



Junior Reactors Pre and Post

Mad Science sparks imaginative learning with inquiry-based science for children. Ask us about other programs that meet regional curriculum requirements.

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Included are activities for you to do with the class—before and after the workshop—to reinforce the concepts and terms in the lesson. It also includes a section on activity extensions; books, resource suggestions; vocabulary; and a Junior Reactors pop quiz related to the topic.

BEFORE THE WORKSHOP

To maximize the workshop's impact and educational value, we recommend introducing the students to the concept of matter, molecules, and chemical reactions prior to the workshop. Here are several fun, easy, and educational activities that will prepare the class for the workshop. These experiments will also help the students become familiar with the concept of observation, hypothesis, experimentation, and the scientific method.

The Hypothesizing Game

Students draw conclusions about the absence of sight.

Materials

- 1 opaque cardboard box or container
- Paper (1 per student)
- Pencils (1 per student)
- 1 pair of scissors
- Packing tape
- 3 various objects (i.e., pine cones, marbles, apple, etc.)

Safety Warning: Do not put sharp or pointy objects in the box.

Procedure

1. Before class begins, cut a fist-sized hole in the side of the box. The students will need to fit their hand through this hole.
2. Place the three objects into the box, and tape it shut.
3. Shake the box, and ask the students if they can guess—by the rattle—what is inside the box. Give them a few minutes to provide some suggestions.

- Explain to the class that part of the scientific method is to use a variety of clues to identify an object and its function.
4. Circulate through the class, and have the students take turns feeling the objects in the box. Instruct the students to observe the characteristics of each object—whether it is hard, soft, rough, smooth, etc.
 5. Instruct the children to record their observations on a piece of paper. Encourage them to include as much information as possible; they can draw diagrams to describe the objects.
 6. Instruct the students to discuss and guess what items are in the box. Explain that these are their hypotheses.
 7. Discuss how to determine if their hypotheses are correct: Explain that scientists often study things they cannot see. They make observations and conclusions based on the information they gather from performing experiments and sharing the results of their experiments.
 8. Draw conclusions about what objects are in the box. Open the box to verify the hypotheses.

Explanation

Molecules and atoms provide many challenges for scientists because they are so difficult to observe. Scientists often face the same challenge as the students in this activity. Scientists often have to draw conclusions from limited information.

A bag of air molecules!

Students witness a demonstration of the concept of matter.

Materials

- Cloth bag (not plasticized or waterproof)
- Plastic bag (with no holes)

Note:

The bags should be about the same size.

Procedure

1. Ask the class to describe the two bags.
2. Have two volunteers blow up the two bags (one volunteer will not be able to blow up the cloth bag because holes in the bag prevents trapping air). Close both bags so that no air can escape from the opening. Challenge the two volunteers to squish their bags.
3. Challenge the students to explain why the plastic bag was harder to squish than the cloth bag. Discuss the concept of molecules and matter, and then discuss the size of molecules (see explanation below).

Explanation

Everything in this world is made up of matter. Matter can be found in three states: solid, liquid, or gas. All matter is made up of molecules. The distance between neighboring molecules determines the state of matter. Air is matter in a gas state. The molecules in a gas state are very energetic and far apart

from one another. We can move through air, but it still takes up space. The volunteers pushed air matter into the bags when they inflated them. Air matter molecules are very small. If there are holes in the bag that are larger than the air molecules, the molecules will move through the holes. When the bags were closed and squeezed, the plastic bag retained the air while the cloth bag allowed air molecules to escape. The matter used to create a plastic bag does not have holes large enough to allow air to escape. We cannot squish a plastic bag full of air. The matter used to create the cloth bag is full of holes as cloth is made up of woven fibers. We can squish a cloth bag full of air.

AFTER THE WORKSHOP

Here are some activities you may wish to do with the class after the workshop to reinforce and expand the science concepts.

Limiting Reactants—S'mores Please!

Students get a tasty lesson on limiting reactants.

