

# Comparing costs when building a rocket

Students plan and build a straw rocket with the goal of making one that flies the farthest for the lowest cost.

## Learning goals

### Big idea

Planning ahead and comparing costs can help you make good spending decisions.

### Essential questions

- How can you make spending decisions that are best for you?
- Are things that cost more always better?

### Objectives

- Practice comparing costs and making spending choices
- Explore whether things that cost more are always better

## What students will do

- Build and launch a test rocket using different combinations of materials.
- Reflect on which materials help them build a rocket that flies the farthest for the lowest cost.


### NOTE

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Please remember to consider your students' accommodations and special needs to ensure that all students are able to participate in a meaningful way.

### KEY INFORMATION

Building block:

 Financial knowledge and decision-making skills

Grade level: Elementary school (4-5)

Age range: 9-11

Topic: Spend (Buying things)

School subject: Math, Science

Teaching strategy: Competency-based learning, Project-based learning, Simulation

Bloom's Taxonomy level: Understand, Apply, Analyze, Evaluate

Activity duration: 75-90 minutes

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### National Standards for Personal Financial Education, 2021

Spending: 4-1, 4-3, 4-5, 8-2

These standards are cumulative, and topics are not repeated in each grade level. This activity may include information students need to understand before exploring this topic in more detail.

## Preparing for this activity

- While it's not necessary, completing the "[Understanding our money choices](#)" activity first may make this one more meaningful.
- Print copies of all student materials for each student, or prepare for students to access them electronically.
- Print a copy of the straw rocket instructions in this guide for each student so they can use the instructions' templates to build their rockets.
- Obtain colored construction paper, clear tape, masking tape, and a tape measure for students.
- Obtain enough straws (disposable or reusable), sharpened pencils, scissors, and sticky notes for students to have one of each.
- Create a space where students can fly their rockets safely.
- Create a materials station where students can get the paper and tape.
- On the board, create a bar graph where students can post sticky notes to show what their rockets were made of and how far they flew.
  - Be sure the graph shows the four combinations of materials that can be used to build the rockets. You might consider creating a bar graph similar to the one in this guide's "Individual and group work" section.
- Build a sample test rocket that you can show to students.
  - You can follow the straw rocket instructions in this guide or view a tutorial at <https://www.jpl.nasa.gov/edu/learn/project/make-a-straw-rocket/>.

### What you'll need

#### THIS TEACHER GUIDE

- [Comparing costs when building a rocket \(guide\)](#)  
[cfpb\\_building\\_block\\_activities\\_comparing-costs-when-building-rocket\\_guide.pdf](#)

#### STUDENT MATERIALS

- [Comparing costs when building a rocket \(worksheet\)](#)  
[cfpb\\_building\\_block\\_activities\\_comparing-costs-when-building-rocket\\_worksheet.pdf](#)
- [Straw rocket instructions \(in this guide\)](#)
- Paper, tape, sharpened pencils, scissors, sticky notes, and a tape measure

## Exploring key financial concepts

When you're preparing to build or make something, it's important to research and plan what you will do and how much money you will spend before you start. Researching options can help you make the best choices for you and your project. Comparing prices, features, benefits, and risks of materials can help you make more informed spending decisions. That is called comparison shopping. Comparison shopping also can help you decide whether what you're buying is cost-effective. If something is cost-effective, it means it's a good value for the amount of money you paid. We can figure out a thing's value by considering its importance, usefulness, or how much money it's worth. It's always a good idea to use comparison shopping and to figure out what's cost-effective, but it's especially helpful when you're buying or building something expensive.

One thing that's expensive to build is a rocket that flies into space. Modern rocket design began near the beginning of the 20th century. Since then, we've learned a lot about building rockets and are still improving rocket designs. Engineers developing new rockets must identify challenges. By changing one part of a rocket at a time, engineers can figure out if that change led to better or worse performance. They think about how their design might fail so they can improve it. At the National Aeronautics and Space Administration (NASA), engineers also have to think about how to build the best rocket for the least amount of money.

## Teaching this activity

### Whole-class introduction

- Ask students if they've ever seen a rocket launched into space on television or in real life.
- Explain that NASA is always trying to build a better rocket for less money.
  - It may be helpful to read the "Exploring key financial concepts" section to the students to give them some background information.
- Explain that decisions on how rockets are built are based on many factors and that cost is just one factor.
- Ask volunteers to share what they think some of the other factors might be.
  - Be sure they talk about things like safety, durability, and how far the rocket can fly.

- Be sure students understand key vocabulary:
  - **Comparison shopping:** The practice of comparing prices, features, benefits, risks, and other characteristics of two or more similar products or services.
  - **Cost-effective:** To have good value for the amount of money you paid.

**TIP**

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Visit CFPB’s financial education glossary at [consumerfinance.gov/financial-education-glossary/](https://consumerfinance.gov/financial-education-glossary/).

