Launch It: An Engineering Design Challenge

Teacher Implementation Guide

Day 1:

- For students who are not familiar or need a review with what an engineer is or what they do, use slide 3 to guide a class discussion. If students are knowledgeable about engineers and their roles in the world, then after slide 2 skip to slide 4.
- Discuss the engineering design process that students will use for this challenge found on slide 4. Talk about how students will create, test and improve multiple times until they find the best solution to the challenge.
- Inform students of what a rocket is and how NASA uses rockets on slide 5.
- Show a diagram of the main parts of a rocket on slide 6.
- Hand each student a copy of slide 7 “Launch It Design Challenge” instructions sheet. Read and discuss all instructions with the students. Show students all materials and tools they may use for the challenge. Have students choose a partner to work with or assign partners.
- Have students open their STEM Journal in Google Classroom and discuss how to use the journal to document all of their group’s ideas, plans, improvements, successes, failures, and reflections. Have slide 8 on the Activboard as a reference for questions to think about when working in the Imagine and Plan stage.
- With their partners, students will collect all of their supplies and complete the ASK, IMAGINE, and PLAN slides in the STEM Journal.

Days 2-3:

- Review the design challenge and answer any questions. Demonstrate a sample rocket launched at the target. Model the following: how to build the launcher, blow up the balloon and pinch at the end so air will not release, place rocket on launcher, measure the launch angle, aim, and release air from balloon to launch rocket. Have slide 9 on Activeboard as reference for instructions and questions to think about.
- Have students collect their group’s materials. Groups will finish the planning stage if needed.
- Groups will complete the CREATE, TEST, and IMPROVE stage in the design process as many times as needed and document their observations and findings.

Days 3-4:

- Students will review their STEM Journals for completion and reflect on the engineering design challenge by answering the SHARE questions.
- Each group will prepare to present their rocket and SHARE questions to the class.
- Have a class discussion of similarities and differences of each group’s rocket, findings, and science occuring during the rocket launch.
- If time allows in class, for homework, or for an additional class day - hand out copy of rocket stories on slide 10. Have students read and discuss with their partners their thoughts about traveling by rockets. Then students will write down their responses and what they learned.

LAUNCH IT

A Design Challenge

WHAT'S AN ENGINEER?

Engineers dream up creative, practical solutions and work with other smart, inspiring people to invent, design, and build things that matter. They are changing the world all the time.

WHAT DO ENGINEERS DO?

