Washington's complex geology gives rise to many geologic hazards—earthquakes, active volcanoes, landslides, tsunamis, and abandoned mines. One of the more important missions of the Division of Geology and Earth Resources is to reduce the impact of geologic hazards on the citizens of Washington. As Washington's geological survey, the Division contributes to the safety and economic well-being of Washington's citizens by educating the public, government, and industry about the consequences of foreseeable geologic events and the nature of the land around us, including the availability of important resources such as aquifers and sand and gravel. The Division has provided this information at very low cost to taxpayers, and studies have shown that providing geologic information to the public more than pays for itself over time. The Division of Geology is regarded as the primary source of geological products and services in support of decision-making by Washington's government agencies, its businesses, and the public.

The Division of Geology provides:
- Evaluation of geologic hazards and advice on their mitigation,
- Disaster response and damage assessment,
- Surface and subsurface geological mapping,
- Inventory and regulation of mineral, oil & gas, and geothermal resources,
- Technical support for environmental and forest protection,
- A comprehensive library collection on the geology of Washington,
- The Washington State Interactive Geologic Information Portal, and
- Easily accessible information on Washington geology.

ENVIRONMENTAL GEOLOGY AND HAZARDS
Division geologists identify and assess geologic hazards using modern geotechnical and geophysical methods. Our hazard maps are critical for transportation, land-use, and emergency-management planning, as well as disaster response and building-code implementation. As our population grows, there is increasing pressure to develop in hazardous areas. Delineation of these areas has never been more important.

Our mapping program identifies geologic materials characteristics, areas of low and high water infiltration potential, and probable groundwater pathways, as well as areas subject to ground failure during earthquakes and large precipitation events. In the Puget Sound area, we work closely with the Puget Sound Partnership, the Hood Canal Dissolved Oxygen Program, and local agencies to help implement our findings.

Additionally, we are mapping tsunami hazard zones and collateral earthquake-induced ground failures. We are partnering with the Washington Emergency Management Division to do the public outreach that fosters tsunami-resilient communities. This can contribute to good policy decisions, such as preserving the coastal habitats that serve as tsunami buffers.

In response to the Growth Management Act's mandate to use the 'best available science', our geologists meet with local governments and citizens in at-risk communities to educate them about geologic hazards and ensure that these hazards are considered in growth-management and disaster planning.

The Division is also among the first responders to disasters, helping staff the State Emergency Operations Center at Camp Murray and later documenting damage in the field.

Landslides
Landslides are a continuing problem along our hillsides, shorelines, and roadways. Just since 1996, landslides have caused hundreds of millions of dollars in damage and at least six deaths in Washington. Average loss from landslides over the last 30 years is more than $20 million per year.

The Division is a leader in landslide hazard identification, mitigation, and emergency response. Our geologists responded to landslide emergencies in Seattle in 1997, in Olympia and Grand Coulee in 1998, and in Snohomish County in 2002. We have mapped Cowlitz County's landslide hazard areas to assist with growth-management planning that will protect future homeowners. The county's Aldercrest landslide, which destroyed 138 homes, was declared a federal disaster area. Damage to public and private property was estimated in excess of $30 million.

Storms in 2007 and 2009 resulted in thousands of landslides and millions of dollars in damage. The Division's Quick Reports and use of the Internet on these events has set a new standard to help with emergency response. Our statewide landslide database, with over 50,000 mapped landslides, is available on our new interactive Washington State Geologic Information Portal.

Landslide hazard maps can help avoid loss to property and save lives by showing those areas that are unsafe for building. To this end, additional landslide mapping projects are planned for the shorelines of Puget Sound.

Division geologists are also studying large ancient landslides that may record
prehistoric earthquakes to help document the recurrence intervals for major earthquakes, which could be devastating to western Washington.

**Earthquakes**

Washington is the second most at-risk state for damage and monetary losses from earthquakes, with estimated annualized losses of $228 million. Estimated loss from a M 6.7 event on the Seattle fault is $33 billion, with 1600 fatalities and 24,000 injured.

Seattle is the seventh most at-risk city in the U.S. because of the Seattle fault, but geologic evidence suggests that most of Washington is at risk from large earthquakes. In 1700, a megquake occurred on the Cascadia subduction zone off the coast of Washington. The largest quake since European settlement was in a sparsely populated area east of the Cascades in 1872. Puget Lowland earthquakes in 1946, 1949, and 1965 killed 15 people and caused more than $350 million in property damage, and the Nisqually earthquake in 2001 caused more than $2 billion in damage.

The Division produces earthquake hazard maps for at-risk urban areas. These maps show areas where earthquake damage from soil liquefaction or amplification of earthquake waves can be expected to be high. Damage can then be mitigated by either reinforcing structures in these areas or not building there at all.

Nine detailed liquefaction maps and one ground-shaking map have been published by the Division to date. Our Olympia map was tested by the 2001 Nisqually earthquake and successfully predicted areas of greatest liquefaction.

Division geologists hold workshops to show cities and counties how to use these maps for land-use and emergency-management planning.

**Volcanoes**

In the past 12,000 years, Washington’s five active volcanoes have erupted more than 200 times, producing ash, lava, and massive mudflows. The 1980 eruption of Mount St. Helens killed 57 people, blanketed eastern Washington with ash, and caused more than $1 billion in damage.

Mount Rainier is our most dangerous volcano because of the large population close to the mountain. Previous lahars (mudflows) from Mount Rainier inundated Puget Lowland valleys as far as current-day Renton, Tacoma, and the Nisqually delta. The Division has mapped and determined the age of many of these events to present a much clearer picture of their frequency and magnitude.

In the past, lahars from Glacier Peak have flowed through the Skagit Valley all the way to La Conner. Recent mapping by Division geologists in Skagit and Whatcom Counties has identified previously unrecognized, young lahars from Glacier Peak that would obliterate small towns, such as Darrington, and destroy sections of Interstate 5 should they occur today.

