Geology

Leader Guide
For Junior Girl Scouts

A collaboration
Between
Discovery Place, Inc.
and Hornets' Nest Girl Scout Council.

BRIDGING THE GAP

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The activities described in this Leader Guide are intended to be used under the direct supervision of adults. Discovery Place, Inc. and Hornets' Nest Girl Scout Council cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from failing to follow the supplied directions, or from ignoring the cautions contained in the text.

Geology

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These activities are designed to simplify the activities found on pages 107-108 in the "Girl Scout Badges and Signs" handbook. They are designed to be fun, easy, and inexpensive. The layout of each activity contains simple instructions for preparation, as well as for sampling the activity before presenting with the Girl Scouts. All GSUSA guidelines should be followed when doing these activities.

Introduction

As Girl Scout leaders and professionals, it is our goal to provide quality programs designed to enable girls to meet the many challenges of the future. Bridging the Gap (BTG) does that by providing easy, fun, and inexpensive activities that build confidence, both in the girls who do them, and in the leaders who guide them. All BTG activities are designed to be hands-on explorations of science, engineering, and mathematics (SEM), where the only limits are the boundaries of the imagination. Here, there is rarely a right or wrong answer. Instead, there is a sense of accomplishment in discovering something new in every effort.

As leaders, BTG gives **you** the opportunity to provide a more successful SEM program for your girls. By providing simple activities in an easy-to-follow format, BTG will enable you to guide your troops with confidence in both the execution and the success of your SEM programming.

With the increasing importance of science and mathematics in our everyday lives, from balancing a checkbook, to surfing the Internet, as well as in the professional world of the future, building confidence and excitement in exploring SEM activities is essential to the success of our girls in the world of tomorrow. But beyond the immediate challenge of these specific activities, there is even a greater importance attached to motivating our girls to explore science, engineering, and mathematics.

Gender Equity and SEM

Girl Scout Councils across the country have done extensive research in the area of gender bias and how girls are affected by it, with a particular view toward science, engineering, and mathematics. In developing materials to be used by troop leaders, special attention has been given to the teaching methods and attitudes that our girls have been exposed to in the conventional classroom.

We know that in formal classroom settings, girls are not always encouraged to develop an interest in advanced science and mathematics studies. Research shows that both male and female teachers tend to expect more from boys, especially in the areas of science, engineering, and math, and, as a result, often unconsciously promote a learning bias. Sometimes this bias is a result of lower expectations for girls, and often reflects the teacher's personal lack of confidence in their own command of the material.

As Girl Scout adults, we need to encourage girls to explore their interests in science, not only for those who seek to become scientists, but also for those who want to become good parents, homemakers, businesswomen, and/or political leaders. Science and math are part of everyday life, from managing the household budget (accounting), to rearranging the furniture (geometry), and even while cooking dinner (chemistry).

The only way that we, as Girl Scout leaders and professionals, can implement a successful SEM program with our girls, is to motivate their natural excitement and curiosity, while reexamining our own perceptions as to what science is, and the role it plays in our lives.

We need to project an enthusiasm for the subject matter, a confidence in using the materials and in teaching the activity. We, the role models, must be *excited* at the opportunity to expand our knowledge through hands-on experiences in science, engineering and math, so that our girls will feed off that enthusiasm, and actively seek to gain the experiences that all of the data suggests they have been missing.

Bridging the Gap lets ***you and your girls*** explore, ask questions, take risks, and stretch your interests as far as your enthusiasm will allow. After all....

Learning is directly proportional to the amount of fun you have!!!

Why SEM is essential for your Girl Scouts

According to data from the Departments of Education and Labor:

- While girls score higher than boys in reading from the 4th grade on, they fall behind boys in science and math test scores as they move further through high school.
- Over the past few years women were awarded fewer than 25% of the degrees in chemistry, less than 20% of the degrees in physics and math, and less than 1 of every 10 degrees awarded in engineering.

This happens despite research that indicates:

- Engineering will be among the highest paying and fastest growing occupations over the next decade.
- Women with good math skills earn more than women without good math skills.
- The fastest growing occupations - computer technology, engineering, and statistical analysis - all require strong backgrounds in science, technology, math, and/or engineering.

Tips for Leaders Beginning SEM Activities

- Examine your own attitude about science and math before attempting the following activities.
- Practice the activities yourself.
- Take risks, get messy, explore, and observe.
- Have fun doing the activities.
- Develop a sense of confidence knowing that it works, it's easy, it's fun, and you can do it.
- Hold high expectations for the girls.
- Encourage the girls to take risks, get messy, explore, and observe.
- Invite the girls to have fun doing the activities.
- Don't readily give the girls answers. Instead, encourage them to discover on their own.
- Help the girls achieve a sense of accomplishment and confidence knowing they can do it.
- Whenever possible invite real role models, female engineers and scientists, to talk with your troop about their careers, and how the girls can start planning a career of their own.