## Individual and group work

- Tell students that they’ll pretend they’re working on a NASA rocket research project.
- They’ll build their own test rocket, using different types of paper as the rocket’s body and fins and using tape as the rocket’s pretend “screws.”
  - They’ll pretend that the paper and screws are made of aluminum or titanium and have different costs.
- Explain that the goal is to see which materials will help them build a rocket that flies the farthest at the lowest cost.
- Give the “Comparing costs when building a rocket” worksheet and the straw rocket instructions to each student.
- Assign each student a number so they know their flight order and have them write the number on their worksheet.
- Tell students to review the materials and costs on the worksheet and check the boxes next to the materials they will use for their rocket.
- To make sure that all four combinations of materials are used, you may need to assign the materials to students or ask for volunteers to build their rockets with specific materials. The combinations are:
  - Aluminum body and fins and aluminum screws (copy paper and masking tape)
  - Aluminum body and fins and titanium screws (copy paper and clear tape)
  - Titanium body and fins and aluminum screws (construction paper and masking tape)
  - Titanium body and fins and titanium screws (construction paper and clear tape)
- Students will add up the cost of the materials they’re using and write the total on the worksheet.
- Have students go to the station you set up to “buy” their materials.
- Give each student scissors, a sharpened pencil, a straw, and a sticky note.

- Review the straw rocket instructions with students.
- Students will then build their rockets.
  - Circulate among the students to help if they get stuck building their rockets.
  - Note that students who choose to use construction paper will need to take the extra step of tracing the parts from the instructions onto the construction paper and cutting the construction paper along the trace lines.
- Once students are done, tell them that they will:
  - Fly their rockets, one at a time.
  - Use the tape measure to measure the distance flown.
  - Write the distance on their worksheet and a sticky note.
  - Write their flight number on the sticky note and post it on the appropriate place on the graph on the board, based on the materials used and the distance flown.
- Show students the bar graph you created on the board, with a row for each combination of materials. You might consider using a bar graph similar to this one:

Materials	Distance
Aluminum body and fins (copy paper) Aluminum screws (masking tape)	
Aluminum body and fins (copy paper) Titanium screws (clear tape)	
Titanium body and fins (construction paper) Aluminum screws (masking tape)	
Titanium body and fins (construction paper) Titanium screws (clear tape)	

- Show students the sample rocket you built.
  - Blow into the straw to demonstrate how it flies.
  - Show the students how to use the tape measure to measure the distance flown.
  - Write the distance on the sticky note and post it on the row that corresponds to the materials you used for the rocket.

- Be sure students understand that they'll place their sticky notes on the row in order of distance.
- Ask students to form a line at the launch area based on their flight order and launch their rockets one at a time.
- After each student has flown their rocket and recorded and posted their flight number and distance on the bar graph, they'll pick up their rocket.
- Once all students have finished, have them return to their seats.
- Ask them to look at the graph to see which two rockets flew the farthest.
  - Ask them to compare the rockets' materials.
  - Ask them why they think some rockets flew farther than others.

## Wrap-up

- Ask students to share which materials they chose for their rockets and why.
- Ask students to share whether they think the more expensive materials were worth the cost.
- Ask students if they had to choose between building three rockets that fly a shorter distance or one rocket that could fly a longer distance, which would they choose and why?
  - Explain that when people work with budgets, they often have to make choices about how they spend money.

## Suggested next steps

Consider searching for other [CFPB activities](#) that address the topic of spending, including buying things. Suggested activities include ["Using a budget to shop for a party"](#) and ["Choosing the perfect trip."](#)

## Measuring student learning

Students' answers on their worksheets and during discussion can give you a sense of their understanding. **Keep in mind that students' answers may vary, as there may not be only one right answer.** The important thing is for students to have reasonable justification for their answers.

# Straw rocket instructions

(Adapted from National Aeronautics and Space Administration [NASA] instructions at [https://www.jpl.nasa.gov/edu/pdfs/strawrocket\\_worksheet.pdf](https://www.jpl.nasa.gov/edu/pdfs/strawrocket_worksheet.pdf).)



- 1. Cut out the rocket body and fins.** Use the rectangle below for the rocket body and the double-arrow shape for the fins.
  - If you use copy paper to build your rocket, use the cutouts for your rocket body and fins.
  - If you use construction paper, use the cutouts to trace the shapes on the construction paper. Then cut the construction paper along your trace lines to get your rocket body and fins.
- 2. Shape the rocket body.** Wrap the rectangle around a sharpened pencil length-wise and tape the rectangle so that it forms a tube.
- 3. Cut out and attach the fins.** Carefully cut apart the two fin units. Notice that each fin unit has a rectangle running through the middle of it. Align the bottom of that rectangle with the end of the rocket body and tape the fin unit to the body tube. Do the same thing for the other fin unit on the opposite side, making a "fin sandwich."
- 4. Bend the fins.** Bend the fins on each fin unit 90 degrees so that they are each at a right angle to each other. When you look along the back of the rocket, the fins should form a "+" mark.
- 5. Make the nose cone.** Twist the top of the body tube into a nose cone around the sharpened end of your pencil.
- 6. Prepare to launch!** Remove the pencil and replace it with a straw. Be sure your launch area is clear of people and hazards. Then, blow into the straw to launch your rocket!

