EXPERIMENTS

Stay Home. Hit Play.

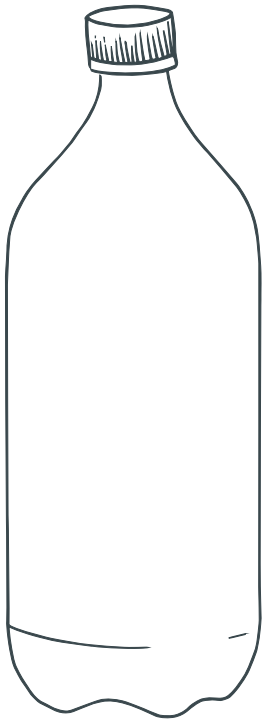
museum of science+industry chicago

DESTINATION RESPIRATION

Investigate how your lungs work by building a model of a lung.

MATERIALS

- ☐ Plastic water or soda bottle
- ☐ 2 balloons
- ☐ 2 rubber bands
- ☐ Tape
- ☐ Scissors



INSTRUCTIONS

1. Carefully cut off the bottom of the plastic bottle. Put tape over the cut edge so that it won't be sharp.
2. Place one balloon into the mouth of the bottle, through the neck, so that it hangs inside. Stretch the opening of the balloon over the opening of the bottle. Use a rubber band and tape to hold the balloon in place. Make sure it is sealed tightly, so that air can go into the balloon but not into the bottle.
3. Cut the mouthpiece off the second balloon, cutting the balloon nearly in half.
4. Stretch the balloon over the open bottom of the bottle and secure it in place with a rubber band and tape. You may need a partner to help you.
5. Push up on the stretched balloon at the bottom of the bottle. Then pull it down. What do you notice happening to the other balloon that's inside the bottle?

WHAT'S HAPPENING?

When we breathe in, air (containing oxygen) flows into our mouth and down our trachea, or windpipe. The air then moves into our lungs, which are protected by our ribs. A large muscle called the diaphragm is located under our lungs. The diaphragm moves down in order to cause the lungs to fill up with oxygen. The diaphragm moves up in order to squish the lungs and force air and carbon dioxide (CO2) out. In your model, the balloon at the bottom of the bottle represents your diaphragm and the other balloon inside the bottle represents a lung.

WEATHER STATION

Build your own weather station to record weather events that happen in your own backyard!

GENERAL MATERIALS

☐ Thermometer ☐ Tray or box ☐ Weather station instruments and weather log (see below)

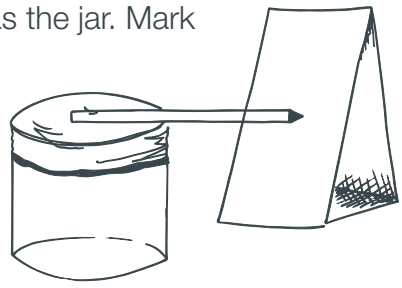
BAROMETER

MATERIALS

☐ Small jar or cup, like a juice glass or yogurt container
☐ Index card or piece of thick paper
☐ Balloon ☐ Tape ☐ Pen or Pencil
☐ Rubber band ☐ Scissors ☐ Straw

INSTRUCTIONS

Cut the neck off a balloon, stretch the balloon over the top of a jar or small cup and secure it with a rubber band. Cut a straw in half and cut at an angle to make a point. Tape the straw to the balloon so the end is in the center and the pointed end extends over the edge of the jar or cup. Place tape over the full length of the straw that's on the balloon so that it's secure. Make a gauge by folding an index card in half (or taping two together in a V shape) so that it stands next to the straw. The card should be about twice as tall as the jar. Mark on the index card gauge the ocation where the straw points each day.

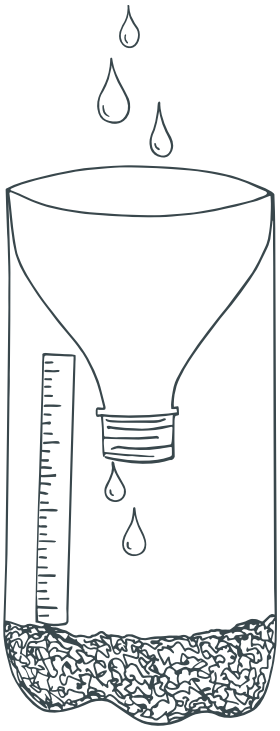


RAIN GAUGE

MATERIALS

☐ Plastic bottle, 1- or 2-liter (with straight, not curved, sides)
☐ Gravel ☐ Ruler ☐ Tape

INSTRUCTIONS



Cut off the top fourth of your plastic bottle. Add about two inches of gravel to the base of the bottle. Tape a paper ruler on the outside of the bottle, with the "0" mark at the top of the gravel. Add water until it reaches the top of the gravel. Make a funnel by inverting the top of the bottle that you cut off, placing it inside the base and covering the cut edges with tape. When it rains, measure the rainfall amount on the ruler.

