CLASS LESSON PLANS

***(Facilitator Role)*:** All Lesson Plan Creation

Week 2: Class- Intro + Lung Model

- https://youtube.com/shorts/tH_LKUpK0wI?si=sq6yNPFJYnrbJAb7

- Come at lunch to set up materials and seating arrangements (***Facilitator Role)***
- Bring chairs into a circle and stand in the middle ***(Mentoring from the Middle)***
- Phase 1 (10-15 mins)
    - Tell me about yourself! ***(Heightening anticipation)***
        - 2 truths and a lie
    - Conduct the creativity test
        - Hand out physical paper tests (we can't let them know their scores)
- Phase 2 (20-25 minutes)
    - ***(Looking twice)/(Coach Role)*** Start by writing down on the board what students know/think they know about lungs
        - How they work, why we have them, how big are they, what system are they a part of, any diseases they know that affect the lungs, etc…
        - Then fact check or correct their notions → teach a bit about the lungs
    - Explain the model experiment (show a demo) ***(Model Role)***
        - ***(Listening for smells)***
    - Once the models are created have students explain them to each other and correct each other ***(Critical Reflector Role)***
- Phase 3 (5-10 minutes)
    - Have them all stand up and do fun acting charade type of actions to finish the lesson on the lungs ***(Having a ball)/(Artist Role)***
        - E.g. act like you are a marathon runner after the run, act like you are underwater and holding your breath, act like you are blowing out candles at your birthday party (maybe give the 'best actor' for each prompt a candy)

Materials:

- Clear plastic drink bottle (A Gatorade bottle is a good size)
- Two balloons
- Tape (masking tape or duct tape)
- Scissors
- Whiteboard markers
- straws

Week 3: Class- Intro + Elephant Toothpaste

- Come at lunch to set up materials and seating arrangements (***Facilitator Role)***
- Bring chairs into a circle and stand in the middle ***(Mentoring from the Middle)***
- Phase 1 (10-15 mins)
    - Question to the class: what do you think the elephant toothpaste experiment is? ***(Coach Role)***
    - What do you think is happening at the molecular level during the elephant toothpaste reaction?
        - What compounds?
        - What kind of reaction?
- Phase 2 (20-25 mins)
    - Explain molecule structure on the whiteboard ***(Artist Role)***
        - When you look very closely (on the molecular level), the liquid that we'll be using is very similar to water. (Hydrogen peroxide, the solute we'll be using, is very similar to the molecular composition of water since it's made up of two hydrogens and two oxygens.)
        - Ask "How can we make hydrogen peroxide break down quicker?" ***(Getting out of locked doors)/(Coach Role)***
            - Answ: Catalyst (Adding something else that makes the breakdown of hydrogen peroxide faster, aka catalase found in yeast)
                - A catalase enzyme is a type of catalyst that specializes in specifically breaking down hydrogen peroxide to protect an organism from its acidic nature
                    - Rearranges the structure into water and one oxygen
                - $2H_2O_2 \rightarrow 2H_2O + O_2$
                    - Dishsoap captures the oxygen released to create bubbles and elephant toothpaste!
                - Examples of other catalysts: Laundry detergent
    - Explain elephant toothpaste experiment and have them gather around to one half of the circle standing (semi-circle) so everyone can see ***(Mentoring from the Middle)***
        - Hand out an instruction manual and have them read out each step aloud to us as a class and then we complete that step ***(Getting in deep water)/(Critical Reflector Role)***
- Phase 3 (5-10 mins)
    - ***(Having a Ball and Building sand castles)/(Scholar Role)***
        - Elephant toothpaste Inspired the creation of firefighting foam due to how it could easily capture large amounts of oxygen. What would you want to do with elephant toothpaste?

          West Metro Fire Rescue: Firefighting with foam

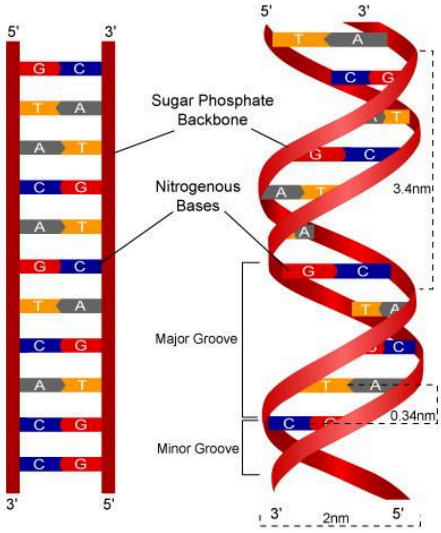
- Would you want to make a ginormous toothbrush and brush elephant teeth?

