Geology

Our solar system has nine planets and a sun. All the planets move around the Sun, which is at the center of the solar system. The planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and finally Pluto. Earth is the planet that we live on. It is part of our solar system. It has a moon that moves around it, just like the Earth moves around the Sun. You see parts of our solar system every day- the moon and the Sun. Scientists study our planet to learn more about how it was made and about the other planets in the solar system.

Scientists study how rocks form and change to learn about our planet Earth. Scientists study our planet Earth to help them learn about other planets in our solar system. Rocks are one of the things scientists study. Rocks are always changing. Wind and water wear rocks down and turn them into smaller rocks and dirt. These small rocks and dirt get washed away by the water and into lakes and oceans. Then the dirt and rocks settle at the bottom of a lake or ocean and harden into rock again.

A geologist is a scientist that studies rocks. Geologists classify rocks in three groups, according to the major Earth processes that formed them. The three rock groups are:

- Igneous,
- Sedimentary, and
- Metamorphic.

To learn about our planet Earth, we will start a rock collection and learn about the three types of rocks. Then, we will help out a fellow scientist studying the nearby planet Mars by sending him a few rock samples of our own.

Here are the activities we'll do as we investigate our Earth and solar system:

1. Start a rock collection and learn about the three basic types of rock
2. Collect a new rock and help a fellow scientist study Mars
3. Learn about the Mars rovers

The experiment kit contains:

1. A DVD called Total Eclipse: Solar Eclipses and the Mysteries of the Corona
2. A small bag with two round gray rocks
3. A NASA bookmark
4. A small bag with one small volcanic tuff rock

Igneous Rocks

Believe it or not, you can make a rock melt just like a piece of chocolate left in the sun. Igneous rocks are made from rock that has been melted, cooled, and solidified (gotten hard). When rocks are buried deep underground (REALLY deep), they melt. This is because it is **very hot** far underground.

Melted rock is also called molten rock or magma. Magma can be pushed up from underground until it explodes or oozes out through the ground. This is called a volcano.

Look for the rock labeled "Yucca Mountain Tuff" in your science kit. This is an example of an igneous rock. It is from a place called Yucca Mountain in the state of Nevada. It is a special type of igneous rock called tuff. The tuff was made by many explosive eruptions of volcanoes a very long time ago.

Yucca Mountain was made when volcanoes exploded and blew out many layers of ashes and rock. The ash and rock cooled into many thick layers of tuff. One of the layers is called the Topopah Spring. It is very hard rock. Your rock is from Topopah Spring.

What you'll need:

1. The map of the United States at the end of your handout (pg 14).
2. The tuff sample from your science kit.
3. Ruler and colored pencils.

What to do:

Find the state of Nevada on the map of the United States. Write a number 1 on the state, and make a circle around it, like this: 1

Wash and dry your rock with regular water. Now, look at your rock, and answer the questions on the following page. These are the same basic question geologists ask themselves when they study a new rock.

Neat words to remember

Igneous rocks
Solidified
Molten
Magma
Volcano
Tuff

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Rock Sample #1: Volcanic Tuff

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture you draw below to show where you measured.

My rock **my hand**

2. Where is the rock from?

_____

3. What kind of rock is it?

_____

4. What color is the rock? Use your colored pencils to color in the outline you made.

_____

5. Look closely at the rock. Do you see crystals? Does it all look the same, or do you see different things in the rock?

_____

6. How hard is your rock? Go outside to your front step. Hit the rock on the front step (get permission first).
Did the rock break? _____

Did it leave a mark on the step? _____

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Sedimentary Rocks

Sedimentary rocks are formed at the surface of the Earth, either in water or land. They are made from layers of sediment –little bits of rocks, minerals, and animal or plant material that settle down to the bottom of a lake, stream, river, or ocean. When an animal or plant material becomes part of the rock, they become fossils.

