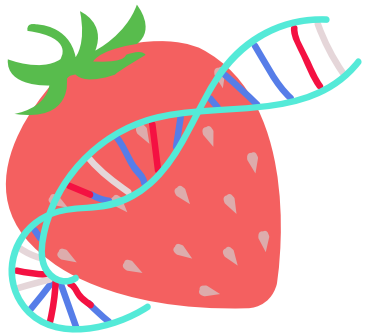

DNA Extraction

Objective:

Students will use strawberries to extract DNA samples.

Introduction:

All living things have DNA: the chemical instructions for how to make a living thing. It can easily be seen with the naked eye when collected from thousands of cells. This simple method allows you to extract DNA from a strawberry and view it.

One of the reasons strawberries work so great is that they are soft and easy to pulverize. Also, ripe strawberries produce pectinases and cellulases, which are already breaking down the cell walls. Most interestingly, strawberries have enormous genomes. They are octoploid, meaning they have 8 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 are not precipitated with the DNA.

DNA is not soluble in ethanol, therefore it will clump together and become visible. The colder the ethanol, the less soluble the DNA will be in it, which is why it is important for the ethanol to be kept cold.

Materials:

- Strawberries
- Zip-closure sandwich bags
- DNA extraction solution (see below)
- Coffee filter (or cheese cloth)
- Small plastic cups (condiment sized)

- A few large plastic cups with the bottom cut out
- Coffee stirrer
- Denatured alcohol [ethanol or isopropanol (rubbing alcohol)]
- Microtube, containing about 1 mL of water
- Paper towels
- Small funnels (not absolutely necessary but helpful)
- Small plastic Pasteur pipette

Preparation of solutions and additional notes:

- The zip lock baggies should be as thick as possible. The freezer baggies are best suited as they are thicker and less likely to break during the "mashing" of the strawberry.
- Strawberries can be fresh or frozen. If using frozen strawberries be sure to thaw them prior to the lab. Other soft fruits will work but do not yield as much DNA as strawberries.
- Preparation of DNA extraction buffer (enough for 100 groups)
    - 100 mL (3/8 cup) of shampoo (w/o conditioner)
    - 15 gm NaCl (2 teaspoons)
    - 900 mL water

  **50 mL liquid dish washing detergent can be substituted for the 100 mL shampoo
- Ethanol must be at least 90% and 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.
- If using cheese cloth instead of coffee filters, cut squares (2 layers thick) large enough to hang over the edge of the funnel/plastic cup.

Protocol:

1. Place a strawberry in a zip-closure bag and remove most of the air before you seal the bag.

2. Mash the strawberry through the bag in your hand. DO not hit against the table.

3. Add 10 mL of the DNA extracting solution.

4. Continue mixing and mashing the bag in your hand.

5. Place a large plastic cup (with the bottom cut out) over a small, condiment-sized, plastic cup. Place a coffee filter into the funnel and then place the funnel into the top of a large plastic cup.

6. Carefully pour the strawberry mixture into the coffee filter making sure to catch the solids with the filter. The small cup below will catch the filtrate.

7. Add 3 mL of the ice-cold alcohol to the filtrate in the small cup. Do not mix the two liquids.

8. Observe the line between the strawberry mixture and the alcohol. You will notice a white thread-like cloud appearing at this line. This is strawberry DNA. Gently stir the solution with the coffee stirrer, spooling (wrapping) the DNA on to the stirrer. Take the collected DNA and transfer it to the microtube containing water.

Expected Results:

When the students layer the ethanol on their strawberry extract, they will start to see bubbles form and the fine white strands of DNA at the interface. The bubbles are the result of the DNA molecule folding in on itself capturing the air in the liquid. When the students stir the DNA into the ethanol layer, it will form cotton candy like fibers that will spool onto the coffee stirrer.

More Information about DNA

Below is more information on DNA, and how the experiment works to extract and make visible this tiny molecule.

What does DNA stand for?

DNA stands for deoxyribonucleic acid. DNA is a molecule in the form of a double helix - two spirals twisting around each other. These spirals are the backbone of the DNA, and are made up of sugars and phosphates. The spirals are connected by chemicals known as bases, which stretch between the spirals like the rungs of a ladder. DNAhas four types of bases: adenine (A), thymine (T), guanine (G) and cytosine (C). A and T always join together, as do G and C.

What does DNA do?

DNA is the genetic instruction manual for making an organism. All processes in the body are controlled by DNA. A gene is a sequence of DNA.

Genes in Common

You don't look much like a fly or a worm. But, believe it or not, you share genes with both of them - and with every other living organism. Scientists study the genes in bacteria, fish, chimpanzees and other living things to learn more about humans.
How much DNA do you share with these living things? Fruit fly - 36%, Chimpanzee - 98%, Zebrafish - 85%, Bacteria - 7%, Mustard Grass - 15%, Round Worm - 21%.

Why do we use the dishwashing liquid?

The dishwashing liquid busts open the cells of the strawberries, releasing the DNA.

Why do we use the salt?

It ensures that the proteins in the cell are not separated from the rest of the solution with the DNA.

What does the alcohol contribute to the experiment?

When molecules are insoluble (unable to be dissolved), they clump together and become visible. DNA is not soluble in alcohol; therefore, it makes the DNA strands clump together and become visible to the naked eye.