BUILD A BALL LAUNCHER

Test your engineering skills with FLUOR's 2018 Challenge! Visit https://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p052/build-ball-launcher#summary for more details about entering the contest and scoring your project.

Construction Materials (but not necessarily needed!):

- Corrugated cardboard base (12"x12")
- Paper or plastic cups
- Wooden ruler or paint stirrer
- Printer paper
- Wooden pencils
- Rubber bands
- Large paper clips (2")
- Roll of clear adhesive tape

Tools and Testing Materials:

- Paper and pencil (for sketching design ideas)
- Scissors
- Tape measure
- Sheet of aluminum foil (12"x12"), tightly crumpled into a ball
- Open area of floor space for testing

Directions:

Design

If you are unsure how to start designing, try these tips:

1. Take some inspiration from other launching or receiving devices you have seen in the real world or online, like slingshots, catapults, a baseball pitcher and glove, bowls, baskets, and nets.
2. Sketch more than one idea when you are brainstorming.
3. Compare ideas—remember that the more materials you use, the more points it costs.
4. If you are working in a team, compare and contrast your ideas and even try combining them to make a better idea.

Build

1. Once you have decided on a design, build it. If you are working with a team, you may want to assign different jobs to each person in the group to make sure everyone gets a chance to participate. For example: one person can gather the materials, one person can hold the items in place while someone else tapes them together, and one person can monitor the design to make sure it matches the sketch you drew. Or, you could split into sub-teams, and one team can build the launcher while the other team builds the receiver.
2. You might need to modify your design, even as you build it! For example, you might discover that two parts do not fit together like you thought they would. This is OK and a normal part of the engineering design process. Just be sure to keep track of the materials you use in

your *final* design when you calculate your score (materials you used in earlier prototypes do not count, so do not be afraid to experiment!).

Test

1. Crumple up a sheet of aluminum foil (12"x12" or 30x30 cm) into a wad with a diameter of less than 2 inches. This will be your "ball."
2. Experiment with your launcher. Try using it to launch the aluminum foil ball.
    a. Can you operate the launcher as described in the rules (one person uses one hand to hold down the base and one finger to activate the launcher)?
    b. Is the launcher sturdy? Do all the parts stay together? Can it stand up to the stress of repeated launches?
    c. What is the range of your launcher? How far can you launch the ball?
    d. How accurate is the launcher? Can you hit the same spot on the floor more than once?
    e. Are there any changes you can think of to improve the design of the launcher?
3. Experiment with your receiver. Try using your launcher to launch the ball into it and/or just throwing the ball at the receiver. Remember that you cannot touch the receiver during a test.
    a. How easy is it to hit the receiver? Would changing its size or shape affect this?
    b. How stable is the receiver? Does it fall over when the ball hits it? If so, does the ball stay inside without touching the ground?
    c. How bouncy is the receiver? Does the ball tend to stay in it or bounce out of it?
    d. Can you think of any changes to improve the receiver?
4. If you are working with teammates, discuss your observations as a group. You might want to modify your launcher and/or receiver design before you start official testing. Remember that this is OK! Real engineers rarely get a design perfect on the first try. You can go back to re-design, re-build, and re-test your design as needed (as time allows).
5. When you think your design is ready, move on to the next section to try an official test and calculate your score (you will still be allowed to come back and make further changes to your design).

Background:

This challenge gives you the opportunity to explore some interesting topics in physics and engineering.

First, this is a great opportunity to learn about **simple machines**, like the *lever* or the *inclined plane*. You can also investigate more complex machines, like *catapults*, *trebuchets*, or *slingshots,* which are used to launch projectiles. Think about how you could incorporate different aspects of these machines into your design.

You can also use this project to learn about **projectile motion**. How do the *initial velocity* (starting speed) and *launch angle* (angle at which an object leaves the launcher) of a projectile affect its *range* (distance it travels)? What *trajectory* (path through the air) will make it easier to catch the ball? A high, steep trajectory or a low, shallow trajectory?

You can also use this project to learn about **energy**. The ball needs *kinetic energy*, the energy of motion, in order to fly through the air. Where will that energy come from? It could come from *elastic potential energy*, the energy stored in a stretched material, like a rubber band. It could come from *gravitational potential energy*, the energy stored in an object that is raised up off the ground. Or, the energy could

come from *work* that you do with your hand by exerting a *force*. How could your machine convert one form of energy to another?

Finally, you can use this project to demonstrate the **engineering design process**. You will probably not think of an idea for a machine, sit down and build it, and have it work perfectly on the first try. You might need to come up with multiple designs, test more than one of them, and modify the designs to improve them. This is OK—real engineers rarely get things right on the first try!

Source:

Finio, Ben. "Ball Launcher Challenge" *Science Buddies*. Science Buddies, 16 Jan. 2018. Web. 31 Jan. 2018 <https://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p052/build-ball-launcher>