

Date: _____

Name: _____

Invent Like an Engineer (Part 1) - Anemometer

This activity was created by Habiba and Sophia.

Imagine this:

You would like to start practicing for a kite flying competition later this year. But you know that you can only fly a kite if the wind is going at least 10km/h and no faster than 40km/h. Unfortunately, all the weather stations and apps are down for a mass update this summer, and there's no information about the wind available. You need to determine the wind speed on your own each day to see if you're able to practice kite flying this summer! How can you solve this problem?

In this activity, you will use your engineering and design skills to make an anemometer! An anemometer is a wind speed calculator. Based on the amount of time it spins, you can determine the wind speed. But first, you will need to build and calibrate it.

Materials

- 3 thin wooden dowels (skewers will work)
- 5 paper cups
- An empty water bottle
- Hole puncher
- Tape

Instructions

- 1 Ask an adult for help to punch holes in one side of four of the paper cups. Add a piece of tape or colour one of these cups so it's easily identifiable.
- 2 Ask an adult to make four evenly spaced holes around the fifth cup.
- 3 Slide two of the wooden dowels through the cup so it makes an "X" inside.
- 4 Add one cup to each end of the dowels and secure them with tape. Make sure the cups are all facing the same direction in the circle!
- 5 Take the third wooden dowel and poke a hole in the centre of the fifth cup. Slide it up until it touches the "X" you made before. This is the axis!
- 6 Place the middle dowel into the empty water bottle.

To Calibrate:

Ask an adult to drive down the street on a windless day at 20km/h and hold your anemometer out the window (if it's okay with the adult!). Count how many rotations the marked cup makes as it spins for 30 seconds. Now you know how many rotations it makes when going 20km/h.

Evaluate how consistent the machine is. Try calibrating five different times. Will it always make the same amount of revolutions each time? Find an average based on the five trials.

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| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 |
|---------------------|---------|---------|---------|---------|---------|
| Rotations at 20km/h | | | | | |

An average can be found by adding all 5 numbers together and dividing by 5.

Based on your calibration, you can now use the anemometer to determine if the wind is fast enough to fly your kite! For example, let's say the average rotations of your anemometer during calibration was 10 rotations. On a day when you do not know the wind speed, use your anemometer and find out how many rotations it makes, then use the following equation to determine the windspeed:

$$\text{Windspeed} = \frac{\text{Rotations on unknown wind speed day}}{\text{Average rotations from calibration}} \times 20$$

Criteria for Evaluation:

Some things to consider when evaluating the prototype:

- How well did it function? i.e. did it stand on its own?
- Did it spin consistently?

Write down some strengths and weaknesses you observed:

Based on these observations, what can be done to solve the problem efficiently? Think about the problem at hand. Is there an easier way to solve the problem? When considering your next prototype, do you want to modify the current model or create a new machine that has a similar function?

Evaluating the design:

Is there a way you can recreate this prototype using cheaper materials or other materials you might find at home? Could you list them below?

Are there other materials you can use to attach things that may be more effective? (ex. instead of tape)

What would you improve on this prototype so that the anemometer can be more efficient?

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Invent Like an Engineer (Part 2) - Pulley

This activity was created by Habiba and Sophia.

Imagine this:

You and your friend are socially distancing. They want to come over to play a fun game. Your friend will have to go in your basement, while you have to stay on the main floor. You want to be able to hand each other toys while you're on the main floor and they're downstairs, but you don't want to throw them, so they don't break. How can you solve this problem?

In this activity, you will use your engineering and design skills to make an elevator using a pulley! A pulley is a wheel with a grooved rim around which a cord passes. It acts to change the direction of a force applied to the cord and is chiefly used (typically in combination) to raise heavy weights.

Materials

- A plastic water bottle with its cap
- 2 pieces of cardboard cut in circular shapes of the same size
- Yarn
- Hot glue
- Wooden skewer
- Scissors

Instructions

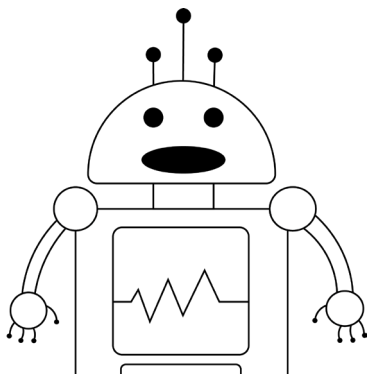
- 1 With the help of an adult, take the plastic cap off the bottle and punch a hole its center.
- 2 Cut a hole in the center of the two cardboard pieces.
- 3 Using the hot glue, glue the two pieces of the cardboard to each end of the cap.
- 4 Insert the skewer in the middle of the hole.
- 5 Using the scissors, cut off the bottom third of the water bottle to make a basket.
- 6 Cut two holes in the basket.
- 7 Cut a long piece of lanyard (however long you would like your pulley to extend).
- 8 Pass your string through the holes you created in the basket while passing the extended part through the bottle cap/cardboard piece through placing it on top of the cap.
- 9 Place the ends of the skewer on two high surfaces while having the middle part suspended.
- 10 Place an item in the basket and use the yarn to pull it with the help of your pulley.

Evaluating the design:

Is there a way you can recreate this prototype using cheaper materials or other materials you might find at home? Could you list them below?

Try placing a range of items with different weights in the basket. List the items you use below. Did it feel easier using a pulley to lift the heavier items, compared to directly lifting them?

What would you improve on this prototype so that the pulley can be more efficient?



Evaluation

is an important part of computer programming!

Evaluation is when a program's success is measured. For example, if you were testing a program that delivered results for math questions, some things you might evaluate for success would be how accurate the answer is or how fast does it take the program to get the answer. In this case, how would you measure your pulley's success?