Extracting DNA from Bananas

As discussed in the program, for something to be called living or alive, it must be able to reproduce. Cells are the functional units of living things. They reproduce, in part, by making and passing deoxyribonucleic acid (DNA) from the parent cell to the offspring cell. All DNA is made up of the same chemical bases, adenine, thymine, guanine, and cytosine. The order of the bases determines the proteins the cell makes and the functions the cell performs.

In this activity, students extract DNA (and also some RNA) from bananas. They see that:
- DNA is a component of living and once-living things.
- DNA can be extracted and observed.

Materials:

- *Extracting DNA from Bananas* student handout
- 1 large banana
- 3/4 cups distilled water
- 1 teaspoon clear, colorless (i.e., not cloudy) shampoo or liquid soap containing EDTA
- 1/4 teaspoon table salt
- 15 ml 91% isopropyl (i.e., rubbing alcohol) in 25 ml or 50 ml sealed test tube; chill the alcohol by placing the test tube in a beaker containing ice cubes and some water
- Blender or smoothie maker
- 3 16-ounce plastic cups
- tape (optional)
- 2 plastic spoons
- 1 set of measuring spoons and a measuring cup with 1/2-cup markings
- 1 #4 cone paper coffee filter
- 250 ml beaker
- 1 plastic pipette or medicine dropper
- 1 thin glass rod

Key Terms

- **DNA:** Deoxyribonucleic acid, which is the hereditary material in cells that contains the instructions for producing the cell and enabling it to function
- **Extraction:** A procedure to obtain a substance by chemical or mechanical action
- **Filtrate:** The material collected after a solution or mixture passes through a filter
- **Precipitate:** Solid material that comes out of solution as a result of a chemical or physical change

National Science Education Standards Connection

Science Standard C: Life Science
- Grades 5–8: Reproduction and Heredity
- Grades 9–12: The Cell; The Molecular Basis of Heredity

Video is not required for this activity.

Procedure

1. Review the procedure with students, discussing key terms and responding to any questions. Explain that crushing the bananas separates its cells and exposes them to the soap and salt. The soap helps break down cell membranes and release DNA. The salt helps bring the DNA together, and the cold alcohol helps the DNA precipitate and come out of solution so it can be collected.

2. Demonstrate the following:
   - Show what it means to stir gently so as not to cause the solution to froth or foam.
   - Demonstrate how to place the coffee filter in the cup so that the solution can pass through the filter and be collected in the cup. Leave about one to two inches between the bottom of the cup and the bottom of the filter. (Taping the filter to the cup is optional.)
   - Remind students to get their test tubes with alcohol only when they are ready to use them.
   - Remind students of the importance of following the procedure carefully.

3. Divide the class into teams. Have students gather their materials and begin their extraction. Consider keeping the blenders, the beaker with the alcohol test tubes, a gallon of distilled water, the soap, and the salt in one general area. You may also want to prepare a batch of blended bananas for the entire class and distribute the mixture to teams. Make sure students know to answer the questions at the bottom of the student sheet after finishing the extraction.

Answers to questions on student handout:

1. Describe the appearance of the DNA you extracted.

   The DNA will appear white and will form a clump made of string-like strands that wrap onto the glass rod.

2. Summarize the main steps involved in extracting DNA from bananas.

   Possible answer—We crushed the bananas to help release the DNA. We made a solution—water, soap, and salt—to free the DNA from other components. The soap breaks apart the cellular and nuclear membranes, and it releases the DNA. The salt helps the DNA strands come together. We used coffee filters to remove large particles, and we used alcohol to precipitate the DNA. DNA is not soluble in alcohol. Last, we observed our product, the DNA, on a glass rod.

3. Do you think your results would be different if you were to use a fruit or vegetable other than bananas? Explain.

   Since DNA is in the cells of every living organism, students could use this technique to extract DNA from any fruit or vegetable.

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For something to be considered living, it must be able to reproduce. Cells reproduce in part by passing deoxyribonucleic acid (DNA) from parent cells to offspring cells. DNA provides a blueprint for an organism's growth and development. Studying DNA is one way scientists learn about what is necessary for life. In this activity, you will extract and observe DNA from bananas.

Procedure

1. Put 1/2 cup of distilled water and one banana into the blender. Blend for 25 seconds, making sure the banana is completely pulverized. Pour the mixture into a beaker.
2. Mix 1 teaspoon of soap with 1/4 teaspoon of salt in a plastic cup. Add 2 tablespoons of distilled water. Stir gently to avoid creating a foam. Continue for a few minutes until the soap and salt are dissolved.
3. Add 2 tablespoons of the banana mixture to the cup containing the soap solution. Use a spoon to stir the mixture for at least 10 minutes.
4. Insert a filter into a clean plastic cup so it does not touch the bottom of the cup. If necessary, tape the sides of the filter to the cup.
5. Pour the mixture from step 3 into the filter. After 10 minutes, some liquid, called the filtrate, should have collected in the bottom of the cup. Gently stir the mixture in the filter and let it sit for another minute. Remove the filter and set it aside.
6. Get a test tube of cold alcohol. Use a pipette or eyedropper to collect your filtrate. Add it to the alcohol.
7. Place the test tube with the alcohol and filtrate in a beaker or test tube holder. Let it sit undisturbed for about four minutes. Do not shake. The white material coming out of solution as a precipitate is DNA.
8. Dip the glass rod into the tube, slowly rotating it to spool out the banana's DNA.

Questions

1. Describe the appearance of the DNA you extracted. _____

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2. Summarize the main steps involved in extracting DNA from bananas. _____

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3. Do you think your results would be different if you were to use a fruit or vegetable other than bananas? Explain. _____

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