Category II Summaries for Physical Science Examples

Addressing commonly held ideas

Matter and Molecules

Matter and Molecules addresses students' difficulty in appreciating the intrinsic motion of particles in solids, liquids, and gases in the *Science Book* (pp. **T-21**, T-34, T-35 [transparency]) and in the *Activity Book* (p. **5s**, Question Set 1.3). *Matter and Molecules* addresses students' ideas that particles have macroscopic attributes, such as hardness, expansion, and physical state in the *Science Book* (pp. T-21–22, T-34–35, T-72, T-81–82) and in the *Activity Book* (Activity 6.2, pp. 33s, T-33; Activity 6.3, pp. 35s, T-35).

To address students' ideas, the material employs three strategies: (1) prompts students to react to commonly held misconceptions and contrast them with the scientifically correct idea (e.g., see the *Activity Book*, p. **33s**, question 2); (2) elicits students' ideas and then juxtaposes them with the scientifically correct ideas (e.g., see the *Science Book*, p. **T-72**); or (3) suggests that teachers emphasize the correct response (e.g., see *Science Book*, p. T-21).

Strategy 2 may not be successful unless students are asked explicitly to contrast their ideas to the scientifically correct idea. Given the tenacity of students' misconceptions in the area of the kinetic molecular theory, it is not likely that strategy 3 (stressing the right response) will help many students to progress from their own ideas to the scientifically correct ones.

Lesson 1.4: Molecules and the Three States of Water

Purpose:

To help students describe the differences among the three states of matter in terms of the arrangement and movement of water molecules.

Teaching Suggestions:

In using this lesson with students, stress that the difference in properties among ice, liquid water, and water vapor is due to the arrangement and movement of the molecules and not due to any change in the molecules themselves.

Also, stress that molecules are constantly moving and never stop, even in a solid.

Question Set 1.3: The Smallest Pieces of Water

1. What are the smallest pieces of water called? _____

   What are these smallest pieces made of? _____

2. Draw a picture of a water molecule and label the atoms in it.

3. Suppose you saw a tiny speck of dust floating in a drop of water. Draw a picture to show how the size of the speck of dust compares to the size of water molecules.

4. Draw arrows in the picture you drew above to show how the water molecules are moving.

5. My friend said that if you froze some water into ice, then let the ice sit completely still in the freezer, the water molecules would eventually slow down and stop moving.

   Was my friend right? _____Explain your answer _____

_____

_____

Question Set 6.2: Heating and Cooling Solids

1. Try to summarize the main points of this lesson by writing two sentences, one about heating solids, and one about cooling solids. Your sentences should mention both changes in substances and molecules.

   Heating solids: _____

   _____

   _____

   Cooling solids: _____

   _____

   _____

2. Three of my friends were arguing about why heating the metal ball made it bigger. This is what they said:

   Barry: The ball gets bigger because the heat makes the metal molecules expand.
   Mary: The ball gets bigger because you are adding heat molecules to the ball.
   Terry: The metal molecules are still the same size but they move farther apart.

   Who was right? _____ Why do you think so?

   _____

   _____

   _____

3. My friend taught me a way to open stuck jar lids. If you run hot water over the lid, it gets a little looser and some times you can open it. Try to explain why this works.

