



Lunar Roving Vehicle

Purpose

To construct a model of a lunar roving vehicle.

Background

The **Apollo lunar roving vehicle** was a battery-powered space buggy. The **astronauts** on Apollo 15, 16, and 17 used it to explore their landing sites and to travel greater distances than astronauts on earlier missions. The lunar rover neatly folded up inside the lunar lander during trips to the Moon. Once on the Moon's surface, it unfolded with the help of springs. The lunar rover carried two astronauts and was manually driven. It was designed to climb steep slopes, to go over **rocks**, and to move easily over the Moon's **regolith**. It was able to carry more than twice its own weight in passengers, scientific instruments, rocks, and regolith samples. The wheels on the rover were made of wire mesh (piano wire) with titanium cleats for treads. Engineers did not use solid or air-filled rubber tires because they would have been much heavier than were the wire mesh wheels. The Apollo **spacecraft** had a fixed amount of mass (payload) it could deliver to the surface, including the rover, rover batteries, scientific instruments, sample collection devices, etc. Hence, the wire-mesh wheels were important to the overall payload mass. This rover was not designed for prolonged use, and it is uncertain if future lunar explorers would use similar designs and materials for their vehicles, use new, more durable components, or turn to **robotic** rovers.

If students are interested in constructing models that actually move, then refer to Page 38 for more information on rocket and model building.

Preparation

Review and prepare materials listed on the student sheet. While commercial building sets are very popular, models can be built with more simple and recyclable materials such as cardboard boxes, tubes, cans, straws, construction paper, string, tape, pins, styrofoam trays, thread spools, balloons, rubber bands, and mouse traps (for propulsion).

In Class / Wrap Up

After construction, students should name their vehicles and write a description of the capabilities and special features.

Lunar Roving Vehicle

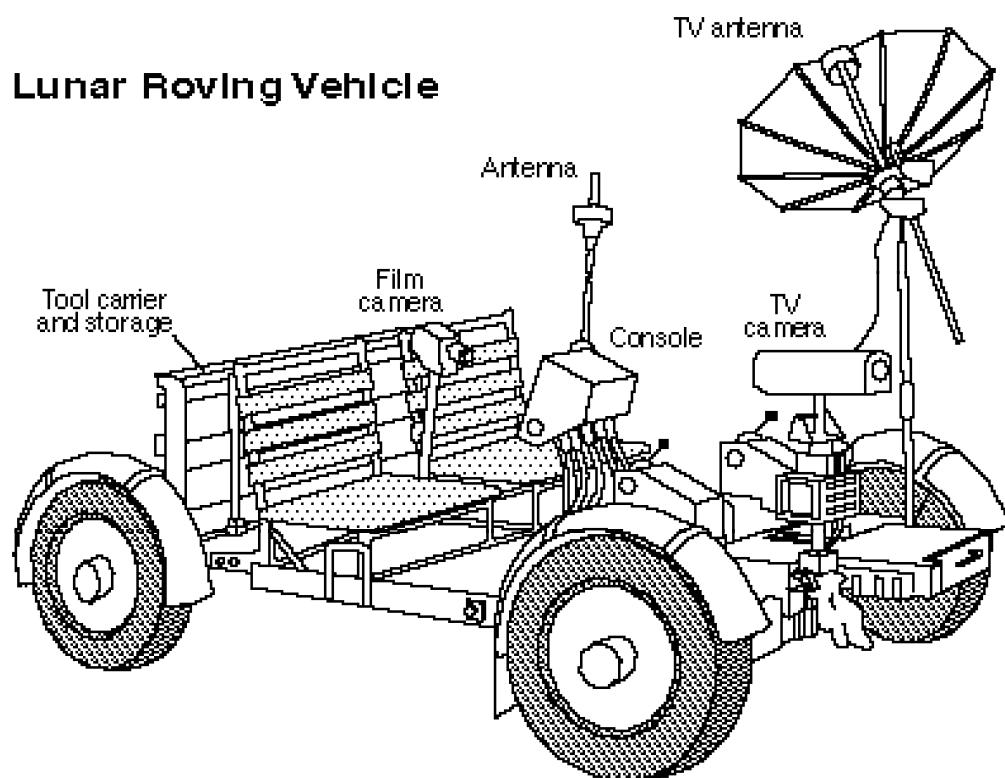
Extensions

Hold competitions between student vehicles with these criteria for judging:

1. Can the vehicle actually move -- by gravity; by some kind of propulsion system?
2. Can the vehicle go over different surfaces -- smooth, flat, bumpy, or inclined?
3. Is the vehicle sturdy?
4. Can the vehicle carry a heavy load? Have the students decide the weight of the load.
5. Could the vehicle withstand meteoritic bombardment?
6. Would the vehicle work on the Moon?

