iBIO STEM Kits: Build and Calibrate a Simple Anemometer

Adapted from: NASA - Aeronautics Research Mission Directorate

iBIO STEM Kits welcomes you to a SCIENTIFIC JOURNEY!

This kit contains the materials you will need to build a simple anemometer. The purpose of this kit is to challenge you to understand how we measure windforce. However, we also challenge you to build and calibrate as a scientist would. What does this mean?

Scientific exploration is different than just playing around because it asks you to think about HOW you investigate. This means you need to do your investigation by observing what happens when you change an element of your design that you have carefully chosen. Good observation will help you to understand WHY something happens. Scientific exploration also means that you record WHAT you see or measure so that you can alter your design based upon what works for you. The STEM Kit Journal that you are holding will help to guide your investigation and give you a place to record your observations and your design changes.

There are many resources for you to use on iBIO's website. This type of investigation is associated with some very exciting careers! We hope that you will explore these resources while you are doing your investigation!

Let's Get Started!

FIRST, you will need to prepare your workspace. Having a clear space where you can see all of your materials and tools is very helpful. A kitchen table will work nicely. To make your clean up easier, you should protect your surface by laying out some used newspaper or opening up a paper grocery bag.

SECOND, you want to unpack your materials. Use the list below to identify which materials are used in each part and organize them in your workspace. There are some additional materials that you will need to supply from your home.

Kit Materials for Part A:	**Needed for Part B:**	**Needed for Part C:**
● 4 3-oz Plastic cups ● 1 Pushpin ● 2 Non flexible plastic straws ● 1 Pencil with an eraser ● Tape ● 1 Play-Doh container ● Sticker	A car that can drive 10 mph and an adult that can drive it for you!	A space to place your anemometer where it has access to the wind!

LAST, you need to be prepared for experimenting safely. When you are pushing the pin through the straws, make sure that the straws are on a surface and NOT in your hand. If you have difficulty pushing the pin through, you might want an adult to help you.

Part A: BUILD: Making a Simple Anemometer

Here is what you need from your STEM kit:

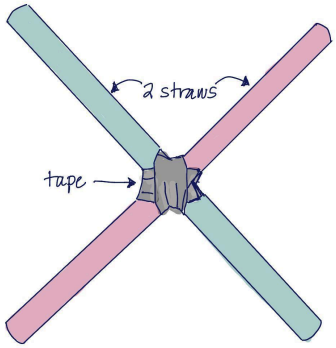
- 4 3-oz Plastic cups
- 1 Pushpin
- 2 Non flexible plastic straws
- 1 Pencil with an eraser
- Tape
- 1 Play-Doh container

What is a way to measure the speed of wind?

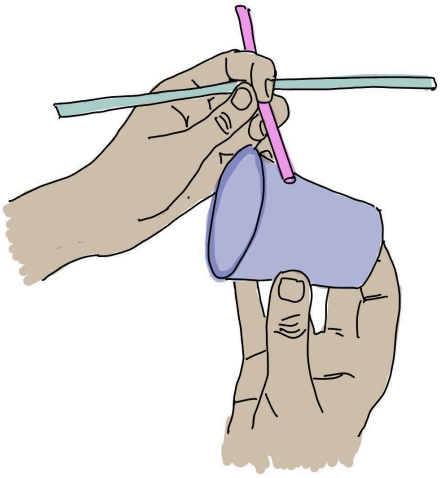
AN ANEMOMETER!!!

The movement of air in any direction is called wind. The speed of wind varies from a calm breeze to the very high speeds of hurricanes. Temperature changes that occur each season and the movement of the Earth's rotation can affect wind speed and direction. An anemometer is a device for measuring wind speed. It has a spinning wheel that moves faster as the strength of the wind increases. The spinning wheel on our anemometer captures the wind force using cups at the end of extended arms. When we count the number of rotations of the spinning wheel, we can calculate the wind speed.

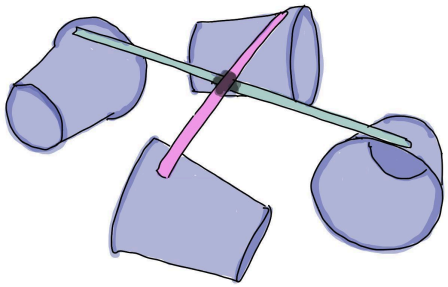
1. **Connecting the straws:**
    a. Make a cross with two plastic drinking straws.
    b. Tape them together so that the cross has four legs of equal length. Tape them securely enough that the straws are secure and do not move.



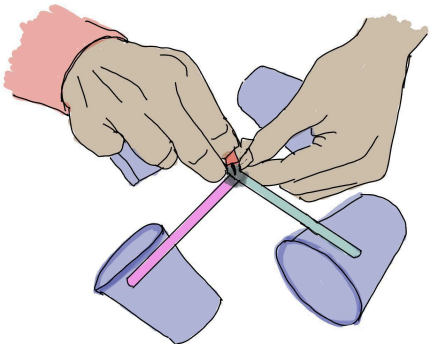
2. **Adding the cups to catch the wind:**
    a. Align one of the cups sideways on one of the extensions of the straw as shown in the diagram below. Shift the cups so that they tilt slightly upwards.



