our body – millions and millions of them. Each cell has the same number of chromosomes. ***Do you want to guess how many?***

46 in each or 23 pairs (Other plants and animals have different numbers of chromosomes).

What is located within the chromosomes that carry genetic traits?

DNA (Deoxyribonucleic) (de-ox-y-ri-bo-nu-cle-ic Acid) - There are 6 feet of DNA in all 23 chromosomes. DNA is a large molecule with a shape similar to a twisted ladder. The rungs of the ladder are made up of molecules called bases. Adenine (ad-e-nine), thymine (thy-mine), guanine (gua-nine) and cytosine (cy-to-sine). ***Have you heard of DNA before?*** DNA holds the information which tells living things how to grow and function. Every cell in your body has about six feet of DNA coiled up inside it (give an example of 6 feet).

The last parts of a cell we are going to explore are genes. Each gene is a segment of DNA. Before we move on, let's think about

Use the Cell Poster

Show poster of DNA Bases – hang this poster on the board. Place the pairs on the poster.

genes a bit more. (Ask the following as questions) **How many of you have straight hair? How many of you have curly hair? How many of you have brown eyes and how many have blue or green eyes? How many of you have your ear lobe connected to your head? Or is it loose from the rest of your ear?** All of these characteristics are controlled by genes and are passed down from your parents to you.

Do you think genes exist in just people?

Genes exist in all living things. Genes are a segment of DNA (refer back to the poster).

Let's build a DNA model to help you understand the different parts of DNA. As we pass out your materials, please arrange them in front of you – but don't eat them.

DNA Model Activity (10 minutes)

Have the students get a partner.
Pass out supplies using rubber gloves.

Do a demonstration in front of the group as they go along.

You should have four pieces of licorice, three Life Savors and four different colored gumdrops. You should also have a pipe cleaner and two toothpicks and one piece of paper towel.

Begin by taking a pipe cleaner and bending one end. String a sugar (red twist) onto the string then a phosphate (white Life Savor), then another sugar, etc. until you have four red twists and three Life Savors. Bend the pipe cleaner at

the other end to keep the sugar and phosphates from falling off.

Take a purple (A) gum drop which represents Adenine and a yellow (T) gum drop which represents thymine and skewer them with a toothpick so they are facing each other in opposite directions and opposite ends of the toothpick.

Do the same with the green (G) gum drop which represents guanine and orange (C) gum drop which represents cytosine.

With your partner stick the ends of the toothpicks into the red twists with a pair at different sections so there is a section of bases at each phosphate.

Now hold the ladder at the top and at the bottom, and twist it a little bit so that it begins to spiral like a double helix.

Congratulations! Your DNA model is done. Please set your model to the side on the piece of paper towel you were given and you may eat it when we have completed the lesson .

Of course real DNA is a lot smaller and not so colorful. Let's look at some real DNA. We are going to look at the DNA of (one of the volunteers).

Begin getting DNA extraction material ready

Explain the process as you do it.

DNA Extraction Activity (5 minutes)

Use large poster
Use bases poster for spelling

Demonstrate to the students the following:
Place a teaspoon of Gatorade in the plastic cup.

1. Swish the Gatorade in your mouth for no less than 30 seconds. Be sure to rub your tongue on the inside surface of your cheek to dislodge cells. Then return the Gatorade solution to the cup.
2. Pour the solution in the test tube until about half-full.
3. Add 10 drops of the detergent to the test tube and cap the test tube.
4. Gently rock (DO NOT SHAKE!) the test tube back and forth to mix the contents, but do not form bubbles.
5. Remove the cap and add 1 teaspoon of cold alcohol.
6. Small bubbles with white strings attached will slowly make their way to the top of the alcohol. THIS IS DNA!
7. Walk around with DNA so the students can see it.

Let's review by completing the DNA worksheet.

**DNA Purpose Activity
(8 minutes)**

Use soybean product poster

Now that we understand what DNA looks like and it's purpose, let's talk about biotechnology and agriculture.

