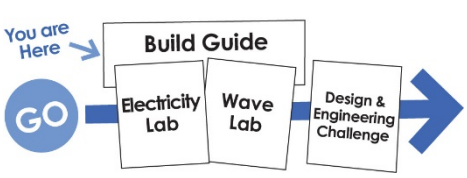
SUPER WIGGLE-BOT BUILD GUIDE & LABS



This is a real engineering project (not a toy). What does that mean? You get to design and build your own unique Super Wiggle-Bot, rather than just following directions.

STEM TRUE STEAM

VERSION:

- ☐ OUT OF THE CLASSROOM (SIMPLY DESIGN AND BUILD)
- ☑ IN THE CLASSROOM (LEARN WITH LABS, AS YOU BUILD)

Download classroom documents at **teachergeek.com/learn**

For use with TeacherGeek Super Wiggle-Bot Activity Pack, or Maker Cart available at **teachergeek.com**

Name: _____ Set: _____ Date: _____

The Lab

Let's have some fun and learn a little bit about *electricity*.

TEACHERGEEK COMPONENTS

Here's what you'll need to complete this part of the activity:

1 - Motor with Holder & Leads

3 - AA Batteries

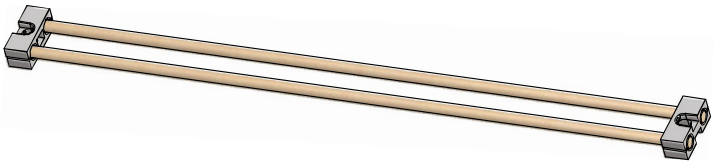
2 - Dowels (each at least 15cm (6") long)

2 - Blocks

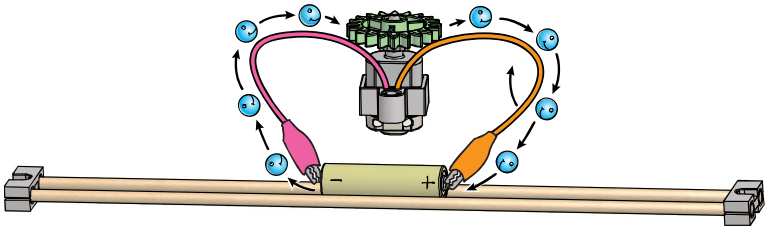
Other Materials (such as a metal wire, paper clips, connector strips, metal screws, etc.)

LET'S GET STARTED

1. Make a battery holder out of two **blocks** and two **dowels** as shown below.

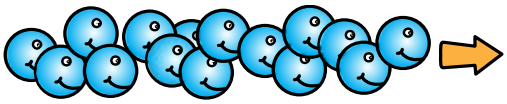


2. Run your **motor**. Touch your **motor leads** to the ends of a **AA battery**. The **motor** should turn on. Is it magic? Nope, it's *electricity*!



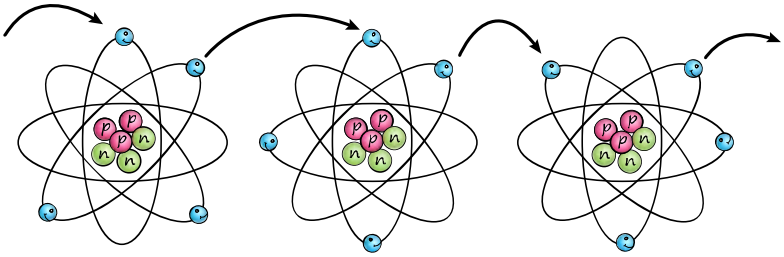
What is electricity?

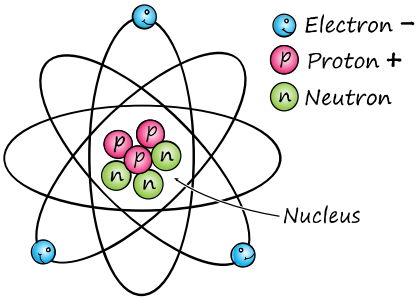
Electricity is the flow of *electrons* from one place to another. *Electricity* flows through your motor to make it run.



Electrons can move?

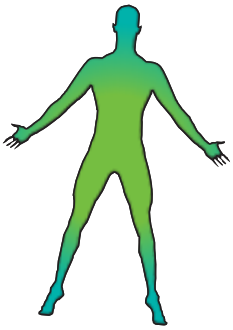
Yes! *Electrons* can move by hopping from *atom* to *atom*. *Electrons* are flowing through you right now; allowing you to think, feel, and move your muscles.



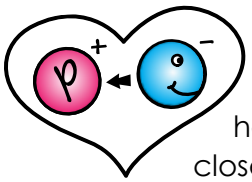


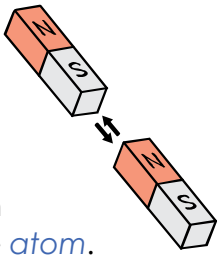
What is an atom?

Look around you. Every object is made of *atoms*. The average adult is made of around 7,000,000,000,000,000,000,000,000,000 *atoms*! How many *atoms* do you think you are made of?



Why do electrons move?