Materials:

- 3% Hydrogen peroxide (buy or borrow)
- Yeast
- Warm water
- Plastic bottle
- Dish soap
- Food colouring
- Clear plastic bin
- Dongle cord
- Gloves
- Measuring cups

Week 4: Class - Candy DNA model

- Come at lunch to set up materials and seating arrangements. (***Facilitator Role)***
- Bring chairs into a circle and stand in the middle. ***(Mentoring from the Middle)***
- Phase 1 (5-10 minutes):
    - DNA fact or fiction! ***(Heightening anticipation)***
        - E.g. 99.9% of humans have the same DNA. Fact or Fiction. **Fact!**
- Phase 2 (25 minutes):
    - Explain nucleotide pairings (GC and AT) on the whiteboard (USE COLORED MARKERS) ***(Artist Role)***
        - Guanine and cytosine, adenine and thymine
        - We're all made up of DNA, they're the blueprints to our bodies and they have a very specific structure: made up of sugar-phosphate backbones (there's sugar in your licorice too!) and then they have nitrogenous bases that connect these backbones together
        - Explain Central Dogma (DNA → RNA → Proteins)
        - Have the students summarize in pairings **(*Cutting corners*)**



- Explain activity of candy DNA model and give out materials
- Let the students use their sight, smell, and touch of the candy to understand DNA (and eventually taste!) **(*Listening for smells)/(Artist Role)***
- Make up a gene (CATGGTAGATCCA) and have them make a corresponding segment ***(Critical Reflector Role)***

- Phase 3 (10 minutes):
  - ***(Building Sand Castles and Shaking hands with tomorrow)/(Scholar Role)*** By asking students questions like such:
    - What if you could use DNA to create new kinds of plants or animals? What would you create?
    - What if your DNA could be used to make medicine? How could it help people?
    - How could understanding DNA help with medicine?
      - Talk about IGEM → using alterations of DNA to make things!

Materials:

- Twizzlers or licorice (represent the backbone consisting of sugars and phosphates)
- Toothpicks
- Soft Candy (Gumdrops in 4 colours)
- 4 cups to separate candies by color
- Colored expo markers
- Paper towels - have the kids make their dna model on

Class 5: Soda Can Experiment

- Bring chairs into a circle and stand in the middle. ***(Mentoring from the Middle)***
- Phase 1 (5-10 minutes):
  - Gather in a circle and ask the students what their favorite soda is? ***(Heightening anticipation)***

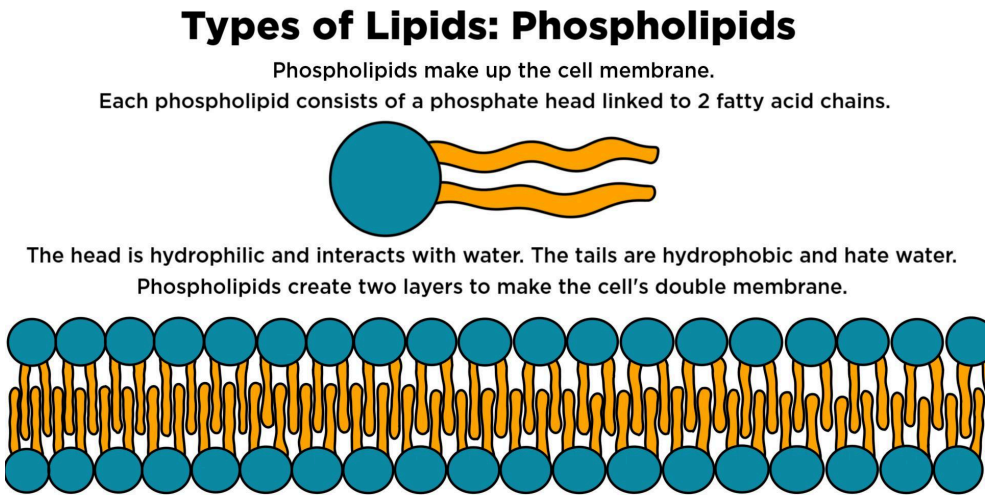
    - Now present all the sodas that will be used in the experiment and summarize the experiment
    - ***(Critical Reflector Role)*** Have them hypothesized in pairs/groups (no one left out!) on a handed out sheet of paper
        - Place majority vote on the board for whether each type of soda will sink or float
- Phase 2 (20-25 minutes):
    - ***(Artist Role)*** Conduct experiment and have students place the soda cans in (have the students very involved by having someone count down and everyone stomping their feet dramatically like a drum roll)
        - ***(Getting in deep water)***
    - Have the students go back to their original hypothesis and see where they were wrong ***(Looking twice + Crossing out mistakes)/(Critical Reflector Role)***
        - Have them reason out why they may be wrong or right (without lesson)
            - ***(Getting out of locked doors)***
    - Explain density - what it is and the role of sugars that impact it (diet sodas vs. regular sodas)
- Phase 3 (10 minutes):
    - Using what they now know about density, what fields do they think it could be useful in? **(*Shaking hands with tomorrow)/(Scholar Role)***
        - Would it make for a useful superpower (be able to control the density of objects or control their own density)? ***(*Having a ball - Gives humour to the lesson)**

