Science in the Kitchen

Trap gas to bake a tasty treat. Make tarnished silver shine without rubbing it. Trick your taste buds into believing that soggy crackers are apple pie. Make a powder that will fizz on your tongue. Strip an egg naked without touching it. And lots more! The family kitchen is the perfect science laboratory, and there's lots of action ahead. So let's start investigating!

CHAPTER 1

Biology in the Kitchen

Make Monster Beans 3

Young investigators will discover that seeds go through a surprising change to get ready to sprout.

Fuel Up

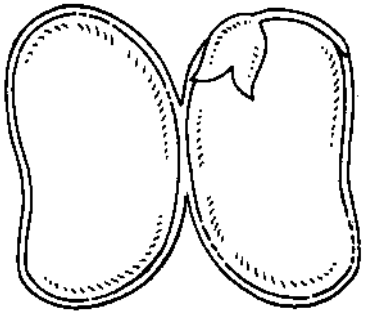
½ cup dried soup beans, such as great northern beans or pinto beans
empty plastic film container with snap-on lid (or pill container with snap-on lid)
water
paper plate

Blast Off!

1. Pour enough soup beans into the container to fill it to the top. Remove just enough so that the lid will snap on.
2. Pour in water to fill the container to the rim and snap on the lid.
3. Set the container on the paper plate and leave overnight.

Brain Booster

By the next morning, the beans will have popped the top off the container. Take several out and compare them to a handful of dried soup beans. The beans from the container will be huge monster beans! (Well, they'll be bigger than the dried beans, anyway.) That's because the beans soaked up the water, and the starchy material inside the seed swelled up. If you use a magnifying glass to take a close look at one bean, you'll see a tiny hole on the indented edge. Dried beans are bean



seeds, and they have a tough, protective covering called the seed coat. To sprout and begin to grow, the seeds take in water through the tiny hole in the seed coat. Then they swell, and the seed coat splits open. Carefully separate the two parts of the swollen monster seed, and you'll discover the tiny plant that's ready to start growing.

Bonus Pack

Soak a paper towel in water, squeeze out the excess, and fold the damp towel into fourths. Place the damp towel inside a self-sealing plastic bag. Lay six of the monster beans on the damp towel and seal the bag. Place the bag in a warm spot but not in direct sunlight. Check daily, and you'll soon see the young plants beginning to grow. Once that happens, open the bag, mist with more water, and tape the open bag to a window with masking tape. Mist daily and watch the plants continue to grow. Once green leaves appear, transfer the young plants to flower pots full of potting soil and let them keep on growing.

Or, soak another half cup of beans and add them to your half cup of Monster Beans to whip up a batch of Alphabet Chili (see the recipe in the box on this page).

Alphabet Chili

Fry 1 pound of lean ground beef until it just starts to brown. Stir in ½ cup of minced onion and ½ teaspoon of garlic powder. Brown. Add a cup of soaked beans (any kind of dried beans plus your Monster Beans), ½ teaspoon of chili powder, ½ teaspoon ground cumin, ½ of a cinnamon stick, and salt and pepper to taste. Next, stir in 4 cups of chicken stock (powdered bouillon dissolved in boiling water) and a 16-ounce (453 g) can of chopped peeled tomatoes. Simmer for 1 hour. Meanwhile, cook ½ cup alphabet macaroni in boiling water until tender. Remove the cinnamon stick from the chili mixture, add the alphabet macaroni, and serve.

Create a Juicy T-Shirt 2

Ever wonder how water gets from the soil into the stems and the leaves of a plant? Here's how you can observe this process and put it to work to change a white T-shirt into a colorful creation.

Fuel Up

mordant solution (a chemical solution that prepares the cloth to hold a dyed color—see How to Make Mordant Solution on this page)

plastic bucket

white T-shirt

1 clean 20-ounce (600-ml), or larger, plastic bottle

rubber bands

rubber gloves

1 kitchen juice dye (dyes you make yourself from stuff around the kitchen—see How to Make Kitchen Juice Dyes on page 10)

newspapers

How to Make Mordant Solution

In a large saucepan, combine 1 ounce (28 g) of powdered alum (available in grocery stores) with 1 ounce (28 g) of baking soda. Stir in 4 cups of water, bring to a boil, then reduce the heat to simmer for about 20 minutes. Cool to lukewarm.

Blast Off!

Note: This activity can be messy, so wear old clothes and do the soaking steps outdoors.

1. Pour the mordant solution into the bucket. Soak the T-shirt for an hour. Remove and dry. Rinse the bucket. If you want, save the mordant solution in an empty milk jug to reuse with other dying projects.
2. Gather a handful of cloth from the lower half of the front of the T-shirt and twist it. Wrap a rubber band tightly around the twisted cloth to secure it.
3. Repeat, twisting at least three more handfuls of cloth on the front and several on the back of the T-shirt.
4. Slip on the rubber gloves and pour the dye solution into the bucket. Hold the shirt so that the bottom edge is touching the dye solution. Watch as the dye moves up through the cloth.

5. Let the dye continue to climb until it is about halfway up the shirt.
6. Lift the shirt out of the dye and squeeze out any excess dye solution.
7. Without removing the rubber bands, spread the shirt out on newspapers to dry in the sun.
8. After the shirt is dry, rinse it in fresh water and dry again.
9. Remove the rubber bands.

Brain Booster

The water and the dye in it were carried up through the shirt by a process called **capillary action**, the movement of a liquid through a porous material due to the attraction of the liquid to the material and the attraction of the liquid's molecules to each other. This process starts because water **molecules** (the smallest bit of something that can exist and still have all of its characteristics) naturally stick to substances like cloth, soil, and plant tissues. Yet water molecules also tend to stick to each other, so the water molecules stuck to the shirt and moved into the tiny spaces between the fibers. Next, these molecules pulled along more water molecules, and the first molecules climbed higher. Then those molecules dragged along other water molecules, and the water climbed higher up the T-shirt. Did you notice that the water continued to climb up the T-shirt after you removed it from the dye? How high did the water climb before the drying action of water evaporating (escaping into the air from the cloth) stopped it?

Capillary action is essential to green plants because it's how water and minerals move from the soil through the roots and up the stem to the leaves. There, the water helps the plant to produce food.

How to Make Kitchen Juice Dyes

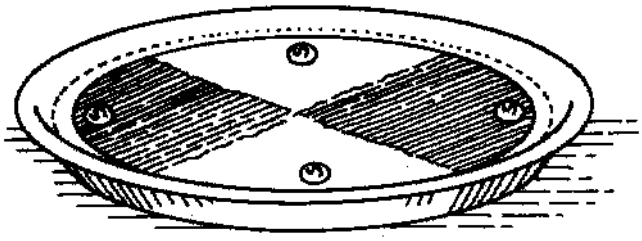
***Beet (red) Dye*: Drain a can of sliced beets, collecting the juice in a plastic bottle. (Do not use pickled beets—the vinegar dilutes the juice.)**

***Coffee (brown) Dye*: In a saucepan, boil 1 cup of coffee grounds in 1 quart (0.9 l) of water. Continue boiling for 15 minutes. Let it cool and pour the liquid (a kind of matter that has a definite weight but whose shape can change easily) through a strainer into a plastic bottle.**

***Mustard (yellow) Dye*: Scoop ½ cup of prepared American-style yellow mustard into a plastic bottle. Stir in 3 cups of water.**

***Purple Cabbage (purplish-blue) Dye*: In a saucepan, boil 2 cups of chopped purple cabbage in 1 quart (0.9 l) of water. Reduce to a simmer and cook for 30 minutes. Let it cool and pour the liquid through a strainer into a plastic bottle.**

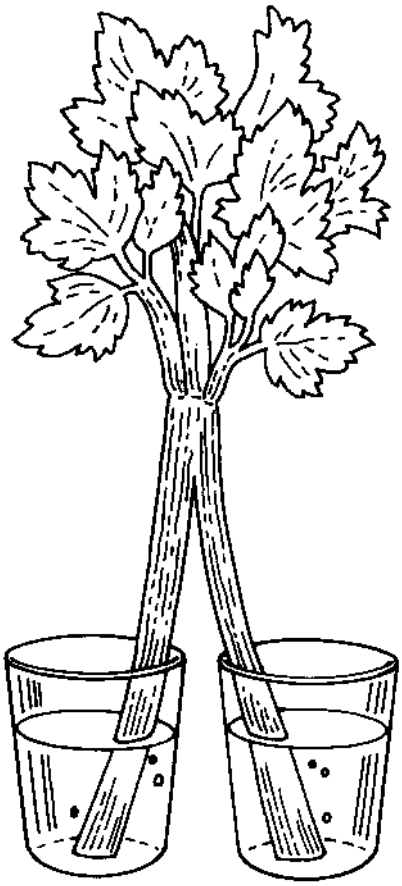
Bonus Pack



Use capillary action to create candy art. Start by cutting a circle out of a coffee filter. Use a pencil to draw lines dividing the circle into 4 nearly equal slices. Pour just enough water into a pie plate to form a thin layer on the bottom. Next, lay the coffee filter in the water. Place 1 different colored hard candy, such as Skittles or M&Ms, on the edge of each section.