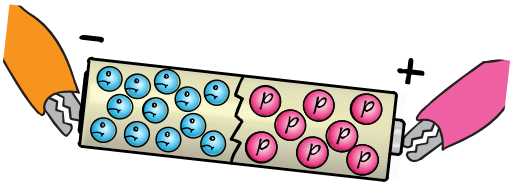


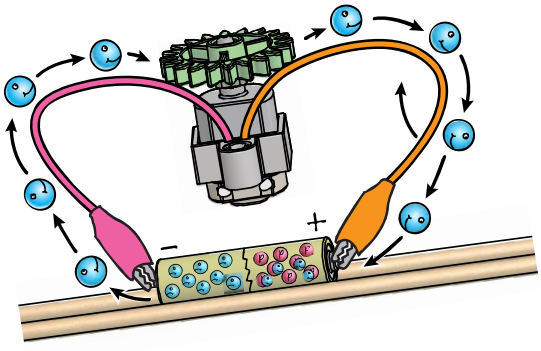
Have you ever heard the phrase "opposites attract"? Well, it's true. *Electrons* move because they are attracted to the oppositely charged *Protons*. *Electrons* have a negative (-) charge and *Protons* have a positive (+) charge. *Electrons* will do almost anything to move closer to a free *Proton*—even hop from *atom* to *atom*. Only *Electrons* can move. *Protons* and *Neutrons* (neutral charge) are stuck in the nucleus of the *atom*.

1. Fill in the blanks below with the parts of an *atom*.

An _____ has a negative (-) charge. A _____ has no charge. A _____ has a positive charge.

How does a battery work?





A chemical reaction inside a battery causes the *Electrons* to build up on one side of the battery (the negative side). A battery works because the *Electrons* want to get to the *Protons* on the positive side. However, the *Electrons* cannot travel inside the battery. They need an outside path to get to the *Protons*.

2. What makes the negative side of the battery negative?

_____

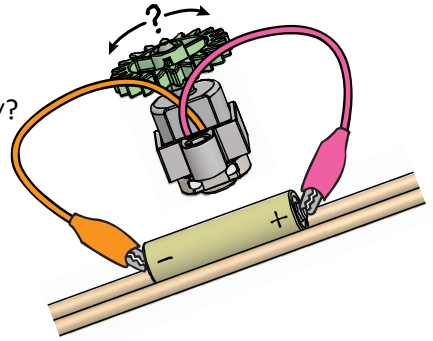
_____

3. What make the positive side of the battery positive?

_____

Where is the reverse?

4. Can you find a way to make your motor turn in the reverse direction? Does your solution have anything to do with the direction *electrons* flow? Explain how you turned the motor in different directions.



_____

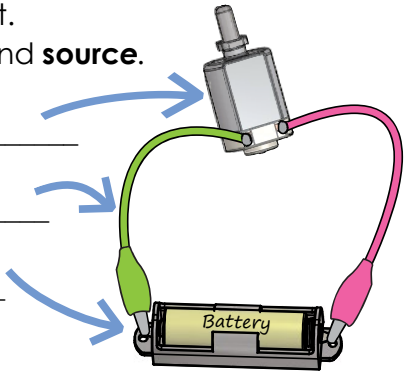
_____

5. Label the parts of the circuit.
Use the words **load**, **path**, and **source**.

_____

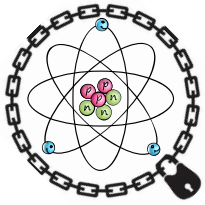
_____

_____



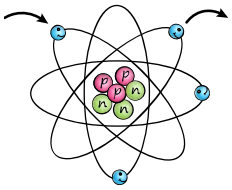
Circuit

*A circuit is a complete path for electricity to flow. In fact, you created one when you connected both leads of your motor to the battery. In a circuit, electricity flows from the **source**, through a **load**, and back to the **source**.*



Insulator

Insulators are materials that do not let Electrons easily flow through them.

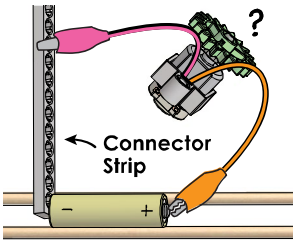


Conductor

Conductors are materials that let Electrons easily flow through them.

What can electricity flow through?

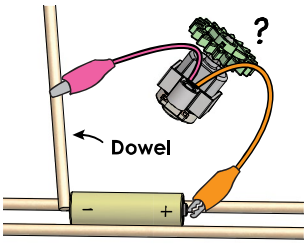
Test different materials to see if they are an *insulator* or a *conductor*. Put them between the battery and one of the motor leads. If the material is a *conductor*, then the *electricity* should flow through it and turn the motor on.



Is it a(n)… (mark your answer)

Insulator _____

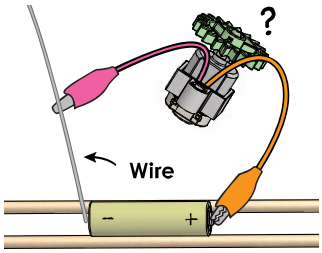
Conductor _____



Is it a(n)… (mark your answer)

Insulator _____

Conductor _____



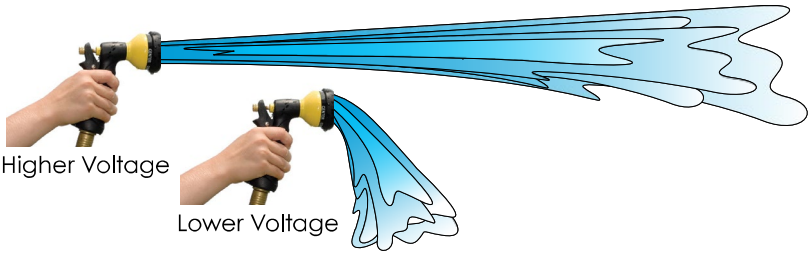
Is it a(n)… (mark your answer)

Insulator _____

Conductor _____

What is Voltage (v)?

Voltage is the pressure (or force) that pushes the Electrons and causes the flow of electricity. It's like water pressure. Look at the picture. The amount of water coming out of the nozzle is the same, but the pressure (or voltage) of the water is different. It is measured in volts.



