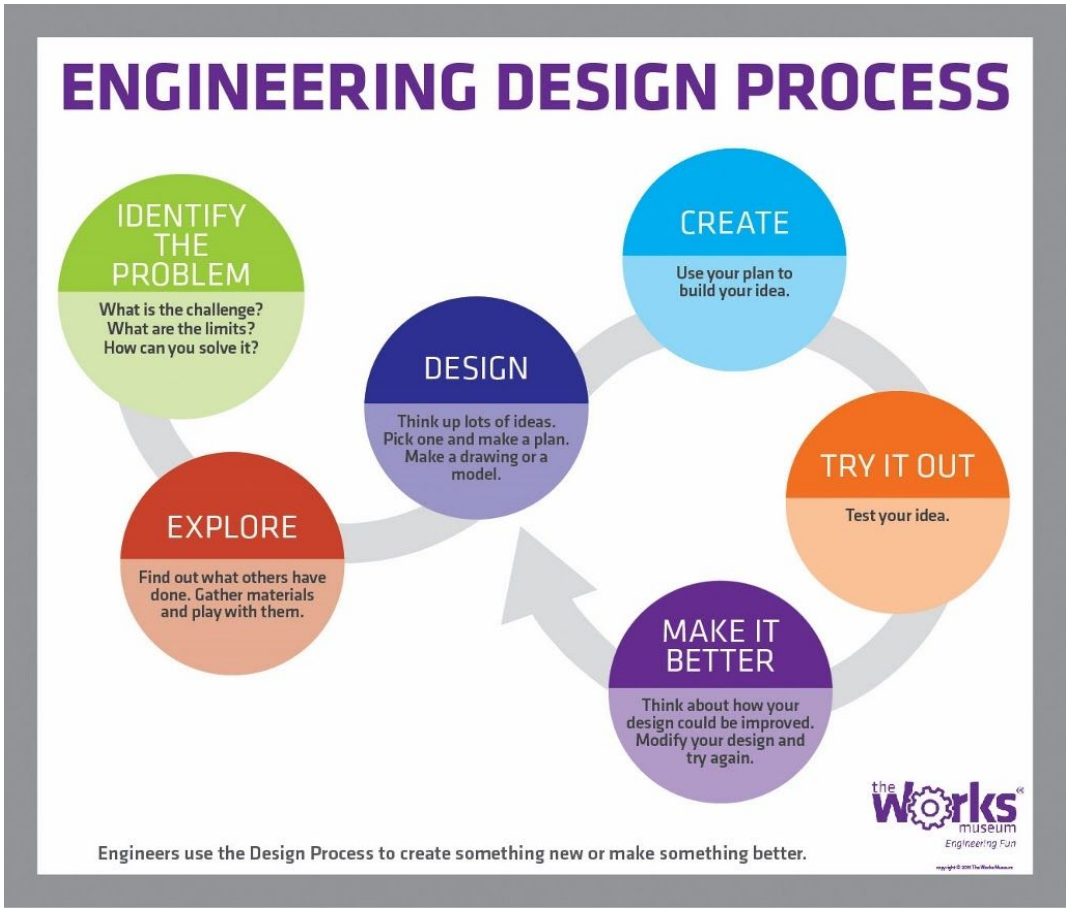
STEAM Kit-Vibrobot/Artbots

Have you ever noticed that if you leave a cell phone sitting on a table in "vibrate" mode and it rings, it will move around (and maybe even fall off the table)? The cell phone has a tiny vibrating **motor** inside that makes it buzz. The same motors are used inside video game controllers to make them rumble. You can use these motors, along with tiny **batteries**, to make **vibrobots**, or tiny robots powered by vibrations.

Since they are powered by a single vibrating motor, vibrobots are not very easy to steer. They tend to bounce around randomly. However, how you design and build the robot's body can have a big impact on how it moves. You can build fast robots and slow robots, robots that go straight and robots that spin in place. A fast robot that goes in a straight line might be better for racing against other robots, but a heavy one that spins in circles might be better for "sumo wrestling" and pushing other robots out of the way. In this project you will use the **engineering design process** to decide what type of robot you want to build, then experiment with the design until you get the behavior you want.



Artbot materials

small 3V DC motor, AA battery holder with insulated wire leads, electrical tape/masking tape, plastic cup/paper cup/small box, Adhesive velcro dots, cork or large eraser, 3 markers, plain white paper or butcher paper, googly eyes, decorative glue-ons, permanent markers, scissors.

