NEWTON'S BALLOON CARS

Where Science & Engineering Intersect!

With this activity you will explore how science and engineering intersect. Engineers often use science concepts to help them design and test new technologies. The process that engineers go through when developing new technologies is commonly referred to as the engineering design process. Through this process, engineers observe the world around them, identify problems they want to solve with a new technology or invention, sketch out their ideas (creating design drawings or schematics), build and test their ideas, and then refine their ideas to ensure their invention solves the initial problem they identified.

Materials

- 1 cardboard tube
- 1 rubber band
- 1 latex balloon
- 2 skewers (length 5 inches)
- 2 small-diameter straws like those you get at a restaurant (length 2 inches)
- 1 large-diameter straw like those used for a Boba drink
- 4 wheels (options include plastic bottle caps, wooden circles, etc.)
- Tape
- Modeling Clay
- Timer (could be on a phone or a stopwatch)
- Tape measure (or string that is marked by foot or by inch)
- Markers/decorations (to personalize your balloon car)

Directions

Building the base of your car:

Place the cardboard roll on a flat surface and tape the two small tubes on the top of the roll making sure they are parallel to each other.

Choosing your wheels:

Select four wheels that you want to use for your balloon car. As you make your selection, think about the size of the wheel that you want. Also, do you want all four wheels to be the same size?

Stop and think:

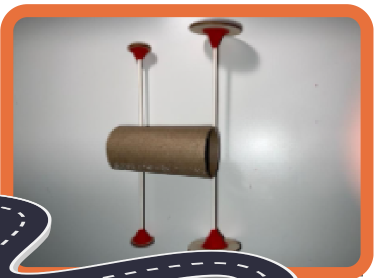
How might your wheel selection affect the way your balloon car travels?

Once you have your four wheels selected, place a dime size amount of modeling clay in the center of each wheel. Form a mountain with the modeling clay to ensure that it can properly grip the end of the skewer.

Engineer's Tip:

If you are having difficulty attaching the keeping your wheels on your skewers using only the modeling clay, how might you change your design? For example, do you need more or less clay? Do you need an additional adhesive material (ex. tape or glue)?

This activity is intended for use by adults and children who can read and follow directions and warnings. Children under 8 years can choke or suffocate on uninflated or broken balloons. May contain latex. Adult supervision advised.



Creating the Axles:

For your balloon car, you will use the two skewers that are your axles (i.e. the part of the car attached to the wheels that allow for spinning). Slide one skewer into each small tube at the bottom of your car. Once connected you can now stick each wheel on the end of the skewer using the clay as a binder. Pinch around the mountain to secure.

Engineer's Tip:

Take your Time! The wheels of your car are the most fragile, so it is important that we are gentle and patient during this step.

Science Connection!

Understanding Isaac Newton's First Law of Motion

- An object at rest remains at rest, and an object in motion remains in motion at constant speed and in a straight line unless acted on by an unbalanced force (that is, a force applied in one direction is greater than the force applied in the opposite direction).
- The source of the force that will move your car is the balloon: this is because, once inflated, air will travel out of the balloon and propel the car forward.

Engineer's Tip:

Make sure you leave enough straw hanging off the end of your cardboard tube so that you can inflate the balloon

Final Step:

Place the balloon over the longer straw and use a rubber band to tighten it to the straw. Use tape to secure your straw to the top of your car (i.e. the opposite side of the cardboard tube from where you placed the skewers).

Test Time

To make the balloon car travel, you will inflate the balloon. Pinch the tip of the boba straw to prevent any air escaping as you place the balloon car on a solid surface. Let go of the straw and see your car race!

Engineers test and refine their inventions to make sure their designs work the way they wanted. When thinking about cars, we often want to know how far they can travel and how long they can stay in motion. To help you stay organized, consider using the data table below. Engineers (and scientists!) often use data tables to organize their measurements and help them see patterns among the various numbers.

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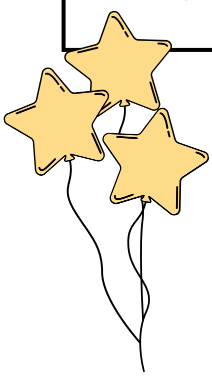
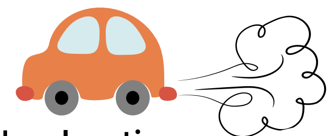
	Distance Traveled (measure the length traveled by the car in feet or inches)	**Travel Time** (measure how many second time the car was in motion)	**Observations** (What did you notice about the way the car traveled?)
Trial 1			
Trial 2			
Trial 3			
Trial 4			



If you want to keep tinkering with your balloon car (and we hope you do!), consider one of the extra challenges:



1. We focused on the car traveling in a straight line. Using the wheel options that you have access to, how might you make your car able to travel in a circle?
2. How does the surface over which your balloon car travels affect the way it moves? How does your car travel over different surfaces like tile, wood, carpet, dirt, and/or sidewalk? Why do you think this is?

Remember, when engineers and scientists work on any project, they ask lots of questions! Sometimes the questions they ask have a science focus (ex. Exploring a particular concept) and at other times the questions have an engineering focus (ex. Improving a design). However, when addressing the question - engineers and scientists typically end up thinking about how science can be applied to engineering and vice versa.

Engineering-Focused Questions

1. How could we redesign the car to prevent any turns (i.e. it travels straight)?
2. How can we improve the car's ability to travel the same pathway multiple times? (Reliability)
3. How can we prevent the car from slowing down so quickly?

Science-Focused Questions

1. How does air resistance impact the motion of the balloon car?
2. How well do the wheels "grip" each surface (ex. Tile, grass, etc.) that they travel over and how does this impact the motion of the balloon car?

Science Connection!

After you've tested and refined your balloon car, how can you describe Newton's First Law of Motion in your own words? When was your car acted on by an unbalanced force?

Want to learn more about Newton's Laws of Motion (there are three)? Check out this PBSKids Video (11 min).

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