The Division collaborates with the U.S. Geological Survey’s Cascades Volcano Observatory to produce volcano hazard maps and develop response plans for each volcano. We assist at-risk communities with their land-use, evacuation, and emergency-management plans and hold open meetings in at-risk communities to present the danger and allow citizens to ask questions and voice concerns.

Mount St. Helens from the Pumice Plain, about one mile north of the mountain, on April 16, 1983. Photo by Pat Pringle.

**Tsunamis**

The coast of Washington is at risk from tsunamis of both local and distant origin. Our current technology gives us adequate warning for tsunamis produced by distant quakes. An earthquake on the Cascadia subduction zone, however—like the 1700 event or the Indian Ocean earthquake of 2004 that killed more than 225,000 people—could generate a tsunami that would strike our coast with great force within a few tens of minutes.

The Division is on the front line in disseminating information about tsunamis. To date, we have produced eight tsunami hazard maps showing projected areas of inundation for much of our outer coast, where more than 40,000 residents and $1.5 billion in property are at risk, as well as for the Strait of Juan de Fuca, northern Puget Sound, and Seattle. We hold educational workshops in coastal communities and help local governments develop evacuation and emergency-management plans.

We have worked with coastal counties to prepare 14 tsunami evacuation brochures. In addition, we participated with the Applied Technology Council and Federal Emergency Management Agency to produce engineering guidance for structures to be used for vertical evacuation from tsunamis in areas where there is no nearby high ground available for evacuation.

We also participate in the National Tsunami Hazard Mitigation Program (NTHMP) to improve tsunami warnings, inundation modeling, and dissemination of tsunami research. Our librarian, under a grant from the NTHMP, prepares and publishes TsuInfo Alert, a...
newsletters that links tsunami scientists, emergency responders, and community planners to the latest tsunami research. Our library holds the NTHMP’s collection of tsunami information.

**Coal Mine Subsidence**

Abandoned coal mines underlie at least 50,000 acres in King, Kittitas, Lewis, Pierce, Skagit, and Whatcom Counties. Some of these mines are near the surface and pose a risk to buildings from mine collapse. Information about the location and condition of coal mines is necessary to identify hazardous areas. Our extensive coal mine map collection and staff expertise are invaluable in guiding development in these areas. We work with local governments to accurately locate mines and interpret mine maps. We also respond to collapses in urban areas.

**Abandoned Metal Mines**

There are more than 3800 abandoned metal mines in Washington. The mines were worked and abandoned before there was a requirement for reclamation and cleanup. Mine hazards include water quality degradation from high concentrations of heavy metals, and physical hazards such as vertical pits, caving shafts, and collapsing underground workings. These hazards have obvious liability problems for land owners, the public, and government. Other states have found that it only takes one accident to create a headline in every newspaper in the state.

We are currently cataloging and investigating these sites for the Inventory of Inactive and Abandoned Mine Lands. The Division works closely with the U.S. Forest Service, BLM, and Ecology in cleanup because of our technical expertise and the extensive collection of reports and data about these mines in our library. We publish our findings on each mining district as the site investigation work is done.

**GEOLOGIC MAPPING**

Geologic maps show the types and ages of rocks that occur at or near the Earth’s surface. They show the locations of faults and folds, landslides, glacial deposits, and other regional or local features, depending on the scale of the map. Geologic maps are the most fundamental and important tool of earth scientists.

Most geologic mapping done by companies and universities is for a specific purpose and covers a small irregular area. Our job as the state survey is to produce maps that cover whole areas of the state at various scales. We compile mapping done by others and add our own mapping to complete the coverage.

Our geologic maps are used for a broad range of practical applications, including growth-management planning, transportation, dam safety, hazard and risk assessment, Puget Sound cleanup and restoration, water-resource appraisals, resource use and protection, education, recreation, and scientific research. Our work on Hood Canal is proving critical to solving the dissolved oxygen problem.

Virtually every Environmental Impact Statement (about 50 each year) begins with a geologic map. Without our maps, EIS originators would be required to generate their own information at significant cost.

Storm-water runoff mitigation in the West Plains area of Spokane was based on our geologic mapping, which discovered permeable rock into which storm water could be drained, thus preventing frequent flooding.

Our current mapping focuses on 7.5-minute quadrangles at a scale of 1:24,000. This work is partially supported by grants from the U.S. Geological Survey STATEMAP Program.

**Subsurface Mapping**

Division geologists gather subsurface data to create maps and cross sections that can be used for ground-water resource planning and evaluation, aggregate resource evaluation, and earthquake and volcano hazards. For instance, our subsurface mapping of the Spokane aquifer was critical in planning new development to make the best use of available water. Subsurface mapping also aids in environmental cleanup.

**Resource Mapping**

Washington has an $800 million/year mineral industry that includes sand and gravel, crushed stone, metals, and industrial minerals, such as diatomite, clay, silica, and olivine. Industry uses our maps and publications, along with other reports from our library, to help find new resources.

The Division has done many mineral and other resource inventories. Recent emphasis has been on locating the aggregate resources needed for highway and infrastructure construction. We have produced aggregate resource maps that are useful for guiding zoning decisions and balanced resource planning at the local level. To date only about 10 percent of the state has been mapped for aggregate resources.

**RESOURCE REGULATION**

**Surface Mine Reclamation**

There are about 1100 active surface mines in Washington, primarily sand and gravel operations. The Department of Natural Resources oversees surface mine reclamation. The Division monitors the operation of these mines to ensure current environmental protection and future beneficial use. Mines are often reclaimed for fish and wildlife, grazing, forestry, wetlands, and commercial and industrial uses.

The Division has produced a ‘best management practices’ manual for surface mining to educate miners in the art and science of reclamation, and also holds workshops and provides technical assistance to train miners on reclamation. Both of these efforts are aimed at reducing the cost to the State of cleaning up after badly managed mines.
Every other year, we document active mine site footprints using orthorectified air photos with permit boundary and disturbed acreage lines. This allows the history of each mine site to be tracked visually over time.

