Primarily JASON

Adapting *Mysteries of Earth & Mars* for Elementary Students

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Setting the Stage:

- Use *Mysteries of Earth & Mars* as your teaching theme for the year. Decorate your classroom accordingly.
- Set up a solar system exploration center. Load it with books about the planets, Mars, Earth. Get children excited about *Mysteries of Earth & Mars* by allowing them to preview what they will learn.
- Use a large box to construct a rocket ship in the reading corner. Stock it with plenty of space-related reading material and appropriately stuffed "creatures".
- Send your students a welcome back to school letter on space-theme stationery. Tell them about what you will be studying.
- The first week of school, have your class "dress" themselves as astronauts. Using the digital camera, take a picture of each student (face only). Have them cut out their face and glue it to a pattern of a body then dress themselves in a space suit. Glue the rim of a small paper plate around the face to create the space helmet.
- Coloring pages

Enchanted Learning: Mars printout/coloring page
http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/Mars.shtml
Dover Coloring Book: Mars Exploration Fact and Fantasy
ISBN 0-486-41864-2; cost $3.95
The Space Place Coloring Book
http://spaceplace.nasa.gov/en/kids/coloring_book/index.shtml#

Ongoing Activities:

Morning Work

Correct factual sentences about Mars and teach the mechanics of language at the same time!

- Start your day with "morning work". Find facts about Mars @ http://cmex-www.arc.nasa.gov/CMEX/index.html under the Science heading OR @ http://www.exploringmars.com/science/ataglance.html. Write facts on the board without capitalization or punctuation each morning and have students correct the errors. Once corrected, have students enter the facts into a booklet about Mars and illustrate.
- OR alternate facts about Mars with facts about Earth to create a booklet that compares and contracts the two planets. Information comparing Earth & Mars can also be found @ http://cmex-www.arc.nasa.gov/CMEX/index.html under the Science heading.
- Find out what day it is on Mars. Check out the link to the Martian calendar @ http://cmex-www.arc.nasa.gov/CMEX/index.html under the Calendar heading. Mars Year One is referenced to Earth year 1976, the year of the first successful landing on Mars.

JASON Journals/Portfolios:

- Space Dictionaries: Have children keep an ongoing illustrated space dictionary. Use spiral bound notebooks with tabs. As students learn a new word, have them write a definition, illustrate, and add to their dictionary.
- JASON Experience Journal: Students of any age can keep JASON journals. At the end of each day children should write a sentence or two about what they have observed and/or learned about JASON that day.
- Simplified JASON Booklets: The teacher can go through the curriculum and copy pictures, maps, etc. to create a simplified JASON booklet for younger students to record their information in. These booklets can be either hole punched then organized in a three-ring binder OR prebound with plenty of blank pages in between. Vocabulary words can also be included with spaces to write and/or illustrate meanings.
- All student work (journals, graphs, stories, reports, drawings, poetry, etc.) can be collected and kept in JASON portfolios. Create portfolios by folding and stapling large pieces of tagboard into giant envelopes.

Weather Activities:

- Read Cloudy with a Chance of Meatballs for a fun introduction to weather. Have students use *Kid Pix* to create their own creative version of the weather.
- Have children illustrate how a water cycle works. Make a water cycle wheel. Instructions @ http://www.epa.state.il.us/kids/fun-stuff/water-cycle/
- Learn about clouds @www.brainpop.com/science/weather/clouds
- Create charts of different clouds. Use white paint & clear glitter for cirrus clouds. Use cotton balls for cumulus clouds. Use cotton balls colored gray with a marker and pulled thin for stratus clouds.
- Use a digital camera and take a picture of the sky each day. Post in sequence. Write a description of the weather underneath the picture - temperature, precipitation, etc. Guide the children into making generalizations between the kinds of clouds they observe and the weather.
- Available from NASA - Teacher's guide: A Look At Weather, Activities for the Primary Student. This book addresses kinds of weather, forecasting, weather lore, weather on Mars, etc.
- Have a student serve as the weather person for the day. Look up the forecast for your area as well @ http://www.weather.com/. This site also has a converter that changes Fahrenheit to Celsius.
- Plot the information onto an ongoing line graph (using large graph paper from a roll). Graph in Fahrenheit, Celsius, or both.
- Color in thermometers to show the average daytime and nighttime temperature. Compare & contract to your area by also marking your average daytime and nighttime temperatures. Use Fahrenheit and Celsius.
- More advanced - Do a line graph of average monthly temperatures and /or the average monthly rainfall in your area.
- Keep an ongoing chart comparing the times of the daily sunrise/sunset. Calculate number of daylight hours.
- Find out the 5-day weather forecast for your area. Graph (in red) the predicted highs and lows. Draw an illustration indicating whether sun, clouds, or precipitation are expected. Then graph the actual temperatures in blue. Compare to the predictions.

