

JSD 3D Learning Activity 6.2.2

Grade: 6th Grade
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Title: Movement of Water Molecules at Different Temperatures
During the Three States of Matter

Utah Science with Engineering Education Standard (SEEd): 6.2.2 Develop a model to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating).

Key crosscutting concept(s) (CCC): Effect

Key science and engineering practice(s) (SEP): Develop a Model

Materials: computers or iPads; paper; materials to show the movement of molecules

Time: Three 45 minutes classes.

Teacher background, key content information and hints:

All matter, regardless of its chemical makeup, has three states: solid, liquid, and gas. Matter alternates between these three states as its temperature increases and its particles accelerate.

When the particles of matter accelerate, the space between them also increases, which alters the properties of the same element of matter in each of its three states.

The three main points of the kinetic theory of matter explain why matter in each state behaves in a different manner when placed in a container:

Matter in its solid state moves the slowest. This is why, regardless of the shape or size of the container it is in, it maintains its original structure.

Matter in a liquid state moves at a faster rate and thus has more space in between each particle. This is why liquids will stretch to fit any container they are placed into, but maintain a consistent volume.

Matter in its gaseous state is the hottest and therefore the fastest moving with the most space between the particles. As a result, gasses expand to fill a container completely.

These changes of phase always occur with a change of heat, leading to change in temperature. When we heat a solid, the energy supplied is used to increase the kinetic energy of its molecules, and thereby its temperature increases. Energy is required to melt a solid, because the cohesive forces between molecules must be partially overcome to allow the molecules to move about. Similarly, energy is required to vaporize a liquid, because in so doing the molecules are separated and molecular attractive forces are overcome.

Prior knowledge that students need: Students should know that there are certain combinations of atoms that form specific molecules. The combination of specific molecules forms different substances. The students should know the different states of matter—solid, liquid, and gas and that all matter can go through these different states of matter.

Learning Activity Plan

These three aspects of a lesson should be identified in your learning activity.

Gathering:

The students are to watch the different stages of water by watching ice melt into a liquid and watching the liquid turn into a gas.

They will make predictions as to what the changes are and why they change. They are to do research about the three states of water to find out how and why water makes these changes.

The students will write an abstract of what they found out about the three states of matter. They will draw models of the three states of matter with the information they found out about the three states of water.

The students will carry out a kinesthetic activity by using their bodies as molecules and show the movement of molecules in the three states of water.

Reasoning:

By the students using their research of the movement of water of the three states of matter, they will be able to develop an argument of how and why water molecules behave the way they do in its three states of matter.

They will use their models to predict and develop the evidence of the movement of water in its three states.

Communicating:

(Communicate Information, Argue from Evidence (written & oral), Use Models to Communicate).

Students will communicate their arguments by the research they found and models they have drawn to explain their reasoning of the movement of the three states of water.

Phenomenon: When heat is applied to ice, it turns into a liquid, and then turns into water vapor.

Learning Activity:

Day 1:

1. Put some ice a cooking pot and tell the students that you are going to put it on a burner and heat it up. Have a discussion as to what changes the stages ice will be going to go through. Have them write their thoughts on paper.
2. By this time the ice has melted into liquid and the liquid is boiling and evaporating into water vapor in the air. Have a discussion about this with relationship to what they have discussed.
3. Have a discussion with the students about the properties of a solid, liquid, and gas separately. Ask them to write what their definitions are of each using the ideas of what is happening of each at the molecular level. They can do this individually or with a partner. Have a discussion with the whole class as to what they have come up with, without giving out the answers.

4. Ask the students what heat has to do with the changes in the states of matter. Have them discuss this with their partners and write down some ideas. Have a discussion as a whole class what they have come up with.

Day 2

1. With the knowledge they have about molecules, ask the students what they think is really happening with the ice at the molecular level that is causing the changes from a solid, liquid and gas. They can do research on the Internet of the relationship of heat and matter and the movement of the molecules in each of the states matter. They can do this individually or within a partner.
2. When they are done with the research, have a class discussion of the answers they have come up with.
3. Ask the students to draw models of what is happening at each state of matter. The students can work with a partner or in small groups. They should be showing heat as a source of energy for the movement.
4. When significant time has been given, have them share with each other what they have drawn and to defend it with the knowledge they have learned about the movement of the molecules in the different states of matter with the source of heat.
5. Have the students brainstorm of ways they could make 3D models of the movement of the molecules in the three states of matter. (bee-bees in baby food jars; marbles in Baggies; marshmallows in baggies; using students standing in a small space enacting the movement of molecules in the different states of matter; any small objects in containers)