WEATHER STATION (CONTINUED)

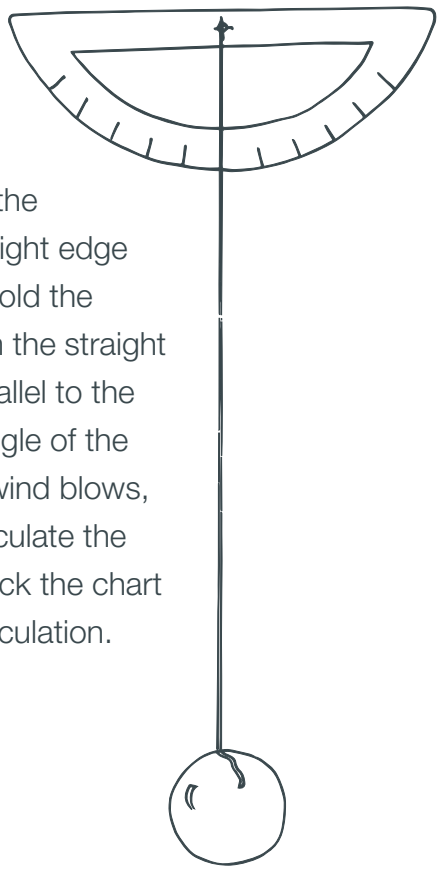
ANEMOMETER

MATERIALS

- ☐ String
- ☐ Ping pong ball
- ☐ Scissors
- ☐ Tape
- ☐ Protractor

INSTRUCTIONS

Tape one end of a piece of string to a ping pong ball and the other to the center of the straight edge of a protractor. Hold the anemometer with the straight edge on top, parallel to the floor. Note the angle of the string when the wind blows, then use it to calculate the wind speed. Check the chart below for this calculation.



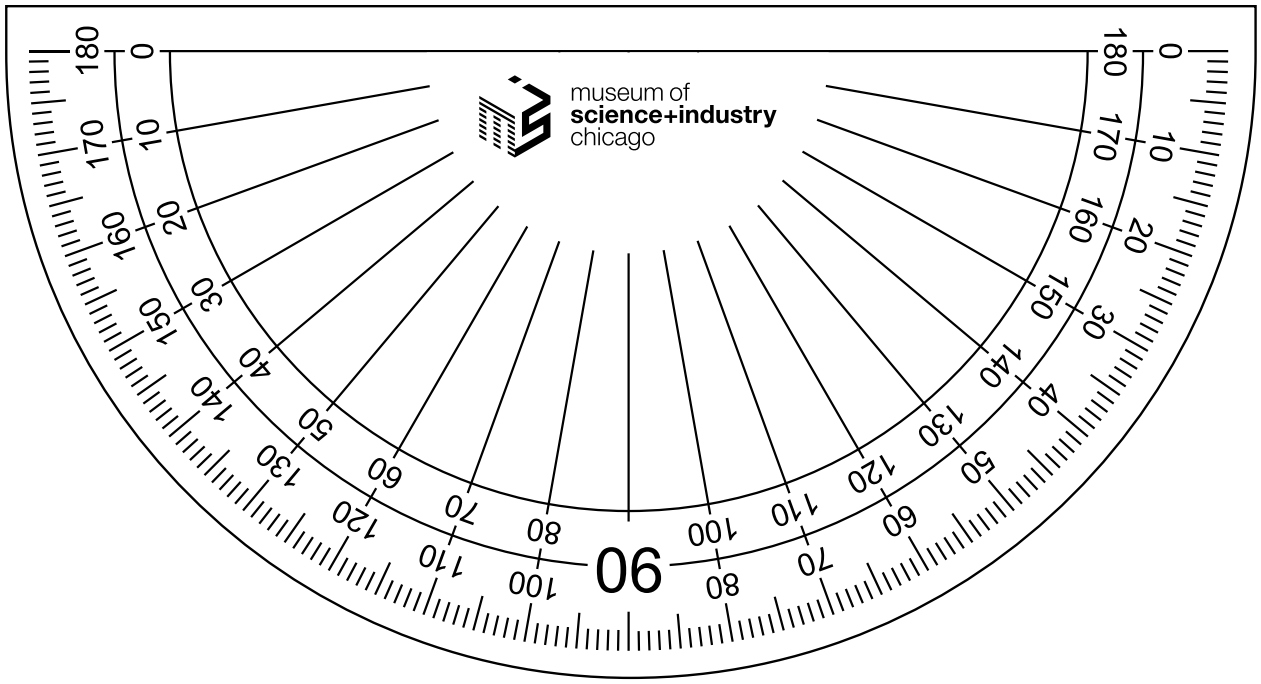
WHAT'S HAPPENING?