As the candy dissolves, capillary action will spread the candy's coloring through the coffee filter. Surprisingly, the colors will spread out only until they meet. This paints each slice of the paper pie a different color. The reason this happens is that the colors spread out from where the concentration is greatest. When two colors meet, the concentrations are the same, so the spreading stops. If the filter is left in the water, some additional spreading will eventually take place. Or you can take the uniquely colored disk out to dry, and the action will stop.

Make Celery Show Its Stripes 3



If capillary action worked to dye the T-shirt and also moves water through plants, could you use it to dye a plant? Perform this activity to investigate.

Fuel Up

tall 12-ounce (350-ml) water glass
water
red food coloring
a sturdy stalk leaf-topped celery
kitchen scissors

Blast Off!

1. Fill the water glass half full of tap water.
2. Drip in at least 3 drops of red food coloring, enough to make the water turn bright red.
3. Wash the celery stalk and snip off just a little bit of the end that doesn't have any leaves.

4. Place the celery in the glass of colored water, with the trimmed end down.
5. Wait 30 to 60 minutes. Remove the stalk from the water and snip in half lengthwise to expose the celery's red stripes.
6. Munch!

Brain Booster

Celery stalks look solid, but they're really full of strawlike tubes, called xylem (pronounced z-eye-lum) tubes. These tubes transport water from the celery plant's roots to its leaves. Normally, you don't notice the tubes because they're green like the surrounding supporting tissue. But the colored water traveling through the xylem tubes stained them, making them easy to see. Green or red, these tubes have sturdy walls that help strengthen the celery stalks and give them their *crunch*.

Bonus Pack

You can make celery stalk stripes that are two different colors. Use kitchen scissors to snip halfway up the celery stalk before you put it into the colored water. Then fill two glasses nearly full of water. Use food coloring to color one red and the other blue. Set the glasses side by side and place half of the celery stalk in each glass. You may need to set the glasses in the kitchen sink and lean the stalk against the side of the sink to keep it from falling out.

After an hour, snip each half of the celery stalk lengthwise in half again to see the results. Then enjoy your colorful snack.

Could you use this strategy to change the color of a flower—or even make a two-toned flower? Try it and find out.

Get the Water Out 2

Plants are full of water, which makes fruits and vegetables juicy. It's also a problem because water encourages mold growth, making fruits and vegetables rot. This activity introduces a method of getting the water out that's been used to preserve foods since ancient times. In the process, you'll create a shrunken head—an apple head, that is.

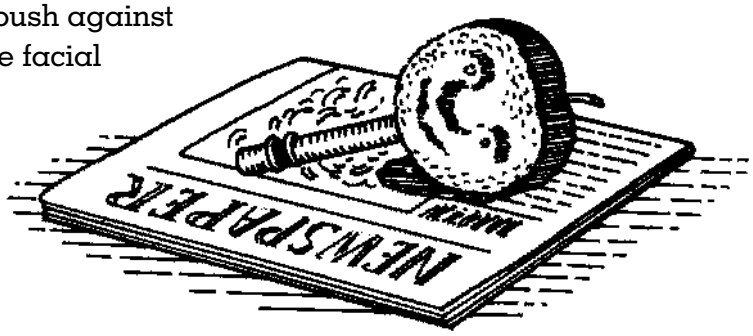
Fuel Up

peeler
apple

cutting board
knife (for adult use only)
2 pencils
newspapers or paper towels

Blast Off!

1. Use the peeler to remove the peel from part of the apple. This will become the apple head's face. Leave the peel on the rest of the apple for the head's hair.
2. Have an adult, working on the cutting board, cut away sections on the face to give the head a nose, eye sockets, and a mouth.
3. Have an adult insert the writing end of one pencil into the bottom of the apple.
4. Use the other pencil's eraser end to push against the apple's flesh to finish shaping the facial features.
5. Set the apple on newspapers or paper towels in a sunny place.
6. Be patient and wait 1 week before checking your apple head.



Brain Booster

The apple head has shrunk, and the face appears to have shriveled with age. That's because the apple has lost much of its natural moisture, but it won't be rotten or moldy. One way that people have always preserved food for use during the winter was to dry it. The lower moisture content discourages bacteria and mold growth.

Bonus Pack

Use tissue paper or cloth scraps to make clothes and turn the apple head into an apple doll. In the United States during pioneer times, children sometimes played with apple-head dolls.

Or make a popular old-time treat—apple leather. Start with 4 cups of applesauce. Add 4 tablespoons of honey to help keep the fruit leather flexible once it's dried. Use a cookie sheet with a raised edge all the way around to prevent spillage. Line this with plastic wrap. Spread the fruit and honey mixture in a thin layer about ¼-inch (0.62-cm) thick. Set the

oven to 140°F (60°C), place the cookie sheet in the oven, leave the oven door open a couple of inches, and let the mixture dry for about 4 hours. The apple leather is dry enough when a corner can be lifted and peeled back easily. Remove from the oven and let it cool completely. Then roll it up—plastic wrap and all—to store it. Apple leather can be kept at room temperature for about a month or much longer in the refrigerator. Slice it into pieces to unroll and eat.

Mummify Steak 2

Now, let's investigate another way to get the water out of food. This method was even used by the ancient Egyptians to prepare their mummies.

Fuel Up

palm-sized piece of flank steak, round steak, or any thin, inexpensive steak
baking pan
cutting board
knife (for adult use only)
salt

Blast Off!

1. Wash your hands with soap and water before beginning. Be sure all of your equipment is clean.
2. Rinse the meat in cool water. Put it on the baking pan and bake in the oven at 160°F (71°C) for about 10 minutes or until the meat is cooked through.
3. Take the baking pan out of the oven, let the meat cool, and place it on the cutting board. Wash and dry the baking pan.
4. Have an adult cut slits in the upper surface of the meat.
5. Cover the bottom of the baking pan with salt. Place the meat on the salt and completely cover with more salt.
6. Place the baking pan in an oven set to 140°F (60°C), keep the oven door open a crack, and leave the meat in the oven for about 4 hours or until it is completely dried out.

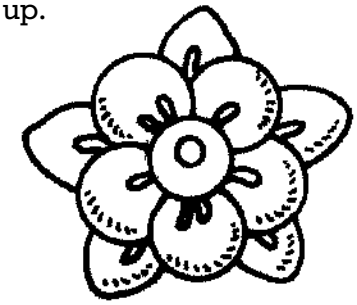
Brain Booster

You've just prepared what's nicknamed beef jerky. Be sure to brush off the salt crust before eating the jerky. Drying is an ancient way of preserving

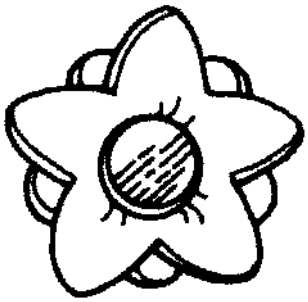
meat that goes back to the ancient Egyptians. It preserves the meat by removing moisture that could encourage bacteria and mold growth. Cooking the meat before drying it helps to ensure that any bacteria present are killed before you start the preserving process. Jerky is also lighter and easier to carry along than fresh meat, so it's been popular with travelers for centuries. Native Americans used to mix dried meat with dried fruit and suet (fat) to make what they called pemmican.

Bonus Pack

The ancient Egyptians used a similar method to preserve human bodies, creating mummies. For this process, they used a special salt mixture called natron. You can mix up natron by combining ½ cup of baking soda, ½ cup of a powdered laundry bleach that contains sodium carbonate, and ½ cup of table salt. Pour the natron mixture into a plastic mixing bowl, then bury a piece of meat in it and let it set. Check after a week and continue checking until the meat is dried up. The mummified meat is *not* edible, but compare its appearance and texture to the beef jerky you prepared. According to ancient records, it took about 70 days to mummify a human body. Of course, Egypt's hot, dry climate helped.



Or you can make a salt dough that won't mold and can be used to create refrigerator art. Mix together 1 cup of flour, ½ cup of table salt, 2 teaspoons of cream of tartar, and 1 cup of water. Have an adult cook this over medium heat, stirring until it's thick and smooth. Cool and knead in a drop or two of vegetable oil to help make it more moldable. Then use the dough to create interesting shapes, such as small flowers or pretend cakes. Press a small magnet into the soft dough. When the sculpture has hardened, coat it with craft varnish and let it dry. Then stick it to the refrigerator as a decorative note holder.



Grow Monster Bean Sprouts 3

Find out what extremes green plants will go to in their search for the light energy they need to produce food.

Fuel Up

12 dried soup beans, such as great northern beans (select only whole beans)
bowl
water
pencil
3 Styrofoam cups
potting soil
clear plastic wrap
gift or packing box about a foot square

Blast Off!

1. Place the beans in the bowl, cover with water, and let set overnight.
2. Use the pencil's point to poke 3 holes in the bottom of each cup.
3. Fill each cup two-thirds full of potting soil.
4. Push 4 soaked beans into the soil in each cup. Lightly cover with soil.
5. Sprinkle water on the soil and cover each cup with clear plastic wrap.
6. Place one cup on a warm, sunny windowsill. Place another cup in the same room but somewhere that the light is dim, such as in a corner behind a chair. Place the third cup in the same room and cover it with the overturned box.
7. Every third day, uncover the cups just long enough to sprinkle the soil with water.
8. Watch for a week after sprouts appear.