Oil and Gas Regulation
The oil and gas regulatory program supervises exploration and drilling so that these activities are done in a manner that protects the environment and conserves resources, including ground-water resources.

About 600 oil and gas wells have been drilled in Washington, although there has been no large-scale commercial production. The gas storage project at Jackson Prairie in Lewis County has been the state’s most beneficial oil and gas project. Jackson Prairie is the world’s third-largest natural gas storage field and stores enough natural gas to provide uninterrupted supplies to our region.

TECHNICAL SUPPORT
The expertise of the Division is often sought on various environmental issues. For example, the Division:

- Participated in a study of the effects of mining on the Yakima River. Partners in the project were Yakima County, the Yakama Tribe, and the Washington Departments of Ecology and Fish and Wildlife. The emphasis of the project was on salmon recovery and developing better mining methods.

- Has ongoing work in Puget Sound. For instance, we have assisted in environmental cleanups, including the Asarco smelter site and Elliott Bay.

- Provides critical mapping and data for the Hood Canal Dissolved Oxygen Program to help restore Puget Sound.

- Assists the Emergency Management Division with planning for and responding to geologic disasters.

- Helps educate local government and citizens about beach erosion and effects of armoring coastlines.

- Assists the Department of Natural Resources in evaluating land-management practices, assessing land values for land trades or acquisitions, and identifying resources.

- Reviews State Environmental Protection Act (SEPA) and National Environmental Protection Act (NEPA) documents to ensure that geologic hazards and resources are considered.

GEOLOGY LIBRARY
Geologic research is expensive and time-consuming. Fortunately, research reports retain their value and utility for many years, providing an economic return to society many times their original cost. To fully understand the geology of an area requires studies of its soils, surficial deposits, bedrock, stratigraphy, paleontology, mineralogy, geochemistry, geochronology, structural geology, hydrology, and geophysics (seismic, gravity, magnetic and other surveys), to name a few.

The Washington Geology Library has the state’s largest collection about the geology of Washington, and more than 1000 items are added each year. Our librarian is knowledgeable and eager to help users find what they need. A full library catalog and geologic map index are available online.

The library has many unique and exhaustive collections. For example, the periodically updated U.S. Geological Survey topographic maps are invaluable for understanding river channel migration, landform changes, development patterns, and land use. We have the largest collection of Washington topographic maps held anywhere. Master’s theses and doctoral dissertations are important original sources of geologic information but are usually held only by the originating university. The library has copies of all of these works about Washington geology—more than 2000 of them—from all universities, internationally.

As populations grow and land-use pressures increase, government and industry on all levels need quick access to geologic and geotechnical information to address growth-management issues and decide where to build roads and other public lifelines. The Growth Management Act’s mandate to use the ‘best available science’ only increases this need. Our users often have very little time to do their studies and cannot afford to do original research. For them, time is money. They rely on existing reports, which they can find most efficiently through us. Their work would be much more difficult and expensive without ready access to our library.

GOVERNMENT OUTREACH
Division cartographers and editors prepare the results of geologic mapping, earthquake, landslide, tsunami, and volcano research for publication in various formats, such as maps, road guides, and scientific papers.

The Division’s website provides a wealth of information on the geology of Washington for a variety of audiences, including introductory information on many topics, geographic information system (GIS) data, forms, teacher resources, how-tos, and our new Washington State Geologic Information Portal. Interactive mapping sites are the most prominent features of the portal, designed to make geologic map data more accessible and allow the user to create, save, and print custom maps and find out more information about map features.

Washington Division of Geology and Earth Resources
PO Box 47007
Olympia, WA 98504-7007
Phone: 360-902-1450; Fax: 360-902-1785
E-mail: geology@dnr.wa.gov
Website: http://www.dnr.wa.gov/AboutDNR/Divisions/GER/
Online catalog and bibliography: http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/washbib.aspx

© 2009 Washington Division of Geology and Earth Resources
SELECTED REFERENCES ON WASHINGTON GEOLOGY
FOR TEACHERS AND STUDENTS

General Works

College level material

Specific Regions
Cascade Mountains

Columbia Basin and Columbia Gorge

Puget Sound and Puget Lowland

Geologic Hazards

Pacific Coast

Special Subjects
Caves

Geologic Hazards - Earthquakes

Olympic Mountains

Geologic Hazards - Landslides

Geologic Hazards - Volcanoes

Geothermal Resources

Mineral Collecting and Prospecting
Jackson, Bob, 1978, The rockhound's guide to Washington: Jax Products [Renton, Wash.], 4 v. Volumes 1, 2, and 3 are out of print
Out of print

Mineral Resources

Mining History

Paleontology

* Starred titles can be ordered from Washington Division of Geology and Earth Resources Library, PO Box 47007, Olympia, WA 98504-7007; (360) 902-1473.
** Double-starred titles can be ordered from USGS Information Services, Box 25286, Denver, CO 80225. Fax: (303) 202-4693 Phone: 1-888-ASK-USGS

Out of print titles can be requested from your local public library.

The rest of the titles should be available from local bookstores or your local library. All titles are held in the Library of the Division of Geology and Earth Resources, Department of Natural Resources 1111 Washington Street SE, Room 173 Olympia, WA 98504-7007
Open Monday, Tuesday, Thursday, Friday 8:00 AM to 4:30 PM

9-25-2007
Northwest Origins

An Introduction to the Geologic History of Washington State

Catherine L. Townsend
John T. Figge

The lands of Washington State have evolved over more than a billion years of geologic history. (Image: A Digital Atlas of the United States)

Copyright © 2002 The Burke Museum of Natural History and Culture, University of Washington except as noted. All rights reserved. This online exhibit is supported by the National Science Foundation, The University of Washington, The Burke Museum of Natural History and Culture, and the Robert Frost family.

Reminders from a Restless Planet

We live in one of the most geologically active regions of the Earth.

