

Engineering Projects Suitable for Senior Classes

Projectile Physics and Catapult Science

Equipment

1. 8 LOLYPOPSTICKS
2. 4/5 RUBBER BANDS
3. GLUE
4. PLASTIC BOTTLE CAP
5. COTTON BALL (IF YOU DON' T HAVE ANY
YOU CAN MAKE A SMALL BALL BY CRUMBLING UP SOME PAPER)
6. SMALL OPEN AREA, FLAT SURFACE



Preparation:

- Take six craft sticks, stack them one on top of the other. Secure these sticks together by wrapping rubber bands around both ends of the stack. You will anchor the launching stick to this stack, as described in the next step.
- To add the launching stick, take one stick and attach it perpendicular to the stack you just made, around the middle, so you get a cross shape. You can do this with one or two rubber bands that are crossed in an X over the sticks. If you cross it this way, the sticks will stay nicely perpendicular.
- Next, add the base by attaching a stick to one end of the launching stick with a rubber band. If it were not for the stack of sticks in between, the launching stick would fall flat on top of the base. Now the launching stick and the base form a V shape lying on its side with the stack of sticks in the middle.
- Put your catapult on its base, locate the end of the launching stick that sticks up and glue the bottle cap there so it forms a small cup to hold the missile.
- Wait until the glue is dry.
- Put your catapult in an open area with a sturdy, flat surface such as a table or an open space on a hard floor. Clear about a meter of open space for the launched object (the missile) to fly and land.
- Place a cotton ball in the launching cup, push the cup down just a little bit and let go

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Junkbots: Robots from recycled Materials

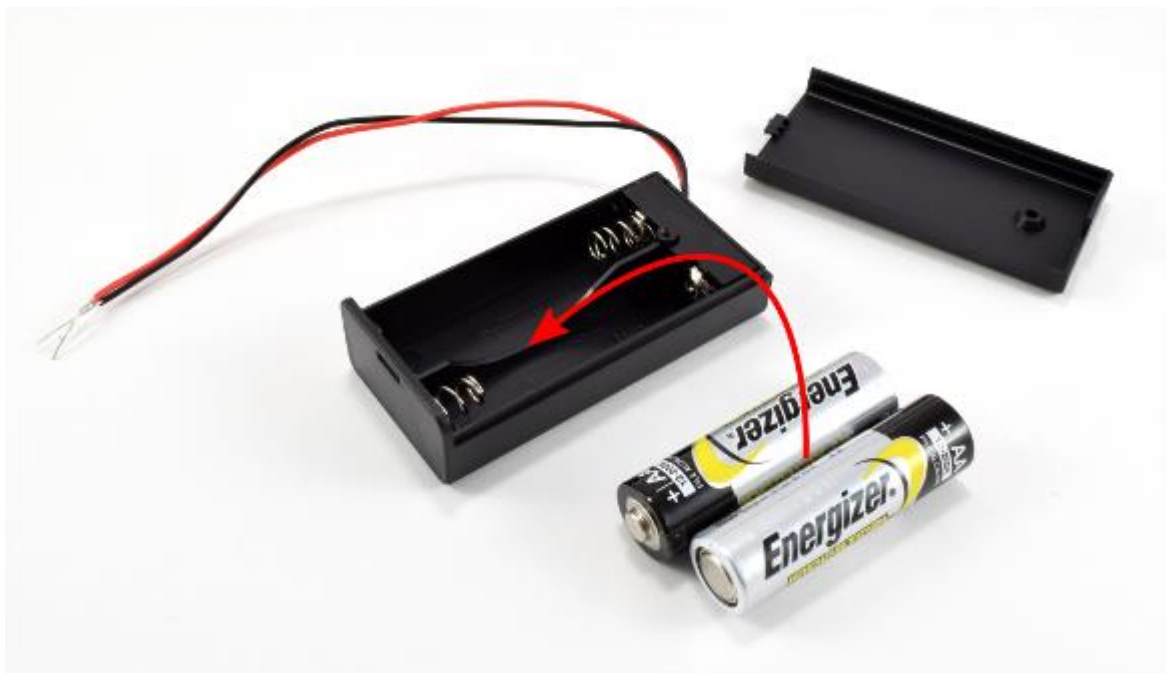
Equipment:

