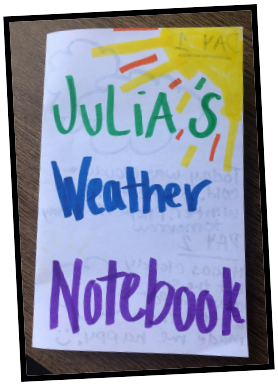
Meteorology Kit

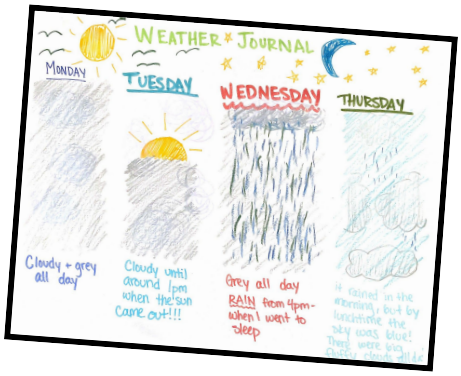
What's the weather? Does it change over time? Use Chabot's meteorologist notebook and DIY weather station instructions to observe and measure the weather in your area.

Instructions

To use Chabot's Meteorologist Notebook, print out the pages below and assemble it by folding it in half from top to bottom, then in half again from left to right. Insert page 4 inside page 3, and use a stapler or tape to hold them together. Use the assembled journal to observe the weather in your area for the next 6 days.

Or design your own journal! Make sure to include multiple pages and plenty of space for your observations. Some example journals are featured below.





Use the directions on pages 6-16 to build some additional tools to help you measure the weather more precisely. Directions for each piece of the weather station are on the corresponding pages: Rain Gauge (6-7), Anemometer (7-11), Weather Vane (12-14), Wind Chime (15-16).

Be sure to share your notebooks, weather stations, and observations with us by tagging @chabotspace and using the hashtags #LearningLaunchpad and #ChabotMeteorologist

For Grown Ups

What's Going On?

Weather is the daily pattern of atmospheric conditions that we experience in a given place. Weather shifts from day to day, and depends on the amount of heat (or sunlight), water, and air (or wind) in a given area at any time. We call these three things (heat, water, wind) the **three elements.**

We get different types of weather when these three elements interact in different ways. For example, on hot, sunny days, we have lots of heat and sunlight, and less water and wind interacting. On snowy days, we have lots of water and some wind, and less heat interacting.

A **meteorologist** is someone who studies the weather. We study the weather to learn patterns over time, which can help us learn when the best time is to plant food, be prepared for extreme weather events, and even just pick out what to wear day to day

We can observe weather using our **5 senses** and using **tools.** The different types of tools meteorologists use are highlighted in the rest of this guide. Enjoy becoming an amateur meteorologist!

What will we be learning?

Next Generation Science Standards

Completing these activities and experiments will satisfy the following NGSS Standards:

- K-ESS2-1: Use and share observations of local weather conditions to describe patterns over time.
- 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
- K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Next Generation Science Standards: Practices for K-12 Science Classrooms

Through these activities, learners of all ages will practice skills such as:

- Asking Questions
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Obtaining, Evaluating and Communicating Information

Next Generation Science Standards: Cross Cutting Concepts

Completing these activities will help learners understand the following about crosscutting concepts:

- **Patterns:** patterns in the natural world can be observed and used as evidence.
- **Stability and Change:** it's important to study and understand the conditions that affect stability and control rates of change in both designed and natural systems.

Meteorologist Notebook

Use this notebook to track and observe how the weather changes over 6 days.

Each day, write and illustrate your weather observations in the space provided. Be sure to check in with all your senses (sight, hearing, touch, smell, taste).

If you build a weather station, record daily measurements, for temperature, rain, and wind direction and speed, too

How did the weather in your area change over time? Was it always the same, or did it vary from day to day?

All weather is made up of three elements: heat or sun, wind or air, and water. Which element did you observe the most of? The least?