Materials

- 60 small chocolate squares (i.e. from a flat chocolate bar)
- 60 graham crackers
- 60 jumbo marshmallows
- Pre-moistened towels
- Paper (one per group)
- Pencils (one per group)
- Plates (two per group)

Safety Warning: Do not perform this activity if it conflicts with the dietary restrictions of any student in the class.

Procedure

1. Divide the class into groups of five.
2. Tell the groups they are each a chemical reaction assembly line that will create molecules using three types of atoms.
3. Tell the groups that they need three marshmallow atoms, two chocolate atoms, and one graham cracker atom to make the S'more (chocolate candy treat) molecule. Each S'more consists of two chocolate atoms layered between three marshmallow atoms, all pressed onto one graham cracker atom.
4. Give each group a different ratio of chocolate to marshmallows to graham crackers. Each group should have two parts of one type of food to one part of the other types of food. For example, one group gets 20 crackers, 10 marshmallows and 10 chocolate pieces. Tell them these are their atoms.
5. Challenge the groups to make the most S'more molecules possible with their atoms. Instruct each group to hypothesize which atomic ingredient will limit the number of S'mores that can be made (the leftover pieces will determine this).
6. Discuss the limiting atomic ingredient (see explanation below), and explain that chemical reactions can have limiting reactants that affect the quantity of a product that forms. Mention that in a real chemical reaction, the atoms join and require another chemical reaction to separate again. Clean up the classroom, and then enjoy the S'mores!

Explanation

The first lacking ingredient is the limiting atomic ingredient. In a chemical reaction, reactants are the chemicals that mix to create a reaction. The chemicals produced from a reaction are the products. When reactants mix, one

reactant exhausts and prevents the formation of any more products. This reactant is the limiting reactant. The limiting reactant is not always the reactant lowest in quantity. Certain calculations are required for chemists to determine which reactant(s) will be the limiting reactant(s).

Apples and Oxidizers

Students will observe the effect of chemicals on food products.

Materials

- 2 tablespoons
- 3 apples
- 3 bowls
- Hydrogen peroxide
- Knife
- Lemon juice

Safety Warning: Do not eat the apples after this experiment.

Procedure

1. Cut one apple into small cubes per bowl.
2. Instruct the class to hypothesize the aftereffect of leaving the apple exposed to air.
3. Leave one bowl untouched. Add five tablespoons of lemon juice to the apples in one bowl, stirring to cover the cubes well. Add five tablespoons of hydrogen peroxide to the apples in another bowl, stirring to cover the cubes well.
4. Discuss the concept of oxidation: a chemical reaction in which oxygen molecules react with the apple molecules, turning the apple brown as a result. Discuss the contents of hydrogen peroxide (oxygen molecules in water), and lemon juice (acidic preservative). Discuss the role of preservatives in food (see explanation below).

Explanation

Enzymes inside apple cells react with oxygen. The cut and exposed part of an apple turns brown because of this chemical reaction. This is called enzymatic oxidation, and the enzyme responsible for the reaction is tyrosinase. Tyrosinase is found in humans and is responsible for creating melanin (results from exposure to sun), which provides the brown color of tanned skin! In the above experiment, one apple is exposed to hydrogen peroxide (a high concentration of oxygen). The second apple is exposed to lemon juice. The untouched apple is exposed to normal atmospheric conditions. There is enough oxygen in the air to cause the apple to turn brown over time. Hydrogen peroxide speeds up the reaction and causes the apple to turn brown quickly. The ascorbic acid (vitamin C) in the lemon juice prevents the tyrosinase from reacting with the oxygen. Adding vitamin C to fruits prevents enzymatic oxidation.

MORE TO DO

Language Arts

- Create a large grid, ten rows by ten columns. Have the class create word search puzzles by making a list of five to ten words (no longer than 10 letters), and placing the words, one letter per box, into the grid. Have the students fill up the empty squares with random letters to camouflage their words in the grid. Encourage them to trade their word searches with one another.
- Write down vocabulary key words from the Junior Reactors Workshop (matter, molecules, atoms, etc.), and place a variety of words in envelopes. Distribute one envelope to each student. Challenge each student to write a story using the words in the envelope.

