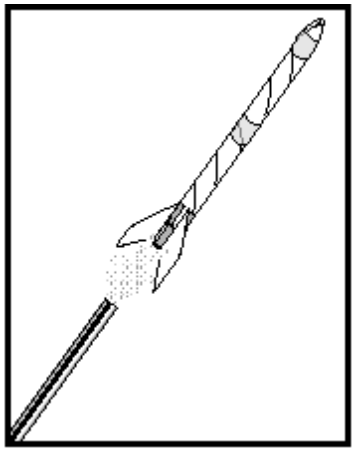
# Paper Rockets



**Teacher Overview:**

In this activity, students construct small flying rockets out of paper and propel them by blowing air through a straw**.**

**Objectives:**

To design, construct, and fly paper rockets that will travel the greatest distance possible across a floor model of the solar system.

**Next Generation Sunshine State Standards:**

**SC.6.N.1.1:** Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

**SC.6.N.1.4:** Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

**SC.6.N.3.4:** Identify the roles of models in the context of the sixth grade science benchmarks.

**SC.6.P.11.1**: Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

**SC.6.P.13.1:** Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.

**SC.6.P.13.2:** Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.

**SC.6.P.13.3:** Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.

**Materials and Tools:**

- Scrap bond paper
- Scissors
- Eye protection
- Sharpened fat pencil
- Milkshake straw (slightly thinner than pencil)
- Cellophane tape
- Masking tape
- Metric ruler
- Pictures of the Sun and planets

**Space Knowledge:**
Although the activity uses a solar system target range, the Paper Rockets activity demonstrates how rockets fly through the atmosphere. A rocket with no fins is much more difficult to control than a rocket with fins. The placement and size of the fins is critical to achieve adequate stability while not adding too much weight.

**Management:**
After demonstrating a completed paper rocket, have students construct their own paper rockets and decorate them (see p. 20). Students may work individually or in pairs.

When students complete the rockets, distribute straws. Select a location for flying the rockets. A room with open floor space or a hallway is preferable. Prepare the floor by marking a 10-meter test range with tape measures or meter sticks laid end to end. As an alternative, lay out the planetary target range as shown on the next page. Have students launch from planet Earth, and tell them to determine the farthest planet they are able to reach with their rocket. Use the planetary arrangement shown on the next page for laying out the launch range.

Pictures for the planets are included as well. Enlarge these pictures as desired.

Students should record data from each rocket launch on their Paper Rocket Test Report (see p. 20). The form includes spaces for data from three different rockets. After the first launches, students should construct new and "improved" paper rockets and attempt a longer journey through the solar system. Encourage the students to try different sized rockets and different shapes and number of fins. Students can create a chart listing how far each planet target is from Earth or can measure these distances for themselves. Making and Launching Paper Rockets:

***Rockets are projectiles! Make sure students wear eye protection!***

1. Distribute the materials and construction tools to each student.
2. Students should each construct a rocket as shown in the instructions on the student sheet.
3. Tell students to predict how far their rocket will fly and record their estimates in the test report sheet. After test flying the rocket and measuring the distance it reached, students should record the actual distance and the difference between predicted and actual distances on the Paper Rockets Test Report.
4. Following the flight of the first rocket, students should construct and test two additional rockets of different sizes and fin designs.

**Teacher Suggestions:**

1. Allow a wide variety of rocket lengths.
2. Experiment with different sizes and number of fins.
3. Keeping accurate records is an important skill. Students should record each time they change a variable until they have the best design.
4. See "MISSION: KSC Space Week Teacher's Guide for Launch Specialists 2007-2008" pg. 35 for Discussion, Extensions, and Assessment ideas.

**Discussion:**

1. What makes one rocket perform better than another? (Do not forget to examine the weight of each rocket. Rockets made with extra tape and larger fins weigh more.)
2. How small can the fins be and still stabilize the rocket?
3. How many fins does a rocket need to stabilize it?
4 What would happen if you placed the rocket fins near the rocket's nose?
5 What will happen to the rocket if you bend the lower tips of the fins pinwheel fashion?
6. Are rocket fins necessary in outer space?

