
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

Objectives of the Activity

Description of What the Activity Does

Assessment Ideas

Standards

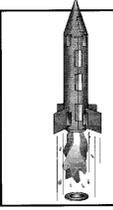
Background Information

Extensions

Management Tips

What You Need

Discussion Ideas



Teacher Information
3-2-1 POP!

Objective:
To demonstrate how rocket liftoff is an application of Newton's Laws of Motion.

Description:
Students construct a rocket powered by the pressure generated from an effervescent antacid tablet reacting with water.

Science Standards:
Physical Science - Position and motion of objects
Science and Technology - Abilities of technological design - Understanding about science and technology

Process Skills:
Observing
Communicating
Making Models
Inferring

Management:
For best results, students should work in pairs. It will take approximately 40 to 45 minutes to complete the activity. Make samples of rockets in various stages of completion available for students to study. This will help some students visualize the construction steps.

A single sheet of paper is sufficient to make a rocket. Be sure to tell the students to plan how they are going to use the paper. Let the students decide whether to cut the paper the short or long direction to make the body tube of the rocket. This will lead to rockets of different lengths for flight comparison.

The most common mistakes in constructing the rocket are: forgetting to tape the film canister to the rocket body, failing to mount the canister with the lid end down, and not extending the canister far enough from the paper tube to make snapping the lid easy. Some students may have difficulty in forming the cone. To make a cone, cut out a "Packman" shape from a circle and curl it in a cone. See the pattern on the next page. Cones can be any size.

MATERIALS AND TOOLS:

- Heavy paper (80-110 index stock or construction paper)
- Plastic 35 mm film canister*
- Student sheets
- Cellophane tape
- Scissors
- Effervescent antacid tablet
- Paper towels
- Water
- Eye protection

*The film canister must have an internal-sealing lid. See management section for more details.

Background Information:
This activity is a very simple but exciting demonstration of Newton's Laws of Motion. The rocket lifts off because it is acted upon by an unbalanced force (First Law). This is the force produced when the lid blows off by the gas formed in the canister. The rocket travels upward with a force that is equal and opposite to the downward force propelling the water, gas, and lid (Third Law). The amount of force is directly proportional to the mass of water and gas expelled from the canister and how fast it accelerates (Second Law). For a more complete discussion of Newton's Laws of Motion, see pages 13-17 in this guide.

Procedure:
Refer to the Student Sheet.

Discussion:

- How does the amount of water placed in the cylinder affect how high the rocket will fly?
- How does the temperature of the water affect how high the rocket will fly?
- How does the amount of the tablet used affect how high the rocket will fly?
- How does the length or empty weight of the rocket affect how high the rocket will fly?
- How would it be possible to create a two-stage rocket?

Assessment:
Ask students to explain how Newton's Laws of Motion apply to this rocket. Compare the rockets for skill in construction. Rockets that use excessive paper and tape are likely to be less efficient fliers because they carry additional weight.

Extensions:

- Hold an altitude contest to see which rockets fly the highest. Launch the rockets near a wall in a room with a high ceiling. Tape a tape measure to the wall. Stand back and observe how high the rockets travel upward along the wall. Let all students take turns measuring rocket altitudes
- What geometric shapes are present in a rocket?
- Use the discussion questions to design experiments with the rockets. Graph your results.

Student Instruction Pages

3-2-1 POP!

1



Wrap and tape a tube of paper around the film canister. The lid end of the canister goes down!

2



Lid

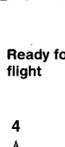
Tape fins to your rocket.

3



Ready for flight

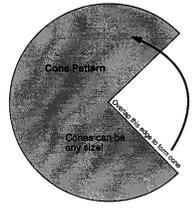
4



Roll a cone of paper and tape it to the rocket's upper end.

5





Cone Pattern

Cone can be any size!

Student Data Pages

ROCKETEER NAMES

COUNTDOWN:

1. Put on your eye protection.
2. Turn the rocket upside down and fill the canister one-third full of water.

Work quickly on the next steps!

3. Drop in 1/2 tablet.
4. Snap lid on tight.
5. Stand rocket on launch platform.
6. Stand back.

LIFTOFF!

What three ways can you improve your rocket?

1. _____
2. _____
3. _____

