

DNA Extraction from Strawberries

Strand	Life Systems
Topic	Investigating DNA and genetic engineering
Primary SOL	LS.12 The student will investigate and understand that organisms reproduce and transmit genetic information to new generations. Key concepts include a) the structure and role of DNA; b) the function of genes and chromosomes; c) genotypes and phenotypes; d) characteristics that can and cannot be inherited; e) genetic engineering and its applications; and f) historical contributions and significance of discoveries related to genetics.
Related SOL	LS.2 The student will investigate and understand that all living things are composed of cells. Key concepts include a) cell structure and organelles.

Background Information

In this activity students will extract DNA from a strawberry. Students will use this experience to make connections to genetic engineering, and will investigate how it affects our lives.

Strawberries are an exceptional fruit to use because each student can complete the process individually. Strawberries yield more DNA than any other fruit because they have eight copies of each type of chromosome.

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. A buffer solution will be used to break up the strawberry. The salt in the solution will break up protein chains that bind around the nucleic acids. The soap in the solution will dissolve the lipid part of the strawberry cell wall and nuclear membrane.

Every gene contains a DNA code that gives the cell instructions about how to make specific proteins. These proteins form the basis for the structural framework of life. Due to scientific advancements, now genes can be changed through genetic engineering. In this process, scientists insert into a cell's DNA the genetic instructions to make a specific protein. The cell will manufacture the protein, which affects a particular characteristic, and the cell will also pass the new instructions on to its offspring. Genetic engineering gives scientists the ability to improve and alter the basic composition of a living cell. This is called biotechnology.

Materials

- Container with a lid
- Water
- Shampoo (without conditioner)
- Salt
- Teaspoon

- Heavy duty zip-top bag
- 1 strawberry per student (frozen strawberries that have been thawed are good)
- 1 coffee filter, cone-shaped #2 size, per student
- 1 plastic cup, 5 oz., per student
- 1 plastic pipette per student
- Graduated cylinder
- 20 mL DNA extraction buffer per student
- 10 mL ice cold ethanol in a test tube per student
- Wooden craft stick
- Lab sheet (attached)

Vocabulary

biotechnology, cell membrane, cell wall, DNA, genetic engineering, nucleus

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

1. Prepare a buffer solution before class: In the container, mix 900 mL of water, 100 mL of shampoo, and 2 teaspoons of salt. Place the lid on the container, and slowly invert to mix the solution. Have enough ethanol on hand for each student to have 10 mL. The ethanol should be kept in the refrigerator until the students are ready to use it.
2. Give each student a plastic bag, coffee filter, plastic cup, pipette, strawberry, and 20 mL of buffer solution.
3. Have each student place his/her strawberry in the bag, zip it closed, and mash up the strawberry for two minutes. Then direct students to each add the 20 mL of buffer solution to their bag, zip it closed, and mash again for one minute. Have students then set aside the bags.
4. Now instruct the students to place their coffee filters in their cups, making sure the top of the filter is folded over the top of the cup and that the filter does not touch the bottom of the cup.
5. Tell students to pour their mashed strawberries with the extraction buffer into the filter and let it drip into the bottom of the cup. This will take about 10 minutes.
6. After 10 minutes, give each student 10 mL of ice cold ethanol in the test tube.
7. Have students remove the filters from their cups and throw the filters away.
8. Have students use their pipettes to remove some of the strawberry “juice” from the bottoms of their cups. Direct students to slowly and carefully drop the strawberry juice into the test tube of ethanol.
9. Emphasize to students that they should not shake the test tubes, but should very gently swirl the tubes once or twice.
10. Have students watch where the alcohol and extract layers come in contact with each other. Tell students to look at the tube at eye level. The stringy substance that appears is the extracted DNA.
11. Have each student complete the lab sheet.

Assessment

- **Questions**
 - What was the purpose of mashing the strawberry?
 - Why would scientists want to remove DNA?
 - When would it be beneficial to add genetic instructions to an organism’s DNA?
 - What are the ethical issues surrounding genetic engineering?
- **Journal/Writing Prompts**
 - Biotechnology can improve or change the genetic information in a cell. Speculate how biotechnology would be helpful in treating diseases.
 - Genetic engineering is used to produce crops that can be drought and disease resistant. Explain how this might be helpful to our world food supply.

Extensions and Connections (for all students)

- Bananas and kiwis are also good fruits for DNA extraction. Perform an investigation to extract DNA from these.

Strategies for Differentiation

- Have students write a research-based essay on genetic engineering’s role in finding cures for common genetic diseases.
- Have students investigate a particular crop, such as tomatoes or corn, for the various developments made to produce hardier plants. Have students write a persuasive letter to a farmer suggesting improvements for these crops.



Strawberry DNA Extraction Lab

Name: _____

Date: _____

Introduction

Have you ever wondered what DNA looks like? You are going to break apart the cell membrane of a strawberry and separate the DNA from the nucleus. Strawberries are a good source of DNA because they have eight copies of each type of chromosome. This large number of chromosomes will filter out of your solution and you will actually get to see DNA.

Review

1. Where in the cell is the DNA found? _____
2. Do all living things have DNA? _____ Why or why not?

DNA Extraction Procedure

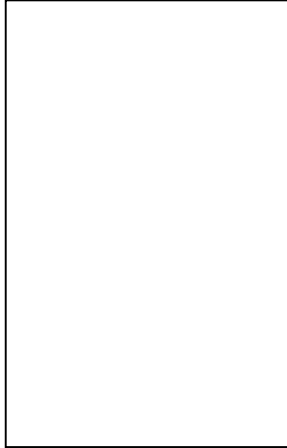
1. Obtain these materials from your teacher:
 - 1 zip-top bag
 - 1 coffee filter
 - 1 paper cup
 - 1 plastic pipette (dropper)
 - 1 strawberry
 - 20 mL buffer solution in the graduated cylinder
2. Zip your bag closed with the strawberry inside. Massage the bag for two minutes. Leave the bag on your table.
3. Pour the buffer solution from the cylinder into the bag. Zip the bag closed. Massage the bag for one minute. Leave the closed bag on the table.
4. Drape the coffee filter in the cup. Make sure the top part of the filter is folded over the top of your cup and that the bottom of the filter does not touch the bottom of the cup.
5. Open the bag. Pour the mashed strawberries with the extraction buffer into the filter and let it drip into the bottom of the cup. This will take about 10 minutes
6. Answer these questions while you wait for the solution to filter:
 - What was the purpose of mashing up the strawberry?

 - What does the extraction buffer do? (Hint: Extraction buffer contains soap. What does soap do when you wash your hands?)

 - What does the filter do?

7. After ten minutes, go to the teacher and get a test tube that contains ice cold ethanol.
8. Remove the filter with the strawberry stuff inside and throw the whole filter away.

9. Using a dropper, remove some of the strawberry “juice” that is in the bottom of the cup. Slowly and carefully, drop the strawberry juice into the test tube of ethanol.
10. *Do not shake the tube!* Very gently, swirl the tube once or twice.
11. Watch where the alcohol and extract layers come in contact with each other. Stoop down and look at the tube on your eye level.
12. Draw a picture of what you see happening.



13. Answer these questions:

- What happened when you added the strawberry “juice” to the alcohol?

- What did the DNA look like?

- 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 from even further away. How is this statement an analogy to our DNA extraction?

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

- Scientists are now able to add genetic information to an organism’s DNA in order to change the organism. This is called genetic engineering or biotechnology. How would this be beneficial to producing crops that are drought- and disease-resistant?

- How would genetic engineering, or biotechnology, be helpful in treating genetic diseases in humans?