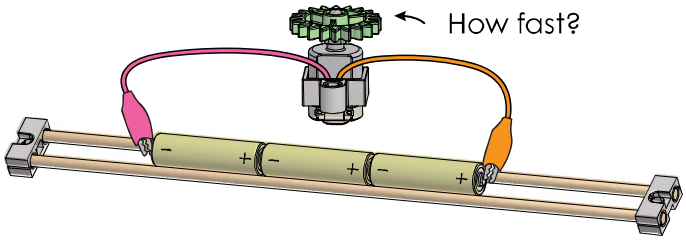
6. Look at your AA battery. How many *volts* does it produce?

_____

7. Approximately how many *volts* does a 9-volt battery produce?

_____

8. Feel the power! Put 2 or 3 batteries together. Make sure they are all facing the same way. How does this change the speed of the motor?



_____

_____

9. Create your own electrical experiment. Describe it below. Here are some ideas…

a. The graphite (black stuff) in pencils slows down electricity (lowers the *voltage*). Can use it to slow down a motor? You will need to make the *electricity* flow through it.
b. What happens if you hook up more than one motor to a battery. Does it matter how they are hooked up?

_____

_____

_____

_____

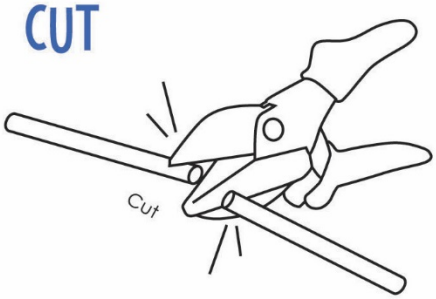
_____

BUILD GUIDE FOR SUPER WIGGLE-BOTS

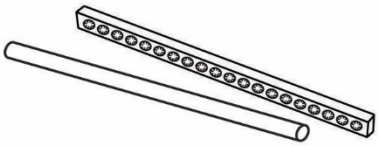
Designing and building your own unique Wiggle-Bot will take some out of the box thinking.
Use the TeacherGeek Quick Start guide below to help you make the most out of your components.

Don't worry, we will help you start your Wiggle-Bot on the next pages.

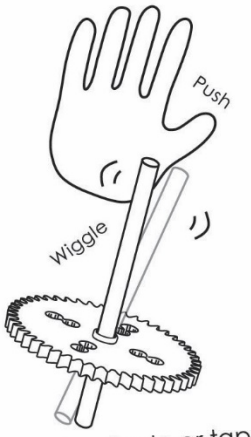
CUT



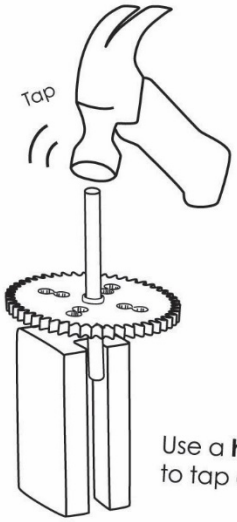
Multi-Cutters cut wood & plastic (like **dowels** and **connector strips**). They do not cut metal.



PUSH, WIGGLE, TAP



Push, wiggle or tap **dowels** into holes.



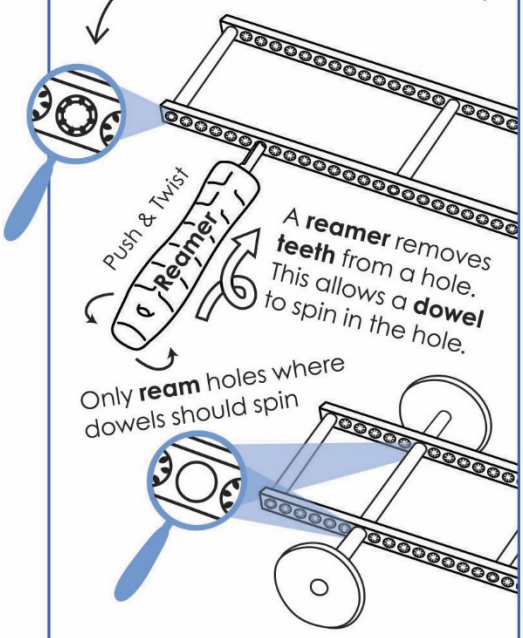
Use a **hammer** and **slider block** to tap **dowels** farther through holes.

QUICK TIP!

Use a crayon or soap on the end of a Dowel to make building easier.

REAM

Most parts have holes with **teeth**. The **teeth** hold **dowels** (keep dowels from falling out).



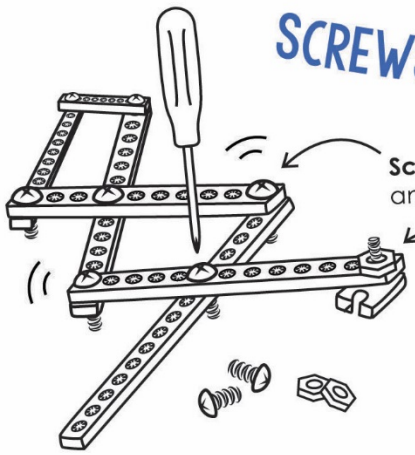
A **reamer** removes **teeth** from a hole. This allows a **dowel** to spin in the hole.

Only **ream** holes where dowels should spin

Never **ream pulleys**, **gears**, **wheels**, or any hole a **dowel** stays stuck into.

SCREWS & NUTS

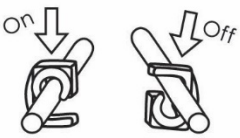
Do not **ream** holes you will put **screws** into.



