

Activity: See DNA Without a Microscope

Activity Level: Advanced

Source: Adapted from “Discovering DNA” *Science of Soy*
“See DNA Without a Microscope Activity Bench” *Life Science Lab*

Purpose

Model DNA extraction using wheat germ.

Example Topics It Supplements

Heredity; biological adaptations; genetics; DNA

Activity Snapshot

1. Organize and Prepare Supplies
2. Read Background Information
3. Interest Approach
4. Conduct Activity
Students mix wheat germ with water and stir. They add dish soap, meat tenderizer, and baking soda to the mix. Yellow liquid rises to the top, collected, and placed in a test tube. Denatured alcohol is added. DNA is collected with a wooden stick.
5. Ask follow up questions and make connection to agriculture.
 - What are some traits that we exhibit that are controlled by genes?
 - What organisms contain DNA?
 - Briefly explain the DNA extraction we did today.
 - DNA extraction happens in agriculture to improve farming practices. Why would a genetic engineer wish to improve seed performance?

State Standards It Supports

SC 12.3.2.b—Describe the basic structure of DNA.
SC 8.1.1.d—Select and use equipment appropriate to the investigation, demonstrate correct techniques.
SC 8.3.2.a—Recognize that hereditary information is contained in genes within the chromosomes of each cell.
SC 8.3.4.a—Describe how an inherited characteristic enables an organism to improve its survival rate.

Materials

- Plastic Cup (12 ounces)—1 per student
- Graduated Cylinder (100 mL)
- 100 mL of water—per student
- Plastic Spoon—1 per student
- Wheat germ—1 spoonful per student
- Liquid Dish Soap
- Meat Tenderizer—1/8 teaspoon per student
- Baking Soda—1 teaspoon per student
- Pipette—1 per student
- Test Tube—1 per student
- Denatured Alcohol
- Wood Stick—1 per student

What’s the Connection to Agriculture?

DNA is found in every living thing. Scientists have developed ways to improve farming practices to have healthier fields with higher yields. Better seed (like soybeans and corn) means more food, fuel, and fiber for animals and people.

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PROCEDURES:

1. Organize and Prepare Supplies
See “Materials” on cover page.
2. Background Information
DNA is found in every cell of every living thing and it gives the instructions on how the organism should be built. Since crops like, soybeans, wheat, and corn are living organisms they have DNA! Since DNA was discovered in the 1950’s, scientists have come up with many new technologies that have improved farming practices. In this activity, you will “extract” or remove some of your own DNA, just like scientists do in order to work with it and learn more about it.
3. Interest Approach
Ask students to guess when DNA was discovered. Follow up with questions. What does DNA control? What do you know about DNA?

All living organisms have DNA and the study of DNA in farming crops is a huge industry called biotechnology. It helps farmers improve farming practices to get the best results in providing food.

4. Conduct Activity
 - a) Take a plastic cup. This will be your mixing container. Fill a graduated cylinder with 100 mL of water and pour the water into the cup.
 - b) Use a plastic spoon to scoop out 1 spoonful of wheat germ. Add the wheat germ to the water in the cup. Use the spoon to stir it together. Wheat germ contains cells with wheat DNA.
 - c) Add 1 pump of liquid dish soap to cup and stir. The mixture may feel thicker. Soap helps break open the cell membranes. Keep stirring!
 - d) Add 1/8 teaspoon of meat tenderizer to the cup and stir. Meat tenderizer contains an enzyme called papain that works to break down proteins. It makes meat easier to chew and what germ DNA easier to see.
 - e) Add 1 teaspoon of baking soda to the cup and stir. Make sure to mix all the way to the bottom of the cup since the baking soda can sink. Baking soda increases the pH of the mixture making it even easier to see the wheat germ DNA.
 - f) Stop stirring and dispose of the spoon. Wait for wheat solids to settle.
 - g) Collect yellow liquid from top of the cup with the pipette. Squeeze into test tube. Do this about three times and the test tube will be about 1/3 full. It is okay to get some wheat solids in the test tube.
 - h) Slowly add denatured alcohol so that it runs down the inside of the test tube. Add an amount of alcohol equal to the amount of wheat liquid. Take care not to tilt or tip the test tube at this point.
 - i) Carefully observe the test tube. Notice what is happening at the interface (the line where the alcohol and the wheat liquid meet). You may see some bubbles with thin, white strings attached. That is the DNA. When DNA touches alcohol, it precipitates or forms a solid (the thin, white strings). When enough DNA is together it can be seen with the naked eye.
 - j) Use wooden stick to collect wheat DNA. Carefully place the stir stick into the tube just to the level where the alcohol and wheat germ layers meet (the interface). Swirl the stick at the interface using small circles to spool or wrap the DNA around the rod. Gently lift the stick up and observe the DNA collected there.

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5. Ask Follow-Up Questions and Make the Connection to Agriculture.

- What are some traits that we exhibit that are controlled by genes?
Tongue rolling is not something you can learn to do! Either you have the gene that allows your tongue to roll up like a taco or you don't. You get your DNA from your parents. You have two copies of the tongue rolling gene. If you have one copy that is dominant you can roll your tongue. If both of your copies are recessive then you will not be able to roll your tongue, no matter how hard you try.

Check out your hairline! Do you have a widow's peak? We are not sure where that name came from. Some people call it an "Eddy". The widow's peak is a dominant trait but that doesn't mean that more people have it. Also, this trait is hard to identify in people with no hair. Two parents with straight hairlines will have children with straight hairlines.

Do your ears hang low? Do they hook right into the side of your head? Earlobes are one of the several traits determined by one gene. You only need to receive one copy of the dominant "free" earlobe gene to have "free" or unattached earlobes. For your earlobes to be attached, you need to receive two recessive genes. Dominant genes do not always appear more frequently in the gene pool. They simply refer to the strength of that version of the gene to appear when present in an organism.

- What organisms contain DNA?
DNA is found in every cell of every living thing, and it gives the instructions on how the organism should be built. Since soybeans are living organisms, they have DNA, too! Since DNA was discovered in the 1950s, scientists have come up with many new technologies that have improved farming practices!
- Briefly explain the DNA extraction we practiced today.
Wheat germ was added to water. Soap, meat tenderizer, and baking soda were added as well. Alcohol was poured into the mixture and the DNA could be seen and pulled out of the solution with a wood stick.

This is a very basic approach to DNA extraction. Scientists use DNA extraction to modify and improve plants in agriculture to have better plants. Did you know that "Roundup Ready Soybeans" are a type of bean in which scientists have added DNA from a bacterium to the DNA of the plant? Why would they do this? While Roundup® herbicide will stop the growth of many plants, it has no negative impact on this bacteria. Roundup® would typically harm soybeans, but by putting the bacterium's DNA into the soybean DNA, farmers can spray Roundup® on their fields to kill the weeds, but not the soybeans. Fewer weeds mean healthier soybeans, and more of them, too!

- DNA extraction happens in agriculture to improve farming practices. Why would a genetic engineer wish to improve seed performance?
Scientists can improve seed performance so farmers can grow more seed in order to produce more food, fiber, and fuel for animals and people.