Fruit DNA Extraction Activity

Objective:

To extract DNA from fruits like bananas, kiwi, strawberries, etc. using simple items found in many bathrooms and kitchens.

Video of the Project Plan: https://youtu.be/sxd1IKNBnfQ

Materials and Tools:

All measurements are approximate. This activity does not require precise amounts of the materials.

- 1 Piece of fruit (banana, strawberry, kiwi, etc.)
- 30mL (1 fl. oz.) of water
- 30mL (1 fl. oz.) of COLD isopropyl/rubbing alcohol (min 70%, 95-99% is better)
- 2 Drops of dish soap
- 1 Pinch of table salt
- 1 Small/Medium zip-top plastic bag
- 1 Coffee filter
- 1 Elastic band
- 1 Toothpick, chopstick, or popsicle stick
- 1 Clear plastic cup
- Scissors (optional)

Method



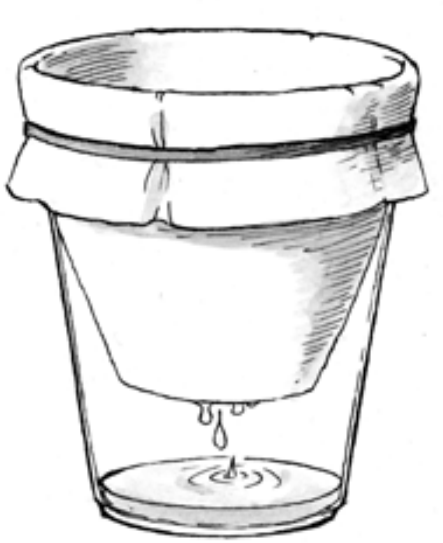
1. *Before you begin, make sure you have chilled your alcohol.* (Pop the whole container in the freezer to chill it. The alcohol will not freeze!)

2. Put a 2-3cm (1 inch) piece of banana (or similar amount of other fruit) in a small zip-top plastic bag. Remove the air and seal the bag. (Alternatively, you can use a cup and spoon.)

3. Squish the fruit in the bag with your hands! (Or mash it in an extra cup.) Once it's turned into a paste, set the bag (or cup) aside.

4. Add ~30mL (1 fl. oz.) of water and a pinch of salt to the mashed fruit. Continue to mash for another 2-3 minutes. Set the bag (or cup) aside.

5. Secure a coffee filter over the opening of a clear plastic cup using an elastic band.



6. Pour the mashed fruit mixture through the coffee filter and into the plastic cup. (Tip – cut a small section off the corner of the zip-top bag to let the fruit mixture drip through the filter.)

7. Once the fruit mixture has completed straining through the coffee filter carefully remove the filter and discard it, keeping the plastic cup and the liquid that is in it. (You can *gently* squeeze the filter to get more liquid out, just don't break it!)

8. Add 2 drops of dish soap to the liquid in the plastic cup. *Gently swirl the liquid in the cup on the table without making bubbles*.

9. Tilt the cup and slowly pour ~30mL (1 fl. oz.) of isopropyl alcohol so that it gently runs down the inside of the cup and forms a layer of alcohol on top of the fruit mixture.

10. Let the solution sit for a few minutes. (You will see some white, fluffy strands begin to appear at the boundary between the water and alcohol layers. That is the DNA!)



11. Collect the DNA by dipping the stick into the liquid and turning it like you're collecting cotton candy or twirling spaghetti. Remove the stick from the cup to see your glob of extracted DNA!

12. If you want to save your fruit DNA, you can store it in a small container filled with rubbing alcohol.

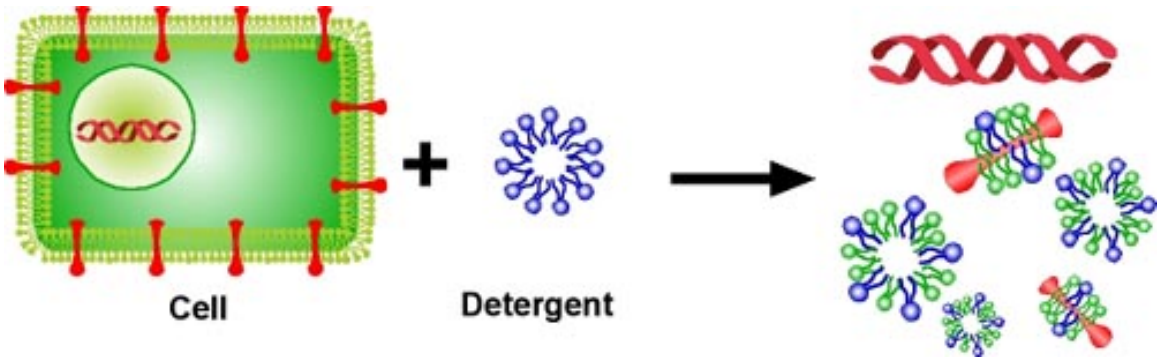
Alternatives & Further Experiments:

- Compare two different sources to see which source yields more DNA
- Try using other fruits (oranges, watermelon, apples, blueberries, blackberries), vegetables (potatoes, split green peas, spinach), grains (raw wheat germ, oats), meat (chicken/beef liver), or even cheek cells from inside your mouth!
    - For vegetables, put in a blender with the water and salt at the start
    - For grains, soak in hot water for 3-10 minutes at the start
    - For beef liver, soak pieces in fresh (not canned) pineapple juice or contact lens solution for a day first (this breaks up the proteins that protect the DNA in the cell)
    - For cheek cells, swirl a mouthful of saltwater around while you shake your cheeks
- Try freezing your fruit/vegetable/other and thawing before you begin – this will help to break down the cell wall.
- Try adding a pinch of meat tenderizer to the dish soap mixture (this breaks up the proteins that protect the DNA in the cell)

Additional Information:

Why do we use detergent?

- Detergent dissolves the lipids in the cell membranes and nuclear envelope, releasing the DNA into the solution
    - Soap molecules and the lipids (fats) in cell membranes are made of two parts: hydrophilic heads and hydrophobic tails
    - When detergent comes close to the cell, it captures the lipids and proteins (due to their similar structures) and breaks them apart



Why do we use salt?

- DNA has a negative electrical charge (due to the phosphate groups on the DNA backbone) and the electrical charge makes it soluble.
- When salt is added to the fruit mixture, the positively charged sodium ions (Na+) of the salt (NaCl) are attracted to the negative charges of the DNA, neutralizing the electrical charge of the DNA. This allows the DNA molecules to come together instead of repelling each other.

Why do we use alcohol?

- When molecules are soluble, they are dispersed in the solution and are therefore not visible. When molecules are insoluble, they precipitate (clump together) and become visible.
- DNA is soluble in water, which is why it is invisible in the filtered mash solution.
- DNA is not soluble in high salt and alcohol solutions, so the addition of the alcohol makes the DNA precipitate.
- Molecules are less soluble at lower temperatures, so we chill the alcohol to get more of the DNA to precipitate