Category V Physical Science Examples

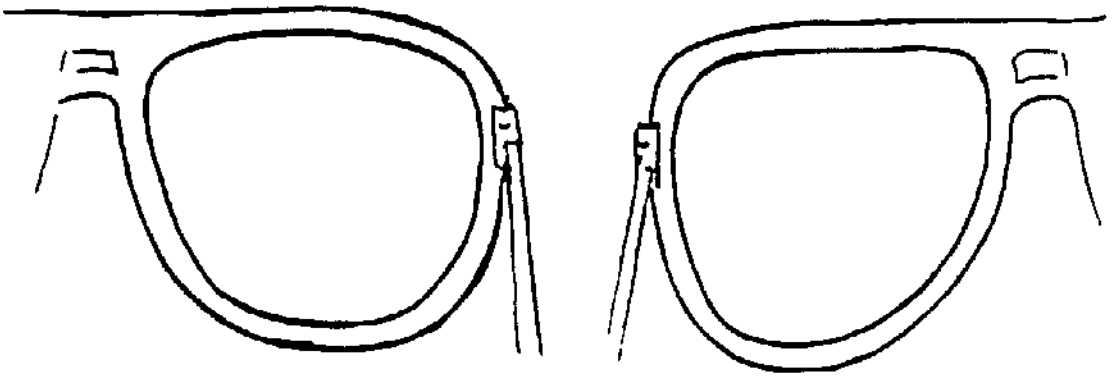
Guiding student interpretation and reasoning

Matter and Molecules

Matter and Molecules routinely provides question sequences to help students interpret their activities. The questions are structured carefully in order to lead students step-by-step from one insight to another (e.g., *Activity Book*, pp. **18–20s**, **25-26s**). Questions frame important issues (e.g., *Activity Book*, p. **25s**), help students relate their own ideas to phenomena (e.g., *Activity Book*, p. **32s**), help students relate their experiences with phenomena to the scientific ideas presented (e.g., Activity Book, pp. **26s**, **32s**), anticipate common student misconceptions (e.g., *Activity Book*, p. **26s**), or prompt students to contrast common misconceptions with their scientific alternatives (e.g., *Activity Book*, p. **22s**, **38s**).

Activity 4.2: Compressing Air and Water

Before we begin this activity, let's review what we've learned about how molecules are arranged and how they move in liquids and gases. Draw in one of the magic eyeglasses below how molecules are arranged in a liquid like water, and in the other magic eyeglasses how molecules are arranged in a gas like air.



WATER (LIQUID) AIR (GAS)

1. How far apart are the molecules of a gas compared to a liquid? _____

_____

2. In which of these two states of matter do you think it would be easier to push the molecules together? _____ Why?

_____

_____

_____

The following activity will help you see if your prediction is correct.

Your teacher will give you a plastic syringe and a cup of water. Look carefully at the syringe and move the plunger in and out. Notice that the end of the plunger has a seal so that no air can get past the plunger. Air can move in and out only through the hole in the tapered end. While you are moving the plunger in and out, feel the air coming out of the syringe.

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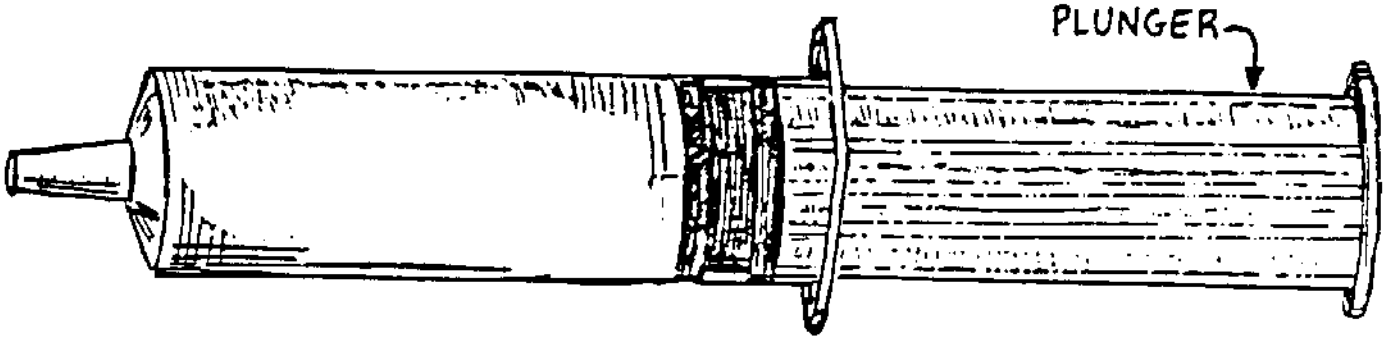
3. Below is a drawing of a syringe. How would molecules of air be arranged in the syringe when the plunger is all the way out? Draw the air molecules in the syringe.



4. Now fill your syringe with water. Hold it over the cup. Now carefully place your thumb over the end of the syringe so that no water can escape and try to push the plunger in. Can you push the plunger in when the syringe is filled with water?

5. Now try the same experiment with air instead of water and pull the plunger out as far as it will go. Place your thumb firmly over the end of the syringe. Keep your thumb on the syringe tightly so no air can escape. Try to push the plunger in. What happened?

