HARVEST of the MONTH in the CLASSROOM June

Grades 7-12 • 1 Period

Extracting DNA from Strawberries

S.T.E.M.

OBJECTIVES

Students will understand that DNA tells an organism how to develop and function, and is so important that this complex compound is found in virtually every one of its cells. In this activity, students will make their own DNA extraction kit from household chemicals and use it to separate DNA from strawberries.

MA STATE FRAMEWORK(s)

8.MS-LS1-7
8.MS-PS1-2
HS-LS1-1
HS-LS1-4.

ESSENTIAL QUESTIONS

- What is DNA and what does it do?
- How is DNA extracted?

MATERIALS NEEDED

- Each group will need:
- Rubbing alcohol
- Measuring cup & spoons
- Salt and water
- 3 strawberries
- Dish washing liquid
- Glass or small bowl
- Cheese cloth
- Funnel
- Drinking glass
- Small glass jar
- Reusable plastic sandwich bag
- Bamboo skewer

PROCEDURE

Preparation

Chill the rubbing alcohol in the freezer. Mix one half teaspoon of salt, one third cup of water and one tablespoon of dish washing liquid in a glass or small bowl. Set the mixture aside. This will be the extraction liquid. Completely line the funnel with the cheesecloth, Insert the funnel tube into the tall drinking glass (not the glass with the liquid). Remove and discard the green tops from strawberries.

Launch

Explain to your students that whether you're a human, rat, tomato or bacterium, each of your cells will have DNA inside of it (with some rare exceptions, such as mature red blood cells in humans). Each cell has an entire copy of the same set of instructions, and this set is called the genome. Scientists study DNA for many reasons: They can figure out how the instructions stored in DNA help your body to function properly. They can use DNA to make new medicines or genetically modify crops to be resistant to insects. They can solve who is a suspect of a crime, and can even use ancient DNA to reconstruct evolutionary histories! To get DNA from a cell, scientists typically rely on one of many DNA extraction kits available from Biotechnology companies. During DNA extraction, a detergent causes the cell to pop open (or lyse) so that the DNA is released into the solution. Then alcohol is added to the solution to extract the DNA. In this activity, strawberries will be used because each strawberry cell has eight copies of the genome, which means a lot of DNA per cell! Most organisms only have one genome copy per cell.

Procedure Worksheet Attached

After students have completed the lab, ask them to participate in a whole group conversation to share their observations:

Were you able to see the DNA in the small jar when you added the cold rubbing alcohol?
Was the DNA mostly in the layer with the alcohol and between the layers of alcohol and strawberry liquid?

Here is what happened:
When you added the salt and detergent mixture to the smashed strawberries, the detergent helped lyse (pop open) the strawberry cells releasing the DNA into solution, whereas the salt helped create an environment where the different DNA strands could gather and clump, making it easier for you to see them. When you added the salt and detergent mixture, you probably mostly just saw more bubbles form in the bag because of the detergent. After you added the cold rubbing alcohol to the filtered strawberry liquid, the alcohol should have precipitated the DNA out of the liquid while the rest of the liquid remained in solution. You should have seen the white clear gooey DNA strands in the alcohol layer as well as between the two layers. A single strand of DNA is extremely tiny to tiny to see with the naked eye, but because the DNA clumped in this activity you were able to see just how much of it three strawberries have when all of their octoploids cells are combined. (octoploid means they have eight genomes.)

EXTENSIONS & VARIATIONS

Students can try using this DNA extraction activity on other things. Try some oatmeal or kiwis! After using different subjects, students can compare which foods give you the most DNA.
If students have access to a milligram scale (called a balance), they can measure how much DNA they get (called a yield). Students should weigh their clean bamboo skewer and then weigh the skewer again after they have used it to fish out as much DNA as you could from your strawberry DNA extraction. They can subtract the initial weight of the skewer from its weight with the DNA to find the final yield of DNA. What was the weight of your DNA yield?

Students can change the variables in this activity to see how they could change your strawberry DNA yield. For example, they could try starting with different amounts of strawberries, using different detergents or different DNA sources (such as oatmeal or kiwis).
Which conditions give you the best DNA yield?

Here are other resources for this lab:
About Genetics, [https://www.thetech.org/ask-a-geneticist] from the Tech Museum of Innovation
DNA Extraction Virtual Lab, [https://bit.ly/DNA-Extract-Lab] from Learn Genetics, the University of Utah
Do-It-Yourself DNA, [https://bit.ly/42wMQxW] from Science Buddies

Extracting DNA from Strawberries
Procedure Worksheet

1) Put the strawberries into a resealable plastic sandwich bag and push out all of the extra air. Seal the bag tightly. With your fingers, squeeze and smash the strawberries for 2 minutes.

How do the smashed strawberries look?

2) Add three tablespoons of the extraction liquid you prepare to the strawberries in the bag. Push out all the extra air and reseal the bag.

How do you think the detergent and salt will affect the strawberry cells?

3) Squeeze the strawberry mixture with your fingers for 1 minute.

How do the smash strawberries look now?

4) Pour the strawberry mixture from the bag into the funnel. Let it drip through the cheesecloth and into the tall glass until there is very little liquid left in the funnel. Only wet pulp should remain.

How does the filtered strawberry liquid look?

5) Pour the filtered strawberry liquid from the tall glass into the small glass so that the jar is one quarter full. Measure out 1/2 cup of cold rubbing alcohol. Tilt the jar and very slowly pour the alcohol down its side. Pour until the alcohol has formed approximately a 1 in deep layer on top of the strawberry liquid you may not need all of the one half cup of alcohol to form the one inch layer. do not let the strawberry liquid and alcohol mix.

Study the mixture inside of the jar. the strawberry DNA will appear as gooey clear/white stringy stuff. Do you see anything in the jar that might be strawberry DNA? if so where in the jar is it?

6) Dip the bamboo skewer into the jar where the strawberry liquid and alcohol layers meet and then pull up the skewer.

Did you see anything stick to the skewer that might be DNA? Can you spool any DNA onto the skewer?

Were you able to see the DNA in the small jar when you added the cold rubbing alcohol?

Was the DNA mostly in the layer with the alcohol and between the layers of alcohol and strawberry liquid?

Questions for the whole class discussion:

Were you able to see the DNA in the small jar when you added the cold rubbing alcohol?
Was the DNA mostly in the layer with the alcohol and between the layers of alcohol and strawberry liquid?