Lesson 1

Topic: Heat and Temperature
Date:
Subject: Physical Science
Grade level: 8
NSES Standards:

Teaching Standard B: Teachers of science guide and facilitate learning. In doing this, teachers:

- Focus and support inquiries while interacting with students;
- Challenge students to accept and share responsibility for their own learning;
- Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

Teaching Standard D: Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science. In doing this, teachers:

- Structure the time available so that students are able to engage in extended investigations;
- Create a setting for student work that is flexible and supportive of science inquiry;
- Ensure a safe working environment.

Assessment Standard A: Assessments must be consistent with the decisions they are designed to inform:

- Assessments are deliberately designed;
- Assessments have explicitly stated purposes;

Assessment Standard D: Assessment practices must be fair:

- Assessment tasks must be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, or limited English proficiency;
- Assessment tasks must be set in a variety of contexts, be engaging to students with different interests and experiences, and must not assume the perspective or experience of a particular gender, racial, or ethnic group.

Grades 5-8 Content Standard A: As a result of activities in grades 5-8, all students should develop:

- Abilities necessary to do scientific inquiry;
- Understandings about scientific inquiry.

Grades 5-8 Content Standard B: As a result of their activities in grades 5-8, all students should develop an understanding of:

- Transfer of energy.

SOL: PS.7

The student will investigate and understand temperature scales, heat, and heat transfer. Key concepts include:
a) Celsius and Kelvin temperature scales and absolute zero;

Topic: Motion of particles and temperature

Intended Learning Outcomes:
- Student will (SW) compare motion of slow particles with motion of fast particles to determine their relative energies.
- SW relate motion of particles to temperature and define temperature with respect to the motion of particles.

Daily Question: How is the motion of particles related to temperature?

Procedures for Learning Experience	Guiding Questions	Materials Needed	**E**valuation (Assessment)	Approximate Time
Engagement: Move the tables and chairs toward the edges of the classroom to give a bigger open space in the middle of the room. Each student will hold their accelerated reading book (have them remember which one is theirs) and begin exchanging the books when I say to start trading. Each student must trade with seven other people, and at the end of the trading we will see what has happened with the assortment of the books. The books represent particles in a closed system, and we can draw two analogies from this activity: 1) that students should not end up with their own book, and this represents the random movement of the particles; 2) the physical aspects of the books may represent the different size of the particles, which in turn affects their energy. Ask the two guiding questions after the students have finished trading, and repeat the trading two more times (for a total of three times). Move the desks and chairs back into their normal positions and have the students return to their seats.	Did you end up with the same book you started with? How long did it take to make the seven trades?	Accelerated reader books Students	Student participation	10 minutes

Exploration: Each student will tell me how tall they are, and as a class we will calculate the average height for the class. The students will take the data individually on their worksheet as I take it on the computer, and then I will lecture on averages. The lecture flow: Averages are useful for telling us information about what is most likely to happen in a given instance, and for us it is height. Is anyone the exact average height? How far are you from the average height?	What is an average? What does an average predict?	Presentation software	Student participation	10 minutes
Exploration: Demonstration with the molecular motion machine (plexiglass box filled with ping-pong balls). Place the machine on a table in the middle of the front of the room, and adjust the air flow such that some of the ping-pong balls are moving about halfway up the side of the box. There needs to be enough difference between those balls that are flying up into the air versus those that are trapped on the bottom so that the students may qualitatively see the difference between high particle velocity and low particle velocity. Ask the students for their observations and how we would characterize the energy for the entire set of ping-pong balls.	What did you observe? What is different about the high flying balls versus the trapped balls? How would we find an overall velocity for the balls?	Molecular motion machine	Student worksheet	10 minutes
Explanation: Using the analogy of the average heights, discuss the energy of particles in a closed system. Incorporate the analogy of the random movement of the books to discuss the random movement of the particles, and show the equation KE = ½ m v^2. Discuss this equation and how it ties into energy and motion of particles, and ask how this ties into what we observed for the movement of the ping-pong balls in the molecular motion machine. Define temperature as the average kinetic energy of the particles, and ask if this makes sense.	How does kinetic energy relate to temperature? How is the motion of particles related to temperature?	Presentation software	Student participation	15 minutes

Extension: Use the molecular motion machine one more time to show the state with the lowest kinetic energy/temperature and the state with the highest kinetic energy/temperature. The students will also complete a 3-2-1 chart as an exit slip, so that I may see what they took away from the day's lesson.	Which state has the highest kinetic energy? Which state has the highest temperature? What 3 things did you learn? What 2 things did you find interesting? What is 1 question that you still have?	Paper/pencil	Student worksheet	10 minutes

Notes:

Vocabulary: average, kinetic energy, temperature

Safety:
- The students will be passing books, so be on the lookout for any type of horse-playing or roughhousing.

Differentiation:
- Multiple modalities: demonstrations, writing, hearing.
- Notes for those with IEPs so that they may have a copy if they are not able to read the ones they have written.

Technology:
- Presentation software for entering averages.
- Molecular motion machine.