iSTEAM After School

CHEMICAL REACTIONS

CURRICULUM

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CURRICULUM SCHEDULE

Week #	Dates (Monday thru Friday)		Experiment
1	5-Sep	10-Sep	Elephant's Toothpaste
2	12-Sep	17-Sep	Rainbow pH
3	19-Sep	24-Sep	Dancing Raisins
4	26-Sep	1-Oct	Inflating Balloons
5	3-Oct	8-Oct	Changing Temperature
6	10-Oct	15-Oct	Slime
7	17-Oct	22-Oct	Pop Rocks and Soda
8	24-Oct	29-Oct	Apple Science
9	31-Oct	5-Nov	Lava Lamps
10	7-Nov	12-Nov	Magic Milk
11	14-Nov	19-Nov	Citrus Volcanoes
12	21-Nov	26-Nov	Oobleck
13 (see week 1)	28-Nov	3-Dec	Elephant's Toothpaste
14 (see week 2)	5-Dec	10-Dec	Rainbow pH
15 (see week 3)	12-Dec	17-Dec	Dancing Raisins

iSTEAM After School FULL SUPPLY LIST

SUPPLIES TO PURCHASE/BRING*

- Baby oil or vegetable oil
- Beans
- Brown rice
- Coca-Cola soda
- Diet Coke
- Flour
- Full-fat milk
- Gala apples
- Grape juice (or other dark-colored juice)
- Lemon juice
- Lemons
- Limes
- Oranges
- Plain seltzer water
- Raisins
- Shaving foam (non-scented is best)
- Sprite or other clear, carbonated drink
- Sugar
- Tapioca starch (or alternative starch)
- Vinegar (16 fluid oz)
- Water (at school/classroom)

SUPPLIES PROVIDED IN ISTEAM BOX

- Alka Seltzer tablets
- Baby shampoo
- Baking soda
- Balloons
- Bowls (plastic or Styrofoam)
- Cornstarch
- Cream of tartar
- Cutting board
- Dish soap / Hand soap / Sponges
- Food coloring
- Funnels (4)
- Hydrogen peroxide
- Knife
- Measuring spoons
- Metal mixing bowls
- Milk of magnesia
- Paper for each class
- Pencils
- Plastic cups
- Plastic Water bottles (empty)
- Plastic spoons
- Plates (Paper)
- Plates (8 waterproof for Lesson 10)
- Pop Rocks
- Popsicle sticks
- Q-tips
- Quick-rise yeast
- Saline contact lens solution
- Salt
- School glue
- Small plastic bags
- Thermometers

FOR ILLINOIS ONLY

*For instructors in ILLINOIS, some supplies on the "Purchase" list will already be included in the supply bin, check what you have before going to the store.

- First Aid Kit
- Scissors (1)
- Shaving Cream
- White Board
- Vinegar (16 fluid oz)
- Rags
- Paper Towels

iSTEAM After School

SUPPLY LIST
BREAKDOWN BY CLASS

Week #	Dates (Monday thru Friday)		Experiment	All Supplies	Included in iSTEAM Supply Box	Please Buy/Bring (NOT included in supply box)
1	5-Sep	10-Sep	Elephant's Toothpaste	• 4 empty plastic soda bottles • 2 bottles of hydrogen peroxide • Quick-rise yeast • 1 bottle of dish soap • Food coloring • 4 plates • 4 plastic cups • 4 spoons • Water	• 4 empty plastic soda bottles • 2 bottles of hydrogen peroxide • Quick-rise yeast • 1 bottle of dish soap • Food coloring • 4 plates • 4 plastic cups • 4 spoons	• Water (from sink at school)
2	12-Sep	17-Sep	Rainbow pH	• 15 small clear, plastic cups • 15 plastic spoons • 1 bottle of grape juice • 4 lemons • 1 knife • 1 cutting board • 1 container of cream of tartar • 1 bottle of baby shampoo • 1 container of baking soda • 1 bottle of milk of magnesia • 12 pieces of paper and 12 pencils	• 15 small clear, plastic cups • 15 plastic spoons • 1 knife • 1 cutting board • 1 container of cream of tartar • 1 bottle of baby shampoo • 1 container of baking soda • 1 bottle of milk of magnesia • 12 pieces of paper and 12 pencils	• 4 lemons • 1 bottle of grape juice (or dark colored juice)
3	19-Sep	24-Sep	Dancing Raisins	• 12 clear plastic cups • 12 plates • 1 bottle of vinegar (32 fl oz) • 1 box of baking soda • Large bag of raisins or 6 small boxes of raisins • 1 1L bottle of Sprite or other clear, carbonated drink • 1 box of brown rice • 1 bag of beans • 12 pieces of paper and 12 pencils • 12 teaspoons or small plastic spoons	• 12 clear plastic cups • 12 plates • 1 box of baking soda • 12 pieces of paper and 12 pencils • 12 teaspoons or small plastic spoons	• 1 bottle of vinegar (32 fl oz) • Large bag of raisins or 6 small boxes of raisins • 1 1L bottle of Sprite or other clear, carbonated drink • 1 box of brown rice • 1 bag of beans
4	26-Sep	1-Oct	Inflating Balloons	• 6 clear plastic water bottles (empty) • 1 bottle of vinegar • 1 box of baking soda • 12 balloons • 12 pieces of paper and 12 pencils • 3 funnels • Measuring spoons	• 6 clear plastic water bottles (empty) • 1 box of baking soda • 12 balloons • 12 pieces of paper and 12 pencils • 3 funnels • Measuring spoons	• 1 bottle of vinegar (32 fluid oz)

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SUPPLY LIST
BREAKDOWN BY CLASS

Week #	Dates (Monday thru Friday)		Experiment	All Supplies	Included in iSTEAM Supply Box	Please Buy/Bring (NOT included in supply box)
5	3-Oct	8-Oct	Changing Temperature	• 12 clear plastic cups • 1 bottle of vinegar (32 fluid oz) • 1 box of baking soda • 1 small bottle of hydrogen peroxide • 2-3 packages of dry quick-rise yeast • 6 thermometers • 6 teaspoons • 12 pieces of paper and pencils	• 12 clear plastic cups • 1 box of baking soda • 2-3 packages of dry quick-rise yeast • 6 thermometers • 6 teaspoons • 12 pieces of paper and pencils	• 1 bottle of vinegar (32 fluid oz) • 1 small bottle of hydrogen peroxide
6	10-Oct	15-Oct	Slime	• 1 cup of school glue • 1 travel-size bottle of saline solution • 1 can of shaving foam (non-scented is best) • 1/4 cup of baking soda • Measuring spoons • 12 plastic cups • 12 spoons • Food coloring (optional)	• 1 cup of school glue • 1 travel-size bottle of saline solution • 1/4 cup of baking soda • Measuring spoons • 12 plastic cups • 12 spoons • Food coloring (optional)	• 1 can of shaving foam (non-scented is best)

7	17-Oct	22-Oct	Pop Rocks and Soda	• 9-10 packets of Pop Rocks
				• 1 bottle each of
				  ◦ Coke
				  ◦ Diet Coke
				  ◦ 7-Up or Sprite
				  ◦ Seltzer Water
				• 4 funnels
				• 8 balloons
				• Extra bottles of water and/or juice (optional)
				• 12 pieces of paper and 12 pencils
					• 9-10 packets of Pop Rocks
					• 4 funnels
					• 8 balloons
					• 12 pieces of paper and 12 pencils
						• 1 bottle each of
						  ◦ Coke
						  ◦ Diet Coke
						  ◦ 7-Up or Sprite
						  ◦ Seltzer Water
						• Extra bottles of water and/or juice (optional)

8	24-Oct	29-Oct	Apple Science	• 4 Gala apples • Knife to cut apples • Cutting board • 3 paper plates • 3 large bowls • 1 bottle of lemon juice • 1 mixture of salt water (dissolve 1-2 teaspoons of salt in water) • 1 bottle of plain water • 12 pieces of paper and 12 pencils	• Knife to cut apples • Cutting board • 3 paper plates • 3 large bowls • 12 pieces of paper and 12 pencils	• 4 Gala apples • 1 bottle of lemon juice • 1 mixture of salt water (dissolve 1-2 teaspoons of salt in water) • 1 bottle of plain water

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SUPPLY LIST
BREAKDOWN BY CLASS

Week #	Dates (Monday thru Friday)		Experiment	All Supplies	Included in iSTEAM Supply Box	Please Buy/Bring (NOT included in supply box)
9	31-Oct	5-Nov	Lava Lamps	• 6 clear plastic soda bottles • 2 bottles of baby oil or vegetable oil (clearer is better) • Water • Food coloring • 6 Alka Seltzer tablets • 12 pieces of paper and 12 pencils (optional)	• 6 clear plastic soda bottles • Food coloring • 6 Alka Seltzer tablets • 12 pieces of paper and 12 pencils (optional)	• 2 bottles of baby oil or vegetable oil (clearer is better) • Water (from sink at school)
10	7-Nov	12-Nov	Magic Milk	• 6 Styrofoam or plastic plates • 3 cups full-fat milk • 3-4 Food coloring options • Liquid dish soap • 6 plastic cups • Q-tips	• 6 Styrofoam or plastic plates • 3-4 Food coloring options • 6 plastic cups • Q-tips	• 3 cups full-fat milk • Liquid dish soap
11	14-Nov	19-Nov	Citrus Volcanoes	• 3 lemons • 3 limes • 3 oranges • 2 boxes of baking soda • 1 knife and cutting board • Food coloring (optional) • 6 popsicle sticks • 6 spoons • 6 large bowls or plates • 12 pencils and 12 pieces of paper (optional)	• 2 boxes of baking soda • 1 knife and cutting board • Food coloring (optional) • 6 popsicle sticks • 6 spoons • 6 large bowls or plates • 12 pencils and 12 pieces of paper (optional)	• 3 lemons • 3 limes • 3 oranges
12	21-Nov	26-Nov	Oobleck	• 12 bowls • 12 spoons • 4 cups cornstarch • 4 cups flour • 4 cups tapioca starch (or alternative starch) • Water • 6 pencils and pieces of paper (optional)	• 12 bowls • 12 spoons • 4 cups cornstarch • 6 pencils and pieces of paper (optional)	• 4 cups flour • 4 cups tapioca starch (or alternative starch) • Water
13	28-Nov	3-Dec	Elephant's Toothpaste	*See Week 1*		
14	5-Dec	10-Dec	Rainbow pH	*See Week 2*		
15	12-Dec	17-Dec	Dancing Raisins	*See Week 3*		

CLASS RULES

- Always wash your hands
- Have an adult supervise or complete tasks that require use of hot or sharp objects
- Listen to the instructions carefully
- Raise your hand, if you want to ask a question
- Ask for permission, if you need to use bathroom
- Act like a scientist and have fun!

ACT LIKE A SCIENTIST

What does it mean? Scientists believe that through observation, study and analysis everything happening around us can be understood and explained.

Scientists have developed some scientific methods:

- Observe
- Ask questions
- Do research
- Make educational guesses, called hypothesis
- Test hypothesis
- Analyze experiment results

Try to act like a scientist in the class by observing, asking questions, and analyzing.

REMINDER: ALLERGIES

Some experiments may include food items. Make sure all ingredients or food items are NUT FREE, as some kids may have severe allergies to nuts. Do not allow students to eat any food items during class unless ALL students' allergies have been verified.

IMPORTANT REMINDERS

1. All items for class purchased by instructors will be 100% reimbursed by iSTEAM. Remember to submit your receipts via the employee portal so your reimbursement can be processed.
2. Any questions or concerns, please contact your Program Coordinator for help!

UNIT CONVERSIONS

VOLUME:

CUP, TABLESPOON (tbsp) and TEASPOON (tsp) to MILLILITERS

1	cup	=	16	tablespoons	=	48	teaspoons	=	240	ml
3/4	cup	=	12	tablespoons	=	36	teaspoons	=	180	ml
2/3	cup	=	11	tablespoons	=	32	teaspoons	=	160	ml
1/2	cup	=	8	tablespoons	=	24	teaspoons	=	120	ml
1/3	cup	=	5	tablespoons	=	16	teaspoons	=	80	ml
1/4	cup	=	4	tablespoons	=	12	teaspoons	=	60	ml
1	ml	=	1	cm^3						
1	tablespoon	=	15	ml						
1	teaspoon	=	5	ml						

GLOSSARY

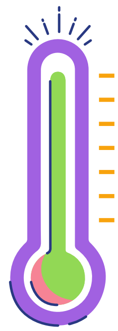
- Acid is any substance that in water solution tastes sour, changes blue litmus paper to red, reacts with some metals to liberate hydrogen, reacts with bases to form salts, and promotes chemical reactions.
- Atom is the basic building block for all matter in the universe.
- Base is a substance that can neutralize the acid by reacting with hydrogen ions.
- Carbon dioxide is a molecule that contains two oxygen atoms and one carbon atom. It can be found as a gas in the air, or as a solid in the form of dry ice, which is very cold. Carbon dioxide is produced from breathing and from burning certain substances called fossil fuels.
- Catalyst is a substance able to increase the rate of a chemical reaction without itself being consumed or changed by the reacting chemicals
- Citric acid is a weak organic acid. It occurs naturally in citrus fruits. It acts like a preservative. It is also used to add a sour (acidic) taste to foods
- Consistency is a degree of density, firmness, viscosity
- Density is a word we use to describe how much space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass)
- Endothermic absorbs heat and cools the surroundings
- Exothermic releases heat, causing the temperature of the immediate surroundings to rise.
- Gas is air-like substance that can move around freely or they might flow to fit a container.
- Hydrogen is a gas that has no color, odor, or taste
- Hydroxide consists of a hydrogen and an oxygen atom which are held together by a covalent bond.
- Ion is a particle like an atom that has lost or gained electrons.
- Magma consists of molten, or hot liquefied, rock located deep below the Earth's surface
- Microorganism are living things that are too small to be seen with the naked eye
- Molecule is two or more atoms joined (or "bonded") tightly together.
- Non-Newtonian fluid is a fluid in which the viscosity changes with the applied shear force
- Non-polar molecules are molecules that do not have any electrical charges or partial charges.
- Oxygen a chemical element found in the air as a colorless odorless tasteless gas that is necessary for life.
- pH level of a substance is a measure of how acidic or basic the substance is.
- Reaction is any substance that is consumed or used up during the reaction.
- Solid is a state of matter that retains its shape and density when not confined.
- Viscosity is the property of a liquid that describes how fast or slowly it will flow.
- Yeasts are tiny one-celled organisms. Some are harmful to humans, but most are very useful, especially in making bread and other food and drinks.

AT THE CORE

Since the whole session is dedicated to observing different chemical reactions, please make sure kids know and can identify the signs of chemical reaction.

CHEMICAL REACTION

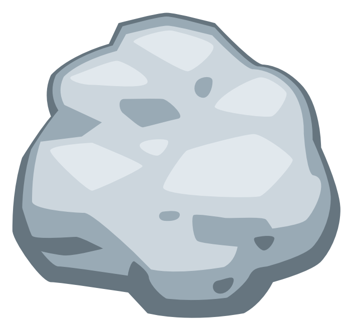
A chemical reaction is where different substances (reactants) are changed into a new substance (product)



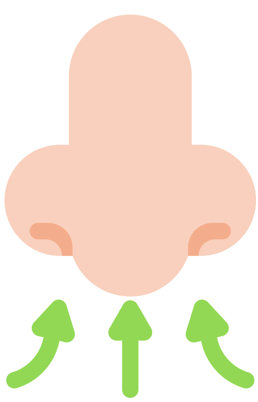
CHANGE OF TEMPERATURE

EMISSION OF LIGHT

CHANGE OF COLOR



PRODUCTION OF A SOLID



CHANGE OF SMELL

PRODUCTION OF GAS

LESSON 1:
ELEPHANT'S TOOTHPASTE

Students will learn about chemical reactions through an experiment with hydrogen peroxide and yeast.

OBJECTIVES

- How is elephant's toothpaste created?
- What is a catalyst in the experiment?
- What is the evidence that a chemical reaction has occurred

SUPPLIES

- 4 empty plastic soda bottles (about 16 oz)
- 2 bottles of hydrogen peroxide (the 3% version you can get at the store)
- 4 packages of quick-rise yeast
- Water
- 1 bottle of dish soap
- Food coloring (optional)
- 4 plates to hold the water bottle (and to contain any mess!)
- 4 plastic cups
- 4 spoons

PRE-TEST

5-7 min

Tell the students that this session will be all about chemical reactions. Ask students:

- What do you think a chemical reaction is?
- Then, give children the following scenarios. They must try to identify the ones that are chemical reactions and the ones that are not. They will get one point for each correct answer. (Answer key: Chemical reactions are marked with - CR).

1. Ice melting
2. Rust on your bike - CR
3. Dying your hair a different color - CR
4. Plants growing through photosynthesis - CR
5. Boiling water
6. Baking cookies - CR
7. Digestion - CR
8. Dissolving sugar in water
9. Mixing sand and water
10. Fireworks - CR

Review the answers with students and let them tally up how many they got correct. Then, ask them to discuss as a group, what do you think the chemical reactions have in common? Using this, how would they define a chemical reaction?

A chemical reaction is where different substances (reactants) are changed into a new substance (product). A chemical reaction produces a new material and is usually irreversible.

There are often clues that show that a chemical reaction has occurred. These include change of color, change of temperature, change of smell, production of gas, production of a solid, or emission of light.

In chemical reactions, a catalyst can be used to speed up the reaction.

LESSON 1

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Reaction
- Catalyst
- Yeast
- Atoms
- Reactant
- Product
- Exothermic reaction

HOOK

3-5 min

- What would elephant's toothpaste look like?
- How do you think we could make pretend elephant's toothpaste using the materials you see here?
- Let students brainstorm and discuss ideas for how it might be created.

HYPOTHESIS

3-5 min

Using the ideas from their discussions, have students predict:

- How is elephant's toothpaste created?
- What chemical reaction occurs?
- Which materials interact to cause the chemical reaction?

EXPERIMENT

20-25 min

1. Place students in groups of 3.
2. Prepare the experiment by adding about 1/2 cup of hydrogen peroxide into each water bottle.
3. Have students place the water bottles into the bowl or tray to contain the mess.
4. Let students choose the food coloring of their choice and add a few drops to the water bottle.
5. Then, have students add a squirt of dish soap to the bottle and swirl it to mix.
6. In a separate bowl, have students use a spoon to mix a packet of yeast with (if possible, warm) water until the yeast is nearly dissolved.
7. Then, have students carefully pour the yeast mixture into the water bottle and observe the results.
8. When the reaction is complete, ask students to carefully touch the foam and make note of any observations.

LESSON 1

EXTENSION

7-10 min

If there is extra time, the students can extend this activity by experimenting with variables.

They can repeat the experiment with different amounts of yeast.

They should find that the less yeast, the slower the reaction since yeast is the catalyst.

Alternatively, they can try adding the yeast dry without water and seeing the impact that this makes.

OBSERVATION

5 min

Ask students to discuss: What happened when yeast was added to the water bottle?

EXPLANATION

5-10 min

- Hydrogen peroxide is a mixture of hydrogen atoms and oxygen atoms. It is usually stored in brown or dark colored bottles because light causes it to break down. When hydrogen peroxide breaks down, it separates into water and oxygen. This usually happens slowly over time.
- In this experiment, a catalyst, yeast, was added to speed up the breakdown of the hydrogen peroxide. Yeast contains a chemical called catalase which helps to quickly break the hydrogen peroxide down into water and oxygen. Oxygen is a gas and when the breakdown occurs, small oxygen gas bubbles are created. Usually, we cannot see these oxygen gas bubbles because they quickly pop. However, when dish soap is added to the mixture, it creates surface tension, allowing the oxygen gas bubbles to get trapped. This causes a foam to form.
- The foam felt warm to touch because the reaction was an exothermic reaction, meaning it produced heat. The foam is just water, soap and oxygen but is often referred to as 'elephant's toothpaste' because it looks like a big squirt of toothpaste. But be careful, it will not taste good so do not try it!

