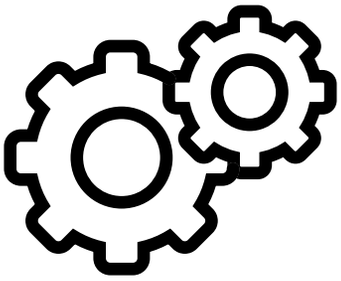
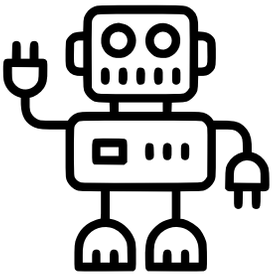
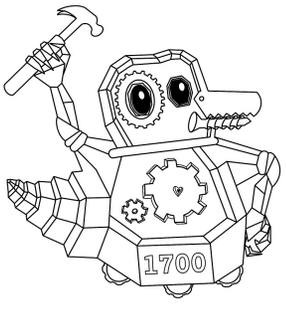


Gear up!



_____'s design journal!

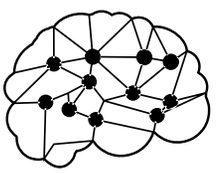
DESIGNING FOR CHANGE



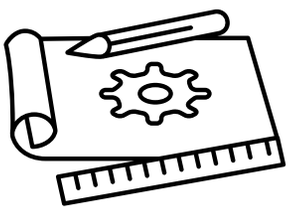
The Game Plan

Step 1: Understand

Step 2: Brainstorm

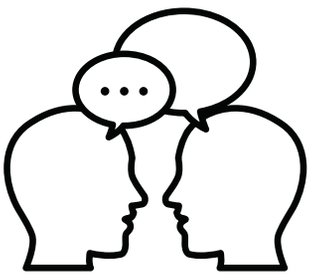


Step 3: Prototype



Step 3: Feedback

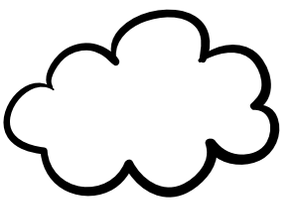
Step 5: Share



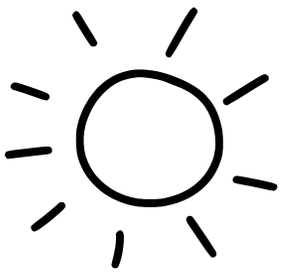
Step 1: Understand

- When designing new products, we want to ensure that they will be useful. In order to build the most useful product, we need to fully understand the challenge we are trying to solve.
- For this project, we will be working on robots that can help fight **climate change.** Before we figure out what we want our robots to do, we have to understand the problems we want to solve.

First, what is climate change?



"Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time.



NASA scientists have observed Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years."
- NASA Climate Kids

Why is it a problem?

As the earth gets warmer, sea levels are rising, mountain glaciers are shrinking, and the land is getting drier. Weather is also getting stranger, droughts are getting more serious, and massive storms are becoming more frequent. People's homes are getting washed away in floods and farmers are having trouble growing enough food for everybody.

Research Roundup!

Let's learn more about what causes climate change, so we know what we want our robots to do!

What causes climate change?

Climate change is caused by a buildup of **greenhouse gases** in the atmosphere.Here are a few actions that produce carbon dioxide:

1. Burning fossil fuels (like coal, oil, or gas) makes electricity, which produces greenhouse gases.
2. Most transportation (cars, planes, buses, and more) make greenhouse gases
3. Heating and cooling systems like air conditioning, refrigerators, and heaters produce greenhouse gases
4. Raising animals on farms, food waste, and trash deposits like landfills can also produce greenhouse gases

Can you think of some more ways humans produce greenhouse gases?

- _____
- _____
- _____
- _____

Stuck? Think: What are some ways we use electricity?

Understanding effects

Once we have an idea about what may cause climate change, let's start thinking more seriously about the effects of climate change.