Earthquakes, volcanic eruptions and rising young mountains all remind us that Washington State is situated along the violent boundary between ocean and continent. As the Pacific Northwest shudders with earthquakes and erupts with volcanoes, we directly experience the powerful geologic forces that have built our land over hundreds of millions of years.

The geologic evolution of Washington State is one of the most fascinating geologic stories ever told. It is a tale of the breakup of ancient giant continents, the birth and death of great ocean basins, the collision of exotic islands, the uplift and wearing away of generations of mountain ranges, enormous floods of molten lava and great continental glaciers of the Ice Ages. Washington’s geologic history stretches back in time more than a billion years, and it continues to unfold around us every day.

Modern Insights into Ancient History

We live in a remarkable time of geologic discovery. Over the last few decades, scientists have revolutionized our understanding the geologic processes that shape our land and lives in the Pacific Northwest. New technologies allow us to study our region from space, to map the adjacent ocean floor, to look deeply into the Earth’s interior, and to pinpoint the location and magnitude of earthquakes with great precision. We can even directly measure the motion of Earth’s great tectonic plates and reconstruct their movements through time.

http://www.washington.edu/burkemuseum/geo_history_wa/
The Pacific Northwest Seismic Network

All about earthquakes and geologic hazards of the Pacific Northwest

Quick Links:

- Mount St. Helens Volcanic Advisory & Updates
- Latest PNW Quakes
- Notable Quakes
- NEWS
- Volcanoes
- ShakeMaps
- Webicorders

- The PNSN operates seismograph stations and locates earthquakes in Washington and Oregon.
- Our web site provides information on Pacific Northwest earthquake activity and hazards.
- We are based at the University of Washington in the Department of Earth and Space Sciences.
- We are operated jointly by several northwest institutions.
- We are funded by the US Geological Survey (USGS), the Department of Energy, and the State of Washington.
Cascadia and Seattle Fault Scenarios - September, 2005

M 9.0 Cascadia Subduction Zone Earthquake Scenario - From CREW

- PDF Version
- Link to order form for bound copies

- Cascadia SZ Scenario - Related Products
  - PDF of Bellingham area Tsunami Inundation model for M 9.0 earthquake on the Cascadia SZ - from WA State DNR
  - NOAA Tsunami Project - mitigating tsunami hazards in WA, OR, CA, AK, and HI
    - Tsunami Animations on the Washington Coast
    - Tsunami Animations on the Oregon Coast

Transportation Corridor Earthquake Vulnerability
Port of Seattle to Port of Tacoma - From Project Impact

SCENARIOS FOR:
- Crustal earthquakes on the Seattle or Tacoma faults
- Deep earthquakes (like the 2001 Nisqually event)
- A megathrust earthquake on the Cascadia Subduction Zone
  - Slide Show
  - Final Report PDF

M 6.7 Seattle Fault Scenario - From Washington State EMD and EERI

- PDF of the Scenario Document and Powerpoint Presentations - From EERI
- 2005 - Scenario for a Magnitude 6.7 Earthquake on the Seattle Fault: selected graphics

- Seattle FZ Scenario, Related Products
  - PDF of Elliot Bay Tsunami Inundation model for M 7.3 earthquake on the Seattle Fault - from WA State DNR
  - DNR Liquefaction Map of the Kent Valley - From Washington State DNR
Announcing the New Theme for Earth Science Week:

"The Pulse of Earth Science"

October 14-20, 2007

This year marks the tenth annual Earth Science Week. With this theme, Earth Science Week activities will promote public and professional awareness of the status of earth science in education and society. The theme will also focus attention on geoscience research, such as that associated with the International Polar Year (IPY) and the International Year of Planet Earth (IYPE), of which AGI is a Founding Partner. Through these major initiatives Earth Science Week will help spread understanding of the impact the earth sciences have on society.

Find more ideas about how you and others can become involved in Earth Science Week 2007 by visiting the pages on this site!

Click here to find out about the USGS and IPY!

What's New?

- Pre-order your 2007 Earth Science Week Tookit! Now Available! Click here for ordering information.
- Check out the latest edition of our e-newsletter, The Earth Science Week Update. (July 23, 2007)
- AGI's Press Release announcing the theme for Earth Science Week 2007! (March 27, 2007)
- Earth Science Week 2004 and 2006 are sold out, however 2005 Toolkits are still available! Click here for more information. (March 27, 2007)

Sign up to receive free Earth Science Week Updates via email!

Link to all 2007 Earth Science Week-related press releases.

Meet Our Sponsors and Program Partners:

http://www.earthsciweek.org/
Curriculum Materials for Teachers

**EarthComm** -- The EarthComm vision is the teaching, learning, and practice of Earth science by all students in all U.S. high schools. This website contains resources for teachers, students, and parents, as well as information on the goals and learning approaches EarthComm uses.

**IES** -- Investigating Earth Systems is a new, standards-based, Earth Science curriculum for the middle grades developed by the American Geological Institute (AGI) in association with It's About Time Publishing. Field tested and content reviewed, IES is part of AGI's ongoing efforts at implementing effective Earth Science education reform. On this website you will find resources that will supplement the text.

**CUES** -- AGI is developing a comprehensive earth system science program for the middle grades. Project CUES (Constructing Understandings of Earth Systems) will be comprehensive in its treatment of earth and space content standards of the National Science Education Standards (NSES) and feature innovative approaches to helping students to develop understandings of earth systems concepts, scientific inquiry, and nature of science.

**HSES** -- AGI is developing a comprehensive environmental science program for high school. HSES (High School environmental science) will be comprehensive in its treatment of...
Welcome to K-5 GeoSource

the online Earth science professional development tool
for K-5 teachers

Welcome to K-5 Geosource, the one-stop professional development web site for Earth science! If you are involved in elementary science education in any way, this Web site is for you. The site has a rich store of content, activities, services and links for you to explore, but this is only the beginning. Over the coming months the site will grow as more items and activities are developed, tested and added. We encourage you to come back often and tell us what you think.

