



## Easy DNA Extraction

**Subject:** Science

**Grades:** 6<sup>th</sup> – 8<sup>th</sup>

**Rational or Purpose:** Students will do an easy step by step exercise in which they use detergent, meat tenderizer (papain enzymes), and alcohol to extract DNA from a vegetable (peas, spinach, etc.). They will describe what DNA looks like and discuss why DNA is important.

**Materials needed:**

thumb-size pieces of fresh strawberry	10 mL graduated cylinder
plastic 15 mL reaction tubes (labeled: reaction tube)	2 1 ml disposable transfer pipets
ICE COLD 95% Ethanol in freezer	1 plastic cup of liquid detergent
plastic 15 mL reaction tube (labeled: salt)	plastic 15 mL reaction tubes (labeled: meat tenderizer)
paper weighing boat or paper	mortar and pestle
beaker of distilled water	paper clip, bent
Microcentrifuge tubes (to store DNA)	cheese cloth

**Lesson Duration:** 60 minutes

**TEKS:**

112.22 Science, Grade 6: (1a) (4a) (10a) (10b)

112.23 Science, Grade 7: (1a) (4a)

112.24 Science, Grade 8: (1a) (4a)

**Background:**

DNA is the building block of life that is found in all living organisms. DNA is important because it carries vital information for the cells which contain it, so important, in fact, that DNA is commonly referred to as the “blueprint of life.” DNA is a sequence of four chemical molecules called nucleotides that give information to the cell to produce proteins and other cell structures. A single strand of DNA cannot be seen by the naked eye since it is very small in size. Scientists use chemicals similar to those used in this lab to extract DNA and viewing it using x-ray crystallography.

**Activity:**

Students will be able to demonstrate how to extract DNA using simple household materials. In the process of extracting DNA, they will become familiar with the general structure of DNA. At the conclusion of the lab they will discuss why DNA is important in everyday life.

## Procedure

***Each person needs to read and carefully do their part. If one person does not do his/her part, then the experiment will not work.***

### *Person #1*

1. Weigh the empty weigh boat or a small square of paper on a triple beam balance.
2. Write down the mass of boat or paper in grams on the student answer sheet.(to the nearest  $1/10^{\text{th}}$ , or .1 of a gram)
3. Remember to consider the mass of the paper or boat when measuring out your reagents. If the paper or boat weighs 1.1 grams, then to obtain 1.0 gram of salt you would need to add enough salt to the paper or boat until the balance reads 2.1 grams.
4. Weigh out 1.0 gram of salt onto the paper or boat on the balance. Give the salt boat to Person #3 and wait for that student to return the empty boat. Be sure and share your numbers with all group members so they can record them on their student answer sheet.
5. Again place the paper or boat on the balance and weigh out 2.0 grams of meat tenderizer. Give the meat tenderizer to Person # 3 and wait for that student to return the empty boat.
  - Meat tenderizer contains enzymes that will destroy the proteins, called histones. Histones stick to and bind up the DNA and protein enzymes called DNases. DNases are enzymes that destroy DNA.

### *Person #2*

6. Measure 9.0 mL of distilled water in the 10mL graduated cylinder and give it to person #3.
7. Use one of your disposable transfer pipets to add approximately 1 ml (fill to the bottom of the bulb) of liquid detergent soap into the mortar. Be careful the soap is very messy.
8. Dispose of disposable transfer pipets into the lined trash can, without dripping!
9. When water and soap have been added to the mortar, let person #3 continue with his/her job.

- The detergent/salt solution breaks down the lipid membrane of the cells to release the cytoplasm and the cell contents. The salt shields the negative ends of the phosphate molecules from interacting with water molecules on the side chains of the DNA molecule. This will make the DNA less water soluble and thus easier to precipitate or capture.

*Person #3*

10. Get a thumb-sized piece of strawberry from your teacher.
11. Place strawberry in the mortar and pestle. Macerate (mash it up) the strawberry in the mortar.
  - The macerating action further breaks apart the cell membranes of the strawberry cells.
12. Try not to macerate too hard as you will get foam and bubbles, making it harder to extract the DNA.
13. As team members #1 and #2 hand you reagents, carefully pour all the reagents into the mortar, return the container, and continue to macerate while mixing all the reagents.
14. Once all of your reagents are added the resulting mix should be a runny thick paste, called a lysate. If it is not a runny paste, add a couple more milliliters of water, measuring the water in the graduated cylinder. Show the lysate to all members and ask them to describe it in the space provided on their student answer sheet.

