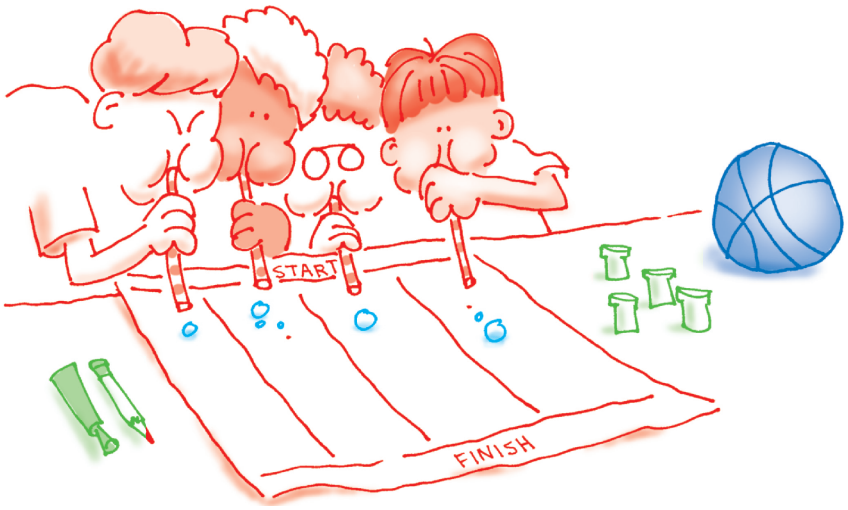
Kitchen Chemistry

By Jill Frankel Hauser



Previously published as *Super Science Concoctions* by Williamson Books, an imprint of Ideals Publications.

Printed in the United States of America

My Father's World
PO Box 2140, Rolla, MO 65402
www.mfwbooks.com
February 2024

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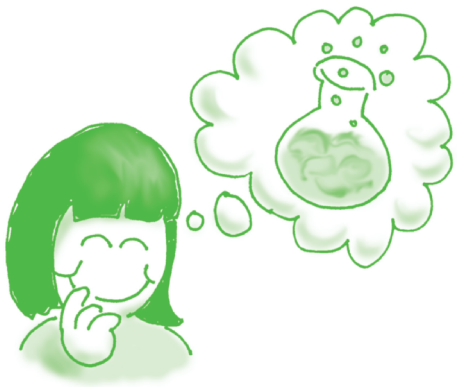


Molecules and Solutions

Moving molecules, mixed-up molecules, and molecules just joining together are the basis for concocting some amazing mixtures.

So what's a molecule, you ask? Just think of a drop of water. If you were to divide that drop into the tiniest droplet possible and still have actual water, that particle would be called a molecule—in this case, a water molecule.

The *chemical formula* for water—H_20—tells you something about its make-up. If you could further divide that water molecule, you would discover the even tinier particles from which it is made, but you wouldn't have water anymore. Instead, you'd have two atoms of hydrogen (2H) and one atom of oxygen (O). Each of these atoms can exist by itself as something quite different from the molecule of water formed when they combine. In fact, hydrogen is an explosive gas and oxygen is the gas we breathe to survive!

The concoctions in this section explore miraculous molecules. Watch them move, mix, and un-mix right before your eyes!

Molecule or Atom?

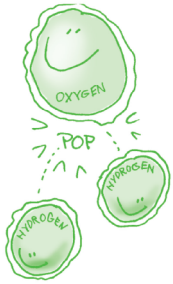
A *molecule* is the smallest particle of a substance that is still that same kind of substance. It's made of atoms—atoms that by themselves may not be at all like a molecule of the substance they combine to create.

An *atom*, on the other hand, is the smallest particle of a substance that can exist by itself. In fact, the word atom in Greek means "uncuttable." Now you know why.

Molecule

water

Atoms



Molecules in Motion

There's no need to stir this solution—the solute dissolves without any help!

