

## DNA Extraction Lesson: How to extract DNA from Strawberries and cheek cells

### Major concepts

Cells are the basic unit of life and make up all plants, animals and bacteria. Deoxyribonucleic acid, or DNA, is the molecule that controls everything that happens in the cell. DNA contains instructions that direct the activities of cells and, ultimately, the body. If you uncoiled the DNA in a cell, it would be **about three meters long**. This activity will demonstrate how DNA can be isolated from a strawberry using common household materials.

### Objectives

- To learn an easy way to extract DNA from a strawberry using household products.
- To see a large sample of DNA

### Background

This DNA extraction activity results in a large quantity of DNA that can be seen with the naked eye. It is an easy activity and, if you follow the instructions, there is almost no way to make a mistake that would affect the results. It is much more effective than extracting DNA from any other source because strawberries are soft and easy to smash. In addition, ripe strawberries produce enzymes (pectinases and cellulases), which are chemicals that help in breaking down the cell walls.

Strawberries have enormous genomes. Humans have two copies of each chromosome (diploid genome). A chromosome is an organized package of DNA found in the nucleus of the cell. Strawberries have up to eight copies of each chromosome (octoploid genome).

### Materials (per person)

- 1 resealable plastic bag<sup>[1]</sup><sub>[SEP]</sub>
- Strawberries (fresh or frozen)<sup>[1]</sup><sub>[SEP]</sub>
- 2 teaspoons of dish detergent<sup>[1]</sup><sub>[SEP]</sub>
- 1 teaspoon of salt<sup>[1]</sup><sub>[SEP]</sub>
- 1/2 cup of water<sup>[1]</sup><sub>[SEP]</sub>
- 2 plastic cups (One cup will be used for the filtering apparatus below) Filtering apparatus: coffee filter and plastic cup<sup>[1]</sup><sub>[SEP]</sub>
- Ice cold 90 percent rubbing alcohol<sup>[1]</sup><sub>[SEP]</sub>
- 1 wooden popsicle stick or plastic coffee stirrer

## Procedures

1. Pull off any green leaves on the strawberry that have not been removed yet.
2. Put the strawberry into the plastic bag, seal it and gently smash it for about two minutes. Completely crush the strawberry. This starts to break open the cells and release the DNA.
3. In a plastic cup, make your DNA extraction liquid: mix together 2 teaspoons of detergent, 1 teaspoon of salt and 1/2 cup of water.
4. Add 2 teaspoons of the DNA extraction liquid into the bag with the strawberry. This will further break open the cells.
5. Reseal the bag and GENTLY smash for another minute (**Avoid making too many soap bubbles**).
6. Place the coffee filter inside the other plastic cup. Open the bag and pour the strawberry liquid into the filter. You can twist the filter just above the liquid and gently squeeze the remaining liquid into the cup.
7. Next, pour down the side of the cup an equal amount of cold rubbing alcohol as there is strawberry liquid. **DO NOT MIX OR STIR.** You have just isolated the DNA from the rest of the material contained in the cells of the strawberry.
8. Within a few seconds, watch for the development of a white cloudy substance (DNA) in the top layer above the strawberry extract layer.
9. Tilt the cup and pick up the DNA using a plastic coffee stirrer or wooden stick.

**What's going on here?** By adding soap to your cheek cells, it breaks the membranes of the cell open and the contents of the cell, including the DNA, spill out. The salt changes the ionic concentration of the water and makes it easier for the DNA and RNA to separate. DNA will not dissolve in alcohol, so when you add alcohol to the solution the DNA collects where the two layers meet.

### Follow-up questions:

1. What does DNA stand for?
2. Where in your body can DNA be found?
3. Discuss with students the relationship between genes and family. Have students compare traits such as height, eye color and hair color.
4. Have students make a Family Tree. You can have them trace their ancestors back to their grandparents or even further

If there's time, move on to extract your own DNA!

1. Mix a half glass of water (approximately 6 oz.) with 1 tablespoon of table salt. Label the cup 1.

2. Have students swirl the 10ml of salt solution in their mouths for 30 seconds. This will remove dead cells lining the mouth.
3. Have students spit their solution back into their dixie cup and then add the rest of the detergent solution from before.
4. GENTLY mix for 2-3 minutes. IMPORTANT: Don't shake or mix it too vigorously. DNA will break into smaller fragments and will be harder to see later on.
5. After 3 minutes, slightly tilt it and carefully pour the chilled alcohol down the side of the test tube. The alcohol and the detergent should form two distinct layers with the alcohol sitting on top.
6. Have students let the tube stand for one minute. Then, have them use the coffee stirrer to slowly move some of the ethanol into the soap layer. DNA will start to precipitate out of the soap solution. Have students twirl the stirrer to spool the DNA strands around it. If the DNA fragments are too short to wind up, students can use the pipette to suck up the fragments.
7. Students can transfer the DNA into a small tube (Eppendorff tubes work well), filled with rubbing alcohol, and take it home. The DNA should be stable in that form for a long time.