Concepts Explored

Students can explore the following based on their age/grade:

- Simple circuits
- Electricity
- Engineering design process
- Movement with motors
- Art integration
- Literacy
- Prototyping
- Troubleshooting

Vocabulary and Concepts to Explore

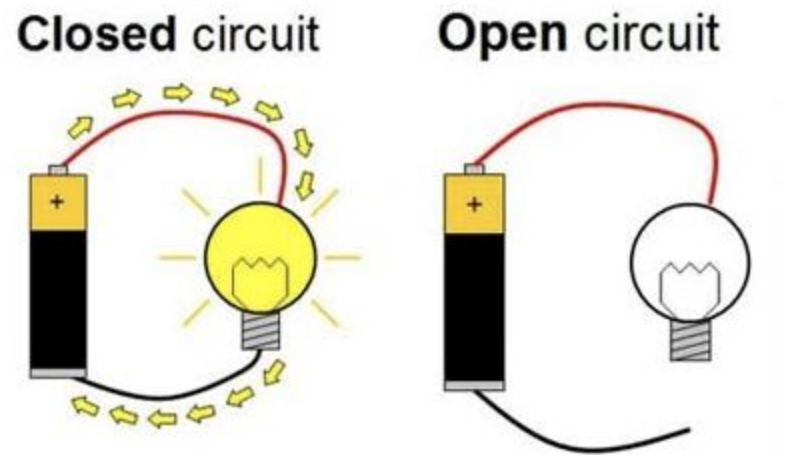
Engineer - A person who designs and builds things.
Battery - A source of power that helps electricity flow.
Motor - A machine, sometimes powered with electricity, that has moving parts.
Electricity - The flow of electrons from one atom to another.
Conductive Materials - A material that provides a path for energy to flow. Metals are the best electrical conductors. The most commonly used electrical conductor is copper which is used in electrical wiring and electrical circuits.
Circuit - An electric circuit is a path that allows electrons to flow.
Closed circuit - A circuit where the loop is connected and the electron current can flow.
Open Circuit - A circuit where the loop isn't fully connected and there isn't any current flow. When you turn off the light you are opening the circuit so that electrons aren't flowing.
Current - An electric current is the flow of charge. The charges do not disappear when the circuit is broken, or the "current stops flowing".
Friction - The amount of resistance to movement between your robot and the surface it rests on. If there is too much friction, your robot might move slowly or not at all. Certain items, like a toothbrush with slanted bristles, can have directional friction (more friction in one direction than another), and can help your robot move more easily in one direction.

Mass - Is how heavy your robot is. If your robot is too heavy, the motor might not be strong enough to make it move. However, heavier robots might be better at sumo wrestling since they are harder to push around.
Center of mass - The middle of your robot, or the point where all the mass is effectively concentrated. If a robot's center of mass is too high off the ground, it may tip over easily. The motor and battery are both heavy, so where you put them can have a big impact on the center of mass.
Moment of inertia-How spread out your robot's mass is. Robots with a small moment of inertia tend to spin rapidly (think about how ice skaters tuck in their arms when they want to spin quickly—this decreases their moment of inertia).
Energy - The ability to cause change.
Electric Energy - Comes from tiny charged particles called electrons. A lightning bolt is one form of electrical energy. The electricity in our homes is made by humans. It is a form not a source of energy because it can't easily be stored.
Mechanical Energy - Stored in objects by tension. When the tension is released, motion occurs. A compressed spring contains mechanical energy as does a stretched rubber band.

Additional Information

- *Safety* Make sure learners understand that while these materials are safe to work with, electricity is very dangerous and should not be played with.
- If your Art Bot stops moving suddenly, check to make sure that one set of wires did not get disconnected.
- As your robot wobbles around, some pieces may fall off. If necessary, use more tape to reattach them.
- Your Art Bot might fall over frequently if it wobbles too much. To make it wobble less, try adjusting the position of the eraser.
- The battery doesn’t store or create electricity, it provides a source of energy to get the electrons flowing. When a battery becomes “dead”, it’s not because it lost its charge, it’s because the chemicals that create the energy have all reacted.
- The electrons aren’t necessarily moving very quickly; the energy is. Imagine flicking a marble at the end of a row of marbles— the marbles may only travel to the next one and stop, but the energy from the flick moves quickly.
- Other types of particles can flow with energy to make electricity, but electrons are what flow in metals.
- Wires aren’t empty until they are attached to a source such as a battery. When a battery is connected, electrons move very slowly everywhere at the same time, like a wheel.

