EXPLORING MAGNETIC FORCE

Set a course for the moon! Students use a pair of magnets to launch and propel a rocket ship through space.

Objective
Students will explore the push and pull forces of magnets.

Standards
NGSS
3-PS2-3 Determine relationships of magnetic interactions between objects not in contact
3-5-ETS1.C Optimizing by testing different approaches

Time
20 minutes

Materials
- Fly to the Moon! activity sheet
- Two disc or bar magnets and one clear plastic sheet protector per student pair
- Tape, markers
- Optional: Scientists in Space reading passage (online)

Get the reading passage + more activity PDFs at scholastic.com/overthemoon.

Remote Ready

1 **Ask** your students to share what they know about rocket launches. Prompt for ideas like countdowns, noise, smoke, heat, fire, light, and excitement.

2 **Explain** that rockets are launched with the help of rocket fuel and a chemical reaction called combustion, which creates a lot of heat, light, and energy—enough to propel (push) a rocket off the ground and into space.

3 **Explain** that some scientists and engineers have different ideas about how to create enough energy to launch a rocket.

4 **Pair** up students and distribute the Fly to the Moon activity sheet, pairs of magnets, and a plastic sheet protector.

Fridge magnets found around the house work well for this activity too! For students without magnets at home, share a video recording of the experiment and invite students to use their observations to complete the activity.

5 **Direct** pairs to designate one magnet as their rocket ship and place it flat inside the sheet protector. (The sheet protector helps the rocket ship to move more smoothly and keep from flipping over. Students can cut paper to size, then draw and tape a rocket ship to this magnet for added effect.)

6 **Have** students place the sheet protector on top of their activity sheet, which includes an illustrated space scene. Students should follow the experiment instructions to "launch" and "guide" their rocket ships using the forces of attraction and propulsion, or the pull and push forces between magnets.

7 As students steer the ship, **challenge** them to note and refine their steering technique. What distance or angle of the steering magnet gives them finer control over the "rocket ship"'s motion and ability to move around the obstacles?

8 **Wrap up** the magnet activity with a discussion of student findings.

Extension Read the inspiring profiles in the Scientists in Space reading passage; use as a read-aloud or solicit volunteers. Point out that scientists must use their imagination, not just technical skills, to solve problems. Ask: *How do these scientists use creativity in their jobs?*

Activity Sheet Answer Key

1. Magnets are famous for snapping together, but magnets also push apart. The opposite poles of magnets attract and the like poles of magnets repel.
2. Varied student input; the repel force pushes and the attract force pulls.
3. Varied student input; likely the push felt trickier to guide the rocket in the desired direction, whereas the pull guided the rocket ship more easily.
4. Varied student input.

Name _____

FLY TO THE MOON!

Launch your rocket and land on the moon! Challenge yourself to try to get there without letting your magnets touch each other.

1. Place your **rocket magnet** on the launch pad.
2. Use your **second magnet** to launch your rocket into outer space using the **push (repel)** force.
3. Then use the **pull (attract)** force to guide your rocket through the stars to the moon. Be careful to avoid the space junk too!

Use a separate sheet to answer the questions.

1. Do magnets always stick together? Explain your thinking.
2. Explain how you launched your rocket and how you steered your rocket. How are the forces that repel and attract different?
3. Brainstorm how you could use magnets to tidy up space junk (the metal left behind from missions in space). Which magnetic forces would your solution use? Sketch or explain your idea on a separate sheet of paper.

THE GEOMETRY OF ROCKETS

Challenge students to create a rocket ship blueprint that incorporates geometric shapes and angles.

Objective
Students will identify and explore grade-standard geometry and geometric properties.

Standards
Common Core Math
3.G.A.1 Categories /attributes of shapes
3.G.A.2 Partition shapes, express as fraction
4.G.A.1 Angles
4.G.A.2 Lines, right triangles
4.G.A.3 Symmetry
5.G.A.1 Coordinate system
5.G.A.2 Graph on a coordinate plane

Time
60 minutes

Materials
- Blast Off With Math activity sheet
- Graph paper
- Protractor (optional)

Get more activity PDFs at **scholastic.com/overthemoon**.

Remote Ready

1 **Introduce** the term *rocketry*—the science of rocket design, development, and flight.

2 **Explain** that students will examine the blueprints for two existing rocket ship designs and then play the role of rocket scientist as they design their own spacecrafts using geometry.

3 **Hand out** the Blast Off With Math activity sheet. Complete its grade-specific instructions individually or as a class. (As a rough guide, grade 3 = A, grade 4 = B, grade 5 = C.) Review vocabulary as needed (see below).