Weather describes the temperature, humidity, atmospheric pressure, wind, rainfall and other meteorological characteristics of the atmosphere in a specific place at a specific moment in time. Instruments help measure the weather. A barometer measures air pressure; low or falling pressure (when the straw points downward) means a storm is approaching, while high or rising pressure (when the straw points up) means sunny weather. A rain gauge measures how much rain falls at a time. An anemometer measures the speed of the wind.

WEATHER STATION (CONTINUED)

WEATHER STATION INSTRUMENTS

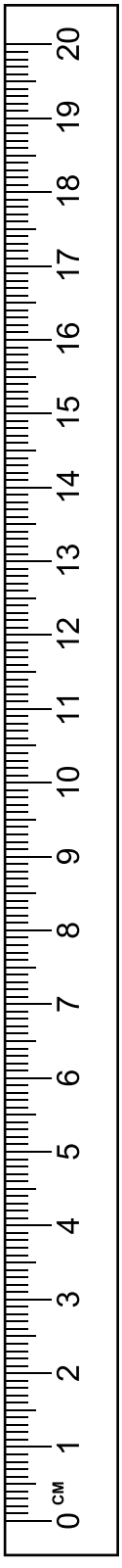
Anemometer



Wind Speed Chart

Angle	Wind Speed (km/hr)
90°	0
95°	9
100°	13
105°	16
110°	19
115°	21
120°	24
125°	26
130°	29
135°	31
140°	34
145°	37
150°	41
155°	46
160°	52

Rain Gauge



WEATHER STATION (CONTINUED)

WEATHER LOG

DATE	TIME	PRESSURE Barometer	PRECIPITATION Rain Guage	WIND SPEED Anemometer	TEMPERATURE Thermometer	OBSERVATIONS

PADDLE BOAT

Build your own boat that uses kinetic energy stored in rubber bands to move.

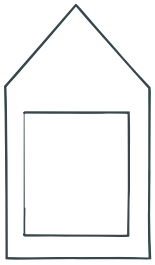
MATERIALS

- ☐ Cardboard
- ☐ Rubber bands
- ☐ Ruler
- ☐ Scissors
- ☐ Duct tape
- ☐ Clear tape
- ☐ Craft sticks or straws
- ☐ A sink, tub or large container filled with water

INSTRUCTIONS

1. Cut the cardboard into pieces of these dimensions: one piece that is 5 inches by 10 inches, and two pieces that are 1.5 inches by 2.5 inches each.

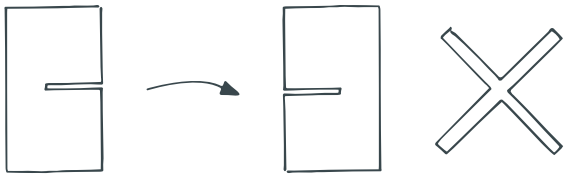
2. Take the large piece of carboard, which will be the body of the boat. Towards one end,



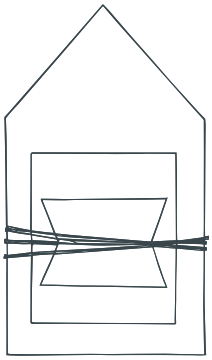
cut a rectangular window that measures 3 by 4 inches and is 1 inch from the edges. This is the back of the boat. On the front of the boat, cut two angles so that the front is pointed.

3. Cover the entire body of the boat with duct tape to make it waterproof. The better you cover everything, especially the tricky inside corners, the longer your boat will last.

4. On both of the smaller pieces of cardboard, cut a slit in the center of the long edge that goes halfway through. Fit the two slits together so the cardboard makes an X shape. Cover your X-shaped paddle wheel with duct tape.



5. Attach the paddle wheel to the boat body by stretching two rubber bands across the center of the boat's back window. Place the paddle between the rubber bands, with one on each side of the X.



6. Wind up the boat by turning the paddle backwards. Hold on to the paddle as you place the boat in water, then let it go!

