MISSION MARS

A LEGOLAND© California
Educational Resource Guide
Grades 3-6

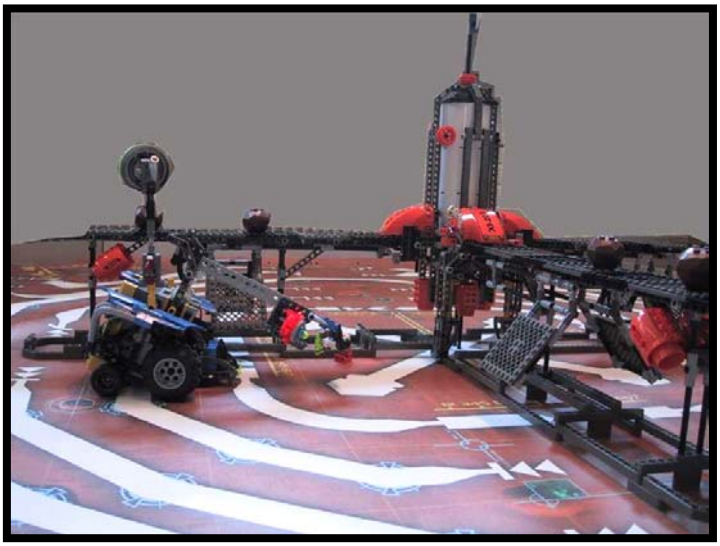


Table of Contents

Welcome to LEGOLAND California

Education Programs: "Mission Mars" was developed by LEGO® and LEGOLAND Education Dept., and has been reviewed for content accuracy by The Planetary Society. For information on LEGOLAND Education programs, visit www.LEGOLAND.com/edu.

Directions: From Interstate 5, buses exit Palomar Airport Road East. Turn LEFT on Hidden Valley Road, and LEFT into LEGOLAND. Cars exit Cannon Road East and turn RIGHT on LEGOLAND Drive.

Arrival and Entry: Please arrive 30 minutes before your instructional program time. Teachers must be present during the 45-minute program. Materials provided.

Lunches: Lunches may be pre-ordered when you book your program, or purchased at LEGOLAND restaurants. School groups may bring lunches in disposable containers and use self-storage bins.

Safety: LEGOLAND Parks are built to the highest standards of quality and safety. Height restrictions apply on selected attractions throughout the Park.

Background Information

The Marvels of Mars

Mars is the 4th planet from the Sun. As it travels in its elliptical orbit, Mars ranges from 125-155 million miles from the sun.

Mars is farther from the sun and colder than Earth. The average temperature on Mars is -75°F, with a range of -200° to 32°F.

Gravity on Mars is less than on Earth. A person who weighs 100 lbs. on Earth would weigh only 38 lbs. on Mars!

Mars' moons, Phobos and Deimos, are smaller than Earth's moon, and shaped like potatoes.

Mars takes 687 Earth-days to orbit the Sun. A Mars day (called a "sol") is 24 hours, 39 minutes.

Travel from Earth to Mars takes between 8 months and 2 years, depending on the path. The time difference is due to the relative distances between the planets as they orbit the Sun.

Mariner 4 was the first spacecraft to visit Mars in 1965. After several attempt to land on Mars, Viking I was successful in 1976. In 2004, the Mars Expedition Rovers *Spirit* and *Opportunity* landed on Mars, and sent back data and pictures. Mars Global Surveyor, Mars Odyssey, and Mars Express now orbit Mars.

Mars Surface

Mars is a rocky planet like Mercury, Venus, & Earth, not gaseous like Jupiter, Saturn, Uranus, & Neptune. A variety of rocks were found by Mars landers--flat, white rocks; small, gray rocks; and large, rounded rocks.

Mars is a dry planet. Low air pressure on Mars causes ice to turn to gas without first turning to liquid, so we probably will not find surface water on Mars. But erosion patterns on Mars look like water channels on Earth, which means water probably once flowed on Mars.

The Hellas Planitia crater is deep enough to swallow Mt. Everest.
The Olympus Mons volcano is the largest volcano in the solar system, 3 times as tall as Mt. Everest.
Valles Marineris canyon is as long as the continental U.S. is wide.

Mars' reddish-brown soil contains iron that has rusted by combining with oxygen.
Duststorms on Mars can cover the whole planet for months at a time.