As the planet warms, the oceans are rising, the polar ice caps are melting, and the balance of our natural world is thrown off. These changes have a ripple effect that can be felt all around the world.

Can you think of some specific effects of climate change? Try to list at least 4, and remember, they don't only have to affect humans— animals are struggling, too.

- *ex: Droughts in California make it harder to grow food*
- _____
- _____
- _____
- _____

Who might be affected by these challenges? Think of at least three groups (could be humans or animals!) and list them below:

- _____
- _____
- _____

Research!

Research tip:
Know where your information is coming from! If you're reading a book, look at the author's biography. *Who are they and how do they know what they've written?* If you are using online resources, check your website. *Who is publishing this and why?* Not everything you read is true! If you're having trouble looking for good sources, look for government or university publications.

Your turn! Pick 2 causes and 2 effects of climate change that you listed above and do some more research to answer the questions below.

Cause 1: _____

Why is this a problem? What are the effects?

_____

What's being done to fix it?

_____

_____

What source did you use? (website name, book title, etc.)

_____

Cause 2: _____

Why is this a problem? What are the effects?

_____

What's being done to fix it?

_____

_____

What source did you use? (website name, book title, etc.)

_____

Effect 1:

Why is this a problem? What is causing it?

_____

Who does this issue affect?

_____

_____

What source did you use? (website name, book title, etc.)

_____

Effect 2:

Why is this a problem? What is causing it?

_____

Who does this issue affect?

_____

_____

What source did you use? (website name, book title, etc.)

_____

Let's Synthesize!

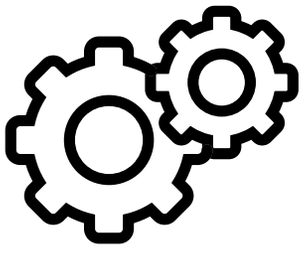
**to synthesize is to combine and clarify your thoughts*

Was there a common theme between your causes or effects?

Why haven't these issues been solved? What's getting in the way of progress?

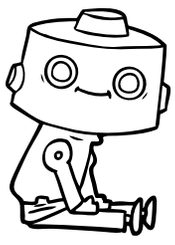
What is one specific issue (a cause or an effect) that you would like to focus on to build your robot?

Why are you picking this issue? Why is it important to you?



Step 2: Brainstorm

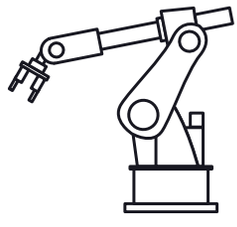
Now that we've got an issue to solve, and we've done some research into it, it's time to think about solutions! Come up with at least 4 robots to solve your challenge and sketch them below! Don't worry about being perfect, these are just quick drawings!



1)

2)

3)



4)

Label each of your sketches with a name or a short description!

Feedback is fun!

Now that you have some fantastic ideas, it's time to pick a few to move forward with.

Find a friend and explain your 2 **favorite ideas:**

- Listen to their questions and ask for feedback: how would they improve your design?
- Give them feedback on their top 3 as well! Focus on constructive and positive comments. Be specific, don't just say "Cool!" tell them which part was cool and which part you'd do differently.
- It's important to get feedback because we all have different perspectives- your friend may make you think about something in a whole new way!

What are 3 ideas your friend had to improve your ideas?

1. _____
2. _____
3. _____

More time? Find another friend and get more feedback!

_____

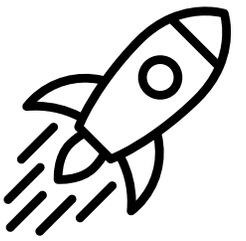
_____

_____

_____

You never have to use feedback, but it's a good idea to listen and consider other's ideas, just in case you missed something!

Design away!

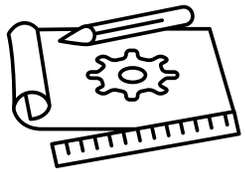


Consider your feedback and pick one design that you think will most effectively solve your challenge. Sketch your idea below, it can be different than the idea you originally came up with! Sometimes you can even mix and match pieces of multiple designs and ideas to make a new design entirely.