Materials:

- Bucket
- Water
- Whiteboard markers
- Paper
- Pencils/Pens
- Different soda cans (some diet, some not)

Week 6: Class - Milk and dye experiment

- Bring chairs in a circle and stand in the middle. ***(Mentoring from the Middle)***
- Phase 1 (5-10 mins)
    - Bingo: of terms! ***(Artist Role)***
    - Ask the class what their favourite color is and write their name and fav color on the whiteboard
    - Looking at the materials, what do you think our experiment today will be?
        - ***(Heightening anticipation)/(Critical Reflector Role)***

- Phase 2 (20-25 mins)
    - Explanation
        - Explain phospholipids head and tail ***(Model Role)***
        - 

        - Also explain how phospholipids destroys bacterial cell membrane
        - Hydrophilic head and hydrophobic tail
            - What do you think Hydrophilic and hydrophobic means?
                - Hydrophilic: Attracted to water
                - Hydrophobic: Repels water
            - ***(Heart of the lesson)***
    - Split them into 3 equal groups and have them collect the materials for the experiment: plate, cotton swabs, cup of milk, dish soap (we provide color later)
- Explantation: Milk is a big pool of fat and the dish soap acts like a phospholipid. The food colouring is water based so the dish soap is chasing the food coloring and repels the milk creating movement in the plate.
- Hydrophilic head attracted to the water based food dye and repelling fats
- Hydrophobic tails are attracted to the fats and repelling the water-based food dye
    - That is why it swirls!

Definitions for the Bingo Terms:

- **Phospholipid**: Phospholipids are molecules that form the basic structure of cell membranes, consisting of a hydrophilic "head" and hydrophobic "tails." They arrange themselves into a bilayer, with the heads facing outward and the tails facing inward
- **Hydrophilic**: Hydrophilic means "water-loving," describing substances that are attracted to water and can dissolve or mix easily in it. The "head" of a phospholipid is hydrophilic.
- **Hydrophobic**: Hydrophobic means "water-fearing," describing substances that do not mix well with water. The "tails" of a phospholipid are hydrophobic and avoid contact with water.

- **Permeable**: Permeable refers to a material or membrane that allows substances to pass through it. The cell membrane is selectively permeable, allowing some molecules to pass while blocking others.
- **Membrane proteins**: Membrane proteins are proteins embedded in or associated with the cell membrane, responsible for functions like transport, communication, and acting as enzymes or receptors.
- **Head**: In phospholipids, the "head" is the hydrophilic part that is attracted to water, typically consisting of a phosphate group.
- **Amphipathic**: Amphipathic refers to molecules that have both hydrophilic (water-attracting) and hydrophobic (water-repelling) parts, like phospholipids, which have a hydrophilic head and hydrophobic tails.
- **Fatty acids**: Fatty acids are long chains of carbon atoms with hydrogen atoms attached, forming the hydrophobic tails of phospholipids in cell membranes.
- **Tail**: The "tail" of a phospholipid is the hydrophobic part, made of fatty acid chains, that repels water and faces inward in the bilayer.
- **Semi-permeable**: Semi-permeable means that a membrane allows certain substances to pass through while blocking others, helping the cell control its internal environment.
- **Diffusion**: Diffusion is the movement of molecules from an area of higher concentration to an area of lower concentration, often across a membrane.
- **Cytoplasm**: The cytoplasm is the jelly-like substance inside a cell that surrounds the organelles, providing a medium for chemical reactions.
- **Nucleus**: The nucleus is the control center of a cell, containing the cell's genetic material (DNA) and regulating activities such as growth, metabolism, and reproduction.
- **Organelle**: Organelles are specialized structures within a cell, such as the mitochondria or ribosomes, that perform specific functions necessary for the cell's survival.
- **Barrier**: In the context of the cell membrane, a barrier refers to its role in protecting the cell by regulating what enters and exits, helping to maintain homeostasis.
- **Cell membrane**: The cell membrane is the outer boundary of the cell, made up of a phospholipid bilayer, and it controls the movement of substances in and out of the cell
- Experiment
    - Go around the room dropping every groups favourite color into the milk dish
    - Have the students each have a cotton swab and dip their swab into the dish soap
    - On the count of 3, every student dips their cotton swab into the dish and sees what happens
        - ***(Getting in deep water)/(Artist Role)***
    -
- Phase 3 (10 mins)
    - After completing this experiment, why do you think it's so important to wash your hands? ***(Singing in one's own key)/(Critical Reflector Role)***