_____

_____

_____

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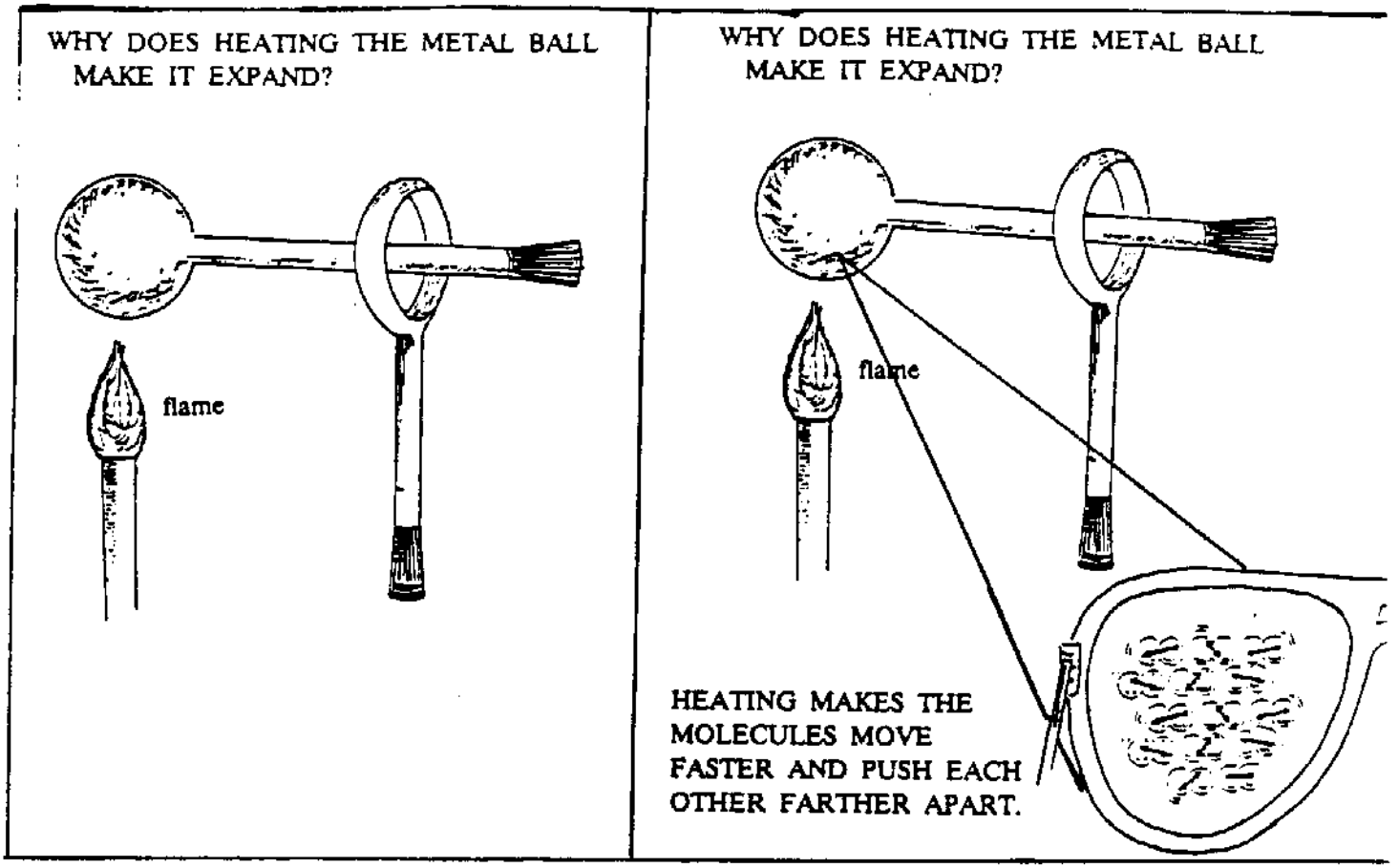
Transparency 11 (to be used with Lesson 6.2)



TRANSPARENCY 11: WHY DOES HEATING THE METAL BALL MAKE IT EXPAND?

Bottom Layer

Most students are amazed when the heated ball will not go through the ring, and are not able to explain this phenomenon. This is because they believe that, until the solid melts, heating will have no effect.

Overlay

Use the overlay to counter these naive conceptions. Just like in liquids and gases, when a solid is heated, the molecules move faster. They do not move fast enough to break out of the rigid pattern (melting), but they do push each other a little further apart, causing the metal ball to expand (expansion caused by heating).