Art

- Fill some film canisters or small containers halfway with water, and add a couple of drops of food coloring to each. The students can paint with the physical changes they created!
- Provide your students with Styrofoam balls (light, resilient polystyrene plastic), pipe cleaners, clay, toothpicks etc. Challenge them to create their own molecule models by attaching the Styrofoam or clay with the pipe cleaners or toothpicks.

Math

- Challenge the children to build molecule models based on a word problem. For example, "Make a molecule with one oxygen atom and nine minus the number of days in a week hydrogen atoms."
- If the children are younger, use easier word problems. For example, "Make a molecule that has as many hydrogen atoms as you have eyes, and as many oxygen atoms as you have noses."

Social Studies

- Have a discussion on the roles of chemical reactions in our lives. Invite the children to think of all the chemical reactions they use in one day (brushing teeth, cooking eggs, eating food, washing dishes, etc.).
- Have the children research a scientist or an application of chemistry from a different time period. (Embalming in Ancient Egypt, alchemy in Medieval times, etc.).

Field Trip Suggestions

- Visit the chemistry section at a Science Center.
- Invite a chemist to visit the classroom.
- Visit a supermarket, divide the class into groups, and have students research common chemicals found in specific sections or aisles.

BOOKS

Title: The Periodic Table: Elements with Style!

Author: Dingle, Adrian and Simon Basher

Publisher: Kingfisher Books Ltd

ISBN #: NA

Description: This is an entertaining book of the periodic table. Each element is described with illustrated detail: the name, symbol, atomic number, atomic weight, color, standard state of matter, and classification up to element 111. This book is suitable for students in 3rd to 6th grade.

Title: Horrible Science: Chemical Chaos

Author: Desaulles, Tony

Publisher: Scholastic

ISBN #: 0590108859

Description: This book is filled with chemistry facts that also reveal the secrets of some very strange scientists. It provides experiments with easily accessible chemicals to perform at home. This book is suitable for students in 4th to 6th grade.

Reference Books

Title: Experiments with Chemistry

Author: Challand, Helen J.

Publisher: Children's Press

ISBN#: 0516011510

Description: This book provides an introduction to chemistry and the basics of this scientific field, such as atoms, molecules and chemical changes. This book is suitable for students in kindergarten to 3rd grade.

Title: Adventures with Atoms and Molecules: chemistry experiments for young people

Author: Mebane, Robert C. and Thomas R. Rybolt

Publisher: Enslow Publishers

ISBN #: 0894901206

Description: This book contains chemistry experiments that can be performed at home or in school to demonstrate the properties and behavior of various kinds of atoms and molecules. This book is suitable for students in 4th to 6th grade.

Title: Exploring the World of Chemistry

Author: Burns, George

Publisher: Franklin Watts

ISBN #: 0531201198

Description: This book suggests simple experiments and activities that explore chemistry, and the chemical substances that make up our world. This book is suitable for students in 4th to 6th grade.

Title: Chemistry

Author: Newmark, Ann

Publisher: Dorling Kindersley Publishing

ISBN#: 1564582310

Description: This book explores the world of chemical reactions and illustrates the important role that chemistry plays in everyday life. There are excellent diagrams and colorful photographs. This book is suitable for students in 4th to 6th grade.

Title: Simple Chemistry Experiments with Everyday Materials

Author: Loeschig, Louis V.

Publisher: Sterling Publications

ISBN#: 0806906898

Description: This book has exciting experiments with materials that can be gathered from around the house and emphasizes the basic principles of chemistry. This book is suitable for students in 4th to 6th grade.

Title: Cool Chemistry

Author: Steven W. Moje

Publisher: Sterling Publishing

ISBN#: 0806963492

Description: Household items provide kids with experiments that utilize everyday materials to illustrate the basic concepts of chemistry. This book is suitable for students in 4th to 6th grade.

Title: Exploring Matter with Toys: using and understanding the senses

Author: Sarquis, Mickey

Publisher: McGraw-Hill

ISBN #: NA

Description: This book teaches students to use their five senses to explore the particle nature of matter through recording, classifying, presenting, and explaining their observations. This book is suitable for students in 4th to 6th grade.