Do you remember earlier when we talked about biotechnology helping to make seeds to crops?

Do you remember the foods we eat that have been improved through biotechnology?
Seedless grapes, tomatoes, navel oranges.

Using biotechnology, farmers can plant Round-Up Ready soybeans that are not killed by the weed killer Round-Up. **Do your Mom and Dad use something around the house or garage in the summer to kill weeds?** This is the same for farmers. To produce good crops, fields need to have as few weeds as possible (Show poster).

Scientists were able to insert a gene into the soybean seed that made it resistant to Round-Up. So when a farmer sprays Round-Up it will kill the weeds and not the soybean plants. Not only does this reduce the amount of spray used, it also reduces the loss of soil because farmers do not have to do as much tillage to control weeds. It also allows farmers to grow more food because there are fewer weeds and plant diseases.

Use Poster with Carrot

Biotechnology can also help make food more nutritious and prevent human diseases.

1. ***Have each of the students put their hands over their eyes – Does this give you a clue? What can you see?*** In some countries, thousands of children go blind because their diets do not have enough Vitamin A. Using biotechnology, people from these countries that count on rice, as a major food, will be able to have Golden Rice with Vitamin A that can help prevent blindness. *Review the poster explaining a piece of DNA is taken from the Daffodil containing Vitamin A and placed into the rice plant.*

How many of you like getting shots? Not many of you – In the future, biotechnology may let you eat a banana instead of getting a shot. Genes from the medicine in the shot may be inserted into the banana, just like the gene from the daffodil was inserted to the rice plant.

2. **Can you think of other benefits of using biotechnology?** *Bacteria that will clean up oil spills, safer and healthier food and saving endangered animals.*

**Conclusion
(5 minutes)**

Show posters and products to review the lesson.

Let's review what we have learned:

What is biotechnology?

What are some examples of products made from living things?

What are the parts of a cell?

What do we take from a cell to help make a new biotechnology product?

How can biotechnology help agriculture and the environment?

Biotechnology is new and a little hard to understand. It is important that we learn all we can so we can make good decisions about using technology to improve our lives.

“Putting it all Together...DNA and Biotechnology”

Material list

(Designed for 2 classes of 35)

1	Definition of Biotechnology poster
1	Cell poster
1	DNA Bases Poster
1	Biotechnology foods/Soybean Poster
1	Golden Rice Poster
1	Large poster of the DNA Helix Lab Sheet
8 sets	Products/living things cards
70	Pipe cleaners
70	Copies of the DNA Helix Lab Sheet
300 pieces	Licorice – 1” pieces of Red Vine
300	Wintergreen Life Savors
100 Gum Drops	of each color:
	• Yellow
	• Purple
	• Green
	• Orange
1	Small containers of Gatorade
1	Small test tube
1	Eyedropper
5	Small clear plastic cups
1 teaspoon	
1 box	Toothpicks
1 bottle	Dawn Detergent
1 bottle	Rubbing alcohol (95 percent ethyl)
1 roll	Paper towel
5 pairs	Rubber gloves

“Putting it all Together...DNA and Biotechnology” Term Sheet

1. DNA (Deoxyribonucleic acid) - de-ox-y-ri-bo-nu-cle-ic acid

- ❑ a nucleic acid consisting of large molecules shaped like a double helix; associated with the transmission of genetic information.
- ❑ The backbone structure of the helix is made of sugar (life savor) and phosphate (licorice).

2. Adenine - ad-e-nine

- ❑ A base found in DNA that pairs with thymine.

3. Thymine - thy-mine

- ❑ A base found in DNA that pairs with adenine.

4. Cytosine - cy-to-sine

- ❑ A base found in DNA that pairs with guanine.

5. Guanine - gua-nine

- ❑ A base found in DNA that pairs with cytosine

Biotechnology

Bio:

short for biology

Technology:

tools used to apply science concepts



HOW BIOTECHNOLOGY HELPS US!!

