Ladies in the Lab

Volunteer Packet

What: Ladies in the Lab

When: Saturday, September 28 from 10:00 am to 2:00 pm

Schedule:

8-10

10:00-10:30 Check in, Introductions and Lab Safety (1221)

10:30-11:30 Non-Lab Activities (1111)

- Fruit DNA Extraction
- Paper Chromatography

11:30-12:30 Lunch Break & Dessert Cells (1111)

12:30-2:00 Lab Activities (Intro Bio Labs)

- Pipette Practice
- Gel Electrophoresis
- Agar Art

11-13

10:00-10:30 Check in, Introductions & Lab Safety (1221)

10:30-12:00 Lab Activities (Intro Bio Labs)

- Pipette Practice
- Gel Electrophoresis
- Agar Art

12:00-12:30 Lunch (1280)

12:30-2 Non-Lab Activities (1111)

- Dessert Cells
- Skin Cell DNA Extraction
- Paper Chromatography

Where: Integrated Science Center
Biology Labs, ISC 1111, ISC 1121, ISC 1280

Audience: Upper Elementary & Middle School, ages 8-13

Activities

8-10

- Fruit DNA Extraction
- Paper Chromatography
- Dessert Cells
- Agar Art
- Pipette Practice
- Gel Electrophoresis

11-13

- Skin Cell DNA Extraction
- Pipette Practice
- Gel Electrophoresis
- Agar Art
- Dessert Cells
- Paper Chromatography

Fruit DNA Extraction: Teacher/Volunteer Protocol

Learning Objectives

Students extract DNA from fruit to get a tangible sense of what DNA looks like on a macroscopic scale. They should understand that there is DNA in every cell and that DNA contains the instructions for life. They are also introduced to protocols that synthetic biologists use in order to research genetics and modify DNA.

Materials

Per student:
1/4 of a banana, substitutable with any other fruit
Ziploc bag with 1 inch of water
Lysis Buffer
Cup with 2 coffee filters
Ethanol (refrigerate before use)
One wooden skewer

Procedure

1. Introduce the idea of DNA. DNA is a tiny molecule that acts like an instruction manual for each of your cells. Your DNA tells you to be you, and a banana's DNA tells it to be a banana. Let students guess what DNA looks like on a human scale (without a microscope).
2. Give each student (or pair of students) 1/4 of a banana in an open ziploc bag with water, and close the bag.
3. Tell students to gently mash up the banana by squeezing the bag. Once the banana is a lumpless mush
4. Put some lysis buffer into each bag and close the bag.
5. Students should gently mix in the detergent, trying to avoid creating bubbles.
6. Give each student or pair a disposable cup with two coffee filters taped to the top.
7. Carefully pour the contents of the bag into the coffee filters and let the liquid drip through the filter into the cup.
8. Let the banana-detergent mix sit in the cup for 20-30 minutes.
9. Throw away the coffee filters and any material that didn't drip through the filter, keeping the cup and the liquid that collected in it.
10. Pour cold ethanol into the cup. The more you pour in, the more DNA will precipitate out of the liquid.
11. Use the toothpick or skewer to stir the white-clear substance that precipitates out, or collects at the top of the liquid: this is the DNA!

Skin Cell DNA Extraction: Teacher/Volunteer Protocol

Materials per Student:

5 mL Lemon-Lime Gatorade (original)
5 mL 95% ethanol
2 mL 25% detergent (dilute in water)
Small disposable cup
15mL test tube
One wooden skewer

Procedure

1. Distribute 5ml of Gatorade to each student.
2. Instruct them to vigorously swish 5 ml of Gatorade around in their mouth for 10-15 seconds, then spit it back into a cup and transfer into a test tube.
3. Add 2 ml of a 25% dishwashing detergent to the test tube.
4. Instruct the students to Cap tube and invert the tube 5 times.
5. Let tube sit for 2 minutes.
6. Hold tube at 45° angle and gently pour approximately 5 ml of ice cold 95% ethanol on top of the solution
7. Let stand for 10 minutes.
8. You should see DNA at the alcohol/Gatorade interface.
9. Spool DNA around glass rod or stick. (If students want to keep their DNA, have them transfer it to a microcentrifuge tube.)

Paper Chromatography

Background

Paper chromatography is a method used by chemists to separate the parts of a solution. The components of the solution start out in one place on a strip of special paper. A solvent (such as water, oil or isopropyl alcohol) is allowed to absorb up the paper strip. As it does, it takes part of the mixture with it. Different molecules run up the paper at different rates. As a result, components of the solution separate and, in this case, become visible as strips of color on the chromatography paper. Will your marker ink show different colors as you put it to the test?