Sedimentary rocks are forming around us all the time. Sand and gravel on beaches or in river bars look like the sandstone they will become. Dry mud hardens into a type of rock called shale.

The two small round gray rocks in your kit are called geodes. Geodes can be sedimentary rock or igneous rock. Sometimes when an igneous rock is being made, it has a bubble of gas in the middle. In a sedimentary rock, sometimes a hollow space can be made from an animal burrow, tree root or mud ball. Water gets inside the rock and over time the water evaporated, leaving a hollow space in the rock that is filled with different types of crystals. It may take up to 240 million years to form a geode! Geodes can be found in Tennessee in Loretto and in Pegrum, near Nashville.

What you will need:

1. The map of the United States at the end of your handout (pg. 14).
2. Ruler and colored pencils.
3. The geodes from the experiment kit- the two rocks that look like little gray balls.
4. An old sock or piece of thick cloth you can throw away when you are done
5. A hammer
6. A grown-up to use the hammer!!!!

What to do:

1. Wrap one of the geodes in the old sock.
2. Ask your parents if break open your geode with the hammer.
3. Find the state of Tennessee on the map of the United States. Write a number 2 on the state, and make a circle around it, like this: 2
4. Wash and dry your rock with regular water. Now, look at your rock, and answer the questions on the following page. These are the same basic question geologists ask themselves when they study a new rock.

Neat words to remember

Sedimentary rocks
Sediment
Fossil
Geode

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Rock Sample #2: Geodes

1. Trace the outline of your rock here, and next to it or over it, trace your hand:
How big is your rock? Use your ruler to measure your rock. Draw a line on the picture you draw below to show where you measured.

My rock **my hand**

2. What does the geode look like on the outside?

_____

3. Did your geodes have crystals on the inside?

_____

4. What color is the outside? What color are the crystals, if any, on the inside?

_____

5. Look closely at the rock. How does it look compared to the volcanic tuff?

_____

6. How hard is your rock? Were your parents able to break it open with a hammer?

_____

Metamorphic Rocks

Sometimes sedimentary and igneous rocks are subjected to pressure so intense or heat so high that they are completely changed. They become metamorphic rocks, which form while deeply buried within the Earth's crust. The process of metamorphism does not melt the rocks, but instead turns them into different rocks.

A sample of white marble.
photo taken from:
http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Metrocks/Metrocks15.html

Marble is metamorphosed limestone or dolomite. Limestone and dolomite are types of sedimentary rocks. Marble has many different sizes of crystals. Marble comes in many colors. This is because of the different materials that the rocks can be made of. Some of the different colors of marble are white, red, black, gray, pink, and green.

Marble is much harder than the rock it was made from. For example, marble is much harder than limestone. Because it is very hard, it can be cut and polished. This makes it a good material for use as a building material, making sink tops, bathtubs, and a carving stone for artists. Today, things like building blocks and statues are made from marble and granite because both of these rocks weather very slowly and carve well with sharp edges.

Marble is quarried in Vermont, Tennessee, Missouri, Georgia, and Alabama.

What to do:

1. Find Vermont, Tennessee, Missouri, Georgia, and Alabama on the map on page 14.
2. Mark these states with a letter "M" to show they have metamorphic rocks.

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Rock Collecting- Keep up the good work!

A good rock collection starts with rocks that you like to look at- any color or shape. You have just started a collection with the Yucca Mountain tuff and the geodes you broke open. You can keep adding to your collection with rocks that you find around your home or buy at a rock shop. **Take a look at the rock collection in the school library to get some ideas.**

The U.S. Geological Survey (USGS) has some very good instructions on how to start a rock collection. Check out the USGS website at:

http://pubs.usgs.gov/gip/collect1/collectgip.html

- It is important to label each rock and ask yourself the same questions about your rocks. How big is it?
- What does it look like?
- How hard is it?
- Where did you find it?
- What did the land where you found it look like- was there water nearby? Was it on a mountain?
- Look at your rock under the magnifying glass. Can you see any particular crystals or spots on the surface? The colors you see usually represent different types of minerals that make up the rock.
- Does the rock have any fossils in it?
- Which of the three major rock types is it?