How to Use This Guide

The activities in this guide are intended to be as user-friendly as possible. They were developed to be easy to do, easy to set up, and virtually always successful. Each refers to a corresponding section from an official Girl Scout leader handbook, and that is noted on the 'Contents' page as well as in each activity. For your convenience, we have included an overview, the estimated amount of time you'll need in doing the activity with the troops, the materials needed, safety and clean-up suggestions, and planning suggestions in order to better prepare to do the activity with your girls.

The step-by-step instructions include tips, cautions, questions to challenge your girls, and explanations. Since trying the activities before the troop meeting is strongly encouraged, we have included instructions with most of the activities on how to do it by yourself first. Please read all sections of the activity before trying with your girls. With many of the activities we have included references and resources at the end of the section, or in the back of the Leader Guide, to direct you to areas where your girls may explore further, or where specialty items might be purchased.

You will also find various icons throughout the guide which are placed to draw special attention for the following reasons:

When you see this **pay close attention** to the instructions.

These are questions you may wish to use to challenge your girls.

Look here for an explanation of what is happening and why.

This icon indicates a more in-depth explanation of what is happening.

Here you will find hints on making an activity easier.

Sorting Sand

Corresponding Activity

Geology Badge, Activity 8,
p. 108, Girl Scout Badges and Signs Handbook

Overview

In examining what makes up soil, the girls will notice that sand is a part of soil. In this activity, the girls will compare different samples of sand by measuring the size and the roundness of sand particles, and observing their arrangement.

Big Ideas

The girls will learn that rock breaks down to make sand by using science process skills of observation, measurement and analytical thinking.

Estimated Activity Time

30 - 45 minutes

Materials Needed

Your VSC provides:

- ☐Rock and Mineral Kit with guidebook
- ☐Magnifying lenses
- ☐Sand Kit

Items you provide:

For each girl:

- ☐Copy of "Sand Chart" sheet
- ☐Copy of "Sorting Sand" worksheet
- ☐Pencil

Additional supplies:

- ☐Package of small cups (3-ounce)
- ☐Small bowls (To hold the sand; 1 per station)
- ☐Roll of clear tape (1 per bag of sand)

Safety

No special precautions are necessary.

Clean-Up

Dispose of cups in trash; clean or dispose of bowls when finished.

Sorting Sand was largely derived from materials and activities in the book *Rock Cycle. Understanding the Earth's Crust* by Joyce Blueford. The Sand Chart is included courtesy of Math/Science Nucleus. The *Rock Cycle* book, the Sand Kit, the Rock and Mineral Kit with guidebook, and additional supportive geological materials may be directly purchased from:

Math/Science Nucleus
4009 Pestana Place
Fremont, CA 94538
(510) 490-math

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How to Do It

Background Information

Sand is made from rocks, which have been broken down or eroded by the action of wind and/or water. A geologist studies the minerals found in sand and can identify the parent rock from which it was formed. In this activity, the girls will do the same thing.

1. The "Rock and Mineral Kit" contains a bag of **granitic sand**. Open the bag of granitic sand and take out a small amount to study.

An easy way to get a small sample is to tear off a one to two-inch piece of tape and put it into the bag of sand. Grains of sand will stick to the tape making it easy for you to examine them.

2. Turn to page 3 of the kit guidebook to see a list of all the rock and mineral samples in your kit.

3. Now, look at the two rock samples of granite, one from Monterey, and one from Sierra Nevada. The granitic sand you are looking at came from one of those two types of rocks. See if you can determine which.

Look at the color of the sand and the size of the grains, and then examine the rock samples. Compare the color of the minerals with the size and color of the mineral pieces in the rock. You will see that the Monterey granite best matches the sand, meaning that the sand came from Monterey.

4. Compare your sand sample to the sand chart, taking note of the size and shape of the grain.

Some grains may be over 7 millimeters (mm) in diameter, and others may be smaller than 1 mm within the same sample. Being able to observe, ask questions, analyze, measure, and make decisions are the kinds of scientific thinking that your girls will be using when they do this exercise. Each girl will have to make her own decisions on how to describe and classify the sand.

Your girls could say the average grain size of this sample is 1 to 3 millimeters. They could say the sand size varied from 1/2 mm to 7 mm. They could also say the sand was very poorly sorted. These are all valid ways to describe the sample's grain size.

5. Observe the roundness of the grains of sand in your sample, and then look at the chart. Note if the sand is very angular, well rounded, or a mixture of types.

The roundness of the sand is an indicator of how far the sand has traveled and for how long. As sand travels by wind or water it becomes more rounded over time. The Monterey sand was collected near its parent rock. It tends to be more angular because it has not traveled very far.

6. Take a copy of the "Sorting Sand" worksheet, and tape your first sample in the top block under "Tape Sample".

7. Take small samples of the other sands with tape, and attach them to the "Sorting Sand" sheet in the appropriate place. Describe the size, roundness, and sorting of each type.

Look at other ways that you can describe the sand such as color or if it has bits of seashells in it. Perhaps you can identify some of the rocks and minerals it is made up of. Studying sand is similar to looking at a miniature rock collection.

To help identify what rocks and minerals are in your sand, look at the specimens of serpentinite, chert, Monterrey granite rock, and quartz mineral.

