

5th Grade - Molecules

Objective:

Students will learn all matter is composed of particles called atoms, and all matter is made up of different combinations of atoms called molecules.

Introduction:

The concepts students should understand are:

- Each element is made up of one kind of atom.
- The amount of matter stays constant, only its form is changed
- A chemical element is made up of atoms that are alike
- Each element has a unique chemical symbol
- The Periodic Table of Elements is a chart of all the known chemical elements
- A molecule is the smallest particle of any substance
- A chemical formula shows which element make up a particular chemical compound



PS1.A: Structure and Properties of Matter

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under any given conditions) that can be used to identify it. (MS-PS1-2)

MS-PS1

Develop models to describe the atomic composition of simple molecules and extended structures.

General Scheduling Guidelines:

1. Schedule a date and time with your teacher to have the students come into the lab.
2. Docent(s) should plan to arrive early to set up before the class arrives.
3. Input the day and time into the Science Lab Master Schedule. You will need about 15 minutes of clean up time.
4. Have the students sit on the carpet at the start of class and either lead a short discussion about molecules or show the video listed below from Khan Academy.

5. After the video is over review the experiment instruction and make one molecule together with the class.
 6. The goal is to have the students do as much of the assignment on their own. There is an extra challenge worksheet for students who finish early.
 7. Students will work in pairs. If there is enough materials they can do it on their own.
 8. Debrief the last 5-10 minutes of class.
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Helpful Observations noted from Previous Classes:

The following tips are based on doing this experiment with the 5th graders for the first time in March 2016. The 3 - fifth grade classes were scheduled back to back, as requested by the teachers. There was only about 10 minutes between classes to reset the tables for the next group.

1. The task which takes the most time when setting up this experiment is bagging the marshmallows and toothpicks. In some classes one or two of the docents takes all the toothpicks and marshmallows home to complete the task at home. In other classes a group of docents gets together and bags and sorts.
 2. When setting up for the lab consider the short turnaround time and set out enough materials to make the turnaround time smoother. You really have to move fast.
 3. During class one docent can walk around with the goReact app open for students to use to help them figure out what they have created.
 4. This lab can run smoothly with 2 docents per class. More docents is always helpful but 2 can manage comfortably.
 5. Before class arrives make a sample to show the students.
 6. In previous years some students left their work in the Science Lab and it was displayed on the "STUDENT SCIENCE WORK" wall. Other years the teacher put them on display in her classroom. Or the students can take their work home.
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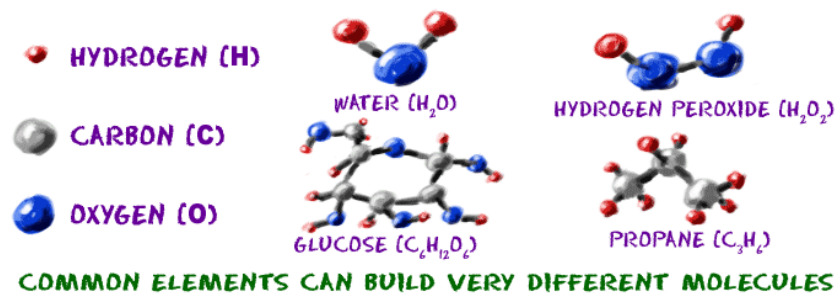
States of Matter Basics: **For Docent's Reference Only**

What is matter and why is it important?

Atoms are building blocks. If you want to create a language, you'll need an alphabet. If you want to build **molecules**, you will need atoms of different **elements**. Elements are the alphabet in the language of molecules. Each element is a little bit different from the rest.

Atoms are the general term used to describe pieces of matter. You have billions of billions of atoms in your body. However, you may only find about 40 elements. You will find billions of **hydrogen** (H) atoms, billions of **oxygen** (O) atoms, and a bunch of others. All of the atoms are made of the same basic pieces, but they are organized in different ways to make unique elements. In chemistry, you are working with almost 120 elements. When you combine them, you can make millions of different molecules.

Common Elements



Molecules are groups of atoms **bonded** together in the same way that words are groups of letters. An "A" will always be an "A" no matter what word it is in. A **sodium** (Na) atom will always be a sodium atom no matter what compound it is in. While the atoms have different masses and organization for each element, they are all built with the same parts. **Electrons**, protons, and **neutrons** make the Universe the way it is.

From Simple to Complex

Super-tiny subatomic particles are used to create the parts of atoms. Protons, neutrons, and electrons can then organize to form atoms. Atoms are then used to create the molecules around us. There are almost 120 elements that can be found in the molecules we know. Smaller molecules can work together and build **macromolecules**. It just goes on. Everything you see or imagine is built from something else.

You could start really small...

- Particles of matter
- Atoms
- Molecules
- Macromolecules
- Cell organelles
- Cells
- Tissues
- Organs
- Systems
- Organisms
- Populations
- Ecosystems
- Biomes
- Planets
- Planetary Systems with Stars
- Galaxies
- The Universe...And finish really big.