Hints for rock collectors-

- A general book on geology will help you identify rocks that you put in your collection. It is also a good idea to get a plastic case with dividers, like a craft case or fishing lure case, with a top, to put you rocks in.
- Label your rocks as soon as you collect them so they will not get mixed up.
- Ask for **permission** to collect rocks on private property.
- **Do not** collect rocks in national parks, monuments or in State parks; it is **illegal**.
- Collect small rocks so your collection can be easily stored and transported.
- Fossils can also be an exciting part of your rock collection.

"Rock Around the World"

The next rock you are going to collect is going to be sent to the National Aeronautics and Space Administration (NASA) to a scientist who is collecting rocks from all over the world. This program is called "Rock around the World."

Scientists studying Mars are asking students from around the world to help them understand the red planet. Send in a rock from your neighborhood or yard and they will use a special tool, like the one on the Mars rover, to tell you what your rock is made of. They will post a picture of your rock on their website,

http://marsprogram.jpl.nasa.gov/rockworld/

and send you a certificate. They will take its fingerprint, otherwise known as its spectrum. Every rock has a unique fingerprint. Your rock will be kept in a special collection where scientists from around the world will come to study it. **It is very important that you take a rock from its natural setting and not one that has been used for decoration purposes and comes from another area.**

Be sure and save a rock just like it for your collection. Now you will have three rocks!

Here's how you can participate:

1. Find 4 inches on your ruler.
2. Pick out two rocks that are about 4 inches in size. The rocks can be from 2 inches but no greater than 6 inches in size.
3. Wash and dry your rocks and put one in a paper or plastic bag. The other rock is for you to keep for your collection.
4. On a piece of paper, write down the following information:
   - Your name
   - Your age
   - Your Address, complete with name of city, state, country and zipcode

   You can also include some of the following information:

   - Latitude and longitude of sample site
   - Name of geographic feature (if it has one) where the rock was collected, like on a mountain
   - Copy of map with location where rock was collected

- Picture of rock in your hand for size
- Picture of location where rock was collected (with no people)
- Short paragraph describing area where rock was collected
- Phone number

5. On another piece of paper copy down the same information, so you will have a copy for your rock collection.
6. Put one of the pieces of paper in the bag with the rock you will send to the scientists so they will stay together and close the bag (tape, folding, staples, whatever).
7. Bring your rock sample to the collection box in front of the school library **BY MARCH 30 (the week you get back from spring break).** This means you have all of spring break to find some rocks! We will collect and send our rocks to Dr. Phil Christensen at the Mars Space Flight Facility, Arizona State University.
8. If you do not make the March 30 deadline to get your rock to the library, here is the address to send your sample to:

Dr. Phil Christensen
Mars Space Flight Facility
Arizona State University
PO Box 876305, Moeur Building Rm 131
Tempe, AZ 85287-6305

THE MARS MISSION

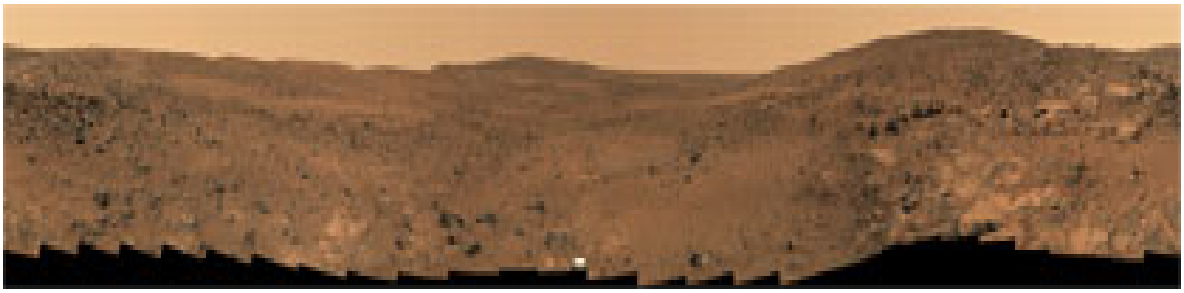
Mars, known as the Red Planet, is being explored by two robots sent up there by NASA. The robots are called Opportunity and Spirit. They are moving around on the planet's surface and collecting samples of rocks (just like you!). In 2004, Opportunity and Spirit landed on opposite sides of the planet and began their mission. Scientists thought they would only last three months, but it is two years later and they are still working! What a nice surprise. Scientists are looking for signs of life on Mars.