*Person #4*

15. Carefully pour the lysate from the mortar into a clean plastic reaction tube, using a small square of cheese cloth to strain out chunks of strawberry. Put the cheese cloth into the trash can after straining. Wipe off lysate from the sides of the reaction tube so all the lysate is in the bottom of the tube.
16. If you have any foam or bubbles on top of your lysate or in the bottom of the reaction tube, try to wipe some of them out with a paper towel. Dispose of paper towels in a lined trash can.
17. Examine your reaction tube. Notice it has volume markings. Carefully, using a squeeze bottle, squirt 15-20 ml of ice cold ethanol down the side of the reaction tube to form a visible alcohol layer on top of the lysate. Do not touch the squirt bottle tip to the reaction tube and do not squirt directly into the lysate. The ethanol must enter the lysate gently.

- The 95% ethanol must be ICE COLD. It should be left in a plastic squeeze bottle in the freezer or on ice. DNA, in the presence of alcohol, will become an insoluble mucous-appearing stringy solid, called a precipitate.

18. You should immediately begin to see bubbles forming in the alcohol layer (showing that the DNA is becoming a solid.). DNA will form a mucous looking solid with small bubbles, causing it to rise from the lysate layer to the alcohol layer. Gently twirl your test tube to allow more DNA to come up into the alcohol layer. Allow all group members to observe the tube and sketch its appearance on their student answer page.
19. Taking turns, use a clean pipet to suck the DNA out of the alcohol layer and put it into a small DNA test tube that your teacher provided.
20. Person #4 should make sure that each member gets a small amount of DNA in his/her microcentrifuge tube. After each student gets some DNA, Person #4 can add a little ethanol from the alcohol layer to each person's microcentrifuge tube.
21. If the DNA is too thick for the bulb pipet, use a paperclip with a bent tip to pull the DNA out of the alcohol layer.

- Congratulations! You have extracted DNA!!

*Person #4:*

22. After you have extracted DNA, dispose of the contents of the reaction tube into a lined trash can. Do not throw away the reaction tube.
23. Answer the analysis chart and conclusion activity on the student answer page.

### **CLEANING DUTIES:**

*Person #1* ---→ Wipe down balance pan with a damp paper towel, help Person #2.

*Person #2* ---→ With Person #1, wipe down the lab table with wet paper towels.

*Person #3* ---→ Wipe off items in the equipment container including the container itself with damp paper towels.

*Person #4* ---→ Rinse the mortar and pestle in sink. Rinse and clean out the reaction tube.

**Berry Exciting DNA**  
**Isolating DNA, Deoxyribonucleic Acid, from Strawberries**

**HYPOTHESIS:**

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If strawberry cells are treated with \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ then when exposed to ethanol the lysate will precipitate DNA.

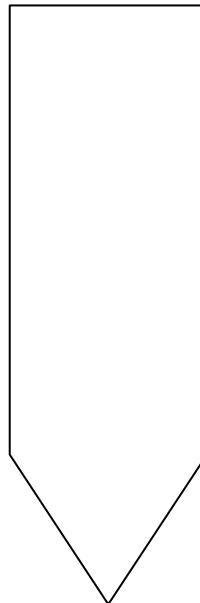
**DATA AND ANALYSIS**

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Weigh boat mass from step : \_\_\_\_\_

Description of lysate's appearance:

Labeled sketch of lysate, DNA precipitate and alcohol layers in the reaction tube:



<b>Chemical added to strawberry</b>	<b>Role of chemical in the reaction</b>
Salt	
Meat tenderizer	
Detergent	

### **CONCLUSION**

Draw a comic strip illustrating each step of the procedure, with labeled equipment and explanations of each reagent's purpose on the back of this paper. Be sure to include both you and your teacher in the comic strip. The comic strip must be neat and use colors. It can be one big scene or multiple smaller scenes.

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