Day 3

1. Use the students to show the movement of molecules in the different states of matter.
 - a. Movement of students in a solid.
 - i. Ask the students what they think they would be doing if they were water molecules in a solid (ice). (The students would be standing by each other with their arms down by their sides and twisting in place. They are to move just far away from each other where they are barely not hitting each other when they are twisting. This would signify that molecules are still moving a bit being part of solid. They wouldn't walk around.)
 - b. Movement of students in a liquid
 - i. Ask the students what they think they would be doing if they were liquid water molecules. (The students would be standing by each other with their hands on their hips and twisting in place. They are to move just far away from each other where they are barely not hitting each other when they are twisting. They could also begin to move around at a walking speed just far enough away from each other where they are barely not hitting each while walking around. This would signify that molecules are moving around at a moderate speed as liquid molecules would.)
 - c. Movement of students in a gas
 - i. Ask the students what they think they would be doing if they were molecules in a gas. (The students would be standing by each other with their arms and hands stretched out and twisting in place. They are to move just far away from each other where they are barely not hitting each other when they are twisting. They could also begin to move around at a running speed just far enough away from each other where they are barely not hitting each while walking around. This would signify

that molecules are moving around at a fast speed as gas molecules would. This would signify that molecules are moving around at a quicker pace and need a lot of space.)

2. Have the students write about their experience of what molecules at the different states of matter. Have them explain why the molecules' movement is in this pattern. Have them tell why heat or the lack of heat is causing this pattern of molecule movement. Have them share their ideas.
3. Have the students draw a model of the three states of matter according to how the students moved in the activity. Have them share their models.

Assessment of student learning

1. Students are able to tell of the movement of molecules of the different states of water.
 - a. Solid State: Molecules in a solid state move very slowly. They don't need a lot of room for movement.
 - b. Liquid State; Molecules in a liquid state move faster but not speedily. They need more room for movement. They are spread out farther from each other for a faster motion.
 - c. Gas State: Molecules in a gas state move speedily around. They need a lot of room for movement. They are spread out really far from each other since they need a lot of room for room rapid movement.
2. Students are able to draw a model showing the movement of the three states of water.
 - a. Solid State: This drawing would show that the molecules are close together for the movement is very minimal.
 - b. Liquid State: This drawing would show that the molecules are spread farther apart for the movement is greater than molecules in a solid state.
 - c. Gas State: This drawing would show that the molecules are spread very far apart for the movement is very great for they need a lot of room for movement of these speedy molecules.

Name _____

Student Directions

The Movement of Water Molecules in Different Temperatures
During the Three States of Matter

Introduction:

Atoms and molecules in matter react to heat energy and lack heat energy. We want to investigate the movement of water molecules when heat is applied to matter.

Materials: computers or iPads, paper, material to represent the movement of molecules in different temperatures; a gym room or outside if weather permits

Procedures:

Day 1: Finding out about the stages of water

1. With a partner, discuss what you think will happen to the ice in the next 10 minutes as it is heated. Write your ideas below.

2. Explain how you think water goes through these different stages?

3. After about 10 minutes discuss with a partner what you saw happen and write it down. This is the phenomenon.

4. Write your definitions of the three states of matter--ice, liquid water, water vapor.

5. What do you think heat has to do with the changes of water to the three states of matter?

Day 2: Researching the Three States of Water

1. Something is happening at the molecular level when heating water at its three different states. To find out what is happening and why it is happening, do some research with a partner on your iPads. Discuss what you find out what is happening at each of the states of water. Write your finding down below.

Ice:

Liquid Water

Water Vapor

2. Now that you have found out why and what is happening during three states of water, draw pictures below of what you think the molecules are doing for the changes to happen.

3. Share with the class what you have found out and show your drawings to confirm your explanations.

4. Brainstorm ideas how you could show a 3D physical model of what is happening at each state of water.

Day 3: Kinesthetic Movement Activity

Now that you know about the movement of water molecules at their different states, our class is going to gather together in the gym and act like you are molecules of different states of water because of the temperature. When we are done with each states, you will answer these questions.

Water as a Solid:

1. How did you move when you were told that you were a frozen water molecule? Why?

2. What did you notice about the amount of space you needed when you were moving as a solid piece of ice?

Water as a Liquid:

1. How did you move when you were told that you were a liquid water molecule? Why?

2. What did you notice about the amount of space you needed when you were moving as a liquid?

Water as a Gas:

1. How did you move when you were told that you were a gas water molecule? Why?

2. What did you notice about the amount of space you needed when you were moving as a gas?

Writing about Your Kinesthetic Water States Experience

1. You are to write about you experience as a molecule at the different states of matter. Explain what you did and why the molecules move this way. Explain how heat or the lack of heat is causing these different movements of molecule.