Come up with a fun name for your design:

_____

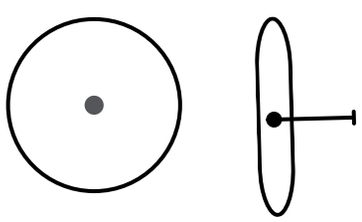
Step 3: Prototype!



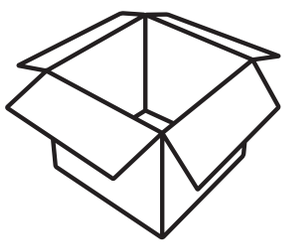
Now it's time to bring your design to life! Before engineers build a full size product, they build a practice product called a prototype. Prototypes are usually smaller and less fancy than real products so engineers can play around with details and make sure they end up building the best version of their design.

It's your turn to prototype!

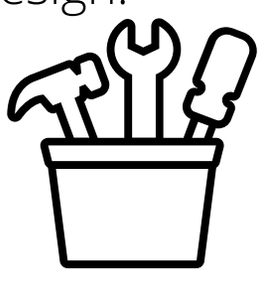
The following chart can help plan your build:

What do you want it to do?	How will it work?	Sketch it quickly
example: drive around	*Wheels!*	

Prototypes can give you an idea of how different parts and pieces work together; if a prototype is really not working out, it may be time to make some changes in your design.

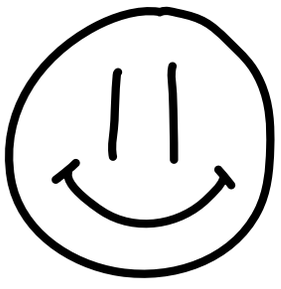


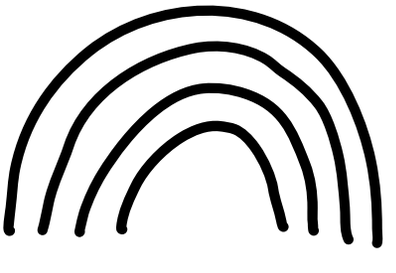
Time to build!

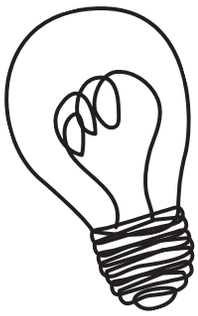


Doodle page!

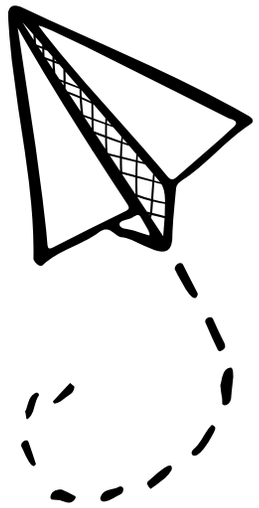
You can also use these pages as scratch paper for prototype sketches!







Get creative!



Prototype reflections

Nice job with your first prototype! Let's do some reflection to see how we can improve!

What went well with your prototype?

What could've gone better with your prototype?

What changes do you want to make with your design? What could you add to the next version?

Intro to Electronics

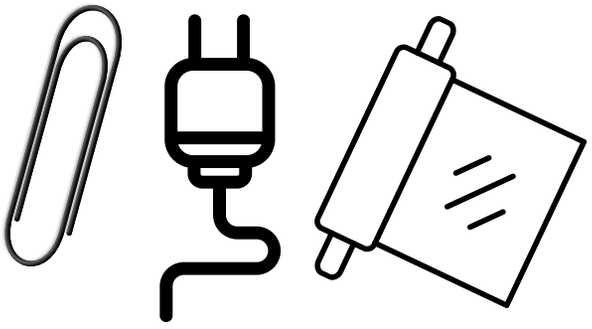
also known as the fun stuff!

