

Matter Madness

Activity Description

Students learn about the different states of water through a bean bag toss

Take Home Message

Water is made up of oxygen and hydrogen and is the only known substance on earth that can exist in three forms: solid, liquid, and gas. Water in its solid state is less dense than its liquid state.

Massachusetts Frameworks

Physical Science

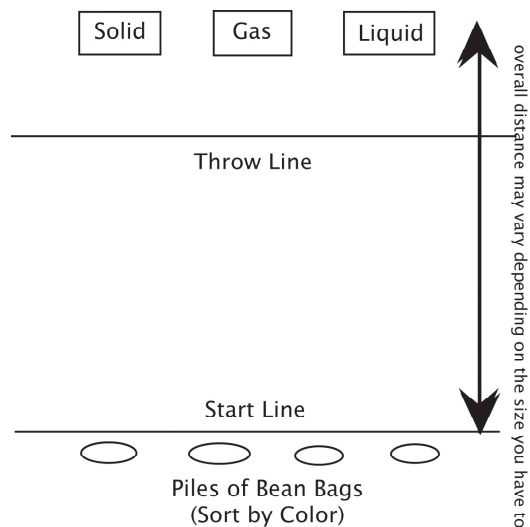
Properties of Matter #2

Supplies

- 3 Boxes with diagrams of the different phases of water on them: solid, liquid, and gas
- Five sets of bean bags with drawings
- roll of duck or masking tape

Set-Up

1. Start by putting the three boxes against the wall with the diagrams of the water molecules facing towards you.
2. Next, get some duck or masking tape and tape a line about 3 feet away from the boxes (the finish line). The line should be in front of the boxes. The children will be stopping at this line to throw the bean bags. (Like in darts)
3. Now (according to how much space you have) put a second line of tape – (the start line)(approx. 15 ft) parallel to the first. Give enough room so the kids can run. Like the 50 yard dash in school.
4. At this second line that you have made, make piles of bean bags for each of the separate colors with the words facing down. There should be Red, Yellow, Green, and Orange. There are also purple bean bags that work if you have 5 students in a group. If you have 6 or more, break them into two groups and have two different rounds.
5. **Have the students gather and sit down in front of the boxes, inside the finish line.**



Matter Madness– Set up of the Floor



Activity Procedure/Script

- **Tell the students they are going to learn about the different states of matter, water molecules, and how water has special qualities that other types of matter don't have.**
- **Ask the students if they know what matter is.** A substance that has mass and occupies space. Energy is not matter. Explain that molecules are the basic building blocks of matter.
- **See if they know what molecules are made of.** Atoms
- **Ask the students if they know which atoms make up a water molecule? You can give them a hint by asking if they know the scientific name for water.** Some may know the answer, H_2O . Talk about how water is made up of two hydrogen atoms and one oxygen atom. You can use the pictures on the boxes to show the water molecules. An easy way for them to remember this is to have them put their fists on either side of their head. Tell them their head is round like the O for oxygen, and their hands are like the hydrogen atoms (both hands and hydrogen start with the letter H). You can also compare the shape to Mickey Mouse to help them remember.
- **Explain that one end of the molecule (the hydrogen end) is positively charged and one end is negatively charged (the oxygen end). When two water molecules come together, the opposite ends are attracted to each other and form very strong bonds that make them cling together.**
- **Water can exist in three forms or states of matter. See if they know what these are.** Some may know solid, liquid, and gas. Tell the students that a very special property of water is that it is the only known substance on earth, that can exist in all three forms.
- **See if they can tell you some differences between solids, liquids, and gases. Use the boxes to demonstrate.**
 - Properties of solids
 - Solids have a definite volume and shape. The molecules are attracted so closely together that they can vibrate a little, but can't move around and change shape.
 - **Ask the students if they can think of any examples of solid water.**
 - Ice Cube

- Snowflake

- Properties of Liquid

- Liquids have a definite volume, but can change their shape by flowing. The particles have enough energy to overcome some of the attractive forces holding them together so they can move around take on the shape of their container. (Again, a great place to use the box with a picture of liquid.)
- On the subject of Clouds which can be confusing: Clouds form when water vapor (a gas)turns back into liquid water droplets. That is called condensation. It happens in one of two ways: when the air cools enough, or when enough water vapor is added to the air. You've seen the first process happen on a summer day as drops of water gather on the outside of a glass of ice tea. That's because the cold glass cools the air near it, causing the water vapor in the air to condense into liquid. Unlike the drops on the side of your glass though, the droplets of water in a cloud are so small that it takes about one million of them to form a single raindrop. Most clouds form this way, but the cooling comes not from ice in a glass, but as the air rises and cools high in the sky. Each tiny cloud droplet is light enough to float in the air, just as a little cloud floats out from your breath on a cold day.
- **Ask the students if they can think of any examples.**
 - Water in the ocean
 - Shower, rivers, streams
 - Clouds are a liquid because they are really millions of droplets floating in the sky.
 - Here are some others: fog, smog, and steam