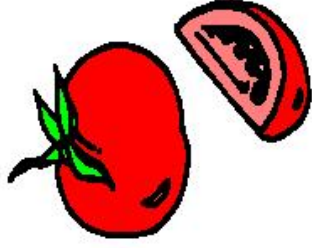


Seedless Grapes

Non-Resistant to Round-Up



Weedy



Fresher Tomatoes



Navel Oranges

Resistant to Round-Up



Weed-Free

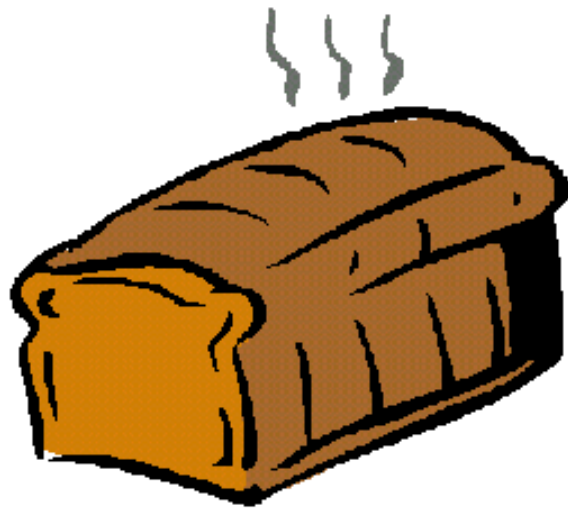


Lotion

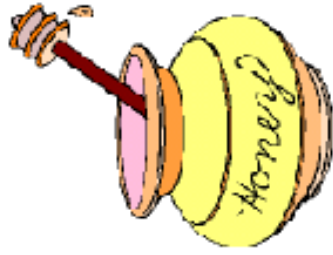
Yogurt



Bread



Honey



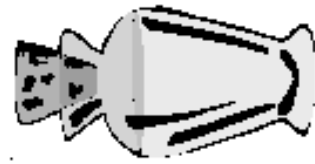
BeesWax



Lanolin



Glycerin



Bacteria



Milk



Fruit



Sugar



Wheat



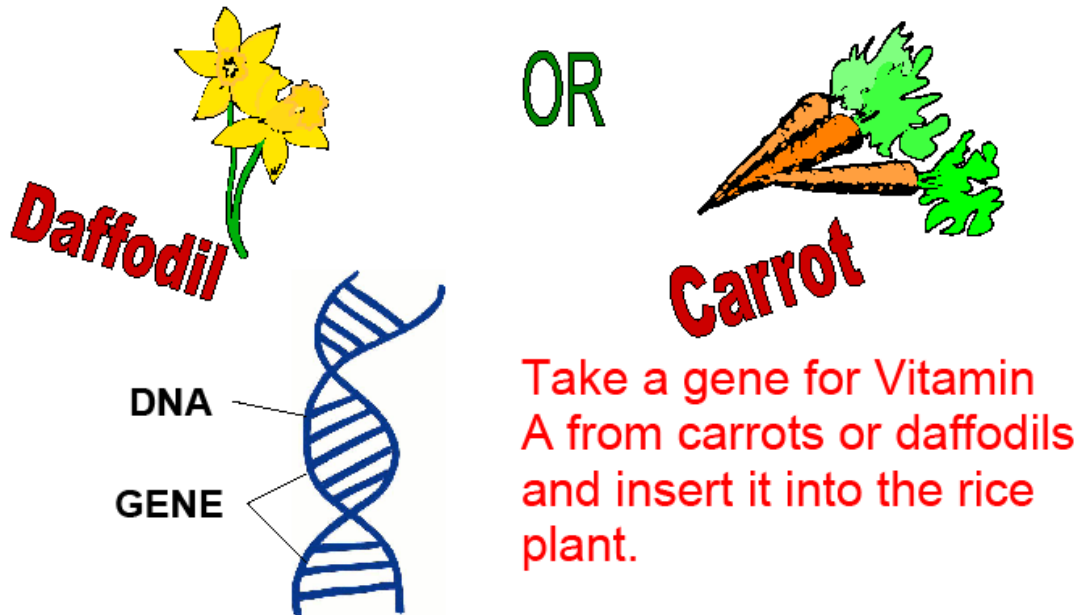
Yeast



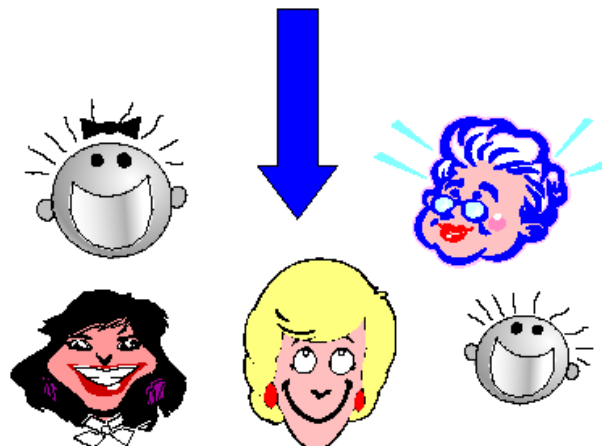
Butter



NEW PRODUCTS FROM BIOTECHNOLOGY