Example of an Open and Closed Circuit- Notice the flow of electric



Getting Started

We recommend beginning a conversation with your family about “What is a Robot?” Here this video for an explanation:
https://www.youtube.com/watch?v=6iJu9-8pjcQ

Mystery Science has some great lessons on electricity for further learning
www.mysteryscience.com

For 6-8 students, here is an explanation about how a DC motor works:
https://theengineeringmindset.com/dc-motor-explained/

Generation Genius offers these Electricity lessons with their free account:
3-5 https://www.generationgenius.com/videolessons/energy-transfer-video-for-kids/

6-8
https://www.generationgenius.com/videolessons/electricity-and-circuits-video-for-kids/

Generation Genius Engineering and Design lessons
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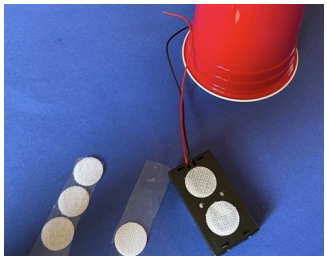
6-8
https://www.generationgenius.com/videolessons/engineering-design-process-video-for-kids/

Building an Artbot

Tell students that they are going to create a robot that moves. Ask students to share their ideas of what a robot is.

1. Insert 2 AA batteries into the battery pack. Make sure to turn off the battery pack as the batteries will drain if left on. Some battery packs don't have an on/off switch.

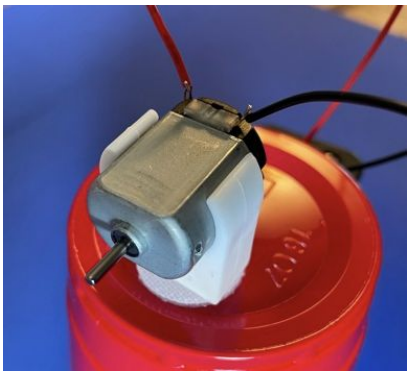
2. Place two circles of velcro to the back of the battery pack.



3. Attach the battery pack to the side of the cup with the positive(red) and negative(black) wires pointing up. Gently bend the exposed wire on the positive and negative leads so that they can hook to the DC motor copper connection.

4. Place double sided velcro to the bottom of the DC motor holder. Attach to the bottom of the cup. Place the motor with the eraser in the motor holder, making sure to place the copper leads on the same side as the battery pack.

5. Attach the positive wire to one copper mount on the motor. Attach the second wire when you have completed your robot and are ready to make it move. You can test the two wires touching the copper mount on the DC motor, but then remove one wire to finish building your artbot.



6. Attach the eraser off center onto the motor shaft.

7. Tape 3 markers to the side of the cup. You can adjust the height as needed.

8. Attach the googly eyes to give your vibrobot a little personality, or decorate your cup with stickers, colored sharpies, and anything your imagination can come up with. This is your robot!

9. Take the caps off the pens, and place your artbot on top of a large piece of paper.

10. Connect both wires from the battery pack to the DC motor copper mount and watch what happens.

11. What modifications can you make to change the movement of the vibrobot by adjusting the position of the eraser, the markers, the battery pack, and the motor.

Questions to Ask and Record

- What makes vibrobots move?
- What other common household materials could you use to build a vibrobot?
- What if you alter the position of the eraser?
- What happens if you remove the eraser and try another object to change the balance of the motor? (milk cap, cork, popsicle stick, piece of tape)
- Do you think your robot would move faster on a smooth surface or a rough surface?
- Which do you think would move faster, a heavy robot or a light robot?
- Which do you think would tip over more easily, a very tall robot or one that is low to the ground?
- Which do you think would spin in circles faster, a robot whose body is tightly bundled up, or one that has long legs sticking out in all directions?
- Literacy connection: change the robot to represent a character in a story. Create a different body for the robot to represent the character. Create scenery for the location of the story and for the robot to travel on.

Other Vibrobot ideas

http://makezine.com/projects/make-10/vibrobots/

https://www.youtube.com/watch?v=KM9Ym5bKm7E

https://www.sciencebuddies.org/Files/12483/7/Robotics_p014-Procedure.pdf

We hope you have lots of fun creating and making your Vibrobot! Please share your pictures and videos with your Education Coordinator. We'd love to see your robots in action!

Bibliography

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Artbot Engineering Design Process Journal

Ask What is the problem? What needs to be improved? What is your goal?

Imagine What are the solutions? Brainstorm ideas. Choose your best idea.

Plan Draw your design. Gather your materials.

Create Build your prototype/model. This is your first model.

Improve What went well? What could work better? How could you improve your prototype/model?