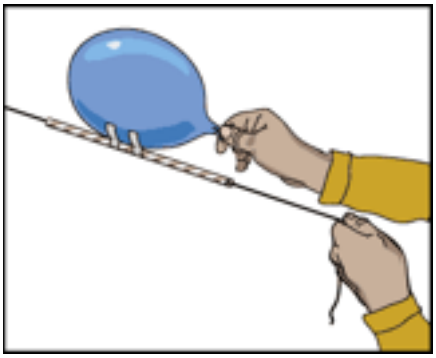
Lesson #2 Rocket Balloons



Synopsis

This lesson will give the students the engineering task of designing a rocket balloon that can be guided towards a designated target.

Grades K - 4
Duration Each lesson part takes about 30 min

Engineering Criteria: Design a rocket that travels to a pre-determined destination.
Design Constraints: Limited materials, rocket must travel at least four meters and reach a designated destination.

Materials

Engineering Notebook worksheets
Per Group

- Balloon (more than 1 may be necessary if the student blowing up)
- String (a little more than 4 meters,)
- Tape (masking, approx. 25 cm)
- Popsicle sticks
- Straws
- Cardboard / Card stock
- Dixie Cups
- ISS Image (or image of Mars, Moon, etc.)
- Other? (whatever materials might be used to construct guidance for the balloon)

Activity

In this lesson students will use balloons as their rocket vehicle. Tell the students that today's rocket will be a balloon. By blowing up the balloon they are creating more pressure inside the balloon than outside. When the internal pressure is released it propels the balloon. One could demonstrate the effects of blowing up a balloon a small amount versus a great deal.

Their criteria for success is reaching the International Space Station (ISS) (a photocopied image) which will be four meters from their launching point. Their constraints will be the limited materials they are given and the need to travel four meters.

Before experimenting, review the Engineering Design Process. Have them re-state today's criteria (reaching space station) and constraints (materials and traveling a minimum of 4m). To keep students engaged one could then get right to Part 1 of the lesson, but later on one should talk about how the students' design variations are like the variables discussed in the fair test that was conducted with the antacid rocket.

Ask

What are ways that people fly or get into space?
What will happen if I inflate a balloon and then release my hold on it?

Imagine

When astronauts fly into space where do they go?
How can they guide their rockets to reach their destinations?

What can we do to our rocket balloons to make them fly straighter?

Plan

Work with a partner to design solutions to balloons that fly in random directions. What will you be looking for to determine if your rocket is a successful design?

Create

Build balloon modifications and test them out.

Improve

Look at what you and others discovered. Use what you learned to make your balloon fly in a manner that gives you more control.

Ask / Reflect

What might you do to make your rocket fly farther or faster?

Activity Step-by-Step

Part 1 Free flow Rocket Balloons
Synopsis: Students inflate and release balloons in an attempt to reach a target.
Duration 30 min

1. Review the Engineering Design Process
2. Tell them that today's goal is to launch a balloon rocket and have it "dock" with the International Space Station (one could substitute an image of the moon, Mars, etc).
3. After partnering students in groups of 2-4, have one student take the "target" image and have them move 4 meters away from their partner. One could give each group their 4m string to help them find the proper distance.Their partner then inflates the balloon and releases it in the direction of the target.
4. 15-20 min of experimentation, in which partners switch positions and try and improve aim.
5. Regain classes attention and discuss observation / experiences.
6. Have students brainstorm ways they could make it fly with improved direction control.
7. Supply students with materials (straws, popsicle sticks, tape, etc.) and have them experiment with creating fins, stabilizers, etc that could make it fly straighter.
8. Follow engineering design process to test and improve on ideas.
9. As students experiment they needn't focus on measuring the distance or accuracy of their balloon rocket. The main idea is to experiment and adjust designs as they conduct tests.

Part 2 Strings and Straws
Synopsis: Students guide their rocket balloons with strings and straws.
Duration: 30 - 45 min

Depending on students solutions in part 1, you could then steer the lesson towards using straws and string to guide the balloon.
Teacher's Choice: You could either show how strings/straws can be used or have the students try and figure it out themselves.