- **Content** answers your "how" and "why" questions about earthquakes, volcanoes, hurricanes, and other topics in the Earth sciences.

- **Activities** provide ideas for Earth science lessons and stimulating classroom activities that supplement those lessons.

- **Assessment** gives you the tools to evaluate student learning and tailor instruction to meet your students' identified needs.

- **Careers** provide information and vignettes describing the many exciting career opportunities available to your students in the geosciences.

- **Resources** include links to additional educational resources in the geosciences.

http://www.k5geosource.org/
Everything We Have and Everything We Use
Comes From Our Natural Resources
The Source for FREE Teaching Materials

Find out WHY you Absolutely, Positively Must Have Someone Somewhere Who Develops the Resources You Use Every Day.

Every American Born Will Need . . .

3.7 million pounds of minerals, metals, and fuels in their lifetime

Click here to download the MII Baby as a PDF file.
Click here for more information about the MII Baby and historical minerals consumption.
Click here to find out how the numbers are calculated.

The purpose of MII's educational programs is to help you teach your students about the importance of our natural resources - How we use them every day and usually never bother to think about where they came from.

By using natural resources as topics to teach the various curriculums that you are being held
Ask-A-Geologist

Do you have a question about volcanoes, earthquakes, mountains, rocks, maps, ground water, lakes, or rivers?

You can email earth science questions to:

Ask-A-Geologist@usgs.gov

- **Before** sending your question, please search USGS web sites or check the USGS Frequently Asked Questions, or check the USGS Library FAQ.

- Each message goes to a different USGS scientist. You should get an answer in a few days.

- Because of limited resources and junk email, some questions don't get replies.

- Students -- we won't write reports and we won't answer test questions for you.

- We can't answer questions about specific locations, or with direct financial impacts, and we can't recommend products or companies.

- Please read our Privacy Statement

Want to learn more about Ask-A-Geologist?

Other sources of information:

- Ask USGS
- USGS Educational Resources
- USGS Frequently Asked Questions
- USGS Library FAQ
- USGS Science Challenge -- 196 Questions & Answers.
- USGS Ask-A-Biologist -- birds, amphibians and reptiles, ecology, wetlands, contaminants, wildlife monitoring, biodiversity.
- Ask An Expert (not maintained by USGS)
- British Geological Survey Ask-about-Geology (not maintained by USGS)

Want to learn more about Ask-A-Geologist?

Want to learn more about Ask-A-Geologist?

Want to learn more about Ask-A-Geologist?

Want to learn more about Ask-A-Geologist?
Geology of National Parks

3D and Photographic Tours Featuring Park Geology and Natural History

Click on a national park below to start an image tour.
Or, use a Location Map, Thumbnail Gallery index, or selected Subject index.
Standard photography websites mirror the 3D image websites.

Navajo National Monu
Pip

<table>
<thead>
<tr>
<th>Parks</th>
<th>3D Image Galleries</th>
<th>Standard Images</th>
<th>.gov sites</th>
<th>Selected On-line Field Guides and WWW Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arches National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Aztec Ruins National Monument</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td></td>
</tr>
<tr>
<td>Badlands National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Geology of Badlands National Park</td>
</tr>
<tr>
<td>Big Bend National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Bryce Canyon National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Canyon de Chelley National Monument</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Canyonlands National Park (recent and historic)</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Capitol Reef National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>park stratigraphy</td>
</tr>
<tr>
<td>Capulin Volcano National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Raton-Clayton volcanic field, NM (CVO website)</td>
</tr>
<tr>
<td>Carrizo Plain National Monument</td>
<td>3D</td>
<td>Photo</td>
<td>BLM</td>
<td>Virtual Tour, Geologic Map</td>
</tr>
<tr>
<td>Carlsbad Caverns National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td></td>
</tr>
<tr>
<td>Chaco Culture National Historic Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Sources of Chacoan Maize</td>
</tr>
<tr>
<td>City of Rocks National Reserve</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td></td>
</tr>
<tr>
<td>Colorado National Monument</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Geologic Map</td>
</tr>
<tr>
<td>Columbia River Gorge National Scenic Area</td>
<td>3D</td>
<td>Photo</td>
<td>NFS</td>
<td>Columbia River Gorge (CVO)</td>
</tr>
<tr>
<td>Crater Lake National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Crater Lake Data Clearinghouse</td>
</tr>
<tr>
<td>Death Valley National Park</td>
<td>3D</td>
<td>Photo</td>
<td>NPS</td>
<td>Death Valley National Park</td>
</tr>
</tbody>
</table>

http://3dparks.wr.usgs.gov/
The USGS and Science Education

The U.S. Geological Survey provides scientific information intended to help educate the public about natural resources, natural hazards, geospatial data, and issues that affect our quality of life. Discover selected online resources, including lessons, data, maps, and more, to support teaching, learning, education (K-12), and university-level inquiry and research.

What's New, What's Happening

New! USGS Education Resources for Teachers—Encourage your staff to use USGS science in lesson-planning with this convenient brochure.

Earth Science Week 2007
This year marks the tenth annual Earth Science Week, and it's time to take a look at the status of earth science in education and society. How far have we come, and where do we need to go? This year's theme, "The Pulse of Earth Science," will focus on the role that earth science research can play in addressing some of society's most urgent problems and assess our success in training an informed citizenry. Want to learn more? Visit the USGS Earth Science Week Web site, and watch this site for announcements about USGS Earth Science Week activities across the Nation.

Digital Topographic Maps
Learn how to print them free of charge at the USGS Store.

A new USGS film—take a look!
Riding the Storm—Landslide Danger in the San Francisco Bay Area.

USGS Celebrates 40 Years of Working With Students in the NAGT/USGS Cooperative

Educational Resources

USGS Educational Resources For Primary Grades Grades K-6

USGS Educational Resources For Secondary Grades Grades 7-12

USGS Educational Resources For Undergraduate Education Community Colleges and Universities

USGS Resources For California's Education Standards (K-12)
This Web site links selected online resources to an established list of Science and History-Social Science content standards for California.