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Make sure to leave the classroom the way you found it.

LESSON 2:
RAINBOW pH

Students will learn about acids, bases, and pH levels by exploring how they react with everyday items to produce different colors.

OBJECTIVES

- What is pH level?
- How do acids and bases interact to cause chemical reactions in cabbage?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 15 small clear, plastic cups
- 15 plastic spoons
- 1 bottle of grape juice (or beet juice)
- 4 lemons
- 1 knife
- 1 cutting board
- 1 container of cream of tartar
- 1 bottle of baby shampoo (clear and fragrance-free is best)
- 1 container of baking soda
- 1 bottle of milk of magnesia
- 12 pieces of paper and 12 pencils

HOOK

3-5 min

What color can grapes be? What is your favorite?

Red grapes has a red hue because of anthocyanin, a type of natural pigment. When anthocyanin mixes with warm water, it is quickly extracted and turns water a purple color.

STUDY

5-10 min

Acids and bases are two kinds of chemicals. Nearly every liquid is either an acid or a base, depending on its ions. Acids have mainly hydrogen ions. Bases have mainly hydroxide ions. To measure how acidic or basic something is, scientists use the pH scale. The pH scale ranges from 0 to 14. The range 0 to 7 is for acids (0 being the most acidic) and from 8 to 14 is for bases (with 14 being the most basic). A 7 on the scale is considered neutral.

Tell the students that today they are going to study chemical reactions with acids and bases, using red grape juice. Show the students the 5 liquids being used in the experiment today.

HYPOTHESIS

3-5 min

Have the students copy down or create a chart like the scientist worksheet. Have them predict whether each liquid is an acid or a base. Then, have them predict what color the grape juice will turn when it is mixed with that liquid.

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LESSON 2

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

TIP

It may help to draw a model scale on the board for students (like right), showing them the range and labelling it from acidic to basic.

KEYWORDS

- pH level
- Acid
- Base
- Ion
- Hydrogen

EXPERIMENT

20-25 min

Before starting the experiment, remind the students that these materials are all household materials, but can be dangerous if not used correctly. Ensure that they do not touch the liquids where possible and mix carefully.

1. Split students into 3 groups.
2. Start by giving each group 5 cups. Have them fill each cup with a small amount of one liquid - lemon juice, cream of tartar, baby shampoo, baking soda, and milk of magnesia.
3. Then, add the grape juice to fill the cup halfway and stir with a spoon. (Note: Use a different spoon for each different cup so you do not mix the liquids.) As they mix the solution, make a note on their chart of what happens to each different liquid.

OBSERVATION

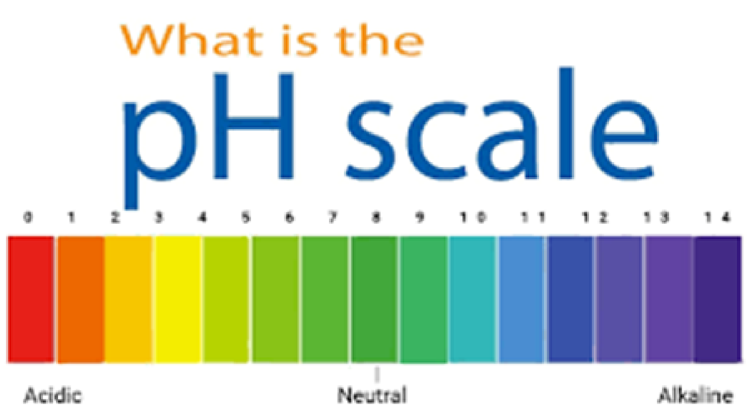
5-10 min

Ask students to discuss:

- What happened when the purple juice was added?
- What colors did the liquids turn?

Students should note that when the juice was added, the cups of water turned a different color.

- pink-red (lemon juice)
- lilac (cream of tartar)
- purple (baby shampoo)
- blue (bicarbonate of soda)
- green (milk of magnesia)



LESSON 2

CONCLUSION

5-10 min

Ask students to share their findings.

- Which liquid do you think is the most basic?
- Which do you think is the most acidic?
- Can you order them from most acidic to basic?
- Why do you think the liquids changed colors?

The lemon juice was the most acidic while the milk of magnesia was the most basic. Students should notice that when lined up in order, they form a rainbow from pink to purple to blue to green. Students should note that a chemical reaction occurred here (because the change of color) but may not know exactly what happened.

EXPLANATION

5-10 min

Anthocyanin is an acid-base indicator. This means that when it mixes with an acid or a base, it changes color to indicate the pH level. Today, most pH indicators are man-made, but anthocyanin is a natural occurring pH indicator.

When it mixes with an acid (less than 7 on the pH scale), anthocyanin turns red. When it mixes with a base (8 or higher), anthocyanin turns blue or green. When it mixes with a neutral liquid (7), it stays purple.

As we learned in the 'Study' section, acids and bases are classified according to their hydrogen or hydroxide ions. Basic solutions accept hydrogen ions while acidic solutions donate hydrogen ions. Anthocyanin responds to the levels of hydrogen ions in a liquid.

A chemical reaction occurs when the levels of the hydrogen ions in the solution changes, altering the structure and thus changing the color of the liquid. When anthocyanin mixes with the different liquids, it causes them to donate or accept ions, thus changing the structure and the color to indicate the pH level.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Dispose of the liquids carefully. Make sure to leave the classroom the way you found it.

EXTENSION

5-10 min

If there is extra time, ask students how they think they could change the colored water back to a purple color.

Allow students to experiment with their mixtures and the resources in attempts to change it back. Ask them to use their knowledge of acids and bases to help them.

Students should find that to turn an acidic solution back to a purple color (neutral) they need to add a base to it. To turn a basic solution back to neutral they will have to add an acid to it.

Students may also begin to discover strong acids and strong bases (lemon juice and milk of magnesia) vs weak acids and weak bases (cream of tartar and baking soda). For example, if they add a strong base to a weak acid, the solution will turn basic rather than neutral.

LESSON 2

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Acid or Base?	Hypothesis - What do you think will happen?	Observation - What does happen?
Lemon Juice			
Baby Shampoo			
Baking Soda			
Cream of Tartar			
Milk of Magnesia			

LESSON 3: DANCING RAISINS

Students will learn about acids, bases, and pH levels by exploring how they react with everyday items to produce different colors.

OBJECTIVES

- What happens when vinegar and bakingsoda mix?
- How does this solution affect the density of different foods?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 12 clear plastic cups
- 12 plates
- 1 bottle of vinegar (32 fluid oz)
- 1 box of baking soda
- Large bag of raisins or 6 small boxes of raisins
- 1 1L bottle of Sprite or other clear, carbonated drink
- 1 box of brown rice
- 1 bag of beans
- 12 pieces of paper and 12 pencils
- 12 teaspoons or small plastic spoons

Extension Supplies:

- 3-4 glue sticks or 4-5 school glue bottles
- Paper Plates or Construction paper
- Bin or cake tin to catch things

HOOK

3-5 min

- Review with students what acids and bases are from the previous lesson. Show them the baking soda and vinegar and ask them if each is an acid or a base?
- Acids are liquids with a pH of 0-6, while bases have a pH of 8-14. Neutral liquids have a pH of 0.
- Tell students that today they will experiment with acids and bases, while exploring the density of other objects.

HYPOTHESIS

3-5 min

Have the students copy down or create a chart like the scientist worksheet. Then, have them predict:

- What happens when baking soda and vinegar mix?
- If we add raisins to this new solution, do you think they will sink or float?
- If we add rice to this new solution, do you think it will sink or float?
- If we add beans to this new solution, do you think they will sink or float?

EXPERIMENT

20-25 min

1. To start the experiment, give each student a clear plastic cup and plate (to put the cup on for any mess).
2. Have each group fill their glass halfway of the way up with vinegar (approximately 2/3 cup).
3. Then, add some raisins.
4. Next, add a teaspoon or two of baking soda.
5. Observe and record what happens to the raisins.

Have students dispose of the solution and repeat the experiment but this time adding rice instead of raisins. Observe and record what happens to the rice. Have students dispose of the solution and repeat the experiment, but this time adding beans instead of raisins/rice.

LESSON 3

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- pH level
- Acid
- Base
- Carbon Dioxide
- Density
- Surface

OBSERVATION

5-10 min

Ask students to discuss:

- What happened when the baking soda and vinegar mixed?
- Did the raisins sink or float?
- Did the rice sink or float?
- Did the beans sink or float?

Students should note that when the baking soda was added, the mixture fizzed. The material added to the cup began to 'jump' up and down.

CONCLUSION

3-5 min

Ask students to share their findings.

- Why did the baking soda and vinegar fizz?
- What type of solution was made by the baking soda and vinegar?
- Why did the materials added to the solution jump up and down?

Students should note that a chemical reaction occurred. Students should apply their knowledge of acids and bases to realize that they have combined one acid and one base to make a neutral solution. Many different predictions may be developed for why the materials jumped up and down.

EXPLANATION

5-10 min

When the baking soda and vinegar combine, a chemical reaction occurs. Vinegar is an acid and contains hydrogen ions. Baking soda is a base and contains sodium and bicarbonate ions. When vinegar and baking soda combine, they react, and the ions change to form new substances. As a result, carbon dioxide is formed, creating bubbles and foam.

In this experiment, when the materials (raisins, rice, and beans) were dropped into the vinegar, they sank to the bottom. This was because each material had a greater density than the vinegar. However, when the baking soda is added and the solution reacts to make carbon dioxide, the carbon dioxide bubbles begin to stick to the raisins/rice/beans.

LESSON 3

EXTENSION

5-10 min

If there is extra time, ask students to predict if the results would be the same if they used a different type of object or even a different liquid.

Art Project:
Utilizing a glue stick or standard school glue and ask the kids to create a design with the glue on a paper plate or piece of construction paper. Then dump some beans or rice or even a mix of the two onto the glue and let rest until close to the end of class. (or 2-5 minutes) Then dump the excess rice and beans off the design and let the kids take home their dancing raisin project!

