ROCKETS

An Educator’s Guide with Activities In Science, Mathematics, and Technology

National Aeronautics and Space Administration
Office of Human Resources and Education
Office of Education
Washington, DC

Teaching From Space Program
NASA Johnson Space Center
Houston, TX

This publication is in the Public Domain and is not protected by copyright. Permission is not required for duplication.

EG-2003-01-108-HQ
Acknowledgments

This publication was developed for the National Aeronautics and Space Administration with the assistance of hundreds of teachers in the Texas Region IV area and educators of the Aerospace Education Services Program, Oklahoma State University.

Writers:

Deborah A. Shearer
Gregory L. Vogt, Ed.D.
Teaching From Space Program
NASA Johnson Space Center
Houston, TX

Editor:

Carla B. Rosenberg
Teaching From Space Program
NASA Headquarters
Washington, DC

Special Thanks to:

Timothy J. Wickenheiser
Chief, Advanced Mission Analysis Branch
NASA Lewis Research Center

Gordon W. Eskridge
Aerospace Education Specialist
Oklahoma State University

Dale M. Olive
Teacher, Hawaii
How To Use This Guide

Rockets are the oldest form of self-contained vehicles in existence. Early rockets were in use more than two thousand years ago. Over a long and exciting history, rockets have evolved from simple tubes filled with black powder into mighty vehicles capable of launching a spacecraft out into the galaxy. Few experiences can compare with the excitement and thrill of watching a rocket-powered vehicle, such as the Space Shuttle, thunder into space. Dreams of rocket flight to distant worlds fire the imagination of both children and adults.

With some simple and inexpensive materials, you can mount an exciting and productive unit about rockets for children that incorporates science, mathematics, and technology education. The many activities contained in this teaching guide emphasize hands-on involvement, prediction, data collection and interpretation, teamwork, and problem solving. Furthermore, the guide contains background information about the history of rockets and basic rocket science to make you and your students “rocket scientists.”

The guide begins with background information on the history of rocketry, scientific principles, and practical rocketry. The sections on scientific principles and practical rocketry focus on Sir Isaac Newton’s Three Laws of Motion. These laws explain why rockets work and how to make them more efficient.

Following the background sections are a series of activities that demonstrate the basic science of rocketry while offering challenging tasks in design. Each activity employs basic and inexpensive materials. In each activity you will find construction diagrams, material and tools lists, and instructions. A brief background section within the activities elaborates on the concepts covered in the activities and points back to the introductory material in the guide. Also included is information about where the activity applies to science and mathematics standards, assessment ideas, and extensions. Look on page 3 for more details on how the activity pages are constructed.

Because many of the activities and demonstrations apply to more than one subject area, a matrix chart identifies opportunities for extended learning experiences. The chart indicates these subject areas by activity title. In addition, many of the student activities encourage
student problem-solving and cooperative learning. For example, students can use problem-solving to come up with ways to improve the performance of rocket cars. Cooperative learning is a necessity in the Altitude Tracking and Balloon Staging activities.

The length of time involved for each activity varies according to its degree of difficulty and the development level of the students. With the exception of the Project X-35 activity at the guide's end, students can complete most activities in one or two class periods.

Finally, the guide concludes with a glossary of terms, suggested reading list, NASA educational resources including electronic resources, and an evaluation questionnaire. We would appreciate your assistance in improving this guide in future editions by completing the questionnaire and making suggestions for changes and additions.

A Note on Measurement

In developing this guide, metric units of measurement were employed. In a few exceptions, notably within the "Materials and Tools" lists, English units have been listed. In the United States, metric-sized parts such as screws and wood stock are not as accessible as their English equivalents. Therefore, English units have been used to facilitate obtaining required materials.
**Activity Format**

### Teacher Information

**Title:** 3-2-1 POP!

**Objective:** To demonstrate how rockets are used in space exploration and technology.

**Description:** Students construct a simple rocket and observe its flight. This activity is designed to engage students in the principles of physics and engineering.

### Standards

- Physical Science: Rocketry and astronautics
- Mathematics: Geometry and measurement
- Technology: Rocketry and astronautics

### Students

- **Process Skills:** Observation, measurement, problem-solving, critical thinking
- **Materials:** Index cards, tape, straws, plastic tubing, and a small canister

### Management

- **For home projects:** Students should work in pairs or small groups.
- **For school:** Students should work in teams.

### What You Need

- Index cards taped together to form a tube
- Straws for the rocket body
- Tape to secure the straws
- Small canister for the gas canister
- Ways to demonstrate the rocket's flight

### Objective of the Activity

The main objective is to evaluate the design and functionality of the rocket. Students will observe the rocket's flight and evaluate its performance.

### Description of What the Activity Does

- Students build a simple rocket using materials provided.
- They launch the rocket and observe its flight.
- The rocket is designed to explode and disperse the gas canister.

### Assessment Ideas

- Students should evaluate the rocket's flight and the explosion.
- They should also consider the safety of the experiment.

### Background Information

- Rocketry is a branch of science that deals with the design, construction, and operation of rockets.
- Rockets are used in space exploration, defense, and other applications.

### Materials and Tools

- Index cards taped together to form a tube
- Straws for the rocket body
- Tape to secure the straws
- Small canister for the gas canister
- Ways to demonstrate the rocket's flight

### Discussion Ideas

- How does the rocket's flight depend on the design of the rocket?
- What are the safety considerations in this experiment?

### Background Information

- Rocketry is a branch of science that deals with the design, construction, and operation of rockets.
- Rockets are used in space exploration, defense, and other applications.

### Objectives of the Activity

- Students will learn about the basics of rocketry.
- They will design and build a simple rocket.
- Students will observe the rocket's flight and evaluate its performance.

### Minitips

- Always ensure that safety precautions are followed.
- Students should be encouraged to think critically about their design.

### Background Information

- Rocketry is a branch of science that deals with the design, construction, and operation of rockets.
- Rockets are used in space exploration, defense, and other applications.

---

**Student Instruction Pages**

1. **Wrap and tape a tube of paper around the film canister.**
2. **Tape fits to your rocket.**
3. **Roll a cone of paper and tape to the rocket's upper end.**

---

**Student Data Pages**

**ROCKETEER NAMES**

1. **COUNCERNING:**
   - Put on your eye protection.
   - Turn the rocket upside down and fill the canister with water.
   - Work quickly on the next steps.
   - Drop in 1/2 tablet.
   - Snap lid tight.
   - Stand rocket on launch platform.
   - Stand back.

2. **LIFFOFF!**

   What three ways can you improve your rocket?
   1. 
   2. 
   3. 

---

**Assessment:**

- Evaluate the students' designs and the rocket's flight.
- Consider the safety of the experiment.

---

**NASA**

Rockets: An Educator's Guide with Activities in Science, Mathematics, and Technology

EG-2003-01-108-HQ