Schoolyard Geology
Activities and examples to turn your schoolyard into a rich geologic experience.

The "GIS Lab"
Lessons, data, and information about using Geographic Information Systems (GIS) and spatial analysis in education.

The "GPS Class"

Of Special Interest

Check out CoreCast! The new USGS podcast series!
USGS CoreCast brings you straight science insight on natural hazards; climate change; satellite imagery and monitoring; water quality; human health and wildlife disease; and much more. It's natural science from the inside out.

Videos and Animations
A collection of USGS videos and animations covering a wide range of science.

Find A Map!
Links to popular USGS map resources and map databases, including the: Education Map Catalog, The National Map, and The National Atlas.

Our Changing Planet
Think that geography is just memorizing state capitals? With these USGS resources and lessons, you'll be investigating our changing planet!

Careers in Science
Web resources and videos about USGS Science

http://education.usgs.gov/
Resources for K-12 Earth Science Educators

▲ Resources by Topic

- **Free Lesson Plans**: Downloadable lesson plans and web site links to lesson plans.
- **Free Additional Resources**: Educational information links, computer software, videos, books and other teaching media.

**The Status of Secondary Earth Science Teaching** - one of a series of reports based on data from the 2000 National Survey of Science and Mathematics Education, a survey of 5,765 science and mathematics teachers in schools across the United States. The Earth Science report is organized into these major topical areas: characteristics of the earth science teaching force in the U.S.; professional development of earth science teachers, both needs and participation; earth science classes offered; earth science instruction, in terms of both objectives and class activities; and resources available for earth science instruction.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Elementary: lesson plans; additional resources</th>
<th>Intermediate: lesson plans; additional resources</th>
<th>Secondary: lesson plans; additional resources</th>
<th>More resources can also be found in GeoMART Your Geoscience Directory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Science in General</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Earthquakes and Volcanoes</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Science</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Geology &amp; Geologic Time</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Mapping and Geography</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: additional resources</td>
<td></td>
</tr>
<tr>
<td>Paleontology and Evolution</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Plate Tectonics</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Rocks, Minerals and Mining</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
<tr>
<td>Space Science</td>
<td>Elementary: lesson plans; additional resources</td>
<td>Intermediate: lesson plans; additional resources</td>
<td>Secondary: lesson plans; additional resources</td>
<td></td>
</tr>
</tbody>
</table>

http://www.geosociety.org/educate/resources.htm
### Resources by Age Group

**Free Lesson Plans:** Downloadable lesson plans and web site links to lesson plans.

**Free Additional Resources:** Educational information links, computer software, videos, books and other teaching media.

---

**The Status of Secondary Earth Science Teaching** - one of a series of reports based on data from the 2000 National Survey of Science and Mathematics Education, a survey of 5,765 science and mathematics teachers in schools across the United States. The Earth Science report is organized into these major topical areas: characteristics of the earth science teaching force in the U.S.; professional development of earth science teachers, both needs and participation; earth science classes offered; earth science instruction, in terms of both objectives and class activities; and resources available for earth science instruction.

---

<table>
<thead>
<tr>
<th>Topic</th>
<th>Elementary</th>
<th>Intermediate</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth Science in General</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Earthquakes &amp; Volcanoes</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Earthquakes and Volcanoes</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Energy</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Environmental Science</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Geology &amp; Geologic Time</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Mapping and Geography</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Paleontology and Dinosaurs</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Plate Tectonics</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Rocks and Minerals</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Rocks, Minerals and Mining</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td></td>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Space Science</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

More resources can also be found in [Your Geoscience Directory](http://www.geosociety.org/educate/resources.htm)

---

9/21/2007
<table>
<thead>
<tr>
<th>Water</th>
<th>Water</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
<tr>
<td>Weather &amp; Atmosphere</td>
<td>Weather &amp; Atmosphere</td>
<td>Weather &amp; Atmosphere</td>
</tr>
<tr>
<td>• lesson plans</td>
<td>• lesson plans</td>
<td>• lesson plans</td>
</tr>
<tr>
<td>• additional resources</td>
<td>• additional resources</td>
<td>• additional resources</td>
</tr>
</tbody>
</table>
The Seismological Society of America publishes two research journals - The Bulletin of the Seismological Society of America, issued bi-monthly, and Seismological Research Letters, issued bi-monthly. The Society also sponsors a national meeting in the spring of each year and a meeting of the society's Eastern Section in the fall.

Menu

The following list of reference materials was prepared to provide teachers (primarily grades K-12) with resource information that will be of use in teaching topics related to seismology. The resources are separated into seven categories:

- Reference information (primarily books, scientific papers and pamphlets)
- Maps
- Slide Sets
- Videotapes
- Computer Hardware/Software
- Seismographs
- Databases

Suggestions for "first-time-users" of seismology materials and some information on how to obtain copies of the resources listed here are given at the end of this brochure. Inclusion of materials in this brochure does not constitute an endorsement by the SSA. (Internet: http://web.ics.purdue.edu/~braile/edumod/seisres/seisresweb.htm)

Reference List

Nearly everything we do each day is connected in some way to Earth: to its land, oceans, atmosphere, plants, and animals. The food we eat, the water we drink, our homes and offices, the clothes we wear, the energy we use, and the air we breathe are all grown in, taken from, surround, or move through the planet.

By 2025, eight billion people will live on Earth. If we are to continue extracting resources to maintain a high quality of life, then we, as individuals and citizens, need to know more about our planet—its processes, its resources, and its environment. And only through Earth science education can students understand and appreciate our complex planet.