Mars has polar ice caps that expand and shrink as seasons change. The south cap is made mostly of frozen carbon dioxide, and the north polar cap is made mostly of carbon dioxide covered by water ice.

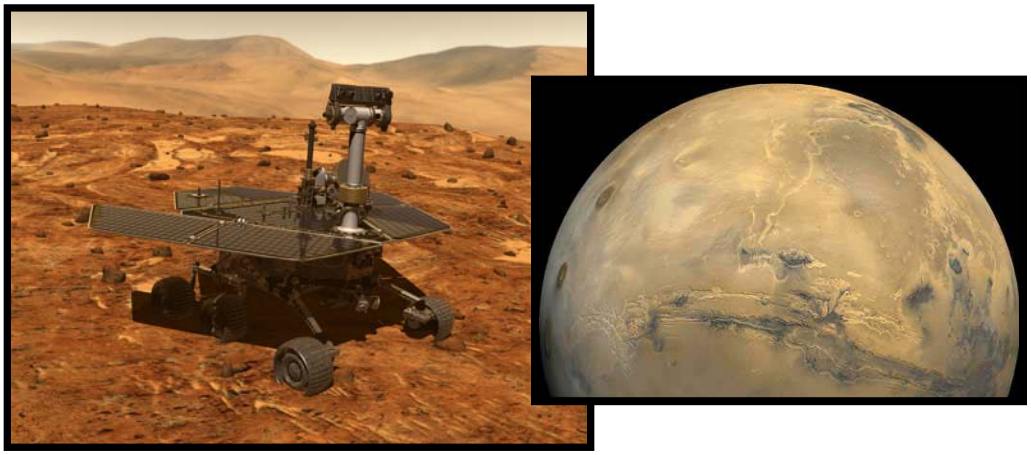
Mars may have been warmer and had more moisture in the past. The rover *Sojourner* found conglomerate rocks (pebbles, gravel, or boulders, bonded by cement). It may be that running water smoothed pebbles, swept them downstream, and embedded them in Martian sediments.

Additional Resource
The Planetary Society website http://planetary.org/mars.

Before and After the Visit: Minds-On Activities

Mars Sample Return Mission

Plan to send a spacecraft to Mars, collect samples from the Mars surface and return them to Earth.



First, Think About Goals.

NASA has 4 goals for a Mars sample return mission. The search for water is common to all these goals.

- Search for evidence of past **climate.**
- Search for past or present **life.**
- Study the **history** of Mars' surface and interior.
- **Prepare for human exploration.** What elements could be resources for future human missions?

Next, Select the Best Landing Site.

It may be a challenge to find a landing site that is both safe and interesting! Eroded crater edges create steep slopes. Dunes may cover crater floors. Would these areas be good landing sites?

In 2001, a group of international students helped scientists decide which areas of Mars to photograph, and helped program the camera of Mars Global Surveyor! Students suggested the hematite region as a landing site. On earth, the crystalline hematite mineral forms in the presence of liquid water. Scientists had also selected this region as a landing site, and NASA rover *Opportunity* discovered evidence for past standing liquid water.

Predict Where the Spacecraft Will Land.

Even when a landing site is chosen, it is hard to know exactly where a spacecraft will land. The orbit of Mars, the spacecraft's position when firing rockets, and conditions of Mars' thin atmosphere all affect the landing.

Scientists think about these factors, then draw a landing ellipse, also called an ellipse of uncertainty. A landing ellipse is an oval, drawn to scale on a picture of Mars, which shows where spacecraft might land.

Plan to Select a Sample.

Only one or two sets of samples from the whole planet can be returned, so samples must be selected carefully! A hematite region sample would help scientists learn about:

- Whether water or life was once in this area.
- Interior rocks, ejected when impact craters were formed.
- Interaction of volcanic and water processes.

Ready to Blast Off to Mars!

Discovery Worksheet

Experience Robotics on Knights' Tournament!

Choose the power of your ride!
Robotic arms are programmed for five power levels.
Within each power level, random combinations
of movements make each ride a unique experience!

Models of NASA Spacecraft in Miniland!

Kennedy Space Center

Listen to the audiotape for answers to these questions.