Screws (without nuts) can connect parts, and allow them to rotate.

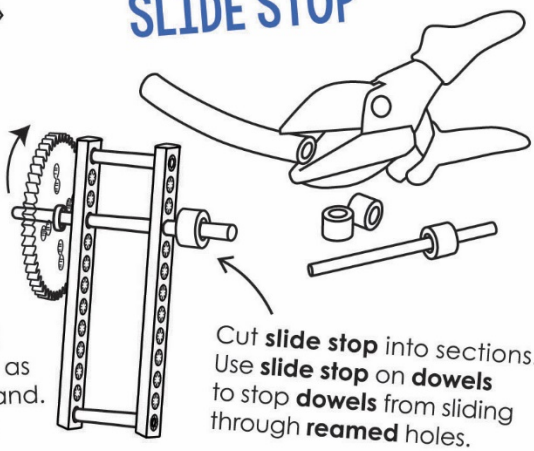
Screws (with a nut) can connect parts, and keep them from rotating.

STOP CLIP



Press a **stop clip** onto a **dowel** to keep it from sliding or use it as a hook for a string / rubber band. It takes little force to get it on.

SLIDE STOP



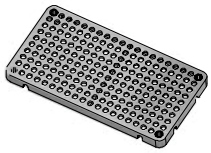
Cut **slide stop** into sections. Use **slide stop** on **dowels** to stop **dowels** from sliding through **reamed** holes.

TEACHERGEEK COMPONENTS

Below is the list of "ingredients" you'll need to build a Super Wiggle-Bot. It includes some extra components to allow you to make it into your own unique design.

2 - Connector Strips

8 - Dowels
4 - 30cm (12"), 2 - 15cm (6")
1 - 7.5cm (3"),1 - 5cm (2")



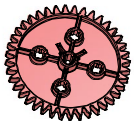
1 - Hole Plate

2 - 25mm Screws
#10 25mm (1")

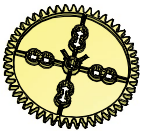
2 - Nuts
#10

1 - 10 Tooth Gear

1 - 20 Tooth Gear



1 - 40 Tooth Gear

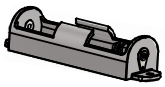


1 - 50 Tooth Gear

Please Note:
Colors of components will vary

3 - Blocks

4 - Steel Wire
30cm (12")



1 - AA Single Battery Holder

1 - Motor with Holder & Leads

TEACHERGEEK TOOLS

This isn't a kit. You're going to really build (cut, hammer, bend) your Super Wiggle-Bot. Here are tools you'll need to get started:

Multi-Cutter
(optional)
SKU 1823-81

Pliers
(optional)
SKU 1823-86

Hammer
(optional)
SKU 1824-41

Tapping Block
(optional)
SKU 1823-91

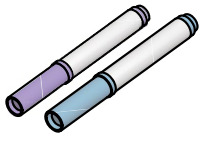
Or get the complete **TeacherGeek / Maker Tool Set**
Single SKU 1823-24
Class Set SKU 1823-85

MATERIALS YOU SUPPLY

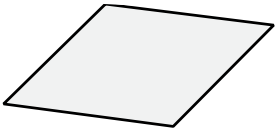
Tape

Recycling Materials
What else could you use for a Wiggle-Bot body?

AA Battery



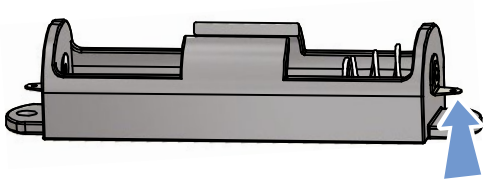
Markers
(for scribble-bots)



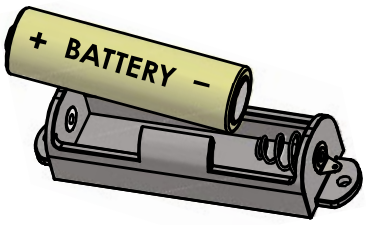
Large Paper or **Poster Board**
(for scribble-bots to draw on top of)

LET'S GET STARTED

1. Bend up the tabs on the **battery bolder**, if it is not already bent.



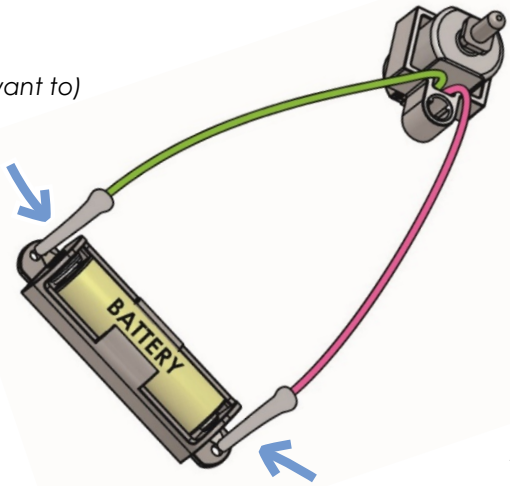
2. Put the battery into the **holder** with the flat side against the spring.