Compound Basics

Let's start with molecules. **Molecule** is the general term used to describe any atoms that are connected by **chemical bonds**. Every combination of atoms is a molecule. A compound is a molecule made of atoms from different elements. All compounds are molecules, but not all molecules are compounds. **Hydrogen** gas (H₂) is a molecule, but not a compound because it is made of only one element. Water (H₂O) can be called a molecule or a compound because it is made of hydrogen (H) and oxygen (O) atoms.

There are two main types of chemical bonds that hold atoms together: covalent and ionic/electrovalent bonds. Atoms that share **electrons** in a chemical bond have covalent bonds. An oxygen molecule (O_2) is a good example of a molecule with a covalent bond. Ionic bonds occur when electrons are donated from one atom to another. Table salt (NaCl) is a common example of a compound with an ionic bond.

Physical and Chemical Traits of Compounds

When we discuss phase changes in **matter**, we are looking at **physical** changes. Physical forces alone (unless you're inside of the Sun or something extreme) rarely break down compounds completely. You can apply heat to melt an ice cube, but there will be no change in the water molecules. You can also place a cup of water in a container and decrease the pressure. The water will eventually boil, but the molecules will not change.

Chemical changes in compounds happen when chemical bonds are created or destroyed. Forces act on the bonds between atoms, changing the molecular structure of a substance. You can pour liquid acid on a solid and watch the solid **dissolve**. That process is a chemical change because molecular bonds are being created and destroyed. Geologists pour acids on rocks to test for certain compounds.

Video to show class:

What all the matter? Atoms and molecules by Khan Academy (run time: 4:35 mins.)

<https://www.khanacademy.org/partner-content/mit-k12/mit-k12-materials/v/atoms-and-molecules>

Vocabulary:

Atom - The smallest component of an element having the chemical properties of the element

Element - Any of the more than 100 known substances (of which 92 occur naturally) that cannot be separated into simpler substances and that singly or in combination constitute all matter

Compound - A substance made up of atoms of two or more different elements joined by chemical bonds in fixed ratios or proportions

Molecule - The simplest structural unit of an element or compound

Organic Compound - A compound that contains carbon. Organic compounds also contain Oxygen, Nitrogen, Hydrogen, Sulphur, and Phosphorus

Experiment: Building Edible Molecules

Materials:

1 sandwich size Ziploc Bags – 1 bag per pair/individual. If doing this experiment in pairs each class will need 17 bags. If done individually each class will need 34 bags.

Within each Ziploc place the following items:

- 12 - White Mini Marshmallows
- 12 - Orange Mini Marshmallows
- 10 - Pink Mini Marshmallows
- 5 - Green mini marshmallows
- 5 - Yellow mini marshmallows
- 30 - Toothpicks

White School Glue

Worksheet (one per student)

Copies of the Periodic table

Pencils (one per student)

White pencils

Black Construction Paper (1 per student or 1 per pair)

IPads with the App “goREACT” open

Procedure:

1. HAVE THE STUDENTS COUNT OUT THEIR SUPPLIES. THEY MUST HAVE THE CORRECT COLOR OF MARSHMELLOWS.
2. Explain to the students which color marshmallow is to be used for each atom:
 - White = hydrogen
 - Pink = oxygen
 - Orange = carbon
 - Green = chlorine
 - Yellow = sodium
3. The toothpicks will represent chemical bonds.
4. Explain the chemical bonding rules for each element. The number of bonds each element must have are as follows:
 - Hydrogen = 1
 - Oxygen = 2
 - Carbon = 4
 - Chlorine = 1
 - Sodium = 1
5. First build a water molecule with the entire class, according to the picture on the worksheet. Some toothpicks should be broken in half when making closer bonds so that

the marshmallows actually touch each other and the toothpicks barely show. Do not break all the toothpicks. Longer ones will be needed.

6. Ask the students if anyone knows the chemical formula for water (H₂O). Write it on the board and have the students enter it in the space provided on their worksheet. Have the class explain what a subscript means.
7. Working in pairs the students will build a compound using the appropriate colored mini marshmallows and toothpicks. Each student will then fill in the first two worksheets. They can test their results on the “goREACT” app on the iPad by using the Periodic Table to test their results.
8. Students will glue down their chemical compound on the black construction paper and label their compound with both the name of the compound and its chemical formula.
9. If they have completed the first two worksheets they can move on to the challenge sheet.
10. 10 minutes before class is over review the worksheet labeled “Evaluation” with the entire class. Ask the questions on this form to the class. Have the class note down any information they do not have listed.

Check for Understanding:

Check student’s work to make sure they have correctly counted the atoms on for molecule. Ask them “What type of atom is the blue mini marshmallow? How did you know how many to put together for your molecule? How many atoms are in one molecule of your compound?”

Informational Videos for Docents:

The two videos by Dr. Rebecca Keller, below will help give docents an understanding of making molecules for this age group.

<https://www.youtube.com/watch?v=t8W1WrJLQWg>

<https://www.youtube.com/watch?v=PsodvnpPmbg>