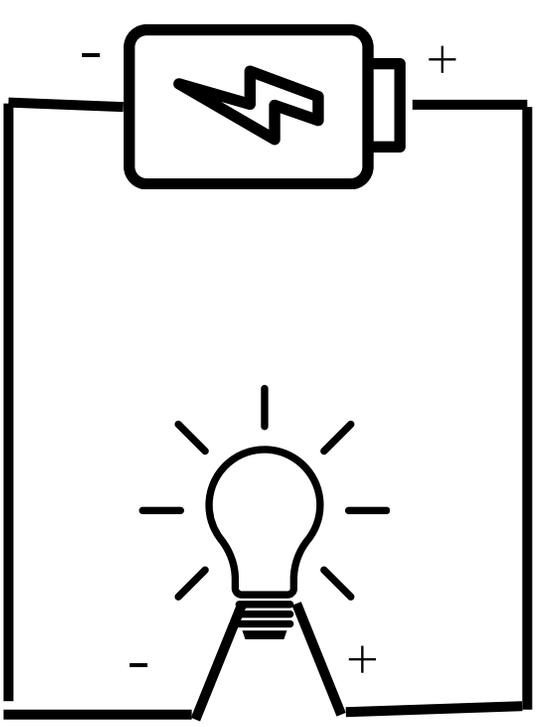
You may have parts in your prototype that you want to be able to move or light up, how do we do that?

We can use electronics!

Electronics is the study of how to control the flow of electricity, called electric charge, using circuits. Lots of everyday items use electricity to operate (lights, phones, X-rays, and more!)

Conductors are materials that allow charge to flow through them. Some example conductors are wires, tin foil, paper clips, and most metals.

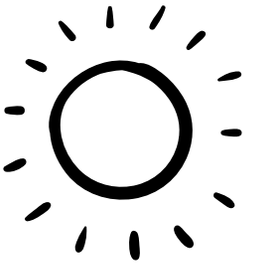




A circuit is a closed loop where charge can flow, a complete path of conductors with a power source and something to be powered. A power source, like a battery, sends a positive charge through conductors to reach the load, or the thing that uses the power. Negative charge then returns to the power source. Power sources can be batteries and the load is often lights or a motor of some kind.

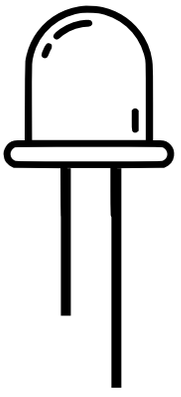
Light up your world!

So how do we make things **light up**?



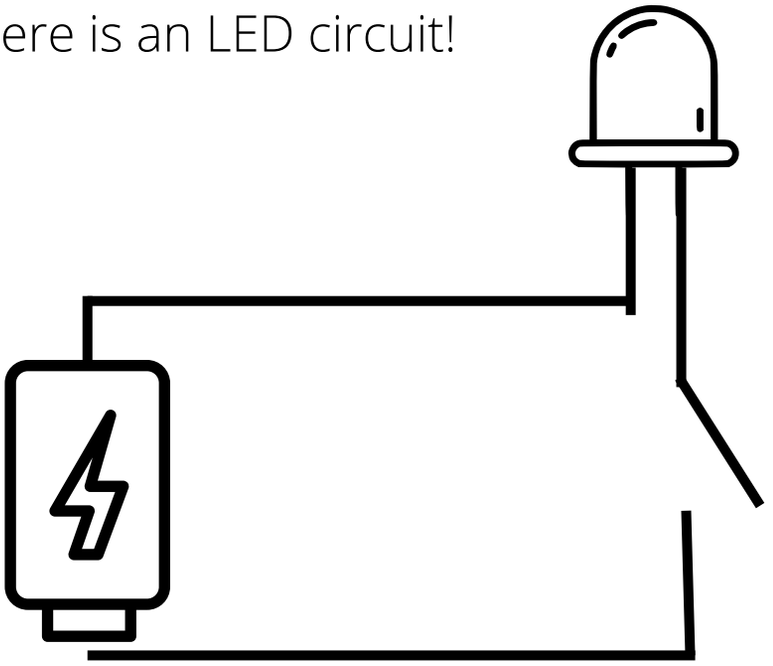
We can connect lightbulbs in a circuit to incorporate light. One cool kind of lightbulb is an LED, which stands for Light Emitting Diode.