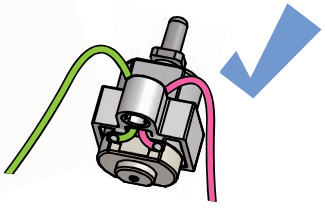


3. Connect the **motor** leads to the **battery holder** tabs. This should turn the motor on.

*Turn the **motor** off (when you want to) by disconnecting a **lead**.*

*Open **alligator clip leads,** by pinching, to attach and detach them.*

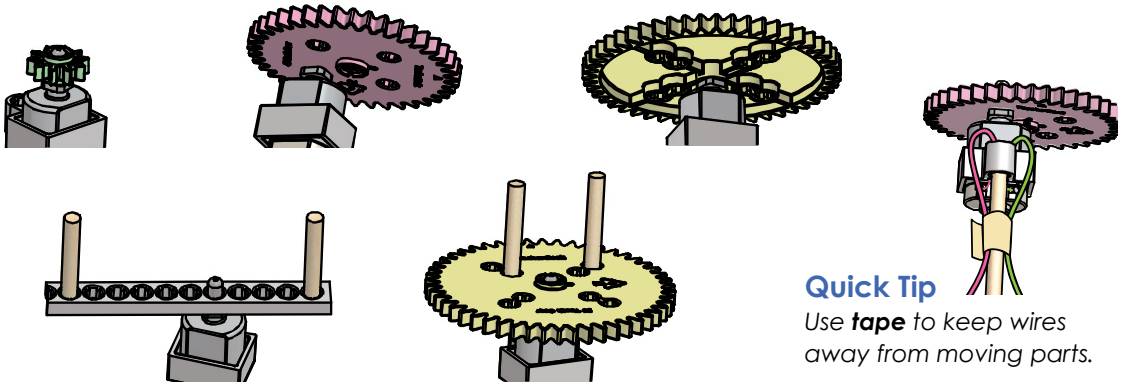




Make sure the wires go through the motor mount. If they do not, then they will break off.

MAKE IT SPIN

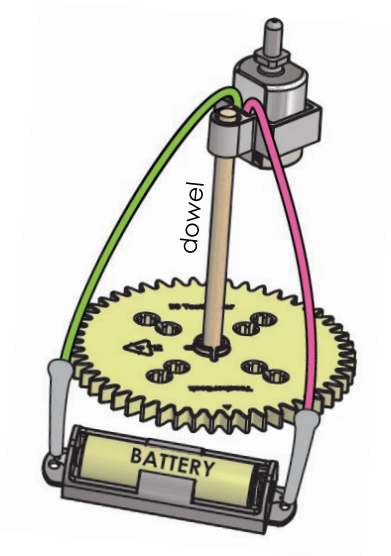
Attach different components to your **motor,** in different places. Can you make it vibrate slow or fast? Vibration (wobbling) can make your Wiggle-Bot move.

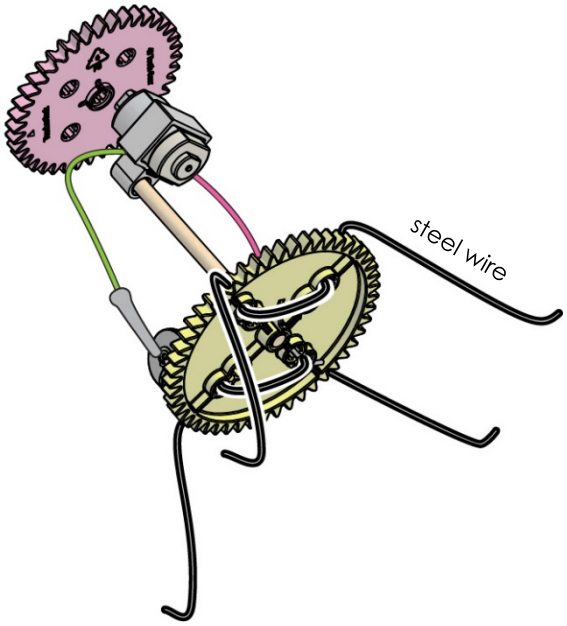


Quick Tip

*Use **tape** to keep wires away from moving parts.*

EXAMPLE WIGGLE-BOT DESIGNS





Idea #1
Attach the **motor** to a **dowel**. Then attach the **dowel** to other components, like **hole plates** and **gears**.

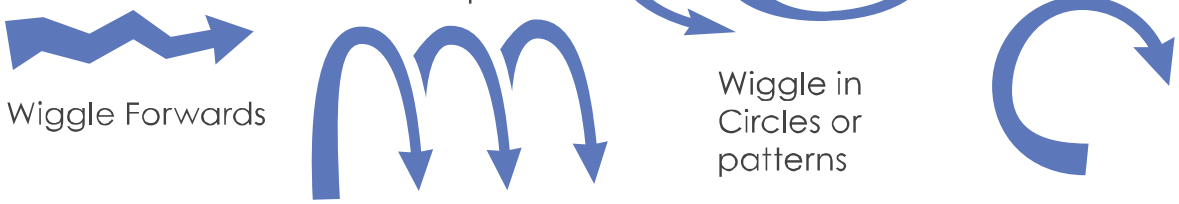
Idea #2
Use **steel wire** to create legs. Bend them to change how it wiggles.

Idea #3
Use other materials to add to and change your Wiggle-Bot.

KEEP EXPERIMENTING!

Keep improving and changing your design (there is no perfect design, every design can be improved).

Can you make it...

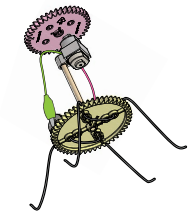


Name: _____ Set: _____ Date: _____

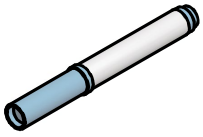
You will convert your built Wiggle-Bot into a Scribble-Bot for this activity. It does not need to look like the one in the picture below. It's better if it is your own unique design.