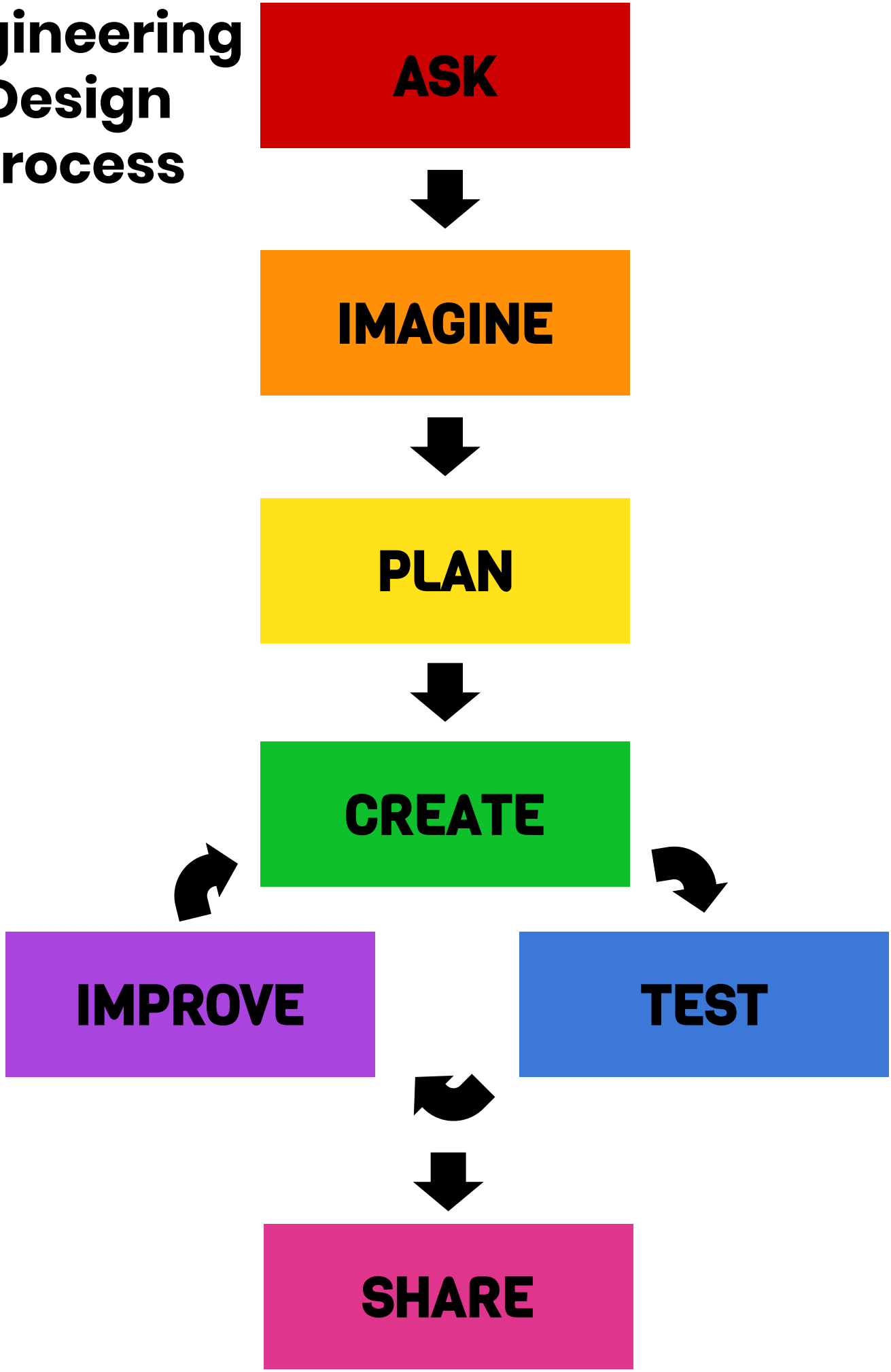
- **Think creatively.** Engineering is an ideal outlet for imagination and creative problem solving—the perfect field for innovative thinkers.
- **Work with great people.** Engineering takes teamwork. As an engineer, you'll be surrounded by smart, creative people.
- **Solve problems and design things that matter.** Engineers improve people's lives by tackling problems, improving current designs, and coming up with solutions no one else has thought of.
- **Change the world and make a difference.** Among many other pursuits, engineers develop systems that save lives, prevent disease, reduce poverty, and protect our planet.

HOW DO ENGINEERS MAKE THE WORLD A BETTER PLACE?

Here are some things engineers do to help improve people's lives.

- Build spacecraft that travel to the moon
- Develop state-of-the-art cell phones
- Create more fuel-efficient cars
- Invent artificial retinas to help restore vision
- Design lighter bike frames
- Construct tall skyscrapers and high bridges
- Build systems to purify water and process waste
- Design clothing that repels mosquitoes
- Create satellites that detect drought around the world
- Develop feather-light laptops

Engineering Design Process



What is a rocket?