1. Recycled construction materials, like plastic bottles, cardboard tubes, etcetera
2. Other construction materials, like popsicle sticks and straws
3. Various adhesives and attachment mechanisms, like clear tape, duct tape, rubber bands, zip ties, glue (a hot glue gun is helpful, but adult supervision is recommended)
4. Decorative items, like googly eyes, pipe cleaners, construction paper, glitter, crayons and markers, etcetera
5. Corks (these are pressed on to the motor shafts to make the motors vibrate)
6. Scissors (older students can use hobby knives, adult supervision recommended)



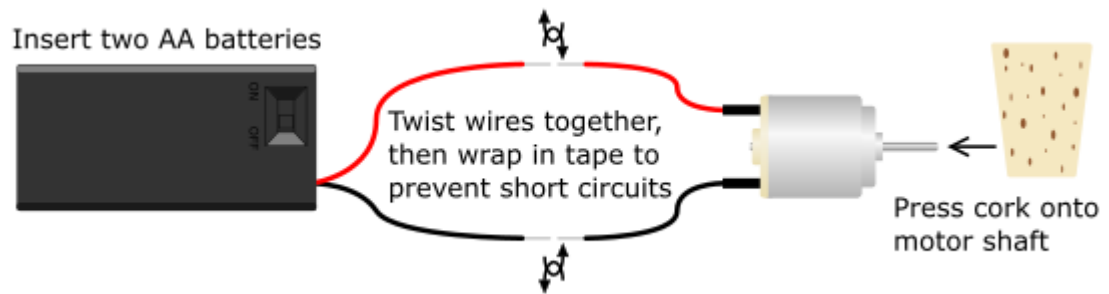
Procedure:

1. Make sure your battery holder's switch is in the OFF position.
2. Use a small Phillips-head screwdriver to remove the screw, then slide off the battery holder's cover.
3. Insert two AA batteries into the holder. The flat ends of the batteries should be against the metal springs.



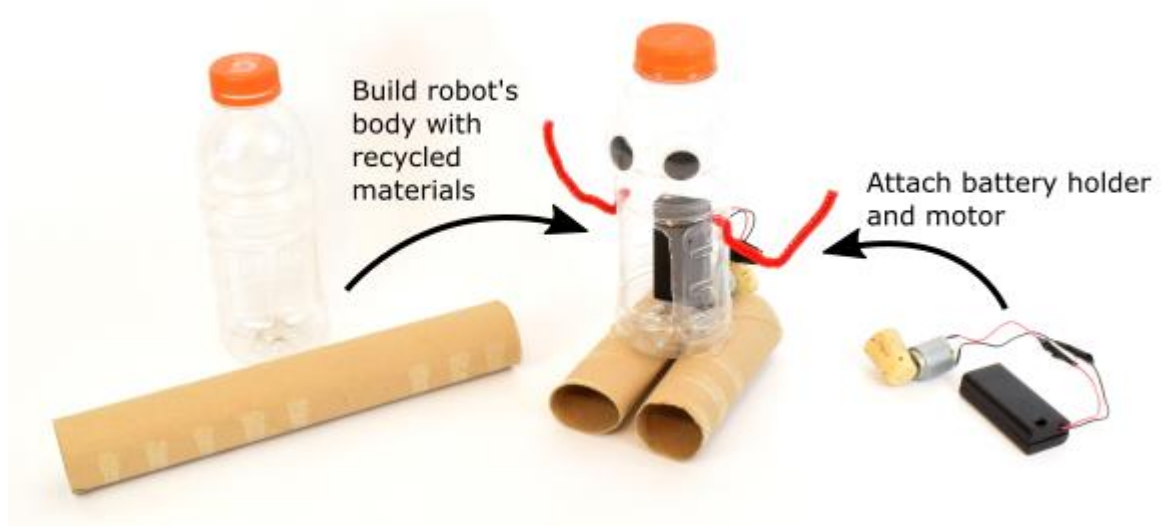
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4. Slide the cover back on until it clicks into place. You do not need to replace the screw.
5. Twist together the red and black wires from the motor and battery holder.
6. Wrap the exposed metal parts of the wires in tape to help prevent short circuits.
7. Firmly press a cork onto the motor's shaft.