The Lab

Here's what you'll need to complete this part of the activity:

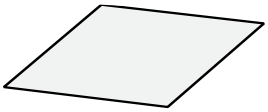


Built Wiggle-Bot



1 - Marker

Tape



Large Paper
or **Poster Board**

1 - AA Battery

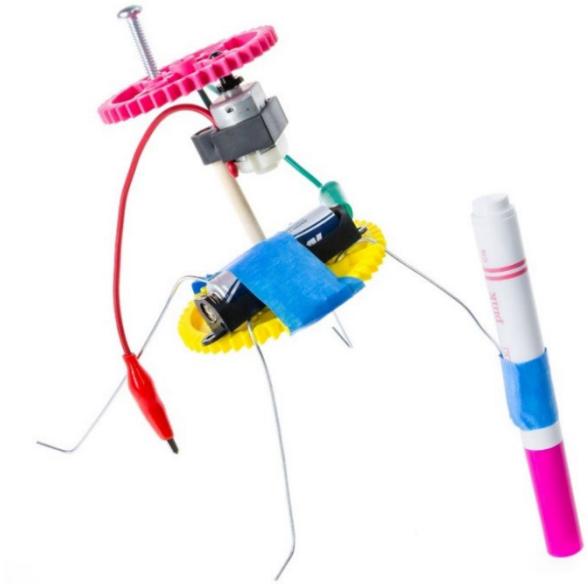
Scissors

Glue
(optional)

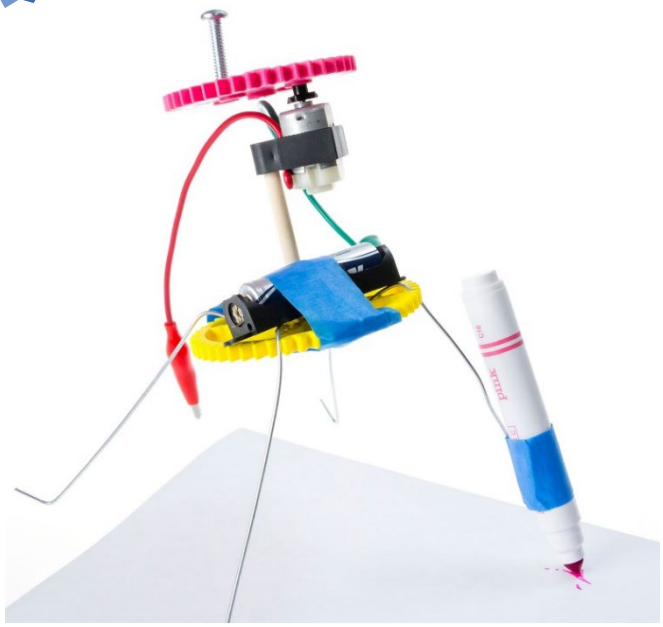
1 - Stopwatch
SKU 1824-15

LET'S GET STARTED

1. Turn your **Wiggle-Bot** into a **Scribble-Bot**. Using **tape**, attach a **marker** to one of the legs of your **Wiggle-Bot**.

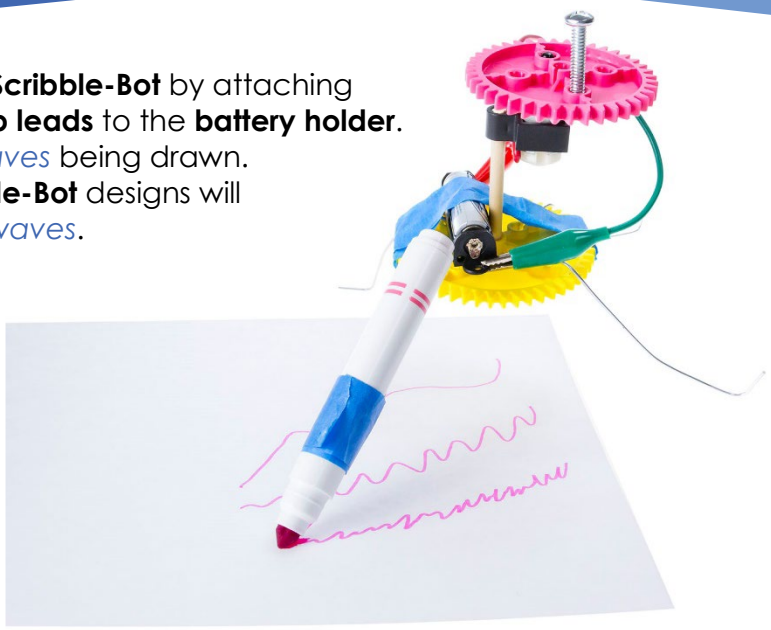


2. Uncap the **marker** and place on top of a **large piece of paper** or **poster board**.



SUPER WIGGLE-BOT WAVE LAB

Power on your **Scribble-Bot** by attaching the **alligator clip leads** to the **battery holder**. Observe the *waves* being drawn. Different **Scribble-Bot** designs will draw different *waves*.

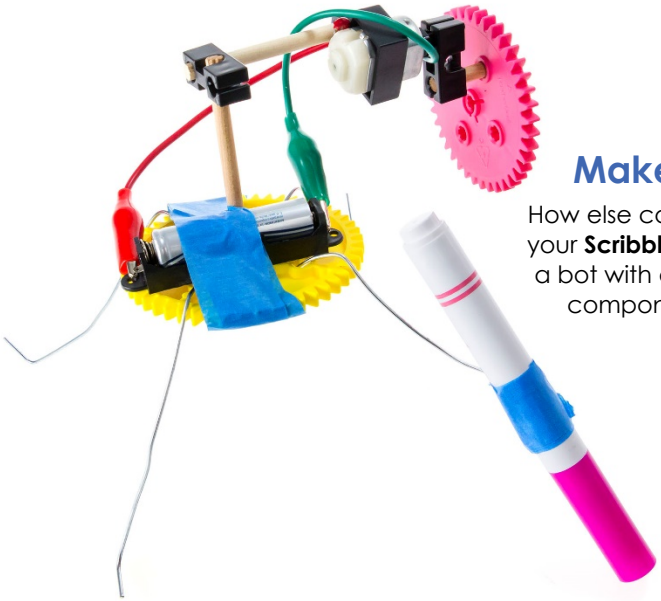


DO THE WAVE

Changes in your **Scribble-Bot** will result in changes to the *wave frequency* and *amplitude*.