Vocabulary Support
vertex (plural, vertices): a point where two lines meet
trapezoid: a quadrilateral with only one pair of parallel lines
parallel lines: two lines that are always the same distance apart (never touch)
right triangle: has a right angle
line of symmetry: the imaginary line where, if an image were folded, both halves would be the same
x-axis: the horizontal axis
y-axis: the vertical axis

4 **Tell** students they will now design their own rocket ships. Have them select three or more bolded items from the activity sheet. Instruct them to design a rocket on separate paper with the geometric features they selected. You may also assign additional geometric features from the list that follows.

GRADE 3 designs may include a:
- triangle
- rectangle
- square
- rhombus
- trapezoid
- shape with 3 vertices
- shape with 4 vertices
- shape with 5 vertices
- shaded area representing ½
- shaded area representing ¼

GRADE 4 designs may include:
- a line of symmetry
- a set of parallel lines
- a set of perpendicular lines
- a right triangle
- a right angle
- an acute angle
- an obtuse angle

GRADE 5 designs will:
- appear on a coordinate plane
- have a labeled x- and y-axis
- include three design features (examples: door, window, control panel) labeled with coordinate pairs

5 **Ask** students to write 2–3 sentences explaining how they used the selected geometric features in their rocket designs. Then invite them to pair up and share their rocket ship designs and discuss where and how they used geometry.

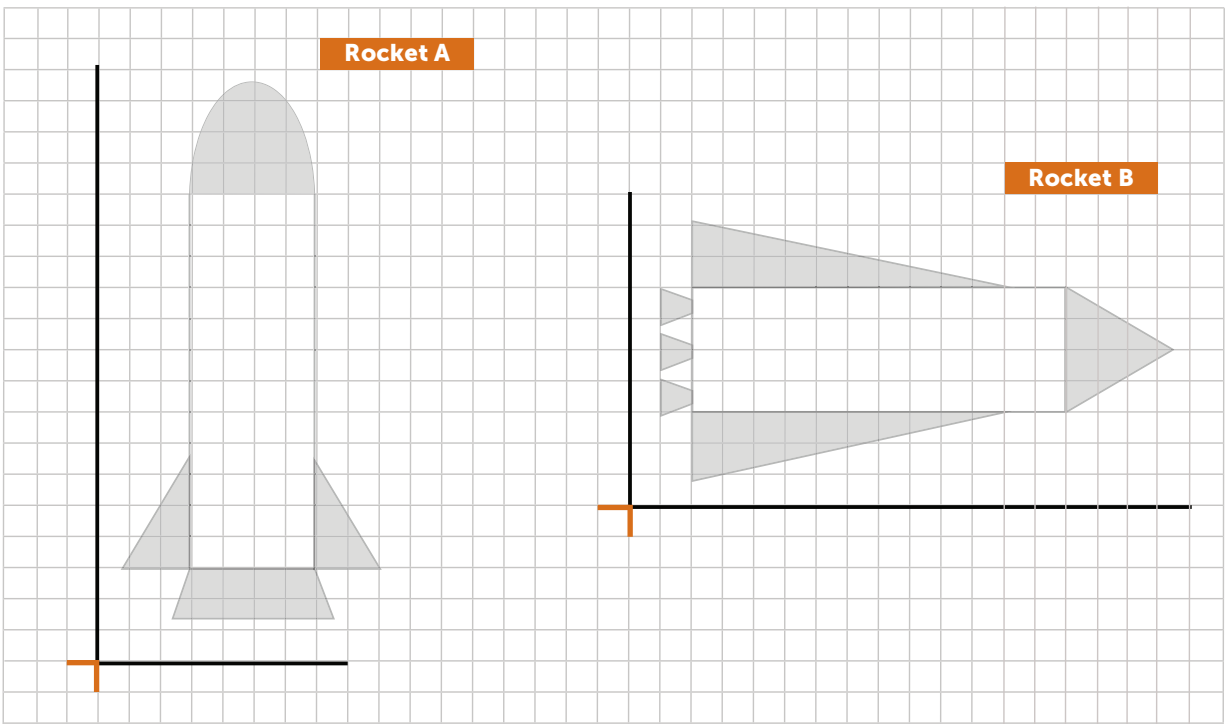
Students may upload an image of their designs and their sentences to a group discussion board for remote class discussions.

Family Extension Send home the Reach for the Moon family activity sheet to continue the learning.

Name _____

BLAST OFF WITH MATH

Examine the rocket ship blueprints below, then answer the questions!



