Exploring Geology on the World-Wide Web – Planetary Geology, Asteroids, Comets, and Meteorites

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INTRODUCTION

A top candidate for mankind's crowning achievement in this century would certainly be our ability to break free of Earth's gravity and travel through space. As if there weren't enough unanswered questions about the history and mechanisms of our own Earth, we can now probe and ponder the inner workings of our neighboring planets, moons, asteroids, and visiting comets. Our questions range from the simple to the complex: "What are they made of?" "What geologic forces have acted on them?" "Could any of them support life now or in the past?"

Planetary geology is also a very timely subject. Back-to-back successes of the Mars Pathfinder/Sojourner mission and Jupiter's Galileo orbiter and probe have revitalized NASA and stirred the spirit of exploration in all of us. And with the discovery earlier this year of water ice on the moon. we have all the makings of an astronomical renaissance. On May 20-21, 1998, NASA/JPL will host A *Day on Europa*, celebrating the unique geologic environment of that icy Jovian moon. Check out their web site listed below and be a part of the festivities!

All of the URL addresses in this article are available as links from a web page at:
http://www.geo.utexas.edu/bexton/jge/jge.htm

PLANETARY IMAGES

NASA Planetary Photojournal

http://photojournal.jpl.nasa.gov/

If NASA has photographed it, here's the place to find it. The layout and navigation are simple and quick, providing easy access to high-quality, press-released images. Pull-down menus allow the user to select images by target, telescope, or spacecraft. Most images provide the original captions and technical data and can be downloaded in a variety of formats (.gif, .jpg, .pic, and .tif). As many readers may have already deduced, most of the resources on the World-Wide Web related to this topic are government sites of excellent quality.

PROFESSIONAL ORGANIZATIONS

GSA Planetary Geology Division

http://www.planetary.brown.edu/~crumpler/Planetary_Division.html

The Geological Society of America's Planetary Geology Division, maintained by Larry Crumpler at Brown University.

AGU Planetology Section

http://earth.agu.org/sections/planet/planet.html

Home page for the American Geophysical Union's Planetology Section, with links to planetary science publications.

The Planetary Society

http://www.transatlantech.com/TPS/spacegate.**html**

A comprehensive listing of space science resources on the Internet.

GENERAL PLANETARY SCIENCE

NASA StarChild

http://rxte.gsfc.nasa.gov/docs/StarChild/StarChild.**html**

This NASA site on astronomy and planetary science was developed primarily by teachers at Lakeside Middle School in Evans, Georgia, and is an ideal starting point for young students.

NASA SpaceLink

http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/.index.html

A list of current NASA educational products available, including activities, slide sets, videos, and so forth, with target audience and grade level given.

Lunar and Planetary Institute

http:Ncass.jsc.nasa.gov/

Includes images grouped by geologic process, a good collection of slide sets, and links to other planetary web sites.

Welcome to the Planets

http://pds.jpl.nasa.gov/planets/

A collection of some of the best NASA images, as well as ordering information for the CD-ROM version of the site.

National Space Science Data Center

http://nssdc.gsfc.nasa.gov/planetary/planets/

The site to visit for the most current *data* on the planets.

Views of the Solar System

http://www.hawastsoc.org/solar/

One of the best sites for comprehensive facts and figures for all bodies in the solar system. Maintained by Calvin Hamilton on the Hawaiian Astronomical Society's web server.

The Nine Planets
http://www.anu.edu.au/Physics/nineplanets/nineplanets.html

A multimedia tour of the planets, designed by Bill Arnett at the University of Arizona.

SPECIFIC EXTRATERRESTRIAL BODIES

The resources below feature information about specific targets in the solar system, excluding the earth.

Mercury
http://nssdc.gsfc.nasa.gov/planetary/planets/mercurypage.html

Mercury fact sheet and additional resources from the National Space Science Data Center.

Venus – The Venus Hypermap
http://www.ess.ucla.edu/hypermap/Vmap/top.html

A clickable map to the images returned by the Magellan spacecraft. Also contains general information about Venus.

Venus – The Face of Venus
http://www.eps.mcgill.ca/~bud/craters/FaceOfVenus.html

Learn about the surface of the planet Venus on this site, which is maintained by Glen Newton and Paul Budkewitsch at McGill University.

Venus – Ice on Venus?
http://www.lhs.berkeley.edu/SII/SII-VenusIce/venusice.1.homepage.html

An online activity for grades 4-12, designed by Alan Gould at the University of California, Berkeley Campus.

Moon – Clementine Mission
http://www-phys.llnl.gov/clementine/

Contains mission information and lunar images processed at Lawrence Livermore National Laboratory.

Moon – Lunar Prospector Mission
http://lunar..arc.nasa.gov/

Detailed information on NASA's first moon mission in 25 years. Also includes data related to the recent discovery of ice at the lunar poles.

Moon – Lunar Sample Laboratory Facility
http://www-curator.jsc.nasa.gov/curator/lunar/tour/welcome.htm

Learn how rock samples from the moon are stored and investigated.

Mars – Center for Mars Exploration
http://cmex-www.arc.nasa.gov/

The Center for Mars Exploration page provides a variety of links related to Mars exploration of the past, present, and future.

Mars – The Whole Mars Catalog
http://www.reston.com/astro/mars/

Commercial site with links to everything one always wanted to know about Mars and more.