        - The hydrophilic nature of soap is able to break down and disturb the germs and dirt on your hands just like it does with the milk
    - What is one thing you learned today? Go around in a circle.
    - ***(Artist Role)*** Make a story: Supervillian or superhero about how phospholipids work to protect the cell

Materials:

- Plates
- Milk
- Dish soap
- Cotton swabs
- Food colouring

CONSENT FORMS USED

INFORMED CONSENT FORM 2C

CALGARY YOUTH SCIENCE FAIR

You are invited to take part in a research study. Before you decide to be a part of this study, you need to understand the risks and benefits. This consent form provides information about the research. If you agree to participate in this research, you will be asked to sign this consent form before taking part. This process is known as *Informed Consent*.

Student Researcher (1): Tala Shukeir **School:** Renert School **School Phone: (**825) 735-5831	**Student Researcher (2):** Lily Ma **School:** Renert School **School Phone: (**403) 604-7104
Project Title: Thinking Outside the Textbook: Cultivating Creativity in the Classroom	
Science Fair Coordinator (Adult Supervisor): Ms. Haney **Name:** Sara Haney	**Phone:** (587) 353-1053

Project Description:
Your child has expressed interest in joining the choice Friday "The Mad Scientist Workshop!" In this class, students will be interacting with fun science experiments and activities such as elephant toothpaste, candy DNA model making, balloon lung model making and many more! Additionally, we would like to measure the creativity scores of participating students using the RAT's test and torrance test. These short tests include writing 10 different words on a slip of paper and coming up with different uses for everyday objects. Their scores will be used in a Calgary Youth Science Fair project and their identities will be kept anonymous. Throughout the Choice Friday, we will be using various teaching techniques like the Torrance Incubation Model and the Mentoring in the Middle Model to try and nurture their creativity. The Torrance Incubation Model aims to promote creativity in the classroom through a three phase system, by first heightening anticipation, fuelling creativity and curiosity, and finally closing with humour or connecting the lesson to the student's life. The Mentoring in the Middle Model has similar goals with the teacher taking on 6 roles: the facilitator, coach, artist, critical reflector, model and scholar to encourage creative thinking in students. In the sixth week of the Choice Friday, creativity scores will be measured once more.

Your child's benefits from participating: Participate in fun and interactive science activities during the Third Choice Friday round.

Your child's risks from participating: None

Your child's time commitment: Every period 3 during the 3rd choice Friday round.

The confidentiality of your data:

The results of this research will be given with all information about individual participants removed. No personal information will be stored on a computer. All information on paper that could be used to identify individuals will be shredded at the end of the research project.

Withdrawal:

Your participation is voluntary, and you have the right to withdraw at any time for any reason. If you wish to do so, please talk to the Science Fair Coordinator/Adult Supervisor.

Review:

This project has been reviewed by the Ethics Committee of the Calgary Youth Science Fair Society and has received permission to proceed.

Feedback:

The results of this research will be provided to you in the public presentation of the Science Fair Project.

By signing below, you are agreeing to participate in this study.

Name _____(please print)

Signature _____ Date _____

If this participant is under the age of 18, permission of a parent or guardian is also required:

I give permission for the person named above to participate in this study.

Name _____ (please print) Phone _____

Signature _____ Date _____

MEDIA WAVERS USED

MEDIA WAIVER CONSENT FORM

CALGARY YOUTH SCIENCE FAIR

We would appreciate it if parents completed this consent form in order to allow their children to be photographed or videoed during the Choice Friday "The Mad Scientist Workshop". If you do not want to have your child photographed/photographs published, indicate this in the section below by leaving the corresponding checkbox(es) empty.

As the parent of a child participating in the "Mad Scientist Workshop" Choice Friday, I agree to the following:

- I understand that my child may be photographed at Renert School during the Choice Friday class.
- I understand that these photographs may be used in a Calgary Youth Science Fair project.
- I give permission for my child's photographs and videos to be shown on Calgary Youth Science Fair's website.
- I hereby irrevocably authorize the use of editing, altering, copying or publishing these photos and or videos for purposes of scientific research.

☐ I **do not consent** to the above

By signing below, you are agreeing to the terms above

Name _____**(please print)**

Signature _____ **Date** _____

If this participant is under the age of 18, permission of a parent or guardian is also required:

I give permission for the person named above to participate in this study.

Name _____ **(please print) Phone** _____

Signature _____ **Date** _____