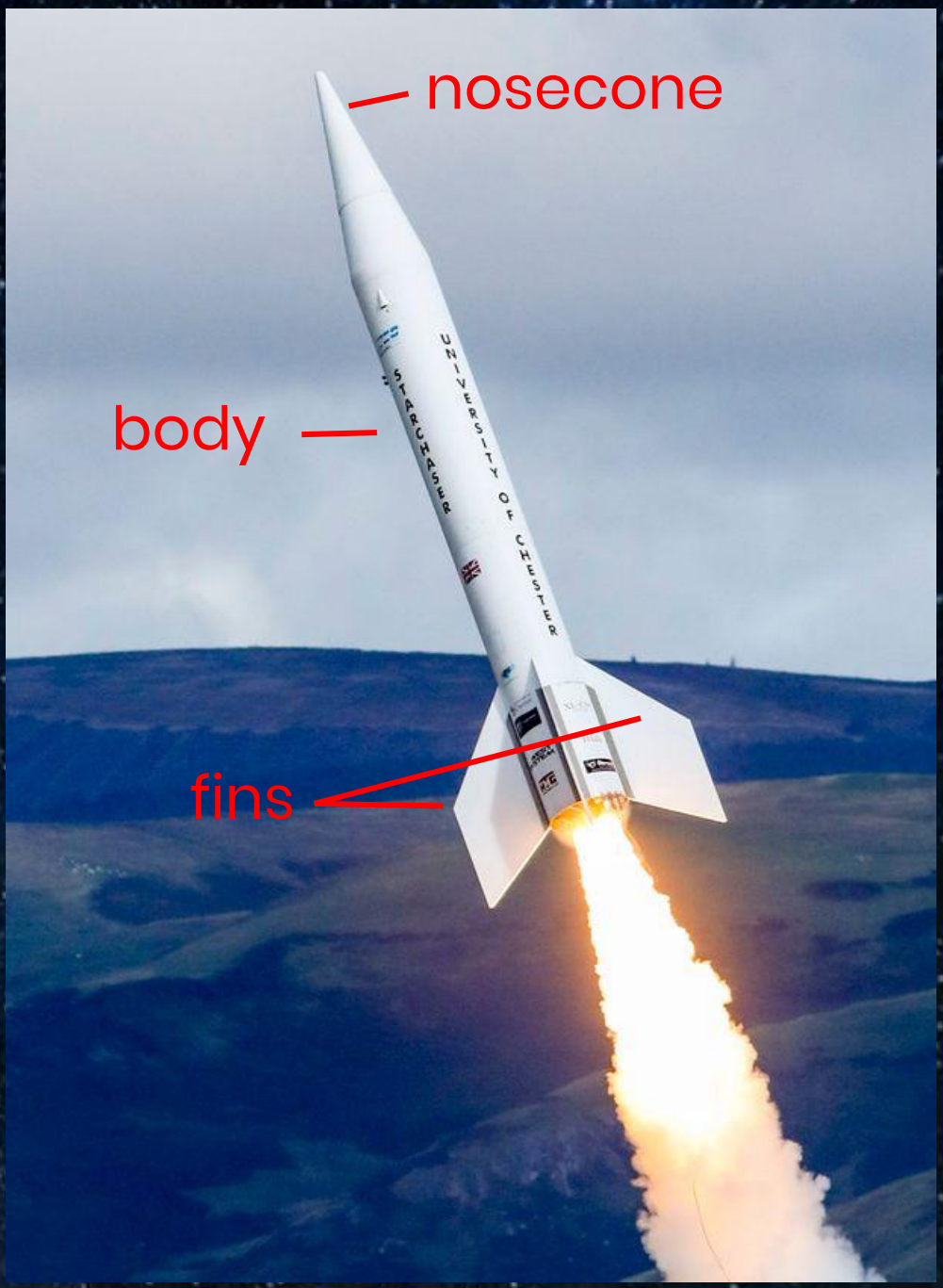
A huge engine that lifts things into space

How does NASA use rockets to get to the moon?

- To carry people (astronauts) into space
- To carry NASA's space shuttle, a satellite, or other piece of equipment into space

The rockets NASA sends to the moon go up to 18,000 miles per hour. But it takes about 3 days to get there.

Main parts of a rocket



LAUNCH IT
DESIGN CHALLENGE

I challenge you to. . .

. . . design and build an air-powered rocket that can hit a distant target.

You and a partner will use the **engineering design process** to solve this challenge. It will require teamwork and collaboration!

Directions:

1. Each group will get these materials:
   a balloon
   small lump of clay
   1 sheet of copy paper
   1 wide straw
   1 thin straw that fits inside wide straw
   tape

   Tools provided: scissors, protractor, and ruler

2. Your group will brainstorm and design how you want to build your rocket.

3. Then you will test, evaluate, and redesign your rocket to make the best rocket possible that will hit a target 5 feet away.

