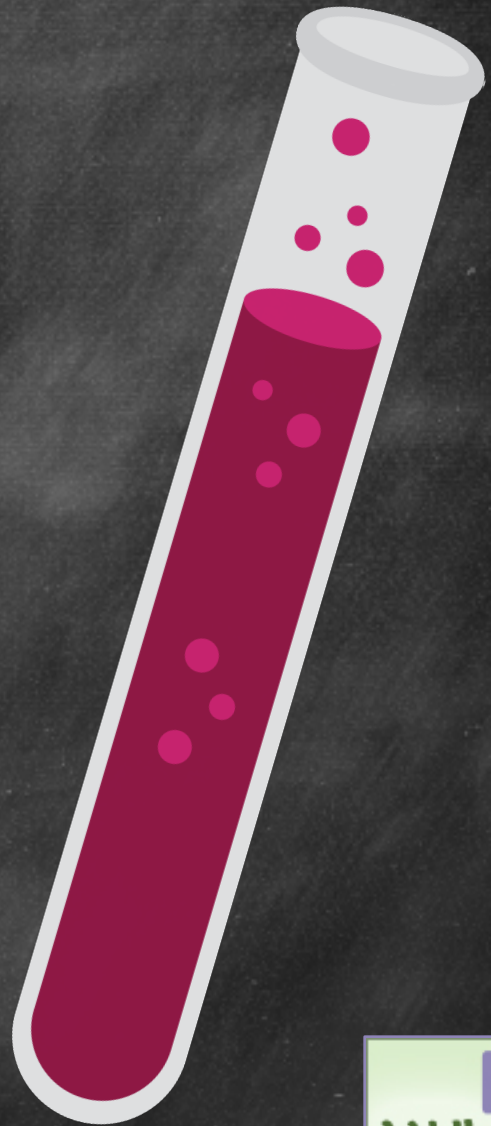
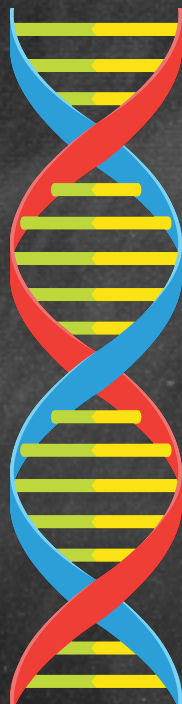


**Grades 6-12
NGSS Aligned**

Strawberry DNA EXTRACTION LAB



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What's Cooking with Kids: Lesson Plan



Overview:

Subject & Topic	Life Science, Biology: DNA & Genetics Not Grade Specific		
Lesson Title	Extracting DNA from Strawberries		
Content Standards	NGSS LS1.A: Structure and Function <ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (secondary to HS-LS3-1) 		
Tools / Equipment	Beakers Bowl for berries Test tubes Ziplock sandwich bags	Glass Rods Or Loops Or Chopsticks Funnel	Cheesecloth or Coffee filters Cleaning supplies
Preparation & Organization	<p>This lab is an ideal activity to do <i>after</i> students have learned about cellular structures and DNA. It reinforces the concept that cells have membranes that help to contain the cytoplasm and all of the organelles. There is also a nuclear membrane protecting the DNA – and this will need to be destroyed if the students hope to extract the DNA.</p> <p>Lab Preparation</p> <ul style="list-style-type: none"> For 5 periods of biology, I used this recipe to make the soap/salt buffer solution: 900 ml. water, 50 ml dish soap and 2 tsp salt. If you are doing this activity at home, you will need ½ cup of water, 2 tsp. liquid soap and ½ tsp. salt Each lab group only needs one strawberry. While you can use fresh strawberries, frozen strawberries can be purchased all year and are less expensive. Be sure to take them out of the freezer in advance, so they can thaw before the activity begins. Keep the alcohol in the refrigerator or in an ice bath until ready to use. You can use rubbing alcohol, but it needs to be 70% strength or higher. 		

Let's Get Down to Details...

