Hands-On Activity

Modeling Gas Behavior

Objective: Students will use marbles and compressed rubber balls to model principles of the kinetic theory of gases.

Estimated time to complete: 10 minutes

Materials:

For each small group:

- 3–4 standard glass marbles
- 3–4 compressed rubber balls
- 1 high-sided tray

Procedure:

Break the class into small groups of 3 or 4 students. Provide each group with a high-sided tray, several compressed rubber balls, and several glass marbles. Emphasize that students should keep the balls and marbles inside the tray at all times and never throw them at each other or roll them on the floor.

Instruct groups to use these materials to illustrate some of the principles of the kinetic theory of gases. (If students need to review this topic, they may view the video segment Kinetic Energy Theory of Gases: Kinetic Energy and Momentum.) Explain that the tray represents a closed container and that the marbles and balls represent particles of different gases.

For example, students should understand that gas particles spread evenly throughout a closed container; therefore, they should spread their marbles and balls evenly through the bottom of the tray. Students should also understand that gas particles are constantly moving and bouncing off each other and off the container's walls; although they won't be able to keep all their marbles and balls in constant motion, they should roll individual marbles and balls around the container and observe their collisions.

Ask students questions to guide their activity, such as:

- *How do the marbles and balls move when you roll them: in straight lines or zigzags?*
- *Does this motion accurately model the motion of gas particles?*
- *What happens when you roll the marbles and balls more quickly or slowly?*
- *How do the marbles and balls interact with each other and with the sides of the tray?*
- *Do these interactions accurately model interactions between gas particles?*
- *Which collisions, if any, are elastic? Which collisions, if any, are inelastic?*
- *How does the kinetic energy of the marbles and balls change throughout the activity?*
- *Kinetic Molecular Theory (KMT) is an ideal representation of the behavior of matter. The real world, things do not always behave ideally. Use a Venn Diagram to show how this activity can represent both the ideal and non-ideal situations.*

Inquiry and Nature of Science Skills in this Activity:

- Design Investigations
  - Make or use models that:
    - Simulate a real thing that cannot easily be studied or manipulated
    - Function exactly like or similarly to the real thing
  - Practice lab safety by:
    - Following lab safety procedures
  - Use senses to observe:
    - Seeing (color, shape, size, texture, motion)
    - Touching (temperature, texture, shape, size, vibration, motion)
- Scientific Endeavor
  - Characteristics of Science:
    - One way to make sense of something is to think of how it relates to something more familiar.