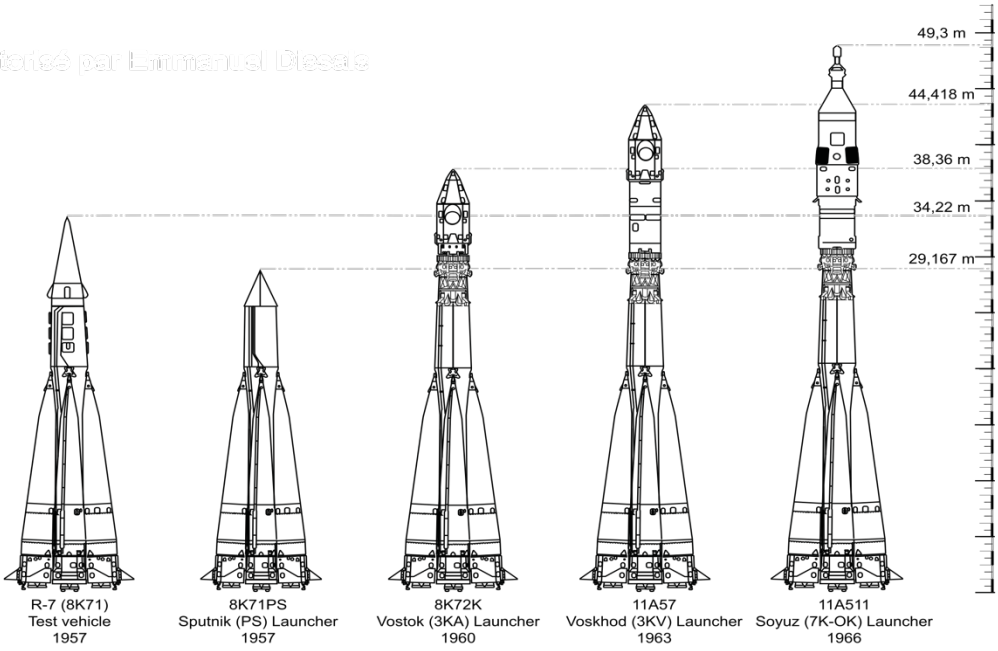
Engineering Lesson Plan:
Russian Rocket Ships!



Sputnik, Vostok, Voskhod, and Soyuz Launcher Schematics

Uttering the text "rocket ship" can excite, mystify, and inspire young children. A rocket ship can transport people and cargo to places far away with awe-inspiring speed and accuracy. The text "rocket scientist" indexes a highly intelligent and admirable person, someone who is able to create, or assist in the creation of machines, vehicles that can actually leave the world we all call "home." Rocket scientists possess the knowledge to take human beings and fantastic machines to space. This knowledge is built upon basic scientific principles of motion and form—the understanding, for young learners, of shapes and their function. This lesson uses the shape of a rocket to ignite engineering knowledge and hopefully, inspiration in young pupils and introduces them to a space program on the other side of the world.

Did you know that the first person in space, Yuri Gagarin, was from the former Soviet Union? That the Soviet Union (now Russia) sent the first spacecraft, Sputnik I, into Earth's orbit? That today, American NASA-based astronauts fly to Russia to launch and must learn conversational Russian as part of their training? Now, in 2020, there are Russians and Americans working together in the International Space Station (ISS), the latest brought there by an American-based commercial craft. Being familiar with the contributions Russia (and the former Soviet Union) has made to space travel is an integral part of understanding the ongoing human endeavor to explore the space all around us. After all, Russian cosmonauts use rocket ships too!

The following lesson plan is intended for kindergarten students in Indiana to fulfill state engineering learning requirements. The lesson can be extended or truncated due to time restrictions, or as the teacher feels appropriate for any given group of learners.

Guiding questions:

How does the shape of something change the way it moves?
Why are rocket ships pointy at the top?
What is "air flow?"
How do you think air moves around a rocket ship?
What do planes and rocket ships have in common?
Which countries launch rockets into space?

Example Guiding questions for advanced students (Learning objective K-2.E.3):
How can someone change the air flow around a rocket?
If you want to build a faster rocket, how can you make it faster?
If you want to build a slower rocket, how can you make it slower?
Why do you think someone would want a slower rocket? [Hint: Think of the people and equipment inside the rocket.]