New "golden rice" with Vitamin A



Fewer blind children because Vitamin A is added to their diet

A - T C - G

A - T C - G

A - T C - G

A - T C - G

BASES OF DNA

A = Adenine =

T = Thymine =

G = Guanine =

C = Cytosine =

HOW BIOTECHNOLOGY HELPS US!!

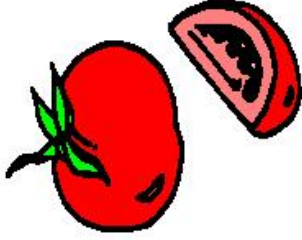


Seedless Grapes

Non-Resistant to Round-Up



Weedy



Fresher Tomatoes



Navel Oranges

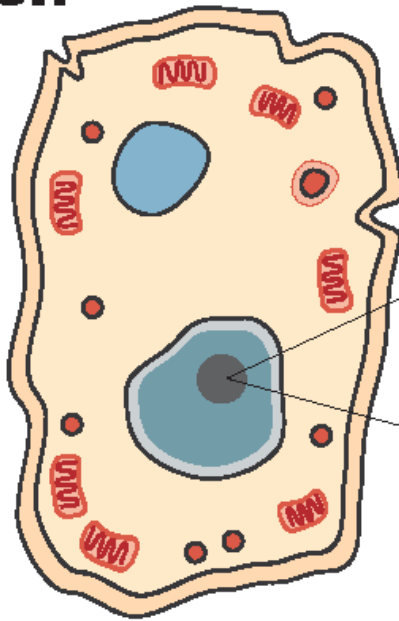
Resistant to Round-Up



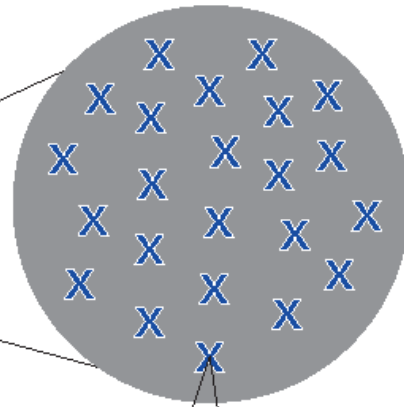
Weed-Free

What's In A Cell?

