

# BERRY FULL OF DNA

## TEACHER RESOURCES

### Overview:

This DNA extraction results in beautiful, white, spoolable DNA. It is so easy and there is almost no way for students to make a mistake that would affect the results. It is so much more effective than extracting DNA from any other source! You will never be able to eat a strawberry again without thinking of how much DNA is in it!

### Background:

One of the reasons strawberries work so well is that they are soft and easy to pulverize. Also, ripe strawberries are producing pectinases and cellulases which are already breaking down the cell walls. Most interestingly, strawberries have enormous genomes. They are octoploid, which means they have eight of each type of chromosome.

The detergent in the shampoo helps to dissolve the phospholipid bilayers of the cell membrane and organelles. The salt helps to keep the proteins in the extract layer so they aren't precipitated with the DNA

DNA is not soluble in ethanol. When molecules are soluble, they are dispersed in the solution and are therefore not visible. When molecules are insoluble, they clump together and become visible. The colder the ethanol, the less soluble the DNA will be in it. This is why it is important for the ethanol to be kept in the freezer or in an ice bath.

### Expected Results:

When the students layer the ethanol on their strawberry extract, they will start to see the fine white strands of DNA form at the interface. When they stir the DNA into the ethanol layer, the DNA will form cotton candy like fibers that will spool onto the stirring rod.

### Materials (per student group):

1. heavy duty zip lock baggie
2. 1 strawberry (fresh or frozen)
3. 10 ml DNA extraction buffer (soapy, salty water)
4. Filtering Apparatus: cheesecloth, funnel and small beaker
5. Ice cold ethanol
6. clear test tube
7. Glass rod or inoculating loop

### Preparation of solutions and notes on materials

- The zip lock baggies should be as thick as possible. Baggies designed for freezer storage are thicker and resist breaking much better than the sandwich type.
- Strawberries can be fresh or frozen. If using frozen, thaw them out before the lab. Other soft fruits like kiwi's or bananas will work, but do not yield nearly as much DNA.
- DNA extraction Buffer (enough for 100 groups)  
100 mL (3/8 cup) of shampoo (without conditioner)  
15 grams NaCl (2 teaspoons)  
900 mL water  
  
50 mL liquid dish washing detergent can be substituted for the 100 mL of shampoo
- Ethanol must be at least 90% and it needs to be cold. Putting it in several small dropper bottles and keeping them on ice in the front of the room makes it easy to dispense.
- Cut squares of cheese cloth (two layers thick) large enough to hang over the edge of the funnel

## Answers to Student Questions

1. What did the DNA look like? Relate its chemical structure to how it looks when lots of it is clumped together.

The DNA looked like spider webs. The DNA precipitate look like long and thin fibers. This makes sense since the molecular structure is so long and narrow.

2. DNA is soluble in water, but not in ethanol. What does this fact have to do with our method of extraction? Explain what happened when the ethanol came in contact with the strawberry extract.

The DNA was soluble in the DNA extraction buffer so we could not see it. When it got stirred into the ethanol, it clumped together and formed thicker and thicker strands large enough to see.

3. 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 at some distance. How is this statement an analogy to our DNA extraction?

DNA is far too narrow to see, but if there are many thousands of strands together, it is thick enough to be visible

4. In order to study our genes, scientists must first extract the DNA from human tissue. Would you expect the method of DNA extraction to be the same for Human DNA? Why or why not?

Animal cells do not have cell walls. It won't be necessary to filter out the cellulose debris. Also, animal cells can be lysed if put in hypotonic solution.

5. Would the DNA be the same in any cell in the human body?

Since we were once one cell and grew to an organism by mitosis, all of the DNA in our cells is identical.

6. If you wanted to extract DNA from a living person, what cells would you use and why?

Blood is the easiest tissue to obtain from living humans. White blood cells contain a nucleus, while red blood cells do not. Skin cells would also work if only a small amount of DNA were needed.

7. List two reasons why a scientist might want to study the DNA of strawberries.

Scientists might want to compare the DNA of a type of strawberry that is more disease or frost resistant than other strawberries

Scientists may want to study the evolutionary relatedness of strawberries to other berries.

Scientists may want to study a gene that codes for a particular protein in strawberries. For example, strawberries are known to have some chemical in them that slows the growth of some tumors.

Scientists may want to clone a particular gene in strawberries. Perhaps they want to make large quantities of the protein that makes strawberries red or produces the desired flavor of strawberries.