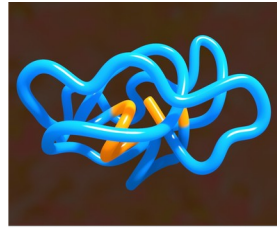


Molecules of Life: Protein and DNA

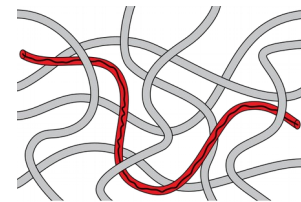
- Living things are made mostly of very long molecules called **polymers**
- **Proteins** are the building blocks of cells. They are chains with sticky patches that let them fold into complicated structures.
- **DNA** molecules are very long chains that store the instructions for how to make a specific living creature.
- When a lot of polymers stick or tangle together in a liquid, they make a **viscoelastic** (stretchy, snot-like) substance.



folded protein



DNA chains



polymer solution

Work with a partner!

Part 1: Proteins In an Egg

1. Crack both eggs and pour them into 2 separate bowls. We only need the **egg white**. Throw out the yolk, or leave it unbroken in the bowl.

2. Poke the **egg white** with your fork. Lift it up and let it drip back down. **What does it feel like? (Circle one).**

Liquid Solid Viscoelastic (snot-like)



3. Add 2 spoons of pineapple juice to one bowl.

4. Add 2 spoons of alcohol to the other. Wait about 10 seconds.

Then try lifting up the egg whites in each bowl and letting them drip down again

What happened to the egg with pineapple juice?:

more liquid (drips) more solid (stretches)

What happened to the egg with alcohol?:

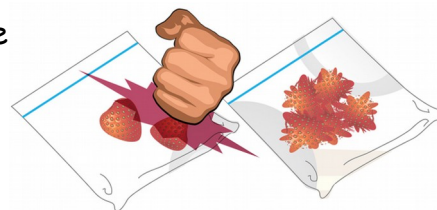
more liquid (drips) more solid (stretches)

What did the alcohol do to the color of the egg white?

- Eggs contain a lot of **protein** molecules, folded up into globs that are tangled together. This gives the egg white its "snot-like" consistency.
- Pineapple juice has "enzymes" - special molecules that cut up proteins. This leaves less tangled polymers and a more liquid egg white.
- Alcohol makes proteins "denature" (unfold) into long sticky chains. This makes them more visible (less see-through), and makes the egg liquid more solid-like. The same sort of protein denaturation happens when you cook an egg!

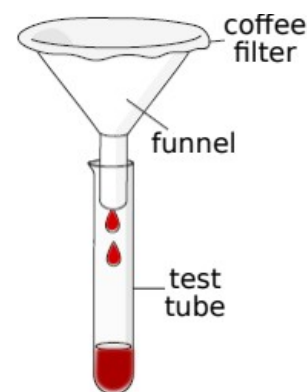
Part 2: DNA in a Strawberry

1. Pull the leaves & stems off **2 strawberries**.
2. Put both in one ziploc bag. Seal the bag and smash the strawberries inside into a pulp, so no big chunks remain.



3. In a large cup, mix up the extraction liquid:
3 spoons dishwashing fluid + 1 spoon salt + 1 dixie cup water
4. Add 2 spoons of extraction liquid to the bag of strawberry pulp. Reseal the bag, and smash again to mix gently (try to avoid making bubbles!).

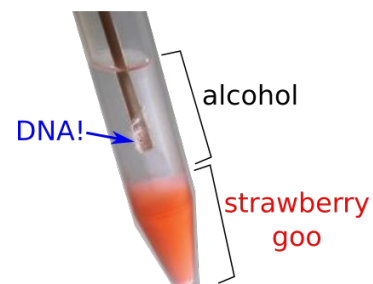
5. Put a coffee filter in a funnel and insert the funnel into a tube. Pour the **strawberry liquid** over the filter. Wait until about 1 inch of liquid collects at the bottom.



6. Remove the filter from the funnel. Carefully add **alcohol** through the funnel to the top of the tube. Make a layer about 1 inch deep.

7. Watch a cloudy substance form in the clear alcohol layer.

That's the strawberry's DNA!



- The alcohol breaks the DNA's interactions with water molecules, and allows the salt to stick to it better. The salt makes bridges between DNA strands, forming a stretchy "snot-like" substance.

9. Use a stick to spool some DNA and pull it out of the tube. Try stretching it between two sticks to check the consistency.

How is the DNA similar to the protein solution in the egg?¹

¹ DNA activity modified from: <https://www.genome.gov/Pages/Education/Modules/StrawberryExtractionInstructions.pdf>