If you completed this journal 6 months from now, what type of weather do you think you'd observe? Why?

Keep monitoring your weather station! *Use the additional blank journal pages to continue tracking the weather.*
Check out the GLOBE Observer app to compare your observations to NASA satellites and participate in ***citizen science*** *experiments.*

Fold Here First

Day 1 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Fold Here First

Day 6 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Day 5 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Day 2 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Fold Here First

Fold Here First

Day 3 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Day 4 Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

Fold Here First

Fold Here First

Date:

What do you observe about the weather?
Record your observations below

Date:

What do you observe about the weather?
Record your observations below

Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:

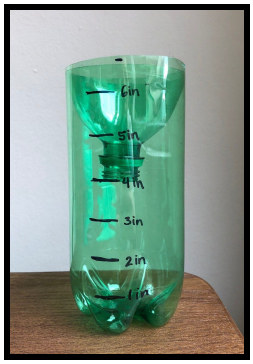
Weather Station Measurements

Temperature:

Rainfall:

Wind Speed:

Wind Direction:



Water Bottle Rain Gauge

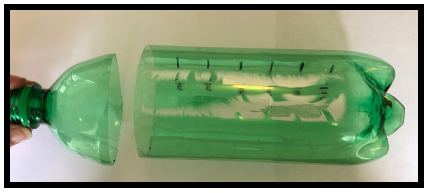
A **rain gauge** is a tool that meteorologists use to measure rainfall over a given period of time. Did you know you can build one yourself from a water bottle?

Materials Needed

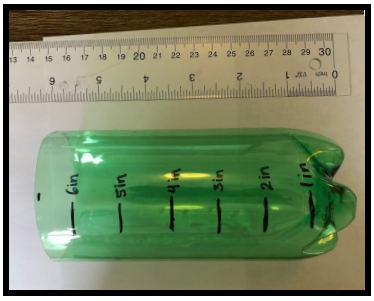
- 1 1L plastic bottle
- 1 pair of scissors
- 1 ruler
- 1 permanent marker

Instructions

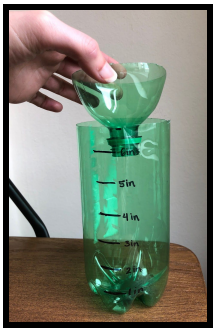
1. Cut off the top part of your water bottle. It's good to start cutting about a ½ inch below the neck of the water bottle. **TIP!** This part can be tricky, so ask a grownup for help if needed.



2. On the base of your water bottle, use a ruler and marker to measure up the side, making marks in one inch increments.



3. Flip the top half of your water bottle upside down, and insert it into the bottom half, like a funnel. You now have a rain gauge!



Testing Your Rain Gauge

Before the next big storm, take your rain gauge outside! Find a spot where you can set your rain gauge to collect rain - your spot shouldn't be covered or have any trees above it. After picking your spot, leave the rain gauge out in the storm to collect rain!

After the storm is over, come back outside to check! Your rain gauge should have collected some water inside. Use your measurements to estimate how many inches of water were caught inside your bottle. That estimate in inches is the amount of rain in inches!

After the storm, you can choose to dump out your rain gauge and start over before the next one, or keep it full and measure rainfall over a longer period of time. The choice is yours!

Egg Carton Anemometer

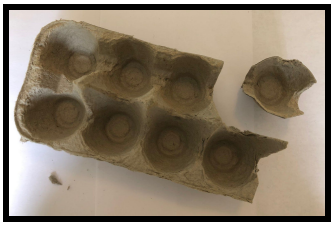
An **anemometer** is a tool that meteorologists use to measure the wind. Scientists can measure how fast the anemometer spins, then calculate wind speed! Did you know you can make your own anemometer using an egg carton?

