# *THE MIGHTY MARS ROVERS: The Incredible Adventures of Spirit and Opportunity*

**By Elizabeth Rusch**


## ABOUT THE BOOK

Five, four, three, two, one . . . liftoff! On June 10, 2003, a little rover named Spirit blasted off on a rocket headed for Mars. Less than a month later, a twin rover named Opportunity soared through the solar system with the same mission: to find out if Mars ever had water that could have supported life. Totally dependent on solar power, which is scarce during harsh Martian winters, Spirit and Opportunity were expected to survive for three months. Instead, in what may well be the most successful space mission ever, the two go-cart-size, six-wheeled rovers explored the red planet for more than six years. Opportunity has driven farther than anyone can believe, and Spirit survived so many impossible situations that engineers call her "the Indiana Jones of Mars." Defying all expectations, Opportunity is still exploring! *The Mighty Mars Rovers* tells the greatest space robot adventure of all time through the eyes—and heart—of Steven Squyres, professor of astronomy at Cornell University and lead scientist on the mission. Join Steve as he sweats through the rovers' dramatic landings, puzzle with him and his team as they figure out how to make delicate rovers explore deep craters and travel up the sides of jagged mountains, and hold your breath with Steve as Spirit and Opportunity find themselves in grave danger again and again.

## PRE-READING DISCUSSION

Ask students to share what they know about Mars and what they think the surface of Mars is like. Discuss what challenges robots—or people—visiting Mars might encounter.

## DISCUSSION QUESTIONS

In order to get the rovers to Mars, many scientists and engineers had to work together. Describe a situation where you had to work with others to get a job done. What went well? What challenges arose? Why?

What obstacles did Steve Squyres face getting the rover project started? What did he do to try to overcome them? How did he finally succeed? What qualities does he have that helped him accomplish this goal? Do you have any of these qualities?

Sofia Collis won the rover naming contest, calling the two Spirit and Opportunity. Why are these appropriate names? If you were entering the contest, what names would you submit? Why?

Why is it important to calculate the launch date of a rover? What could happen if a launch does not happen at the right time? Explain.

Opportunity landed in a shallow crater. Rusch writes, "It was like scoring a great big interplanetary hole in one!" (31). What does she mean?

On page 32, the author compares rock layers to rings on a tree. How are rock layers similar to and different from tree rings?

What signs did the rovers find that pointed to the existence of water on Mars? Are you convinced that Mars once had water? Why or why not?

A Martian year lasts twice as long as an Earth year, and a Martian day is about forty minutes longer than an Earth day. What does this mean? Why does Mars have longer years and days? Martian drivers suffered jet lag when

switching rovers. Why? Have you ever experienced this phenomenon? How does it feel?

On page 49, Rusch talks about the scientists making "a color-coded map that used red for the spots where the slope tilted toward the sun and blue for areas that faced away from the sun." Why was this important for Spirit's survival?

The scientists named the dune where Opportunity got stuck "Purgatory Dune." What does *Purgatory* mean? Why is this name appropriate? What are some other names that would work?

At one point, Spirit broke a wheel. How did the broken wheel become an advantage? Describe a time in your life when something that seemed like a bad situation turned into a positive one.

With the United States in debt and budget cuts affecting everything from food stamps to education, do you think it is important to continue to send rovers to explore Mars? Why or why not? This could be a class debate, with half arguing for and half arguing against.

What have the rovers taught us about Mars? How is it similar to our planet? How is it different? How have the rovers' discoveries changed the way we see Mars?

Rusch has said that she strives to write nonfiction with heart. What does she mean by this? Where in the book did you see this approach in action? Is it effective? Why?

Would you be interested in space exploration? Why? What job would you like best? Why?

## POST-READING ACTIVITIES

### Language Arts

**Create a Rover Timeline/Comparison**

Though Spirit and Opportunity look alike, they each had a unique experience on Mars. Have students create a timelines for each rover, including launch prep problems, the launches, landings, and major movements, discoveries, and crises on the red planet.

**Special Features of the Book**

This book uses special text and visual features, such as sidebars, photos, captions, maps, text call-outs, and diagrams, to enhance the story and add information. Discuss what features the author uses and why they are effective.

**Rover Writing Activities**

Students can expand their imaginations and show off their writing skills with these fun, creative writing prompts.

1. Create a Mars rover journey journal. Students write an entry per "day" and can include takeoff, landing, driving the rover, exploring craters, potential problems encountered, etc.
2. Imagine you are the first person to step foot on Mars. What do you see? What do you do?
3. Imagine the rover breaks down and you have to fix it from Earth. What do you do?
4. Imagine you are a life form on Mars and you see a rover for the first time. What do you think? What do you do? Create a story.
5. Imagine that we have created a colony on Mars and you are moving there. Describe your journey to Mars. What is the station like? What is it like to live on Mars?

### Science/Engineering

**Design a Mars Rover**

Challenge students to draw a picture of their own invention of a Mars rover. Each Mars rover has specific tasks to perform. Have your students label the parts and their functions. Ask: How did your Mars rover land? How does your rover get around? Does it work on unstable ground? How is it powered? How does it collect samples? How does it record images of its surroundings? Send your pictures to author@elizabethrusch.com and the author may post it on her website!

**Egg Drop**

The rovers needed a way to land safely on Mars. Spirit and Opportunity landed with the help of a parachute, rockets, and airbags. Have students create landing contraptions to keep an egg safe when dropped from a certain height. Discuss which contraptions worked, which didn't and why,

what could be fixed to make them better, and how they are similar and different from the rover landers. For added challenge, limit the materials to be used, the size, and/or the weight.