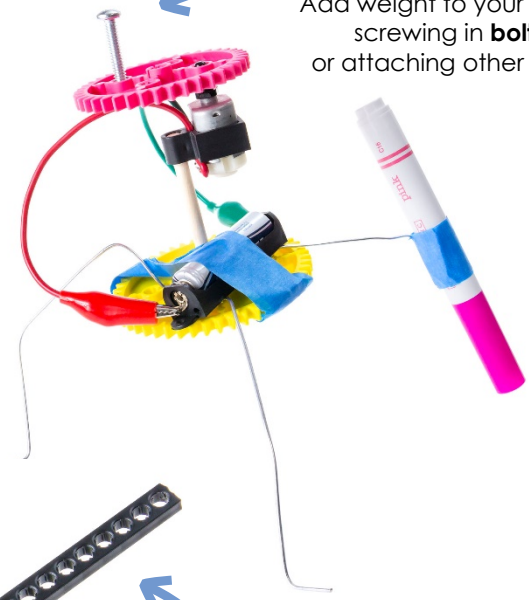
Make it Short

Bend the **wire** legs to shorten or lift them up off the paper entirely. How about building a three-legged bot?



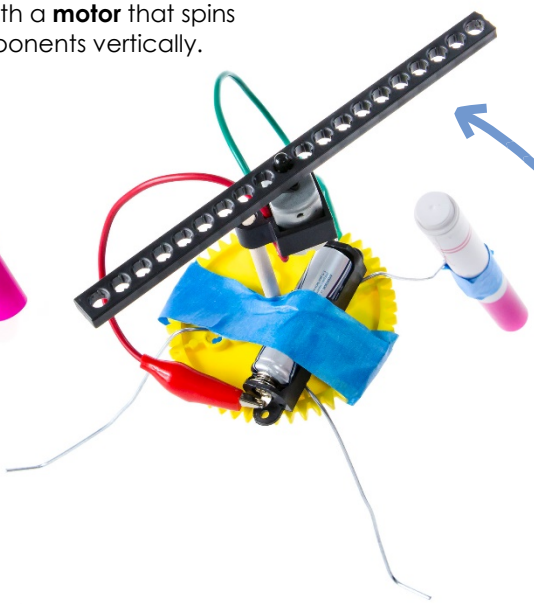
Make it Heavy

Add weight to your bot by screwing in **bolts**, or attaching other parts.



Make it Again

How else could you construct your **Scribble-Bot**? Try building a bot with a **motor** that spins components vertically.



Add & Replace

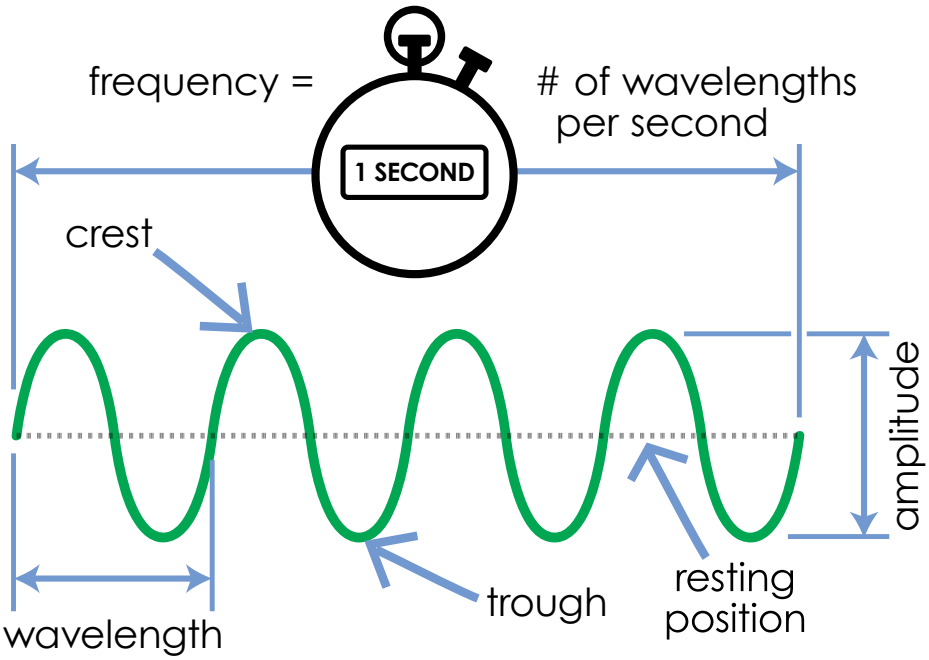
Change your **Scribble-Bot** design using other TeacherGeek components or recycling materials.

Better Marks

Does the marker come off the paper? Are the scribbles short or small? Try making your **Scribble-Bot** heavier and wider. Add weight to it or change what is spinning.

What is a wave?

A *wave* is a regular pattern of motion. You can find *waves* all around you! Ripples in a pond, ocean waves crashing along a beach, even light and sound travel in *waves*.



Crest

The *crest* is the highest point, or peak, of a *wave*.

Trough

The *trough* is the lowest point, or valley, of a *wave*.