Materials

- 1 egg carton
- 2 straws (or cardboard strips)
- 4 toothpicks
- 1 pin or pushpin
- 1 pencil
- Scissors
- Glue or tape
- Markers or paint
- 1 cardboard square (4” X 4” or larger) (optional)
- Clay (optional)
- Timer or stopwatch (for testing)

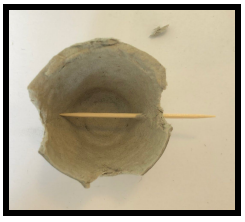
Instructions

1. Cut four cups out of the egg carton.

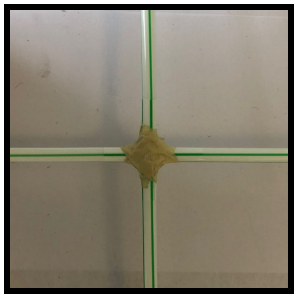


2. Color or paint the egg carton cups so that three are the same color, and one is a different color. If needed, let the cups dry.

3. Push one toothpick directly through the sides of each egg carton cup. The stick should go all the way through the center of the cup.

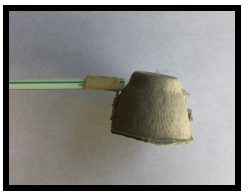


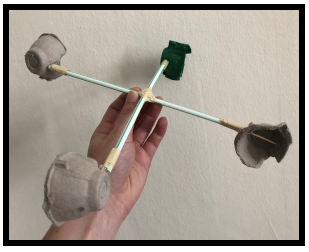
4. If needed, secure the toothpicks with glue or tape



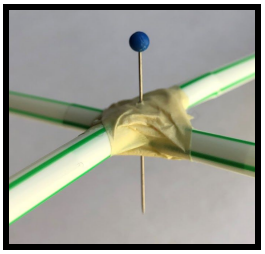
5. Tape or glue the straws together in the center, so that they make a plus sign. Try to make each leg of the straw the same length.

6. Tape one end of the toothpick (with the cup attached) to the end of a straw. Repeat so that there is one cup attached to each straw. **TIP!** Make sure the opening of each cup is facing the same direction.

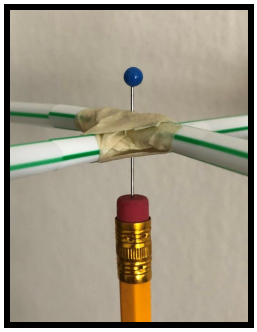




7. Poke a pin through the center of the two straws. It can be helpful to wiggle the pin around a little - the straws should be able to spin.

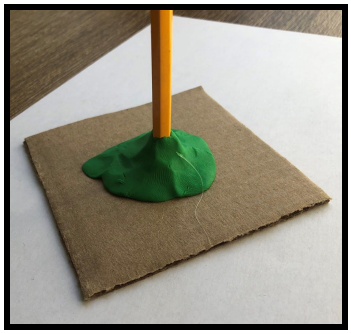


8. Poke the pin (with straws and cups still attached) into the eraser on the pencil. You've made an anemometer!



Optional Extension - Anemometer Stand

1. Decorate your cardboard square
2. Take a clump of clay and stick it in the center of your cardboard square
3. Poke the end of the pencil into your clump of clay. Your anemometer should stand on its own!



Testing Your Anemometer

Now that you've made an anemometer, it's time to test it. An anemometer tells us how fast the wind is blowing.

To use your anemometer, take it outside - it should start spinning in the wind! If you focus on the one cup that's colored differently than the others, you should be able to keep track of it as it moves in a circle. One spin for this cup is called a **revolution**. To measure wind speed, we can count the number of revolutions that happen in one minute.

It's easier to count the revolutions per minute with a buddy! Grab a friend or family member and have them help you by setting a timer for one minute. While they keep track of time, count how many revolutions the colored cup makes. The number at the end of one minute is how fast the wind is moving in **revolutions per minute**

For Grown Ups

What's Going On?

Since the cups are equally positioned and facing the same direction, they catch the wind, causing the anemometer to spin regularly. We can count how many times the anemometer rotates in a minute to measure speed.