Continue on next page

6. Why can you push the plunger in when there is air in the syringe, but not when there is water in it?

7. Why can't you push the plunger all the way in with air in it?

Did your explanations for Questions 6 and 7 talk about molecules? Remember that a good explanation talks about molecules. These explanations should talk about the way molecules are arranged in liquids (water) and in gases (air). Go back and write some more for Questions 6 and 7 using these ideas about how molecules are arranged in order to explain what happens in the syringe.

Now, pull the plunger out as far as it will go. Place your thumb firmly over the end of the syringe and push it in as far as it will go. Keep your thumb on the syringe. Let go of the plunger.

8. Explain why the plunger moves back out.

LESSON CLUSTER 5

Explaining Dissolving

Activity 5.1: Where Did The Sugar Go?

1. Look at a tea bag and some grains of sugar with a magnifying glass. Draw how they look below.

TEA BAG GRAINS OF SUGAR

a. Does the tea bag have holes in it? _____

b. Are the holes in the tea bag big enough for a grain of sugar to get through? (If you aren't sure, try it and see! Put some sugar in the tea bag and shake it. Does any come out?)

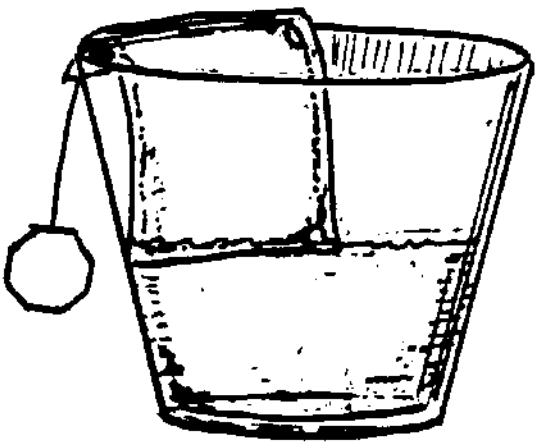
_____

c. Do you think the holes in the tea bag are big enough for molecules of sugar to get through? Explain your answer.

_____

_____

2. Put half a spoonful of sugar in the tea bag. Drape it over the rim of the cup. Add just enough water to reach the bottom of the tea bag.



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a. What do you see happening underneath the tea bag? (You can draw on the picture on the previous page to illustrate your answer if you want.)

b. Taste the water. What do you taste? _____

c. Why can't you see the sugar anymore? _____

d. How do you think the sugar got out of the tea bag?

Now look back at your text. See how your explanation compares with the one there!

e. If you let this cup stand overnight, would the sugar rise to the top, settle to the bottom, or spread evenly throughout the water?

_____

Talk about molecules to explain your answer. _____

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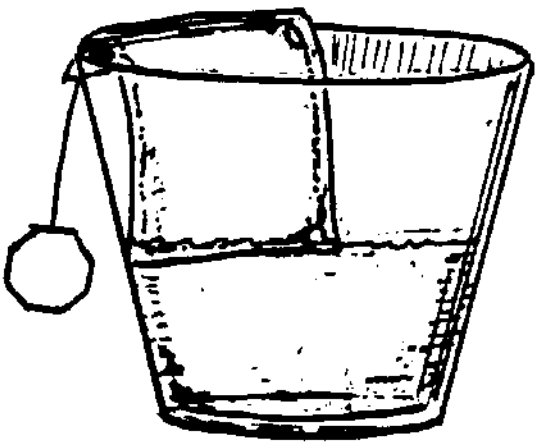

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Look at the two cups after 10 minutes and compare them. Were your predictions correct? Try describing and explaining what you see.

2. a. How are the two cups the same?

_____

_____

b. How are the two cups different?

_____

_____

3. There are many ways that the two cups are the same after 10 minutes, and one important way is that some of the candy dissolved in each cup. Try to write an explanation of how this happened. Look back at Lesson Cluster 5 if you need to. Remember to answer the question about substances and the question about molecules in your explanation.
Explain what happened to the candy in the water.

_____

_____

_____

_____

4. An important difference is that the candy dissolved faster in one of the cups.

In which cup did the candy dissolve faster? _____
What was different about the molecules of hot and cold water that would make the candy dissolve faster or slower? (Write down your best guess, then discuss your answer with the class.)

_____

_____

_____

_____

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Question Set 4.4: Explaining Bicycle Tire

1. What is happening to the air as it is being pumped into a bike tire? Is it expanding or being compressed? _____ Explain in terms of molecules.

2. My friend says there is more air near the valve of the bike tire where the air was pumped in. Do you agree with him? Explain why or why not.

3. What is happening to the air as it is released from a bike tire? Is the air expanding or being compressed?_____ Explain in terms of molecules.

4. Briefly state the two parts of a good explanation.

   a. _____

   b. _____

Question Set 6.4: Lesson Cluster Review

1. Try to summarize the main points of this lesson cluster by answering the two questions below. Talk about substances and molecules in each answer.

   a. What happens when substances are heated?

   b. What happens when substances are cooled?

2. In the ball and ring experiment, my friend figured out a good way to get a hot ball through a cold ring. He heated the ring! Explain why his method worked.

3. Is it correct to say that heat makes the molecules of a substance expand?

   Why or why not? _____

4. If you want something to dissolve fast, should you mix it with hot water or cold water? _____ Why? _____