Cell



Nucleus



DNA

Gene



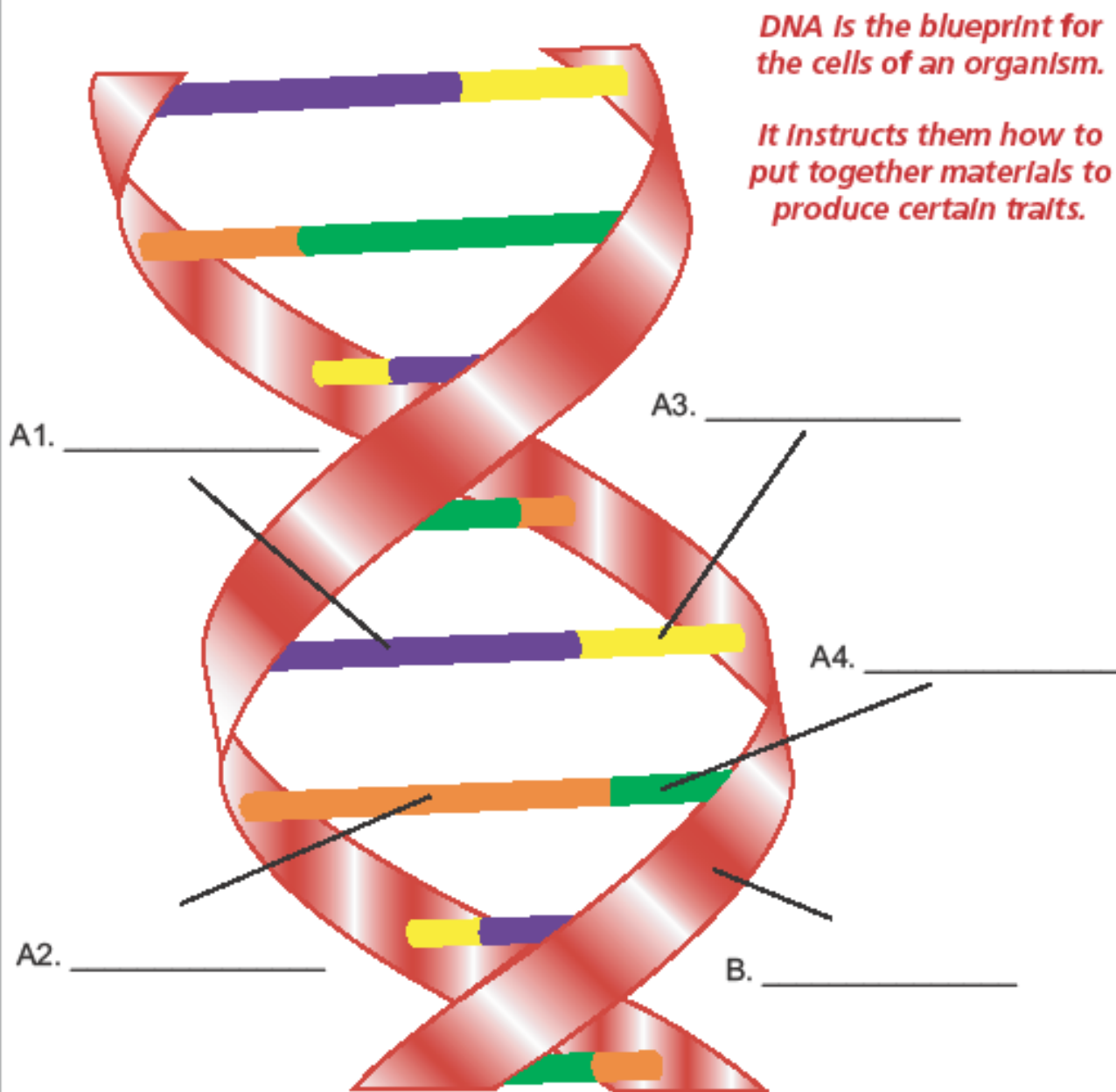
Chromosome

Name: _____

How much do you know about DNA?

A. Can you name the four different bases that make DNA?

B. What makes up the backbone structure of DNA?



Name: _____

How much do you know about DNA?

A. Can you name the four different bases that make DNA?

B. What makes up the backbone structure of DNA?

DNA is the blueprint for the cells of an organism.

It instructs them how to put together materials to produce certain traits.