Brain Booster

While the plants grown in the sunshine and in dim light looked normal, the sprouts developing in the dark became long, thin, and pale. Seeds contain stored food that fuels a young plant's initial growth. To continue to grow, green plants need to produce their own food by combining water from the soil and carbon dioxide from the air during a process called **photosynthesis** that is powered by the sun's light energy. When exposed to sunlight, plants produce a special green **pigment** or coloring matter, called **chlorophyll** (the green coloring matter produced in plants), to trap the sun's energy. Without sunlight, young plants remain

pale. Using up their stored energy to generate stem growth, they also grow long and thin. Normally, this increases the sprout's chances to reach sunlight. Your sprouts growing in dim light are likely to be longer and thinner than those growing in the sunny window.

Bonus Pack

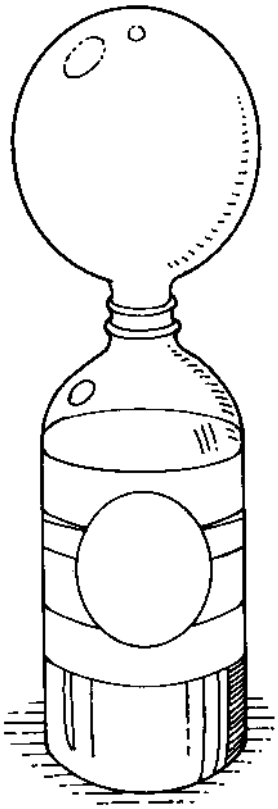
Sprout a new set of seeds under the box. This time, though, cut a ping-pong-ball-sized hole in the box. Watch to see if the plants can meet the challenge of growing toward this light source. Do any of the plants eventually grow out through the hole?

Or, grow your own sproutwich. Sprouts are a popular food, and sprouts grown in the dark are thought to be more tender and tasty. Here's how to do it:

1. Purchase seeds that are described as being especially for producing sprouts, such as mung beans, alfalfa, or barley seeds from a health food store.
2. Line a colander or a strainer with a piece of muslin cloth or a sturdy paper towel. Put the seeds in this. Rinse the seeds.
3. Place the rinsed seeds in a quart-sized (liter-sized) jar. Cover the top with another piece of muslin cloth or a piece of clean (unused) nylon stocking material. Secure with a rubber band.
4. Keep the jar in a dark place. Each day, remove the cover, rinse, and drain the seeds again.
5. Sprouts will appear in about 3 to 5 days. Once most of the seeds have sprouted, rinse and drain them. Then add grated cheese and chopped egg or vegetables, such as tomato or avocado. Tuck the mixture into a pita pocket and enjoy.

Make Yeast Blow Up a Balloon 1

What a way for kids to discover that even tiny organisms, like yeast, give off a waste gas! Before starting, pour the contents of a package of baker's yeast into a bowl. Brainstorm what might be needed to make the yeast grow, such as food, water, and being warm. Then follow the directions to see what happens when the yeast starts to grow.



Fuel Up

1 package yeast
empty 20-ounce clear plastic water bottle (600 ml or larger)
1 teaspoon sugar
½ cup lukewarm tap water
round rubber balloon

Blast Off!

1. Carefully pour the yeast into the empty plastic bottle.
2. Pour in the sugar and the water.
3. Gently tip the bottle back and forth to mix.
4. Slip the neck of the balloon over the bottle's mouth.
5. Check the size of the balloon every 15 minutes for an hour.

Bonus Pack

Use yeast to make a fun, yummy bread. See the Peanutty Rolls recipe in the box on this page.

Peanutty Rolls

In a mixing bowl combine 1 package of yeast, 2 tablespoons of sugar, and ½ teaspoon of salt. In a saucepan, heat ½ cup of milk and ¼ cup of crunchy peanut butter until warm. Add to the dry ingredients. Use an electric mixer to stir in 1½ cups of flour. Put the dough on a floured cutting board. Slowly sprinkle on more flour and knead until the dough is smooth and elastic. Place the dough in a greased mixing bowl. Cover with paper towels and let it rise in a warm place for about an hour. Divide dough into egg-sized lumps and roll into balls. Place on a greased cookie sheet, cover with paper towels, and let the balls rise for about 1 hour. Bake at 350°F (180°C) for 10 minutes or until golden brown. Cool, slice, fill with jelly, and eat.

Don't worry that you're eating living yeast or alcohol. Baking kills the yeast and makes the alcohol turn into a gas that escapes into the air.

Brain Booster

Once the sugar became warm and wet, the yeast used it as food and began to grow. During the process, the yeast gave off carbon

dioxide gas and a kind of alcohol as waste products. The gas bubbled up and escaped until it was trapped by the balloon. Slowly, the gas inflated the balloon. The balloon will never inflate as fully as it would if you blew into it, but you may be surprised by how much the trapped gas will inflate the balloon.

That's Amazing

Yeast is a tiny organism that can be found wild in the soil and even in the air. Although bakers in ancient Egypt didn't know about yeast, they knew that letting their dough set exposed to the air would make it start to rise. Today, we know that these early bakers were catching wild yeast that blew through the air.

Raise Brine Shrimps 2

Here's your family's chance to observe wildlife in the kitchen. Before launching this activity, consider what conditions these aquatic animals will likely need to live. As the activity continues, make a family journal—complete with pictures—recording how the animals change and behave as they grow up.

Fuel Up

2 identical 20-ounce (600-ml), or larger, clear plastic bottles filled with water
measuring cup
mixing bowl
aquarium salt
brine shrimp *(Artemia franciscana)* eggs (available at pet and aquarium stores)
magnifying glass (if you have one)
*yeast (this is used in the Brain Booster activity)

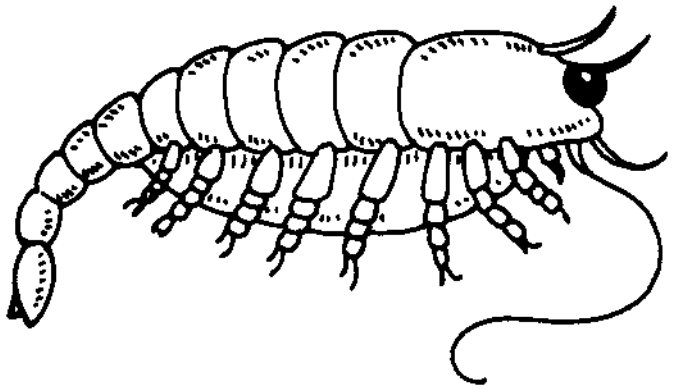
Blast Off!

1. Pour water from one bottle into the mixing bowl a cup at a time, keeping track of how many cupfuls are used.
2. Add 1 tablespoon of aquarium salt per cup of water. Stir to dissolve and pour the salt water back into the bottle.
3. Repeat to add salt to the second water bottle. Cap this bottle and set it aside for the Brain Booster activity.
4. Add a pinch of brine shrimp eggs to the uncapped bottle. Place it in a warm spot but not in direct sun.

5. Check every day. If you have a magnifying glass available, use it to help you get a better view.

Brain Booster

Because you supplied the right conditions, the eggs will hatch in 3 to 5 days. Then you'll see newly hatched brine shrimps. These will appear as tiny active orange spots. Watch and add more water from the capped bottle as needed to keep the brine shrimps' home full. Feed with a few grains of yeast about twice a week. In about 6 days, the young shrimps will mature into adults that have lots of legs and appear to glide through the water. Within 2 to 3 weeks, the adults will mate, and you'll be able to identify the females by the eggs in their bellies. Female brine shrimps each produce over a hundred eggs every 3 to 4 days. These will hatch, multiplying the critters in your bottle. The adults live about 6 months.



Bonus Pack

Conduct tests to find out how different conditions affect the brine shrimps. Design your own tests or try these:

- Observe how they behave in bright light and in dim light.
- Observe how they behave in extra salty water by adding another tablespoon of aquarium salt.
- Observe how they behave when chilled by placing the container in the refrigerator for 5 minutes.

You may want to see how long your brine shrimp colony will keep on going. Or you can add vinegar until all activity stops. Then dispose of the remains by pouring the contents of the bottle down the drain.

Trick Your Tongue 2

A kitchen is the perfect place to investigate how the senses of smell and taste work together.

Fuel Up

diced very sharp cheddar cheese (one cube per person)
diced tofu (one cube per person)

Blast Off!

1. Take turns taking this test.
2. The people being tested will need to keep their eyes shut and pinch their noses between their fingers.
3. The helper should use a fork to place one taste cube—either the sharp cheese or the tofu—on each test taker's tongue.
4. Without taking a breath, each test taker should try to judge which cube is on his or her tongue.
5. Then each test taker should release his or her nose, take a deep breath, and guess again.
6. Switch places so that everyone has a chance to be both helper and test taker.

Brain Booster

Your senses of smell and taste work together to give food flavor. The taste buds on your tongue are able to detect only whether food is bitter, salty, sweet, or sour. Then they send messages to your brain. But your brain also receives more complex messages about the smell of food. Scents given off by food are carried on the air you breathe into your nasal passages, where sensors detect them and transmit lots more messages to the brain. Most people can detect from 4,000 to 10,000 different scent messages. When your brain analyzes both sets of messages, it makes you aware of the flavor in your mouth. Of course, this happens almost instantly. If you have your nose closed, however, your brain receives messages only from the taste buds. Then foods like cheese and tofu will likely taste pretty much the same.

