**Extracting DNA from Strawberries**

Grade 4

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Materials (students should be in groups of 3­5 students each):

Shampoo or dish soap (need 1 tsp per group)

Salt (need 1 tsp per group)

Water (need ¼ cup per group)

1-2 strawberries per group

1 ziplock bag per group

1 plastic or glass standing test tube per group

ICE COLD ethyl rubbing alcohol (drug-store 70% rubbing alcohol works fine)

1 coffee filter per group

1 toothpick per group

Benchmarks/GLIs:

* 4.ST.A.1 Explain how technology from different areas has improved human lives.
* 4.LS.B.2 Relate plant structures to their specific functions
* 4.LS.B.3 Classify common plants according to their characteristics

Initial Introduction:

Begin with a discussion of terms related to the experiment.  (For example: fruit, cells, DNA, extract). You can start by asking what they know about cells and DNA and then give them a basic description of what they are.

Some things you can tell them: Cells are the basic units of living organisms. All plants and animals are made up of these cells. Inside of the cells is DNA. DNA contains all of the information about an organism. Cells are so small that we can see them only with a microscope. DNA fits inside of cells and is very tiny. It is long and thin…so thin that we cannot see a single piece of DNA, even with a microscope!

Explain to them that today, we’re going to learn how to remove DNA from strawberries. Even though the DNA is very tiny, there is *so much* DNA in strawberries that we’ll be able to see it… we just won’t be able to make out individual strands. Now…see if anyone remembers where the DNA is stored! (In cells) and ask them how they think we might be able to get it out of the cells. Once a few students have given their ideas, begin to pass out supplies and have the teacher divide the students into groups of 2.

Procedure:

1. You can have all supplies ready at the tables before the discussion above, but tell the students not to touch them until you tell them to. If not, begin by passing everything else (same rule; they can’t touch it until you tell them to). The ethyl rubbing alcohol should be up front.
2. Divide the students up into the same number of groups as the number of volunteers (have the teacher divide them up).
3. Start by as a group making the ***DNA Extraction Buffer.*** Explain to them that “extracting” DNA means removing it from the cells and separating it. Each extraction buffer will contain 1 tsp of shampoo or dish soap, 1 tsp of salt, and 1/4th of a cup of water. Have the students pour each item in and mix it up.
4. Once you have that made, have each group pick up their strawberry (should be in a ziplock bag) and take turns mushing it. Do this for 1-2 minutes. Ask them why they think they’re doing this since they’re planning to extract DNA. If they need help, explain to them that they are starting to break apart the cells in the strawberry, which contain the DNA.
5. Now, the groups should add the DNA Extraction Buffer to their ziplock bag and help them reseal the bags. Ask the students to remind you what is in the DNA extraction buffer and then ask them what they think that will do to the DNA. (It’s breaking down the cell membrane—or the wall around each cell—so that the DNA can get out!) Once each group’s bag is resealed, they should mush the strawberry + buffer around for another minute.
6. Now each group should put the coffee filter into the test tube. Help them to carefully pour their “mush” into the test tube through the coffee filter. It will take a minute for it to start draining through. Tell them to be patient! Ask them what a coffee filter does (help them if they don’t know). Knowing that, ask them why they think we’re putting it through the coffee filter. (Hint: getting rid of the big stuff… only the small stuff—smaller than the tiny holes in the filter—can make it through).
7. Once it has drained a bit, take around the garbage can so that they can discard the filters.
8. Meanwhile, also have volunteers going around with the ice cold ethanol. The students will need to carefully pour a small amount of ethanol, roughly equivalent to the amount of filtered strawberry mush, into the container. **DO NOT mix it!** It’s ideal to have them pour carefully down the side. If it’s easier, you can pour a small amount into a Dixie cup, or one of the funnels and have them pour it into their experiment.
9. Instruct the students to wait for3-4 minutes, don’t touch, and **observe** what is happening inside their test tube.
10. Have the students share what is happening in their test tubes.
11. Explain to them that DNA doesn’t dissolve in ethanol…it doesn’t “want” to be in the ethanol, so it tries to get away from it. The furthest away it can get is to rise to the surface of the ethanol.
12. If you have extra time, have the students swirl the DNA with their toothpick. Ask them to share what they observe. It should have the consistency of mucous!

Discussion Questions

1. Why is it tricky to extract DNA? Why did we have to mush up the strawberries and add the cell extraction buffer ?
   1. DNA is inside of the cells…the cells protect the DNA. To remove it, we had to find a way to get it out of the cells.
2. DNA is VERY tiny. Why can you see it?
   1. Think of a singly tiny thread sitting across the room. If we looked, we would not see it. But what if you took hundreds of thousands of threads and wound them together in a rope? You would be able to see that rope on the other side of the classroom. We can see the DNA because there is *so much* of it!
3. DNA extraction is something done by scientists in the lab. Why do you think a scientist would want to extract DNA?
   1. There are a lot of answers to this!! Hopefully this will start an interesting discussion with the students. You may be studying, for example, a disease that causes a “genetic mutation,” which changes the DNA code. If you can learn about that, you can work toward a cure for the disease.