Spirit and Opportunity have been working very hard to help scientists better understand what it was like a very long time ago on Mars. The rovers are finding new kinds of rock in the areas they are exploring on opposite sides of Mars. By studying the information the robots have collected about rocks on Mars and comparing them to rocks here on Earth, scientists think there may have been water on the now dry planet.

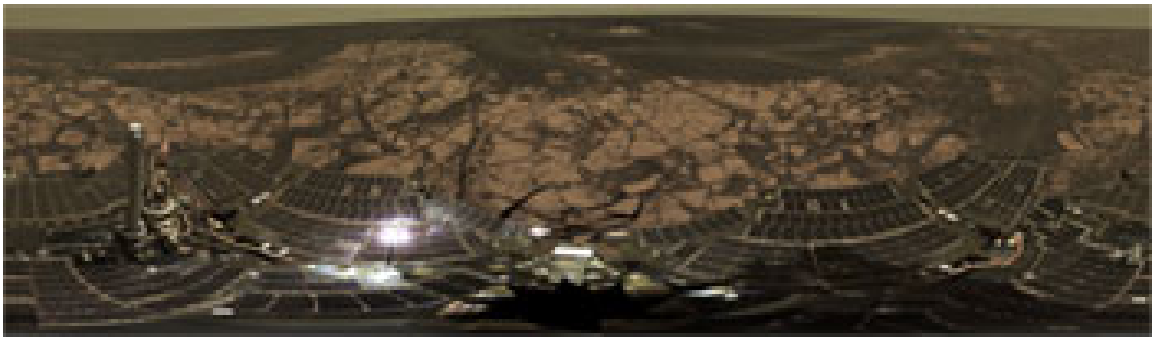
Places on Earth that can help us understand Mars include:

- Death Valley, California, where Ubehebe crater and "Mars Hill" have geologic features similar to those on Mars
- Mono Lake, California, which is a 700,000-year-old evaporative lake that compares to Gusev Crater, a basin on Mars where water once was likely
- Channeled Scabland in Washington, where catastrophic floods swept through the land much like what happened long ago in the Ares Vallis flood plain where Mars Pathfinder landed
- Permafrost in Siberia, Alaska and Antarctica, where subsurface water-ice and small life forms exist
- Volcanoes in Hawaii, which are like those on Mars, though much smaller

Now that you know the similarities between Mars and Earth, you can see why the NASA scientists want to study rock from your neighborhood.



In late November 2005 while descending "Husband Hill," Spirit took the most detailed panorama to date of the "Inner Basin."
Image credit: NASA/JPL/Cornell



This is the Opportunity rover's panorama of "Erebus Rim," acquired as the rover was exploring sand dunes and outcrop rocks in Meridiani Planum.
Image credit: NASA/JPL/Cornell

For information about NASA and other agency exploration programs on the Web, visit:
http://www.nasa.gov/home/

For images and information about the rovers and their discoveries on the Web, visit:
http://www.nasa.gov/mars/

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SPECIAL EVENT!

