Engineer an air-powered car

Materials

- 2+ pieces of cardboard, roughly 4 × 6 inches
- 2+ straws
- 2+ long, thin dowels or skewers
- 1+ balloon
- Tape
- Scissors

Identify the Problem

You will be designing, constructing, and testing a balloon-powered car! First, figure out what you want your car to achieve. Do you want it to be the fastest car in the room? The one that can travel the farthest distance? Instead, maybe you'd prefer to build an all-terrain vehicle capable of driving on almost any surface.

Once you've identified your goal, do a little investigation and think about what different types of vehicles have in common. For example, an all-terrain vehicle usually has unique tires that allow it to travel over road hazards. Sports cars tend to be low to the ground and have rounded edges so that air can flow freely around them.

How can you gain inspiration from these designs?

Map Out Your Design

Examine the materials you've gathered and start planning out your custom vehicle. Here are the key components of cars:

Axles—These are two rods underneath the car that rotate the tires and support the car's body. They attach the front two tires together and the back two tires together.

Tires—These parts of the car touch the ground and allow the car to roll. Different tires have different specialties—their size and material affect how the car operates.

Engine—This piece stores energy and then releases it to power the car. (Hint: you have to blow it up using one of your straws!)

Body—This is the sturdy base for your design. It is responsible for holding all your other components together.

Think through what you can do with these materials and sketch out a few designs. How could different shapes and arrangements affect your car?

Construct Your Car

1. Create your tires. Think about a design or shape that will help you achieve your car's goal for speed, distance, or stability.

2. Grab your other cardboard piece to serve as the body. Cut it to a size and shape you think will work best for your design.

3. Cut two straws to be slightly shorter than the axel rods. Out of the three straws you need for this design, which two do you think will work well for the axels and which would be best for blowing up the balloon?

4. Stick each axle rod into the cut straws, then attach the tires to the axle. You may need to poke a hole in each tire to insert the axle.

5. Slide a straw into your balloon and then tape them together to form a seal around the straw. Make sure it's as airtight as possible!

6. Flip the car over so the axles are on the bottom. Attach the balloon and straw to the top of the body.

Test the Design

On your mark... Get set… Go!

When everything is ready, blow up the balloon, pinch the straw so the air doesn't escape, place your car on the ground, release the air, and watch it go.

Did you reach your goals? Is your car the fastest, capable of going the farthest, or most adept in crossing terrain?

Modify and Test Again

Change your design if it didn't reach your goal or if something unexpected happened. Testing, measuring, and modifying are key elements in engineering. Did you know that it took Thomas Edison over 2,700 attempts to find the right materials for his light bulb?

How can you modify your design to reach your goal? Consider changing the size or number of your tires, trying different body shapes, or using different straws for different pieces of your design.

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Teacher/parent guide

Additional materials (optional)

- Measuring tape for distance
- Tape markings on floor to conduct races
- Different floor options, such as tile, carpet, and dirt
- Timer for speed

Additional challenges and hints for students (optional)

What goal did your students set for their cars? Suggest the following changes as necessary.

For terrain

- Consider adding an extra layer of cardboard to increase tire thickness.
- Add more grip to tires by altering their shape.
- Increase or decrease the number of tires to change the car's stability.
- Increase or decrease the size of tires to model the design after tractors, ATVs, or other vehicles.

For speed

- Reduce the weight of the car to minimize drag and friction.
- Change the shape of the car to improve aerodynamics.
- Use an extra balloon along with an extra straw for a design with two power sources.
- Examine the straw type used. Thicker straws release air much more quickly than thinner ones.

For distance

- Change the shape of the car to improve aerodynamics.
- Smooth the tire edges to reduce friction.
- Straighten the axle rods for more efficient tire rotations.

STEM Lessons

Engineering processes

- Identifying a need
- Researching the problem
- Designing a solution
- Creating a prototype
- Testing the design
- Modifying as necessary

Mechanical engineering

- Creating a mechanical design
- Manufacturing a product using a design
- Testing the product for both safety and performance

Natural forces

- Friction: materials in motion coming into contact with each other, slowing the car
- Pressure: the air trapped in the balloon and used as a power source for the car
- Thrust: the force created by escaping air that pushes the car forward

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