Tip: Avoid a giant mess by using a cake tin, paper towels, or paper plates underneath the project when dumping handfuls of rice or beans onto the glue

EXPLANATION

When the carbon dioxide bubbles are on the surface of the material, it changes the density of the material. As more carbon dioxide bubbles stick to the surface of the material, its density becomes less than that of the solution and therefore the rice/raisins/beans rise to the top of the cup.

When the raisin/rice/bean reaches the surface of the liquid, the carbon dioxide bubbles begin to pop. As they pop, this makes the density of the material Increase again and it sinks back down. This process continues until all the carbon dioxide bubbles have dissolved, or not enough are left to change the density of the material to less than that of the density of the solution.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Dispose of the liquids carefully. Make sure to leave the classroom the way you found it.

LESSON 3

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Sink or Float?	Observation - What happened?
Raisins		
Rice		
Beans		

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LESSON 4:
INFLATING BALLOONS

Students will experiment with the reaction of baking soda and vinegar by creating carbon dioxide to inflate a balloon.

OBJECTIVES

- What happens when vinegar and baking soda mix?
- How do balloons inflate?
- Does the amount of vinegar and baking soda correlate to the amount of carbon dioxide produced?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 6 clear plastic water bottles (empty)
- 1 bottle of vinegar
- 1 box of baking soda
- 12 balloons
- 12 pieces of paper and 12 pencils
- 3 funnels
- Measuring spoons

HOOK

3-5 min

Blow up a balloon in front of students. Ask students:

- What is inside the balloon? How does it inflate?
- Explain that you breathe in oxygen and breathe out carbon dioxide. The balloon is filled with carbon dioxide.

HYPOTHESIS

3-5 min

Discuss this first question orally:

- How could we get the balloon to inflate using the materials visible (water bottle, baking soda, vinegar, and balloon)?

Help students to recall from the last lesson that baking soda and vinegar create carbon dioxide. This is used to inflate a balloon. Then, have the students copy down or create a chart like the scientist worksheet. Then, using the information from the hook, have them predict:

- How long does it take for a balloon to inflate using a chemical reaction?
- Does the amount of vinegar and baking soda affect the amount of carbon dioxide produced?
- Does swirling the bottle make the balloon inflate faster or slower?

KEYWORDS

- Acid
- Base
- Carbon Dioxide
- Catalyst
- Gas
- Inflate

LESSON 4

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

EXPERIMENT

20-25 min

1. Split students into teams of 3 or 4.
2. To start, have each group begin by filling one water bottle 1/3 of the way with vinegar (about 1/4 cup).
3. Then, have the students use the funnel to add 2-3 teaspoons of baking soda to the balloon. It is helpful if one student holds the balloon, another holds the funnel and the third adds the baking soda. The baking soda should rest in the top of the balloon, away from the end you use to blow it up.
4. Carefully, without spilling any of the baking soda, attach the balloon to the water bottle. Hint: One student can pinch the balloon, sealing the baking soda in, while another uses the open end of the balloon to attach it to the bottle.
5. On the count of three, have one group member lift the balloon, allowing the baking soda to fall into the water bottle with vinegar.
6. Assign 1 or 2 groups to whirl the balloon and the other 1-2 groups to keep it steady. Compare results.
7. Have children observe what happens to the balloon.
8. Finally, students will use their second water bottle and repeat the experiment. This time, they can increase the amount of baking soda used. Students will time this experiment and observe what happens when these amounts are changed.

Note: Monitor the amount of baking soda is added, otherwise the balloons will pop!

LESSON 4

OBSERVATION

5-10 min

Ask students to discuss:

- What happened when the baking soda and vinegar mixed?
- Which experiment took the longest to inflate? Which took the shortest amount of time?
- Which experiment produced the biggest balloon?

Students should note that when the baking soda was added, the mixture fizzed, and the balloon began to inflate. When students added more baking soda, the balloon should have taken longer to inflate. When students swirled the bottle, it should have taken the shortest amount of time to inflate. The biggest balloon should have been created when more baking soda was added.

CONCLUSION

3-5 min

Ask students to share their findings.

- What impact did swirling the bottle have?
- What impact did changing the baking soda have?
- Why did the balloon stop inflating?

Swirling the bottle should have sped up the reaction, causing the balloon to Inflate quicker. Increasing the amount of bicarbonate of soda should have made the balloon inflate to a larger size and should have increased the time it inflated for. The balloon stopped inflating when the mixture stopped fizzing.

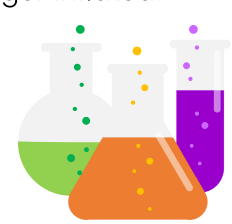
EXPLANATION

5-10 min

When the baking soda and vinegar combine, a chemical reaction occurs. Vinegar is an acid and contains hydrogen ions. Baking soda is a base and contains sodium and bicarbonate ions. When vinegar and baking soda combine, they react, and the ions change to form new substances. As a result, carbon dioxide is formed, creating bubbles and foam.

The carbon dioxide began to Inflate the balloon when it was produced because the balloon was sealing the bottle. When the carbon dioxide gas filled the bottle and ran out of room, it began to fill the balloon. Swirling the bottle acted like a catalyst to speed up the reaction. Swirling the bottle made the bicarbonate of soda and vinegar mix at a more rapid speed, increasing the speed at which the carbon dioxide was produced.

When more baking soda was added to the balloon, there was a larger chemical reaction because there was more hydrogen, sodium, and bicarbonate ions reacting, thus making more carbon dioxide. When the mixture stopped fizzing, the ions have reacted, and a new substance was formed. There was no longer an ongoing reaction, so no further carbon dioxide was produced. Therefore, the balloon no longer inflated.



LESSON 4

EXTENSION

5-10 min

If you have extra time, have students blow up one balloon, as quickly as they can, timing their try. Who is faster at blowing up the balloon, a person, or a chemical reaction?

CLEAN UP & DISMISSAL

Students must then clean their workspace. Dispose of the liquids carefully. Make sure to leave the classroom the way you found it.

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - How long do you think it will it take to inflate?	Hypothesis - Size of the balloon (Large, medium, or small)	Observation - How long does it take to inflate?	Observation - Size of the balloon (Large, medium, or small)
2 teaspoons of bicarbonate of soda, no swirling				
2 teaspoons of bicarbonate of soda, swirling				
_?_ teaspoons of bicarbonate of soda, no swirling				

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LESSON 5: CHANGING TEMPERATURE

Students will experiment with endothermic and exothermic reactions, measuring the temperature of different chemical reactions.

OBJECTIVES

- What happens when hydrogen peroxide and yeast mix?
- How is temperature affected in different chemical reactions?
- What impact does temperature have on yeast?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 12 clear plastic cups
- 1 bottle of vinegar (32 fluid oz)
- 1 box of baking soda
- 1 small bottle of hydrogen peroxide
- 2-3 packages of dry quick-rise yeast
- 6 thermometers
- 6 teaspoons
- 12 pieces of paper and pencils

Additional supplies for Extension Activity

- 6 empty water bottles (optional)
- 6 balloons (optional)
- 1 bag of sugar (optional)
- Water source (optional)

HOOK

5-10 min

Ask students to reflect on the experiments from previous weeks. What happens when baking soda and vinegar mix? What gas is created?

Review with students that at the start of the sessions, we said one way to tell if a chemical reaction took place is a change in temperature. Today, students will explore the temperature of different chemical reactions. How can we measure temperature? What is the unit of measure?

HYPOTHESIS

3-5 min

Ask the students to copy down or create a chart like the scientist worksheet.

Tell them they will be doing two main experiments, combining baking soda and vinegar, and combining yeast and hydrogen peroxide. Then, using the information from the hook, have them predict:

- Which experiment will cause an endothermic reaction?
- Which experiment will cause an exothermic reaction?
- What gases are made from each experiment?

LESSON 5

KEYWORDS

- Endothermic
- Exothermic
- Oxygen
- Carbon dioxide
- Catalyst
- Gas
- Microorganism

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

EXPERIMENT

20-25 min

1. Students will be split into pairs. Each pair is given a clear plastic cup.
2. Fill the cup one third of the way with vinegar.
3. Put the thermometer in the liquid. Have students read the thermometer after one minute and write this temperature as the 'Starting Temperature' on their worksheet.
4. Then, add 1-2 teaspoons of baking soda.
5. Gently swirl the cup.
6. After one minute, read the new temperature and write this down. Be sure to note any other signs of a chemical reaction.
7. Next, students will use their second plastic cup.
8. Fill it with 1 teaspoon of hydrogen peroxide.
9. Put the thermometer in the liquid. Have students read the thermometer after one minute and write this temperature as the 'Starting Temperature' on their worksheet.
10. Then, add 1-2 teaspoons of yeast. Gently swirl the cup.
11. After one minute, read the new temperature and write this down. Be sure to note any other signs of a chemical reaction.

OBSERVATION

5-10 min

Ask students to discuss:

- ·What happened when the bicarbonate of soda and vinegar mixed?
- ·What happened when the hydrogen peroxide and yeast mixed?
- ·What signs were there that a chemical reaction had occurred?

Students should note that when the bicarbonate of soda was added, the mixture fizzed. When the hydrogen peroxide and yeast mixed, bubbles were formed. It is clear a chemical reaction occurred because the bubbles are gas bubbles, showing a new substance was created. Also, during this experiment, the temperatures changed, signaling a chemical reaction.

CONCLUSION

3-5 min

Ask students to share their findings.

- Which experiment caused an endothermic reaction? Support this with your data.
- Which experiment caused an exothermic reaction? Support this with your data.
- What gases are made from each experiment?

The bicarbonate of soda and yeast were colder when mixed then the starting temperature, making it an endothermic reaction. The hydrogen peroxide and yeast were warmer when mixed than the starting temperature, making it an exothermic reaction. Students should recall from previous lessons that bicarbonate of soda and vinegar creates carbon dioxide. They may also predict that yeast and hydrogen peroxide make the same gas, as it also bubbles, or they may remember form previous lessons that it creates oxygen.