To ensure a scientifically literate society, one that maintains wise stewardship of Earth’s precious resources, the American Geological Institute, in coordination with its Member Societies, endorses the National Research Council’s National Science Education Standards (1996) and agrees that Earth science should be:

- Included as part of the science curriculum at all grade levels
- Offered as a core credit science course for high school graduation
- Assessed through state-mandated science tests and exit exams.

There hasn’t been a moment when I had the chance to look down on our planet from orbit when I haven’t been amazed at how geology has played a significant role in the development of humankind.”

Dr. James F. Reilly, Jr., NASA Astronaut/Geologist, reflecting on his experience working at the International Space Station.

Ultimately, however, the future lies in the hands of students, parents, grandparents, teachers, school administrators, school board officials, and politicians at all levels of government. The future of Earth science literacy—indeed, the future itself—lies in your hands.
Our lives and civilization depend upon how we understand and manage our planet—Earth processes affect us all. Weather patterns influence the availability of water resources and the potential for forest fires; earthquakes, volcanic eruptions, hurricanes, and floods can kill large numbers of people and cause millions or even billions of dollars in property damage.

Just as Earth systems directly affect each of us, we—as individuals, communities and nations—affect our planet. Expanding technologies and growing populations increase demand on natural resources. As we extract and use these resources, we impact Earth today, which will in turn impact those who come after us. To enhance our stewardship of the environment, we must proceed into the future with a sound understanding of Earth systems.

Earth science empowers us to think globally and act locally—to make sound decisions about issues important in our lives as individuals and citizens. People who understand how Earth systems work can make informed decisions about where to buy or build a home out of harm’s way. They can debate and resolve issues surrounding clean water, urban planning and development, national security, global climate change, and the use and management of natural resources.

An informed society, conscious of our complex relationships with our planet, recognizes the importance of and insists on Earth science education at all grade levels—elementary, secondary, and adult education. When we emphasize Earth science education, everyone benefits.
If we intend to live on—and with—this planet, we truly need to understand how it works, and to understand the interactions of the many components that make up the Earth. The Earth sciences provide an integrated and interdisciplinary approach to a true understanding of our planet. Earth science includes and applies knowledge from biology, chemistry, physics, ecology, and mathematics to tackle complex interdisciplinary issues.

Earth science education also improves critical thinking skills. It offers a historical perspective and improves our ability to predict future events. To understand Earth processes that affect us now and tomorrow, geoscientists look for evidence of what happened in the past. This connects students to the past, as well as challenging them to think about the future.

Earth science poses questions that are exciting as well as practical to children and adults alike: Why is California prone to earthquakes? Why is the beach eroding and what can we do about it? Why isn’t a floodplain a good location to build a house? Where will we get the fuel to power our cars and planes in the future? Where will we get fresh water to drink? How can I help to protect the environment? Earth science problems and issues are ideally suited for an inquiry-based education approach—an educational process that most closely resembles the reality of scientific endeavor.
The role of Earth science in meeting society’s needs continues to grow in importance. Earth science develops skills that help students become better problem solvers, including three-dimensional analysis and comprehension of time and scale. Earth scientists use these skills to ensure a supply of clean water, explore for oil, gas, and coal, map the oceans, track severe weather, and discover the Earth materials we need to build our homes and roads, and the minerals and nutrients we need to farm the land.

Earth scientists work for a wide range of organizations, including petroleum companies, environmental firms, mining companies, and construction companies. They work in local, state, and federal government agencies and teach in our schools, colleges, and universities. Earth scientists also work in non-traditional industries such as telecommunications and financial planning, assisting their organizations to address Earth-related issues that affect their activities.

More than 800 colleges and universities in the United States offer degrees in the Earth sciences. Nearly half of these colleges offer a Masters Diploma, the professional degree for pursuing a career as an Earth scientist. However, training in the Earth sciences builds a foundation for work in other fields, and nearly half of those graduating with Earth science degrees establish careers in fields as varied as engineering, law, systems analysis, and financial management.

Earth science provides a strong background for many career paths and instills an understanding of how the Earth system influences the many and varied aspects of human activity. However, many students graduate from high school unaware of the contributions that Earth scientists make to society and the unique problem solving skills that Earth science instills. We must make Earth science education a priority at all levels if we, as a society, are to meet the increasing demands of the future.
Earth science has been part of the curriculum in American schools for more than 100 years. Yet many people still think that biology, chemistry, and physics constitute a complete science education. In the 21st Century, that attitude is changing.

The National Science Education Standards and the Benchmarks for Science Literacy define science literacy and reaffirm the centrality of Earth science in education. The Standards promote the idea that Earth science should be taught in parity with biology, chemistry, and physics as part of the country’s national strategy for science literacy. Earth science education enhances our understanding and appreciation of critical issues that affect every state, so it is imperative that students in every state graduate with a thorough understanding of Earth science.

In recent years, 49 states have established science learning standards — outlining what students must know and be able to do. In every case, these standards emphasize the importance of Earth science in producing well-rounded literate citizens. State science frameworks across the country note that Earth science is necessary for all students and that schools should include Earth science topics in the curriculum from kindergarten through grade 12.

To understand how state educational systems have applied standards for Earth science content, AGI conducts annual national assessments of K–12 Earth science education. Our research shows how far we have come, and how much more work we have to do to improve Earth science education. Highlights of our studies demonstrate growing emphasis on Earth science education. Nearly fifty percent of all states include Earth science content in state-mandated high school exams, and thirty-seven states count Earth science courses towards high school graduation requirements.

Education is a local and state-based issue. We need your support and assistance to ensure Earth science education is appropriately incorporated across the country. You need to contact your local school administration to determine if Earth science is an option for core-credit science courses at the high school level, and to see if elementary schools and middle schools teach and assess Earth science.

To learn more about how you can support Earth science education in your state’s schools, or to obtain additional copies of this brochure to distribute to educators in your state, please contact AGI at (703) 379-2480 or education@agiweb.org.
Not so long ago, we had the first view of our planet from space. We were startled to see how beautiful and how fragile our home appeared, "a pale blue dot" said Carl Sagan, very different from the other planets in our solar system. Our home—blue with water, white with clouds, green with life—is a planet unique in our solar system and probably rare in the universe.