LEVEL A

- Find:
  - a shape with 3 **vertices**
  - a **quadrilateral**
  - a **rectangle**
  - a **trapezoid**
- Draw a line to separate the body of Rocket A into **two equal areas**
  - Shade one of the areas and label it as a fraction of the whole
- Partition the body of Rocket B into **three equal areas**
  - Shade two of the areas and label them as a fraction of the whole

LEVEL B

- Find a **right triangle**
  - Circle all the **right triangles** on both rockets
- Find two or more sets of **parallel lines**
- Find and draw:
  - the line of **symmetry** for Rocket A
  - the line of **symmetry** for Rocket B

LEVEL C

- Label the **x and y axes**
- Create a door on Rocket A using the following coordinate pairs:
  (4, 3) (4, 8) (6, 8) (6, 3)
- Create a portal on Rocket B using the following coordinate pairs:
  (9, 5) (10, 4) (10, 6) (11, 5)

Name _____

SCIENTISTS IN SPACE

Read about a few of the scientists helping us learn more about outer space. Then answer the questions on a separate sheet.

Stephanie Wilson
Engineer and Astronaut

Stephanie used her engineering skills to become a NASA astronaut! She went on three **Space Shuttle missions** and lived for 42 days in outer space. Stephanie is an expert in controlling the robotic arm on the International Space Station. The huge robotic arm helps astronauts make repairs to the station.

MiMi Aung
Engineer

MiMi leads NASA's project to **build a new kind of helicopter—to prove it's possible to fly on Mars**. The air on Mars is much, much thinner than on Earth. So MiMi and her team are designing a unique helicopter that is very light, and with blades that spin much faster. The plan is to control the helicopter from Earth, millions and millions of miles away!

Wenzhe Fa
Lunar Scientist

Wenzhe worked with his scientist teammates on China's Chang'e-4 mission. They **landed a spacecraft on the far side of the moon**—which had never been done before! The mission is named after the Chinese goddess of the moon, written Chang'e in English and 嫦娥 in Mandarin. Wenzhe wants to use spacecraft to investigate the moon's powdery surface and what's underneath.

1. What scientific question is MiMi trying to answer?

2. Think of your own scientific question about the moon or outer space. How might you find the answer one day—or today?

Photo courtesy of Wenzhe Fa

Name _____

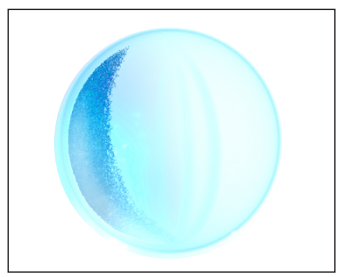
DREAM UP A CREATIVE STORY

Use your imagination to write an adventure story! First, check out the ideas below for inspiration. Then use the prompts to write your own story.

Get Inspired

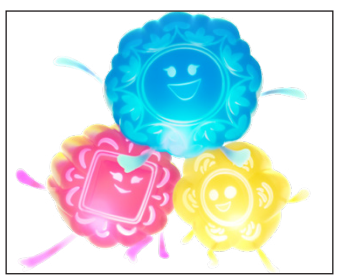
When the character Fei Fei travels to Lunaria (a mythical world on the the moon), she finds:

Space Ping-Pong
A fun, floating game

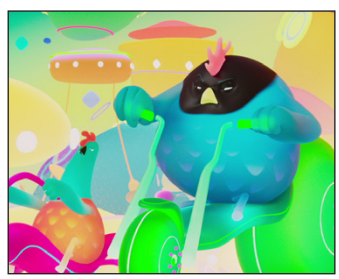


Moon Tracker
A timer

Flying Lions Gentle giants kids can ride



Mooncakes Friendly pastries come to life



Space Motorcycles
Moon vehicles

Gobi A glowing space creature

Get Writing

Use these prompts to plan a story of your own on a separate sheet.

- **Choose a Setting.** Where will your fantasy story take place?
- **Introduce Characters.** Who are the main characters?
- **Create a Conflict.** What problem are your characters trying to solve?
- **Add Adventure.** Do your characters fly? Ride high-tech vehicles? Make new friends?
- **Create a Resolution.** How is the problem in your story solved? How does the story end?

REACH FOR THE MOON

Choose one or more of the moon-themed activities below.

Design a Mooncake

Mooncakes are traditional Chinese pastries in a circular moon shape. Usually mooncakes have beautifully designed messages pressed on top. Design a moon-shaped pastry with your own message!

- **Choose** a word or image inspired by what the moon makes you think of (examples: "sweet dreams" or "beautiful eclipse").
- **Draw/color** your design on paper. Or use a crayon to color a thick layer of wax on paper and etch your message on top.

This mooncake says "long life" in Chinese.

Read All About It

Research a space explorer, scientist, inventor, or engineer like Mae Jemison, Ellen Ochoa, or Katherine Johnson. Create a news article or broadcast to report your findings.

Write a Song

Write a song or poem about the moon. Or create a new set of moon-themed lyrics for a song you already know.

Create a Capsule

Use your imagination to pack a capsule to the moon. Plan to leave it for mythical space creatures to discover. Write a list of the 7–10 things you'll put inside the capsule—and why. Then draw pictures to match.

OVER THE MOON

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