Resting Position

The *resting position* is the midline, center or middle of a *wave* (shown as a dotted line).

Wavelength (λ)

Wavelength is the distance a *wave* travels from a complete cycle: one full *crest* and one full *trough*. *Wavelength* is shown as λ.

Frequency (f)

Frequency is the number of *wavelengths* per second. The illustration above shows the number of waves passing in one second.

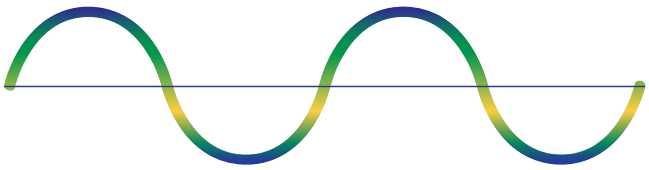
1. How many *wavelengths* are shown above? _____

2. What is the *frequency* of the wave shown above? _____

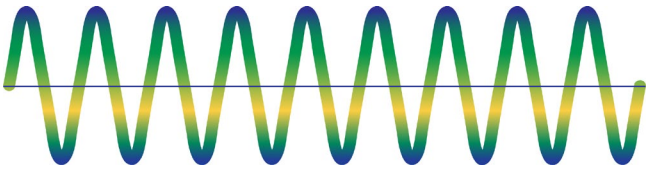
Amplitude (a)

Amplitude is the height of a full *wave*: from the peak of the *crest* to the valley of the *trough*. The greater the *amplitude* of a *wave*, then more energy it is carrying. The lower the *amplitude*, the lower the energy *wave*. *Amplitude* is measured in meters.

Change the Frequency



Low *Frequency*



High *Frequency*

3. Re-Design your **Scribble-Bot** to draw the **lowest frequency** *wave*. How low can you go?

My **Scribble-Bot's** – Lowest *Frequency Wave*

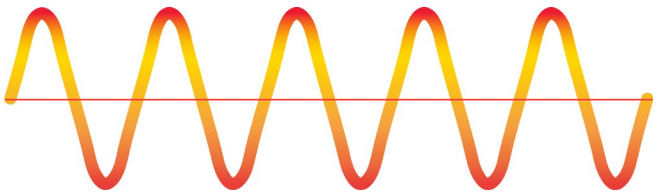
Cut and paste (or tape) a paper with your Wiggle-Bots lowest frequency scribbled wave.

4. Re-Design your **Scribble-Bot** to draw the **highest frequency** *wave*.

My **Scribble-Bot's** – Highest *Frequency Wave*

Cut and paste (or tape) a paper with your Wiggle-Bots highest frequency scribbled wave.

Get "Amped"



High *Amplitude*

Low *Amplitude*

5. Re-Design your **Scribble-Bot** to draw the **highest amplitude** *wave*.

My **Scribble-Bot's** – Highest *Amplitude Wave*

Cut and paste (or tape) a paper with your Wiggle-Bots highest amplitude scribbled wave.

6. Re-Design your **Scribble-Bot** to draw the **lowest amplitude** *wave*. How low can you go?

My **Scribble-Bot's** – Lowest *Amplitude Wave*

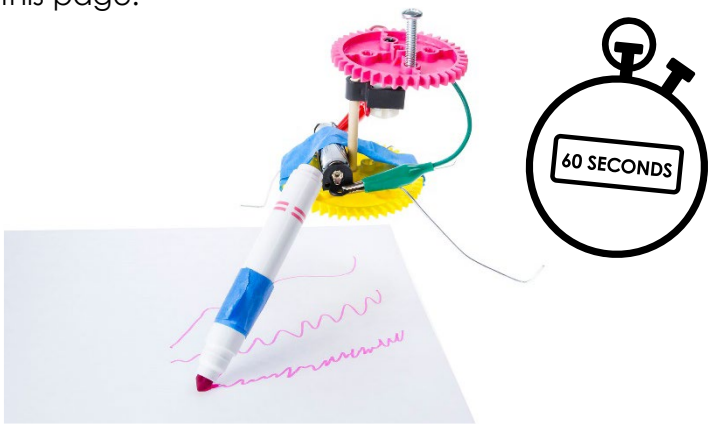
Cut and paste (or tape) a paper with your Wiggle-Bots lowest amplitude scribbled wave.

Calculate the Frequency of your Scribble-Bot

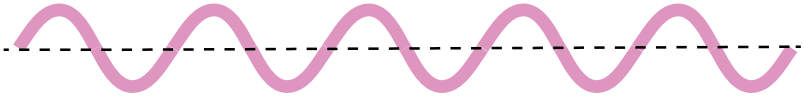
Cut and paste (or tape) a paper with your Wiggle-Bots 60 second scribbled wave.

If it is too big to put here, attach it to this packet.

7. Get your **Scribble-Bot** so it makes a good looking wave (a wave that looks a little bit like the one below). Time it, so that it scribbles for 60 seconds. Cut the 60 second scribble and paste it at the bottom of this page.



8. Draw the *resting position* of your wave with a dotted line (in the center of the wave) and count the number of *wavelengths* (scribbles) it drew. Remember, one wavelength is one full *crest* and one full *trough*.



This example has *wavelengths*: 5

9. How many *waves,* did your **Scribble-Bot** draw in 60 seconds:

_____

10. Calculate the *Frequency* of your **Scribble-Bot**.

_____/ 60 = _____

11. Measure the *amplitude* of the **Scribble-Bot** *wave* above

_____ millimeters

12. Label the *crest* of the **Scribble-Bot** *wave* above.

13. Label the *trough* of the **Scribble-Bot** *wave* above.

14. Name your **Scribble/Wiggle-Bot**

_____