Honors Biology
Unit 4: Genetics

Due Tuesday December 13!

Name: _____ Period: _____

Lab 12: Extracting DNA from Strawberries

DNA extraction is an important lab technique to allow for further, in-depth study of DNA and its functions within living organisms. DNA can be extracted from any living thing! For this lab, you will be extracting DNA from strawberries. Strawberries are great for our in-class (and not extremely precise) DNA extraction because each cell contains lots of DNA. Strawberries are octoploidy; they contain eight copies of strawberry DNA in every cell. Humans are diploidy, meaning they contain containing only two copies. In this procedure, you will complete three steps with three key ingredients to isolate DNA. The first step is to dissolve the cell and nuclear membranes using detergent or soap; the second step is to break apart any cellular proteins to be separated from the DNA; and lastly, alcohol is used to separate out the DNA from the water and enzyme solution. With a partner, follow the instructions below to extract DNA.

Materials:

Materials to Share Between Two Pairs:
Enzyme Solution
10% Detergent Solution
91% Isopropyl Alcohol (kept in freezer)
Digital Scale
Graduated cylinder

Items needed Per Pair:
Approximately 3 strawberry pieces
Coffee filter
Ziplock Bag
Plastic cup
Plastic spoon
Stirring stick
Small cup for measuring mass

Solution Ingredients:

Enzyme Solution:
- Bromelain enzyme (meat tenderizer)
- Distilled water

Detergent Solution:
- Dishwashing detergent
- Small amount of salt
- Distilled water

Procedure: (to be completed per pair!!)

1. Measure the mass of the strawberry pieces in the CLEAN small plastic cup (be sure to first put the cup on the scale, zero it out, and then add the strawberries to find the mass of the strawberries ONLY). Note the mass in your data table.
2. Pour your strawberries into your ziplock bag.
3. Measure 100mL of the 10% Detergent solution (flask labeled DET). Pour in ziplock bag with strawberries and close bag completely, squeezing out the air and trying not to create bubbles with the detergent.
4. **Gently** mash strawberries with your fingers to mix with the detergent mixture to make a slurry. This should take approximately 3-5 minutes. Be careful to mash gently so as not to cause the detergent solution to form soapsuds.
5. Next set up the plastic cup with the coffee filter over the top. Have one person in your pair hold the coffee filter (so it doesn't fall into the cup), while the other person slowly pours the strawberry slurry through the coffee filter into the beaker/plastic cup. Use the plastic spoon to gently push the slurry through the coffee filter (careful, because you can break the filter!).
6. In the plastic cup, add 10mL of the enzyme solution (flask labeled ENZ) to the slurry and gently stir with the stirring stick. (Don't stir too aggressively or you will damage the DNA!)
7. Let the beaker sit for about 3 minutes for the enzymes to work to breakdown proteins.
8. Finally, pour approximately 100mL of the isopropyl alcohol over the strawberry slurry (the amount should be about equal to the amount of slurry in the beaker). It is recommended you tilt the plastic cup and slowly pour the isopropyl alcohol down the side of the beaker avoiding mixing of the alcohol and slurry.

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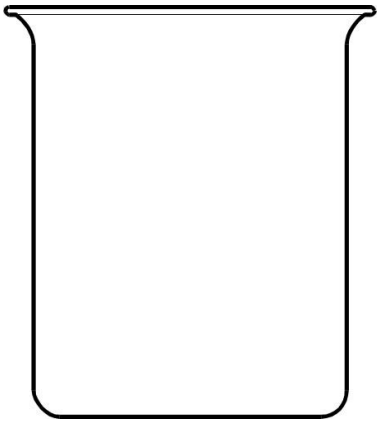
9. Now observe what occurs (you'll have to think way back to 7th grade when you learned about DENSITY!). Draw your observations of the beaker in the diagram below. There should be three layers that appear as the DNA begins to precipitate or separate from the slurry into the isopropyl alcohol.
10. Use the stirring stick to try to gently pull out the white stringy substance in the middle layer. This is the strawberry DNA.
11. Have the small plastic cup on the scale and zeroed out.
12. Carefully pull out the DNA using the stirring stick and put it in the small plastic measuring cup to measure the mass. (Make sure that the cup is clean!) Careful not to stir or separate out the DNA or you will break it apart!
13. Measure the mass of the strawberry DNA. Complete the table your data table

Data Table:

Mass of Strawberries	_____ grams
Mass of DNA	_____ grams
% Yield of DNA	DNA = _____ % of total strawberry mass

***To calculate % Yield of DNA:**
Mass of DNA ÷ Mass of Strawberries
= _____ x 100% = _____ %
*This calculation tells you the percentage of mass that the DNA takes up in the strawberries!

Diagram of Cup:



Post-Lab Questions: (Write in complete sentences!)

1. For this lab, you extracted DNA from strawberry cells. Why would it be advantageous or easy to extract large amounts of DNA from a certain number of strawberry cells compared to the same number of human cells? (Hint: read intro section!)

2. If you extracted DNA from 1,000 strawberry cells today, do you think you would extract more or less DNA from 1,000 cells from the dodecaploidy organism *Xenopus ruwenzoriensi*, a species of frog? (Hint: what does the prefix dodeca mean? Don't know? Look it up!) Do you think you would extract more or less DNA from 1,000 cells from a Salmon fish, which a tetrapoidy organism? Explain BOTH of your answers!

3. In this procedure, you followed three key steps. Describe what the purpose is for each of the following steps: detergent, enzyme, alcohol. (Hint: What cellular structures are broken down to release the DNA?)

4. Is there DNA in your food? In what parts of your food? Do you think you are harmed by ingesting DNA in your food? Why or why not?

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Teacher Prep:

1. This is a "quick and dirty" DNA extraction. There are many other lab procedures for this that can be used to extract a purer sample of DNA. I like this procedure for my standard Biology I students because it is simple and straightforward. It can be done quickly, with minimal lab materials, and students can easily extract the DNA.

2. The temperature of the water is very important. It must be kept between 50 – 60 °C. The water is warm, but not hot. Students should not be concerned about dipping the water from the water bath.

3. Tools that can be used to spool the DNA: Paper clips, wood splints, bamboo skewers, glass stirring rods.

4. It is essential that the alcohol be ice cold. I keep it in the freezer prior to the lab. During the lab, I keep it in an ice bucket.

5. Have students try a variety of other cell materials and compare them. I have also used strawberries, onions and liver.

6. I have tried different brands of dishwashing detergent, and "Dawn" always works the best.

7. Ethyl alcohol seems to give me the best results, but I have used isopropyl alcohol and this also gives good results.

Per class of 36:

Lab group set up: (extractions to be completed per pair with materials provided per group of four)

- 1 100mL grad cylinder
- 2 beakers/plastic cups
- 2 coffee filters (consumable)
- 2 plastic spoons
- 2 wood stirring sticks/popsicle sticks (consumable)
- 2 ziplock freezer bags (consumable)
- Erlenmeyer flasks with detergent solution (labeled DET) and enzyme solution (ENZ)

1.8 L of 10% dishsoap solution with about 1 tablespoon of salt added

180 mL of enzyme solution (2-3 tablespoons dissolved in water)

1.8 L of 91% isopropyl alcohol (about 2 bottles per class period)

******If doing percent yield. Explain and set up lab notebooks the day before! Then possibly do two extractions per group of four and get an average per lab group! Explaining and executing in the same day was too much.**