Module 3: Strawberry DNA Extraction **Teacher/Leader**

Target Audience: 7-12 Life Science, Biology, Ag Science

Overview:

In this lab, students will extract DNA from a strawberry using everyday materials and observe its physical appearance.

Objectives:

As a result of participating in this activity, students will:

- Know how to extract DNA from strawberries.
- Observe what DNA looks like to the naked eye.
- Learn that DNA is found in every living and once living thing.
- Understand that DNA is found in all the food we eat.

National Science Education Standards:

The following information was obtained from the *National Science Education Standards*. National Research Council, copyright 1996, National Academy Press.

Content Standard C: Life Science 5-8

- **Reproduction and Heredity.** Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

Content Standard C: Life Science 9-12

- **The Cell.** Cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
- **The Molecular Basis of Heredity**. In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, G, C, and T). The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism). Each DNA molecule in a cell forms a single chromosome.

Science Content:

To show students a method to extract DNA from strawberries.

Science Process Skills:

- Observing
- Communicating
- Inferring

Life Skills:

- Communicating
- Learning
- Collaboration

Time:

50 minutes

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Materials:

- Worksheets: Student pre-lab, DNA extraction lab, student response.
1 Zip-type, freezer bag (6"x 9")
- 1 Coffee filter, cone-shaped, #2 size
- 1 Plastic cup, 5 oz.
- 1 Plastic pipette
- 1 Strawberry
- 10 mLs DNA extraction buffer (soapy, salty water)
- 15 mLs ice cold ethanol in test tube

Lab Preparations:

The following solutions should be prepared by the instructor in advance of the lab.

DNA extraction buffer

Materials:

- 50 mLs of a clear hair shampoo with EDTA (Ex. Suave). Do not use one that contains a conditioner.
- 1 tsp of NaCl (table salt)
- 450 mLs water

In a one-quart jar or beaker, gently mix the materials so as not to create a lot of bubbles. This will make enough extraction buffer for 50 groups of two students. Provide pipettes for students to draw 10 mLs of the extraction buffer from the jar to add to their plastic bags with mashed strawberries in step three of part one.

Ethanol preparation

Materials:

- 750 mLs of 93% Ethanol or 95% Ethanol (Store in a refrigerator to keep cold.)
- Graduated cylinder or 25 mL pipette
- Ice
- Container for the ice
- Test tubes with corks or caps

Fill 50 test tubes with 15 mLs of ethanol and cap. 750 mLs of ethanol will be enough for 50 groups of two students. You may store the filled test tubes in a non-food refrigerator until class time. Put capped test tubes in ice to keep the ethanol as cold as possible during the lab. The cold ethanol helps the DNA to precipitate out of solution.

Organization tips:

A good way to help organize lab materials for students is to sort the necessary items into plastic boxes labeled with their group number. Use boxes about the size of a standard shoebox. (Regular shoeboxes work as well.) This saves time during class and you know that the students will have the necessary items. Replace the consumed items after each class.

Example of contents of student boxes for this lab:

- 1- Pipette
- 1- Cone-shaped coffee filter
- 1- 5 oz. Plastic cup
- 1- Plastic freezer bag

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Lesson Guide:

Anticipatory Set:

1. Handout pre-lab worksheet, "Strawberries & DNA". Part I: Ask students to list what they know about strawberries and DNA.

2. Discuss their answers to Part I.

3. Part II: Have the students list what their individual questions are about strawberries and DNA.

4. Then, with their partners, have students write one or two questions about strawberries or DNA or both and write on a sheet of colored paper to share with the entire group. Turn questions in to the teacher. These can be put on a large sheet of paper or on the chalkboard, to be answered when appropriate during class or at the end of class.

Lab Introduction:

5. Tell students that today they will have the chance to see what actual DNA looks like by extracting DNA from a strawberry. (Encourage students to write down any new questions as they do the lab, and share them with the group.)

6. Hand out to the students the "Strawberry DNA Extraction" and "Student Response" worksheets.

7. Have the students read the introduction section of the "Strawberry DNA Extraction" worksheet. Be sure to show the plant cell and review its parts.

8. How do we isolate DNA from the cell? (What is the method? It is called DNA Extraction.) To understand how DNA extraction is done, you will extract DNA from strawberries today.