EXPLANATION

5-10 min

A chemical reaction occurs when the baking soda and vinegar combine. Vinegar contains hydrogen ions and baking soda contains sodium and bicarbonate ions. When vinegar and baking soda mix, they react, and the ions change to form new substances. As a result, carbon dioxide is formed, creating bubbles and foam.

This was an endothermic reaction because energy was used to break down the baking soda and vinegar to create the carbon dioxide. Since energy was released and used during the reaction, the temperature of the substance went down, and the substance became colder. This makes it an endothermic reaction.

A chemical reaction also occurs when hydrogen peroxide and yeast combine. Hydrogen peroxide contains hydrogen ions and peroxide ions, while yeast is a microorganism. When they combine, a chemical in the yeast causes the hydrogen peroxide to break down into water and oxygen. The bubbles formed in this experiment were oxygen bubbles.

This was an exothermic reaction because more energy was created when the yeast and hydrogen peroxide mixed. The extra energy caused the temperature to rise, and heat was created. This signified that an exothermic reaction took place.

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LESSON 5

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Endothermic or Exothermic?	Starting Temperature	Experiment Temperature	Observation - What signs were there of a chemical reaction?
Baking Soda and Vinegar				
Yeast and Hydrogen Peroxide				

EXTENSION

5-10 min

If you have extra time and access or hot water, allow students to experiment with yeast further. Have children add warm water to the empty soda bottle. Tip: Use the thermometer to make sure the water Is between 90-100 F.

Add 1 packet of yeast (2-3 teaspoons worth) and 1 teaspoon of sugar to the bottle. Quickly cover the opening of the bottle with a balloon. Observe what happens.

Students should notice that the balloon expands. Yeast is a microorganism and can reproduce or grow in the right environment (90-100 F). The warm water activated yeast and when it combined with the sugar, the yeast began to grow and carbon dioxide was released. The carbon dioxide filled the water bottle and then began to fill the space in the balloon, inflating it.

Students may notice that if they used slightly colder or hotter water, the balloon would not inflate because the yeast would not be activated at these temperatures. Therefore, no growth would occur, thus no carbon dioxide would be produced.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Dispose of the liquids carefully. Make sure to leave the classroom the way you found it.

LESSON 6: SLIME

Students will explore how slime is made through a chemical reaction, experimenting with how the reactants can alter the consistency.

OBJECTIVES

- ☑ How is slime made?
- ☑ What chemical reaction occurs?
- ☑ How does shaving foam affect the consistency of the slime?
- ☑ What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 1 cup of school glue (about 4 bottles of 4 fluid ounces each)
- 1 travel-size bottle of saline solution (approx. 4 fluid ounces; must contain boric acid and sodium borate)
- 1 can of shaving foam (non-scented is best)
- 1/4 cup of baking soda
- Measuring spoons
- 12 plastic cups
- 12 spoons
- Food coloring (optional)

HOOK

5-10 min

Ask students what they know about slime.

- Has anyone made slime before?
- Is it a solid or a liquid?
- Is all slime the same consistency?

Slime is a non-Newtonian substance. This means it is neither a liquid nor a solid. When slime, and other non-Newtonian substances, are squeezed, agitated, or stirred, they are more like a solid. You have seen this if you have ever tried to rip slime apart. However, when left to sit, it is like a liquid and flows if you, for example, put your finger in it.

HYPOTHESIS

3-5 min

Discuss with students:

- What chemical reaction occurs when making slime?
- How does the consistency of the glue change when mixed with the other materials?

Tell students that they will be making slime, one set with shaving foam and one set without. Have them predict:

- How will shaving foam affect the consistency of the slime?
- What will the consistency of the slime without shaving foam be like?

LESSON 6

KEYWORDS

- Reactant
- Consistency
- Ion
- Borate
- Liquid
- Solid
- Non-Newtonian
- Viscosity

TIP

A splash of saline solution on your hands will stop the slime from sticking to you as you begin to knead it. Be careful just to add a splash and not too much or the slime with become very rigid!

EXPERIMENT

15-25 min

Students will each make their own slime, split the class into two so one half of the class makes slime recipe #1 and the second half of the class makes slime recipe #2.

Slime Recipe #1

1. TEACHER ONLY: fill 6 cups with 1 tablespoon of school glue each, distribute cups to each student
2. Distribute spoons to each student.
3. Mix in 1 tablespoon of water.
4. TEACHER ONLY: add ONE drop of food coloring.
5. Students can stir in 1/4 teaspoon of baking soda.
6. Start with 1 or 2 DROPS of saline solution and begin to stir quickly and vigorously until the mixture begins to pull away from the cup and the slime is formed. If the slime is too sticky, add a drop or two more of saline solution.
7. Finally, begin to knead the slime. It may appear stringy at first but will soon begin to take form as you knead it.

Slime Recipe #2

1. TEACHER ONLY: fill 6 cups with 1 tablespoon of school glue each, distribute cups to each student
2. Distribute spoons to each student.
3. Mix in 1/2 tablespoon of water.
4. Mix in 1 tablespoon of shaving cream.
5. TEACHER ONLY: add ONE drop of food coloring.
6. Students can stir in 1/4 teaspoon of baking soda.
7. Start with a couple DROPS of saline solution and begin to stir quickly and vigorously until the mixture begins to pull away from the cup and the slime is formed. If the slime is too sticky, add a drop or two more of saline solution.
8. Finally, begin to knead the slime. It may appear stringy at first but will soon begin to take form as you knead it.

LESSON 6

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

OBSERVATION

5-10 min

Ask students to discuss:

- Are the two slime mixtures the same?
- Did they react the same or differently?

Students should notice that the slime with the shaving foam is fluffy while the slime without the shaving foam is denser. Therefore, the shaving foam slime is bigger in volume. When forming the slime, both types reacted the same way, expect for their consistency.

CONCLUSION

3-5 min

Ask students to share their findings.

- What happens to the consistency of slime when shaving foam is added?
- How does the consistency of the glue change when mixed with other materials?
- What chemical reaction occurs to make slime?

Students should note that when the shaving foam is added, the slime Increases in volume and appears softer and fluffier. As they play with it repeatedly, it begins to lose this volume and 'fluffy' feeling. The glue starts with less viscosity (it moves more freely and pours more easily). However, when it is mixed with the other materials and slime is formed, the viscosity changes and becomes higher. It does not pour easily and move as freely. Children may note that we know a chemical reaction has occurred because we have an entirely new substance (slime).

LESSON 6

EXTENSION

5-10 min

If students have time to expand on this experiment, try exploring the viscosity of the slime.

- Let the slime rest for 2-3 minutes. Then try to get it out of the cup. What do you notice about it? (It has lower viscosity.)
- Try and rip the slime in half. What happens? It should tear completely in half like a solid would.
- Move the slime between your hands, pressing on it. How does it feel now compared to when it was resting in the cup? (It should have a higher viscosity.)
- Move the shaving foam slime between your hands repeatedly for 3-5 minutes. What do you notice about its consistency? It should lose some of the air that was in it from the shaving foam, giving it less volume and 'fluff'.

EXPLANATION

5-10 min

In this reaction, slime is created when the saline solution and the glue mix. The saline solution has two key reactants - sodium borate and boric acid. These mix with the baking soda to form borate ions. Glue is made up of long, repeated strands (or molecules). The molecules flow past each other to keep it as a low viscosity liquid.

When the borate ions from the baking soda and saline solution are added to the glue, it makes the molecule strands from the PVA connect and tangle, until it becomes thick and rubbery, turning into slime. Both slime and glue are polymers. Polymers are large molecules, made from small, repeated molecules. In the case of glue, they are not connected and flow freely, giving it low viscosity. In slime, they are tangled and connected so do not flow as freely, giving it a higher viscosity. When slime is stretched, the molecule chains begin to untangle and straighten out until they break apart (causing the slime to break apart).

The shaving foam makes the slime bigger in volume and fluffier. When shaving foam comes out of a can, it expands because air is added to it. When we add the shaving foam to our slime mixture, it adds air to the slime, making it bigger in volume and fluffier. As you play with the slime or store it for a longer period, the air from the shaving foam will slowly decreasing, affecting the volume and 'fluffiness' of the slime.

This is a chemical reaction because the boric acid and baking soda make borate ions. These ions then mix with the glue to create a new polymer with a higher viscosity. This new substance, slime, was created through a chemical reaction.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Let each student take home one piece of slime. Tell them to store it in an airtight container at home for best results. Make sure to leave the classroom the way you found it.

LESSON 7:
POP ROCKS AND SODA

Students will experiment with the chemical reaction of pop rocks and soda, exploring different variables to assess the differences in reactions.

OBJECTIVES

- What is the product of the chemical reaction?
- Does one type of soda create a bigger chemical reaction than the others?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 9-10 packets of Pop Rocks
- 1 bottle each of
  - Coke
  - Diet Coke
  - 7-Up or Sprite
  - Seltzer Water
- 4 funnels (or these can be shared between groups)
- 8 balloons
- Extra bottles of water and/or juice (optional)
- 12 pieces of paper and 12 pencils

KEYWORDS

- Carbon dioxide
- Catalyst
- Gas
- Carbonation

HOOK

5-10 min

Ask students if they are familiar with Pop Rocks. Let students try a few.

- What happens when you put Pop Rocks in your mouth?
- Why do you think this happens?

HYPOTHESIS

3-5 min

Discuss with students:

- What do you think will happen when Pop Rocks and a soda combine?
- What product do you think will be produced from the chemical reaction?

Then, have students draw out the 'Scientist's Worksheet' and make the following predictions:

- Which soda will produce the biggest chemical reaction?
- Which soda will produce the smallest chemical reaction?

EXPERIMENT

20-25 min

1. Split students into groups of 4.
2. Each group will test a different soda. Give each group one type of soda and 2 packets of Pop Rocks.
3. Ask each group to stretch the balloons over the funnel and fill each two with packets of Pop Rocks.
4. Then, pinch the end of the balloon so the Pop Rocks are sealed off from the balloon opening.
5. Attach the balloon to the soda bottle without combining the Pop Rocks and soda.
6. Once the bottle is set up groups can take turns to raise the balloon so that the Pop Rocks fall into the soda. Observe what happens to the balloons.