Quartz-	clear to white grains of sand
Chert-	red to brown grains of sand
Serpentinite-	greenish grains of sand
Granite-	white quartz with black mineral flecks and orange or pinkish pieces of feldspar
Basalt-	gray grains of sand

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You can also tell which sands may be related by looking at what minerals they are made of. Bodega, Cleone, and Rodeo Beach are related because they all have varying amounts of chert, serpentinite, basalt, or quartz in them. Half Moon Bay, granitic, and Montara sands are related because they are formed from granite which contains bits of quartz, feldspar, and small black flecks of minerals.

Before the Meeting

1. Place the sand samples around the room in stations so the girls can move easily and not be crowded in a small area to get their samples. Putting the labeled bags into bowls will keep the bags in an upright position and help prevent spills. Place a roll of clear tape next to each bag of sand.

2. Put the labeled rock and mineral specimens (quartz, chert, serpentinite, basalt, both granite samples) together in a different part of the room for the girls to examine.

Doing the Activity with the Girls

1. Ask the girls: **Where do you think sand comes from?** Sand comes from rock that has been broken down by erosion from wind, water, temperature changes, and the action of plants and animals, although most rock is eroded by the action of wind or water.

   Sand is the mineral part of soil. Geologists study sand to find out what kind of rock it came from. We are going to study some sand today.

2. Show the girls the bag of granitic sand and tell them this is one of six different kinds of sand they will be exploring.

3. Hand out the "Sorting Sand" worksheets and the "Sand Chart" sheets.

4. Demonstrate how to take a sand sample using the tape, and then sticking it to the work sheets. Review how to measure the size of the sand grains by using the sand chart.

Don't cover the entire piece of tape with sand. Only cover half of it, so that you have enough tape to insure it will stick to the worksheet.

5. Go over how to determine the roundness of the sand by using the chart.

Ask the girls: **What would make a sand grain round?** Give them an opportunity to comment on this before telling them that the longer sand is moved by wind or water, the rounder it gets. Sand that hasn't been moved very much is still very **angular**.

6. Tell the girls that they will make their own decisions about how to describe and classify the sand. Once they have finished classifying the grains they will need to make a guess as to which rocks or minerals the sand was made from. Remind them that their guess should be based on what they have observed and noted.

Real scientists use guidelines to make it easier to measure and classify things, but it still can be challenging since often there is no one right answer. In this case, the sand will not always be one specific type. It may contain attributes of more than one type. The important thing here is for the girls to make their decision based on a reason. If they have a reason for their choice, then they have made a good decision.

7. Have the girls work together in groups of 3 or 4 to gather their samples and classify them. Each girl should complete her own worksheet, but the group should make the decisions on size, roundness and sorting, using the magnifying lenses to examine the sand.

8. After they have completed the worksheet, have them look at things that are the same in more than one sample. Challenge them to divide the sand samples into groups based on what they are made of. Let the girls work on their own or remain in their groups. If girls have difficulty, listen to them and encourage them to come up with their own answers.

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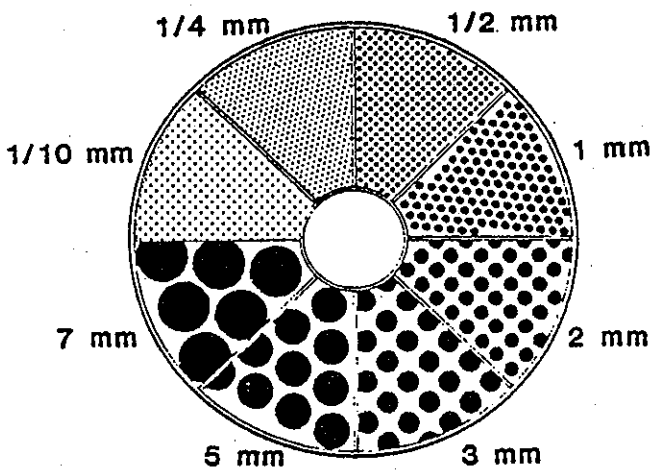
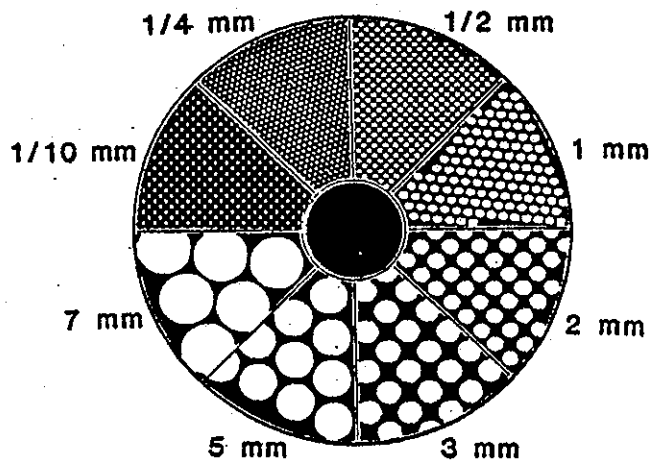
You can separate your sands into two groups based on what rocks and minerals are in them. Bodega, Cleone, and Rodeo Beach are related because they all have varying amounts of chert, serpentinite, basalt, and quartz in them. Half Moon Bay, granitic, and Montara sands are related because they are formed from granite which contains bits of quartz, feldspar, and small black flecks of minerals.