1. If you choose to demonstrate how a string can be used to guide the balloon, attach a straw to an inflated balloon.

2. Thread string through straw and have 2 people hold the string so it's taut.
3. One end of the string can be designated as the Space Station and the student at that end could hold the image of the Space Station.
4. When the balloon, string and students are ready, release the balloon and watch it shoot towards the station.
5. Have students work in group of 2-4 as they try this approach and determine if wings/fins or any other design can help it fly farther or faster.
6. Once the students have a design they like, have them launch towards the Space Station three times and record its total distance and whether it reached its goal
7. Observe / Discuss data and discoveries.

Part 3 Fishing Line vs. Cotton vs. ?

Synopsis: Students repeat balloon rocket experiment, but this time they will compare the difference between using cotton string and fishing line. Yarn or another type of string might be used for comparison purposes as well.
Duration: 30 - 45 min

1. Tell the students they will be conducting an experiment to test two materials that will be used as guidelines for their rocket balloon.
2. Display the cotton and fishing line (nlyon) and have them make predictions with a partner about which they think will work best. Have them share thoughts and reasoning with the class.
3. Ask them if they remember what scientific term we use to describe the element in an experiment that is being tested. (variable)
4. Also come to a common understanding of the parameters of the experiment that will assure it is a fair test. For example, no one can push a balloon once it's released, all strings must be level during the test, only one balloon can be attached to a straw, etc.
5. Have students fill in their prediction on the worksheet and the parameters that will guarantee fair tests are conducted. Of course there are variables that will be difficult to control, such as how much a balloon is inflated or how much tape is used to affix the straw, but in general the students should produce data that demonstrates one string works better than the other.
6. Have students work with their partners so that at least 4 trials are attempted and accompanying data is recorded for each.
7. Older students can find the average distance achieved for each type of string while younger ones can simply identify which was able to reach the greatest distance.

Assessment

Younger Students
Have groups share their results. On a class chart or whiteboard, tally the results of Cotton string vs. Fishing Line.

Older Students
Have groups share results. Tally results on a chart or whiteboard. Have them discuss with students why a particular string might have worked better than the other. Have them complete their engineering notebook worksheet which includes data and discoveries from the experiment.

Possible sentence frames:

I claim that (Type of string #1) allowed the rocket to go farthest because our data showed that the (Type of string #2) had an average distance of _____ cm while the (Type of string #1) traveled _____cm.

Based on our data, I claim that the (Type of string #1) works best because the rocket went _____cm when we used that type of string. On the other hand, when we used the (Type of string #2) it only went _____ cm.

Teacher Tips & Tricks

What's going on scientifically in this lesson?

When we inflate balloons we create more **air pressure** inside the balloon compared to the air pressure outside the balloon. The compressed air inside needs to "escape" and when the opening is released the air rushes out. The rushing air creates thrust and as Newton's law says, "For every action there is an equal and opposite reaction". The escaping air pushes the balloon forward as it rushes out the back. The balloon is literally "jet-propelled".

If you want to introduce more rocket vocabulary, the opening of the balloon is the **nozzle,** the body of the balloon can be called the **airframe** and the front is the **nose.**

How does this lesson relate to the real world?

Modern jets work by taking in air, mixing it with burning fuel, and then forcing the air out at an accelerated rate. This creates forward thrust. Even though we aren't heating air in our balloon, we are creating greater pressure inside so this makes the air escape at an accelerated rate when the nozzle is opened.

What are variations I can do in regards to the lesson or materials?

- Try oblong balloons vs. round balloons.
- Attach string to the ceiling and have rockets launch vertically.
- Add weight to the balloons by taping on paper clips or other weights. Examine how their distribution or amount effects the rocket's flight.
- Use NASA website's to have students read about the history of rockets. Students could do reports on different uses / time periods concerning rockets.

NASA Pictorial History of Rockets
http://www.nasa.gov/pdf/153410main_Rockets_History.pdf

NASA Brief History of Rockets
http://www.grc.nasa.gov/WWW/k-12/TRC/Rockets/history_of_rockets.html

NASA Lesson 2-Stage Rocket Balloon

http://exploration.grc.nasa.gov/education/rocket/TRCRocket/balloon_staging.html