**Build a Rocket**

Students can create their own rockets to launch. To create a baking soda rocket:

1. Tape several large garbage bags to the floor, creating a launch track.
2. Tape a yardstick to the floor at the starting line of the track.
3. Put a small amount of baking soda into a small clear film canister.
4. Add enough vinegar to just cover the baking soda and quickly replace the lid. (Alka-Seltzer tablets and water also works.)
5. Set the rocket on the start line with the cap pressed up against the yardstick. Get ready: The top will pop off, propelling the canister.
6. Time the rocket until it stops and measure how far it goes.
7. Does the amount of baking soda and vinegar used change the distance that the rocket goes? Try different amounts and have students record the results.

Younger students can create rockets to launch manually from a straw.

1. Wrap a rectangle of paper around a pencil.
2. Tape the paper to form a tube.
3. Fold and tape one end of the rocket to close off the end.
4. Fins can be cut and taped to the sides.
5. Remove the rocket from the pencil and put it on the end of a straw.
6. Blow to launch!

**Rover Communication**

The sidebar "Chatting with the Rovers" on page 30 explains how the rovers send the scientists messages about their surroundings and the scientists send the rovers messages about where to go and what to do next. Split the class into four groups: Mission Control, Deep Space Network, Mars Odyssey, and Mars Rovers. Put Mission Control at one end of the classroom, DSN near them, Rovers at the other end of the classroom. Mars Odyssey circles around the Rovers group. Provide the students with materials such as string, paper cups, toilet paper tubes, and pieces of paper to write messages on (or provide messages for them to relay). Let students design a communication network that reflects real rover communication. Students can make telephones or message movers out of tubes, or they can toss paper balls to each other. After the activity, discuss what worked, what didn't, what was easy, what was difficult, and how well the activity reflects real rover communication.

**Driving a Rover Blind**

The rover drivers had to plan maneuvers for the rover from afar without the benefit of watching the vehicles move through the terrain (see pages 28 and 30). Recreate this challenge in your classroom. In a separate room, set up an obstacle course (including something to pick up) and make a simple map of it with distances marked. Split the class up into groups of four or five. One will be the driver, one will relay commands, and three will be the rover. Give the map only to the driver and ask the driver to write a set of commands for the rover students to follow blindfolded. (Remind students to use specific directions, such as "take baby steps," "take giant steps, " and "turn forty-five degrees." Lead the rover students into the obstacle course room. The rover students should be blindfolded and hold on to each other's shoulders in a line (0=0=0). Using *only* the prewritten commands, the command-relay student must navigate the rover through the obstacle course. The command relay students has the option, only once, to stop the rover, marks its position on the map, and return the map to the driver for a new set a commands. After, discuss what worked, what didn't, what made it difficult, and what they learned about real rover driving from this exercise.

## Social Studies

**Planning Mars Meals**

Steve Squyres says, "What I really want, more than anything else, is boot prints in our wheel tracks," meaning that one day he hopes astronauts will make it to Mars. For this to happen, we need to figure out how to sustain

astronauts on the journey. What will they eat? Astronaut meals need to provide nutrition and travel well. Discuss these questions: *What vitamins and minerals do people need? How many calories will we need in space? What foods pack the most punch in terms of calories and vitamins? What foods travel well? What foods don't travel well?* Add some fun by letting students make an astronaut treat. For each student gather 1/8 cup any flavor instant pudding mix, 1/4 cup milk, ziplock bag, scissors. Have students do the following:

1. Pour pudding mix and milk into the bag.
2. Close the bag securely.
3. Gently knead the mixture inside the bag until pudding forms.
4. Snip off one of the corners with scissors.
5. Squeeze the bag to eat like an astronaut!

## EXPLORE MORE

The next Mars rover, Curiosity, landed on Mars in August 2012. Students can learn about its on-going mission at: http://www.nasa.gov/mission_pages/msl/
To help student understand how science is an on-going quest, ask students to compare the two missions. *How are they the same? How are they different? How has rover design, launch, and landing changed? What are the biggest challenges of each mission? How were they overcome? What questions are the missions designed to answer? What tools do the rovers and scientists have to answers those questions? What questions might come next?*

Would your students like to learn more!? Actually watch the rocket launches or an animation of a rover landing? Get an update on Opportunity or Curiosity? You'll find the best links at: *The Mighty Mars Rovers* Cool Stuff page of the author's website: http://elizabethrusch.com/MyBooks/AllBooks/TheMightyMarsRovers/TheMightyMarsRoversCoolStuff.aspx.

You'll find more resources especially for teachers, including links to more space exploration lesson plans at *The Mighty Mars Rovers* for Teachers page: http://elizabethrusch.com/MyBooks/AllBooks/TheMightyMarsRovers/TheMightyMarsRoversCoolStuff/THEMIGHTYMARSROVERSFORTEACHERS.aspx

## ABOUT THE AUTHOR

Elizabeth Rusch has a four-inch-high scale model rover that she kept next to her computer for inspiration while writing this book. The model rover toppled over and broke so many times that she can't believe Spirit and Opportunity have survived roaming Mars for more than six years. Liz has published more than one hundred articles in magazines such as *Muse*, *Smithsonian*, and *Mother Jones*. She is the author of a number of award-winning nonfiction titles for children, including *Generation Fix*, *Will It Blow?, The Planet Hunter*, and *For the Love of Music: The Remarkable Story of Maria Anna Mozart*. To learn more about her writing and school visits, check out her website at www.elizabethrusch.com.

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