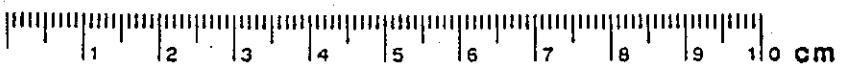
9. When they have competed their grouping, gather the girls together and let them share what they have learned.

SAND CHART

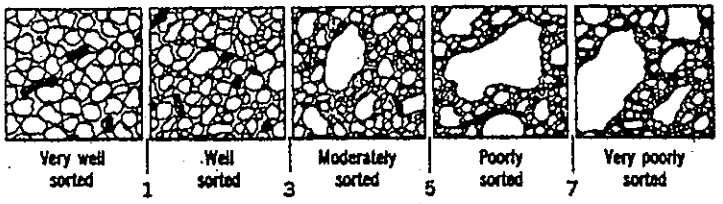
size



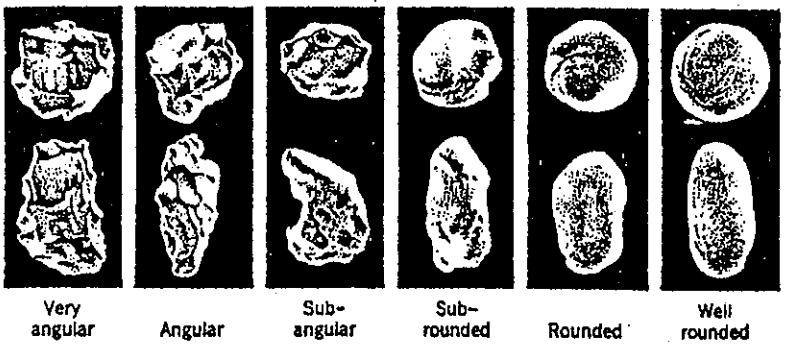




sorting



roundness



Sorting Sand

You have sands from different locations. Use the sand chart to measure the size, sorting, and roundness of the sand grains. Use a magnifying lens to help you look at the samples. Can you find bits of rocks, minerals, or shells in the sand? Look at the display of rocks for clues.

Sand location	Tape sample	Size	Sorting	Roundness	What rock or mineral was the sand made from?
Granitic sand from Monterey California					
Rodeo Beach, California					
Half Moon Bay California					
Cleone, California					
Bodega, California					
Montara, California					

Rock Cycle

Corresponding Activity

Geology Badge,
Activity 2, p. 107, Girl Scout Badges and Signs Handbook

Overview

The girls will study rock samples and review how sedimentary, igneous, and metamorphic rocks are formed. They will note one characteristic of each individual rock sample to help them in identifying the rock samples.

Big Ideas

The girls will learn what sedimentary, igneous, and metamorphic rocks are. They will learn to identify characteristics of specific rocks, such as granite. By learning about rocks and how they were formed, the girls will also be able to better understand how the rocks in their community can give clues as to what geological events have happened in the past.

Estimated Activity Time

25 –45 minutes

Materials Needed

Your VSC provides:

- ☐Rocks and Minerals Kit with guidebook
- ☐"Rocks and Minerals" Golden Guide book

Items you provide:

For each girl:

- ☐Copy of "Identifying Rocks" worksheet
- ☐Pencil

Safety

No special precautions are necessary.

Clean-Up

Dispose of paper as necessary.

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How to Do It

1. Examine the rock and mineral samples in the kit, and review pages 3-4 of the kit guidebook for some basic information on the samples.

2. For this activity, you are going to use samples of all three types of rock - igneous, sedimentary, and metamorphic. Read pages 13-16 of the kit guidebook for a simple overview of these three basic rock types and how they are formed.

For higher-level information, continue reading pages 17-26 of the Rocks and Minerals Kit guidebook, as well as referring to the "Rocks and Minerals" Golden Guide, beginning on page 109.

3. Compare the rock samples with their descriptions on pages 7-9 of the kit handbook. Pick one or more characteristics about each rock that will help you identify it when you see it again.

You might consider its color, weight, if it sparkles, if it has shells or air bubbles, and its texture; if it is hard, soft, smooth, rough, or grainy.

4. Make a copy of the "Identifying Rocks" worksheet and record some of these characteristics for each rock.

The **igneous** rocks are ***obsidian, pumice, basalt, and granite***. Igneous rocks form after other rocks melt to form magma. As the magma slowly cools deep under the earth, it forms large crystals. Granite is a product of this process. When magma rises to the earth's surface, volcanoes are formed and the magma becomes lava. Basalt is formed from lava flows and obsidian is formed when lava cools very quickly. Pumice is formed when gases are released and the lava turns into a froth while it cools.