Internet Activities:

- **Dress Me for Space**
  http://www.nasa.gov/audience/forkids/games/G_Dress_Me_for_Space.html
- **Are There Grocery Stores in Space? (video)**
  http://ksnn.larc.nasa.gov/videos_low_cap.cfm?unit=food

- **Mars Games:** Weight on Mars, Virtual Mars, Take a Mars Adventure, Build a World on Mars then send as a postcard), 3D Mars ROVER Game, Mars Word Find
- **NASA Brain Bites:** one minute videos that answer questions dealing with space http://spaceflight.nasa.gov/brainbite/home.html

Thinkquests

Feature a Thinkquest site of the week at your classroom computers. Thinkquests are internet sites created by teams of students as part of an international competition.

- Find a list of Mars related Thinkquests @ http://www.thinkquest.org/library/search.html

Webquests

- Analyzing Meteorological Data from Mars http://btc.montana.edu/ceres/html/MarsWeather/mars1.htm
- Investigating the Dynamic Martian Polar Caps http://btc.montana.edu/ceres/html/Polar/polar1.htm
- Mars Quest http://btc.montana.edu/ceres/html/MarsQuest/Quemarsintro.html
- First Manned Mission to Mars http://btc.montana.edu/ceres/html/MarsMission/Mission.htm
- Operation Space Travel http://www.gpisd.org/gpisd/modules/Elementary/Space%20Travel/VISIT1.HTM
- Reasons to Colonize Mars http://www.the-solar-system.net/webquests/colonize-mars-webquest.html
- My Trip to Mars http://eprentice.sdsu.edu/J03OP/hughes/wq/s-trip2mars.htm
- Hilton Hotels Planetary Travel Brochures http://www.berksiu.k12.pa.us/webquest/styer/index.htm

Teacher Resources:

Internet

- Mars Activity Book (131pages) FREE pdf download @ http://mars3.jpl.nasa.gov/classroom/

Table of Contents:

- Order an Earth/Mars Comparison Poster @ http://mars.jpl.nasa.gov/classroom/earthMarsForm.html
- The Space Place: Teachers' Corner @ http://spaceplace.nasa.gov/en/educators/
- Mars Exploration: Fun Zone @ http://marsprogram.jpl.nasa.gov/funzone_flash.html

- Reaching for the Red Planet (planning a Mars colony) curriculum available online @ http://cosmos.colorado.edu/~urquhart/outline.html

Books

- Dover Coloring Book: Mars Exploration Fact and Fantasy by Bruce La Fontaine
- Rocket Science by Jim Wiese
  Published in 1995, this book's 7 chapters make devices using mechanics, air power, waterpower, electricity & magnetism, chemistry, acoustics, and optics.
- Physics for Every Kid by Janice Van Cleave
  Published in 1991, this book has 101 experiments. There are chapters on gravity, flight, inertia, and motion.
- Astronomy for Every Kid by Janice Van Cleave
- Exploring Mars and Beyond (Teacher Created Materials) by Greg Young
  Activities include: Martian Orbit, Retrograde in Motion, Chronology of Missions to Mars, Hitting a Moving Target, Time Delay, Capturing the Satellite, and information about the different missions to Mars.
- Arty Facts: Space and Art by Polly Goodman
  Linking art to science
- Astronomy Adventures by National Wildlife Federation
  Published in 1989 with a 1997 update, activities include Creature Feature (adaptation), Whirling & Twirling (rotation song), Cosmic Vacation (creating travel brochures for planets), Astro Match (planets & their moons), Crazy About Craters (modeling craters), A Matter of Gravity, and Our Next Step: Mars by Barry Evans
- Simple Space & Flight Experiments with Everyday Materials by Louis V. Loeschnig
  Published in 1999, there are chapters of experiments about gravity, exploration in outer space, and rocketry.
- The Everything Kids Space Book: All About Rockets, Moon Landings, Mar, and More Plus Space Activities You Can Do at Home! (Everything Kids Series) by Kathiann M. Kowalski

