7th – 12th

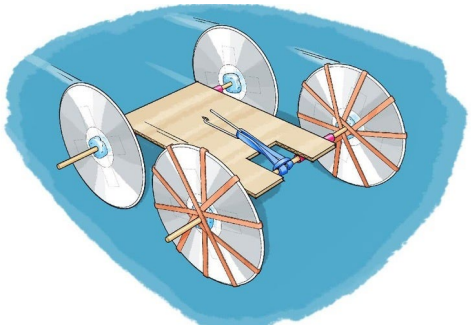
Rubber Band Rover

E-Week Challenge 2023

Program Description

Students will work in groups to design, build, and test a rubber band car that can store energy and release it to bring the rover to rest as close to a target location as possible.

Background & Task



Engineers at NASA are exploring alternative methods of powering vehicles on other planets. One idea that they consider is using a material to store potential energy to be used by the vehicle in a controlled way. NASA engineers need you to create a model for a vehicle that can store energy and release it to bring the rover to rest as close to a target location as possible. To best model their material, NASA Engineers have provided you with a bundle of rubber bands to use as power sources. You may use the rubber bands in any way you would like, but you can use no more than 3 bands as sources of power. Only rubber bands can power your rover.

Time

45 minutes

Activities

- **Introduction:** Learn mission goals and requirements.
- **Activity 1:** *Plan It* - Students will collaborate to create design ideas for their rover
- **Activity 2:** *Build It* - Students will choose materials to construct their designs
- **Activity 3:** *Test It* – Students will test their designs to see if it is successful
- **Analysis and Reflection Questions**: Students will evaluate their designs and form conclusions based on their findings

Materials

- Cardboard (1)
- Straws (2)
- Wooden Skewers (2)
- CDs (4)
- Sponge (4)
- Paper clip (1)
- Rubber bands (6)
- Tape (1 roll)
- Scissors (1)
- Target
- Source Material

INTRODUCTION

Divide class into teams of no more than 5 if possible. Groups will have 5 minutes for an introduction to the challenge and 30 minutes to make Rubber Band Rover. Any additional time will be spent on testing and analysis. Students can build their rovers however they'd like, but they must use the assigned materials – no extras.

ACTIVITY 1: ***Plan It (recommended 5-7 minutes)***

Now that you have received your challenge take some time to examine the supplies that you can work with. Using your blank paper, sketch some ideas for your team's rover and then share with your group. Collaborating with your teams on your designs is a great way to make sure that everything works together and is designed as effectively as possible.

ACTIVITY 2: ***Build It (15 minutes)***

After reviewing the ideas of teammates, the group should decide on a design and begin construction. Work quickly, stopping as needed to fix parts that don't work as expected.

ACTIVITY 3: ***Test It (10 minutes)***

Even the best laid plans can have a few hiccups when it comes to completion. You should test your vehicle a few times before trying to hit the target.

When time is up, take turns lining up at the start point to get as close to the target as possible. Each team should get at least 2 tries.

Building Guide (optional)

1. Carefully cut a piece of corrugated cardboard that is slightly longer and wider than the length of one straw.
2. Tape the two straws to the cardboard, parallel to each other, one at each end.
3. Cut a rectangular notch in the cardboard on one end, about one inch by one inch. This will also cut a segment out of the middle of one of the straws.
4. Insert a wooden skewer through each straw. These will be your car's axles.
5. Cut four small squares from the sponge and carefully press them onto the ends of the skewers.
6. Attach CDs to the axles to form wheels. Do this by stuffing a piece of sponge into the hole in the middle of the CD, then using tape to secure the CD and prevent it from wobbling.
7. Make sure your car can roll smoothly. Put it down on a flat surface and give it a push. If necessary, adjust the wheels so they are all parallel and don't wobble.
8. Loop a rubber band through itself around the middle, exposed part of the wooden skewer (where you cut out a notch in the cardboard and straw).
9. Tape the rubber band to the skewer to prevent it from slipping—when the skewer rotates, the rubber band should rotate with it.
10. Cut a small slot in the middle of the piece of cardboard.
11. Hook a paper clip through the slot.
12. Hook the free end of the rubber band onto the paper clip.
13. Wind up the axle that's connected to the rubber band. If necessary, pinch the rubber band on the axle when you start, to prevent it from slipping.
14. Put your car down and release the axle.

Troubleshooting

If your car didn't move, it's time for some troubleshooting.

- If the rubber band didn't unwind at all, wind it more tightly and try again. You can also try changing the location of the slot for the paper clip to adjust the rubber band's tightness.
- If the rubber band unwound but the axle didn't spin, then the rubber band might not have been attached securely enough to the skewer. Try attaching it to the skewer by tying a tight knot or using hot glue.
- If the wheels spun but the car didn't move forward at all, there might not have been enough friction between the CDs and the ground. Try using the car on a different surface. If that still doesn't work, try giving your CDs more grip by stretching rubber bands around them or by putting a bead of hot glue along the edges. (Let the glue dry completely before you test your car again.)

Analysis and Reflection Questions

Students will evaluate their designs and form conclusions based on their findings

1. How well did your rover work? What would have made it work better?
2. Do you think that rubber bands were a good power source to move the rover? What other sources could be used?
3. Where is potential energy demonstrated?
4. Where is kinetic energy demonstrated?
5. How do Newton's Laws apply to the rover?