The **sedimentary** rocks are ***sandstone, shale, mudstone with fossil shells, conglomerate***, and ***chert***. Sedimentary rocks are formed when erosion breaks down other rocks into sand, pebbles, mud, and silt. Layers of this sediment build up on the bottom of lakes and oceans. Over time, pressure causes these layers to harden and turn into rock. In addition to water, the action of wind or glaciers can also break down rocks into sediments.

Most sedimentary rocks are **clastic**, which means they are made of small pieces of other rocks cemented together. Conglomerate is a good example of a clastic rock. Other sedimentary rocks, such as chert, are formed when rock material is dissolved in water and then precipitated as a solid.

The **metamorphic** rocks are ***marble, serpentine, schist***, and ***slate***. These are rocks that have been changed or "morphed" to another type of rock by exposure to extreme heat and pressure. When rock layers are folded or squeezed, the igneous or sedimentary rocks present can be changed to metamorphic rocks. The more heat and pressure a rock is exposed to, the more it changes. An example of a rock turning into metamorphic rock is limestone turning into marble.

Each of the three, igneous, sedimentary and metamorphic rocks, can be changed to form another type of rock. This is called the **rock cycle**. Like everything else, rocks change over time.

Sedimentary, metamorphic, and igneous rocks can all melt and turn into magma to form new igneous rocks. All three can be broken down or eroded by the action of wind, water, and glaciers to make sediments that become new sedimentary rock. Also, each can be changed by exposure to heat and pressure to make new metamorphic rock.

5. If you wish to learn more about the geology of your state, look at a geological map which will show what kind of rocks and geologic features are found in your area. You can call or write to your state's geological survey to obtain geological maps and other information.

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Before the Meeting

1. Review the rock cycle and the three types of rock: *igneous, sedimentary,* and *metamorphic.*
2. If you want to go further, learn something about the local geology of your area by looking at a geological map of your state, or by talking to a local expert or the state geological survey.
3. If you have Internet access, check out www.usgs.gov, the website for the U.S. Geological Survey for a wide variety of information.

Doing the Activity With the Girls

1. Gather the girls together. Hold up a couple of different rocks for them to see.

Ask them: **What might make one rock different from another?** Give them a chance to offer opinions like the color, weight, and other cosmetic factors.

2. Tell them that there are three basic types of rocks.

Ask them: **What are the three basic types of rocks?** They have probably learned something about them in school, so don't be surprised if they know about them. After they have a chance to answer, tell them that rocks can be igneous, sedimentary, or metamorphic.

Ask them: **How do you think these rocks have been formed?** Let them share their ideas. Get as much information as you can from the girls and add a comment or two as needed.

Igneous rocks are formed in volcanic areas. Cooling magma turns into igneous rocks. **Sedimentary rocks** are formed when other rocks are broken down by erosion into sand, pebbles, mud, and silt that builds up on the bottom of lakes and oceans. Over time, pressure causes these layers to harden into new rocks. **Metamorphic rocks** have been changed or "morphed" to another type of rock by exposure to extreme heat and pressure.

Each of the three types of rock, igneous, sedimentary and metamorphic, can be changed to form another type of rock. This is called the rock cycle.

3. Hand out the "Identifying Rocks" worksheets and pencils. Have a helper place the rock samples in stations around the room. Go over the worksheet columns with the girls. Tell the girls that they need to look at each rock, learn what kind it is, and pick special things about it that will help them be able to identify it when they see it again.

   Advise them to look at things such as texture, color, or luster. Have them note if the rock is light or heavy. Have them consider its appearance – if it has lots of crystals, or does it look more like glass. Have them write down each rock's special characteristics, so they can share them later with the group.

4. Have them complete the worksheet.

5. Gather the girls together afterwards. Go over each rock and ask them to share what they learned.

Ask the girls: **If I found a piece of mudstone with shells in it, what would that tell me about the geologic history of the area?** It would tell me that an ancient ocean was there long ago. **If I found a piece of granite or basalt, what would that tell me?** There was once molten lava under the ground or a volcano in the area. If I found metamorphic rocks such as schist, that may mean there were mountains formed long ago.

6. Tell the girls that you are going to name a geologic event and you want them to tell you what kind of rocks might be found afterwards. Would it be sedimentary, igneous, or metamorphic?
   a. Where a glacier has been **Sedimentary**
   b. Where a volcano has erupted **Igneous**
   c. Where erosion has happened **Sedimentary**
   d. Where water once covered the area **Sedimentary**
   e. Where the earth has shifted **Metamorphic**
   f. Where intense heat has been present **Metamorphic**

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Identifying Rocks

Describe the rock.	Special things that will help you identify this rock.
Igneous Rocks	
obsidean	
pumice	
basalt	
granite	
Sedimentary Rocks	
sandstone	
shale	
mudstone	
conglomerate	
chert	
Metamorphic Rocks	
marble	
schist	
serpentinite	
slate	

Collecting Rocks

Corresponding Activity

Geology Badge, Activity 4,
p. 107, Girl Scout Badges and Signs Handbook

Overview

The girls will learn rock-collecting basics and do a hands-on activity to identify some common minerals.