References	<p>DNA Extraction virtual lab from the University of Utah: http://learn.genetics.utah.edu/content/labs/extraction/</p> <p>Frequently asked questions about DNA extractions: http://learn.genetics.utah.edu/content/labs/extraction/howto/faq/</p> <p>Some good background information on DNA and other important macromolecules in your body: SciShow - https://www.youtube.com/watch?v=kqftxptfm7Y</p>
Special Notes or Suggestions	<p>Extension Activities:</p> <ul style="list-style-type: none">• Have students hypothesize how the experiment would work with different types of soaps (powdered/liquid, shampoo, shower gel etc.) and then test it out.• What other items can they extract DNA from?• Do they expect to get more or less DNA from an equal sample of another fruit or vegetable?• What would happen if they tried to extract DNA from a nonliving item?

Strawberry DNA Extraction Lab

Background:

Almost every cell in a human, except sperm and egg, are diploid, with two copies of each chromosome – one from each parent. Every cell in a strawberry contains eight copies of each of its chromosomes, making strawberries octoploid. That means they contain lots of DNA for us to extract.

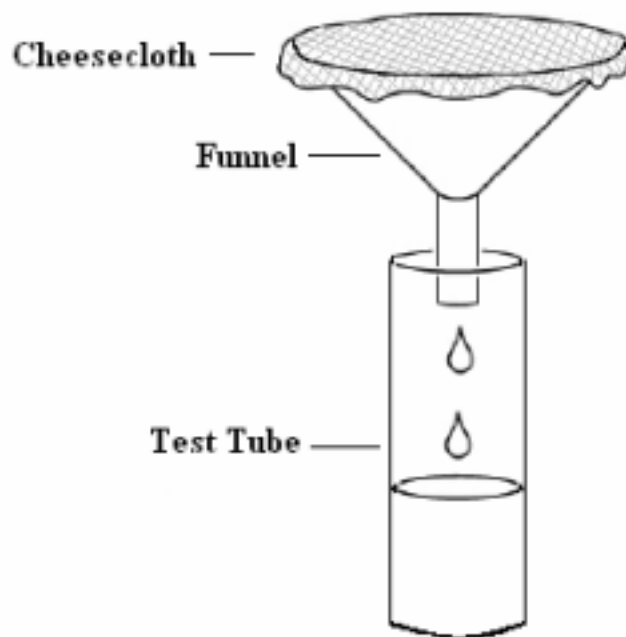
The extraction of DNA uses our knowledge of chemistry. Ripe strawberries themselves produce an enzyme to break down cell walls. Detergents break down the phospholipid cell membrane. Filtering removes cell organelles, broken cell walls, membrane fragments and other cell bits. The result will be a red-colored solution containing DNA and other small dissolved molecules such as sugars and proteins. When cold ethanol (an alcohol) is layered on this solution, molecules of ethanol repel the DNA molecules, and the DNA clumps together. A ropelike clump of many DNA molecules forms that is large enough to see with the naked eye.

Materials:

Strawberry
Ziplock bag
Test tube
Buffer solution
Cold Isopropyl Alcohol
Cheesecloth or coffee filter
Glass rod or loop

Procedure:

1. Place one strawberry in a Ziploc bag. Squeeze out the air and then seal the bag.
2. Smash/grind up the strawberry using your fist and fingers for 2 minutes. Be 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. If you don't have cheesecloth, you can use a coffee filter.
6. Pour the strawberry slurry into the filtration apparatus and let it drip directly into your test tube.
7. Slowly pour cold alcohol into the tube.
8. Dip the loop or glass rod into the tube where the strawberry extract and ethanol layers come into contact with each other and see if you can scoop up anything.



Conclusions & Analysis (Food for thought...)

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.