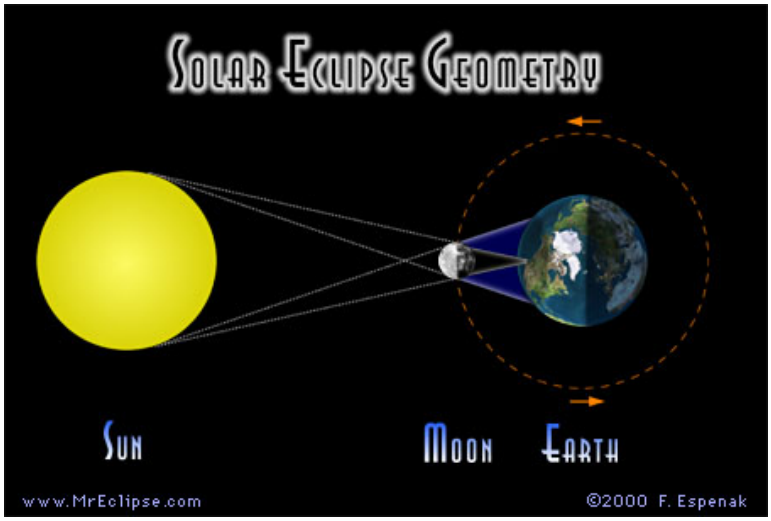
TOTAL SOLAR ECLIPSE

The Sun is the largest body in our solar system. The planets rotate around the Sun. A solar eclipse happens when the Moon passes between Earth and Sun. If the Moon's shadow happens to fall upon Earth's surface at that time, we see most of the Sun covered or 'eclipsed' by the Moon. Most of the time the Moon's shadow usually misses Earth as it passes above or below our planet at Full Moon. At least twice a year, the Moon and the Sun line up just right so that some part of the Moon's shadow falls on Earth's surface and an eclipse of the Sun is seen from that region.

On March 29, 2006, there will be a total solar eclipse. For more information see the website at:

http://sunearthday.gsfc.nasa.gov/whatis.php

You have received a CD of called “Total Eclipse” to watch and learn more before the March 29, 2006 Total Solar Eclipse.



Basic Geometry of the Sun, Moon and Earth During an Eclipse of the Sun

Eclipse figure courtesy of Fred Espenak, NASA/Goddard Space Flight Center.

For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page: sunearth.gsfc.nasa.gov/eclipse/eclipse.html.

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Credit where credit is due….

The experiments, discussions, and pictures in this handout were taken or adapted from the following websites and books:

1. Information about NASA and other agency exploration programs was taken from: http://www.nasa.gov/home/
2. Images and information about the rovers and their discoveries were taken from: http://www.nasa.gov/mars/
3. The discussion on rock collecting was adapted from instructions provided by the U.S. Geological Survey at: http://pubs.usgs.gov/gip/collect1/collectgip.html
4. The map of the United States was taken from: http://www.lib.utexas.edu/maps/united_states/united_states_pol02.pdf
5. The picture describing a solar eclipse was taken from Fred Espenak's Eclipse Home Page: sunearth.gsfc.nasa.gov/eclipse/eclipse.html.
6. The photo of white marble was taken from: http://volcano.und.nodak.edu/vwdocs/vwlessons/lessons/Metrocks/Metrocks15.html
7. Information and instructions for participating in "Rock Around the World" were taken from: http://marsprogram.jpl.nasa.gov/rockworld/
8. For more information total solar eclipse see the website at: http://sunearthday.gsfc.nasa.gov/whatis.php