Bonus Pack

Put your smell memory to the test. Collect plastic film containers with snap-on lids or use self-sealing plastic bags. Soak cotton balls in a variety of juices and cooking essences, such as lemon, chocolate, lime, almond, orange, and so forth. Put one soaked cotton ball in each container and seal. Number each bag with a permanent marker. Make a master list of the numbered bags and which scent they contain. Take turns opening the bags and sniffing. How many scents can each person identify?

CHAPTER 2

Chemistry in the Kitchen

Launch Spaghetti Rockets 1

Investigate the chemical reaction that happens when two different kinds of chemicals—acids and bases—interact. Before you start, explain that weak **acids** are found in many foods like fruit juices and tea. They give these foods a sharp taste. **Bases** are used in many cleaning products because they're naturally slippery and soapy. However, one base, baking soda, is used in foods.

Fuel Up

1 teaspoon baking soda
2-inch (5-cm) square piece of toilet paper
tall 12-ounce (350-ml), or larger, water glass
4 dried spaghetti noodles
2 cups white vinegar

Blast Off!

1. Spoon the baking soda onto the paper. Roll up the paper and twist the ends shut.
2. Place the paper packet in the bottom of the glass.
3. Break the spaghetti into 1-inch (2.5-cm) pieces, and place them on top of the paper packet.
4. Pour the vinegar into the glass.
5. Once the paper breaks down, watch the spaghetti bits zoom up, drift down, and soar again.

Brain Booster

When the baking soda, a base, combined with the vinegar, an acid, a chemical reaction happened, and bubbles of carbon dioxide gas were released. These bubbles stuck to the surface of the spaghetti noodles. Watch closely, and you'll see bubbles build up until there is almost a solid bubble coat on each bit of pasta. Then the spaghetti pieces zoom up as the bubbles burst after being exposed to air. When there are no longer enough gas bubbles to support the weight of the spaghetti, the pieces sink. Then the bubbles begin to re-stick to the spaghetti, and the action starts all over.

Bonus Pack

Eventually, all of the baking soda will have reacted with the vinegar, and no more gas bubbles will be produced. Could adding more baking soda launch the spaghetti rockets again? Add a tablespoonful to find out.

Carbonated drinks cause this same kind of bubble reaction. Repeat the experiment, filling 3 glasses with different carbonated drinks to decide which one produces the most bubbles. This time, the carbon dioxide in the drink replaces the gas produced by an acid reacting with baking soda. Does the drink's temperature affect how bubbly it is? Develop a test to find out.

Strip an Egg Naked without Touching It 3

Find out what happens when vinegar, a weak fruit acid, interacts with an egg's shell, a **solid**, a kind of matter with a definite weight and whose shape can't change easily.

Fuel Up

1 uncooked egg
tall 12-ounce (350-ml) water glass
vinegar

Blast Off!

1. Place the egg in the glass.
2. Pour in enough vinegar to cover the egg.

3. Let the egg sit in the vinegar for about 3 days, or until the shell rolls off when you rub the egg with your fingers.

Brain Booster

The vinegar dissolved or broke down and suspended the calcium carbonate, the main chemical in the egg's hard shell. Some of the calcium carbonate will have naturally moved into the vinegar solution. Rubbing gently removes the rest. However, the vinegar did not break down the tough membrane that was just inside the shell, so the egg is still intact. You can hold this naked egg in your hand. Hold it up to a light and check out the yolk inside.

Bonus Pack

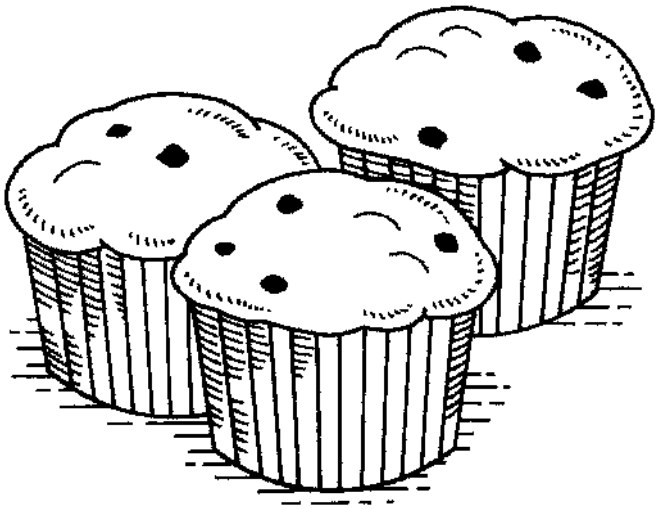
Repeat this activity by soaking a clean chicken bone in vinegar for a week. The bone will become rubbery because, like the egg, it's mainly made up of calcium carbonate.

Bake Foam You Can Eat 2

Here's a tasty way for you to discover that when an acid interacts with a base, the reaction releases a gas. Making a batter that traps the gas will produce foods that are light and fluffy.

Fuel Up

electric mixer
¼ cup margarine
1 cup sugar
mixing bowl
1 egg
1½ teaspoons cinnamon
1 teaspoon baking soda
¼ teaspoon salt
2 cups flour
1¼ cups applesauce
spoon
¼ cup chocolate chips
paper baking cups
muffin tin



Blast Off!

1. Preheat the oven to 350°F (180°C).
2. Using an electric mixer, cream together the margarine and sugar in the mixing bowl.
3. Add the egg and beat.
4. Mix in the dry ingredients and the applesauce.
5. Use the spoon to stir in the chocolate chips.
6. Place paper baking cups in the muffin tin and fill each cup two-thirds full.
7. Bake for 15 minutes or until golden brown.

Brain Booster

The baking soda reacted with the applesauce mixture, producing carbon dioxide gas. Applesauce, like many foods, naturally contains a weak form of acid. Acids give foods that contain them a sharp or even slightly bitter taste. Baking soda is another kind of chemical called a base. When bases and acids are combined, they react. This reaction produces carbon dioxide gas. Because the gas bubbles were trapped by the sticky batter, they made the batter foam, causing it to expand and rise. Muffins and other types of cake dough are actually foam that has solidified. As the batter bakes, it dries but holds its shape. The gas bubbles form all the little holes in muffins or cakes.

Bonus Pack

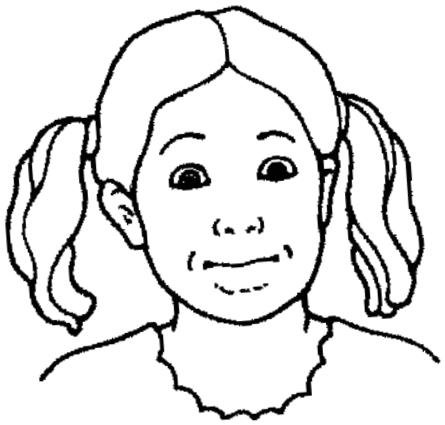
Bend a 3-by-5-inch (7.5-by-12.5-cm) index card or a piece of poster board into a funnel and staple the edges together. Working over the sink, fill the funnel two-thirds full of baking soda. Cap it with a sturdy paper plate. Turn the funnel and plate over and set it in the sink. Use scissors to snip off the funnel's tip, creating an opening about as big around as your index finger. In a mixing cup, add 5 drops of red food coloring to ¼ cup of vinegar. Pour the vinegar into the top of the funnel. When the baking soda and the acid react by producing carbon dioxide gas, the result will be volcanic.

Make a Mouth Bomb 2

Discover that chemical reactions won't happen until conditions are right. In this case, the interacting chemicals are activated when they **dissolve**, or break up into smaller bits. The reaction is a tongue tickler.

Fuel Up

1 tablespoon baking soda
2 tablespoons Ever-Fresh powder or any fruit preserver with citric acid (used to keep sliced fruit from darkening)
1 envelope sweetened, fruit-flavored gelatin
mixing bowl
self-sealing plastic bag
spoon
*glass of water (this is used in the Brain Booster activity)



Blast Off!

1. Mix all of the ingredients together in the bowl.
2. Store in the self-sealing plastic bag.
3. To experience a mouth bomb, scoop about a half teaspoonful onto your tongue and close your mouth.

Brain Booster

The tingle you feel is from a chemical reaction. When the moisture in your mouth dissolved the chemicals, the citric acid in the fruit preserver and the flavored gelatin reacted with the base, the baking soda. That produced carbon dioxide gas bubbles. If you want to see these bubbles and make a tasty drink, mix 1 tablespoon of the powder in a glass of water.

Bonus Pack

Mix up bath bombs for fizzy fun in the bathtub. In a bowl, mix together ½ cup of Ever-Fresh powder or any fruit preserver with citric acid (used to keep sliced fruit from darkening), ½ cup of cornstarch, 1 cup of baking soda, 2 teaspoons of orange essence (available in grocery stores) or use the same amount of citric essential oil (available from stores that sell soaps and bath products), 6 drops of any food coloring, and 3 tablespoons of sunflower oil.

Drop teaspoonfuls of this mixture onto waxed paper and let them harden. Put one or more of these colorful bombs into your bath to start the fizzing reaction and release the scent.

Create Fake Flavors 3

Investigate how chemicals can simulate the unique flavors of foods, such as apples. There aren't any apples in this mock apple pie, but your taste buds will think there are.

Fuel Up

36 Ritz crackers
premade pie crust in aluminum pan
water
saucepan
spoon
1½ cups granulated sugar
1½ teaspoons cream of tartar
2 tablespoons lemon juice
oven mitts
½ teaspoon cinnamon
4 tablespoons margarine
¼ cup flour
¼ cup brown sugar
fork
cooling rack

Blast Off!

