Junior Scientists - Junior (Ages 8 - 11)

Lesson 3: Chemistry Explosions

Intended Learning Outcomes:

Leadership:

L.C.1 Children learn verbal and non-verbal communication skills that support the promotion of physical activity for others

L.P.1 Children will identify and understand the root of a problem and the steps they can take to find a solution.

Content:

C.3 Gain the ability to identify solutions derived from experimentation

C.4 Demonstrate an understanding of the importance of safety in a science laboratory

C.5 Understand the different aspects that define the world of chemistry and physics

Skills:

S.2 Complete a chemistry experiment with a better understanding of the subject

S.4 Be able to conduct an experiment while following safety protocols

Physical Activity:

P.A.1 Understand that chemistry and physics are present in all types of physical activity

Daily Outline:

- Activating: 35 minutes
  - Activity 1 – Scientist of the Day
  - Activity 2 – Chemical or Physical
- Acquiring: 75 minutes
  - Activity 3: Soda Snake
  - Activity 4: Elephant's Toothpaste
  - Activity 5: Egg in a Bottle
- Applying: 50 minutes
  - Activity 6: Baking Soda Balloons
  - Activity 7: Anti-Gravity Columns
- Debrief and Wrap Up: 30 minutes
  - Activity 8: Brain Teasers
  - Activity 9: Favourite Science Experiments

Adaptations:

- Handouts will be provided for all groups so children can review when necessary
- Groups will be inclusive of all skills and abilities
- Determine which children are more outgoing and which children are shy. This will enable the Leaders to identify the children who will need more assistance and encouragement finding partners for activities and making friends.
- If activities are faster than expected, the Group Leader can facilitate Transition Games
- If activities are taking too long, we can do Activity 6 (Baking Soda Balloons) the next day

Safety:

- Review safety rules when participating in the classroom
- For Activity 3, 4, 6 and 7 (Soda Snake, Elephant's Toothpaste, Baking Soda Balloons and Anti-Gravity Columns respectively): students should have their hair tied. Long sleeves should be folded back and baggy sweaters/jackets should be removed
- For Activities 3 and 5 (Soda Snake and Egg in a Bottle Respectively) participants should not touch the matches or lighter. The Mini U Leader should be wearing protective wear (eye goggles, lab coat etc) when using the lighter or matches.

Activating (35 minutes):

- Activity 1: Scientist of the Day – Antoine Lavoisier (10 minutes)
  - Need Poster!
    Our Scientist of the Day is Antoine Lavoisier. Antoine was an 18th century French chemist. While he was not the first person to breathe oxygen, he was the first to recognize oxygen, one of the most important chemical elements on the periodic table. He was also to realize the important of oxygen in combustion. This discovery was the basis of many current scientific theories! He stated that during the process of combustion, not only is a substantial quantity of air used, but there is also a visible gain in the mass of the substance.
    Some children may not understand the word combustion – so use the example of a fire. If there are wooden logs on fire, the flames consume (or eat) air and the ashes are the "visible material" that the fire creates!

- Activity 2: Chemical or Physical? (25 minutes) – (L.C.1, C.5, P.A.1)
  - Today we will be talking about chemical and physical changes in matter/substances. Ask the participants if they know the difference between a physical change and a chemical change. A physical change in a substance doesn't change what the substance is. Instead it changes the look of it. A chemical change involves a new substance being formed and energy is either absorbed or released.
  - A great example of a physical change is the different forms of water. We talked about ice, the solid form of water, and water (the liquid form of water) in a previous lesson. The gas form of water is steam. However with all three of these states, H2O is still H2O. Therefore, these types of changes are physical changes
  - A great example of a chemical change is combining water and carbon dioxide (H2O and CO2). We would end up with sodium bicarbonate (H2CO3). This is a new compound that we have formed. This is a chemical change.
  - How do we know if it is a chemical change or a physical change? Look for one (or more) of five indicators: Odor (smell), bubbles, heat or light, colour change or a new substance is created (ex. If two liquids make a solid).
  - Have the children guess and explain if the following is a chemical of physical reaction:
    1. Adding Lemon Juice to Red Cabbage Juice (natural pH indicator) - Chemical
    2. Melting Ice Cream – Physical
    3. Metabolism of food in the body – Chemical
    4. Using up energy while running – Chemical
    5. Boiling Water – Physical
    6. Breathing – Chemical
    7. A campfire – Chemical
  - In their groups, can they think of one more physical and one more chemical reaction? Have one member per group share with the class.