Reading

Nonfiction PICTURE BOOKS

The Magic School Bus: Lost in the Solar System) by Joanna Cole
The Magic School Bus: Out of This World by Joanna Cole
The Magic School Bus: Sees Stars by Joanna Cole
The Magic School Bus: Taking Flight by Joanna Cole
Discovering Mars: The Amazing Story of the Red Planet by Melvin Berger (1992)
Destination Mars by Seymour Simon (2000)
Exploring Mars (Explore Space) by Deborah Shearer
Life on Mars (grades 3 – 6) by David Getz
A Look at Mars (more advanced) by Ray Spangenburg

Fiction PICTURE BOOKS

Goldilocks and the Three Martians by Stu Smith
After reading and comparing to the original fairy tale, have children create outer space equivalents for other famous fairy tales.

EASY CHAPTER BOOKS for Literature Groups

- Mission to Mars by Franklyn M. Branley
- Planet Pee Wee by Judy Delton
- Midnight on the Moon by Mary Pope Osborne
- Space Explorers (Magic School Bus Chapter Book) by Joanna Cole
- Unleashed in Space (Super Adventures of Wishbone) by Alexander Steele
- Gloria Rising by Ann Cameron
- Martians Don't Take Temperatures (Bailey School Kids series) by Debbie Dadey
- **Commander Toad series:**

Commander Toad in Space by Jane Yolen
Commander Toad and the Space Pirates by Jane Yolen
Commander Toad and the Intergalactic Spy by Jane Yolen
Commander Toad and the Planet of the Grapes by Jane Yolen
Commander Toad and the Big Black Hole by Jane Yolen
Commander Toad and the Dis-Asteroid by Jane Yolen
Commander Toad and the Voyage Home by Jane Yolen

More Reading Experiences to Compliment

- Little Rock on Mars (an online story) @ http://eis.jpl.nasa.gov/~skientz/little_rock/index.html

And now…… on to the curriculum ☺

Mysteries of Earth & Mars

Introduction to Mysteries of Earth and Mars

Where are we going and why? (THE classic JASON question)

Children should first learn about the solar system- sun, 9 planets & their moons, asteroids & comets.

- There is a great collection of Space Theme Poems and Songs @ http://www.teachers.net/lessons/posts/1644.html
- Lots of good activities in Astronomy Adventures by National Wildlife Federation
  Published in 1989 with a 1997 update, activities include: Whirling & Twirling (rotation song), Cosmic Vacation (creating travel brochures for planets), Astro Match (planets & their moons), Solar System Chart, Blast Off (a make-believe trip through the solar system)

Children should then learn the basics of our world - 7 continents, 4 oceans, equator, latitude, longitude, tropical zones, polar zones, & the hemispheres.

- Act out the globe. Have kids touch their heads and say North Pole, put their hands on their waists and say equator, put their hands on their feet and say South Pole.
- Use rubber stamps of the continents and let the children stamp them in their proper hemispheres.
- Be creative. First study the shapes of the continents. Then discuss what each continent looks like. Give the children the shapes of each continent and have them write this sentence underneath: This is the continent of _____ but it looks like _____ to me. Example - *This is South America but it looks like a pork chop to me.*
- Using blue butcher paper, make a map of the world. Use string to put on the longitude and latitude lines. Using a copy machine, enlarge the continents to scale. Have the students place the continents in the correct locations by latitude and longitude.

Thinking Like a Scientist

- Have children draw a picture of a scientist. Most of them will draw a male (with wild hair) in a lab coat surrounded by test tubes. Then introduce the children to the team of scientists for the Mars Expedition (pages 12 – 17 in the Student Activities Book)
- Teach children the steps to "think like a scientist" – Student Activity Book pg. 10
  - Make detailed observations: understand qualitative versus quantitative
  - Ask questions about what you observe: select a research question
  - Form hypotheses: attempt to answer your research question

- Design an investigation to test your hypothesis: determine what you are testing, identify your independent & dependent variables, design your procedure
- Conduct your investigation.
- Record data about what happens.
- Analyze your data,
- Draw conclusions.

- Use the above steps to conduct this simple experiment. Take two identical sponges. Saturate each sponge with exactly the same amount of water. Make qualitative and quantitative observations. Hypothesize as to what might happen if you put one in a zip lock bag and leave the other one out on the chalk ledge. Conduct the investigation, record and analyze the data.