1. Preheat the oven to 350°F (180°C).
2. Wash and dry your hands. Break up the crackers and spread the chunks on top of the pie crust.
3. Pour 2 cups of water into the saucepan. Stir in the granulated sugar and cream of tartar.
4. Bring to a boil. Then reduce the heat and simmer for 15 minutes or until the sauce thickens.
5. Stir in the lemon juice.

6. Have an adult use oven mitts to take the pan off the stove and pour the sauce over the crackers. Sprinkle on the cinnamon and dot with 2 tablespoons of the margarine.
7. In the saucepan combine the remaining margarine, the flour, and the brown sugar. Mix with a fork until crumbly.
8. Spoon the crumbly sugar mixture over the pie filling.
9. Bake 30 minutes or until the crust is golden brown.
10. Have an adult use oven mitts to transfer the pie to the cooling rack. Cool and eat.

Brain Booster

On your tongue, the texture of the crackers felt like cooked apples. The cream of tartar and the lemon juice are both weak acids. They combined with the sugar and the cinnamon to simulate the sweet-tart, spicy taste of apple pie. Artificial flavors are commonly used in foods and even in chewing gum. Sometimes, it's easier and cheaper to produce an artificial flavoring than real fruit flavors. In 1933, the National Biscuit Company developed the Ritz cracker and shortly after that introduced the recipe for Mock Apple Pie. This became a popular fake dessert during World War II, when fresh apples were scarce and expensive.

Bonus Pack

While the Coca-Cola recipe is a carefully guarded secret, you can mix together the following flavorings to produce your own version of this popular drink. Vary the amounts of each ingredient to make the drink more to your personal taste.

Home-Brew Cola

In a saucepan, mix 3 ounces (88 ml) of lime juice, 2 tablespoons of clear corn syrup, 2 tablespoons of chocolate syrup, 1 tablespoon of caramel sauce (for ice cream), 1 teaspoon of instant coffee crystals, a pinch each of nutmeg and cinnamon, 1 teaspoon of orange essence, 1 teaspoon of lemon essence, and 1 tablespoon of vanilla into 4 cups of water. Bring to a boil, let it cool, and serve over ice.

Make Silver Shine without Touching It 2

Discover that a chemical reaction can cause **matter** (any substance or material) to change form. Also investigate how chemicals in the air can cause a chemical change.

Fuel Up

heavy-duty aluminum foil
large metal saucepan
1 to 5 tarnished silver pieces, such as knives, forks, spoons, candlesticks, or jewelry
water
oven mitts
½ cup baking soda

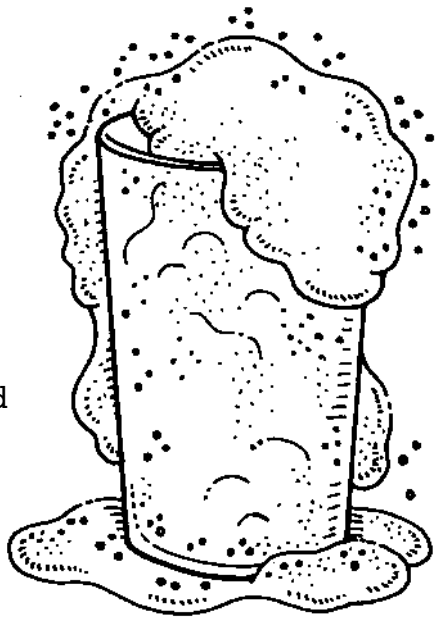
Blast Off!

1. Tear off a sheet of foil about a yard (0.9-m) long and use it, shiny side up, to line the bottom and sides of the saucepan. Fold any extra so that it fits inside the pan
2. Place the silver pieces on the foil.
3. Fill the pan two-thirds full of water or full enough to cover the silver pieces.
4. Bring the water to a boil. Have an adult use oven mitts to move the pan to the sink.
5. Pour in the baking soda. *Be careful. The water will foam and may spill over the sides of the saucepan.*
6. Let the water cool completely before removing the silver pieces for a close look.

Brain Booster

The silver has become shiny! Silver gets tarnished when the surface molecules react with sulfur and form silver sulfide. And silver can come into contact with sulfur in a lot of places, including from people's hands or even being exposed to air. Rubbing the silver with polish makes it shine because you rub off the silver sulfide, but you also rub off some of the silver molecules. If you use the chemical reaction with baking soda water, silver sulfide is transformed back into silver, and the sulfur is freed.

Sulfur is even more strongly attracted to aluminum than to silver. As long as the silver is in contact with the foil, the sulfur is transferred to the aluminum. Heat makes the reaction happen faster.



Bonus Pack

Ready for more bubbling action? Try this. Set a tall 12-ounce (350-ml) water glass in the sink. Pour in 1 tablespoon of powdered laundry detergent, 1 tablespoon of baking soda, and 3 drops of red food coloring. In a 2-cup measuring cup, combine ¾ cup of water and ¼ cup of vinegar. Pour this solution into the water glass as well. The solution will fizz, and foam will pour over the sides. The baking soda and the vinegar are reacting to produce carbon dioxide gas. The gas is then trapped by the soapy liquid, which creates foam.

Stick Oil and Vinegar Together 3

To get started, pour 4 tablespoons of white vinegar and 1 cup of vegetable oil into a clean 12-ounce (about 350-ml) glass. Whip briskly with a fork and watch what happens. The two liquids will quickly separate. The next investigation demonstrates how introducing another substance—egg yolk—can make one liquid stay suspended in the other when they normally would separate. What you'll create is a familiar, tasty food.

Fuel Up

4 tablespoons white vinegar
clean 12-ounce (350-ml) glass
1 cup vegetable oil
whisk
1 egg yolk (Have an adult partner help separate the white from the yolk.)
mixing bowl

Blast Off!

1. Pour 2 tablespoons of vinegar into the glass.
2. Add the vegetable oil and whisk for a count of five.

3. Let the vinegar and oil sit for 2 minutes, then look through the side of the glass. You'll see that the two liquids have separated, with the less thick vinegar settling on top of the denser oil.
4. An adult partner will need to help separate the egg yolk from the egg white, dropping the yolk into the mixing bowl and saving the white for scrambled eggs or another recipe.
5. Whisk the yolk. Then add the vinegar and oil to the mixing bowl and whisk again until the result looks smooth and creamy.

Brain Booster

When you tried to combine the oil and the vinegar, the two liquids first broke into lots of tiny droplets that were mixed together. Then the oil droplets joined into bigger droplets. The tiny vinegar droplets did the same thing. Soon there was an oil layer and a vinegar layer, and the denser oil sank below the less dense vinegar. Whisking in the egg broke the oil and vinegar into tiny droplets again and coated each one with yolk. This kept the oil droplets from joining with other oil droplets and the vinegar droplets from joining with other vinegar droplets. So the two liquids plus the egg yolk remained a mixture of tiny droplets. Taste what you just whipped up. You've created mayonnaise.

Bonus Pack

You may want to add a pinch of salt and stir in ¼ teaspoon of mustard to give your mayonnaise added flavor. Spread it on bread and enjoy it alone or with a slice of tomato or cheese.

Shake Up Butter 1

Now, investigate how to get one kind of dissolved matter to separate out.

Fuel Up

clean glass jar with a screw-on lid, such as a small salad dressing jar
whipping cream

Blast Off!

1. Fill the jar half full of whipping cream.
2. Screw on the lid tightly.

3. Take turns shaking the jar back and forth rapidly until yellow flakes appear. Depending on the shaking action, this can take from 5 to 20 minutes.
4. Keep shaking until the jar contains a yellow solid and a liquid.
5. Drain the liquid into a glass.

Brain Booster

The cream separated into fat (butter) and buttermilk. The shaking made the flakes of fat clump together. When the clumps were big enough, they became too heavy to remain suspended in the liquid.

Bonus Pack

Use cold water to rinse off the butter. Add a pinch of salt and mix in a little honey. Then spread it on bread or crackers for a tasty treat. You may want to try a taste of the liquid, too. It's buttermilk.

Turn Glue into Glubber 2

Watch how runny, liquid glue changes when this chemical reaction makes the glue molecules link together into chains.

Fuel Up

spoon
1 tablespoon borax soap (available in the laundry soap section of grocery stores)
2 paper cups
¼ cup water
¼ cup white glue (Elmer's Glue-All or Elmer's School Glue works best)

Blast Off!

1. Use the spoon to scoop the borax into one paper cup, then pour in the water.
2. Stir until most of the borax is dissolved.
3. Pour the glue into the second cup.
4. Add the borax solution to the glue, leaving any crystals that didn't dissolve in the bottom of the cup.

5. Stir the borax solution into the glue until a solid lump forms.
6. Working over the kitchen sink, scoop this lump into your hands. With the tap running, squeeze the solid lump to get out any trapped liquid glue and rinse it away. Continue until no more liquid glue runs out.
7. Pat it dry with the paper towel and squeeze to shape into a ball—glubber.
8. Drop the glubber on the floor. What happens?

Brain Booster

The glubber bounced. What you created is a substance known as a **polymer**. While all matter is made up of building blocks called molecules, polymers have their molecules linked together. Often polymers, like the glue, are made up of long chains of linked molecules. In this case, the borax soap is a substance that binds the glue's molecule chains together, creating a stronger, thicker polymer material. One of this material's properties is to be rubbery enough to bounce. Test the glubber to determine what other properties it has. For example, can it be stretched? Does it hold its shape? Can it be easily broken into two pieces?