- There are a wide variety of examples out there! Chemical and physical reactions are all around us and are constantly happening every day.

Acquiring (75 minutes):

- Activity 3: Soda Snake (30 minutes) – (C.3, C.4, S.2, S.3)
  - Materials Needed: Sand, Rubbing Alcohol, Baking Soda, Sugar, Baking Sheet, Bowl, Spoon, Lighter
    - Have the children assign roles to their hypothesis (Mad Scientist, Observer/Gatherer, Measure Wizard, Instruction Master). Hand out the Soda Snake handout with the steps on this experiment.
    - Procedure:
      1. Place a small mound of sand on the baking sheet
      2. Press your finger on top of the mound to create and indentation large enough to put a golf ball in.
      3. Pour 1/8 cup (around 25 ml) or rubbing alcohol into the dent. (Do this very carefully!) The Rim should be covered with it as well as the inside indent
      4. Mix 1 tsp of baking soda with 4 tsp of sugar
      5. Carefully pour the powder mixture into the dent on top of the rubbing alcohol
      6. Light the mound with a match or using a lighter. When you do this, touch the flame to the powder mixture. Light all around the rim to help form a snake-like shape.
  - What is fuelling the fire? The fire is being fueled by the rubbing alcohol. The snake, made out of baking soda (aka sodium bicarbonate – $NaHCO3$) is breaking down into sodium carbonate ($Na2CO3$), water ($CO2$) and carbon dioxide ($CO2$). The black snake that it leaves behind is carbonate with black carbon particles.

- Activity 4: Elephant's Toothpaste (30 minutes) – (C.3, C.4, S.2, S.4)
  - Materials: Cup or Graduated Cylinder, 3% Hydrogen Peroxide, Dish Soap, Food Colouring, Yeast, Water
  - Ask children what they know about bread and how it is made. What makes it rise? (Answer: Yeast!) Yeast is living single-celled organisms and are found everywhere! This includes on our desks, on our hands, in our noses and in the air!
  - Have the children assign roles to their hypothesis (Mad Scientist, Observer/Gatherer, Measure Wizard, Instruction Master). Hand out the Elephant's Toothpaste handout with the steps on this experiment.
    1. Procedure:
       1. Measure out 100ml of 3% Hydrogen Peroxide. Pour it in a cup or graduated cylinder.
       2. Measure out 1 teaspoon of dish soap into the cup or graduated cylinder.
       3. Pour 1 or 2 drops of food colouring into the cup or graduated cylinder.
       4. Measure a capful of yeast. Pour this into a separate cup and mix with water.
       5. Pour the yeast/water mixture into the cup/graduated cylinder. Remember to write down observations!
  - Participants/Leaders should see a foam/soap like substance after participants have added the yeast. The yeast speeds up a reaction, just like how it speeds up the process of making bread. In this case, it speeds up the breakdown of hydrogen peroxide ($H2O2$) into oxygen ($O2$) and hydrogen ($H2$). We put the soap in the cup/graduated cylinder to capture the oxygen and create bubbles!

- Activity 5: Egg in a Bottle (15 minutes) – (L.P.1, C.4)
  - Materials: Glass bottle, Hard Boiled Egg, Newspaper, Match or Lighter
  - Before you start, ask the students how do you think we could get this egg into the bottle (without smashing it into the bottle or ripping it up in pieces)
  - This will be a demonstration done by the classroom leader. Make sure students are standing or sitting 2 steps away from the bottle. Make sure to have a source of water (sink, water bottle, cup of water) nearby in case!
  - When the newspaper/match burns they heat up the air inside the bottle and release steam (water) as part of the combustion reaction. Steam is a gas, which causes the molecules to expand in the bottle. Some will be forced out of bottle.
  - When the egg seals the top of the bottle, the match quickly runs out of oxygen and the match will go out. As the air in the bottle cools, the volume of air inside the bottle drops due to the condensation of the water vapor and cooling of dry air.
  - When the volume of the air drops, it exerts less pressure on the egg while the air pressure outside of the bottle doesn't change. The egg is pushed into the bottle as the applied force and gravity will overcome friction.
  - Just a note: sometimes not 100% of the egg will go into the bottle, but as long as there is a loud pop noise and at least 50% of the egg goes through I think it will be a success and children will love the demonstration
  - Procedure:
    1. Make sure to rip off the hardboiled egg shell.
    2. With a match or lighter, light a bit of newspaper and immediately put inside the glass bottle.
    3. Put the egg on the top of the jar and wait for the egg to be sucked in!