4. Like engineers, your group will keep all of your ideas and observations in an online STEM Journal.

Here's the schedule:

DAY 1: Your group will have 30 minutes to complete ASK, IMAGINE, AND PLAN in the engineering design process.

DAY 2: Your group will have 40 minutes to complete CREATE, TEST, AND IMPROVE in the process.

DAY 3: Your group will have 20 minutes to review your STEM Journal for completion, reflect on the engineering design challenge by answering the SHARE questions, and prepare to present your rocket and SHARE questions to the class.

Fasten your seatbelts and prepare for launch!

IMAGINE AND PLAN

Think about things that might affect how your air-powered rocket flies.

- How long will your rocket be?

- How many paper fins will your straw rocket have - 0, 2, or more?

- How will you seal the nosecone?

- How will adding weight to the straw's nose or having fins affect how it flies?

- When you launch your straw rocket, how does the launch angle affect where it lands?

CREATE

1. First, build a balloon-powered launcher.
   - Slide 1-2 inches of the thin straw into a balloon.
   - Make a tight seal by taping the balloon to the straw.

2. Next, build a straw rocket.
   - Use your design plan to create your rocket.

3. Now launch your rocket.
   - Blow into the thin straw to blow up the balloon.
   - Slide the wide straw onto the thin straw.
   - Aim.
   - Measure the angle.
   - Launch!

TEST, EVALUATE, AND IMPROVE

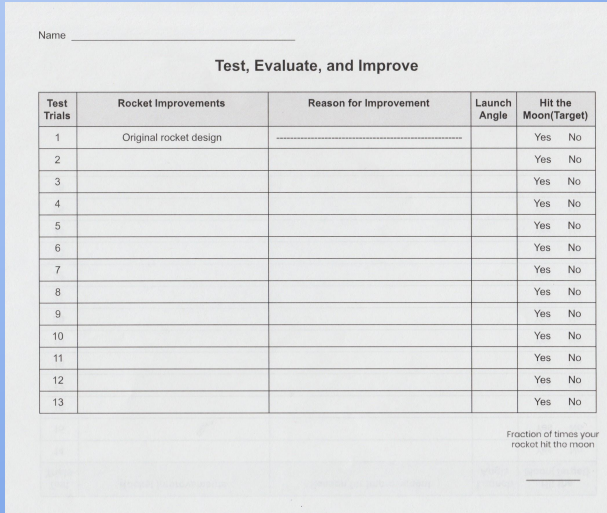
1. Place your rocket 5 feet away (on the taped line) and try to hit the target (moon) with your rocket.

2. The goal is to try and make your rocket hit the target every time.

3. Think about the path of your rocket. What design changes can you make?

4. What launch angle changes can you make?

5. Use table to collect your findings and observations.



Name _____

Test, Evaluate, and Improve

Test Trials	Rocket Improvements	Reason for Improvement	Launch Angle	Hit the Moon(Target)
1	Original rocket design	----------		Yes No
2				Yes No
3				Yes No
4				Yes No
5				Yes No
6				Yes No
7				Yes No
8				Yes No
9				Yes No
10				Yes No
11				Yes No
12				Yes No
13				Yes No

Fraction of times your rocket hit the moon

_____

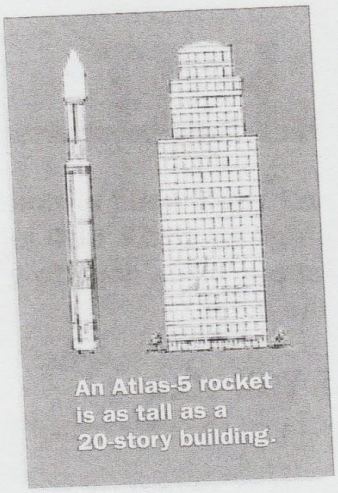
ROCKET STORIES

Name _____

- Read the stories below.
- What do you think about traveling by rocket?
- Discuss with your partner and write down what you learn and your thoughts.