Big Ideas

The girls will gain a basic understanding of how to identify rocks and minerals, and the differences between them. This knowledge is necessary before they can begin their own rock collection.

Estimated Activity Time

30 – 60 minutes

Materials Needed

Your VSC provides:

- ☐Rocks and Minerals Kit with guidebook
- ☐"Rocks and Minerals" Golden Guide book
- ☐"Collecting Rocks" leaflet
- ☐Rivets
- ☐Magnifying glasses
- ☐Geological map

Items you provide:

For each girl:

- ☐Copy of "Identifying Minerals" work sheet
- ☐Pencil
- ☐Egg cartons or another box (to hold rocks)

Additional Supplies:

- ☐White-out correction fluid (a bottle for every 3-4 girls)
- ☐Index cards

Safety

No special precautions are necessary.

Clean-Up

No special clean up is necessary.

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How To Do It

We advise that you complete the "Rock Cycle" activity first.

1. Read pages 4-16 in the kit guidebook to learn more about rocks and minerals. More advanced material is available on pages 17-26.

If you want to explore further, contact your state geological survey to get more specific information about the rocks and minerals in your area before doing the activity with your girls.

2. Page 5 of the kit guidebook gives descriptions of the five different minerals, quartz, copper, calcite, gypsum, and dolomite. Examine the mineral samples from the kit, and compare each mineral to its description. Pick some unique things about each mineral that will help you identify it.

Some things to look for include if it is opaque, metallic, its color, if it easily scratches with a rivet or your fingernail, or if it has a distinct crystal shape.

Minerals are pure substances. Rocks can be made of just one kind of mineral or a mixture of different minerals.

3. Read the *Collecting Rocks* leaflet, which provides good general information on how to start a rock collection.
4. Look through the *Rocks and Minerals* book, which has information and pictures that the girls can use to help identify rocks they find.
5. Find and identify some rocks. Egg cartons are great to store small rocks. To classify your specimens, brush a small dot of White-Out correction fluid on the bottom of your rock and write a number on it as a label. Fill out an index card with basic information such as the number you gave to the rock, and the date and place collected. Other information, such as the name of the rock, can be added to the card later.

Before the Meeting

1. Read over the material on minerals and rock collecting.
2. Use the information in the kit guidebook and in the "Rocks and Minerals" book to identify the minerals in the kit. Gather a few rocks of your own and use that same information to attempt to identify the rocks that you have collected.
3. Locate a good place to take your girls for a rock-collecting trip. Plan a walk either near the meeting area, or arrange to take a field trip.
4. Check the library if you want to find additional field guides to help you and the girls identify the collected rocks.

Doing the Activity With the Girls

1. Ask the girls: **What is the difference between a rock and a mineral?** Give them an opportunity to offer their thoughts.

A mineral is a pure substance. A rock is a mixture of different minerals. Minerals are mined to make many of the things we use. If it doesn't come from a plant or animal, it is a mineral. Minerals can be identified by their hardness, crystal shape, luster, and other properties.

2. Hand out the "Identifying Minerals" work sheet, and review the process for completing it with the girls. Have the girls examine the mineral samples and complete the worksheet.

Have the girls use the rivet or their fingernail to test for hardness. Have them note the shape of the crystals, if they are visible, and the luster, if it's shiny, dull, or metallic, as well as its color.

3. Afterwards, let the girls share what they have learned about minerals. Remind the girls that being able to identify minerals can also help them identify rocks, since rocks are made of minerals.
4. Introduce the girls to collecting rocks by showing them the rocks you have gathered. Show them that it's easier to keep track of your collection if it is organized.

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Suggest that in order to maintain a good rock collection, they will need to label each rock with a number, and write the information about it in a notebook or on an index card. They should record the date and place it was collected. They may want to put their name down as the collector. Later they can put the name of the rock and other information after identifying it.

5. Take the girls on a rock-collecting walk at the location you had chosen before the meeting.

Identifying Minerals

Describe the mineral.	Special things that will help you identify this mineral.
Quartz	
Copper	
Calcite	
Gypsum	
Dolomite	

NOTES

Fossils

Corresponding Activity	Geology Badge, Activity 5, p. 107, Girl Scout Badges and Signs Handbook
Overview	The girls will make a plaster cast of a shell or a fossil.
Big Ideas	The girls will learn about how fossils are formed and the types of rock in which they are found.
Estimated Activity Time	20 – 35 minutes
Materials Needed	**Your VSC provides:** ☐Rock and Mineral kit with guidebook ☐Fossils ☐Medicine cups ☐"Fossils" Golden Guide book **Items you provide:** Dough recipe for 30 girls: ☐5 cups of flour ☐1 cup of salt ☐2 tablespoons of alum ☐2 tablespoons of oil ☐3 cups of hot water *Additional supplies:* ☐2-ounces of Plaster of Paris per girl ☐1 can of a non-stick cooking spray (Pam or similar item) or 1 container of petroleum jelly ☐1 package of paper plates ☐1 large box of quart-size freezer bags ☐Scissors (several pairs) ☐Markers ☐Table coverings ☐Shells (optional)
Safety	No special precautions are necessary.
Clean-Up	Have paper towels available and water to clean plaster spills. Cover the work area to make clean up easier.