Unit 1: Physical Science

Research Article 1.1: Introduction: Destination Mars

Hitting a target from a distance is like sinking a basketball.
One must aim just right, with right force and right arc.

What kinds of missions are sent to Mars? *4 main kinds of missions: flyby, orbiter, lander, rover*

- **NASA Online Activity**: Make a Balloon-powered Nanorover @ http://spaceplace.nasa.gov/en/kids/muses1.shtml
- Read chart on page 23:
  - Examine the pictures of the different missions in Mars Exploration: Fact & Fantasy by Bruce LaFontaine (a Dover Coloring Book)
  - Highlight advantages (in yellow) & disadvantages (in blue) for each type of mission.
- Exploring Mars and Beyond (Teacher Created Materials) by Greg Young
  Illustrations and information about early Mars missions: Mariner, Viking, Observer, Pathfinder.

How does NASA choose when to launch a spacecraft to Mars?

Use the analogy of runners on a track - Earth is on the inside lane.
Every two years Earth and Mars are close for a brief period.

- Take students out to the playground and act out the planets in orbit. Have one student be the sun, a second student be a planet "in an inner orbit" walking around the sun, and a third student be a planet "in a outer orbit" walking around the sun. The children will see that occasionally the planets line up.
- Exploring Mars and Beyond (Teacher Created Materials) by Greg Young
  Activities: Retrograde in Motion, Hitting a Moving Target

What is the science behind a spacecraft launch ?

It takes a powerful force to lift a spacecraft.
Vocabulary for understanding: force, gravity, mass, accelerate, payload

The Law of Gravity

- Weight on other planets @ http://kids.msfc.nasa.gov/Puzzles/Weight.asp
- OR calculate on your own @ http://www.teachtsp.com/products/productextras/SCISCI/gravity.html
- Physics for Every Kid (chapter 4) contains 6 experiments on gravity

Newton's First Law of Motion

An object in motion stays in motion, an object at rest stays at rest.

- Physics for Every Kid (chapter 8) contains five experiments on inertia.
- More inertia experiments @ http://www.teachtsp.com/products/productextras/SCISCI/inertia.html

Newton's Second Law of Motion

Force equals mass x acceleration.

Newton's Third Law of Motion

For every action there is an equal and opposite reaction.

  - Physics for Every Kid (chapter 9) contains experiments on motion. Look at experiments: Balloon Rocket and Paddle Boat. They demonstrate the principles of Newton's Third Law.
- Rocket Science: Two-Stage Rocket and Water Rocket projects work because of Newton's Laws.
- Brainpop movies: on gravity, Newton's laws of motion @ www.brainpop.com
- **NASA Online Activity**: Launch a "Rocket" from a Spinning "Planet" @ http://spaceplace.nasa.gov/en/kids/ds1_mgr.shtml

What are the challenges in sending astronauts to Mars?

Challenges include: length of trip, extreme temperature, low atmospheric pressure, cosmic radiation, amount of fuel needed.

- Talk about packing for an 18 month long trip and what one's needs would be. Make connections to early explorers like Columbus, early pioneers packing to move west and what they had to pack.
- Discuss temperature and what protection would be needed for extreme temperatures.
- Low atmospheric pressure could cause an astronaut's blood to boil.
- Make sure that children understand that Mar's thin atmosphere would not protect the astronauts from cosmic radiation.
- Challenge the children to think about fuel: list ways vehicles are powered – wind, sun, gas, etc. Discuss the way space vehicles are powered and what the fuel requirements to get home would be.

Activity 1.1 Take Off

This activity teaches the concept of mass and Newton's Laws of Motion.

- Build and launch two rockets according to directions in the curriculum. Younger students could do a simplified version of this activity with older students/parent leaders.

Research Article 1.2: Scientist Spotlight: Energizing an Orbiter

What is energy?

Energy is the ability to do work. It takes many forms – motion, light, heat, sound, electricity

kinetic energy (motion)

The energy of motion.

potential energy (stored) –

Stored energy - chemical or gravitational

- Brainpop movies: kinetic energy, potential energy @ www.brainpop.com
- Physics for Every Kid (chapter 9) contains experiments on motion. Look at experiments: Bonk, Loser, Energy Change. They demonstrate the principles of kinetic & potential energy.

What are some ways that energy changes forms?

Energy transfer changes energy from one form to another.

- Explain to the children using the example of a rock falling off a cliff, a firecracker, etc.