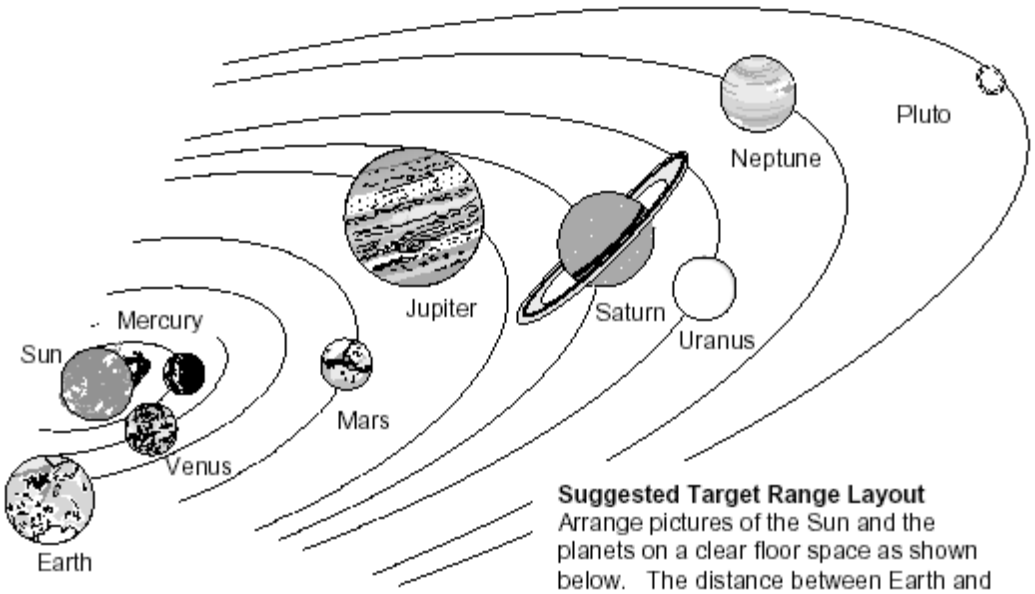
**Extensions:**

Try to determine how high the rockets fly. To do so, place masking tape markers on a wall at measured distances from the floor to the ceiling. While one student launches the rocket along the wall, another student compares the height the rocket reached with the tape markers.

Be sure to have the students subtract the height from where the rocket was launched from the altitude reached. For example, if students held the rocket 1.5 meters from the floor to launch it, and it reached 4 meters above the floor, the actual altitude change was 2.5 meters.

**Assessment:**

Students will complete test reports that will describe the rockets they constructed and how those rockets performed. Ask the students to create bar graphs on a blank sheet of paper that show how far each of the three rockets they constructed flew. Have students write a summarizing paragraph in which they pick which rocket performed the best and explain their ideas for why it performed as it did.

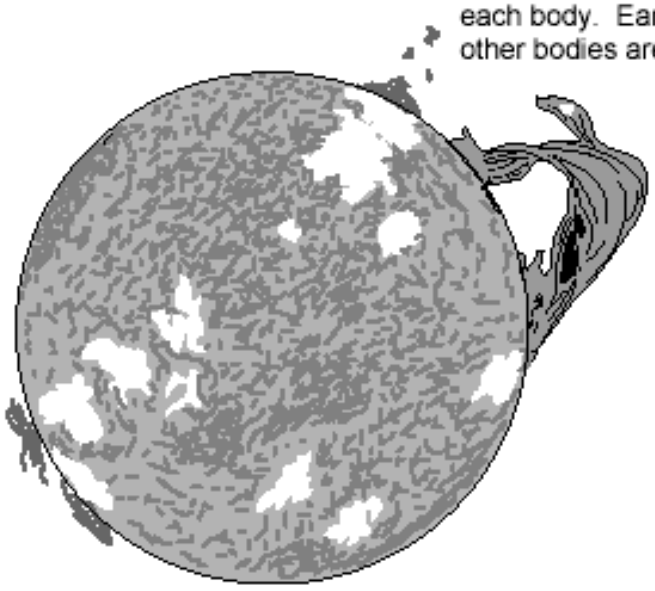



**Suggested Target Range Layout**
Arrange pictures of the Sun and the planets on a clear floor space as shown below. The distance between Earth and Pluto should be about 8 meters. Refer to an encyclopedia or other reference for a chart on the actual distances to each planet.

# Planet Targets

(Not Drawn To Scale)

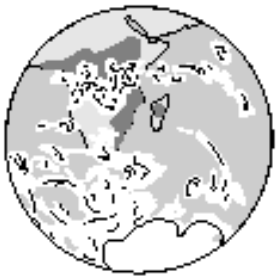
Enlarge these pictures on a copy machine or sketch copies of the pictures on separate paper. Place these pictures on the floor according to the arrangement on the previous page. If you wish to make the planets to scale, refer to the numbers beside the names indicating the relative sizes of each body. Earth's diameter is given as one and all the other bodies are given as multiples of one.