How To Do It

1. Use the following recipe to make the play dough.

Recipe for Homemade Playdough

5 cups of flour
1 cup of salt
2 tablespoons of alum
2 tablespoons oil
3 cups of very hot water

Mix together all ingredients. **Be careful**-it is hot. This recipe makes enough dough for a troop of 30 girls.

2. Coat a fossil with a non-stick cooking spray such as PAM, or petroleum jelly. This keeps the dough from sticking to the fossil.
3. Press the coated fossil into a ball of homemade playdough to make an imprint.
4. Remove the fossil from the playdough and put the molded playdough on a paper plate. You now have a **mold**.
5. Using the 1-ounce medicine cup, measure 2 one-ounce cupfuls of Plaster of Paris and put it into a resealable freezer bag.
6. Add one medicine cup of water to the dry plaster and zip the bag closed. Using your fingers, mix the plaster well until all the lumps are gone.

Check your Plaster of Paris recipe to make sure this is the correct amount of water for the amount of plaster you are using, as amounts could vary from brand to brand.

7. With the scissors, snip the corner off the bag and squeeze the plaster into the playdough mold. By filling the mold, you are making a **cast** of the fossil.
8. Let the plaster harden before you remove the cast from the playdough mold. It will take about twenty minutes, so when you do this with the girls, have another activity planned to do during the wait.

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Before the Meeting

1. Practice making a fossil mold and a cast.
2. Fill enough freezer bags with two medicine cupfuls of plaster so each girl can have her own bag of plaster.
3. Make sure you have access to water. If there is no sink at your meeting site, bring water from home in a thermos or jug.
4. Read through the *Fossils* book to learn more about the different kinds of fossils.
5. Review how rocks are formed. This was explained in some detail in the activity "Rock Cycle" earlier in this Leader Guide. Fossils are only found in **sedimentary** rock such as the mudstone with fossil shells. Igneous and metamorphic rocks don't have fossils.
6. This activity can be messy. Try to do it either outside or in an area covered with paper or plastic. Also, plan to do this activity early in the meeting so the plaster can dry. Have another activity for the girls to do while the plaster dries.
7. Recruit adult helpers to assist.

Doing the Activity With the Girls

1. Ask the girls: **What are fossils?** They will probably have a lot of ideas to share. Use the information you have learned from the *Fossil* book to help organize the discussion, but let the girls lead and share what they know.
2. Talk about the difference between **fossils** and **artifacts**.

Fossils are remains of ancient living organisms. **Artifacts** are tools and other things made by people who lived long ago. **Paleontologists** are scientists who study fossils.

Ask the girls: **Where are fossils found?** They will undoubtedly say the ground, or in rocks. Lead them to a discussion of what kind of a rock they would find a fossil in, by reminding them of the "Rock Cycle" activity.

Fossils are found in sedimentary rock such as the mudstone. It helps to have the Rock and Mineral Kit handy to show the girls the mudstone specimen.

Ask the girls: **Why aren't fossils found in igneous or metamorphic rock?** Encourage them to remember the ways these types of rocks are formed. The extreme heat and pressure used to form these kinds of rock destroys any fossil remains in them.

3. Show the girls how to make a mold from a fossil.
   a) Coat the fossil with non-stick cooking spray or petroleum jelly.
   b) Press the fossil into a ball of playdough to make an imprint.
   c) Remove the fossil and place the imprinted ball on the paper plate.
   d) Take your bag of plaster, add water, and mix by squeezing.
   e) Snip the corner of the bag, and squeeze the plaster into the mold.
4. Hand out paper plates and small handfuls of dough. Using the markers, have the girls write their names on their paper plates.

You may want to put the dough in plastic bags ahead of time to make this easier..

5. Have the girls press their fossils into the dough to make their molds.
6. Once they have completed that, have them request an adult to assist in getting their bag of plaster and the water to add to it.
7. Have them add the water and gently mix their plaster.

An adult should check that the plaster is well mixed before the girls squeeze it into the mold. The girls also may need some help with cutting and squeezing the bags.

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8. Move on to another activity and let the plaster dry for at least 20 minutes.

9. When the plaster has hardened, remove the plaster cast from the mold so the girls can take it home.

Shake, Rattle, and Roll

Corresponding Activity
Geology Badge, Activity 6, p. 108, Girl Scout Badges and Signs Handbook

Overview
The girls will construct simple earthquake tables and build earthquake-resistant structures.

Big Ideas
The girls will learn that earthquakes are caused by the movement of tectonic plates.

Estimated Activity Time
20 – 30 minutes

Materials Needed

Your VSC provides:
- ☐Earthquake placemat
- ☐Marbles
- ☐12-square-inch boards
- ☐Plastic lids (from frozen whipped topping, 1 for every 3-4 girls)
- ☐*Rocks and Minerals* Golden Guide book

Items you provide:
- ☐Toothpicks
- ☐Styrofoam, plastic, or paper cups and plates
- ☐Egg cartons
- ☐Glue
- ☐Other materials to build structures

Safety
No special precautions are necessary.