1. In the box below, draw lines matching the procedure with its function:

<u>Procedure</u>	<u>Function</u>
Filter strawberry slurry through cheesecloth	To precipitate DNA from solution
Mush strawberry with salty/soapy solution	Separate components of the cell
Initial smashing and grinding of strawberry	Break open the cells
Addition of ethanol to filtered extract	Break up proteins and dissolve cell membranes

2. Describe what the DNA looked like
3. What did mashing the strawberry release (that helped digest and break down the strawberry)?
4. Describe the appearance of the strawberry after two minutes of smashing.
5. What organic macromolecule did the detergent destroy?
What part of the cell contains a lot of this macromolecule?

6. What materials were caught in the cheesecloth or other filtering mechanism?
7. DNA dissolves in water, but not in ethanol. Explain what happened when the alcohol came in contact with the strawberry extract during the DNA extraction.
8. 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. How is this statement analogous to our DNA extraction?
9. In order to study human genes, scientists must first extract the DNA from human tissues. Would you expect the method of DNA extraction for human DNA to be the same as the method you used to extract DNA from strawberries? What would be the same, what would be different?
10. List two possible scientific questions that could be explored by studying strawberry DNA.
11. As mentioned in the background, strawberry cells are octoploid, while banana cells are triploid. Which do you predict will yield a greater quantity of DNA, 5 g of strawberry tissue or 5 g of banana tissue? Explain your reasoning.

Answer Key

Conclusions & Analysis (Food for thought...)

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.

1. In the box below, draw lines matching the procedure with its function:

<u>Procedure</u>	<u>Function</u>
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2. Describe what the DNA looked like

The DNA looks like clear egg whites or mucus. It is stringy and there are portions that clump together in a slightly opaque white bundle.

3. What did mashing the strawberry release (that helped digest and break down the strawberry)?

Mashing the strawberry breaks open the cell walls and releases enzymes that will ultimately help to break down the strawberry.

4. Describe the appearance of the strawberry after two minutes of smashing.

The strawberry turns mostly into liquid once the juice is released and the flesh is smashed.

5. What organic macromolecule did the detergent destroy?
What part of the cell contains a lot of this macromolecule?

The detergent destroyed phospholipids (lipids), which are abundant in the cell membrane.

6. What materials were caught in the cheesecloth or other filtering mechanism?

The filter catches pieces of broken cell walls, membrane fragments, organelles and other strawberry tissue.

7. DNA dissolves in water, but not in ethanol. Explain what happened when the alcohol came in contact with the strawberry extract during the DNA extraction.

The molecules of DNA are repelled by the ethanol / alcohol and clump together.

8. 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. How is this statement analogous to our DNA extraction?

DNA is invisible to the naked eye because it is too small. But after a large quantity of it is clumped together, it becomes thick enough for us to see it.

9. In order to study human genes, scientists must first extract the DNA from human tissues. Would you expect the method of DNA extraction for human DNA to be the same as the method you used to extract DNA from strawberries? What would be the same, what would be different?

Answers will vary but may include:

We can not smash up people or body parts to get the DNA, so we need an alternative strategy. Scientists can take tissue samples (by swabbing the inside of a cheek, taking some blood, or even scraping a few skin cells). The subject can not be sacrificed, as we did with this strawberry. Otherwise, once the cells are obtained, the strategy would be similar.

10. List two possible scientific questions that could be explored by studying strawberry DNA.

Answers will vary but may include:

Comparing DNA from different strawberry varieties to determine how it differs for strawberries that taste sweeter or grow better in a cooler environment.

11. As mentioned in the background, strawberry cells are octoploid, while banana cells are triploid. Which do you predict will yield a greater quantity of DNA, 5 g of strawberry tissue or 5 g of banana tissue? Explain your reasoning.

There would be more DNA in the strawberry sample because there are 8 copies of DNA in strawberries, compared to only 3 in the banana.

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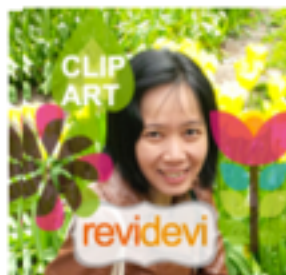
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