What You Need

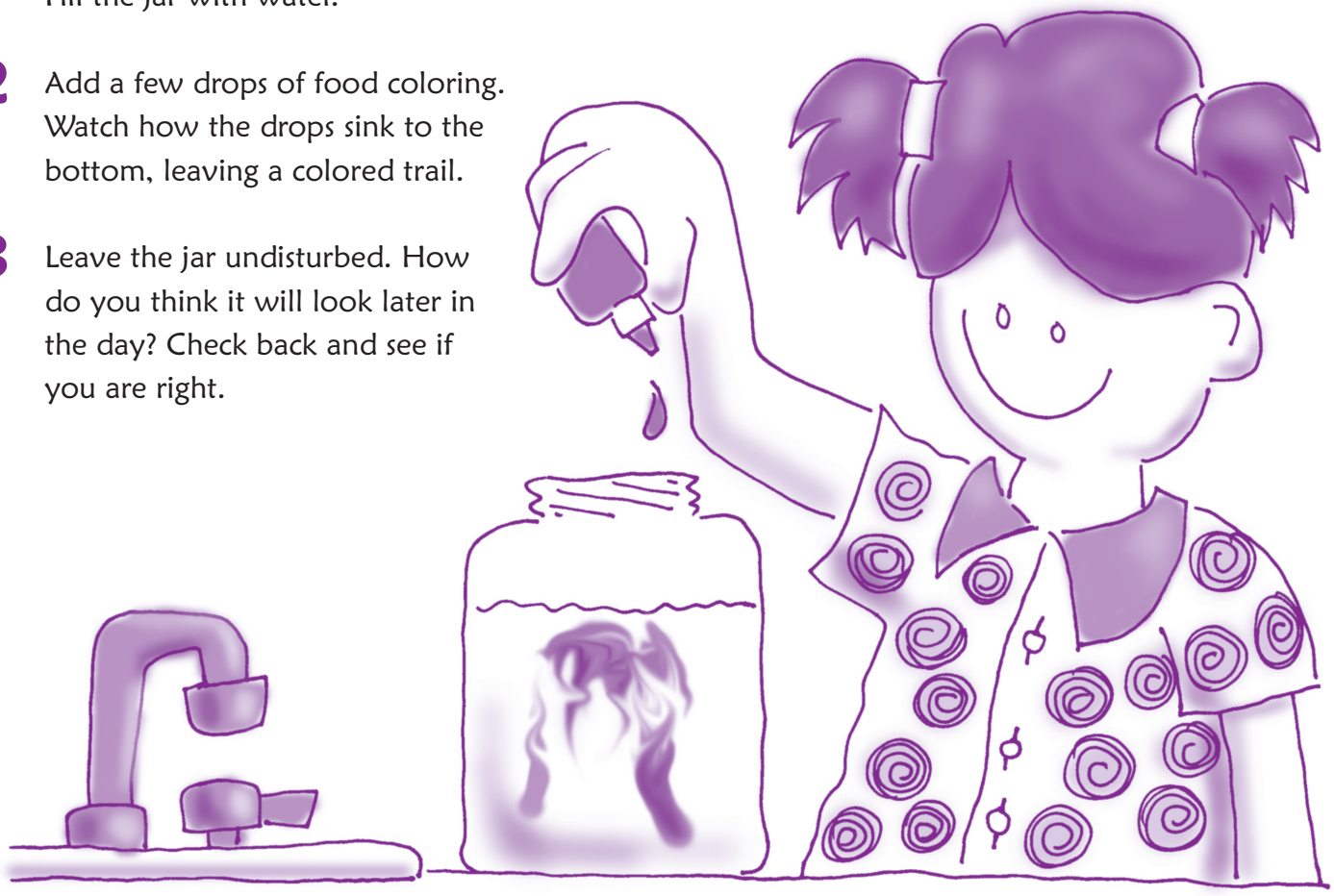
- **Jar**
- **Water**
- **Food coloring**

What You Do

1. Fill the jar with water.

2. Add a few drops of food coloring. Watch how the drops sink to the bottom, leaving a colored trail.

3. Leave the jar undisturbed. How do you think it will look later in the day? Check back and see if you are right.



MORE TO EXPLORE

How quickly does food coloring spread throughout these liquids? Try them and see!

- Ice water
- Hot water
- Brine (see page 62)

Observe what happens in these tasty solutions:

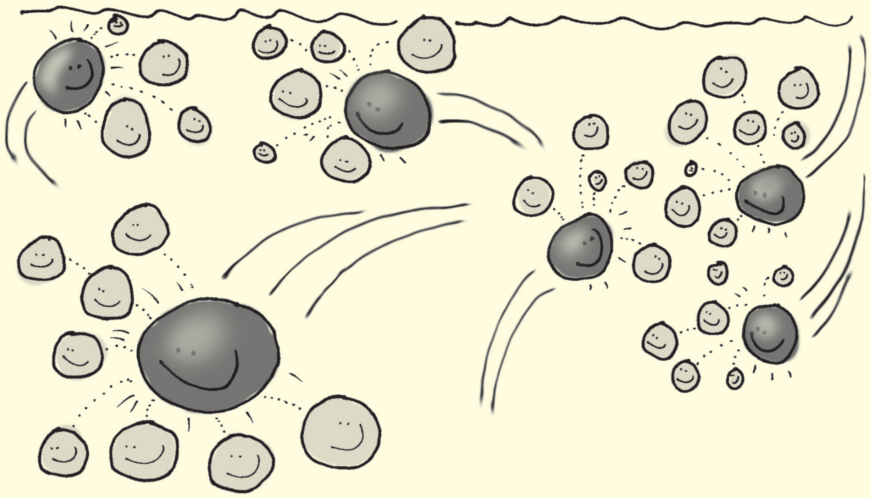
O.K. TO EAT!

- Add instant drink powder to a glass of cold water.
- Add instant soup powder to a cup of hot water.

The Principle of the Thing

Although you can't see them, water molecules are always on the move. The food coloring particles are bombarded by these watery movers and shakers. Eventually the jar of water is evenly colored without anyone ever stirring the mixture!

In hot water, molecules move even faster. So the coloring spreads more quickly in hot water than in cold. What happens in brine? The spaces between the water molecules are already filled with salt, so the coloring can't spread as quickly.