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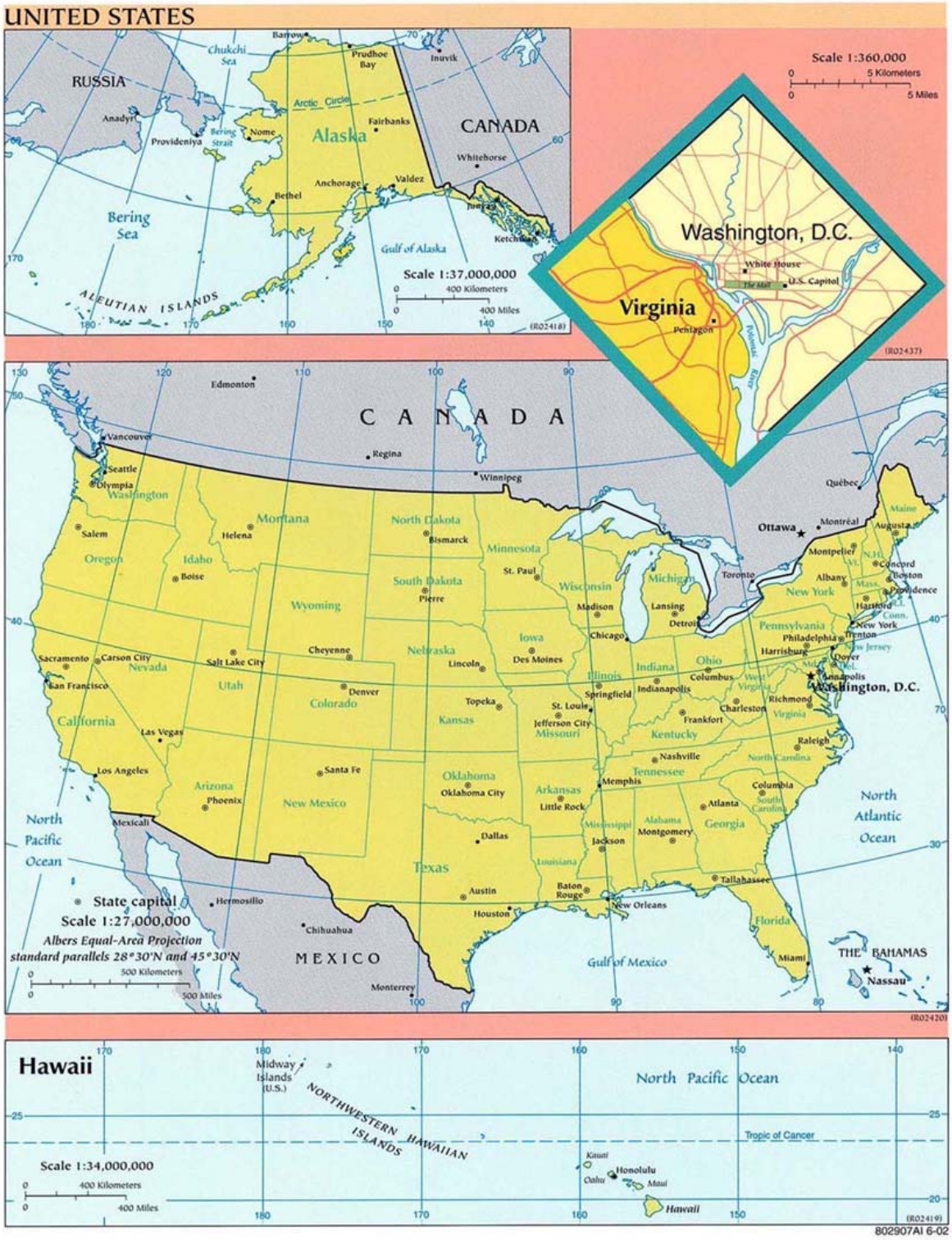

The map of the United States of America was taken from:
http://www.lib.utexas.edu/maps/united_states/united_states_pol02.pdf

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Geology Questionaire

1. Were the materials provided appropriate? Yes _____ No _____

   Please explain._____

2. Did you have enough materials for each experiment? Yes_____ No_____

   Please explain._____

3. Did the experiments work? Yes_____ No_____

   If not, please explain_____

   _____

4. Please provide any suggestions for improvements or additional

   experiments/explanations._____

   _____

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