Lab:

1. See lab handout "Strawberry DNA Extraction"

Questions:

1. Have students complete the "Student Response" worksheet.
2. Answer any questions from the list made at the beginning of class.

Closure:

1. Ask students what they learned about DNA and strawberries.
2. Ask students where DNA is found.
3. Ask them what the four main steps were of the DNA extraction.
   - Crushed the cells to release the DNA.
   - Used the buffer to separate the DNA from the other cell components.
   - Filtered out the large particles.
   - Precipitated out the DNA using ethanol.
4. Ask the students what the DNA looked like.

For more information about DNA, check out the website listed below:
http://www.dnaftb.org/dnaftb/29/concept/index.html

Acknowledgement:
The Strawberry DNA Extraction activity, lab protocol and student worksheets were modified and used with permission from Julie Townsend, Parkview Middle School, Ankeny, IA.

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Strawberries & DNA

I. List what you know.

What do you know about strawberries?	What do you know about DNA?

II. List what you want to know.

What do you **want to know** about strawberries?	What do you **want to know** about DNA?

III. Share with your partner and create one or two questions about strawberries, DNA, or both.

IV. Write the question(s) on the colored paper strip to share with the entire group.

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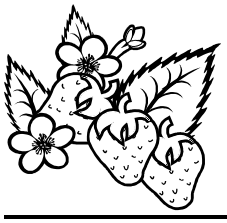
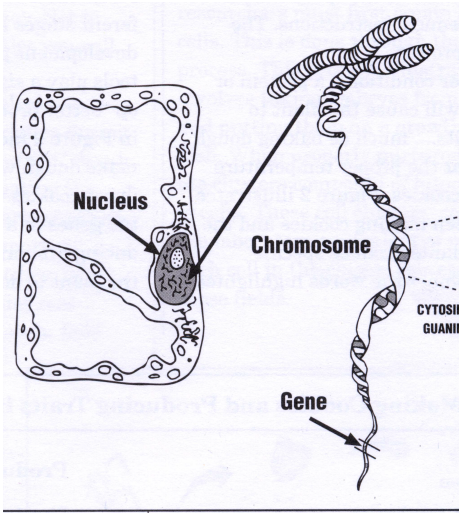


Strawberry DNA Extraction

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 8 copies of each type of chromosome. This large number of chromosomes will filter out of your solution and you will get to actually see DNA.

Review:
Where in the cell is the DNA found?

Take a look at the sketch of the plant cell below. The chromosomes (which are made of DNA) are in the nucleus. This is the place where most of the DNA is located. (There are also small amounts of DNA in the chloroplast and mitochondria.)



What do you think the DNA will look like when you extract it from the plant cell? (Write a brief description.)

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DNA Extraction from Strawberries

Materials:

Lab box contents:

1 Zip-type, freezer bag (6"x 9")
1 Coffee filter, cone-shaped, #2 size
1 Plastic cup, 5 oz.
1 Plastic pipette

Available from your teacher:

1 Strawberry
10 mLs DNA extraction buffer (soapy, salty water)
15 mLs ice cold ethanol in test tube

Procedure:

Working together in groups of two, read through the entire procedure and follow the steps in Parts I, II and III.

Part I- Preparing the DNA extract

1. Have one partner get the lab box while the other partner gets the strawberry and removes the stem and leaves.
2. Place one strawberry in a zipper bag.
3. Mash up the strawberry for 2 minutes.
4. Add 10 mLs of the **extraction buffer** to the bag.
5. Mash again for 1 minute. While one partner is mashing the other partner must do step 6.
6. 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.
7. Pour the mashed strawberries with the extraction buffer into the filter and let drip into the bottom of the cup. This takes about 10 minutes.

As you wait for your solution to filter, complete the following questions:

Part I: Questions

a. What was the purpose of mashing up the strawberry?

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

c. What does the filter do?

