



Winning Experiment Procedures from the NIH LAB Challenge

Isolation of Strawberry DNA Using Household Products

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Suggested grade level: middle school, high school

Background

Deoxyribonucleic acid (DNA) is found in all living cells. One of its major roles is encoding all cellular proteins. The proteins expressed in a cell define the characteristics of the cell, and organisms are collections of many, many cells. Many of our physical characteristics are determined by the sequence of our DNA.

If you could separate and line up the amount of DNA contained in one human cell, it would be about 1 meter long. If all of the DNA found in a person were laid out, the DNA would stretch around the sun! A genome is the entire set of genetic instructions found in a cell.

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) that help break down the cell walls.

Strawberries have enormous genomes. Humans have two copies of each chromosome (a 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).

Objectives

1. To learn an easy way to extract DNA from strawberries using household products.
2. To see a large sample of DNA.

Hypotheses

Isolating DNA requires a few basic steps. DNA can be isolated from a strawberry using common household materials.

Duration

Total in-class time: about 30 minutes

Set-up time: 5 minutes

Experiment's run time: 20 minutes

Take-down time: 5 minutes

Materials for each group of two people

- 1 resealable plastic bag (sandwich-size)
- 1 large or 2 small strawberries (fresh or frozen)
- 2 teaspoons of dish detergent

- 1 teaspoon of salt
- ½ cup of water
- 2 plastic cups
- 1 coffee filter
- Ice-cold 90-percent rubbing alcohol
- 1 wooden popsicle stick or plastic coffee stirrer

Procedure

1. Get one large or two small strawberries. Pull off any green leaves that may remain on the fruit.
2. Put the one large or two small strawberries into the plastic bag, remove excess air from the bag, and seal it. Gently smash the strawberries inside the bag for about two minutes. Completely crush the strawberries.
3. In a plastic cup, make your DNA extraction liquid: mix together 2 teaspoons of detergent, 1 teaspoon of salt, and ½ cup of water.
4. Add 2 teaspoons of the DNA extraction liquid into the bag with the crushed strawberries. This will break open the cells.
5. Reseal the bag and gently smash for another minute. (Avoid making too many soap bubbles.) Place the mixture aside until ready to use again.
6. Place the coffee filter inside the other plastic cup.
7. 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.
8. Next, pour an amount of cold rubbing alcohol equal to the amount of strawberry liquid down the side of the cup. Do not mix or stir. Just let the mixture sit for a few seconds.
9. Within a few seconds, watch for the development of a white cloudy substance (DNA) in the top layer above the strawberry-extract layer.
10. Tilt the cup and pick up the DNA using a plastic coffee stirrer or wooden stick. You have just isolated the DNA from the rest of the material contained in the cells of the strawberry.

Video of Experiment

Available at <http://www.genome.gov/27541804> .

Data Analysis

1. Describe what you see at each step of the activity.
2. Were you able to isolate the DNA? If not, why do you think you were not able to?
3. How would you describe the DNA and how much DNA did you see?
4. How could you improve upon this experiment?

Conclusions

If the activity works, a clumpy whitish material resembling snot should be visible after the alcohol is added to the strawberry extract. This will be the DNA from the strawberries. The amount of DNA that is isolated may vary depending on a few factors such as the size of the strawberries used and how well the strawberry was crushed. This activity demonstrates that DNA from a strawberry can be isolated using household materials.

This activity was derived from the activities found at the National Human Genome Research Institutes website at <http://www.genome.gov/27541804> and the University of Alabama Birmingham's Center for Community Outreach Development <http://main.uab.edu/cord/show.asp?durki=44818>. Minor changes were made to the background, materials, and procedures.

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