Converting to miles per hour

When we measure wind in real life, we measure speed in **miles per hour.** Since anemometers are all different, the number of revolutions per minute will vary based on the anemometer. For example, an anemometer made with shorter straws will have more revolutions per minute than one with longer straws, since the cups on the shorter straws do not have to travel as far.

We can use math and conversions to change the number of revolutions per minute to miles per hour. You can use the following equation to convert your speed in revolutions per minute to mile per hour:

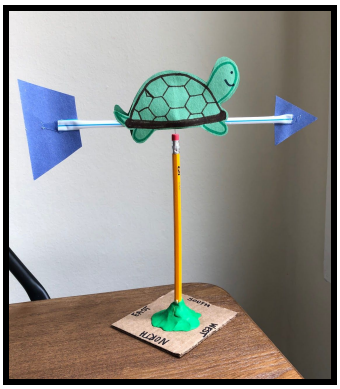
(# revolutions per minute) x (diameter of anemometer in inches) x (0.002973)

Your answer is the wind speed in miles per hour!

The simplified equation above is based on the **unit conversion** shown below.

$$\frac{1\ \text{rev}}{\text{min}} \times \frac{\pi d\ (\text{in})}{1\ \text{rev}} \times \frac{1\ \text{mile}}{63360\ \text{in}} \times \frac{60\ \text{min}}{1\ \text{hr}}$$

We start with one revolution per minute, and convert that revolution to a distance in inches. We can use the equation for the circumference of a circle (pi*diameter) to figure out how far an anemometer cup travels in one revolution. We multiply the circumference of our circle by the number of revolutions, and we're left with inches traveled per minute. To convert inches to miles, we divide this number by 63360, which is the number of inches in a mile. Now we have the number of miles traveled per minute. Since we want miles per hour, we multiply by 60, since there are 60 minutes in an hour. This gives us our wind speed in miles per hour!



DIY Wind Vane

When we measure wind, we can measure its speed and its direction. A **wind vane** is a tool we can use to measure the direction wind is traveling. Follow the directions below to build your own wind vane out of common materials!

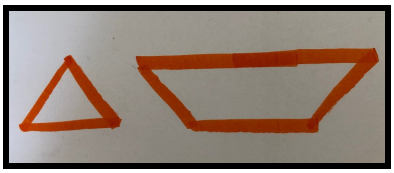
Materials

- Construction Paper
- 1 pin or pushpin
- 1 straw
- 1 pencil
- Scissors
- Markers, Colored pencils, or crayons (to decorate)
- 1 cardboard square (4” x 4 “ or larger) (optional)
- Clay (optional)

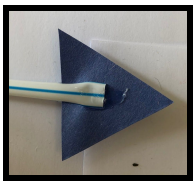
Instructions

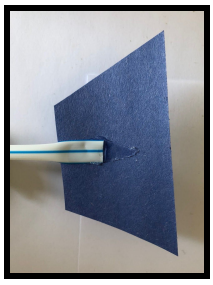
1. Cut a notch in both ends of the straw, about 1 inch long. Make sure that the slits on either end line up with each other.

2. Cut an arrow and a tail for the wind vane out of construction paper.

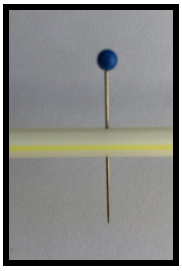


3. Slip the arrow and tail into each of the slits on the straw. Secure with tape.

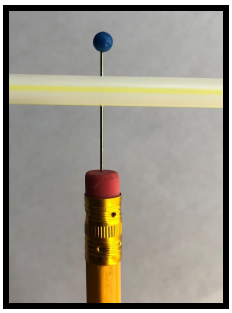




4. Using the pin, poke a hole straight through the center of the straw. Wiggle the pin slightly to make the hole larger, allowing the straw to spin on the pin.