Materials

- 2 strips of coffee filter
- 2 cups filled with water
- 2 empty cups
- Black marker
- Colored marker of your choice
- Pencil

Procedure

1. Draw a pencil line across the width of each paper strip, about one centimeter from the bottom end.
2. Take the black marker and a paper strip and draw a short line (about one centimeter) on the middle section of the pencil line. Your marker line should not touch the sides of your strip.
3. Use a pencil to write the color of the marker you just used on the top end of the strip. Note: Do not use the colored marker or pen to write on the strips, as the color or ink will run during the test.
4. Repeat the previous three steps with the color you chose
5. Hold a paper strip next to one of the cups (on the outside of it), aligning the top of the strip with the rim of the cup, then slowly add water to the glass until the level just reaches the bottom end of the paper strip. Repeat with the other glass, keeping the strips still on the outside and away from the water.
6. Fasten the top of a strip (the side farthest from the marker line) to the pencil with a clip or rubber band.
7. Hang the strip in one of the glasses that is partially filled with water by letting the pencil rest on the glass rim. The bottom end of the strip should just touch the water level. If needed, add water to the glass until it is just touching the paper. Note: It is important that the water level stays below the marker line on the strip.

8. Leave the first strip in its glass as you repeat the previous two steps with the second strip and the second glass.
9. Watch as the water rises up the strips. What happens to the colored lines on the strips? Does the color run up as well? Do you see any color separation?
10. When the water level reaches about one centimeter from the top (this may take up to 10 minutes), remove the pencils with the strips attached from the glasses. If you let the strips run too long, the water can reach the top of the strips and distort your results.
11. Write down your observations. Did the colors run? Did they separate in different colors? Which colors can you detect? Which colors are on the top (meaning they ran quickly) and which are on the bottom (meaning they ran more slowly)?
12. Hang your strips to dry in the empty glasses or on a drying rack. Note that some colors might keep running after you remove the strips from the water. You might need longer strips to see the full spectrum of these colors.

Dessert Cells: Teacher/Volunteer Protocol

Materials:
Cookie
Icing
Assorted toppings to represent organelles

Procedure

1. With students discuss the similarities and differences in animal, plant, and bacterial cell structures.
2. Discuss the role of each organelle.
    a. Nucleus
    b. Mitochondria
    c. Ribosome
    d. Rough ER
    e. Smooth ER
3. Pass one sugar cookie to each child to represent a cell
4. Students can choose whether to model a plant, animal, or bacterial cell a
5. Apply toppings to represent organelles and important cell structures that make each cell type unique
6. Try to make the 'organelles' roughly accurate size: the nucleus should be much larger than other organelles, the mitochondria and ribosomes should be small and there should be many of them
7. After students complete their 'cells' discuss which toppings represent which organelles and why.

Gel Electrophoresis Teacher/Volunteer Protocol

Materials

For Making the Gel

Electrophoresis Gel Box
Agarose
6 Prong Gel Comb
TAE buffer solution

For Experiment

Power supply (either gel electrophoresis machine or 5 9volt batteries)
Gel Food coloring
1.5 ml Microcentrifuge tubes
Disposable pipette (for practice)
100 µl pipette

Procedure

1. Prepare gels 30 minutes to 1 hour before beginning the electrophoresis
    a. Follow iGEM Gel Electrophoresis Protocol to make the gels.
2. Transfer gel food coloring into microcentrifuge tubes to make it easier 9to pipette.
    a. For more colors, mix different colors of food coloring together.
3. Students should be able to pipette well. If not, complete pipetting practice beforehand.
4. Set a P100 pipette to 50 µl
5. Fill it with 50 µl of food coloring from one of the microcentrifuge tubes
6. Carefully pipette the food coloring into the gel
    a. For more colors, mix food coloring in advance.
7. Have students guess what colors their lane will split into, and which molecules they think may be heaviest/go the shortest distance.
8. Once the gel is loaded
    a. Follow the W&M iGEM Gel Electrophoresis protocol
    b. Choose the appropriate voltage, amperage and run time for your gel. In general, we run at constant 160 volts, (250 mA) for 30 minutes
    c. Let the gel run for 30-45 minutes. Check the gel periodically to make sure the sample is running correctly
9. After gel has finished running, shut off current box, slide off cover and let students look at the gel.
10. To easily view the gel, place it on a light source or on a white background.

Agar Art Teacher/Volunteer Protocol

Materials

LB Agar Plates
Bacteria Culture
Inoculation Loops
Microcentrifuge tubes

Procedure

1. Prepare all plates and bacteria culture at least 1 day before the activity.
    a. Follow iGEM Lb Agar Plate and Inoculation protocol
2. Distribute to each student
    a. 1 Agar plate
    b. 1 Inoculation Loop
    c. 1 Microcentrifuge tube with 1 ml of bacteria culture
3. Discuss the process of making agar plates with the students, and why bacterial resistance is important for growing culture.
4. Instruct the students to dip their inoculation loop into the culture and coat the loop with the solution.
5. Then the students will “draw” on their agar plates using the loop.
    a. Make sure they do this very gently as to not disturb the agar.
6. Place the plates in the incubator overnight.
7. Send the class pictures of their creations once they have grown.