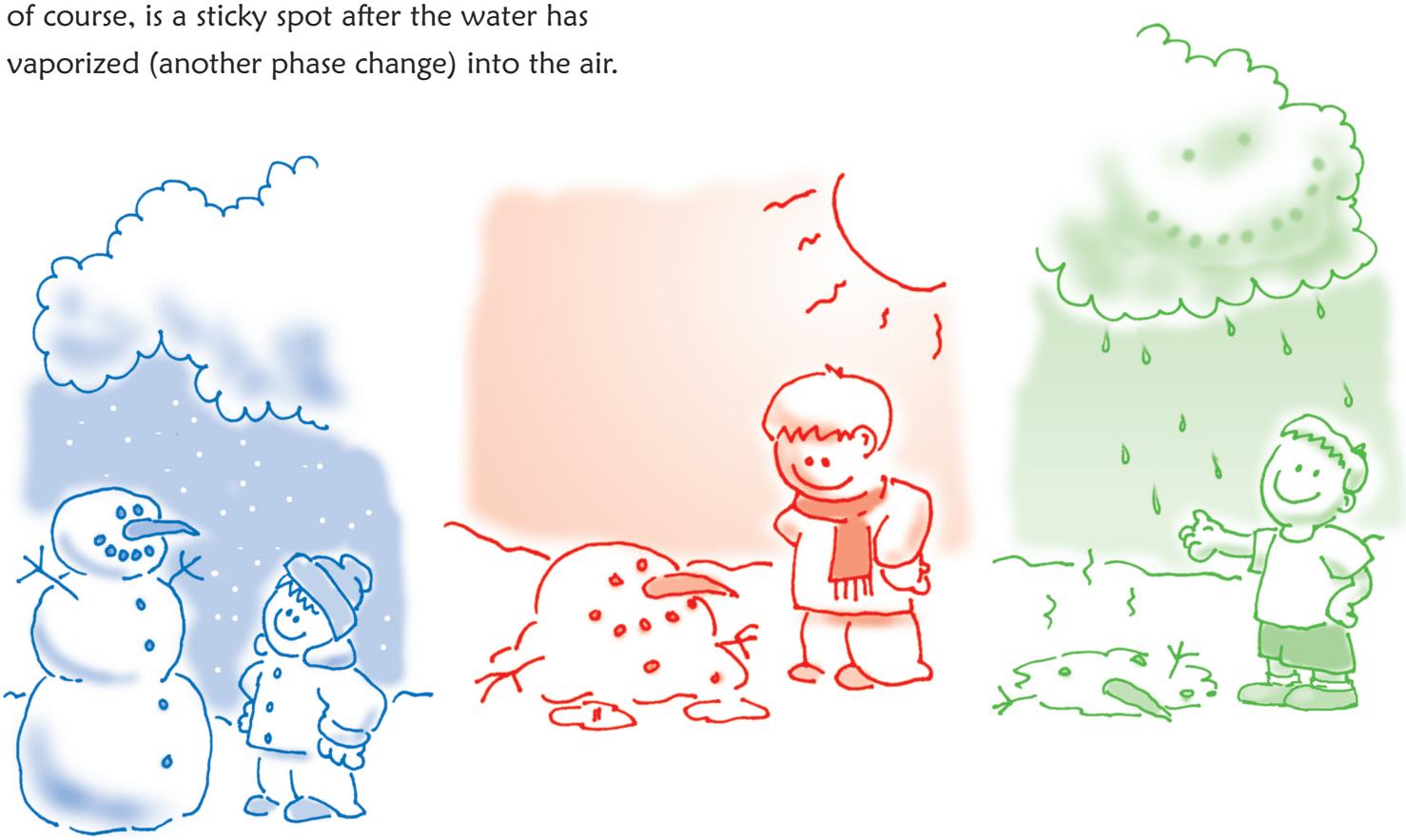


Phase Changes

Amazing changes are happening all around you! Sometimes substances simply change from one form to another. We call this a *phase change*, or *physical change*, because the chemical makeup of the substance itself does not change. For example, a melting Popsicle changes form from a solid to a liquid puddle, but you could put the puddle in a freezer and presto—you have a Popsicle again. Eventually all that's left of the puddle, of course, is a sticky spot after the water has vaporized (another phase change) into the air.

Other times, substances change so completely, you can't recognize them any longer! *Chemical changes* happen when the atoms (see page 13) that make up substances combine in a completely new way.

The concoctions in this chapter put *phase changes* to work for you. Investigate these changes right in your kitchen laboratory.



Frozen, Fried . . . Vaporized!

From a grain of sand to the planet Mars, from a raindrop to your dog's breath, all substances of the universe are made of matter in one of its three phases, or forms: solid, liquid, or gas. Make this concoction and you'll see water transform through all three phases. Can you guess the secret ingredient that makes it all happen?

What You Need

- **Ice cubes**
- **Frying pan**
- **Stove**

What You Do

1 Place ice cubes in a frying pan. Ask a grownup to turn on the heat and then watch the ice melt.

2 The pan is now filled with water. Turn up the heat and watch the water boil. Notice the steaming water droplets rising into the air. Be careful—steam can burn you.

3 Turn off the heat when the pan is empty. The room is now filled with water vapor, an invisible gas, concocted from ice cubes!

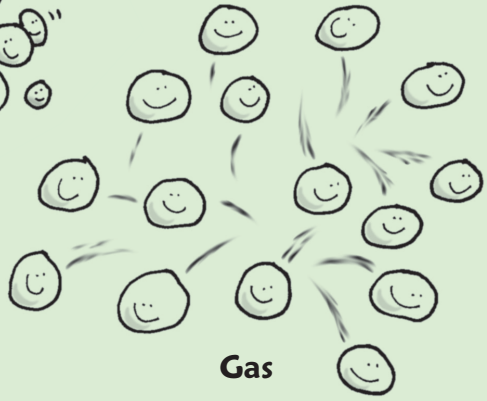
SCIENCE SPEAK

Solid, Liquid, Gas

Scientists organize all matter (every possible substance) into three forms, or phases: solids, liquids, and gases. *Solids*, like rockets, pencils, and icebergs, are rigid and hold their shape. *Liquids*, like water and olive oil, slosh and flow and take the shape of their containers. *Gases* are difficult to sense, but we know they're there. Just think about how a limp balloon changes when it's filled with air.

Solid

Liquid



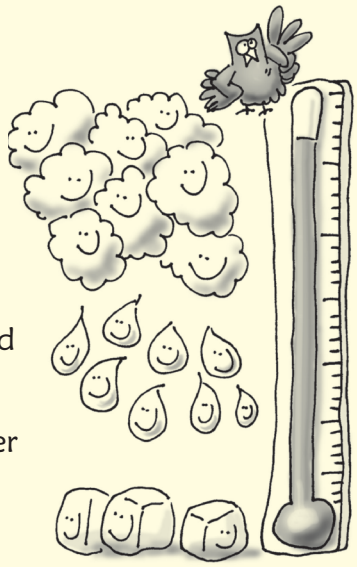
Gas

MORE TO EXPLORE

Place an ice cube in a resealable plastic sandwich bag on a microwave-safe dish. Zap for about 30 seconds and check. Continue to heat for 15-second zaps until the ice cubes have changed to liquid. Then watch closely as you zap for another 15 seconds or until the bag is puffy. Why the puff? Because the bag is now filled with water vapor. The far-apart water molecules of a vapor (gas) take up more space than the tightly packed water molecules of an ice cube (solid) so they puff up the bag. Solid, liquid, gas—they're all in the bag!