VOCABULARY

Atoms: The tiniest part of something that cannot be split easily into something smaller.

Chemical Change: A chemical change occurs when atomic bonds are broken or created at the molecular level. You can identify a chemical change if there is color change, temperature change, gas formation, or precipitation.

Limiting Reactant: The reactant that lacks first in a chemical reaction. The limiting reactant limits the amount of product that forms.

Matter: Any substance that has weight and takes up space. All things are made of matter, and they can take on any of the three forms: liquid, solid, or gas.

Molecules: Two or more atoms held together by bonds. Molecules make up matter.

Products: The chemicals that are produced from a chemical reaction.

Physical Change: A physical change occurs when the molecules forming matter do not change. Matter that undergoes a physical change may have a new shape as a result.

Reactants: Also called reagents. The chemicals that are mixed together to create a chemical reaction.

ASSESSMENT QUIZ

The next page contains a series of questions designed to help assess your students' understanding of the concepts in the workshop. It is in a pop quiz format that can be photocopied and given to children to complete after the workshop.

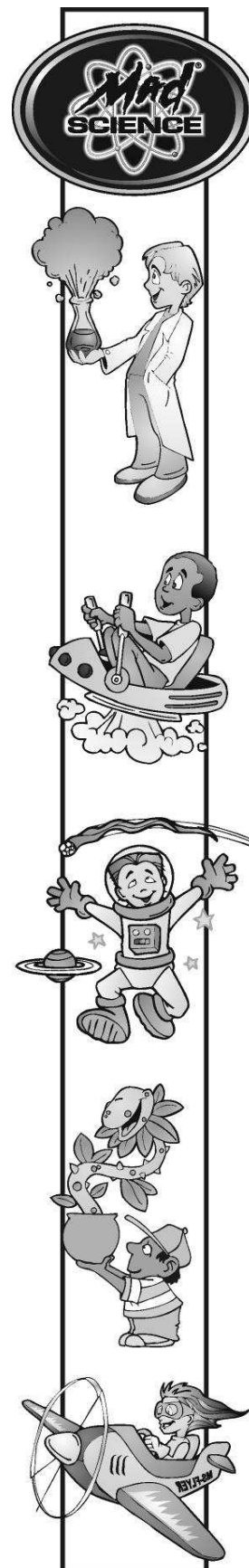
Answer Key to "Junior Reactors" Quiz:

1. C
2. B
3. A
4. A
5. B
6. C

Junior Reactors Quiz

Circle the correct answer for each question.

1. A chemical reaction happens if:
 - a) you hear someone scream
 - b) the chemicals freeze
 - c) gas or bubbles form
2. Molecules are made up of:
 - a) marshmallows
 - b) atoms
 - c) coins
3. A chemical reaction happens if:
 - a) a new chemical precipitate forms
 - b) you were told to wear goggles and gloves
 - c) your partner starts to act funny
4. A chemical reaction happens if:
 - a) the color of the chemical changes
 - b) you don't see anything change
 - c) the room starts to spin
5. The H and O in H₂O stand for:
 - a) Hippo and Octopus
 - b) Hydrogen and Oxygen
 - c) Hexagon and Octagon
6. A chemical reaction happens if:
 - a) your teacher is happy with you
 - b) the chemicals vaporize
 - c) the chemicals' temperature changes



PAPER ACTIVITIES

Letter Tiles

Unscramble the sentence: Use trial and error to place the tiles into the spaces below.

E
C
U
L
E
S
U
P
O
F
A
T
A
D
E
E
M
A
R
O
M
S
M
O
L

Letter Tiles solution

Molecules are made up of atoms

Hidden words

Use trial and error to unscramble the letters to fit into their corresponding boxes. Copy the letters from the numbered boxes into the appropriate box below to find the hidden words. The first one has been unscrambled as an example.

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Hidden Words solution

Clue words:

MOLECULES

ATOMS

CHEMICAL REACTION

PHYSICAL REACTION

BUBBLES

TEMPERATURE

COLOR

CHANGE

Hidden words:

MEGA MOLECULAR MANIA

Hidden words

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