- Properties of gases

- Gases have no definite shape or volume and they are invisible. The water molecules have enough energy to overcome the forces attracting them to each other. They move very quickly and if they are not constrained they will spread out indefinitely. (use the diagram on the box)
- **Ask the students if they can think of any examples.**
 - Some students may say steam from a boiling kettle? Ask them if they can see the steam. Remember that a gas is invisible. The steam that you see is actually very small water droplets suspended in the air-so it is actually a liquid.
 - Water in its gaseous state is called water vapor. See if they can give you some examples of water vapor. Give them a hint-the water cycle. Water vapor is the invisible gas that happens when water evaporates or plants lose water through transpiration. Humidity in the air is water vapor. Our breath contains water vapor. So examples would be:
 - **Water vapor, breath, humidity, polar air mass, maritime air mass.**
- **Ask the students what they think makes water change from one state to another?**
Changes in temperature and pressure. Molecules need heat energy which is many times

seen as a temperature change to change state. Remind them that the molecules themselves are not changing, just the way they interact with each other.

- The differences in temperature cause the changes in phases. This happens because the molecules move faster and faster as the temperature increases and therefore need more room to move in.
 - Molecules in the gaseous state which are found at the highest temperatures need the most room to move because they are traveling so fast.

A great way to drive home the point about space and speed is to push the kids together unexpectedly to make them feel the movement, and move them slower and slower for liquid and solid.

- **Ask the students what it is called when water changes from a solid to a liquid and from a liquid to a solid**
 - Melting and freezing
 - Have them give you some examples-ice cube melting. Here the heat energy travels from your hand (the hot source) to the ice cube (the cold source).
 - pond freezing
 - Ask them what happens when you put a full bottle of ice water in the freezer? Or if they've ever put a bottle of soda in the freezer? Most liquids contract or get smaller when they get colder, but water contracts until it reaches 4 C, then it expands until it is solid. Explain to them that generally solids are more dense than liquids and liquids are more dense than solids. Water is different. When water freezes the molecules form a crystalline structure. The crystals have a number of open regions and pockets that make ice less dense than water. This is why an ice cube floats and why ponds freeze from the top down.
- Liquid and Gas
 - **What is it called when water changes from liquid to gas or a gas to liquid.**
 - Evaporation-liquid to gas and condensation-gas to liquid
 - See if they can give you some examples of water changing from liquid to gas
 - Puddle disappearing
 - Clothes drying on a clothesline
 - Examples of water changing from a gas to a liquid
 - Water dripping down the outside of a cold glass in summer
 - Water dripping down a mirror after a hot shower.
 - We breath out water vapor which can condense on your hand. Have them try this. Make sure their palm is dry. Have them hold their palm about an inch away from their mouth and breathe out slowly about 8 times. Their hand should feel moist.
- Gas and Solid
 - **What is it called when water changes from gas to solid?**
 - sublimation
 - example: Frost
- **Tell the kids they are going to see how much they've learned about the phases of water- take them back to the start line and have them pick colors.**
- Once the students pick a color, have them line up behind their color.
 - Explain the following rules to the kids

- When you say go the kids have to pick up a bean bag and run to the second line, look at the back of the bean bag, and throw it into the box with the right phase on it. (If space is limited, have the students place the beanbags)
- Then they run back and do it all over again until they run out bags
- Once everyone is finished the person with the most right, wins. Students with perfect scores get stickers!
- Go over all the bean bags with the kids, asking them which ones they think are right and wrong.
- Don't forget to do the ones they missed
- Have the kids play a round and see how much everyone remembers.

Clean-up

During the Festival

- After each group put the bean bags back in piles on the start line according to color

After the Festival

- Put all the bean bags in one bin
- Remove the tape from the floor and put the lids on the bins. The empty two bins are needed to pack other activities to the cars and back to the shed. Check with the member coordinator before loading the car. Currently, the hats go in one bin and the bubble booth supplies are in the other one -check what the label says on the top of the box.