Community in the Classroom Presentation Plan

Lesson Name Heat, Temperature, and the jiggling of molecules
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Grade Level 5

Abstract:

Your opportunity to tell teachers and kids what's going to be fun and interesting about your visit!

Ever wondered what the difference is between heat and temperature? This lesson explores heat and temperature at the molecular level. Students will do a hands-on activity exploring heat transfer and see a film showing the thermal motions of several molecular models. At the end of the lesson students will be able to demonstrate their new understanding by acting out the motion of molecules.

Lesson Plan

1. Introduction: 5 Minutes

What do you want to share with students and why? How will you connect this with students' experiences or interests? What questions will you ask to learn about students' prior knowledge?

My name is Jhih-Wei Chu and I work at UC Berkeley in the Chemical Engineering Department. We're trying to figure out how the motions of molecules and atoms achieve life. (1 minute)

You're going to do an activity today that looks at what happens when things heat up and the difference between heat and temperature. (I will ask) What are some different sources of heat? (wait for 5 seconds) (I will write) [sun, stove, living things, furnaces, flame] Write Heat is a form of energy on the board. When light energy from the sun reaches our planet it adds energy to the air, the earth's surface, and anything else it hits, warming it up and creating heat energy. Chemical reactions can also release or absorb heat. Heat always goes from a higher temperature (hotter) object to a lower temperature (colder) one (4 minutes).

2. Learning Experience(s): 25 Minutes

Demonstrations, hands-on activities, images, games, discussion, writing, measuring… What will you do, what will kids do? Describe in order, including instructions to kids and transitions between experiences..

Heat Transfer Activity

Our experiment will study what happens to the temperature of two different cups of water when hot marbles of different sizes are added to them. One cup will get 5 small marbles and the other will get the same number of large marbles. At the beginning, the marbles will be the same temperature and the water in the cups will be at the same starting temperature. What do you think might happen to the temperature of the water in the two cups?

You will work in teams of four (write in a column on the board): with a 1) temperature reader #1, 2) temperature reader #2, 3) time keeper, and 4) data recorder. Let's count off in 4s to pick the positions. Your team will observe how the cups change temperature over a period of 5 minutes. I will pass out a bag like this that contains two cups, two thermometers, and a data table.

> temperature reader 1 and 2: you will be reading the temperature of the water, so you must hold the thermometer above the marbles and read the temperature at each minute. After you get your bag, take out the cups and your teacher will come around fill each cup with the same amount of water. Prepare by reading the starting temperature of the water to the data recorder. Once the experiment starts you will read the temperature in your cup when the time keeper tells you, remember it, and give the temperature to the data recorder.

time keeper: will use the stopwatch to measure time. You must prepare by figuring out how to turn the watch on and off and put it on zero. You must start your watch as soon as both the large and small marbles are added to your team's jars. Read out 1 minute, 2 minutes, etc until the watch reaches 5 minutes.

data recorder: will record all data. Prepare by writing down the team names and the starting temperature of the water. As the time keeper signals each minute, get the temperatures from the temperature readers.

[The teacher/presenter pass out the bags, pour water, and start heating the marbles. Presenter will measure the temperature of hot marbles and write it on the board. The presenter will add marbles in the cups of each group; students will NOT handle the hot marbles. Marbles need to be added gently to prevent water splashing. The presenter will ask students to step back when marbles are added, and the teacher will help to keep the students of the group from touching the hot pan. Both sizes should be added to the water as closely in time as possible to maintain the same starting temperature and time]

Let's collect our data and see what we observed. Ask each table to report their findings. Record on board. Summarize findings: It looks as if, in general, the water around the big marbles reached a higher temperature, faster, than the containers with the small marbles. [If some teams had different findings ask them – and the class - to help think of possible reasons why their data might have been different.] Is this different or the same as what we expected?

Since the marbles were the same temperature when they were added, and the water was the same temperature, why do we think the two containers didn't both end up at the same temperature? Any guesses? What was the only difference between the two containers? [one had bigger marbles] The bigger marbles have more mass (both in weight and volume) than the small marbles. This experiment gives us a clue about what heat energy really is and how it's different from temperature.

Even though both sizes of marbles were at the *same temperature*, the bigger marbles have *more matter* and you were transferring more heat to the water by adding the bigger marbles.

Heat: is the energy form that moves from higher temperature object (marbles) to lower temperature one (water). [write underlined statements on board]

When we measure temperature we're taking a measurement of the average speed of the particles in a substance. The heat of a substance is the energy of its' moving particles.

[Draw circle with little arrows whizzing around inside] The molecules in both sizes of marbles were moving at the same speed, but the bigger marbles have more molecules moving around at that speed. [Draw second larger circle with little arrows of the same size]

Movie of Heated Molecule (5 minutes)

We're beginning to be able to build models of what happens to molecules when heat – energy – is added to a substance. I've brought some pictures from our model. [Show moving pictures] What did you notice? [It moves.] We know that …. The more heat energy is added to a system, the faster the molecules move and the farther apart they get.

Acting Out Heat Energy in States of Matter (5 minutes)

Let's think about that for a minute. Write solid, liquid, gas on the board side by side. We know that frozen water is in crystals, patterns of molecules, [Under the word solid write "close connections", "small movement" and draw a picture of a connected series of dots] but they're always moving a little [Under the word solid write "small, slower movements"]

What happens when you add heat to frozen water? Draw an arrow from solid to liquid with "heat energy" as a label. [It melts, turns into a liquid.] So the molecules in a liquid have more energy and are moving a little faster and are farther apart, but they're still close enough to have some surface tension. Write "looser connections" and "moving through each other but still close".

Now what if we add even more heat energy to our liquid water? Like the sun on a puddle during a hot day? Draw an arrow from liquid to gas with "heat energy" as a label. [It turns to a gas or water vapor] These molecules have

even more energy so they can move further apart and move faster. Write “further apart” and “moving faster”. These gas molecules are far enough apart that they’re hard to see, but it’s still water.

Let’s see if you can act it out. I have 3 pieces of paper that say solid, liquid, gas. I’m going to pick 4 people to come and act like molecules in that state. Let’s have four people. I want you to pick one of these pieces of paper and decide how to act like the molecules of the particular state and then act it out and see if you can make us guess what you are. Remember our tips on the board up here. [Call up two more groups of 4 to act out the other two states of matter.]

3. Wrap-up: Sharing Experiences and Building Connections __5___ Minutes

Pulling the big ideas out of combined experiences – how will students share learning, interpret experience, build vocabulary?

What happened in your cups?

Why do you think you saw different results in your two cups?

What happens when you add energy to a substance?

What is temperature?

Atoms in solid matter don’t move very far or fast. When heat is added solids can become liquids. Atoms in liquid move faster and farther away but still stay close to each other. Even more heat energy can change matter to it’s gaseous state. Atoms in gas move even faster and farther apart and spread out into the space around them.

Some substances are solid at room temperature, while other substances are gas or liquid at that temperature. You might have to add a lot or little energy to change some substances from one state to another.

We know that different elements and substances absorb different amounts of energy before they change state. Each element, molecule, and compound has a particular melting and boiling point and these properties help us identify different substances and create new products for different uses.

4. Close: ___5__ Minutes

How students can see this concept in action, communicate their knowledge, and learn more

You can observe this science idea by …..

Suggest students write a letter explaining “How we learned about _____heat and temperature_____?”

TOTAL LESSON 50 – 60 Minutes

Follow-Up Ideas

Students can learn more about this topic from the following activities, books and websites: