JUNKBOTS

MATERIALS:

- Pool Noodle
- Cell Phone Motor
- Dollar Tree Electric Toothbrush
- Coin Cell Battery
- 2 AA Battery Holder with Switch & Wires
- AA Batteries
- Straws
- Clothespins
- Small Plastic Cups & Lids
- Foam Sheet Scraps
- Aluminum Foil
- Scissors
- Electrical Tape
- Duct Tape
- Clear Tape
- Foam Tape
- Pipe Cleaners
- Popsicle Sticks
- Wiggle Eyes
- Paper Scraps
- Paper Clips
- Corks

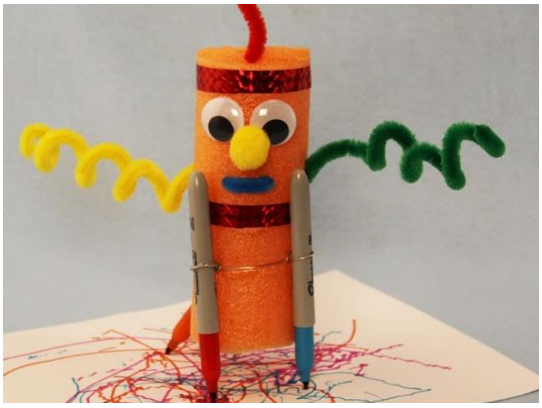
VOCABULARY:

- Robot
- Positive
- Insulator
- Force
- Mass
- Stiffness
- Battery
- Circuit
- Negative
- Conductor
- Friction
- Center of Mass
- Engineering
- Electricity
- Electrons
- Physics
- Motor
- Moment of Inertia
- Wire

BRISTLE BOT DIRECTIONS:

1. Get an adult to use strong scissors or pliers to help you cut the heads off two toothbrushes, one with slanted bristles and one with straight bristles.
2. Stick foam tape to top of toothbrush.
3. Peel backing off foam tape.
4. Insert a coin cell battery into the battery holder. Make sure the battery is facing the correct way. Close the battery holder.
5. Attach battery holder to the foam tape.
6. Peel paper backing off motor.
7. Attach motor to the toothbrush behind the battery holder. See picture for reference.
8. Twist together red wire and one of the wires from the battery pack. Use electrical tape to secure them together.
9. Twist together black wire and the other wire from the battery pack. Use electrical tape to secure them together.
10. Tape the wires down on the bristle bot.
11. Turn the switch to “on” on the battery pack. Your bristle bot should vibrate.
12. Turn the battery pack off and decorate your bot. Use wiggle eyes, paper clips, etc. Be sure to not add to many items or the bristle bot will be off balance or too heavy to move.

NOODLE BOT DIRECTIONS:



1. Take the bottom off of the electric toothbrush.
2. Tap the toothbrush sharply on a table or other hard surface until the inside battery/motor portion falls out.
3. Insert a AA battery into the battery holder.
4. Make a gum wrapper sized strip of aluminum foil and fold over several times to strengthen.
5. Lay the aluminum foil over the bottom of the battery holder to keep the battery in and connect with the small metal prong on the bottom of the compartment. See picture for reference.
6. Use electrical tape to secure the aluminum foil into place. See picture for reference.
7. Test to make sure the connections are working by turning it on.

8. Add “legs” to the pool noodle. They can be made from popsicle sticks, markers, skewers, clothespins, etc. Use electrical tape or duct tape to secure them in place. You want your pool noodle to be at least 2 inches off the ground.
9. Decorate the pool noodle however you wish using wiggle eyes, pipe cleaners, paper scraps, etc. Be sure you do not add to many decorations or the noodle bot will be too heavy and not move.
10. When you are finished decorating, turn on the motor/battery component and insert it into the bottom of the pool noodle.
11. Place the noodle bot on a smooth surface and let it go. It should move, spin, etc.