Below is a diagram of a small LED:



Each leg needs to be connected into the circuit for charge to flow through the LED. If charge flows through, it will light up!

Here is an LED circuit!



When these two wires connect, the circuit will close and the LED turns on. While they are separated, charge cannot flow and the LED is off. This creates a natural on/off switch for the circuit.

Designing with LEDs

Where would you put an LED into your design to help your product light up?

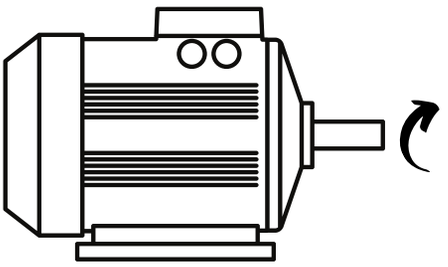
1. Sketch your design with where you want your LED. Think: what purpose will your LED serve? How will it benefit the person using your device?

2. Where will the battery be and how will you wire it? Draw that into your picture as well. Think: where can you put an on/off switch in your circuit?

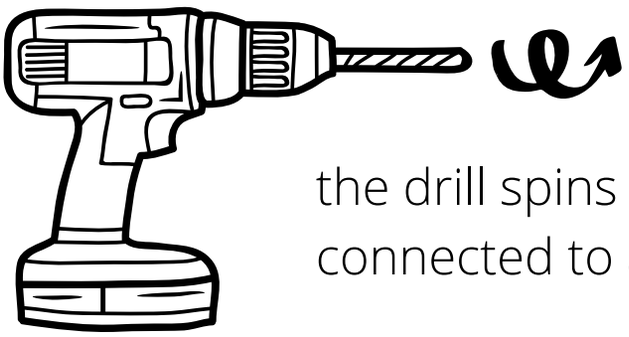
Designing for motion

So how do we make things **move**?

We can connect motors into our circuits which spin when charge flows through them.



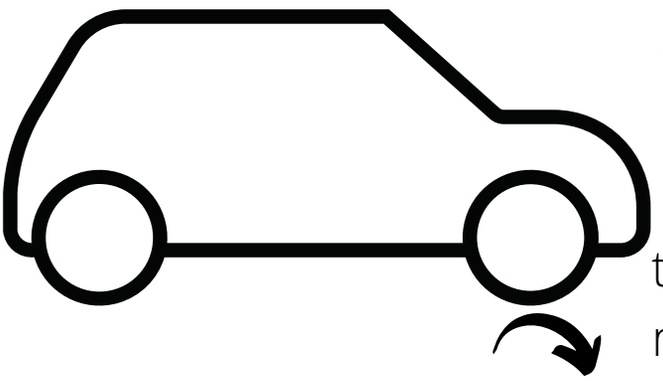
If we want something to spin, we put it on a motor, like a drill:



the drill spins because it's connected to a motor

If we want something to move forward, we attach a motor sideways, like a car:

the car moves forward when the wheels spin



the wheels are attached to a motor, so they spin forward

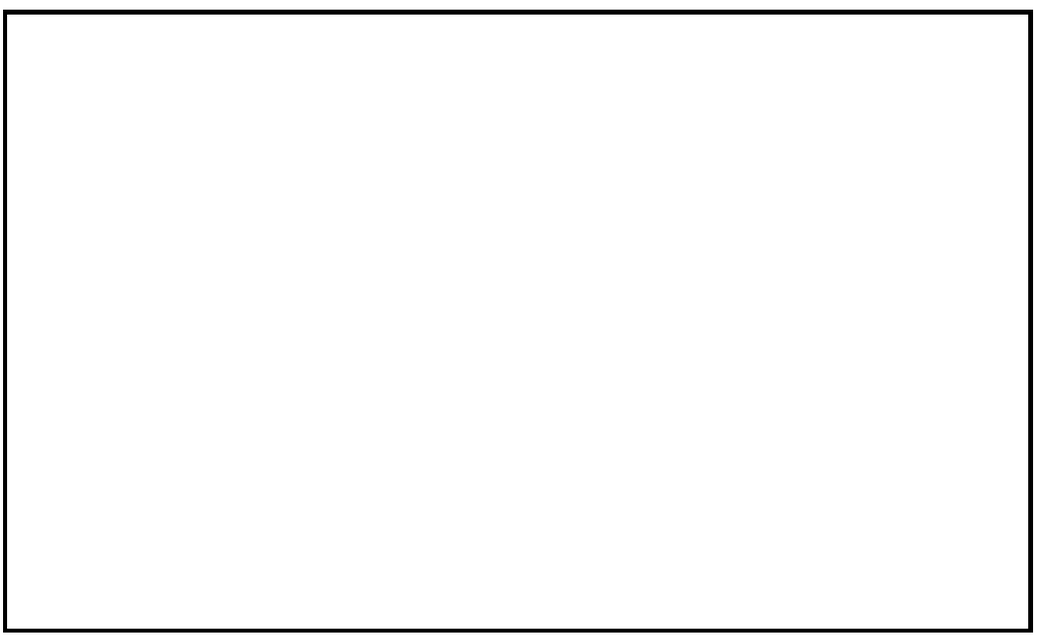
A car is a good example of how we translate the rotational movement (spinning motion) of a motor to linear motion (forward and backwards).

linear vs rotational

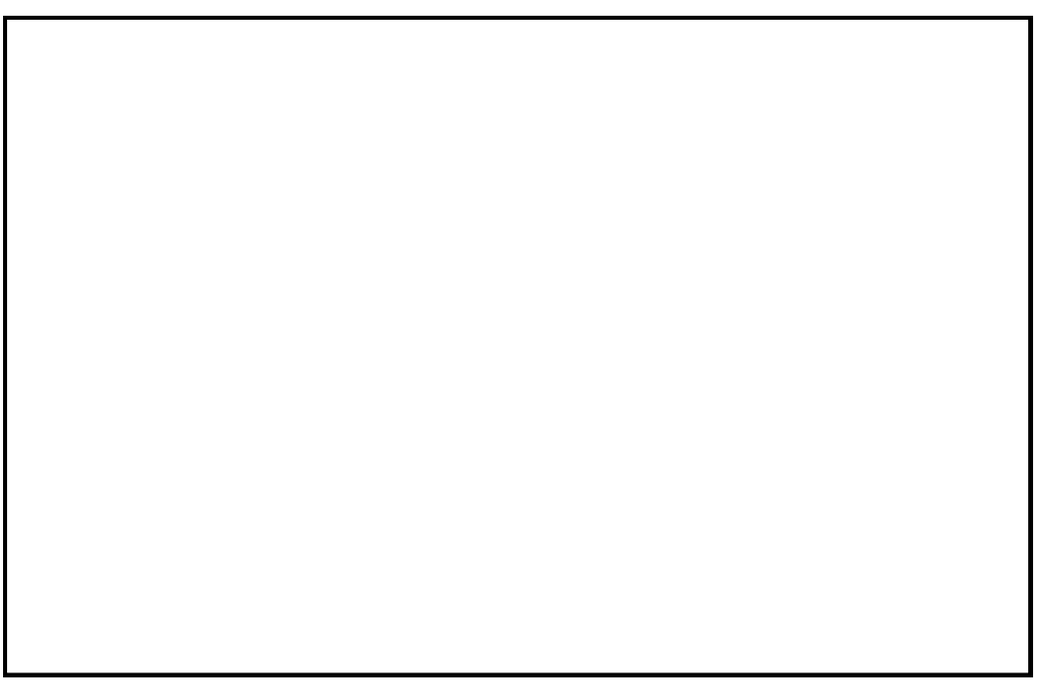
Designing with motors

Where would you put a motor into your design to help your product move?