What form of energy does a Mars orbiter use?

The orbiter uses solar energy (from the sun). Heat is a form of energy.

- Bring in an example of a small solar-powered item like a calculator. Discuss how it works.
- Conduct a simple experiment and predict what will happen when the energy source (light) is removed. Teach children the steps to "think like a scientist" – Student Activity Book pg. 10
  - Make detailed observations: understand qualitative versus quantitative
  - Ask questions about what you observe: select a research question
  - Form a hypothesis: attempt to answer your research question
  - Design an investigation to test your hypothesis: determine what you are testing, identify your independent & dependent variables, design your procedure
  - Conduct your investigation.
  - Record data about what happens.
  - Analyze your data,
  - Draw conclusions.

- Relate to the challenges that the scientists face when planning for the orbiter to fly through night.

Activity 1.2 The Facts of Friction

Friction is a force that resists the motion between two surfaces in contact.

- Rub hands together as a demo of friction.
- Physics for Every Kid (chapter 9) contains experiments on motion. Look at experiments: How Far, Roller, Air Car, Wind Brake, Wobbler. They demonstrate the principle of friction.
- Activity Master 1.2A Putting on the Aerobrakes
  The Fun Fact on page 35 refers to the flat solar panels acting like a parachute to slow down the spacecraft. Physics for Every Kid has an experiment called Bigger (pg.70-71) that demonstrates the principle of air resistance.
- **Mars Global Surveyor model** available to demonstrate aerobraking @ http://marsprogram.jpl.nasa.gov/funzone_flash.html pdf file under activities

Research Article 1.3: Scientist Spotlight: Building a Rover

What are some challenges to designing and building Mars rovers?

Challenges are extreme temperatures & slope.

- Children might be able to relate to extreme temperatures making it more difficult to start a car on a cold morning.
- Have children discover how slope affects speed by rolling small balls, cars, etc. down grooved surfaces. You can also teach geometry concept of angles.

How do engineers make spacecraft lightweight, yet durable enough for space travel?

Mass and its relation to acceleration – kicking a basketball VS bowling ball

Alloys – mixture of materials, usually metals

- Put a can of soda in the freezer to demonstrate weakness of aluminum. Discuss the need for something stronger.
- NASA Online Activity: Test a New Spacecraft Material @ http://spaceplace.nasa.gov/en/kids/nmp_action.shtml

Activity 1.3 Safe Landing

- Design and build a lander. Test it and evaluate its success. Younger students could do a simplified version of this activity with older students/parent leaders.

Research Article 1.4: Local Connection: Water, Water… Nowhere!

Earth's water exists in three states: solid (polar caps), liquid, and gas (clouds).

- Rhymes, crafts, activities, water cycle diagrams, Water Cycle Adventure (A Reader's Theater script), weather quizzes and more @ http://www.EnchantedLearning.com/themes/water.shtml

Books:

- Water(A fun, colorful beginning book about water) by Frank Asch
- Water (An amazing pop-up, pull-tab, lift-the-flap guide to all aspects of water-groundwater, streams, floods, drinking water, and more) by Francois Michel
- Water Dance (Poems and Pictures about water) by Thomas Locker
- The Water's Journey (descriptive text/pictures describe the water cycle in our everyday lives) by Eleonore Schmid

What is a phase change?

Water does not disappear; it changes from one state to another.

How does temperature affect the state of water on Earth and Mars?

Need to understand the concept of melting point and boiling point of water.

- Relate to the concept of snow. It only snows when it is cold enough to freeze.
- When boiling water on the stove, steam (water vapor) forms above the pan.

How does atmospheric pressure affect the state of water on Earth and Mars?
Children need to understand that atmospheric pressure affect the boiling temperature of water.

- Water boils at a lower temperature in the mountains because there is less air pushing down.
- Without an atmosphere, there would be no air pressure so water would boil as it melted.

Activity 1.4 Properties of Fresh Water & Salt Water

Density & Salinity

- *Word Study Tip: Discuss meaning of dense - a dense forest.* Have the children taste chocolate angel food cake vs. fudge, pea soup vs. broth.
- Teach the children the concept of density with vegetable oil and water. Color a cup of water blue. Add a half of a cup of oil and shake. Let the liquids settle so that the children can see the oil resting on top of the water.
- Then explain that salt water has a different density than freshwater because of its salinity. Demonstrate by placing a hard-boiled egg in a tall glass of freshwater. It will sink to the bottom. Take the egg out and increase the salinity of the water (with table salt) until the egg floats.
- If you color salt water then very slowly pour freshwater on top of it. You can create a liquid sandwich to further demonstrate how salinity effects density.