Discuss the pros and cons of manually driven vehicles versus remote-controlled robotic rovers on the Moon.

Diagram of the vehicle used by Apollo astronauts.





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Key Words

antenna
console
tool carrier and storage
robot

Materials

diagram of Apollo lunar roving vehicle
“Moon ABCs Fact Sheet”
construction materials such as cardboard boxes, tubes, cans, straws, construction paper, string, tape, pins, styrofoam trays, thread spools, balloons, rubber bands, mouse traps, etc.
tape measures
stop watches

Procedure

1. Describe the similarities and differences between the Apollo lunar roving vehicle and a typical family vehicle.

2. What was special about the rover's wheels? Why weren't they made of rubber and filled with air?

3. Review the “**Moon ABCs Fact Sheet**.” Design a new lunar roving vehicle. Important design issues include size, weight, power supply, number of passengers, controls, scientific instruments, tools, and storage compartments. Use the space provided on the next page to draw a picture of your design. Label the parts.

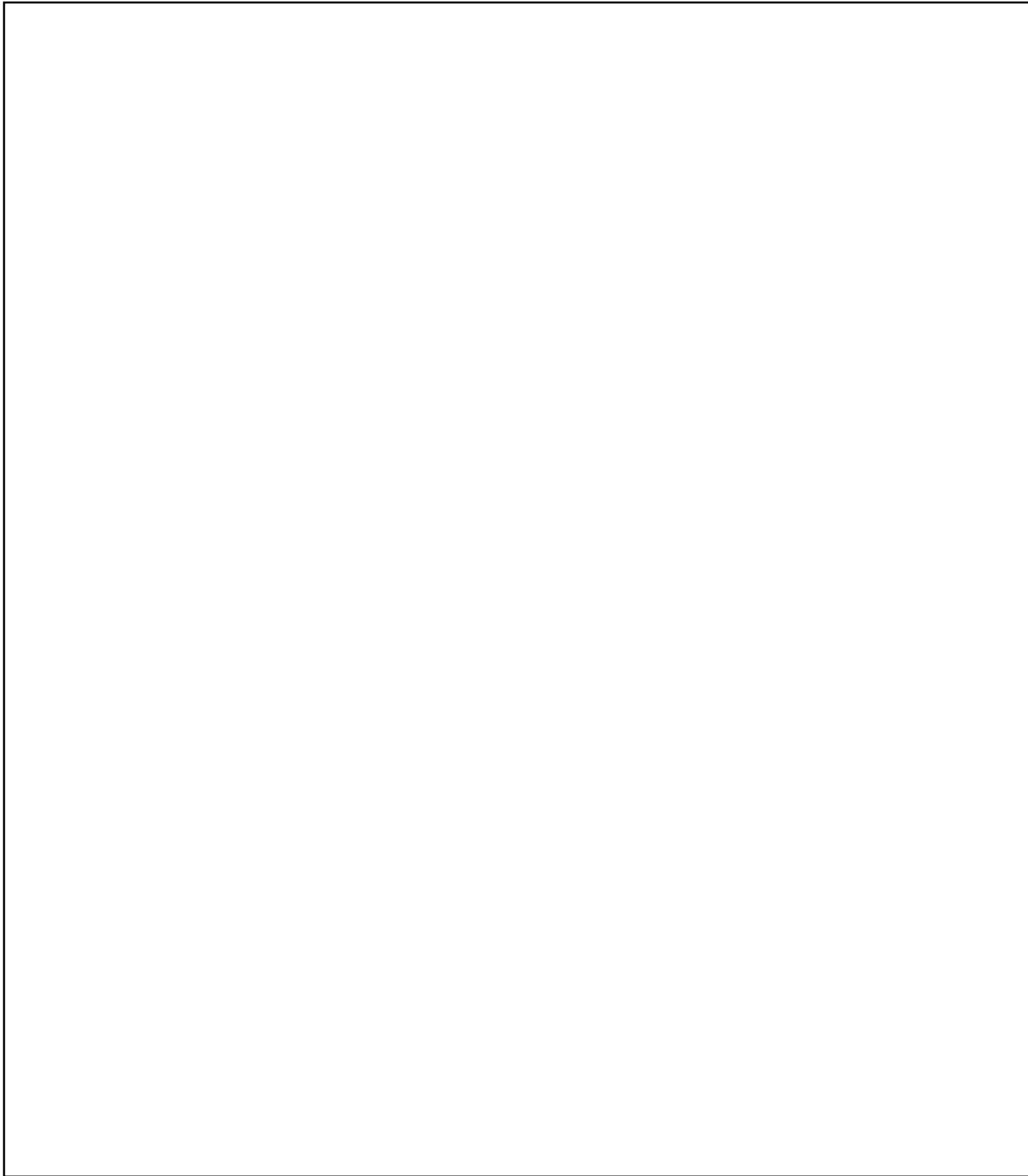
4. Construct a model of the lunar rover based on your design.

