JSD 3D Learning Activity Template

Grade: 6th	**Title:** Hot, Medium, and Cold Water Comparison in a Cup

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

Materials for each group: 3 clear plastic cups, thermometer, container of cold water, container of room temperature water, container of room temperature of water, blue food coloring, red food coloring, small syringe, 3 ice cream buckets, ice, heating unit, water source, journals, 2 empty big buckets for waste water

Time: 45 minutes

Teacher background, key content information and hints:
Particles that make up substances are always moving and always have energy. The increase of heat causes the particles to move faster and inversely the decrease of heat causes the particles to move slower. Heat always travels from hotter to cooler objects. It may seem that when you are holding an ice cube, the ice cube is causing your hand to feel colder. However, the real physics behind this heat transference is: the heat flowing away from your hand and into the ice cube causes the feeling of coldness in your hand. The transfer of energy goes on until all the particles in both objects are moving at about the same speed. When the amount of heat energy of each object is the same, both objects will have the same temperature.

To prepare for this activity, the teacher needs to prepare 3 small ice cream buckets, one with ice water, one with hot water, and one with room temperature water.

Prior knowledge that students need:
Students should have knowledge from previous lessons with the idea that as heat is increased to a solid, liquid, or gas that the particles move faster and vice versa that with the decrease of heat to a solid, liquid, or gas that particles move slower.

Learning Activity Plan

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

Gathering:	*Reasoning:*	*Communicating*
Students will ask questions as to what will happen when different temperatures of water are put next to each other. Students will plan and carry out an investigation by putting the different temperatures of water next to each other and gather data. They will build a model to show what is happening with the different temperatures of water.	Students will analyze and evaluate the data from the experiment and construct explanations and develop arguments from evidence as to what is happening to the water in the cup as it is next to each other. They will use models to show their findings behind their thinking.	Students will communicate their information to others about the behavior of the water next to each other and argue from their evidence what they seem to be true.

Phenomenon: Warmer water rises while cooler water sinks.

Learning Activity:

Gathering:

1. In groups of three or four, begin by telling the students that there are three containers of water in the center of the room with different temperatures of water: ice water, room temperature water, and hot water. They are to go over with their clear, plastic cups and fill all the cups up about half way full. Then they are to go over to the food-coloring table and put in 5 drops of blue coloring in the cold cup and 5 drops of red coloring in the hot cup. The room temperature water is to stay clear.
2. With the three different temperature water cups in front of them, they are to write in their journals what they know about the particle movement in each of the three cups. They are also to draw the three cups and show the particle movement in their cups.
3. Next, they are to write in their journals specific questions that they might have as to what will happen as they put the three temperatures of water together.
4. Tell the students that the room temperature water (clear water) will be the water that the hot and cold water will go into for observation. They will be using the syringe to put the water carefully in the clear cup as to not to disturb the other temperatures of water too much. They are also to use the thermometer as much as they can while doing the investigation.
5. The students will plan an investigation with the three temperatures of water to see how they react with each other. They will write data down of what they found.

Reasoning:

6. Students will then will analyze the data and make models of why they think the phenomenon is happening.
7. Students will construct explanations and to develop their arguments to explain their models.

Communicating

8. The students will communicate their findings about the nature of the phenomenon by using their arguments and models.

Assessment of student learning

Short description of the evidence the teacher is willing to accept that a student is proficient with the performance expectations. This may be a rubric, narrative, or other set of descriptors that are useful for distinguishing proficient from non-proficient performances

1. Students will be able to show through explanation and the models they make what the particles are doing at each temperature.
2. Students will be able to tell about density and why matter that is denser than other matter will not mix together but stay on top or below each other.
3. The students will be able to tell why the temperatures are not mixing.

.

Student Page:

Name:_____ Date_____

Title: Hot, Medium, and Cold Water Comparison in a Cup

Introduction:
Everything around us is made up of matter, from our skin that makes up our body, to the soda pop you drink, and to the air we breathe. All this matter is made up of particles we call atoms and molecules. If we had microscopes that could look close enough we would be able to see how these small particles are arranged in the stuff around us. These arrangements can be very different depending on whether the "stuff" is a solid, liquid, or gas. Warming it up and cooling it down can also change how these particles are arranged. Since we can't zoom in and look at the real thing, we are going to see what the results are when cold water meets hot water and come up with conclusions of why the different temperatures are doing what they are doing.

Prediction/Hypothesis:

1. Which takes up the most space: hot water, room temperature, or cold temperature?

2. Which takes up the least space: hot water, room temperature, or cold temperature?

3. If the hot, room temperature, and cold water represent liquid matter, how can we use this information to show a model of what is happening at each temperature?

Experiment:
Your group is to come up with an experiment to explain what is happening with water particles at the atomic level of hot, room temperature, and cold water.

1. In groups of three or four, you are to get hot water, room temperature water, and cold water in the three plastic cups and fill all the cups up about half way full. Then go over to the food-coloring table and put in 5 drops of blue coloring in the cold cup and 5 drops of red coloring in the hot cup. The room temperature water is to stay clear.
2. With the three different temperature water cups in front of you, write in their journals what you know about the particle movement in each of the three cups. Draw the three cups and show the particle movement in your cups.
3. Write in your journals specific questions that you might have as to what will happen as you put the three temperatures of water together.
4. Room temperature water (clear water) will be the water that the hot and cold water will go into for observation. For the experiment to show what happens when different temperatures of water are brought together, use a syringe to put the water carefully in the clear cup as to not to disturb the other temperatures of water too much. You are also to use the thermometer as much as you can while doing the investigation.
5. You are to plan an investigation with the three temperatures of water to see how they react with each other and what the water particles are doing at each temperature to cause the phenomenon you are viewing.

6. Write down data of what you found and draw a diagram of what you saw happen.

_____

_____

_____

_____

_____

_____

Reasoning:

1. Analyze your data and construct an explanation of why you think this phenomenon happened for each temperature.
2. Make a model to explain what is happening at the atomic level to show your explanation of the phenomenon.
3. Develop an argument by using your explanation and model of the arrangement and motion and the particles that caused this phenomenon to happen.

Hot Water Temperature and Model

_____

_____

_____

_____

Room Temperature Water and Model

_____

_____

_____

_____

_____

Cold Water Temperature and Model

_____

_____

_____

_____

_____

Analysis:

Explain how your group model can help you understand the movement of water particles at the different temperature levels.

_____

_____

_____

_____

_____

Conclusions:

1. Look at your analysis and models from your predictions and compare them with final models.

What similarities and differences do you see?

2. Which water temperature takes up the most space?

Why?

3. Which water temperature takes up the least space?

Why?

4. How does the temperature of the particles affect the volume?

Formative Assessments

- Written Reflection.
- Redesign of models