1. Sketch your design and draw an arrow indicating the direction you want it to move. Think: is it rotational or linear motion?



2. Add a motor and circuit into your drawing. Think: where could the battery go? How would the circuit connect?



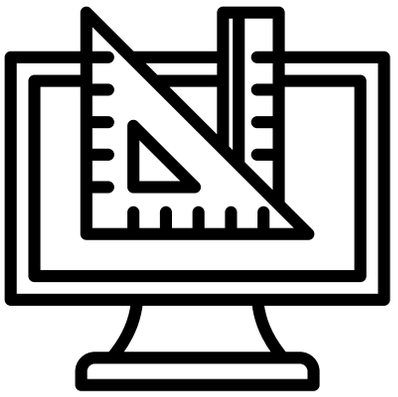
Let's get digital!

Another way engineers practice building is by designing their products online using CAD technology. CAD stands for Computer Aided Design, and it basically means an online, 3-dimensional model of your design!

Why do we use CAD?

- To practice building and ensure the whole product will work the way we want it to.
- Paper sketches only give us 2 dimensions, while CAD can give us 3 dimensions!
- Using CAD, you can model your product with the real materials at no extra cost.

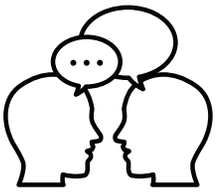
Let's use TinkerCAD to CAD our own designs!



Fun fact: CAD also allows multiple engineers to work on the same project; they can share files more easily than they can send physical prototypes!

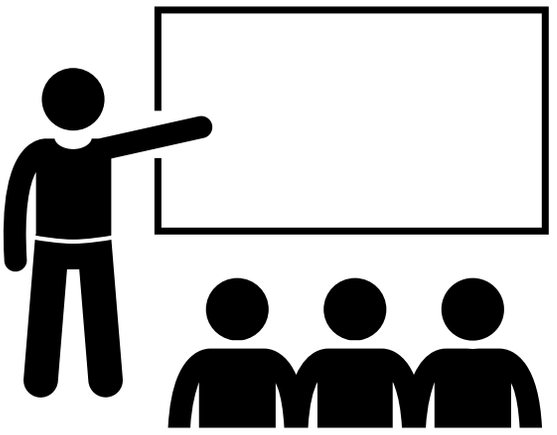
There are many different types of CAD softwares, ranging from simple to extraordinarily complex at the industry level!

Step 4: Share!



Now that we have spent some time prototyping, it's time to present (tell other people) about our ideas. If we want to help solve climate change issues with our robots, we need to show them what our robot can do!

Sometimes talking to people can be scary, but it's okay to be nervous. Take a deep breath and remember that all you're doing is showing people how cool your robot is!



Presentation tips:

- Practice practice practice. Practice what you will say when you present! Use the next page to plan it all out
- Speak loudly and slowly! Make sure everyone in the room can easily hear you and understand what you are saying.

There are many different types of presentations. Sometimes it's useful to make a slide deck and present in a meeting, and sometimes its more useful to casually speak with your friends. There is no one right way to share your ideas.

Telling your story

Answer the following questions, and use them as notes during your presentation!

First, introduce yourself, your issue, and your research:
Say, "Hi, my name is _____ and I worked on solving _____. Through my research I found that this issue affects _____ because _____."

Next, explain your robot. Explain how your robot works to solve the challenge:

_____

_____

Now, explain how you used your light and motor. Where are they and what do they do?

_____

_____

Finally, what is one thing you would do differently in the final, real robot? What could work better?

_____

_____

_____

Ask if anyone has any questions about your robot!
After you answer the questions, say thank you!

Additional Notes

Use the extra space if you need it for more notes or sketches:

This journal was produced by Gatorbotics Robotics Team at Castilleja School

GATORBOTICS