5. Give a name to the vehicle.

6. Write a descriptive essay about the special features and capabilities of the vehicle and how you solved the design issues raised in Question 3.

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**Sketch of
my model**



Moon ABCs Fact Sheet

Property	Earth	Moon	Brain Busters
Equatorial diameter	12,756 km	3,476 km	How long would it take to drive around the Moon's equator at 80 km per hour?
Surface area	510 million square km	37.8 million square km	The Moon's surface area is similar to that of one of Earth's continents. Which one?
Mass	5.98×10^{24} kg	7.35×10^{22} kg	What percentage of Earth's mass is the Moon's mass?
Volume	---	---	Can you calculate the volumes of Earth and the Moon?
Density	5.52 grams per cubic cm	3.34 grams per cubic cm	Check this by calculating the density from the mass and volume.
Surface gravity	9.8 m/sec/sec	1.63 m/sec/sec	What fraction of Earth's gravity is the Moon's gravity?
Crust	Silicate rocks. Continents dominated by granites. Ocean crust dominated by basalt.	Silicate rocks. Highlands dominated by feldspar-rich rocks and maria by basalt.	What portion of each body is crust?
Mantle	Silicate rocks dominated by minerals containing iron and magnesium.	Similar to Earth.	Collect some silicate rocks and determine the density. Is the density greater or lesser than the Earth/Moon's density? Why?

Moon ABCs Fact Sheet

Property	Earth	Moon	Brain Busters
Core	Iron, nickel metal	Same, but core is much smaller	What portion of each body is core?
Sediment or Regolith	Silicon and oxygen bound in minerals that contain water, plus organic materials.	Silicon and oxygen bound in minerals, glass produced by meteorite impacts, small amounts of gases (e.g., hydrogen) implanted by the solar wind. No water or organic materials.	Do you think life ever existed on the Moon? Why or why not?
Atmosphere (main constituents)	78 % nitrogen, 21 % oxygen	Basically none. Some carbon gases (CO ₂ , CO, and methane), but very little of them. Pressure is about one-trillionth of Earth's atmospheric pressure.	Could you breathe the lunar atmosphere?
Length of day (sidereal rotation period)	23.93 hours	27.3 Earth days	How long does daylight last on the Moon?
Surface temperature	Air temperature ranges from -88°C (winter in polar regions) to 58°C (summer in tropical regions).	Surface temperature ranges from -193°C (night in polar regions) to 111°C (day in equatorial regions).	Why are the temperatures of Earth and the Moon so different?
Surface features	25 % land (seven continents) with varied terrain of mountains, plains, river valleys. Ocean floor characterized by mountains, plains.	84 % heavily-cratered highlands. 16 % basalt-covered maria. Impact craters--some with bright rays, crater chains, and rilles.	Compare maps of Earth and the Moon. Is there any evidence that plate tectonics operated on the Moon?