Jupiter – Galileo Project
http://jpl.nasa.gov/galileo/

This is the official Galileo Project home page at the Jet Propulsion Lab in Pasadena, California. Recent images from the Galileo Europa Mission, as well as links to many excellent educational activities relating to the geology of Jupiter's moons. *On May 20-21, 1998, NASA/JPL will sponsor the nationwide event, A Day On Europa. Highlights will include an electronic field trip, interactive web chat, moderated panel discussion, and other media events designed to increase public awareness of the incredible science returned by the Galileo spacecraft.* ***Log on now*** *for up-to-date information on the activities!*

Jupiter – Galileo SSI Education
http://jpl.nasa.gov/galileo/sepo/

Galileo's Solid State Imaging team, led by Michael Belton at the National Optical Astronomy Observatories in Tucson, Arizona, maintains its own web site. Additional educational modules written for middle-school students, as well as posters and stickers, are available for download.

Saturn
http://nssdc.gsfc.nasa.gov/planetary/planets/saturnpage.html

Saturn fact sheet and additional resources, including a link to the Cassini Mission home page, from the National Space Science Data Center.

Uranus
http://nssdc.gsfc.nasa.gov/planetary/planets/uranuspage.html

Uranus fact sheet and additional resources from the National Space Science Data Center.

Neptune
http://nssdc.gsfc.nasa.gov/planetary/planets/neptunepage.html

Neptune fact sheet and additional resources from the National Space Science Data Center.

Pluto – Pluto-Kuiper Express
http://www.jpl.nasa.gov/pluto/contents.htm

Mission mformation and educational materials direct from JPL.

ASTEROIDS, COMETS, AND METEORITES

Kuiper Belt Objects
http://www.ifa.hawaii.edu/faculty/jewitt/kb.html

A nice site with interesting information and animations of these enigmatic remnants from the early solar system. Maintained by David Jewitt at the University of Hawaii.

Asteroid and Comet Impact Hazards
http://ccf.arc.nasa.gov/sstl

The latest news on Near Earth Objects, with links to images, animations, and further reading.

***Sky & Telescope's* Online Comet Page**
http://www.skypub.com/comets/comets.html

From the editors of *Sky & Telescope* magazine, this site has references to articles about comets, as well as a lengthy list of links to other sites.

Exploring Meteorite Mysteries

http://www-curator.jsc.nasa.gov/outreach1/expmetmys/expmetmys.htm

An excellent teacher's guide with background information and activities. Requires Adobe Acrobat Reader.

The Comet's Tale

http://www.cea.berkeley **.edu/Education/comod/com.html**

One of the best interactive sites about comets on the web! Wonderful graphics and straightforward text. Designed by the Science Education Outreach team of The Center for EUV Astrophysics at the University of California, Berkeley Campus.

Meteorites from Mars!

http://www-sn.jsc.nasa.gov/planetscience/marsmet/text.htm

Provides a comprehensive look at meteorites from Mars, including the controversy surrounding the bacteria-like structures contained within them.

COURSE INFORMATION

Brown University

http://www.planetary.brown.edu/planetary/**geo5/**

http://www.planetary.brown.edu/planetary/**geo286/**

http://www.planetary.brown.edu/planetary/**geo287/geo287.html**

These excellent sites, for three different planetary geology courses, are the collected efforts of James Head at Brown University. Each contains a comprehensive syllabus and course materials.

University of Pittsburgh

http://corona.eps.pitt.edu/www_GPS/courses/GEO0870/outline0870.html

Lecture notes for the course *Geology* 0870 – *The Planets* taught by Bruce Hapke at the University of Pittsburgh.

Arizona State University

http://www-glg.la.asu.edu/~glg_intro/planetary/01_start_planet.htm

On-line exercises for the course *Geology of the Terrestrial Planets* taught by Robert Grimm at Arizona State University.

Florida State University

http://geomag.gfdi.fsu.edu/~cain/planetary.html

Lecture notes for the course *Planetary Science* taught by Joseph Cain at Florida State University.

Idaho Virtual Campus

http://wapi.isu.edu/Geo_Pgt/index.htm

Planetary Geology for Teachers is a creative on-line course taught by Scott Hughes at Idaho State University. Although some information is available to browse, the complete course requires registration.

MISCELLANEOUS

National Air & Space Museum

http://www.nasm.edu/GALLERIES/GAL207/gal207.html

Exploring the Planets online exhibit.

Hubble Space Telescope

http://oposite.stsci.edu/

Includes images as well as educational activities related to the Hubble Space Telescope.

Astrobiology Web

http://www.reston.com/astro/

Glitzy commercial site edited by Keith Cowing, with interesting articles and discussions on planetary geochemistry and the greater question of life in the universe.

Extrasolar Planets

http://www.physics.sfsu.edu/~gmarcy/planetsearch/planetsearch.html

Information from Geoff Marcy at San Francisco State University and the team of scientists searching for planets orbiting distant suns. Far out.

SUMMARY

Planetary geology is a hot topic among scientists, and students are naturally interested in anything *extraterrestrial*. Our understanding of planetary geology and geochemistry, as limited as it may be at this time, far surpasses that of twenty years ago. In other words, hanging mobiles of the solar system are out. Information gleaned from the sites above can form the basis for interesting and detailed comparisons between Earth and other planets. Students can download images and use the same observational skills that planetary geologists are currently using to interpret geologic processes. So log on, and experience a whole new world!

WEB TIP OF THE MONTH

Most webmasters expect visitors to knock on the front door first. With detailed URL addresses (such as those found in this column), the user often bypasses the home page and heads directly for a file. If your browser is unable to locate an address, don't give up hope! There's still a good chance it exists *somewhere*. Starting with the most complete address available, remove the filename or subdirectory at the end (highlight and delete) and then try again. Continue this process until you reach an active directory, and then look for a new or related link or file. For example:

http://server.edu/geo/courses/**201.htm** – *URL Not found*

http://server.edu/geo/courses/ – *Access denied*

http://server.edu/geo/ – *Active* and contains **links** for:

http://server.edu/geo/**catalog/**

http://server.edu/geo/catalog/**201/**

http://server.edu/geo/catalog/201/**201.htm** – *Success!*