Bonus Pack

Go on a polymer hunt around the house. Look for things that are made of or that contain these common polymers: plastic, nylon, polyester, rayon, Teflon (nonstick coating on cooking and baking pans), polystyrene (called Styrofoam), and Formica.

Make Your Own Marshmallows 2

Marshmallows are actually polymers—chains of molecules. Before you start whipping some up, role-play what will happen in this activity. Have each family member pretend to be a molecule, a building block of matter. Have all of the molecules circle one leader while you count to five. Then, on your signal, have everyone join hands to form a chain. Now that you know what the molecular structure of marshmallows is like, follow the steps to make some of these yummy polymers.

Fuel Up

2 mixing bowls
¼ cup cornstarch
⅓ cup powdered confectionery sugar
8-by-8-inch square glass or metal baking pan
cooking oil spray
water
saucepan
1 package unflavored gelatin
⅔ cup granulated sugar
oven mitts
½ cup light corn syrup
pinch of salt
1 teaspoon vanilla
electric mixer

Blast Off!

1. In one of the bowls, mix together the cornstarch and powdered sugar.
2. Spray the baking pan with the oil. Dust with about a tablespoon of the cornstarch and sugar mixture.
3. Pour ⅓ cup of water into the saucepan.
4. Sprinkle in the gelatin. Let it soak for about 5 minutes.
5. Add the granulated sugar. Cook over low heat until the gelatin and sugar dissolve.
6. Have an adult use oven mitts to pour the gelatin mixture into the second mixing bowl.
7. Add the corn syrup, salt, and vanilla.
8. Using an electric mixer, beat on high for 15 minutes or until peaks form.
9. Spread the mixture into the greased and dusted pan.
10. Let the mixture set for 2 hours or until firm to the touch.
11. Sprinkle the top with more of the remaining cornstarch and sugar mixture.
12. Cut it into blocks and roll each block in the remaining cornstarch and sugar mixture.
13. Eat some of your polymer.

Brain Booster

The gelatin is the polymer in this recipe. When it's dissolved, the chains are free-floating. When mixed with the sugary solution and cooled, the gelatin chains form a tangled web, trapping the sugary liquid in tiny gaps. That's what gives a marshmallow its familiar springy texture.

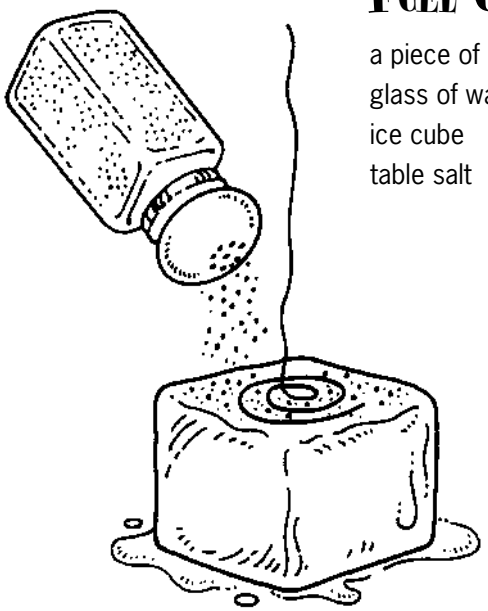
Amazingly, the ancient Egyptians are credited with inventing marshmallows. They made a puffy white treat by combining honey with the sap of the carrot-shaped root of the marsh mallow plant. Candy makers began to produce the first gelatin-based marshmallows in the 1800s.

Bonus Pack

Make more marshmallows, but this time add a fruit essence, such as lemon essence, and food coloring to make special, colorful treats.

Use Salt to Lift an Ice Cube 3

Investigate how salt affects water's freezing point. What happens looks like magic!



Fuel Up

a piece of sewing thread or yarn
glass of water
ice cube
table salt

Blast Off!

1. Dip one end of the thread or yarn in the glass of water.
2. Use your fingers to squeeze the excess water out of the thread.
3. Coil the wet end of the thread onto the ice cube.
4. Sprinkle salt over the coiled thread.
5. Slowly count to 20, then gently pull straight up on the thread.

Brain Booster

The thread has stuck to the ice, so when you tugged the string, you lifted the cube into the air. This happened because water normally freezes at 32°F (0°C). However, salt water won't freeze until the temperature is lower. Placing salt on ice makes the ice melt unless the surrounding air temperature is lower than 32°F (0°C). To melt, ice needs heat energy, and it takes that heat energy from any warmer matter that it's in contact with—such as the water on the wet thread. While the surface of the cube melted, enough heat was removed from the thread to make the water on its fibers freeze. The ice glaze made the thread stick to the ice cube.

Bonus Pack

Will sugar lower the freezing temperature of water the same way that salt does? Try freezing fruit pops to find out. Mix together 1 tablespoon of grape juice concentrate and 1 cup of water. Pour into paper cups until each is about half full. Half fill identical paper cups with plain water. Set all of the cups in a metal cake pan in the freezer. Check after 10 minutes and then every 10 minutes until at least one of the cups is frozen solid. You'll discover that sugar, including natural fruit sugar, dissolved in water, lowers water's freezing point.

Use Salt to Freeze a Watermelon Treat 3

Whip up another taste treat by using salt to affect the freezing temperature of water.

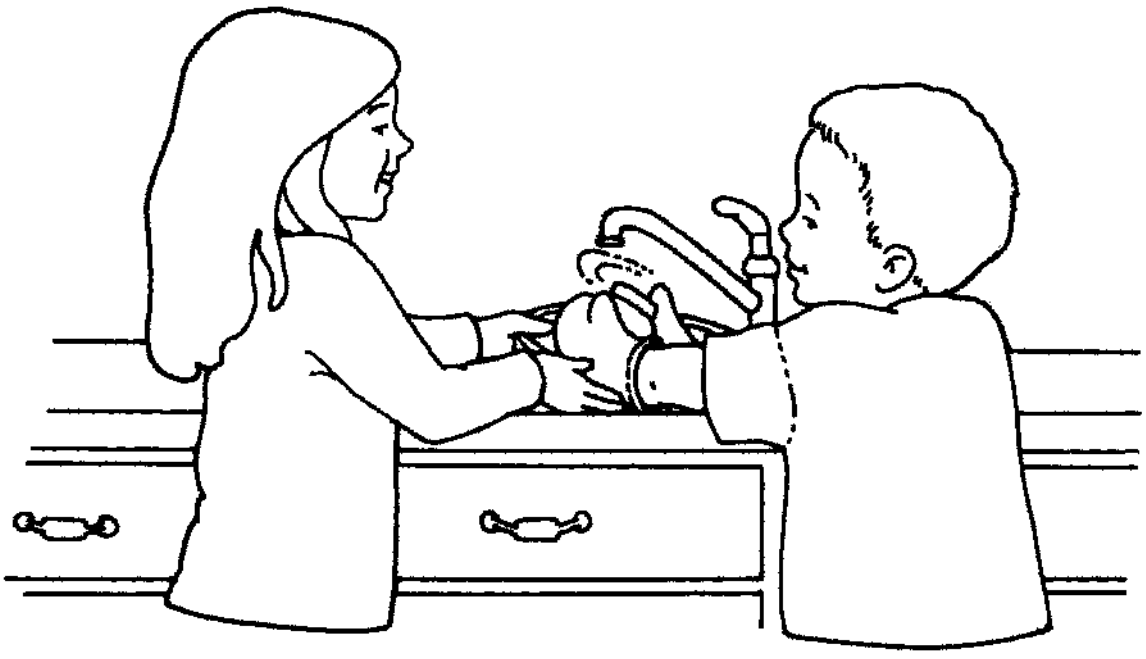
Fuel Up

- nail
- hammer
- plastic bucket
- measuring cup
- 4 cups watermelon puree (whip in a blender or crush with a potato masher)
- saucepan
- 1 tablespoon unflavored gelatin
- large mixing bowl
- 1 cup powdered confectionery sugar

1½ teaspoons lemon juice
1½ cups light cream
clean, empty quart (liter) jar with screw-on lid
crushed ice
spoon
rock salt
oven mitts
long-handled spoon

Blast Off!

1. Have an adult use the nail and hammer to punch 6 holes in the bottom of the plastic bucket.
2. Scoop ½ cup of watermelon puree into the saucepan.
3. Sprinkle the gelatin on the watermelon and let it soak in for 5 minutes. Heat it on low, stirring just until the gelatin dissolves.
4. Let the gelatin mixture cool.
5. In the mixing bowl, combine the powdered sugar, lemon juice, and light cream. Stir in the gelatin mixture.
6. Scoop the watermelon mixture into the jar and screw on the lid.
7. Set the bucket in the kitchen sink. Pour a layer of crushed ice into the bottom. Use the spoon to sprinkle rock salt over the ice.



8. Set the jar in the center of the bucket. Pack crushed ice into the bucket until it's about halfway up the sides of the jar. Sprinkle on more rock salt to cover the surface of the ice. Continue adding ice until it is about 2 inches (5 cm) below the jar's lid.
9. Put on the oven mitts. Have a partner hold the bucket while you grip the jar lid. Twist the jar around and around.
10. Every 5 minutes, unscrew the lid and have a partner use the long-handled spoon to stir the watermelon ice. Then screw on the lid again and keep twisting the jar.
11. As the ice melts and the water drains away, pour fresh ice into the bucket and sprinkle with more rock salt.
12. Continue for about 20 minutes or until the watermelon mixture is thick.
13. Serve and eat.