LESSON 7

OBSERVATION

5-10 min

Ask students to discuss:

- What happened to the balloons?
- Were all the balloons the same size?
- What did you notice happening inside the bottle?

Students should report that the balloons began to inflate. It is likely that the balloons will be slightly different sizes. If any balloon does not inflate at all, this is probably due to a broken seal where the balloon was not secured properly to the bottle. Inside the bottle, students will see some foam or bubbles created.

CONCLUSION

3-5 min

Ask students to share their findings.

- What happened when Pop Rocks and a soda combined?
- What product do you think was produced from the chemical reaction? Explain your answer.
- Which soda produced the biggest chemical reaction?
- Which soda produced the smallest chemical reaction?

When the Pop Rocks and the soda combined, a chemical reaction occurred. Students should be able to note this from the bubbles that were created and the gas that filled the balloon. Students may remember from previous balloon experiments or their taste of Pop Rocks from last lesson that carbon dioxide should have been produced. Usually, Diet Coke produces the biggest chemical reaction while 7 Up or Ginger Ale produces the smallest reaction, but this will be dependent on the drinks you chose. Have students compare results to see which drink produced the biggest and smallest reaction for your group.

LESSON 7

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

EXTENSION

5-10 min

If students have time to expand on this experiment, try one of these alternatives:

- Have students repeat the experiment but with bottled water and juice. How do the results change?

These experiments should produce the following results:

- Water and juice should still create some carbonation from the Pop Rocks, but significantly less than the soda or fizzy drinks. This is because the water and juice do not have carbonation, so there is less of a buildup or volume of carbon dioxide.

EXPLANATION

5-10 min

Pop Rocks are candy that has been heated to evaporate the water and then combined with pressurized carbon dioxide. If you look closely at Pop Rocks, you may even be able to see some of the carbon dioxide bubbles. When Pop Rocks are combined with a liquid, like water or saliva, the candy dissolves and the pressurized carbon dioxide is released. The pressurized carbon dioxide bubbles pop when they are released, making the sound we associate with Pop Rocks.

In this experiment, the Pop Rocks combined with soda. Soda has added carbon dioxide bubbles, which is how it becomes carbonated, or fizzy. When the Pop Rocks combine with the soda, the carbon dioxide bubbles in the soda attach to the Pop Rocks. The candy shell of the Pop Rocks breaks down, releasing the carbon dioxide from the candy and from the soda. The carbon dioxide released from both the Pop Rocks and the soda is a gas and begins to fill the soda bottle and eventually when enough builds up, begins to inflate the balloon.

Different types of soda may have different amounts of carbon dioxide in them, which is why the results between fizzy drinks varied. Diet Coke usually has the most carbonation. 7 Up or Ginger Ale usually is less carbonated than other fizzy drinks.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Liquids can be disposed of safely. Make sure to leave the classroom the way you found it.

LESSON 7

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Size of the balloon (Large, medium, or small)	Observation - What happened inside the bottle?	Observation - Size of the balloon (Large, medium, or small)
Diet Coke			
Coke			
7 Up/Sprite			
Plain Seltzer Water			

LESSON 8:
APPLE SCIENCE

Students will explore the science behind why apples brown and experiment with how to prevent this chemical reaction.

OBJECTIVES

- Why do apples brown?
- How do you stop apples from browning?
- What chemical reaction occurs?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 4 Gala apples
- Knife to cut apples (for the teacher only)
- Cutting board
- 3 paper plates
- 3 large bowls
- 1 bottle of lemon juice
- 1 mixture of salt water (dissolve 1-2 teaspoons of salt in water)
- 1 bottle of plain water
- 12 pieces of paper and 12 pencils

See **Extension** for additional supplies

HOOK

5-10 min

Cut an apple in half for students to see. Watch as it begins to brown. Have students guess how long this will take. Time this to see how long it takes and who was the closest.

HYPOTHESIS

3-5 min

Discuss with students:

- Why do you think apples brown when cut?

Then, have students draw out the 'Scientist's Worksheet' and make the following predictions:

- Which liquid will delay the apple from browning for the longest?
- Which liquid does not help the apple stop from browning?
- Why does a liquid stop the apple from browning?

EXPERIMENT

15-25 min

1. Split students into groups of 4.
2. Give group an apple cut into 5 slices (1 per student plus a control) and one paper plate.
3. Make a bowl of each liquid (lemon juice, water, and salt water) and have students submerge one apple slice in each liquid for 1-3 minutes (keep this time consistent for each liquid) and then lay it on their plate next to the correct label.
4. Have students time the apples to see how long they take to start turning brown.
5. Check the apples at 3–5-minute intervals. After 15 minutes, record the results of which apple is the brownest.

LESSON 8

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Oxidation
- pH
- Enzyme
- Melanin
- Ascorbic acid
- Oxygen

OBSERVATION

5-10 min

Ask students to discuss:

- Did all the apples brown at the same rate?
- Did the apple that turned brown first turn the brownest overall?

Students should report that the apples browned at different rates. The apple that browned first should have been the brownest at the end of the experiment.

CONCLUSION

3-5 min

Ask students to share their findings.

- Which liquid stopped the apple from browning the longest?
- Which liquid does not help stop the apple from browning?
- Why do you think liquids stopped the apples from browning?

Students should note that the salt water was able to stop the browning the best. It may be that students do not see much of a difference between the browning of the apples which were in lemon juice and salt water. The plain water was the least effective but was still more effective than the control slice with no liquid. Students may have various explanations as to why the apples have browned but remind them to use their knowledge of chemical reactions to help them make their predictions.

LESSON 8

EXPLANATION

5-10 min

When apples are cut, the inside of the apple is exposed to oxygen. The oxygen makes an enzyme in the apple, called polyphenol oxidase, begin to react, and oxidize, creating new chemicals called o-quinones. The o-quinones then react with amino acids and it produces melanin, which is what creates the brown color you see on the apple.

Different types of apples have various levels of polyphenol oxidase, so may brown at quicker or slower rates. The browning of apples is a chemical reaction because the oxygen and the enzymes create a new chemical, melanin, which changes the apple's color. We know from our learning at the start of the session that one sign of a chemical reaction is a change of color.

To slow the browning process, the idea is to coat the apple in a protective layer that stops the oxygen from reaching the polyphenol oxidase in the apple, so that the chemical reaction does not occur.

The liquid used in the experiment slowed the oxidation process in diverse ways. Plain water coated the outside of the apple and helped prevent the oxygen from reaching the polyphenol oxidase in the apple. However, after a short amount of time, the water was not able to continue to keep the oxygen away from the apple flesh and the apple began to brown.

Lemon juice is well known for preventing apples from browning. Lemon juice works because it contains ascorbic acid and has a low pH (it is very acidic). Ascorbic acid creates a barrier with the oxygen and the polyphenol oxidase. Additionally, polyphenol oxidase reacts best at a pH level of 5-7. Lemon juice is a level 2, which prevents the polyphenol from beginning to react, as the apple has a lower pH level with lemon juice on it.

Salt water was the most effective way of preventing the oxidation of the apple. Salt water contains chloride ions which prevent the polyphenol oxidase from reacting. It also contains water which acts as a barrier between the oxygen and apple flesh. The combination of these two things makes it take the longest for the oxidation process to affect the apple and for the melanin to be produced.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Liquids and apples can be disposed of safely. Make sure to leave the classroom the way you found it.

LESSON 8

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Which will brown the quickest?	Observation - How long did it take to start browning?	Observation - Which was the brownest after 15 minutes?
Lemon Juic			
Water			
Salt Water			

EXTENSION

5-10 min

If students have time to expand on this experiment, try one of these alternatives:

- Have students repeat the experiment but with other liquids. With their knowledge of pH levels, can they accurately predict which liquids will slow the browning the best?
- Have students choose one liquid (lemon juice or salt water) and repeat the experiment on several different types of apples. Students can then assess which apple type browns the quickest.

Optional supplies for extension:

- 1 can of pineapple juice
- 1 bottle of milk
- 1 bottle of vinegar
- 2-3 apples of different varieties

LESSON 9:
LAVA LAMPS

Students will experiment with density and chemical reactions by making their own homemade lava lamp.

OBJECTIVES

- What happens when water and baby oil mix?
- How do Alka Seltzer tablets react with water?
- How does density affect a chemical reaction?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 6 clear plastic soda bottles
- 2 bottles of baby oil or vegetable oil (clearer is better)
- Water
- Food coloring
- 6 Alka Seltzer tablets
- 12 pieces of paper and 12 pencils (optional)

See **Extension** for additional supplies

HOOK

5-10 min

If you have a lava lamp, turn it on and let children observe what happens. If you do not have a lava lamp, ask children If they know what a lava lamp is. Where have they seen one before?

A lava lamp is a decorative light which has special wax inside it. When the wax heats up, it rises to the top of the lamp and as it cools it falls back down to the bottom. This gives the image of a constantly moving shape through the lamp.

Tell children that today they will be making their own homemade lava lamps by creating a chemical reaction.

HYPOTHESIS

3-5 min

Discuss with students:

- What happens when water and oil combine?
- What happens when water and Alka Seltzer tablets combine?
- How does this reaction look like a lava lamp?

EXPERIMENT

20-25 min

1. Split students into pairs and give each pair a plastic water bottle.
2. Fill bottle about 2/3 of the way up with oil.
3. Then, top up the rest of the cup with water so that there is about an inch of room left in the cup. Have students observe what has happened with the water and oil. They can write this down if they wish.
4. Add drops of food coloring to the cup. Observe what happens to the food coloring.
5. Then, drop in one Alka Seltzer tablet and screw the cap onto the bottle. Observe what happens.

LESSON 9

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Carbon dioxide
- Catalyst
- Gas
- Density
- Molecule
- Atom

OBSERVATION

5-10 min

Ask students to discuss:

- What happened when the water and oil were put in the cup together?
- What happened when the food coloring was added to the solution?
- What did you notice in the cup when the Alka Seltzer was added?

Students should note that the oil and water did not mix, the oil sat on top of the water. When the food coloring was added, it sank to the bottom of the cup. When the Alka Seltzer was added, bubbles appeared, and the food coloring began to move throughout the liquid.

