IMHOTEP'S LEGACY ACADEMY

7.3 Gases & Volumes: CO_2 & 0_2

Grade 7 Activity Plan

Reviews and Updates

7.3 Gases & Volumes

Objectives:

1. To show that gases occupy volume by inflating a balloon with the carbon dioxide produced from the reaction between vinegar and baking soda
2. To show the ability of carbon dioxide to displace air and extinguish a flame
3. To show that gas expands and contracts, and moves from areas of high pressure to areas of low pressure
4. To show that gases exert pressure that can create a force strong enough to move an object
5. To show that gases are less dense than liquids

Keywords/concepts: Air, compress, atmosphere, energy, particles, atoms, fumes, inflate, pressure.

Take-home product: lava lamp

Segment	Details
African Proverb and Cultural Relevance (5 min.)	"Words are like bullets; if they escape, you can't catch them again." **Senegal**
Pre-test (10 min.)	Each student is given a balloon of a different shape and size. They are given time to inflate them and try to in their words explaining how gases work to fill containers. Hopefully students will think along the lines of particles being really spread out.
Background (10 min.)	What are gases? How are their particles arranged? How do they move to fill their container? How are they different from other states of matter. K*ey words to be used later as part of evaluation: Air, compress, atmosphere, energy, particles, atoms, fumes, inflate, pressure*. (Optional "Behaviour of Matter" online activity)
Activity 1 (10 min.)	The addition of vinegar to baking soda is an acid-base reaction that produces CO_2. Use the carbon dioxide to inflate a balloon.
Activity 2 (5 min.)	Mix baking soda and vinegar, and use the resulting CO_2 to extinguish a candle flame.
Activity 3 (5 min.)	Go outside and watch as film canisters full of water and Alka-Seltzer explode upwards from the pressure of carbon dioxide.
Activity 4 (15 min.)	Cover a burning candle with a jar so that the candle is in an air-tight room sealed by the water at the ground. Watch as the oxygen and candle wax react to produce water and carbon dioxide.
Activity 5 (20 min.)	Make a lava lamp using Alka-seltzer, water and vegetable oil.
Post-test (10 min.)	Gases Word Search

Suggested interpretation of the proverb: You should be very careful what you say because once you've said it, you cannot take those words back. In today's activity, you will learn about an equally elusive state of matter – the gaseous state. Gas particles expand to fill whatever container they are in. Unlike liquids or solids they do not stick together; you cannot clean up a gas leak like you can clean up a spill. Similar to words, once gas particles escape, they are out in the world and hard to catch.

BACKGROUND INFORMATION

There are three basic states of matter: solid, liquid, and gas. Everything on Earth is made up of microscopic particles (molecules, ions, or atoms), and the speed and density of these particles determine which state of matter an object is. The properties of the three elements are very easily defined and identified.

Solid: anything that holds a particular size and shape. The particles in a solid are tightly packed and don't make a lot of movements. There is not much free space in between the particles, so there is very little room for the particles to move.

Liquid: anything that has size or volume, but does not have a shape. Liquid can take the shape of any container. Liquid particles are not as close together as particles in a solid, and move around each other much more freely. They have no regular shape or arrangement and move freely.

Gas: has no color, shape or size. The particles in a gas move freely at high speeds. There is a lot of free space in between the particles, and they take the shape of any container

When water is in a gaseous state (steam), the particles remain in constant motion, bouncing off one another and the walls of the container, speeding up or slowing down depending upon how they collide. The gas spreads out to fill the whole container. Hot gas particles move with more energy than do cold ones. When water is in a liquid state, the particles move around and remain much closer to one another than they do as a gas. Forces of attraction keep them in very close proximity, but not "locked in place." If poured, the liquid would flow and change shape. The particles of a hot liquid move more quickly than those of a cold liquid. When water is in a solid state (ice), the atoms no longer move around; they only vibrate in place. Forces between the atoms hold them into a solid shape that does not change. The atoms in hotter solids vibrate more strongly than those in colder ones.

Volume is the amount of space an object takes up. Volume is the quantity of three-dimensional space occupied by a liquid, solid, or gas. Common units used to express volume include liters, cubic meters, gallons, milliliters, teaspoons and ounces.

Additional resources:
http://www.onlineschools.org/resources/kidsmatter/
"Behaviour of Matter" activity for kids:
http://www.bbc.co.uk/schools/ks3bitesize/science/chemical_material_behaviour/behaviour_of_matter/activity.shtml

Activity 1: Gases and Volumes

Purpose: To show that gases have volume by inflating a balloon with the carbon dioxide produced from the reaction between vinegar and baking soda

Item	**Quantity (10 students)**
Plastic soda bottle	10
Vinegar	1L
Baking Soda	60g
Balloon	10
Spoon	5
Funnel	5
Measuring spoon	1

Procedure:

1. Carefully funnel 6Tbsp of vinegar into bottle.
2. Dry funnel with paper towel and use it to fill balloon with 1 teaspoon of baking soda.
3. Keeping the balloon hanging down, stretch the balloon over the neck of the bottle.
4. When the neck is tightly fitted, lift balloon quickly so baking soda falls into bottle (shake gently)
5. Hold neck of balloon while it inflates.

