Shape-Shifter

Q: You're oxygen. Nice to see you. Well, we can't really see you, but you know what I mean. Thanks for being here for this week's broadcast of Matter Matters.

A: Nice to be here. But then again, I'm everywhere. Oxygen makes up about a fifth of the earth's atmosphere.

Q: Very impressive. For someone who gets around so much, it's surprising no one has ever seen you.

A: Not really. Most gases are invisible—transparent and colorless. Not all of us are odorless, of course.

Q: So we've noticed. Do you ever wish you had a definite color or shape, like a solid or a liquid?

A: Not at all. Being shapeless is what makes being a gas such a gas! I never know where I'll be next . . . what shape I'll assume. I could be in a little kid's birthday party balloons . . . pumped into a spare tire. . . blown into a life raft. Imagine how dull—how FLAT—the world would be without gases. A hunk of something solid can't take different shapes like a gas.

Q: No, but a liquid can. Ladle soup into a mug and the soup is mug-shaped. Pour it into a plastic bag, you've got bag-shaped soup.

A: True, true. But liquids have their limits. Two cups of hot chocolate won't fit into one cup. Half of it will slop over the top. You can't stuff a brick into a salt shaker . . . or a St. Bernard into a suit. That's because liquids and solids have definite volume.

Q: And gases don't have a definite volume?

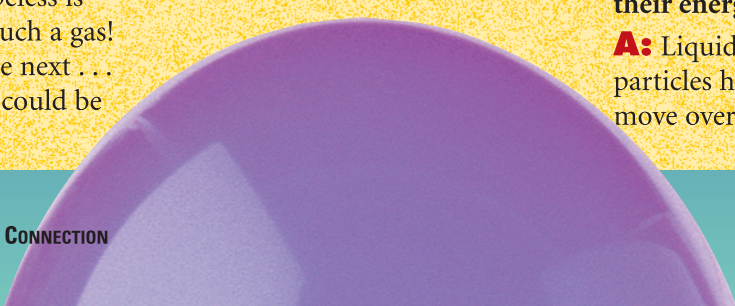
A: Correct. You can keep pushing and pumping more and more of us into the same space. We expand or contract to fit—at least up to a point. Put too much of me in a balloon and it will burst. And we fill that available space evenly. We don't sink to the bottom in a heap like a liquid.