The Principle of the Thing

If a grownup has ever said, "You're just going through a phase," then you've got a lot in common with matter. Matter can change from one phase (form) to another by just adding or subtracting energy. To make ice, take away energy from liquid water. The cooled molecules slow down, move close together, and become solid ice. To melt the ice cube, add heat energy. The molecules move faster, spread apart, and solid ice changes to water. Add more heat energy to the water and the molecules move even faster and farther apart, changing liquid water to water vapor, a gas. So what's the secret ingredient that causes water to make three phase changes? That's right, heat energy!



SUPER FUN!

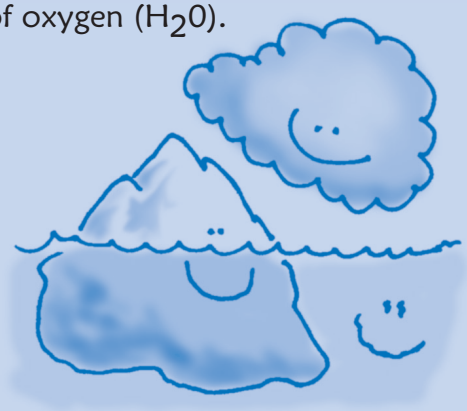
Exploding Corn

Pop some corn and you create an explosion. There's a tiny bit of water trapped in that kernel's tough outer hull. Heat the kernel and the water makes a phase change to a gas. As those water molecules expand, pressure builds, the hull splits, and the fluffy starch within blows out.

WHAT ON EARTH?

Now You See It, Now You Don't

Given the right conditions, water can be as rigid as an iceberg, as flowing as a creek, or as invisible as a vapor. But no matter what its physical form—solid, liquid, gas—water is still water, with the same chemical makeup: 2 atoms of hydrogen and 1 atom of oxygen (H_2O).



A Day in the Life of a Molecule

If you were a molecule in a solid, you and your friends would be packed tightly together like bricks in a wall. That's why solids keep their shape, even when moved.

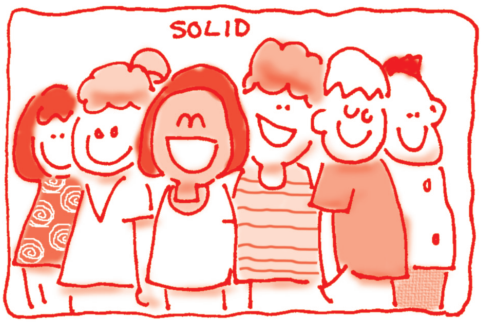
Too tight for comfort? Heat up a solid and the bonds between the molecules break up, causing it to melt into a liquid. Liquid molecules aren't so crowded. In fact, if you were a liquid molecule, you could wander where you pleased, but not too far from your friends. You'd be bumping into them all the time. That's why liquids flow and take the shape of their container.

If life in the fast lane suits you, perhaps you'd like to be a gas molecule! When a liquid heats up, molecules move so rapidly that they break away and become a gas. Life as a gas molecule might get lonely, because they are always on the move and stay far apart from each other.

SUPER FUN!

Dance of The Phase Changes

You and your friends are molecules of matter changing phase. First cluster together making your bodies any shape you please. Hold still. You're a rigid solid. Now make flowing movements as you become a sloshy liquid while still staying close to your friends. Next, dart all around the room, moving further apart from each other, behaving like gas molecules. Can you find music to match the mood of each phase?



Chocolate Meltdown

Phase changes are not only amazing, they can be delicious too! Invite a grownup to help with the heating and eating of this one.

What You Need

- **½ cup (125 ml) chocolate chips**
- **Double boiler or microwave-safe dish**
- **Waxed paper**

What You Do

1 Place the chips in a dish. Microwave on high for one minute. Stir. Repeat for 30 seconds, or until chips are liquefied. Or stir as chips melt in the top section of a double boiler.

2 Dribble spoonfuls of liquefied chocolate onto the waxed paper. (Press in raisins, nuts, or mini-marshmallows, if you like.) Let the dollops harden, or solidify, in the refrigerator.

The Principle of the Thing

It's scrumptious science! Heating the chips adds energy to the chocolate molecules and gets them moving far enough apart to flow and become liquid. When you cool them down in the refrigerator, the molecules come closer together again to form a delicious solid.