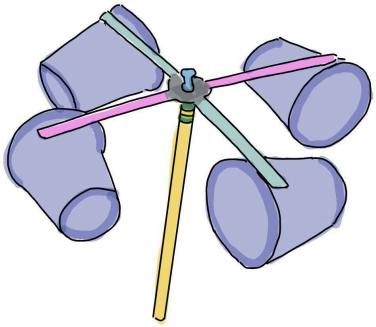
b. Use the tape to secure the end of the straw to the top surface of the cup. Make sure that the cup is taped securely enough to the straw that it does not wiggle.
c. Clearly mark the side of this cup with the sticker. This will be the lead cup that you will use to differentiate it from the other cups while it is spinning.
d. Repeat the steps to attach the other three cups. All four cups should be facing in the same direction.



3. **<u>Making the axle:</u>**
   a. Push the pin through the center of the straws.
   b. Use the pin to slightly widen the hole that the pin made in the straws by reinserting the pin and moving the pin in a back and forth and circular manner. This will allow the anemometer to spin more freely in the wind.

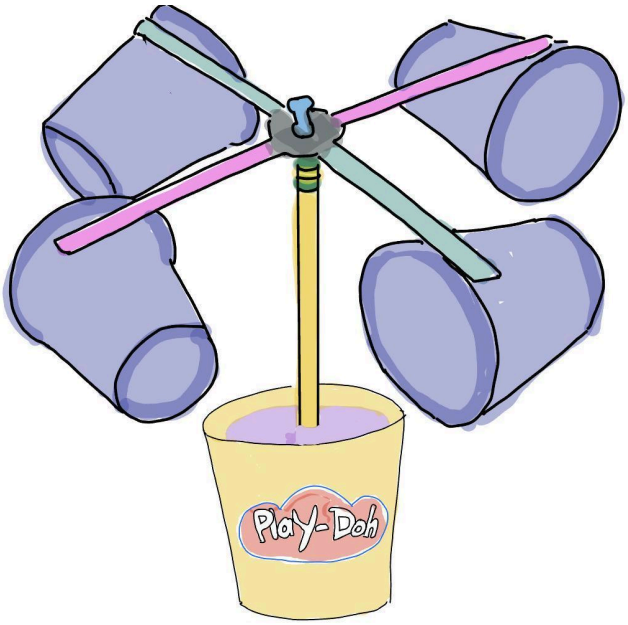


   c. Insert the pin into the eraser of the pencil. This will create the axle and provide something to help keep the anemometer attached to the base.



   d. Spin the straws several times, both clockwise and counterclockwise. This will allow the anemometer to spin more freely in the wind.
   e. If it does not spin freely, re-insert the pin into the hole and wiggle it again to make the hole larger. Repeat steps “c” and “d” to see if it spins freely.

4. **<u>Place the anemometer into the Play-Doh base:</u>**
    a. Open the Play-Doh container.
    b. Insert the pencil into the center of the Play-Doh until the bottom of the pencil reaches the bottom of the Play-Doh container.
    c. The Play-Doh will hold the anemometer upright in the wind.



    d. If you prefer, you can hold the anemometer in your hand when you are measuring wind speed.

Part B: CALIBRATE your Anemometer

5. **Calibrating your anemometer:**
    a. To calibrate your anemometer, you should hold your anemometer in your hand (so remove it from the Play-Doh.)
    b. On a windless day, have an adult drive you down the street at 10 miles per hour. The number of times your anemometer spins in 30 seconds will be consistent with a force wind blowing at 10 miles per hour.
    c. Hold the anemometer out the window and count the number of rotations in 30 seconds. Record your results in Data Table 1.
    d. Repeat the steps three more times so that you have four trials. Record your results in Data Table 1.
    e. Find the Average number of rotations.
        i. Add the four numbers together and record the total in Data Table 1.
        ii. Divide the total by 4 and record the average in Data Table 1.

Data Table 1: Anemometer Calibration (10 mph)	
Trial 1	
Trial 2	
Trial 3	
Trial 4	
Total	
Average number of turns for 10 mph	
Number of turns for 1mph	

    f. Find the number of turns for 1 mph.
        i. Take the average from Data Table 1 and divide that number by 10.
        ii. This is the number of turns for 1 mph. Record this in the bottom row of Data Table 1.

Part C: MEASURE WIND SPEED with your Anemometer

6. **<u>Using your calibrated anemometer to measure wind speed:</u>**
    a. Place (or hold) your anemometer in a source of wind.
    b. Count the number of revolutions the anemometer makes in 30 seconds. Record your results in Data Table 1.
    c. Repeat steps “a” and “b” three more times so that you have four trials. Record your results in Data Table 2.
    d. Find the Average number of rotations.
        i. Add the four numbers together and record the total in Data Table 2.
        ii. Divide the total by 4 and record the average in Data Table 2.

Data Table 2: Measuring Wind Speed	
Trial 1	
Trial 2	
Trial 3	
Trial 4	
Total	
Average number of turns	
Wind speed in mph	

    e. Find the wind speed in mph
        i. Take the average number of turns from Data Table 2 and divide that number by Number of turns for 1mph from Table 1.
        ii. This will give you the approximate wind speed in mph. Record this as “Wind Speed in mph” in the bottom row of Data Table 2.