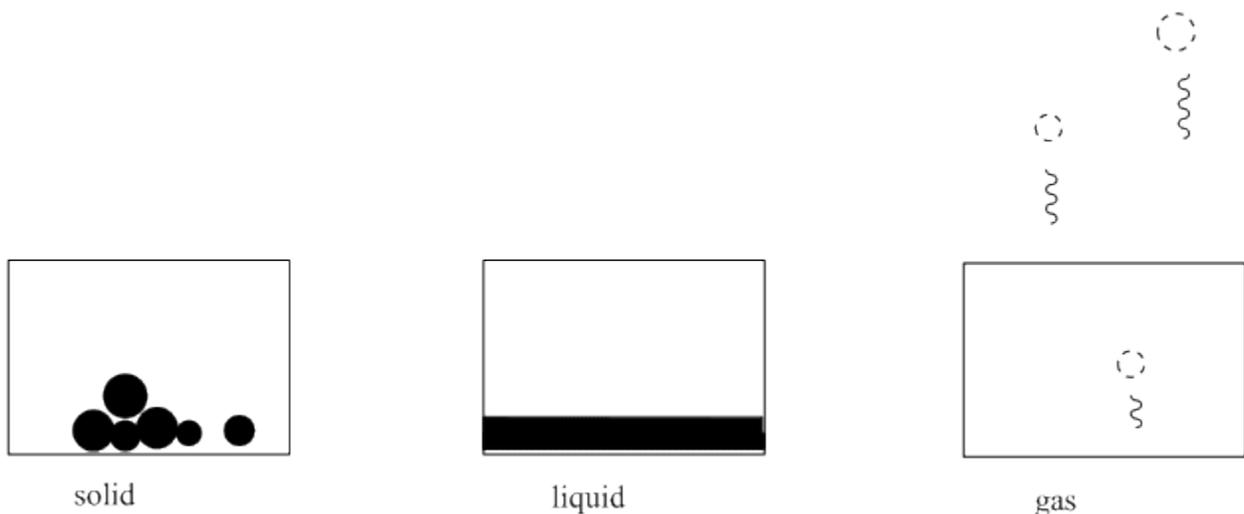


STRUCTURE-PROPERTY RELATIONSHIPS

Changes of state

By now you are probably well aware that all the matter around you exists in one of three states: it is a solid, like the earth; a liquid, like the water; or a gas, like the air. In some places on earth, however, materials are not restricted to one particular state, but can change from one to another depending on the weather. On a winter day Yellowstone Park, you might walk past a hot spring and see frozen ice and snow, liquid water, and clouds of steam all at once.

There are several different ways in which you could describe these three phases of matter. Solids have a definite shape, regardless of the container in which they are placed. A marble is still a marble, whether it is rolling around in a bowl or a flowerpot. Liquids take up the shapes of their containers; a liter of water could get round like a fishbowl or square like a brownie pan. Gases are harder to see and more difficult to imagine. They expand to take up the spaces in which they are placed. A gas will even escape from a container that does not have a tight lid on it, much like the carbon dioxide bubbles rise out of a can of soda once it has been opened.



Another way of thinking about these states of matter has to do with the speed of the molecules in the matter, and how much energy those molecules contain. If you don't feel like you have much energy, you probably lay around a lot near the bottom of your container or dorm room, like a lump of coal on the bottom of a coal bin. If you have more energy, you might move around throughout your room, walking from place to place on the floor, but largely staying within its walls. If you have a great deal of

energy, you may begin to dance or leap into the air or escape through the doorway to the outside.

Matter is a little bit like that, too. How much energy a group of molecules has -- and consequently how quickly they are moving on average -- strongly influences whether that material is in the solid, liquid or vapor phase. Solids tend to be composed of very slowly moving molecules while gases generally consist of speedier ones.

Problem SP2.1.

Draw a picture of a group of methane (CH_4) molecules in the solid state, liquid state and phase.

Remember, each molecule has the same form whether it is in the gas phase, liquid phase or solid phase. The only thing that changes is the amount of energy the molecules have. As a result, the speed of the molecules and the ability of the molecules to attract each other also changes.