CONCLUSION

3-5 min

Ask students to share their ideas.

- Why did the water and oil separate?
- Why did the food coloring sink to the bottom of the cup?
- What evidence was there that a chemical reaction occurred?

Students may note that the water and oil separated because the water was heavier than the oil. They may also note that the food coloring sank to the bottom because it was heavier. Some students may be familiar with density and offer this as an explanation. Students should note that the evidence of a chemical reaction was the formation of bubbles in the liquid.

EXPLANATION

5-10 min

The oil and water do not mix because of their different densities. All liquids are made up of molecules and atoms. How tightly packed together these molecules are affects the density of the liquid. Water has a greater density than oil, which means it is heavier and therefore sank to the bottom of the cup. Meanwhile, the oil floated on top because it is less dense.

When the food coloring was added, it also sank to the bottom of the cup because it has a greater density than oil. The food coloring and the water had similar density levels which is why they were able to mix.

When the Alka Seltzer was added to the liquid, it sank to the bottom as well because of its density. Alka Seltzer is made up of citric acid and sodium bicarbonate. When the tablet enters the water, it begins to dissolve in the water and carbon dioxide is formed.

The carbon dioxide is visible in the liquid as bubbles. The bubbles begin on the bottom of the cup where the Alka Seltzer is. The carbon dioxide bubbles are lighter than water and oil, so begin to rise to the top of the cup. As they do this, the bubbles carry some of the colored water with them. The colored bubbles rise to the top of the oil, where they pop, and the carbon dioxide is released into the air. When the carbon dioxide is released, the colored water that has risen to the surface once again has a greater density than the oil so sinks back down to the bottom.

The bubbles continue to rise and fall until the reaction between the Alka Seltzer, and water is complete, at which point no more carbon dioxide is being produced. As the bubbles rise and fall, they move color throughout the cup, similar to the way the colored wax moves through a lava lamp, therefore creating your own homemade lava lamp!

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Liquids can be disposed of safely. Make sure to leave the classroom the way you found it.

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LESSON 9

EXTENSION

5-10 min

If students have time to expand on this experiment, try one of these alternatives:

- Have students repeat the experiment using one of the following catalysts:
  - Use baking soda and vinegar rather than Alka Seltzer. Mix two spoons of baking soda with your water before adding it to the cup. Add the food coloring as above. Slowly pour vinegar into the cup and watch the reaction.
  - Use salt rather than Alka Seltzer. Add a large amount of salt to your oil/water/food coloring. The salt is denser than the oil and as it falls through the oil, it will carry some of the oil into the water. Once the salt dissolves in the water, the oil that was carried down will immediately float back up to join the top oil layer. This is a slower reaction and will produce fewer bubbles.
- Repeat the experiment but this time try adding more or less oil.
- Repeat the experiment but use warm or hot water rather than room temperature water.

If you try one of these extension activities, ask students:

- How were the results of this reaction similar or different to the original experiment?
- Why do you think this reaction was different?

Children should note that baking soda and vinegar has a similar result to the Alka Selzer. Salt produces the same bubbles but at a much slow rate. Adding more oil means the colored bubbles have further to travel, but also that there is less water for the tablet to react with. Adding less oil means that the colored bubbles haves less space to travel to the surface, so the appearance of moving colored bubbles is reduced. Using hot or warm water speeds up the reaction (acts as a catalyst) because it makes the tablet dissolve faster and thus a quicker production of carbon dioxide.

LESSON 10: MAGIC MILK

Students will experiment with how soap interacts with milk fats to create a beautiful plate of art.

OBJECTIVES

- Name at least 2 molecules found in milk.
- Describe how soap interacts with fats.
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 6 Styrofoam or plastic plates (one plate per group)
- 3 cups full-fat milk (1/2 cup milk per group)
- 3-4 Food coloring options
- Liquid dish soap (1 Tbsp x 6 groups)
- 6 plastic cups (1 cup per group)
- Q-tips

HOOK

5-10 min

What's the first thing we should do in the kitchen before we start to make anything? Wash your hands! Why? Have students discuss why washing their hands is important. Answers may include: to get rid of dirt and bacteria; to make sure we aren't passing around germs; to prevent our food from getting germs on it.

Guide the discussion by prompting students to think about washing with soap vs. without soap. Soap removes bacteria, while water may not be effective enough to get rid of all germs and dirt. Conclude the discussion by introducing today's experiment: we will be adding soap and food coloring to different liquids to understand how soap works.

HYPOTHESIS

3-5 min

Show students the ingredients being used today. Discuss with students:

- What do you think milk is made of?
- What will happen if we add soap to milk?
- Why do you think we're using food coloring in this experiment?

LESSON 10

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Fats
- Proteins
- Non-polar
- Molecule

EXPERIMENT

20-25 min

1. Divide class into groups with two students per group. Each group will be conducting and recording results of their experiment. Prepare 6 cups of soap--one tbsp for each group. (If you have enough plates, each student could perform their own).
2. Have students carefully pour a small amount of milk onto the plate. Emphasize that they should only have a thin layer of milk on the plate.
3. Have students add a few drops of food coloring into the milk. Students can use any colors they like, but have them add no more than 3 drops of food coloring per plate.
4. Have students dip q-tip into their cup of soap.
5. Next, instruct them to firmly press the q-tip into the center of the plate and then pick it up off the plate once the colors have stopped swirling.
6. Allow them to repeat this at a different location on the plate with a NEW q-tip. Remind students that they should not dip a used q-tip into the soap cup.
7. See who can create a more fun and beautiful art on their plate

OBSERVATION

5-10 min

Ask students to discuss:

- What happened when we first put the food dye in the milk?
- What happened when we added the soap to the q-tip?

CONCLUSION

3-5 min

Ask students to share their findings.

- Why did the food coloring move after adding the q-tip with soap?
- Did the colors combine when moving the q-tip around?

LESSON 10

EXTENSION

5-10 min

If students have time to expand on this experiment, try one of these alternatives:

- Repeat the experiment using water (in place of milk). Will you get the same eruption of color?
- What kind of milk produces the best color swirls: skim milk, 1% milk, 2% milk or whole milk?

EXPLANATION

5-10 min

Explain that milk is made mostly of water molecules, but it also has fat molecules and protein molecules. Like other oils, milk fat is a non-polar molecule, which means that it doesn’t dissolve in water. When soap is mixed in, however, the non-polar(hydrophobic) portion of the micelles (molecular soap structures within the solution) break up and collect the non-polar fat molecules. The polar surface of the micelle (hydrophilic) then connects to a polar water molecule with the fat held inside the soap micelle. Thanks to the soap connection, the non-polar fat can then be carried by the polar water.

We have a lot of oils and other molecules on our body. Dirt and germs like bad bacteria can easily stick to these molecules, just like the food coloring sticks to the fat and protein molecules in milk. Water by itself can’t move the germs that much--but using soap helps wash away all the dirt and germs stuck to those molecules, helping us stay clean and safe!

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Be careful with the plates of milk. Make sure to leave the classroom the way you found it.

LESSON 11: CITRUS VOLCANOES

Students will experiment with chemical reactions in citrus fruits to create their own volcano.

OBJECTIVES

- ☑ What happens when citrus fruits and baking soda mix?
- ☑ What is the product of the chemical reaction?
- ☑ How does dish soap affect the reaction?
- ☑ How is this experiment similar to how real volcanoes erupt?
- ☑ What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 3 lemons
- 3 limes
- 3 oranges
- 2 boxes of baking soda
- 1 knife and cutting board
- Food coloring (optional)
- 6 popsicle sticks
- 6 spoons
- 6 large bowls or plates
- 12 pencils and 12 pieces of paper (optional)
- For Extension activity (optional) - one bottle of dish soap

HOOK

5-10 min

Ask students what they know about volcanoes. What happens when they erupt?

Explain that: In a volcano, there is hot liquid rock called magma. Over time, the pressure in the magma builds up. The pressure builds from gas that forms inside the volcano. Eventually, so much gas builds up inside the volcano that there is no space left and the volcano erupts to release the gas. Magma is forced up through the opening in the volcano and when the magma is on the surface of the volcano, it is known as lava.

Have you ever played "The Floor Is Lava"? Why can't you touch the floor? (Because lava is hot!) Lava can be up to 2,200 degrees!

Today we will be creating our own volcano using a chemical reaction.

HYPOTHESIS

3-5 min

Discuss with students:

- What do you know about lemons, limes, and oranges? How might they create a chemical reaction?
- How might this look like a volcano?

Then, have students draw out the 'Scientist's Worksheet' and make the following predictions:

- Which fruit will produce the biggest reaction when mixed with baking soda?
- Which fruit will produce the smallest reaction when mixed with baking soda?

Alternatively, you can write these predictions on the board or discuss them orally.

LESSON 11

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Carbon dioxide
- Acid
- Base
- Magma
- Citric acid
- Hydrogen ion
- Hydroxide ion

EXPERIMENT

20-25 min

1. To begin, roll the lemons, limes, and oranges to release the juices.
2. Then, half the lemons, limes, and oranges.
3. Give each pair of students half of a lemon on a plate/in a bowl.
4. Using the popsicle stick, poke holes in the lemon flesh to loosen the juices.
5. Add a few drops of the food coloring of their choice (optional).
6. Then, add a large spoonful of baking soda to the top of the lemon. Observe what happens.
7. Then, repeat this experiment with the lime and the orange, recording what happens each time.

Tip: To speed up the reaction, use the popsicle stick to poke the baking soda down into the lemon, lime, or orange.

OBSERVATION

5-10 min

Ask students to discuss:

- What happened when the baking soda was added to each fruit?
- Which fruit produced the biggest reaction?
- Which fruit produced the smallest reaction?

Students should report that when the baking soda was added, the fruits began to bubble, and liquid flowed out of them. The lemon produced the biggest reaction while the orange took longer to react and may have just fizzed at the surface rather than overflowed like a volcano.

LESSON 11

CONCLUSION

3-5 min

Ask students to share their findings.

- How do you know a chemical reaction occurred?
- How do you think this is similar to a volcano erupting?
- Why do you think this chemical reaction occurred?