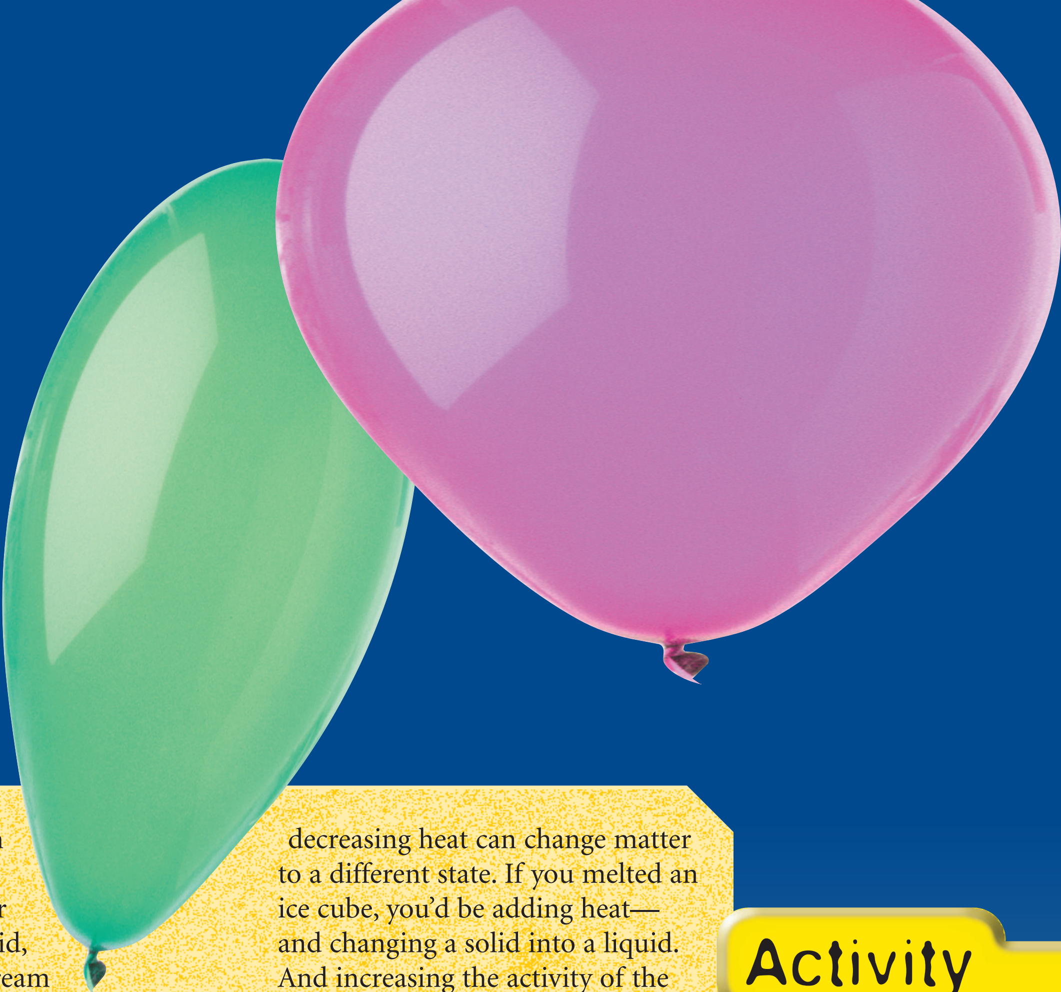
Q: So what's your secret?

A: One word: energy. Gases are loaded with energy. The tiny particles we're made of have so much energy they can fly around in every direction, spread out and stay away from each other. Solid particles don't even have enough energy to crawl from one place to another. They huddle together in a tired mass. Think of a hunk of cheese. A slab of wood. A pile of rock. Talk about a boring life.

Q: How about liquids? How's their energy level?

A: Liquids are a little livelier. Their particles have enough energy to move over and around each other,





but not enough to stay apart. When you pour something liquid, the particles stream and flow over each other. But eventually they gather back into a pool or puddle.

Q: Is there any way liquids and solids can get any more energy? Some kind of high-energy diet?

A: The best way is to turn up the heat. Heat is a wake-up call for couch particles. When they feel the heat, the particles start hopping. You can see it happen every time you heat a pan of water. The surface gets active. Tiny gas bubbles form. If the water boils, big bubbles break the surface and gas with water vapors in it rises—steam.

Q: Wait a minute. Gas! You're talking about changing matter from one state to another.

A: Good thinking! Increasing or decreasing heat can change matter to a different state. If you melted an ice cube, you'd be adding heat—and changing a solid into a liquid. And increasing the activity of the particles. Almost any solid will lose its shape if it's heated enough. And if most matter is heated to 5000° C (9000° F) or more, it becomes the fourth state of matter—plasma. That's where the particles are wild with energy.

Q: Well, you've certainly been a breath of fresh air on our show.

A: Uh-Uh. Air isn't just oxygen. Good thing, too—pure oxygen burns. That's why I'm often found in combination with other elements such as hydrogen to make water. But whatever—it's been a pleasure being here. I'll be seeing you—but don't bother looking for me.

Activity

MELTDOWN What is the fastest an ice cube can melt? What is the slowest? Try this. Take four ice cubes (as nearly identical in size as you can find), and place each one in a glass or shallow bowl. Place each container in a different temperature situation, such as a window sill, the refrigerator (not the freezer), and a tabletop. Hold one about six inches above a lit candle. Invent your own situations. Take the temperature of each situation and note how long each ice cube takes to melt completely. Now make a line graph of time of melting versus temperature. When all the data are recorded, extend the line graph and see if you can determine the fastest and slowest melting times.