The production and distribution of this brochure has been made possible by the generous contributions of the AGI Foundation and its corporate sponsors. Please visit http://www.agiweb.org/associates/list.html for a listing.
The Smithsonian proudly announces a new resource for teachers: *Earth from Space*, an educational website launching in October 2006. Be one of the first teachers to visit www.earthfromspace.si.edu
See our planet from the perspective of an orbiting satellite. Use satellite images to explore geography, ecology, meteorology, and geology! Learn how meteorologists track hurricanes. Understand how engineers design airport runways. Follow along as scientists examine our impact on the earth. Examining these topics and more, this interactive website launches just in time for Earth Science Week and features downloadable lessons based on National Standards.

The *Earth from Space* website complements the traveling exhibition by the same name that kicks off its nationwide tour in November 2006 at the National Air and Space Museum (NASM). Visit the Smithsonian Institution Traveling Exhibition Service’s website (www.sites.si.edu) to see when *Earth from Space* is coming to a city near you.

*Earth from Space* is organized by the Smithsonian Institution Traveling Exhibition Service, in collaboration with the Smithsonian National Air and Space Museum. The exhibition has been supported and technologically enhanced by Global Imagination. Additional support has been provided by the U.S. Geological Survey and the Smithsonian Women’s Committee.
Did the Earth shake near where you live?

On April 20, 2006 a major earthquake occurred in a remote section of Russia, called Siberia. It had a magnitude of 7.7 and destroyed 3 villages. I bet you didn’t know that the ground you were standing on moved from an earthquake that far away! Be a seismologist and investigate the ground motion near where you live for this earthquake.

When an earthquake occurs, waves of energy spread out in all directions and travel through the Earth. These waves can be recorded by seismometers (devices that record ground movement) all over the world. By looking at a seismogram (recording from the seismometer) you can see how much the ground moved at the seismometer nearest you, even though you might not have felt it move. Seismometers are more sensitive than humans and can detect ground motion to the hundredths of a millimeter.

Step 1: To see how the ground in your area moved during this earthquake, go to the Rapid Earthquake Viewer (REV) at rev.seis.sc.edu and click on “Station View”. If you want to look up what a word means in REV, either click on an underlined word or click on the glossary link.

Step 2: On the bottom of the Station View page enter your zip code into the box and click “Go”, or else click on the station (triangle) that you want to view on the map. Seismic stations are located throughout the U.S. and all over the world.

Step 3: You will get a screen that shows the past 24 hours of ground motion recorded at the seismic station closest to your zip code. If you live in an active area or if a large event has occurred somewhere in the world, you might see some earthquakes. If you live in a seismically quiet area you might only see a few bumps in a mostly flat or fuzzy line. You will need to write down the code of your seismic station for later. Most stations are coded according to where they are and what seismic network they belong to. The first two letters before the period are the network abbreviation. The last four letters are the station code and are usually selected as an abbreviation of the place the station is located.

Step 4: To look at the recording from the Siberia earthquake, you need view the recording from the date of the earthquake. Click the “Change date” link on the left side of the page.

Step 5: A calendar will pop up and you can select the date of the Siberia earthquake, April 20, 2006.
This is a zoomed in recording of the earthquake from seismographs around the world. The seismograms are shown in order of distance away from the earthquake with the closest stations on the left and farther away to the right.

Seismometers record motion in three directions: vertically, east-west and north-south. You can see the seismogram for each orientation.

To see where the P and S waves arrive click the box marked “Overlay estimated P wave/S wave arrival times. REV will flag the arrivals for you.

Step 6: Click the “Show earthquakes (if any)” box and if an earthquake was clearly recorded it will be outlined.

Step 7: Click on the earthquake to see a zoomed in recording of the event from other seismographs around the world for the earthquake. The seismograms are shown in order of distance away from the earthquake. The closest stations to the earthquakes are on the left and get farther away to the right. Since the stations are distributed all around the world, the distance is shown in degrees of arc around the Earth’s surface. Using this system, the opposite side of the Earth is 180 degrees away. On the Earth’s surface, 1 degree equals 111 kilometers, so a station shown as 10 degrees distance is 1110 km away. Viewing the plot helps to get an understanding of how seismic waves travel through the Earth. Note that the energy arrives later at the stations that are farthest away from the epicenter of the earthquake.

Step 8: Add your station to the plot. On the left side of the page there is a pull-down menu that says “Add a station”. Pull down the list and find your station. It’s a long list and the stations are listed in distance (in degrees) away from the earthquake. You can look at the already plotted stations (both the map and the seismograms) and use those distances to gauge roughly how far away your station might be.

Step 9: Once you have your station on the plot, click on the station code in the list under the seismograms. This will let you see the details of your seismogram. Seismometers record motion in three directions: vertically, east-west and north-south. In this view you can see the seismogram for each orientation. Guess where the P (Primary) waves and S (Secondary) waves are on the seismograms. Click the box that says “Overlay estimated P wave/S wave arrival times” to see if you’re right. This view also lets you see how fast the ground shook at this station. The amplitude is in units of velocity, or distance moved over time. The speed that the seismometer moved up and down or side to side is slow, which is why you didn’t feel it. For a distant earthquake the ground motion is far slower than a snail moves.

That’s it! Next time there’s a big earthquake you can use this exercise to see how much the ground shook where you live.

More and more seismograph stations are being added each year in the US, thanks to a National Science Foundation funded project called EarthScope (www.earthscope.org). The seismic recording part of the project started on the West Coast in 2004 and over the next 8 years stations will move across the continental US to the East Coast and then move to Alaska in 2013. At some point in the next 10 years almost every county in the U.S. will have a seismic station near them.

http://rev.seis.sc.edu or www.iris.edu/edu/resources.htm
This instruction sheet was produced by the IRIS Education & Outreach Program.