VIBROBOT DIRECTIONS:

1. First, connect your battery pack wires to the motor. Hook the end of the wires from the battery pack into the small metal holes on the side of the motor. Use electrical tape to secure them.
2. Plug in the batteries to ensure the motor works properly. Don’t build the robot while the motor is running.
3. Tape your “legs” the inside or outside of the cup, making sure it can stand on its own without falling over. Use craft sticks, clothespins, markers, etc. Typically you will want to use 3 “legs” that are equal distance apart.
4. Tape a mini-clothespin to the motor’s rotor so it will spin around, be off balance, and cause the motor to vibrate.
5. Tape your motor and battery pack to the outside of the cup.
6. Decorate the cup how you want using wiggle eyes, scrap paper, pipe cleaners, etc. Be sure you do not make it to heavy.
7. Place your robot on a flat surface and turn it on!

MINI VIBROBOT DIRECTIONS:

1. Before you design and build your mini vibrobot, you need to learn how to connect the motor and battery wires to create a **circuit** so electricity flows through the motor and causes it to vibrate. To connect them, twist together the exposed metal parts of the wires , as shown in the picture. The motor should start vibrating when you turn the switch to “On”.
2. You will need to attach the battery and motor to the body of your robot once it is built. The motor has a built-in sticky backing (peel off the protective paper first), but you will need to use tape or glue to attach the battery.
3. Build your vibrobot using small household items, such as bottle caps, cardboard scraps, paper clips, pipe cleaners, etc. Use the picture for ideas. The legs should be small and thin- use pieces of straws, wire, toothpicks, etc.
4. Attach the battery pack to the top of your vibrobot using tape. Attach the motor to the top of the battery pack using the adhesive on the motor and extra tape. Secure the extra wire in place with tape.

TROUBLE SHOOTING:

1. Do not let the exposed metal parts of the red and black wires touch each other directly. This will create a short circuit and drain the battery very quickly, and will prevent the motor from vibrating.
2. If your robot stops moving suddenly, check to make sure that one or both sets of wires did not come loose. This will create an open circuit and prevent the motor from vibrating. Tightly twist the wires back together if this happens.
3. For the Bristle Bot, if your robot falls over a lot, make sure the motor and battery are centered on top of the toothbrush. You can also let the robot run continuously for 3 minutes, and it will slow down slightly as the battery begins to drain.
4. Make sure you turn your robot off when not in use to conserve battery power.
5. Be gentle with the motor wires. They are thin and can rip if you are not careful. You can apply a dab of hot glue at the base of the wires to reinforce them.

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THE STEAM BEHIND THE EXPERIMENT:

The Bristle Bot uses a small electric motor to move. In order to power the motor, the robot also needs a battery. When you connect the battery to the motor, you complete an electrical circuit. This makes a tiny weight inside the motor spin, causing it to vibrate.

When the motor vibrates, it causes the robot to shake and buzz along the tabletop. For the Bristle Bot, the vibrations from the cell phone motor travel down the bristles of the toothbrush and cause the brush to scoot and spin on flat surfaces.

The Vibro Bot and Noodle Bot use a small electric motor to move. In order to power the motor, the robot also needs a battery. When you connect the battery to the motor, you complete an electrical circuit, and this allows the motor to spin. The motor in the Vibro Bot has an off-center weight attached to it, which causes the motor to vibrate. When the motor vibrates, it causes the robot to wobble across the paper. This is the same technology that makes video game controllers and cell phones vibrate; on the inside, they have little spinning motors with weights attached. If your Vibro Bot has markers for "legs," it will also draw on paper as it moves.

Friction is 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 is 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 is 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).
Stiffness is how rigid your robot's body is. Robots with very loose, floppy bodies might not move very quickly, because all the energy from the vibrating motor gets absorbed by the robot's body. Stiffer robots will tend to move faster.

MAKE IT AWESOME:

Try using different sizes of motors and batteries to see how it affects your bots movements.

EXTENSIONS:

1. Try using different types of toothbrushes or other brushes for the bristle bot.
2. Try adding markers for “legs” on the Vibro Bot and making a Scribble Bot that draws.
3. What other changes can you come up with for this experiment?

WEBSITES AND VIDEOS:

1. Video: How to Make a Bristle Bot: https://youtu.be/Q1zToREgV0c
2. Video: How to Make an Art Bot: https://youtu.be/daWU2Oh_xlg

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