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Part II: Pipetting the strawberry extract into the alcohol

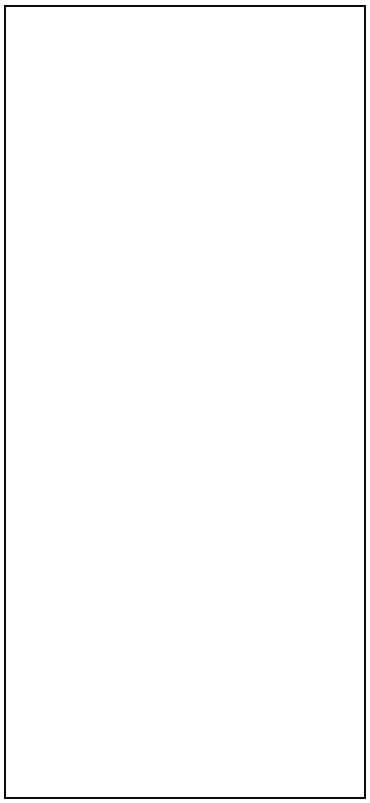
8. One partner gets a test tube that contains **ice cold ethanol**.
9. Using a pipette, remove some of the strawberry extract from the cup. Carefully pipette the strawberry extract into the alcohol in the test tube and watch the solution precipitate (separate). DO NOT SHAKE THE TUBE!!! Very gently swirl the tube once or twice. Then let the tube remain undisturbed.

Part III: Observations

10. Watch where the alcohol and extract layers come in contact with each other. Keep the tube at eye level so you can see what is happening.

    What do you see appearing? (Sketch what you see in the box and note any other observations.)

    Notes:



Questions Parts II and III:

a. What happened when you added the filtrate to the alcohol?

b. What did the DNA look like?

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Name: _____
Student Number:_____
Date: _____
Lab Partner's Name:_____

Strawberry DNA Student Response

1. What does DNA look like?

2. A person cannot see a single cotton thread four classrooms away. But if you wound thousands of threads together into a rope, it would be visible at the same distance. How is this statement an analogy to our DNA extraction?

3. Is DNA found in <u>all</u> living or once living cells?

4. Since the strawberries were once living, and we extracted DNA from them, what does this mean about the foods you eat?

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5. Look at the plant cell pictured on page one of the lab handout. Remember that genes are found on chromosomes, and genes control traits. Give at least two examples of traits that are expressed in the strawberry.

6. Since we are studying about Bt and non-Bt corn in this unit, name at least two traits a scientist would be interested in having in corn.

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Answer Key for pages 6-9.

Page 6:

Part I: Questions

a. What was the purpose of mashing up the strawberry?

To break down the cell wall, cellular and nuclear membranes.

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

The extraction buffer helps to release the DNA from the surrounding cell components of the crushed strawberry.

c. What does the filter do?

The filter removes the larger particles from the solution, such as seeds, pith, etc., allowing only the smaller cell components such as the DNA, proteins, etc. to filter through.

Page 7:

Questions Parts II and III:

c. What happened when you added the filtrate to the alcohol?

The DNA precipitated out of the solution.

d. What did the DNA look like?

The DNA looked like white, thin fibers wadded up together forming a clump.

Pages 8-9:

1. What does DNA look like?

   The DNA will look like a white, cloudy or fine stringy substance.

2. A person cannot see a single cotton thread four classrooms away. But if you wound thousands of threads together into a rope, it would be visible at the same distance. How is this statement an analogy to our DNA extraction?

   DNA is not visible as a single strand to the naked eye, but when thousands of threads of DNA are present, you will be able to see the large groups of threads of DNA.

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3. Is DNA found in all living or once living cells?

   Yes, DNA is present in all living and once living cells. Scientists can use DNA from mummies or seeds that are thousands of years old and identify the genetics of those plants and animals using their DNA.

4. Since the strawberries were once living, and we extracted DNA from them, what does this mean about the foods you eat?

   All the foods we eat that come from plants and animals that contain DNA. DNA has been consumed on a daily basis since the beginning of time and is completely safe to eat.

5. Look at the plant cell pictured on page one of the lab handout. Remember that genes are found on chromosomes, and genes control traits. Give at least two examples of traits that are expressed in the strawberry.

   Examples: Color, size and sweetness.

6. Since we are studying about Bt and non-Bt corn in this unit, name at least two traits a scientist would be interested in having in corn.

   Examples: Yield, drought resistance, insect resistance, disease resistance, stalk strength, root strength, early growth, stays green, days until maturity, and height.

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