1. A real mission launched in 1969 went to_____.

2. Name two astronauts on that famous 1969 mission._____.

3. When the space shuttle stack leaves the Vehicle Assembly Building, it is taken to _____.

Mars Exploration Rover

The Planetary Society and LEGO Company unveiled the life-sized LEGO model of the Mars Exploration Rover at the 2002 World Space Congress in Houston.

Although a few details were changed during the real Rover's final design, the LEGO model faithfully represents the real Rover.

Find the four cameras on top, the magnet in front, and sundial in back.

Answers, Kennedy Space Center: 1. The moon. 2. Neil Armstrong, Buzz Aldrin 3.The launch pad.

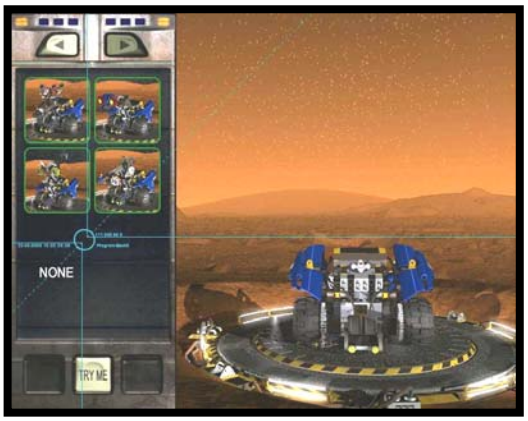
Hands-On Activities

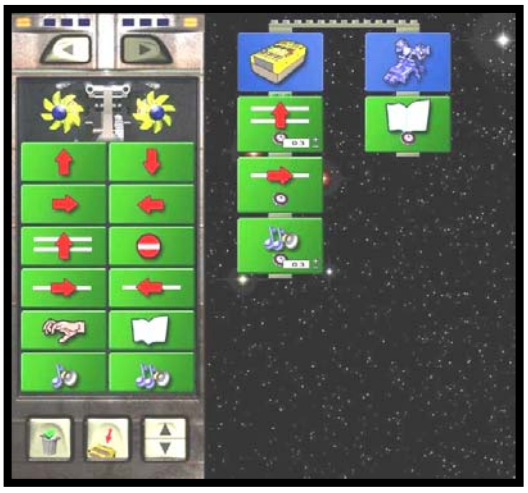
Ready, Robots?

1. First, learn how the robot counts lines, follows lines, goes forward, backward, and turns.

2. Learn about special robotic functions of Cyclo-Bot, Brain-Bot, and Nose-Bot.

3. Survey the Martian landscape to find the stranded scientist and Mars rocks that need to be retrieved.





Choose the Best Bot!

4. Choose a Bot to complete each mission. Some Bots reach low, some reach high, some can lift.

   Click on the screen to show how to attach each special Bot to the rover.

Program the Robot
and
Complete the Missions!

5. Decide on a strategy. Click and drag the commands.

   Download the program, place your robot on the Martian landscape, and send it off!

6. Did your Bot complete its mission? If not, bring it back to the computer and make some changes. There are many ways to complete a mission!

Bring on Bumper-Bot!

Learn about Bumper-Bot's special function and mission!
Our LEGO scientist on Mars is counting on you to complete the final mission on Mars!

About Mission Mars

Educational Objectives

- Learn background information about Mars exploration and objectives of Mars missions.
- Plan a strategy to accomplish a robotic mission.
- Program a robot to perform retrieval tasks.
- Learn to use light and touch sensors.
- Relate hands-on learning activities to the experience of LEGOLAND attractions.

California Content Standards

Grade Three

Science: Investigation and Experimentation

5a. Students will repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods used, or uncertainty in the observation.

5b Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.

5d. Predict the outcome of a simple investigation and compare the result with the prediction.

Math: Measurement and Geometry

2.6 Identify common solid objects that are the components needed to make a more complex solid object.

Grade Four

Science: Investigation and Experimentation

6a. Students will differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6f. Follow a set of written instructions for a scientific investigation.

Grade Five

Science: Investigation and Experimentation

6b. Develop a testable question.

6c. Plan and conduct a simple investigation based on a student-developed question and write it so others can follow to carry out the procedure.

6f. Select appropriate tools… to make quantitative observations.

Grade Six

Science: Investigation and Experimentation

7a. Develop a hypothesis.

7b. Select and use appropriate tools and technology…to perform tests, collect data, and display data.

7e. Recognize whether evidence is consistent with a proposed explanation.