Brain Booster

The melting process drew heat energy away from the watermelon mixture. That lowered the watermelon mixture's temperature enough to transform it into a thick, soft, frozen treat.

That's Amazing

It's believed that the first ice cream was served in ancient Rome. Emperor Nero had slaves run a relay race into nearby mountains and bring back fresh snow, which was mixed with fruit, wine, or honey to make a frosty treat.

Bonus Pack

Following these directions, young children can use the same salt-ice reaction to shake up an ice cream snack on their own. Each child will need: a gallon-sized (4.5-l) self-sealing plastic bag, a quart-sized (1-l) self-sealing plastic bag, oven mitts, ¼ cup of powdered confectionery sugar, ½ teaspoon of vanilla extract, 1 cup of whipping cream, crushed ice, 1 cup of rock salt, and a spoon. The children should pour all of the liquid ingredients plus the sugar into the smaller bag, seal it, and shake to mix. Next, they should place the smaller bag inside the bigger one, scoop in as much ice as the big bag can hold but still close, then sprinkle in rock salt. After sealing the big bag, the children will need to wear oven mitts to hold and shake the bag. The bag should be shaken until the liquid feels thick when the bag is squeezed gently.

CHAPTER 3

Physics in the Kitchen

Stack a Drink 2

Investigate how to make a liquid more dense or thick. Then use what you discover to assemble a colorful and tasty layered drink.

Fuel Up

measuring cup
1 cup grape juice
3 juice glasses
1 tablespoon sugar
spoon
½ cup orange juice
water
¼ cup apple juice
tall 12-ounce (350-ml) water glass
straw

Blast Off!

1. Pour the cup of grape juice into one of the juice glasses. Add the sugar and stir with the spoon until the crystals dissolve and disappear.
2. Pour the orange juice into another juice glass. Add 1 cup of water and stir.
3. Pour the apple juice into the third juice glass. Add ¾ cup of water and stir.

4. Pour enough of the grape juice into the water glass to fill it about a third full.
5. Slowly spoon orange juice on top of the grape juice. Let the juice slip off the spoon.
6. Slowly spoon the apple juice on top of the orange juice.
7. View your stacked juice drink from the side to see the layers. Then slowly insert the straw. Try sipping one layer at a time.

Brain Booster

There was a little mixing where the layers touched, but as long as the glass was kept still, the layers of juice stayed stacked. That's because the more sugary and less watery juices are denser, or thicker, than the others. Juices that are less dense will float on those that are denser. If you choose not to drink the juice, you can watch what happens later. Over time, **diffusion**, the process of something spreading out from where there is a lot of it to where there is very little, will cause the liquids to mix. Find out how long it takes for diffusion to make the different colored juices mix.

Bonus Pack

Drop a hard-boiled egg into a glass of water, and it will sink to the bottom. But with a little trial and error, you can add just enough salt to the water to make the egg float in the middle of the glass. Each time you add more salt, first remove the egg from the water with a spoon. Mix in about a teaspoonful of salt and stir well to dissolve it. Then use the spoon to slip the egg back into the water.

That's Amazing

The densest water in the world is in the Dead Sea on the border of Israel. Nearly 28 percent salt, this water is about six times saltier than the ocean. No wonder it's so easy for swimmers to float!

Always Pick the Winner 3

Investigate how the density of a substance affects the way it moves—even the amount of energy that it uses to roll downhill.

Fuel Up

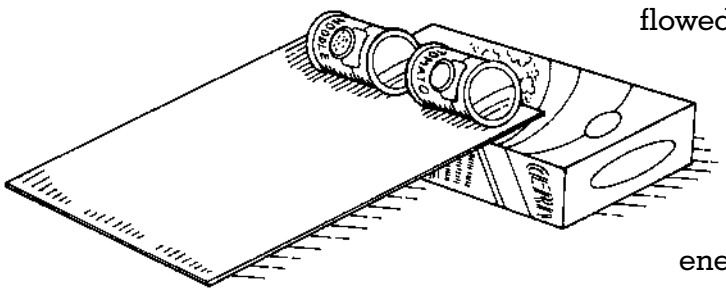
3-foot (0.9-m) square board
cereal box
can of condensed chicken noodle soup
can of condensed tomato soup
Note: Pick soups that are the same brand and cans that are identical except for their contents.

Blast Off!

1. Work on a smooth, flat floor.
2. Prop up one end of the board on the cereal box.
3. At the raised end of the board, line up the two cans—curved side down and side by side.
4. Release both cans at the same instant. Which can wins?
5. Repeat the race several times to be sure the results are likely to happen every time.

Brain Booster

The can of chicken noodle soup was the winner. This happened because even though both cans contained condensed soups, meaning that most of the water had been removed from the liquid, the chicken noodle was less dense and more liquid. At the start of the race, both soups had exactly the same amount of potential energy—the energy that was available for the cans to roll downhill. As the cans rolled, the contents swirled around inside. The less dense chicken noodle soup just flowed downhill, so most of its potential energy was used to propel the can forward. The denser tomato soup, however, used up part of its potential energy to make the thick condensed soup turn around inside the rolling can, so it had less energy left to propel the can forward.



Bonus Pack

Find out what happens when other kinds of soups race. Always think about which can contains the most liquid soup before the race starts, and you're likely to pick the winner. Which kind of soup beats all of the rest?

Make a Boomerang Can 2

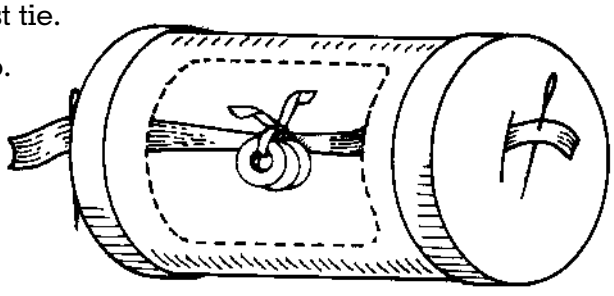
Investigate how to store up energy. Then discover how energy can produce a fun activity.

Fuel Up

can opener
2 identical empty 1-pound (0.45-kg), or larger, metal cans, such as coffee cans, with plastic snap-on lids
scissors
elastic strip 2 inches (5 cm) longer than the can (available at stores that sell sewing supplies)
2 darning needles (available at stores that sell knitting supplies)
3 metal washers (available at hardware stores)
metal twist tie, such as a bread-bag tie

Blast Off!

1. Use the can opener to remove the bottom from one of the cans. You won't need the second can—only its lid.
2. Use the scissors to cut a slit in the center of each plastic lid. Make the slit slightly longer than the width of the elastic strip.
3. Push one end of the elastic strip through the slit in one of plastic lids from the inside to the outside. Have an adult stick the darning needle through the strip to keep it from slipping back through the lid.
4. Slide the can over the elastic strip and snap on the lid.
5. Thread the washers onto the middle of the twist tie.
6. Tie the washers to the center of the elastic strip.
7. Thread the remaining end of the elastic strip—from the inside to the outside—through the other plastic lid.
8. Snap the lid on the can, pulling the elastic strip tight.



9. Anchor the elastic strip with the other needle.
10. On a smooth flat floor, gently push the can to roll it away from you.

Brain Booster

The can rolled forward until it slowed so much that it nearly stopped. Then it rolled back again. This happened because the sections of the elastic strip that were closest to the lids turned with the can, but the weighted center didn't. So the elastic band became wound up while the can rolled away from you. When the can slowed down, the elastic band started to unwind. That made the can roll back to you.

Bonus Pack

See how far you can get the can to roll away and still return. Test to find out if putting a heavier weight on the center of the elastic band increases how far the can will roll away and return.

Bend a Spoon without Touching It 1

This hands-on activity is perfect for first-time science explorers. First, play flashlight tag in a dimly lit room to let kids discover that light usually travels in a straight line. Next, let them conduct this easy experiment to see how the path of light bends when it passes from air through another kind of matter and back through air. The result is an easy-to-see optical illusion that will make this activity memorable.

Fuel Up

tall 12-ounce (350-ml) water glass
water
long-handled spoon

Blast Off!

1. Fill the glass two-thirds full of water.
2. Place the spoon—with the bowl end down—in the glass, resting the handle against the side.
3. Look at the spoon through the side of the glass.

Brain Booster

Light usually travels in a straight line, but when light passes from matter with one kind of density into matter of a different density, the light waves change direction. This shift is called **refraction**. In this activity, the light waves were bent as they traveled both into and back out of the water. That bending made the part of the spoon below the surface of the water appear to be slightly to one side of the handle above the surface.

Bonus Pack

If you have a prism available, use a flashlight to shine a beam of light through it, creating a rainbow-colored light beam. Visible light is actually made up of different colors of light all traveling together. But when a beam of light is refracted, each color of light is slowed to a slightly different rate in comparison with the others. The colored lights separate into a spectrum of red, orange, yellow, green, blue, indigo, and violet. Raindrops are nature's prisms. On a warm, sunny day, go outdoors and let your youngsters use a hose to spray a mist of water into the air. As the water drops bend the light rays, kids will see a spectrum in the form of a rainbow.