Sun
108X

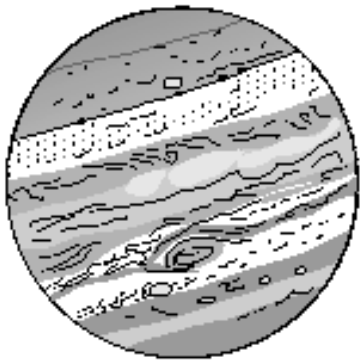
Mercury
0.38X

Venus
0.95X

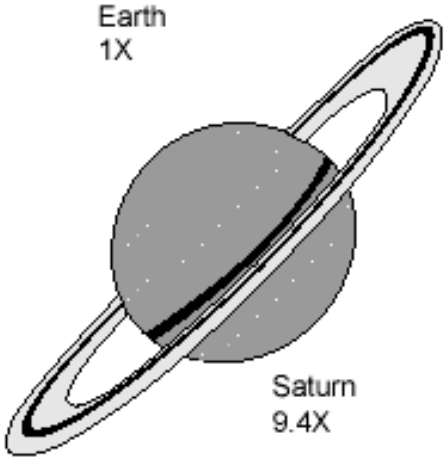


Earth
1X

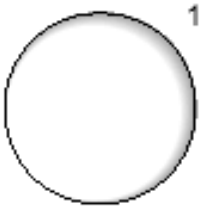
Mars
0.53X



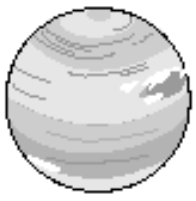
Jupiter
11.2X



Saturn
9.4X



Uranus
4X

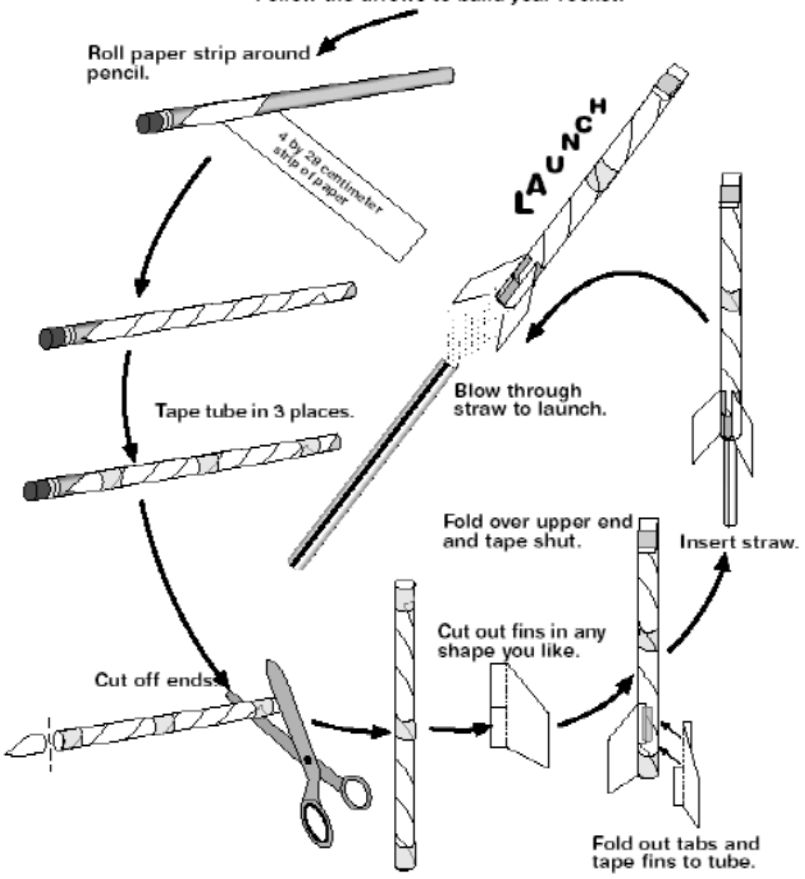


Neptune
3.9X

Pluto
0.9X

# PAPER ROCKETS

Follow the arrows to build your rocket.




Names: _____

_____

# Paper Rocket Test Report

1. Launch your rocket three times. How far did it fly each time. What is the average distance your rocket flew? Write your answer in the spaces below.
2. Build and fly a rocket of a new design. Before flying it, predict how far it will go. Fly the rocket three times and average the distances. What is the difference between your prediction and the actual average distance?
3. Build a third rocket and repeat step 2.
4. On the back of this paper, write a short paragraph describing each rocket you built and how it flew. Draw pictures of the rockets you constructed.

## Rocket 1

Make notes about the flights here.

How far did it fly in centimeters?
1. _____
2. _____
3. _____

Average distance in centimeters? _____

## Rocket 2

Make notes about the flights here.

Predict how many centimeters your rocket will fly. _____

How far did it fly in centimeters?
1. _____
2. _____
3. _____

Average distance? _____

Difference between your prediction and the average distance? _____

## Rocket 3

Make notes about the flights here.

Predict how many centimeters your rocket will fly. _____

How far did it fly in centimeters?
1. _____
2. _____
3. _____

Average distance? _____

Difference between your prediction and the average distance? _____