WHAT'S HAPPENING?

When you wind the paddle, the rubber bands store potential energy. Potential energy occurs because the twisted rubber bands are not in equilibrium—you have to hold them in place or they will unwind. When you let go of the paddle, the rubber bands unwind, rotating the paddle and pushing the boat forward. The unwinding converts potential energy to kinetic energy, which is the energy of motion. The rubber bands moving the paddle, the paddle pushing the water and the boat moving forward are all examples of kinetic energy.

Having a hard time visualizing these directions? Additional visual instructions for this activity can be found here: https://bit.ly/2LpGV8v

BALLOON RACERS

Build balloon racers and explore the idea that for every action, there is an equal and opposite reaction.

MATERIALS

- ☐ String
- ☐ Balloons (long, skinny ones work best)
- ☐ Chicago “L” car template
- ☐ Craft stick
- ☐ Straw
- ☐ Tape
- ☐ Binder clip
- ☐ Scissors
- ☐ Crayons or markers

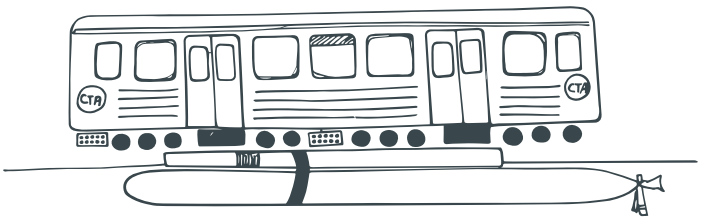
INSTRUCTIONS

1. Cut a long piece of string (at least 8 feet), tape one end to a wall and thread a straw on the string.

2. Blow up a balloon, close the end with a binder clip or clothespin, and tape it to the straw so that the neck of the balloon points in the opposite direction the balloon will travel.
3. Hold the string so it’s parallel to the floor, or even tape the other end to another wall.
4. Position the balloon racer at the end, remove the clip and watch it go!
5. Turn your racer into a Chicago “L” car by cutting out and decorating the template on the next page. Tape it together with a craft stick in the middle for support, then tape it to the straw above the balloon.
6. Set up two string “racetracks” next to each other and challenge someone to a race!

TIPS

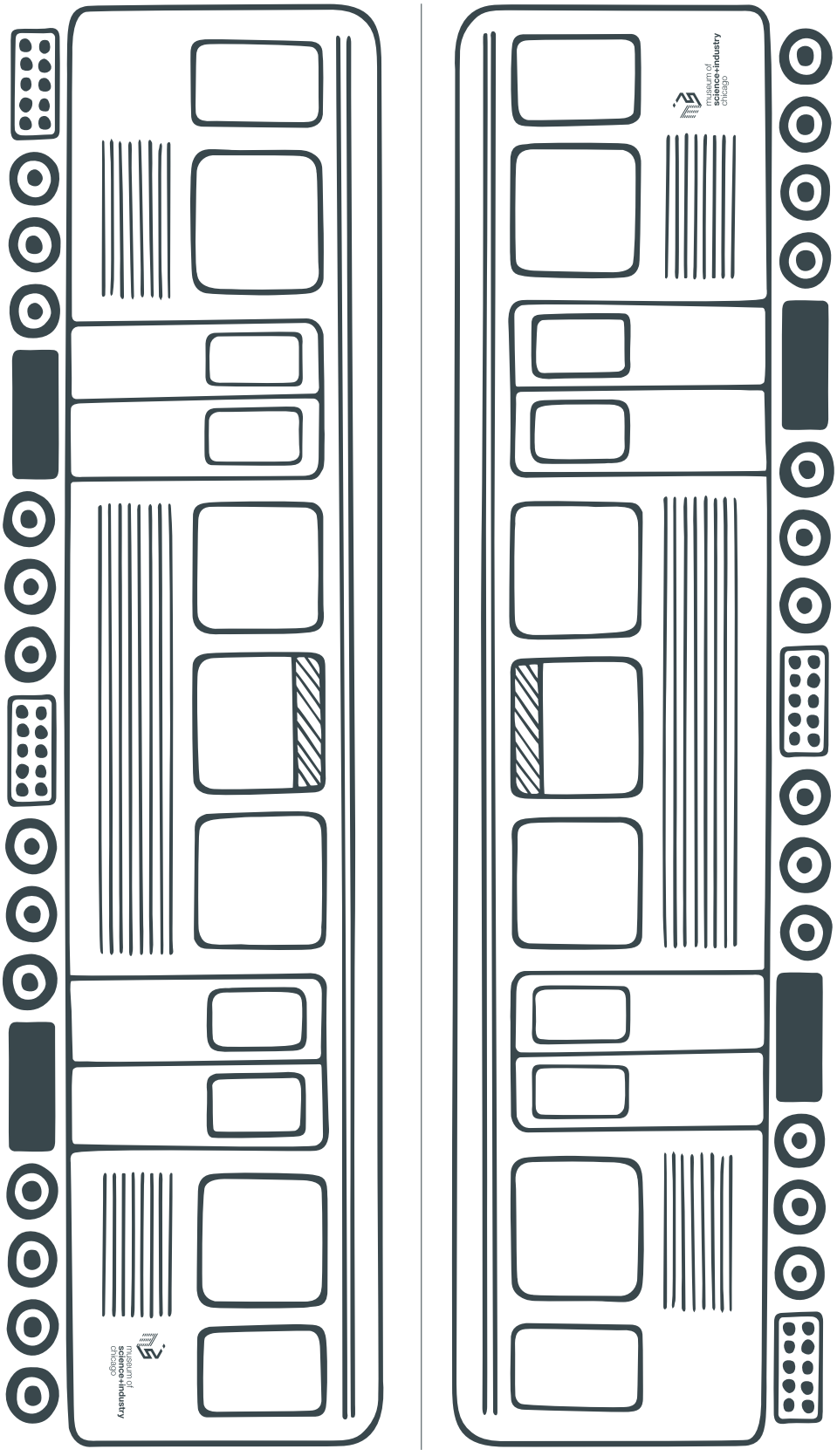
Tape the balloon onto the straw in just one place. The balloon shrinks as it loses air, which can pull off the tape.