Freezing Point & Boiling Point

- Teach the children about the freezing point and boiling point of fresh water. Then hypothesize if the density of salt water might cause it to freeze or boil at temperatures different than fresh water.

Unit 2:Earth & Space Science

Research Article 2.1: Introduction: Exploring Geology on Earth & Mars

- Great lesson on the similarities between the geological features of Earth and Mars @ http://school.discovery.com/lessonplans/programs/thepathtomars/
- Exploring Planets in the Classroom has more than 25 hands-on activities on Mars, Earth, volcanology, impact craters, etc. @ http://www.spacegrant.hawaii.edu/class_acts/index.html

How are the geological features on Earth and Mars similar and different?
Both Earth and Mars have volcanoes, mountains, canyons, polar ice caps, dunes, and craters. The most significant difference between the planets is that liquid water covers 70 % of the Earth's surface and there is no evidence of liquid water on Mars.

- Make sure the children understand the concept of 70% by using dimes.

How are the geological processes on Earth and Mars similar and different?
Tectonics

- All About Plate Tectonics (for younger students). Includes illustrations and animations @ http://www.enchantedlearning.com/subjects/astronomy/planets/earth/Continents.shtml
- Teach the children that the earth is like a jigsaw puzzle with pieces called plates. Then give them the map of the earth cut into plates and have the put it back together like a puzzle. Plate tectonic maps can be found @ http://vulcan.wr.usgs.gov/Glossary/PlateTectonics/Graphics/framework.html
- A more advanced lesson in about plate tectonics can be found @ http://www.extremescience.com/PlateTectonicsmap.htm#Pacificplate
- The Amazing Earth Model Book by Donald M. Silver and Patricia J. Wynne has two models that teach about moving plates: Plates on the Move (pgs. 110 - 118) which teaches how plates create and Plate Time Travel (pgs. 118 - 124) which teaches about Pangea and continental drift.
- Movies from Brainpop (www.Brainpop.com) on Earth's Structure, Plate Tectonics

Volcanism

- How Volcanoes Work: an online resource that combines print information, movies, and interactive quizzes @ http://www.geology.sdsu.edu/how_volcanoes_work/

- A great resource book is **The Amazing Earth Model Book** by Donald M. Silver and Patricia J. Wynne. It has a number of paper models, booklets, etc. that children can out together to help them learn about the earth.
- Suggested books for students: **I Can Read About Earthquakes and Volcanoes** by Deborah Merrians, **Volcanoes and Earthquakes in Action** by Marianne Borgardt, **Volcanoes** by Seymour Simon and **Magic School Bus Inside the Earth** by Joanna Cole.
- Make a 3D model of the layers of the earth (core, mantle, crust). Use a styrofoam ball. Cut in half. Have the children paint the inside layers. Then paint the oceans and the continents on the outside. This activity is also good for teaching the concept of hemispheres.
- Give each child a peanut M&M and have them describe in their journals how it is like the earth and its layers.
- Make sure that you do the experiment with the Alka Seltzer in the film canisters on page 131. The children LOVE it and want to do it over and over!!

Erosion

- Erosion can be caused by wind, water, & ice.
- When you build a sandcastle on the beach incoming waves erode it.

Cratering

- See activities in section 2.2

How do scientists study Martian geology?

With the help of landers and rovers, scientists are able to study the geology of Mars from 30 million miles away.

Activity 2.1 Which Feature Came First?

- Children first should study the pictures on page 57 of the common geologic features of Mars.
- Then discuss the Principle of Cross Cutting (running your finger across a frosted cake analogy) and the Principle of Superposition (pile of clothes analogy). To further explain, go out into an area of the schoolyard where you might find a dog's paw print.
- Work together to determine which came first on activity master 2.1B

Research Article 2.2: Scientist Spotlight: Making An Impact

How do impact craters form on planets?

Vocabulary for understanding: impactors, ejecta, rim.

How do scientists study impact craters on Earth and Mars?

Landers and rovers enable scientists to study craters.

What do scientists learn by studying impact craters?

Scientists can determine the age of different areas and splosh craters are evidence of frozen water beneath the surface of Mars.

Activity 2.2 Modeling Martian Craters

Do as a demonstration for younger students.