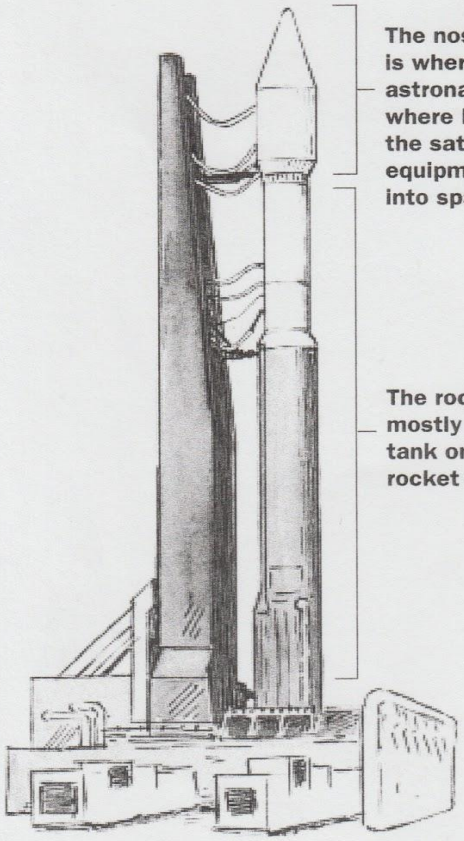
TAKE ME TO THE MOON

It's been over 25 years since NASA's been to the moon. But that's about to change. Soon, two spacecraft—the Lunar Reconnaissance Orbiter and the Lunar Crater Observation and Sensing Satellite—will be on their way. Compared to a rocket, these spacecraft are tiny—together they're the size of a school bus and only about as heavy as a medium-sized elephant. Still, it's not easy to get them into space. The rocket carrying them will burn about 90,000 gallons (341,000 liters) of high-tech fuel in the first few seconds of the trip. When they say, "Blast off," they really mean it.



An Atlas-5 rocket is as tall as a 20-story building.

Check out NASA's moon missions at moon.msfc.nasa.gov.

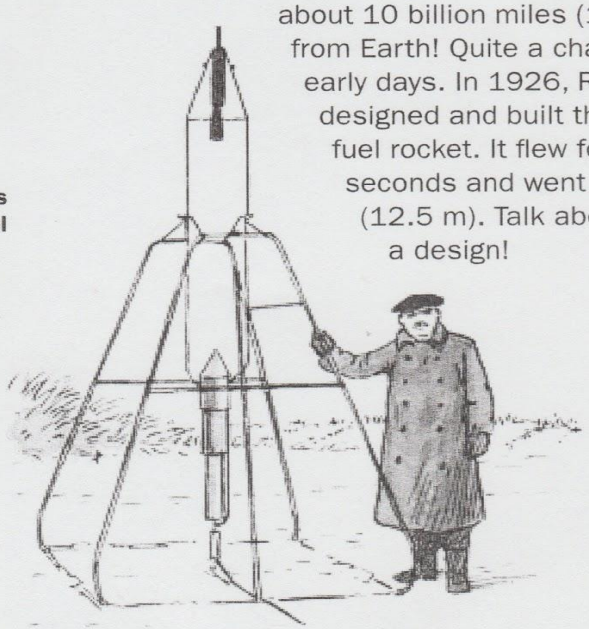


The nosecone is where the astronauts sit or where NASA stows the satellites or equipment it sends into space.

The rocket body is mostly a huge fuel tank on top of rocket engines.

MY, HOW THINGS HAVE CHANGED!

Today's rockets travel fast, far, and for a long time. One rocket, called Voyager 1, has been traveling for more than 30 years and is now about 10 billion miles (16 billion km) from Earth! Quite a change from the early days. In 1926, Robert Goddard designed and built the first liquid-fuel rocket. It flew for only 2½ seconds and went just 41 feet (12.5 m). Talk about improving a design!



Robert Goddard and the first liquid-fuel rocket

References

Design Squad Event Guide. On the Moon. (n.d.). Retrieved from https://pbskids.org/designsquad/pdf/parentseducators/DS_NASA_on_the_moon_complete.pdf