

# BANANA DNA EXTRACTION LESSON PLAN

## Primary Learning Outcomes:

Students will observe first hand that DNA is in the food they eat. Students will learn the simple method of extracting DNA and why each step is necessary. Students will learn how chemical substances can break up the cell structures surrounding DNA and why it is important for scientists to extract DNA

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## High School Georgia Performance Standards Addressed

- SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.
- SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- SB1. Students will analyze the nature of the relationships between structures and functions in living cells
- SB2. Students will analyze how biological traits are passed on to successive generations.

## Middle School Georgia Performance Standards Addressed

- S7CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
- S7CS4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- S7L2. Students will describe the structure and function of cells, tissue, organs, and organ systems.
- S7L3. Students will recognize how biological traits are passed on to successive generations.

**Materials:**

<i>Kit provides:</i>	<i>Teacher provides:</i>
7 x 250 ml Plastic beakers	Large jars of banana baby food (1 per class)
21 x 15 ml Falcon (graduated) test tubes*	Table salt
1.5 ml Microcentrifuge tubes	Permanent markers
Woolite	Distilled water
7 Disposable inoculating loops*	95% ethanol (rubbing alcohol can be substituted however the students will not be able to spool the DNA)
	7 Test tube racks
2 Test tube racks (for ethanol and water bath)	Coffee filters
7 Disposable transfer pipettes	Ice
1 Microcentrifuge tube rack	Beakers for ice
	Rubber bands (optional - to hold up filters)
Waterbath at ~50-60°C (if provided)	Waterbath at ~50-60°C**

**\*Enough materials will be provided for 1 class. The \*ed items can be washed, rinsed and re-used for each class**

**\*\*A water bath can be constructed from a thick-walled styrofoam cooler. Shortly before the water bath is needed, mix hot and cold water to reach approximately the desired temperature.**

**Materials to be assembled for a class of 28 students (7 groups of 4 students each):**

7 test tube racks

21 graduated Falcon test tubes

7 x 250 ml beakers and 7 additional beakers for ice water bath

1 large jar banana baby food

35 ml soap buffer (recipe follows)

35 ml 95% or higher ethanol (or isopropyl alcohol - **rubbing alcohol will work if step 12 is omitted**)

ice

7 coffee filters  
7 disposable transfer pipettes  
7 disposable inoculating loops  
7 microcentrifuge tubes

**Duration of activity:**

Prep time: approximately 15 minutes  
Class time: approximately 30 minutes

**Advance preparation:**

- Prepare soap buffer - add 1.5 g table salt and 10 ml Woolite to 90 ml distilled water. Mix thoroughly. Makes 100 ml buffer.
- Activity will be less time-consuming and messy if you have previously dispensed baby food into graduated test tubes. Also have "souvenir" microcentrifuge tubes aliquoted with 1 ml alcohol each. (keep cool)
- Water bath should be at 50 - 60° C.
- Do not place ethanol in refrigerator but keep on ice.

**Additional tips for middle school:**

- Activity works best with extensive modeling. For example, demonstrate steps 1 - 4; then, while student tubes are incubating, model steps 7 - 11. Finally, when all students complete the alcohol step, demonstrate the spooling technique.
- The questions in the conclusion marked with an asterisk may need to be answered as a discussion question.

**Background:**

The soap in the buffer helps to dissolve the phospholipid bilayers of the cell membrane and organelles (this is known as lysis). The salt is used to help the DNA molecules aggregate and precipitate. The colder the ethanol, the less soluble the DNA will be in it.

## DNA EXTRACTION FROM PLANTS



DNA stores the information for the functioning of the chemistry of life. The DNA found in banana cells can be extracted using common, everyday materials. We will use an extraction buffer containing salt to neutralize the charged nucleic acids, and soap to dissolve the lipid (fat) part of the banana cell wall and nuclear membrane. This extraction buffer will give you access to the DNA inside the cells.

Scientists at Iowa State University estimate that we eat an average of 50 million cells in a single meal. If the average plant cell has 10 feet of DNA, that means we eat almost 100,000 MILES of DNA in one meal!!

### PROCEDURE

1. Spoon 6 ml of banana baby food into a graduated test tube.
2. Add 5 ml of soap buffer to the tube. Close the tube and mix well by repeated inversion, making sure that the buffer is evenly distributed throughout. *NO LUMPS!*
3. Label the tube with your initials and those of your partner.
4. Incubate the tube in a 50-60° C water bath for 10 minutes.
5. During the incubation, each group should assemble:
  - a beaker of ice
  - a tube containing 5 ml of ice-cold ethanol (immediately place the ethanol tube into the beaker of ice)
  - an empty beaker
  - a coffee filter
  - a clean test tube
  - a disposable transfer pipette
  - rubber bands (optional)

6. Remove the reaction tube from the water bath.
7. Assemble the filtration apparatus. Cover a clean empty beaker with a coffee filter, pressing the filter down gently in the center to make a "well." A rubber band can be used to secure the filter.
8. Carefully filter the fruit and soap solution through the coffee filter and into the empty beaker. This process will remove extra cell debris such as cell membranes. After most of the liquid has dripped through, gently squeeze the bag to force most of the liquid into the beaker, being careful not to tear the coffee filter.
9. Pour the filtered fruit liquid into the clean test tube.
10. While holding the tube at about a 45° angle, use the transfer pipette to carefully drizzle 3 - 5 ml of cold ethanol on top of the mixture, allowing the alcohol to flow slowly down the side of the tube.
11. Let the reaction sit for 5 minutes and watch as a cloudy precipitate forms in the ethanol.
12. Use a disposable plastic inoculating loop to carefully spool the DNA from the ethanol layer. Transfer the DNA to a small microcentrifuge tube (filled with 1 ml of ethanol) for storage.

Great Job! You have isolated the "Blueprint" for living things!



## Conclusions and Analysis

1. It is important that you understand the steps in the extraction procedure and why each step was necessary. Each step in the procedure aided in isolating the DNA from other cellular materials. Match the procedure with its function:

### PROCEDURE

### FUNCTION

A. Filter banana mush through the filter

\_\_\_ To precipitate DNA from solution

B. Mix banana food with salty/soapy solution

\_\_\_ Separate components of the cell

C. Using pureed banana

\_\_\_ Break open the cells

D. Addition of ethanol to filtered extract

\_\_\_ Break up proteins and dissolve cell membranes

2. What did the DNA look like? Relate what you know about the chemical structure of DNA to what you observed today.

3. Explain what happened in the final step when you added ethanol to your banana extract. (*Hint: DNA is soluble in water, but not in ethanol*)

\*4. A person cannot see a single cotton thread 100 feet away, but if you wound thousands of threads together into a rope, it would be visible much further away. Is this statement analogous to our DNA extraction? Explain.

\*5. Why is it important for scientists to be able to remove DNA from an organism? List two reasons.

6. Is there DNA in your food? \_\_\_\_\_ How do you know?