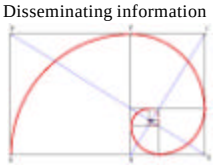
Disseminating information



into our community

University of California Berkeley

Applied Design Engineering Project Teams (ADEPT)

ADEPT is funded by a grant from the National Science Foundation

Particle Party Balloons – Kinetic Energy

Objective/Purpose:

Students watch a demonstration and perform experiments concerning kinetic energy of particles. This is intended to help explain why hot gases will have lower densities, as particles collide with each other harder and more often, pushing each other farther apart.

Topic:

Properties of gases, kinetic energy, particle model of matter

Grade Level: 7-9

Pre-Requisites:

Particle model of matter

- Know that matter, including gases, is made up of particles
- Know that gas particles are widely separated and not bound together like liquids or solids.

Lesson Process Summary:

Preparation For The Lesson

1. Fill cups with soapy water
2. Stretch balloons over mouth of glass bottles
3. Begin heating hot water

Prep—Time: ~10 minutes

Lesson Time: ~60 minutes

Material List:

Per Student—

- Kinetic energy POE worksheet
- Steam engine POE worksheet (optional)

Per Group—

- Beaker for hot water
- Glass bottle with balloon over mouth (or over rubber stopper with hole in center)
- Small plastic bottle with cap
- Cup of soapy water

Per Class

- Box of marbles, petri dish of BB's, or other means of demonstrating particle motion
- Hot pot(s) or other source of hot water.
- Source of cold water

For Optional Demonstration:

- Model steam engine

✍Initiating The Class – Kinetic Energy Demonstration

Discuss or demonstrate the idea of kinetic energy of particles. The approach I took was to place a set of marbles in a clear plastic box projected onto the wall with an overhead projector. The box had a slight depression in the center, so that the marbles collected there when the box was motionless. My procedure was then to:

1. Ask students to imagine that the marbles in the box are particles, and that when I shake the box I am adding heat.
2. Define kinetic energy for the students as energy that particles have because they are moving.
3. Ask students if particles in a solid move (answer: only a little/ they vibrate)
4. Shake box slightly to show vibration
5. Explain that as we add more heat, the particles move faster; they have more kinetic energy. They can start moving past each other, as in a liquid.
6. Shake the box slightly more to demonstrate a "liquid"
7. Explain that in a gas, the particles are moving so fast that they aren't held together at all.
8. Shake the box hard to demonstrate a "gas"
9. Check with students: do the particles move in any particular direction? (no) are they colliding more often? Harder? (yes, yes)
10. Have students answer in their notes:
    a. What is kinetic energy?
    b. What happens to particles (and kinetic energy) when you add heat?
    c. How does the kinetic energy of the particles cause the particles to behave in a solid? In a liquid? In a gas?

✍Optional Demonstration – Steam Engine

The classroom where these experiments were done had an electric model steam engine. This is an interesting experiment for the students to observe, if such a model is available. We used this as a second demonstration of kinetic energy, asking students to think about how the particles inside the boiler were moving around as the engine heated up. Key points to think about were that the hot water and air particles could push the piston because they had lots of kinetic energy and collide with the walls very hard, and that the particles don't always move upwards, but are moving in all directions, for example into the horizontal piston.

✍Procedure for Session – Kinetic Energy Experiments

In their original form, these experiments are very open-ended, with instructions such as, "explore kinetic energy using the soap solution and plastic bottle". Here, I've placed 3 of the 4-5 usual experiments with the materials above in the POE format used for other experiments in this unit.

1. Tell students that they will now need to use the idea of kinetic energy to explain what is happening to a gas in 3 experiments.
2. Pass out POE worksheets
3. Divide students into groups of 3-4 students

4. Ask one student from each group to come pick up their materials
5. Poor a beaker of hot water for each group as they pick up materials
6. Circulate through room as students do experiments, helping as needed
7. At the end of the lesson, ask students to return their materials and clean up their work areas