8. Turn the battery holder's switch to ON. The cork should spin, causing the motor to vibrate
9. Build a "body" for your robot out of recycled and craft materials. There is no right or wrong way to do this step—what you build is up to you!
10. Attach the battery pack and motor to your robot's body. Pay attention to these tips:
 - a. Make sure you do not glue or tape the battery pack shut, or make it difficult to access. Eventually you will need to slide it open to replace the batteries.
 - b. Make sure the cork can rotate completely without getting stuck against the robot's body.
 - c. Make sure the wires will not get tangled in the cork when the robot moves.

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11. Turn your battery pack on, put your robot on the floor, and watch it go! Your robot might not work perfectly on the first try, and it might not work at all. This is okay; fixing and improving your robot is part of the engineering design process.
12. If you are doing this activity with a friend, try racing your robots against each other or making them "sumo wrestle" by pushing each other out of a ring.

Paddle Boat



Equipment:

1. Plastic Bottle
2. 2 Wooden chop sticks
3. Plastic Milk Jug
4. Duct Tape
5. Rubber Bands
6. Ruler
7. Pencil
8. Packing Tape

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Method:

- Cut out four rectangular pieces out of the plastic milk jug. The pieces need to be 2 inches by 3 inches long. You will want to use a pencil to draw your squares onto the milk jug. That will help you cut out rectangles with straight sides. The pencil lines will be easy to erase once you have cut out your rectangles
- Each of the rectangles will then be folded in half. You will then duct tape one side a rectangle to the side of another rectangle to create a cross shape. You could create the cross shape and then tape the sides together.
- Now you will be attaching the chopsticks to opposite sides of the bottle. You will attach the chopsticks about $\frac{3}{4}$ of the way down the bottle with packing tape. You will want at least 3 or 4 inches of each of the chopsticks to hang off the back of the bottle. When you have the chopsticks right where you want them to be, you will wrap duct tape around the area where the strapping tape is
- Attach the rubber band to the chopsticks. It should fit perfectly. You don' t want it to be stretched out, finally you slide two blades of the paddle through the rubber band
- Things to look out for:
 - See if winding the paddle forward makes it go forward.
 - See if winding the paddle backwards makes it backward.
 - See if moving the rubber band closer to the boat makes a difference it how it moves.
 - See how many times you can wind up the paddle in the rubber band. Decide if it makes a difference in how long it moves.

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Humpty Dumpty Science Engineering Activity/ Egg drop

Equipment:

1. Boiled Eggs
2. Selection of items; bubble wrap, cardboard, paper
3. Cello tape
4. Sealable sandwich bag (optional)

Method:

- There are lots of different ways to do the egg drop experiment
- If you want to keep it mess free, half fill the sandwich bag with cotton wool, bubble wrap or even rice and place a boiled egg in the centre
- Hold the bag at the top as high as you can reach and drop the bag
- Check the egg for damage
- Repeat for each material, if the egg cracks use a new egg for the next test
- REMEMBER: drop each egg from the same height and try use similar amount of each test material

Challenge:

Investigate to find the smallest amount of protective material you can use to keep the eggs safe, when you do drop the egg from a greater height

See what happens if you drop the egg from a greater height?