Class: Grade 7 Science

Lesson Title: Heat Kinulation

Class Size: **24**
Time: **60 mins**

Curriculum Outcomes:
308-5 compare transmission of heat by conduction, convection, and radiation
308-2 explain temperature, using the concept of kinetic energy and the particle model of matter

Learning Objectives:
1. Students will gain an understanding of the difference between temperature and heat.
2. Students will learn the mechanisms of how heat is transmitted via conduction, convection and radiation.

Materials:
- Tape for an area to be the thermometer
- Zip lock bags (enough for all students)
- Crumbled pieces of coloured paper (don't have to be large, just enough to represent 1 unit of energy)
- Red pinnies (around 10)
- Hand-held fans (5-6)

Preparation beforehand:
- Have crumpled paper prepared
- Tape area in room for the thermometer

Background:

Conduction is the transfer of energy in the form of heat or electricity from one atom to another within an object by *direct contact*. Conduction occurs in solids, liquids, and gases; however, solids transfer energy most efficiently since the molecules in solids are most tightly packed, and the molecules are closer together.

Convection is a type of heat transfer that can only happen in liquids and gases, because it involves those liquids or gases *physically moving*. Convection happens when there is a difference in temperature between two parts of a liquid or gas.

Radiation is the transmission of energy from a body in the *form of waves* or particles.

Introduction:
1. Introduce the topic. Possible prompt questions include:
    a. What is the difference between temperature and heat?
    b. How do we measure temperature?
    c. What is heat? How is it transferred or how does it move from one spot to another?
    d. What is conduction? Convection? Radiation?
2. Explain what a kinulation is (broken up into kinesthetic and simulation). Ask the students if they'd like to try one out!

Activity #1 - Thermometer:
1. Designate each student as 1 degree Celsius (one unit of temperature).
2. Designate 1-2 students as the "thermometer readers" – these students will be in charge of determining whether the temperature "reading" (number of students) makes sense according to the instruction. These people can also have the role of calling out a temperature for their classmates to model. This task can be rotated if desired (if the temperature they choose is too high for students to model, or is a negative temperature, this opens up discussion for model limitations).
3. If a student steps within the "thermometer" space, then they will be counted as 1˚C in the temperature reading.
4. Run through various scenarios that the students will model:
    a. Model today's temperature (an exact number): 15˚C, 12˚C (around 5 less than the # of students).
    b. Model increasing temperature; decreasing temperature; constant temperature.
    c. Model middle of the night; morning, afternoon (they should be increasing from a low number).
5. (optional) Debrief with some discussion on whether the students represented actual heat, or just a measure

of heat. Can discuss limitations (can't show negative temperatures, or temperatures > # of students).

Activity #2 – Conduction:

1. Divide students into larger groups (10-12 students per group) and have the groups stand in single lines facing each other. Each student will need a zip-lock bag to store the crumpled pieces of paper that will be representing heat energy.
2. They will be kinulating conduction in a solid metal.
    a. Show energy being moved along by passing the crumpled paper along the line of students, starting at the heat source (the heat source will be the students/teacher(s) at the front of the line).
    b. You can alter the amounts of crumpled paper (heat) being passed along the line, and the speed at which the paper is being passed. For example, one line could have 200 crumpled balls and hand out paper slowly, while the other could have 400 crumpled balls and hand it out quickly.
    c. Have students kinulate what they think will occur in this type of system. How will the heat be transmitted?
    d. Will there be some sort of capacity (say 4 balls of paper) that one student needs to reach before he begins to pass it on further in the line? Or will each ball of energy be passed to the end and start filling up bags from there backward? Allow students to discuss and choose.
        i. Heat travels from areas of high concentration to low concentration and it will stay in the metal more readily than dissipating off into the air. Typically the beginning atoms of the metal fill their capacity first, before transferring a lot of energy along to the next particles.
    e. Discuss the differences in transfer between the slow/fast heat sources after the activity is completed.

Activity #3 – Convection:

1. Designate 3-4 students as the "heat masters" (heat source – elements in an oven). They will be in charge of all the crumpled paper (representing heat). They should situate themselves in spot that they won't move from around the room.
2. Choose around 10 students to be air molecules (capable of a capacity of 2-3 balls of energy). They can wear red pinnies and hold their zip-lock bags.
3. The remaining students can be air traffic controllers (fans in a convection oven) or food (something to cook with the heat energy). The air traffic controllers will control the air movement. They can have hand-held fans to "push" the red pinny students around the room, to the "heat masters" to pickup balls of energy, then to the food to transfer the energy to become heat.
4. The food students will choose their favourite food to be cooked in an oven. The classroom will represent the oven and the center of the room will represent the food (students can stand in the middle to represent the food).
5. The red pinny students are going to be what is heating up the food in the oven. The students in the middle are trying to collect heat so they can cook. The red pinny students can drop off heat to the food students only if the fans are "pushing" them around.

Activity #4 – Radiation:

1. Ask students how they think energy might be transferred in radiation (waves, not requiring any medium). Ask if it can be transferred in space (i.e. UV radiation, etc. with no medium to travel through).
2. Ask students what types of devices use radiation to transfer energy (microwaves, radio, cell-phone, TV, etc.).
3. Have students suggest a method of cooking their "food" students in the center of the room since the energy has no medium to travel through (there is no direct contact like conduction, no moving of air particles or other medium like convection).
4. If students can't come up with some feasible solution, suggest throwing the balls of energy to the food to represent the energy travelling in waves to the designated location. Each student can be given 3-4 balls of energy and can be thrown in waves (i.e. everyone throws one at once, then again, …).
5. Discuss with students the distinction between energy and heat (i.e. the balls represent energy when travelling as a wave, but become heat energy as soon as they've touched the food).
    a. Can discuss the operations of a microwave, how they have special features to trap or redirect the remaining radiation energy so that it's not free roaming in the microwave, or exposed to people upon opening the door.

Conclusion – Possible wrap-up questions:

1. Why do you think sometimes only part of the food heats up in the microwave?
2. Ask students if they understand the difference between heat and temperature.
3. How does heat transfer really occur?
4. How does energy travel in conduction, convection and radiation?
5. Does this type of activity help with their understanding or learning of the different methods of heat transfer?