# Atoms and Molecules

**Recommended for Grades K-6**

Have you ever built something from building blocks or Legos? You used small blocks of different shapes and sizes to make something bigger. Atoms and molecules are the same thing. They are the building blocks that make up all the things we see and feel around us.

The smallest drop of water you can get and still have it be water is called a ***molecule***. If you break it up anymore, it won't be water anymore, just like if you break a cup of ice water into ice, water, and a cup, and then took away the ice and cup, it isn't a cup of ice water. Molecules must be very small, because all you can see is water, right? Right!

As small as molecules are, they can still be broken up into smaller pieces called ***atoms***. There are lots of different kinds of atoms. Imagine having a large tub of building blocks. There are all different kinds of blocks - different sizes, colors, and shapes. These atoms go together in all kinds of different ways to make molecules. When you get enough molecules together, you have something you can see, like water.

**TRY THIS:** *Take an index card and cut it in half. Then cut one piece in half, then cut another piece in half, and so on and so on. If you could cut the paper into small enough pieces you would get down to a molecule and then if you could keep cutting you would get an atom.*

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## HERE ARE THE ACTIVITIES WE'LL DO AS WE INVESTIGATE ATOMS & MOLECULES:

- States of Matter
- Let's Make a Molecule
- What A Change Cold Makes
- What Is That Goop?
- Molecules On
- Water on The Move

## THINGS YOU WILL NEED:

1. Index card
2. Plastic sipper stick
3. 2 colors of modeling clay
4. 3 plastic storage bags
5. Glow-in-the-dark ball
6. 3 balloons
7. Plastic cup
8. Craft stick
9. ¼ cup cornstarch
10. 2 tea bags

# States of Matter

Atoms and molecules make up something called **matter**. Matter is the stuff you see all around you – air…water…paper, just to name a few. They are all made of something.

Water is matter. It can be made into ice by making it really cold in the freezer. Water can also turn into steam by making it really hot in the shower. So, what is different about water that is ice and water in your glass you can drink – they are both water, right? The difference is called the **state** of the matter. The ice is a **solid**, while the water you can drink is a **liquid**. The steam you get in the bathroom is a **gas**.

## YOU WILL NEED:

- Plastic cup
- 3 plastic storage bags
- Pencil
- Ball

## WHAT TO DO:

1) Put the ball in one of the plastic bags and close it. The ball is a solid.
2) Put ¼ cup of water into one of the plastic bags. Water is a liquid.
3) Blow air into the third empty baggie and close the bag. Air is a gas.
4) Look at each bag, and answer these questions:
   Does what is inside the bag:
   a) Take up space?
   b) Can you see it?
   c) Can you feel its weight? Is it light or heavy?
5) Open the bags, one at a time, and pour out what's inside into the plastic cup. Did what's inside the bag keep its shape when you poured it into the cup? (Don't forget to empty the cup after you test each thing!)
6) Use your answers to fill out the chart on the next page.

## WHAT HAPPENED:

There are different states of matter because the atoms and molecules that make up the matter are actually moving! When they get hot, they move faster and push each other around. When they cool down, they slow down and they can get closer together.
A gas has molecules that move around a lot. A liquid has molecules that still move around a lot, but not as much as a gas. The molecules of a solid don't move around all that much.

# Properties of Matter

Mark an **X** in the spaces where you noticed the actions in the top row happened.

| | Hold its shape when I pour it in the plastic cup | It takes up space in the plastic cup | I can feel its weight | I can see it in the plastic cup |
|---|---|---|---|---|
| Solid | | | | |
| Liquid | | | | |
| Gas | | | | |

# Let’s Make a Molecule!

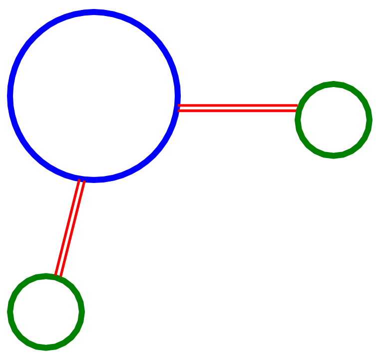
There are lots of different kinds of atoms. Just like building blocks, they join together to make different molecules. Let’s make a molecule of our own!

## YOU WILL NEED:

- 2 colors of modeling clay
- Plastic sipper stick

## WHAT TO DO:

1) With one color of modeling clay, make two balls about the size of nickels.
2) With the second color of clay, make one larger ball – make sure it is bigger than the other two!
3) Cut your sipper stick into two pieces the same size. Put one on each side of the large ball of clay.
4) Now put a small clay ball on the end of each of the stick pieces coming out of the large ball. It should look something like this:



## WHAT HAPPENED:

You just made a model of a water molecule! Your water molecule has two different kinds of atoms – hydrogen and oxygen. A water molecule has 2 hydrogen atoms (the small balls) and 1 oxygen atom (the larger ball). When you get enough of these molecules together, you have a glass of water!

Each type of atom has its own symbol, usually a letter or two from the atoms name. Scientists use the symbols for hydrogen (H) and oxygen (O) to write the recipe for water like this:

$H_2O$

This means there are 2 hydrogen atoms and 1 oxygen atom (they just don’t write the 1).

# What a Change Cold Makes!

What happens if you stop the molecules in a gas from moving around so much? Let's find out!

## YOU WILL NEED:

- Water
- 3 balloons
- Plastic cup

## WHAT TO DO:

1) Fill two balloons with water and tie them. Put one water-filled balloon in a cup and put them in the refrigerator overnight. Put the other water-filled balloon in the freezer for at least one night.
2) Blow up the last balloon and tie it. Put this balloon in the fridge too. (This balloon is full of the air you breathed out. Air is a gas and that has tiny bits of water in it too.)
3) Write down what you think will happen to each balloon overnight to the:
   a) Balloon with water in the freezer:
   b) Balloon with water in the fridge:
   c) Balloon with air (gas) in the fridge:
4) After one night, take the balloons out of the fridge and freezer. What do they look like? How does each one feel?
   a) Balloon with water in the freezer:
   b) Balloon with water in the fridge:
   c) Balloon with air (gas) in the fridge:
5) Compare your predictions (what you thought was going to happen) with your observations (what happened).

# What is That Goop?

Not all matter does what we think it should. It isn't always easy to tell if something is a liquid, a solid, or a gas. Have you ever turned a liquid into a solid just by tapping on it? In this experiment you make just such a liquid.

## YOU WILL NEED:

- Plastic cup
- 1 craft stick
- ¼ cup cornstarch
- Water
- Newspaper (a paper bag or plastic bag are good substitutes)

## WHAT TO DO:

1) Place a sheet of newspaper flat on a table. Put the cup in the middle of the newspaper. Add ¼ cup of dry cornstarch to the cup. Add 6 teaspoons of water to the cornstarch and stir slowly, until all of the powder is wet.
2) Your mixture should feel like a stiff liquid when you stir it slowly but feel like a solid when you tap on it or squish it with your finger.
3) Scoop or pour the mixture into the palm of your hand, then slowly squeeze it into a ball. As long as you keep rubbing it between your hands, it should stay solid. Stop rubbing, and it should "melt" into a puddle in your palm. Can you think of another test you can do with it?

LAB SAFETY NOTE: **Please do NOT wash the goop down the sink, it can only be disposed of in the trash.**

## WHAT HAPPENED:

Why does the cornstarch mixture behave like this?

Think of a busy sidewalk. The easiest way to get through a crowd of people is to move slowly and find a path between people. If you just took a running start and headed straight for the crowd of people, you would slam into someone and you wouldn't get very far. The solid cornstarch acts like a crowd of people. Pressing your finger slowly into the mixture allows the cornstarch to move out of the way but tapping the mixture quickly doesn't allow the solid cornstarch particles to slide past each other and out of the way of your finger.

We use the term ***viscosity*** to describe how easily a liquid can flow. Water has a low viscosity and flows easily. Honey, at room temperature, has a higher viscosity and flows more slowly than water. But if you warm honey up, its viscosity drops, and it flows more smoothly. Most fluids behave like water and honey - their viscosity depends only on temperature. We call such fluids ***Newtonian***, since their behavior was first described the famous scientist, Isaac Newton.

The cornstarch mixture you made was "***non-Newtonian***" since its viscosity also depends on the force applied to the liquid (your tapping it) or how fast an object is moving through the liquid. Other examples of non-Newtonian fluids include ketchup, silly putty, and quicksand. Quicksand is like the cornstarch mixture: if you struggle to escape quicksand, you apply pressure to it and it becomes hard, making it more difficult to escape. The recommended way to escape quicksand is to slowly move toward solid ground; you might also lie down on it, thus distributing your weight over a wider area and reducing the pressure. Ketchup is the opposite: its viscosity decreases under pressure. That's why shaking a bottle of ketchup makes it easier to pour.

**BONUS NOTE:**: Isaac Newton was a member of a science club himself***- The Royal Society of London for the Improvement of Natural Knowledge***, or just the Royal Society. Look him up. You will find out how many cool things he discovered by being interested in math and science!

# Molecules on the Move

Let's see what happens when molecules are heated up. We can actually see the movement of molecules by watching the way a tea bag colors water in a glass.

## YOU WILL NEED:

- Clear glass
- 2 tea bags
- Cup of cold water
- Cup of hot water

## WHAT TO DO:

1) Answer this question to make your prediction: *Do molecules move faster or slower when they are hot? What do you think happens to the movement of molecules when the water is heated?*

I think______________________________________________________________________________

_________________________________________________________________________________

Now test your predictions

1) Fill a glass half-way with cold water. Let it sit on the table a few minutes until the water seems still.
2) Add one tea bag by gently dropping it into the water. Do not touch the glass!
3) Time how long it takes for the tea to color the water in the glass. Do this by counting or using a clock, watch, or timer. Answer questions below with your observations.

*What happens to the watercolor – does the tea make a pattern or color the water all at once?*

_________________________________________________________________________________

_____________________________________________________________________________

*How long did it take for the water to change color?*

_____________________________________________________________________

*Do you think there would be any difference if the water was hot?*

I think_________________________________________________________________

_____________________________________________________________________

5) Let's try it! Rinse the glass then put hot water in it. Let it sit on the table a few minutes until the water seems still.
6) Add the other tea bag. Do not stir or shake the glass.

7) Time how long it takes for the tea to color the water in the glass. Do this by counting or by using a clock, watch, or timer. Answer questions below with your observations.

*What happens to the watercolor – does the tea make a pattern or color the water all at once?*

______________________________________________________________________________

______________________________________________________________________________

*How long did it take for the water to change color?*

______________________________________________________________________________

8) Compare your answers with your prediction to make your conclusion. Use the questions below to help.

*What happens to the movement of molecules in a substance (the water when that substance is heated?*

______________________________________________________________________________

_____________________________________________________________________________