Students should note that a chemical reaction occurred because bubbles were apparent. This was evidence of a gas forming. This experiment was similar to a volcano erupting because the liquid flowed out of the lemon, like lava/magma flows out of a volcano. Some students may be able to specify that the build up of gas in the fruit is similar to the build up of gas in the volcano, causing pressure which eventually results in an eruption.

Students should note that the baking soda and citric acid in the fruit juice reacted to cause this chemical reaction. Some students may note that the fruit is acidic, and the baking soda is a base, thus causing a chemical reaction when they mixed.

EXPLANATION

5-10 min

Lemons, limes, and oranges are acidic and contain citric acid. Citric acid consists of many hydrogen ions. Baking soda is a base and contains many hydroxide ions. When acids and bases mix, they create a neutral substance, because the hydrogen and hydroxide ions combine to balance each other out.

When the baking soda was added to the fruit and met the citric acid in the juice, a chemical reaction began as the ions neutralized. A byproduct of this reaction was carbon dioxide gas. The gas was in the liquid mixture and began to try and escape. As the pressure of carbon dioxide built up in the fruit, it began to overflow (like how magma builds up in pressure and overflows in a volcano). The bubbling foam was the carbon dioxide releasing into the air. The reaction stops when the juice and baking soda mix completely and neutralize each other, meaning no more carbon dioxide gas is being created.

Lemon juice had the biggest reaction because it has the highest level of citric acid. Oranges has the smallest reaction because oranges have the lowest level of citric acid. The higher the level of citric acid, the more hydrogen ions available to react with the hydroxide ions in the baking soda, producing more carbon dioxide.

A chemical reaction occurred here because gas was creating when the acid (citrus juice) and base (baking soda) mixed to neutralize each other. The formation of the carbon dioxide gas was evident in the bubbles the volcano created. This was a big clue that a chemical reaction had occurred!

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LESSON 11

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - What will happen?	Hypothesis - Which reaction will be the biggest?	Observation - What did happen?	Observation - Which reaction was the biggest?
Lemon				
Lime				
Orange				
Fruit and dish soap (optional)				

EXTENSION

5-10 min

If students have time to expand on this experiment, try repeating this experiment with one of the fruits (you can use one of the volcanoes already created) but adding dish soap before adding the spoonful of baking soda.

Ask students:

- Does adding dish soap produce a similar reaction?
- Why do you think this happens?

Students should notice that the bubbles and foam are bigger because the dish soap traps some of the carbon dioxide and the gas creates large bubbles and foam with the dish soap.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. Materials can be disposed of safely. Make sure to leave the classroom the way you found it.

LESSON 12: OOBLECK

Students will explore non-Newtonian substances and their properties.

OBJECTIVES

- Which solids will create a non-Newtonian substance when mixed with water?
- What properties do non-Newtonian substances have?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 12 bowls
- 12 spoons
- 4 cups cornstarch
- 4 cups flour
- 4 cups tapioca starch (or alternative starch)
- Water
- 6 pencils and pieces of paper (optional)

HOOK

3-5 min

Ask students about their slime experiment. What they notice about how the slime acted - was it a solid or a liquid?

Remind students that slime was a non-Newtonian substance.

- ·A non-Newtonian substance is something that can act like a solid or a liquid, depending on how much force is applied. The viscosity (how thick or thin it is) changes depending on the force being applied.

Today we will explore non-Newtonian substances and their properties, as well as the change that happens when they are formed.

HYPOTHESIS

3-5 min

Show students the flour, cornstarch, and tapioca (or alternative) starch. Tell students that some of these solids will make a non-Newtonian substance when mixed with water. Ask students to draw the student worksheet or create a large-scale version of it for the class to complete together. Ask students to predict:

- Which solids will create a non-Newtonian substance when mixed with water?
- What properties will a non-Newtonian substance have?
- How does adding iodine affect the mixture of cornstarch and water?

Remind children that a non-Newtonian substance should behave like a solid when under pressure (or force) and a liquid when there is less, or no pressure applied.

LESSON 12

CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

EXPERIMENT

15-25 min

1. Students will work in groups of three. Give each group 3 bowls, each bowl with 1 cup of a solid in it (flour, cornstarch, and tapioca starch).
2. Have students slowly add approximately 1/2 cup of water to each bowl.
3. Mix the substance SLOWLY with a spoon.
4. Then, explore each substance and make note of any properties on the student worksheet.

Try the following with each substance and note what happens to each substance on the student worksheet:

- Try "punching" your finger into the bowl
- Try rolling it into a ball
- Try squeezing it in your hand
- Try picking it up on the spoon and pouring it back into the bowl

KEYWORDS

- pH level
- Acid
- Base
- Carbon Dioxide
- Density
- Surface

OBSERVATION

5-10 min

Ask students to discuss:
·Did the substances act like a solid, a liquid or both depending on how it was handled?

Students should notice that the cornstarch and tapioca starch were non-Newtonian when mixed with water. Both could be formed into a ball when under pressure but acted like a liquid and could be poured when on a spoon. The flour formed a paste and did not have properties of a liquid. It could form a (messy!) ball but could not pour easily like a liquid.

LESSON 12

SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Newtonian or Non-Newtonian?	Observation - What happens when it is made into a ball?	Observation - What happens when it is squeezed?	Observation - What happens when it is picked up by a spoon?
Cornstartch				
Flour				
Tapioca Starch				

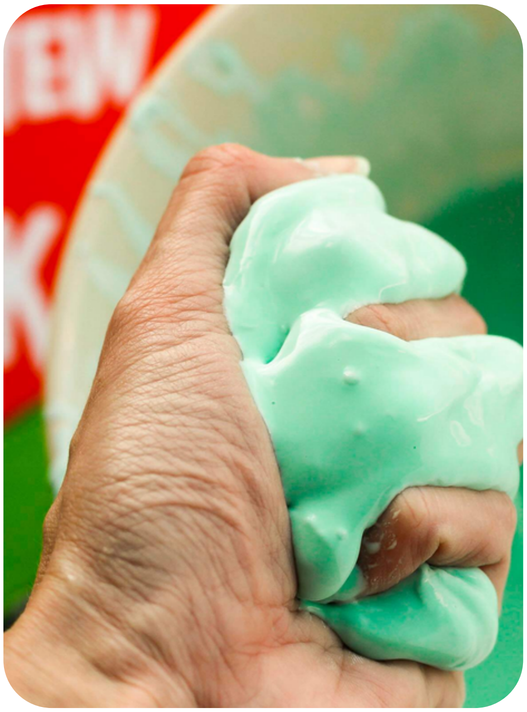
CONCLUSION

3-5 min

Ask students to share their findings.

- Which solids formed a non-Newtonian substance when mixed with water?
- What properties did the non-Newtonian substances have?
- Was there any evidence of a chemical reaction occurring?

Students should note cornstarch and tapioca starch formed a non-Newtonian substance, but flour did not. The non-Newtonian substances acted like solids when under pressure (force) and like a liquid when no pressure was applied. The viscosity of the non-Newtonian substances changed depending on the force applied. The flour kept the same viscosity regardless of the pressure applied. Students may struggle to articulate how a chemical reaction happened, as there was no evidence of a gas, a change in temperature, a change in color, or a smell.



EXPLANATION

5-10 min

In this experiment, you were able to create two non-Newtonian substances with the cornstarch and water and the tapioca starch and water.

The flour and water formed a suspension, where the flour did not dissolve in the water but instead turned it a cloudy color as it mixed. The flour and water retained viscosity (or how it flowed) and this did not alter due to the force being put on it. Therefore, the flour and water were non-Newtonian.

The cornstarch and water and potato starch and water formed non-Newtonian substances. These non-Newtonian substances were also suspensions. Under pressure, they acted like a solid and when the pressure was released, they acted like a liquid. They are often referred to as 'Oobleck' because of the Dr. Seuss book which describes a non-Newtonian substance.

These became non-Newtonian substances because the starches have long solid molecules which form chains. The water molecules are smaller and can flow around each other and between the starch molecules, allowing the chains of the starch molecules to slide and flow. This takes on the appearance and viscosity of a liquid. However, when pressure is applied, the starch molecules press against each other, leaving no room for the water molecules to flow between them, and therefore having more viscosity and acting like a solid. As soon as the pressure is released, the water can flow between the starch molecules again and it acts like a liquid.

All three mixtures were physical changes, not chemical changes. The solids and liquids mixed, but they each retained their own properties and simply mixed, rather than forming something new. This was evident because there was no change in color, temperature, smell, formation of a solid or formation of a gas. However, we can create a chemical reaction in the cornstarch and water by adding a reactant.

LESSON 12

POST-TEST

5-7 min

Explain to pupils that they have reached the final lesson of the unit. Remind them at the start of the unit, they did a pre-assessment. They will now do a post unit assessment to see how much they have learned! This will be a quiz style assessment. They can work Individually or in small group teams.

1) What is a chemical reaction? (A chemical reaction is where different substances (reactants) are changed into a new substance (product). A chemical reaction produces a new material and is usually irreversible.

2) What are some clues a chemical reaction has occurred? (change of color, change of temperature, change of smell, production of gas, production of a solid, or emission of light)

3) Name one type of acid. (Various answers, including lemon juice, vinegar, fruit juices)

4) Name one type of base. (Various answers, including bicarbonate of soda, milk of magnesia)

5) Then, give children the following scenarios. They must try to identify the ones that are chemical reactions and the ones that are not. They will get one point for each correct answer. (Answer key: Chemical reactions are marked with - CR).

1) Ice melting
2) Rust on your bike - CR
3) Digestion - CR
4) Plants growing through photosynthesis - CR
5) Boiling water
6) Baking cookies - CR
7) Dissolving sugar in water
8) Dying your hair a different color - CR
9) Mixing sand and water
10) Fireworks - CR

Have children tally up their results out of 20 points in total (1 point for each answer for question 2 they were able to identify). Who had the highest score?

For added discussion, students can discuss which chemical reaction experiment was their favorite and why.

CLEAN UP & DISMISSAL

3-5 min

Students must then clean their workspace. The substances can be disposed of safely. Make sure to leave the classroom the way you found it.

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