Or indoors, you can place a flat mirror against the inside of a glass bowl full of water. Have a partner shine a bright flashlight through the bowl so that the beam strikes the mirror. Move a white piece of paper around outside the bowl until a rainbow of colors appears on it. The water between the mirror and the water's surface in the bowl acts like a prism to split up the light ray into colors.

Make a Coin Appear 2

Use refraction to create another fun optical illusion.

Fuel Up

penny
shallow cereal bowl
water

Blast Off!

1. Place the penny in the bottom of the cereal bowl.
2. Set the bowl on the kitchen counter.

3. Bend down so that the rim of the bowl is even with your nose, and you're unable to see the coin.
4. While you watch, have a partner pour water into the bowl.

Brain Booster

As water was poured into the bowl, the coin became visible. Refraction of the light bouncing off the coin made an image of the coin appear above the actual coin. That's what you saw.

Bonus Pack

When the water is poured into the bowl and you first see the coin, try to touch what you see. Because refraction makes the image of the coin appear above the real coin, your finger will touch only water.

Put a Balloon in a Candle Flame 1

This activity is a dramatic demonstration of one way to transfer heat energy.

Fuel Up

water
a round balloon
a candle in a holder
oven mitt
matches (for adult use only)

Blast Off!

1. Pour ¼ cup of water into the balloon.
2. Blow into the balloon to inflate it and tie the neck of the balloon to seal it.
3. Set the candle in the kitchen sink and have an adult light it.

4. Have an adult wearing an oven mitt hold the balloon by its tied neck and lower it until the fattest end of the balloon touches the flame.

Brain Booster

The balloon didn't pop. A balloon's rubber skin is thin and fragile. Usually, a flame will make the spot it touches hot enough that the rubber will melt and the balloon will pop. But water is an excellent conductor of heat, and in this project, it drew heat from the spot that was heated by the flame.

Bonus Pack

Use what you discovered to make hot chocolate in a paper cup. With a hole punch, make a hole just below the cup's rim. Make a second hole opposite the first one. Tie on a string handle. Fill the cup half full of water. Loop the handle over the bowl end of a long wooden spoon. Set a candle in the kitchen sink, have an adult light it, and hold the paper cup in the flame. Like the rubber balloon, the cup won't burn because water is drawing heat away from the paper. You may need to take turns holding the cup, as the water will take a few minutes to boil. When it does, remove it from the flame and immediately stir in a tablespoon of hot chocolate mix. Let the drink cool a bit and enjoy.

Separate Pepper from Salt 1

There's more than one way to accomplish this challenge. For the youngest investigators, this project is a perfect introduction to **static electricity**, electrons or charged bits that collect in one place, instead of flowing from one place to another.

Fuel Up

rubber balloon
2 tablespoons coarse pepper flakes (available at grocery stores)
2 tablespoons table salt
2 plates
spoon

Blast Off!

1. Blow up the balloon and tie the neck to seal it.
2. Pour the pepper and salt on one of the plates and stir with a spoon to mix well.
3. Rub the balloon briskly against your hair (or against a wool sweater).
4. Touch the balloon to the surface of the pepper and salt mixture.
5. Brush any pepper flakes that stick to the balloon onto the empty plate.
6. Repeat rubbing and touching the balloon to the pepper and salt mixture until no more pepper flakes collect on the balloon.

Brain Booster

You were able to use static electricity to attract the pepper flakes. Electricity comes from charged particles in matter called **electrons**. Electrons are normally parts of atoms, the building blocks of molecules. Sometimes, though, electrons are knocked out of their atoms. Then those free electrons may be collected in one place or may move from one place to another. When the electrons collect in one place, the charged bits are called static electricity. Rubbing the balloon on hair or wool knocked some electrons free, and they collected on the balloon's surface. When this weak charge was brought close to the plate, the pepper and the salt became charged, too. Because the pepper and salt mixture and the balloon were charged differently, the two unlike charges attracted each other. And, because the pepper was so light, that pull was enough to lift the lightest flakes. This method isn't a complete success, though. Some of the tiniest, lightest bits of salt are also likely to be attracted and to stick to the balloon, and heavier pieces of pepper won't be lifted by the charge in the balloon.

Another Way to Separate Pepper from Salt 2

Let older children brainstorm ways to separate pepper from a mixture of salt and pepper. They could start with the static electricity activity and then think of other strategies. The following technique relies on the fact that salt, like many other solids, dissolves in water.

Fuel Up

2 tablespoons coarse pepper flakes (available at grocery stores)
2 tablespoons table salt
glass pie plate
water
spoon
piece of old nylon stocking or cotton cloth
rubber band
tall 12-ounce (350-ml) water glass

Blast Off!

1. Pour the pepper and salt into the pie plate.
2. Add a cup of water and stir with the spoon until the salt grains are no longer visible.
3. Cover the glass with the cloth and secure with the rubber band.
4. Pour the solution from the pie plate into the water glass.

Brain Booster

The pepper flakes were left on the cloth. The salt seemed to have disappeared. In fact, the salt grains have dissolved, meaning they've broken down and become suspended in the water.

Bonus Pack

Prove that the salt is in the water. Pour the water from the glass back into the pie plate. Let it set until the water has evaporated (moved into the air). This will take a couple of days, but after it happens, only the salt will remain. It will be a crusty layer coating the bottom of the pie plate. This is similar to the method that's used to extract salt from seawater.

Cut Ice with Wire 2

Find out how pressure affects ice.

Fuel Up

3 paper cups
2-liter empty plastic drink bottle, with a flat-topped cap
water

cork drink coaster
paper towel folded into fourths
18-inch (45-cm) piece of strong, thin wire
2 sturdy coffee mugs with handles (Be sure you have an adult's permission to use these.)

Blast Off!

1. Fill one paper cup half full of water and freeze.
2. Fill the drink bottle full of water to give it weight, put on the cap, and set the bottle in the kitchen sink.
3. Place the coaster on top of the bottle and cover it with the folded paper towel.
4. Peel the paper cup off the ice and set the ice block on top of the paper towel.
5. Twist one end of the wire around the handle of each coffee mug.
6. Place the wire across the middle of the ice block. If necessary, shorten the wire so that both coffee cups are suspended in the air.
7. Check the ice block every 15 minutes.

Brain Booster

The ice melted where the wire touched it. That happened because the weight of the coffee mugs put pressure on the wire. The pressure caused the ice to heat up and melt beneath the wire. If you use something heavier than coffee mugs or carefully add coins or other weights to the tipped cups, it will increase the pressure and make the wire slice through the ice faster. This is the same thing that happens when someone ice skates. The person's body weight puts pressure on the skate blades. This makes the ice melt under the blades, and the skater actually slides along on this slick, melted surface.

Bonus Pack

Obtain a piece of dry ice; it's usually available through stores that carry party supplies or from an ice supplier. (*Caution: Use dry ice only with an adult's supervision. Never touch dry ice with your bare hands.*) Dry ice is frozen carbon dioxide gas, rather than water, but it also melts under pressure. Be sure to wear oven mitts for this experiment; then press a metal spoon against the ice. The melting dry ice releases carbon dioxide gas. As the gas slips from under the spoon, it causes the metal to vibrate just enough to make a screamlike noise.

For More Science in the Kitchen Fun

Emeril's There's a Chef in My Soup! Recipes for the Kid in Everyone by Emeril Lagasse (New York: HarperCollins, 2002). Packed with 75 fun, tasty recipes with easy-to-follow instructions. Ages 9–12.

Everything Kids' Cookbook: From Mac 'n' Cheese to Double Chocolate Chip Cookies—All You Need to Have Some Finger Lickin' Fun by Sandra Nissenberg (Avon, Mass.: Adams Media Corporation, 2002). Trivia, puzzles, cooking tips, and recipes for tasty and healthful food. This is a book that kids and parents can enjoy together. Ages 9–12.

Grow Your Own Pizza: Gardening Plans and Recipes for Kids by Constance Hardesty (Golden, Colo.: Fulcrum Publishers, 2003). Recipes and activities for blossoming gardeners and chefs. Ages 9–12.

How to Read a French Fry: And Other Stories of Intriguing Kitchen Science by Russ Parsons (New York: Houghton Mifflin Company, 2003). This book includes recipes, the science behind the recipes, and food lore. It also includes valuable explanations such as what makes apples "mealy." Ages 9–12.

Pretend Soup and Other Real Recipes: A Cookbook for Preschoolers and Up by Mollie Katzen and Ann L. Henderson (Berkeley, Calif.: Tricycle Press, 1994). Easy-to-follow illustrated recipes for adults to share with children. Ages 4–8.

Science Experiments You Can Eat, revised edition, by Vicki Cobb (New York: Harper Trophy, 1994). This book has plenty of action for the kitchen laboratory and budding scientists. Ages 7 and up.

The Science Chef: 100 Fun Food Experiments and Recipes for Kids by Joan D'Amico (New York: John Wiley & Sons, 1994). This book reveals what happens to change ingredients into food. There's plenty of fascinating trivia, too. Ages 9–12.

The Secret Life of Food by Clare Crespo (New York: Hyperion Press, 2002). Quirky and amazingly simple recipes for making everything from sushi cupcakes to chocolate cake baked in terra-cotta pots. This is a culinary adventure. Ages 9–12.