WHAT'S HAPPENING?

As air rushes backwards out of the balloon, it pushes the racer in the opposite direction with the same amount of force. This is Newton’s third law of motion at work—for every action, there is an equal and opposite reaction.

BALLOON RACERS (CONTINUED)



"L" CAR

Decorate your “L” car. Fold between the two cars (so your train is double sided) and trim the excess paper by cutting on the dotted line before attaching to your balloon racer.

CREATE GAS

Mix a solid and a liquid to produce ... well, see for yourself!

MATERIALS

- ☐ Balloon
- ☐ Empty bottle
- ☐ Measuring spoons
- ☐ Funnel
- ☐ Measuring cups
- ☐ Baking soda
- ☐ Vinegar

INSTRUCTIONS

1. Use the funnel to pour two teaspoons of baking soda into an empty balloon. Rinse and dry the funnel.
2. Use the funnel to pour ¼ cup of vinegar into the bottle.
3. Stretch the mouth of the balloon around the bottle top.
4. Lift the balloon, letting the baking soda pour into the bottle. Watch what happens!

WHAT'S HAPPENING?

When you combine the solid (baking soda) and the liquid (vinegar), the chemical reaction creates a gas called carbon dioxide. Carbon dioxide is invisible, except as the bubbles of gas you may have noticed when the vinegar and baking soda mixture began to fizz. This gas is what made the balloon inflate.

ELEPHANT TOOTHPASTE

Release the awesome power of oxygen with an oozing, foaming and safe chemical reaction.

MATERIALS

- ☐ 3% hydrogen peroxide (household grade, the type used to clean minor cuts)
- ☐ Liquid dish soap
- ☐ Plastic bottle with a narrow opening, like one for water or soda
- ☐ Plastic table covering or large pan
- ☐ Measuring cups and spoons
- ☐ Dry yeast
- ☐ Small cup
- ☐ Water

INSTRUCTIONS

1. Pour one cup of hydrogen peroxide into the bottle.
2. Add a good squirt (about one tablespoon) of dish soap and several drops of food coloring.
3. Gently mix these ingredients by swirling the bottle.
4. In a separate small cup, pour one pouch (about two teaspoons) of dry yeast and add two tablespoons of warm water. The temperature doesn't have to be exact, but the temperature you use for a hot bath is good. Mix together with a spoon.
5. The next step will make a bit of a mess, so protect your surface with a plastic table covering or large pan.
6. Pour all of the yeast mixture into the bottle containing the hydrogen peroxide solution. The peroxide should immediately create foam, filling the bottle and oozing out of the top.

TIPS

Tape the balloon onto the straw in just one place. The balloon shrinks as it loses air, which can pull off the tape.

WHAT'S HAPPENING?

As air rushes backwards out of the balloon, it pushes the racer in the opposite direction with the same amount of force. This is Newton's third law of motion at work—for every action, there is an equal and opposite reaction.