

Strawberry DNA Forever



Annotation:

This lesson plan is for the extraction of DNA from strawberries. Strawberries are an exceptional fruit to use for this lesson because each individual student is able to complete the process by themselves and strawberries yield more DNA than any other fruit (i.e. banana, kiwi, etc.). Strawberries are octoploid, meaning that they have eight copies of each type of chromosome.

Primary Learning Outcomes:

Students will observe first hand that DNA is in the food that they eat.

Students will learn the simple method to extract DNA and why each step is necessary due to the complex organization of DNA in cells.

Students will learn why it is important for scientist to extract DNA from organisms.

Georgia Performance Standards:

Characteristics of Science

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.

Biology Content

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.

Duration:

Preparation: 10 minutes

Introduction: 5 minutes

Student Assignment: 30-40 minutes

Conclusion: Adaptable to class schedule

Total Class Time: Approximately 45 minutes

Materials and Equipment:

For each student: heavy duty ziploc bag (freezer or storage bag); 1 strawberry; DNA extraction buffer (900mL water, 50mL dishwashing detergent, 2 teaspoons salt); small plastic cup to hold extraction buffer; cheesecloth to fit in small funnel (4" X 4" should be appropriate); small funnel; 50mL vial / test tube; glass rod, inoculating loop, or popsicle stick; cold ethanol (or isopropyl alcohol), ice

Safety:

Ingestion of or contact with ethanol (or isopropyl alcohol) should be avoided. If contact with the eye occurs, flush immediately with water. Inhalation of fumes or dermal contact with ethanol (or isopropyl alcohol) is of minimal concern.

Procedures:Teacher Preparation:

Prepare the DNA extraction buffer. In a container, add 900mL of water, 50mL of dishwashing detergent (or 100mL shampoo), and finally 2 teaspoons of salt. Slowly invert the bottle to mix the extraction buffer.

Note: A modification can be made based on the needs of the students. Some classes may decide for each student to add individual components of the extraction buffer to the Ziploc bag (roughly, 2 tsp water, 1 tsp soap, 1 pinch salt), while other classes may choose to use the teacher prepared extraction.

Introduction:

Strawberries are soft and easy to pulverize. Strawberries have large genomes; they are octoploid, which means they have eight copies of each type of chromosome in each cell.

The function of the DNA extraction buffer ingredients are as follows: (1) The soap helps to dissolve the phospholipid bilayers of the cell membrane and organelles, (2) the salt is used to break up protein chains that bind around the nucleic acids, and (3) the ethanol is used to precipitate the DNA. DNA is not soluble in ethanol. DNA is least soluble in cold ethanol, so make sure to keep the ethanol in the freezer or on ice. When the students add ethanol to their strawberry extract, they will see the fine white strands of DNA precipitate. The DNA will form cotton like fibers that will spool onto the stirring rod/inoculating loop/popsicle stick. *Note:* More DNA will be obtained with ethanol than isopropyl alcohol.

Student Activity:

This activity can be conducted individually or in small groups. Students should follow the guidelines in the *Strawberry DNA Forever* student handout to complete the activity.

Conclusion:

Students should complete questions on the *Strawberry DNA Forever* student handout and this should be followed by a teacher directed discussion. Teacher should discuss the importance of DNA in living organisms, and why each step was needed and how they relate to the organization of genetic material.

Assessment:

Completion of a lab report and/or discussion questions. Discuss questions as a class to assess the students understanding and ability to communicate scientific concepts.

Extension:

A qualitative comparison of the yield of DNA from this lab may be compared to that of the DNA recovered from the *Banana DNA Extraction* lab. Compare ploidy levels and how it may relate to the amount of DNA recovered. Use varying concentrations of ethanol (70-100%) to determine how ethanol concentration qualitatively affects the yield of DNA.

Background: The long, thick fibers of DNA store the information for the functioning of the chemistry of life. DNA is present in every cell of plants and animals. The DNA found in strawberry cells can be extracted using common, everyday materials. We will use an extraction buffer containing salt, to break up protein chains that bind around the nucleic acids, and dish soap to dissolve the lipid (fat) part of the strawberry cell wall and nuclear membrane. This extraction buffer will help provide us access to the DNA inside the cells.

Pre-lab questions:

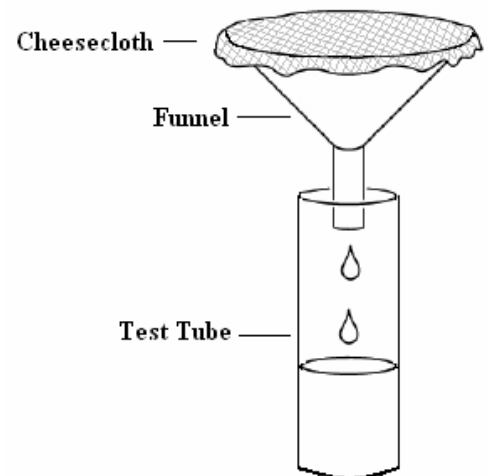
1. What do you think the DNA will look like?
2. Where is DNA found?

Materials:

heavy duty ziploc bag
1 strawberry
10 mL DNA extraction buffer (soapy, salty water)
cheesecloth
funnel
50mL vial / test tube
glass rod, inoculating loop, or popsicle stick
20 mL ethanol

Procedure:

1. Place one strawberry in a Ziploc bag.
2. Smash/grind up the strawberry using your fist and fingers for 2 minutes. *Careful not to break the bag!!*
3. Add the provided 10mL of extraction buffer (salt and soap solution) to the bag.
4. Knead/mush the strawberry in the bag again for 1 minute.
5. Assemble your filtration apparatus as shown to the right.
6. Pour the strawberry slurry into the filtration apparatus and let it drip directly into your test tube.
7. Slowly pour cold ethanol into the tube. OBSERVE ☺
8. Dip the loop or glass rod into the tube where the strawberry extract and ethanol layers come into contact with each other. OBSERVE ☺



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

A. Filter strawberry slurry through cheesecloth

B. Mash strawberry with salty/soapy solution

C. Initial smashing and grinding of strawberry

D. Addition of ethanol to filtered extract

FUNCTION

___ To precipitate DNA from solution

___ Separate components of the cell

___ Break open the cells

___ 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 strawberry 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?