Learning Objectives:

Engineering K-2.E.1; K-2.E.2; K-2.E.3

1. Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
2. Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.
3. Pose questions, make observations, and obtain information about a situation people want to change. Use this data to define a simple problem that can be solved through the construction of a new or improved object or tool.

Lesson Preparation:

Review the lesson plan and collect the materials. Read through and watch the resources listed below, paying special attention to those in the lesson. It you have time, familiarize yourself with both ROSCOSMOS and NASA home pages and NASA's article titled "Rocket Principles." Print out the coloring sheet for students.

The day before the lesson (or for homework if an option), have learners watch "Yuri Gagarin, First Human in Space (1961)." If in class, discuss the contents of the video with special focus on the rocket in which Gagarin went up and have children color the picture of cosmonaut Yuri Gagarin.

Lesson Presentation:

Remind children of the video they watched on Gagarin. Ask to see their coloring sheets and start discussion on the launch vehicle Gagarin went up in, a rocket! Read or show the short YouTube video of *Rocket Science for babies*. Highlight the shape of the ball versus that of a wing and discuss the concepts of thrust, lift, and airflow highlighted in the book. The shape of an object affects all three things!

Lesson Practice:

Break learners into small groups and while there, using the "Build a Paper Rocket" article below, teach them to construct and decorate paper rockets. Go from table to table to provide them "structural" support. While they are building and discussing, play "Rocket Size Comparison, 2018" video in the background. This contains rockets of all shapes and sizes from the world over and might spark discussion in learners.

Lesson Production:

Have students launch their rockets in groups. Whose rocket has more lift or thrust? Whose rocket could use a bit more structural engineering? Discuss why some rockets went far while others did not. Encourage those students whose rockets did go far to help others improve their design.

Wrap up by showing students the first successful rocket launch, "Launch of Sputnik 1- October 4, 1957." Discuss why the footage looks (and is) dated. Which country launched the first rocket into space? If time, compare with footage from the latest US-based commercial launch, "SpaceX rocket launches 2 NASA astronauts into space."

Extend this lesson:

Discuss fin design on the sides of the rocket and the concept of stability with pupils. Which fins are more stable than others? In the "Rocket Size Comparison, 2018" video, compare American designs with Russian, Soviet, Japanese, Italian, Indian, Chinese, and Multinational ones. Why are the rockets different shapes and sizes? How might that affect their lift and thrust? Which rockets could be faster, which slower?

Materials and Media:

coloring sheets
paper (4 pieces per child)
straws
tape
rulers
pencils
markers, crayons, or colored pencils
scissors
construction paper
internet access and large screen to show short videos

1. Informative article: "Rocket Principles"
   https://www.grc.nasa.gov/www/k-12/rocket/TRCRocket/rocket_principles.html

2. Coloring sheet: "Yuri Gagarin and Vostok Space Craft"
   http://www.supercoloring.com/coloring-pages/yuri-gagarin-and-vostok-spacecraft

3. Paper Rocket Instructions: "Build a Paper Rocket"
   https://www.scientificamerican.com/article/build-a-paper-rocket/

4. Video: “Launch of Sputnik 1- October 4, 1957”
   https://www.youtube.com/watch?v=qvPzUAeWZZY

5. Video: “SpaceX rocket launches 2 NASA astronauts into space”
   https://www.youtube.com/watch?v=OFocqVe3NuM

6. Video: “60th Anniversary: Sputnik 1 Launch in KSP”
   https://www.youtube.com/watch?v=rzzMmZ8Jug8

7. Video: “Rocket Size Comparison, 2018”
   https://www.youtube.com/watch?v=HyL36bH8PP8

8. Video: “Yuri Gagarin, First Human in Space (1961)”
   https://www.youtube.com/watch?v=7iMa03BApcQ

9. Video: “Rocket Science for Babies by Chris Ferrie”
   https://www.youtube.com/watch?v=jPaQbJ6A3B0

10. Book: *Rocket Science for Babies (Baby University)* by Chris Ferrie
    https://www.amazon.com/Rocket-Science-Babies-Baby-University/dp/1492656259

11. Educator’s guide: “3…2…1…LIFTOFF! An Educator’s Guide With Activities in Science, Mathematics, Technology, and Language Arts”
    https://www.nasa.gov/pdf/58149main_3.2.1.Liftoff.pdf

12. NASA official site: https://www.nasa.gov/

13. State Space Corporation of Russia, ROSCOSMOS official site: http://en.roscosmos.ru/