Research Article 2.3: Scientist Spotlight: Investigating Mars on Earth

What is a Martian meteorite?

Children need to understand the difference between minerals and rocks. Bake chocolate chip and nut cookies. The entire cookie is like a rock; the chips and nuts are like minerals.

How do scientists study Martian meteorites?

This concept might be difficult for younger students to understand.

What can Martian meteorites tell scientists about Mars?

Scientist can tell that some minerals were from a volcano, some were formed in water, etc.

Activity 2.3 Martian Meteorite Mysteries

This activity in its entirety is probably too difficult for younger students but they can use the Earth Minerals Data Chart to determine possible characteristics of the area on Mars where the meteor was found.

- Some great rock and mineral activities can be found at http://www.nps.gov/brca/Geodetect/Rocks%20%26%20Minerals/RM%20unitpage.htm

  Here's a description of the activities:
  - Everywhere, Rocks and Minerals Explore rock and minerals you have around you everyday.
  - In or Out? Igneous Rocks One of three main rock types, igneous rocks form from molten rock. This game allows students to be molecules of rock minerals that solidify to form various igneous rocks.
  - Limestone, Sandstone and Shale, Oh My! allows students to perform experiments to differentiate between sedimentary rock types.
  - Extension: Depositional Environments uses what was learned in the main sedimentary rock activity and allows students to discover the rock's history.
  - All Stressed Out! teaches about the stresses that make metamorphic rocks.
  - The Sweet Taste of a Sugar Rock Cycle teaches students the various interactions between the three main rock categories.
  - Testing the Physical Properties of Minerals teaches students different tests that can be used to identify an unknown rock or mineral.
  - Building a Rock and Mineral House allows students to use the information they learned about the properties of rocks and minerals to determine their possible uses in the past by Native Americans and in modern life by all of us today.

Research Article 2.4: Local Connection: Digging Up the Dirt

Great Resource:

- Soil Science Education Homepage @ http://soil.gsfc.nasa.gov has a wealth of information and great links. Here are a few examples:
  - **soil cake recipe @** http://soil.gsfc.nasa.gov/students.htm

    1 81/2 inch plastic flower pot
    plastic flowers
    1 garden trowel
    lots of gummy worms
    1 package Oreo cookies, crushed
    1 8 oz. package cream cheese
    1 c. powdered sugar
    8 oz. Cool Whip
    1 large box of chocolate pudding
    1 chocolate cake mix (baked, cooled, and crumbled up)
    Layer 1: (soil layer) Spread crushed Oreo cookies into the bottom of plastic flower pot, reserving 1 cup for Layer 5.
    Layer 2: Combine cream cheese, sugar, and Cool Whip. Mix and spread over Layer 1. "Plant" flowers as you add layers.
    Layer 3: Mix pudding with a little less milk than the directions require so the pudding is thicker. Spread over Layer 2.
    Layer 4: Bake cake mix and allow to cool. Once cooled, crumble over Layer 3. Add gummy worms here.
    Layer 5: (soil layer again) Spread reserve cup of crushed Oreo cookies over Layer 4, then top with more gummy worms and remaining flowers. Serve this yummy "SOIL" with a garden trowel and enjoy!!!!!
  - **Rock 'N Soil (soil songs) @** http://soil.gsfc.nasa.gov/songs/songs.htm
    titles include such classics as: "Dig, Dig, Dig Your Pit", "Oh Give Me a Home With A Deep Mellow Loam", "Old MacDonald Had a Pit", "Where Have All the Bedrocks Gone" and many, many more.

How does soil on Earth compare to soil on Mars?

- Soil on Earth contains organic matter (humus) and varies from place to place. Soil on Mars seems to be fairly similar across the planet – like fine ground cinnamon.

Why do scientists study soil?

- Make sure children understand why soil is so important to life on our planet.
- After reading page 76 with the children create a Venn diagram together that compares and contrasts the reasons for studying soil on Earth and Mars.

Activity 2.4 Soil Sleuthing

Children should be able to do a modified version of this activity.

Unit 3: Life Sciences

Research Article 3.1: Introduction: The Search for Life

What is astrobiology?

Astrobiology is the study of life in the universe.

- Create your own space alien. You may draw it or create a 3D model out of recyclables. Think about what it needs to survive – air, food, water. and shelter.

What are the requirements for life?

Liquid water, nutrients, energy (food chain)

- Illustrate the desert food chain described in the article.