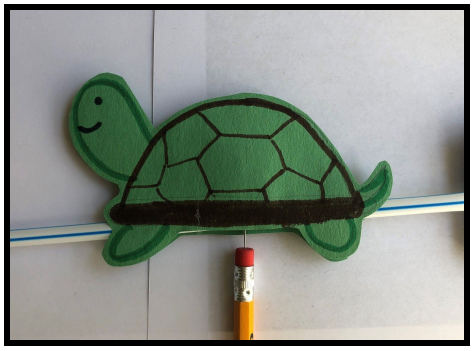


5. Insert the pin into the center of the pencils eraser. You now have a wind vane!



Optional Extensions - Wind Vane Mascot

1. Draw and animal or another figure on construction paper
2. Cut out your figure
3. Tape your figure to the top of the wind vane. Your wind vane has a mascot!



BONUS! *Can you guess why Chabot's mascot is a turtle? Share your ideas with us online by tagging @chabotspace.*

Optional Extensions - Wind Vane Stand

1. Take the cardboard square and working clockwise, label each side North, East, South, and West.
2. Take a clump of clay and stick it into the center of the cardboard square.
3. Poke the tip of the pencil into the clump of clay. You've just made a stand for your wind vane.

Testing Your Wind Vane

Now that you've made your wind vane, it's time to test it! The wind vane will be able to tell you the direction the wind is blowing from.

Take your wind vane outside. Have a grown up help you find which direction is north, and position your wind vane so that the arrow is pointing north. You may have to hold it in place so it doesn't change direction!

When you're ready, allow the wind vane to move with the wind! Where does the arrow end up pointing? Wherever the arrow is pointing is the direction the wind is blowing!

TIP! If your arrow starts facing north and doesn't move when you let go, the wind is blowing from the north. If the wind vane turns around, so that the tail is facing the direction it started, the wind is blowing from the south. If the arrow turns to the right, the wind is blowing from the east; to the left, the west.

TIP! Wind doesn't always blow from exactly the north, south, east, or west. It can also blow from in between, for example, northeast or southwest.

For Grown Ups - *What's going on?*
The tail of the wind vane is catching most of the wind, causing the wind vane to move until it cannot catch the wind anymore. Most of the time, this happens when the tail is completely perpendicular to the windstream.

Since the tail is larger than the arrow, it catches more wind and moves first, almost like it's dragging the arrow behind it. Because of this, the arrow ends up facing the same direction that the wind was blowing from!

Upcycled Wind chime

A **wind chime** is something that makes noise when it blows in the wind! Building your own wind chime is fun and simple using common materials you may have at home.

Materials

- 4-6 clean tin cans
- 1 nail
- Hammer
- String or twine
- Scissors
- Skewers, popsicle sticks, or sticks
- Paint or construction paper, to decorate

TIP! Be careful when handling the tin cans - some have sharp edges that can easily cut you!

TIP! This version uses tin cans as the chimes, but other objects work well too. You can substitute keys, rocks, washers, nails, quarters, or a combination! Pretty much anything that will make noise when it hits something will work, so be creative!

Instructions

1. Using the hammer and nail, poke a hole in the bottom of each tin can. **TIP!** This part can be tricky, so have a grown-up help you if you need to.

2. Cut 1 length of string per tin can, ~2ft long.

3. Thread each string through the hole in each tin can. Tie a knot on one end of the string, so the can is able to hang from it without slipping off.

4. Assemble your wind chime! Tie each of the tin cans to your skewer, popsicle stick, or stick. Vary the length of the string so that the tin cans fall at different levels. Use tape or glue to hold the strings in place

5. Cut 2-4 more lengths of string, about 1 ft long (depending on how many sides your wind chime has)

6. Tie each of these strings to each side of your wind chime, then tie the opposite ends together in a bundle.

7. Cut one more small length of string, and tie it in a loop around the bundle to suspend your wind chime.

8. Decorate the cans! Use paint, construction paper, or other materials to decorate your tin cans.

Testing Your Wind Chime

Hang your wind chime up somewhere outside where it has room to sway in the breeze! Do you hear it? Use your wind chime as a daily reminder to record data in your meteorologist notebook!