Activity 2: Put out a fire with CO_2

Purpose: To show the ability of carbon dioxide to displace air and extinguish a flame

Item	**Quantity (for mentor)**
Flat Bottom Flask	1
Vinegar	6 Tbsp
Baking Soda	2 Tbsp
Saucer	1
Measuring Spoon	1
Funnel	1
Long Candle	1
Modelling clay	Small piece
Match/ Lighter	1

Procedure:

1. Light candle and move it away from anything on table.
2. Put 2 tablespoons of baking soda into bottle using funnel.
3. Put 6 tablespoons of vinegar into the bottle (all at once).
4. Immediately place thumb or palm over mouth of bottle.
5. Tilt bottle close to candle and carefully take thumb away.

NOTE: If needed, use the modelling clay to hold the candle in place within the candle holder

Activity 3: Pocket Rocket

Source: http://www.bbc.co.uk/bang/handson/fizzbang.shtml

Purpose: To show that gases exert pressure that can create a force strong enough to move an object

Suggested format: Do this activity outside to avoid breaking anything and making a mess

Item	**Quantity (10 students)**
Empty film canister	10
Alkaseltzer tablets	5
Water	~10 Tbsp

Procedure:

1. Put water in the film canister so it's about half way full.
2. Break an Alkaseltzer roughly in half.
3. Get the lid of the canister ready.
4. Drop the piece of tablet in the water and snap the lid on as quickly as you can.
5. Put the canister - lid downwards - on the ground.
6. **SAFETY:** step back at least one metre.

NOTE: If the film canister doesn't pop, check to make sure that the seal is air tight

Activity 4: Why does the water rise?

Purpose: To show that gas expands and contracts, and moves from areas of high pressure to areas of low pressure

Item	**Quantity (for mentor)**
Long Candles	1
Cylinder	1
Candle holder	1
Shallow dish (large enough to fit jar)	1
Match/ Lighter	1
Food Colouring	1 Pack

Procedure:

1. Light candle and place in holder
2. Fill a shallow dish with ¾ coloured water and place candle into the middle of it
3. Place the jar over it slowly
4. Observe the level of water in the cylinder.
5. Wait until the candle goes out and then look at how far the water has moved.

Additional resources:
https://www.stevespanglerscience.com/lab/experiments/why-does-the-water-rise/

Activity 5: Making a Lava Lamp

Source: https://www.stevespanglerscience.com/lab/experiments/bubbling-lava-lamp/

Purpose: To show that gases are less dense than liquids

Item	**Quantity (10 students)**
Plastic soda bottle 300-400mL	10
Soda bottle caps	10
Vegetable oil	3L
Alka-seltzer	30 tablets
Food Colouring	1 colour
Water	1L

Procedure:

1. Fill the bottle 3/4 full with vegetable oil.
2. Fill the rest of the bottle with water (almost to the top but not overflowing).
3. Add about 10 drops of food coloring. Be sure to make the water fairly dark in color. Notice that the food coloring only colors the water and not the oil. Hmmm...
4. Divide the Alka-Seltzer tablet into 8 pieces.
5. Drop one of the tiny pieces of Alka-Seltzer into the oil and water mixture. Watch what happens. When the bubbling stops, add another chunk of Alka-Seltzer. It's just like a lava lamp!
6. When you have used up all of the Alka-Seltzer and the bubbling has completely stopped, screw on the soda bottle cap. Tip the bottle back and forth and watch the wave appear. The tiny droplets of liquid join together to make one big lava-like blob.

Additional Resource:
Lava lamp video - http://www.youtube.com/watch?v=WayviQkusxI

Post-test

Gases Evaluation Sheet

Gases Word Search

X Z N Z F O O W Q B P A E N S K

O X Y G E N B H I R Q D M O Q P

C N Q R A R S B E J I H Z O E K

G C H G E C S S D X P T V L R T

K N U E D V S J O I K D E L Y N

Z J I N S U X I I O B Z Y A H E

S T Z C R P D C F P V R M B L T

S C H E N N A T M O S P H E R E

M B Y Z O U K R G J Z R T F B A

G C D B F Q O A T U R A Z U P P

Q H R E J L S B A I L I S M N U

M A O Z N E Y C H F C P A E E H

C E G R S E A W N H A L A S B L

Q F E L L I R I J Y N D E N F N

U B N Q T X F G S M O T A S U Q

S S E R P M O C Y P Q L E R O K

AIR
ATMOSPHERE
ATOMS
BALLOON
BOUNCING
CARBON DIOXIDE
COMPRESS
ENERGY
FUMES
GASES
HYDROGEN
INFLATE
OXYGEN
PARTICLES
PRESSURE