Applying (50 minutes):

- Activity 6: Baking Soda Balloons! (30 minutes) – (C.4, S.2, S.4)
  - Materials: Empty Water Bottle, Vinegar, Baking Soda, Balloon
  - Vinegar and Baking Soda together create a cool reaction. What happens is that the vinegar creates a Carbon Dioxide gas. Because gas needs more space than what the bottle will allow, it must leave through the neck of the bottle. What will happen if we put a balloon over the neck of the bottle? (Answer: the balloon will inflate!)
  - Children will work in groups of 3 or 4. Have the children assign roles (Mad Scientist, Observer/Gatherer, Measure Wizard). Hand out the Baking Soda Balloons handout with the steps on this experiment.
  - Procedure:
    1. Stretch the opening of the balloon. Pour about 1/3 of a cup of baking soda into the funnel and shake it around a bit until it falls through the funnel and into the balloon. (Try and get as much baking soda in as possible!!!)
    2. Slowly pour vinegar until the bottle is 1/3 full with vinegar.
    3. Gently stretch the opening of the balloon over the opening of the bottle. Make sure the balloon is draping down at the side to keep the baking soda from falling in.
    4. Lift the balloon so that it is completely upright allowing all of the baking soda to fall into the vinegar. Make sure to hold the neck of the bottle/the balloon!
    5. Write down Observations!
    6. At the end of the activity, have each group share their observations with the whole class.
    7. Everyone will help clean up! Make sure the tables are clean.

- Activity 7: Anti-Gravity Columns (20 minutes) – (C.3, C.4, S.2, S.4)
  - Materials: Plates, glass cups, water, tea light candles
  - The flame uses up the oxygen in the cup, creating a low pressure. Atmospheric pressure will try to force itself into the cup. However because the water at the base of the cup has created a tight seal, the pressure difference between the inside and outside of the cup causes the water to raise until pressure inside the cup is equal to the pressure outside.
  - Have the children assign roles to their hypothesis (Mad Scientist, Observer/Gatherer, Measure Wizard, Instruction Master). Hand out the Anti-Gravity Column handout with the steps on this experiment.
  - Procedure:
    1. Put the tea light candle in the middle of the plate
    2. Pour ¼ cup of water (make sure the water does not go on the candle!)
    3. Raise your hand and a MiniU Leader will come around and light your tea light candle
    4. Put the cup over the tea candle light
    5. Write your observations!

Debrief and Wrap Up (30 minutes)

- Activity 8: Brain Teasers (15 minutes)
  - No Materials Needed
  - A student, a lab assistant, a janitor and an old man need to cross a bridge to avoid being eaten by zombies. The student can cross the bridge in one minute, the lab assistant takes two minutes, the janitor takes five minutes and the professor takes 10 minutes. The group only has one lantern which needs to be carried on any trip across. The zombies arrive in 17 minutes and the bridge can only hold two people at a time. How can you get across in the time allowed (17 minutes) so you can cut the rope bridge and prevent the zombies from stepping on the bridge and catching you!
    i. The student and lab assistant go together first and the student returns, putting three minutes total on the clock. Then the professor and the janitor take the lantern and cross together, taking 10 minutes (putting the total clock at 13 minutes). The lab assistant grabs the lantern, crosses in two minutes and then the student and lab assistant cross together in just the nick of time – a total of 17 minutes!

- Activity 8: Favorite Science Experiments (15 minutes)
  - No Materials Needed
  - Time to reflect! Ask children what they liked about each of the activities that we did today?