Does Mars have the requirements for like or did it in the past?

The only missing ingredient seems to be water. There is evidence that the atmosphere of Mars was thicker in the past.

- Draw what you think life on Mars may have looked like.

Activity 3.1 It's Alive

Younger students could do a simplified version of this activity with older students/parent leaders.

Research Article 3.2: Scientist Spotlight: Life in the Extremes

What are extreme environments and what lives in these environments?

Places that are too hot, too cold, too dry, too dark, too acidic (see aquatic field study), etc.

- Discuss the kinds of creatures that live in these places: giant tube worms, red algae, etc.

How can studying extreme environments on Earth help scientists look for life on Mars?

Analogs are real life models that help scientists understand extreme environments.

Activity 3.2 Extreme Adaptations

Younger students could do a simplified version of this activity with older students/parent leaders.

Research Article 3.3: Scientist Spotlight: Signs of Life

A microbiologist studies life that can only be seen through a microscope.

What is a biosignature?

A sign of present or pat life - fossils are an example of a biosignature.

- Suggestions for making fossils with children can be found @ http://www.proteacher.net/cgi-bin/asrchwrap.cgi?string=fossils&number=0
- Host an indoor fossil dig. Find instructions @ http://www.state.me.us/doc/nrimc/pubedinf/crest/activity/act26.htm

How does the study of biosignatures help scientists search for life on Mars?

The concept of microbial mats may be difficult for children to understand.

Activity 3.3 Get the Signature!

This activity may be too difficult for younger students. Parts of it may be attempted as a demonstration.

Research Article 3.4: Scientist Spotlight: What's Living in Your Neighborhood?

What are biotic and abiotic characteristics in an ecosystem?

Vocabulary for understanding: biotic (living), abiotic (sunlight, temperature, salinity, pH), ecosystem

What are the "normal" ranges of life?

Are there "extremes" even in paces that aren't extreme environments?

Some environments go through drastic seasonal changes.

- List extreme conditions in your own environment.

Activity 3.4 Local Field Investigation

The Aquatic Field Study (a JASON classic)

- Younger students may need to be paired with older students/ parent volunteers OR parents can man stations. Children could travel from station to station (in small groups) with their water and have an adult help them with the various tests. Prior to doing the Aquatic Field Study, students will also have to become familiar with scientific terms.
- Take a walk around the school for children to get a feel for the topography of their area. Have them observe both at school and at home where water travels after a rain.
- Introduce the children to the concept of freshwater aquatic invertebrates. Do a simulation of collecting and classifying organisms.
- Introduce the children to the concept that aquatic creatures get their oxygen from water. Then they will understand why it is important to test for dissolved oxygen in the water.
- The class weatherman reports the air temperature every day. Discuss different temperatures and how they relate to our weather. Then relate what has been learned to water temperature. Have children practice taking temperatures of water at different temperatures.
- Introduce the concept of PH to the children. Test the PH of everyday liquids and graph the PH results. Make sure that children understand the relationship between PH level and abundance of life.
- Introduce the concept of density and salinity by creating a liquid sandwich. Color liquids with different densities with food coloring. You can literally stack the liquids on top of each other. Make sure that children understand that salinity affects water density.
- Shine light through water to teach the concept of clarity.
- Introduce the children to the different types of sediment.
- Have children practice making weather observations and help them become familiar with the Beaufort Scale.
- Brainpop Movies
  Temperature @
  http://brainpop.com/science/energyandheat/temperature/index.weml
  PH @
  http://brainpop.com/science/matter/ph/index.weml
- Adopt-A-Watershed Curriculum Units by Grade Level can be found @
  http://www.adopt-a watershed.org/matrix/matrix.htm

Culminating Activities:

- Design Mysteries of Earth and Mars shirt to wear to the expedition. Use fabric crayons or permanent markers. Challenge the kids to come up with a design that focuses on everything that they have learned.
- Make a class quilt comparing and contrasting Earth and Mars.
- Create a class ABC book of Mars for your school library.
- Get a large refrigerator box work together to create a jumbo diorama of the Mars and rovers.
- Group children to work on *Kid Pix* slide-shows that tell about Mars.

Final Note: What About Assessment?

- Recommended book for teachers of primary grades - **Rubrics, Checklists and Other Assessments for the Science You Teach** by Ann Flagg. This book provides easy assessments to use with science activities. It gives checklists, journal rubrics, drawing assessments, etc.