Clean-Up
Dispose of any scrap materials.

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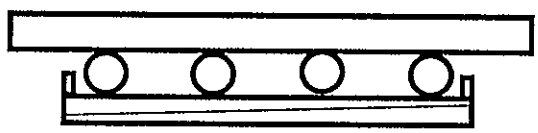
How To Do It

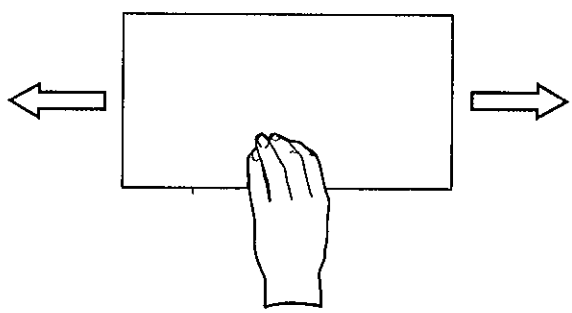
1. Review the information on the earthquake placemat. On the world map, the red areas indicate where lots of earthquakes occur, marking the boundaries of the **tectonic** plates.

Notice the red "ring" around the Pacific Basin. This ring of earthquake activity is often called the "Ring of Fire" because of the number of active volcanoes in the area. Volcanic eruptions, geysers, earthquakes, and tsunamis all tend to occur around the boundaries of tectonic plates.

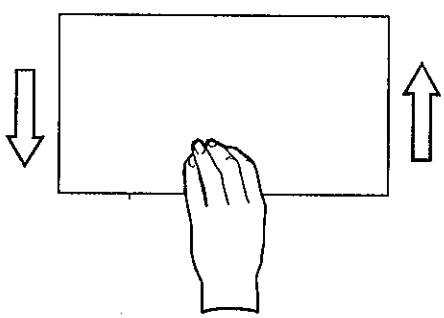
2. Create an 'earthquake' table by turning the plastic lid upside down and putting about 20 marbles in it. Place a wooden 12-inch by 12-inch board on top of the marbles. The marbles act like ball bearings and allow the board to be moved easily.



The board can be slid side-to-side, or forward to back, using one hand. Take a few moments and practice moving the board.



Use your wrist to move it from side-to-side.



Use your arm to move the board forward and back.

3. Build a structure, on top of the board on your earthquake table that will remain intact even when the board is moved. To build your structure use toothpicks, Styrofoam, egg cartons, or any other materials that are inexpensive, lightweight, and easily manipulated and obtained.

4. After building a structure that you believe will be "earthquake-resistant", test it by moving the board side-to-side, and forward and back.

If your structure didn't survive intact, try to look at how to improve your design, and try again.

Before the Meeting

1. Practice making an earthquake board and building a structure.

2. Review the information on the "Earthquakes" placemat.

Doing the Activity With the Girls

1. Have the girls separate into groups of three or four to look at the earthquake mats.

Ask them: **What is an earthquake?** An earthquake is a natural shaking of the earth in a specific location. **What causes earthquakes?** Let the girls share what they know. Pressure builds up under the ground as portions of the earth's crust and mantle move against each other. The release of this pressure causes earthquakes. The basic information is located on the placemat.

2. Draw the girls' attention to the world map on the mat.

Ask them: **What are the red areas on the map?** The red areas on the map mark places where lots of earthquakes occur.

Point out the Ring of Fire area around the Pacific Ocean. It runs along California, the West Coast of Mexico and South America, and along Indonesia, Japan, and over to Alaska.

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The red areas also mark the boundaries of **tectonic plates**. When these plates move they cause earthquakes, volcanoes, geysers, and giant waves called tsunamis (pronounced soo-nah-mee).

A lot of people live in areas that are likely to have earthquakes.

Ask them: **Looking at the placemat, which cities might be most likely to have an earthquake?** Cities such as Tokyo, Los Angeles, and San Francisco would seem to be very likely to have earthquakes, and would need to have buildings that will remain standing through one.

3. Tell the girls that you are going to make 'earthquake tables' and then build a structure on top of that table that will remain standing throughout the shaking and rolling of an 'earthquake'.

4. Show the girls how to make the earthquake tables, one table per group, and how to make the board movements when the table is completed.
   a) Turn a plastic lid upside down, and place about 20 marbles in it.
   b) Place the 12 x 12 board on top of the marbles.
   c) Demonstrate moving the board.

5. Give each group a bag of marbles, a plastic lid, and a square board to make their earthquake tables, and have them practice the movements once they finish constructing.

6. Now that they have built the earthquake table, hand out the materials the girls will use to build their structures, and have the girls build, and then test their structures.

This is an open-ended activity with no one right answer. The goal of any design that the girls create is to stand up to an 'earthquake'.

7. Gather the girls back into one group and let them show off their best designs to the rest of the troop and tell why they chose that design.

Photographs and Maps

Corresponding Activity

Geology Badge, Activity 3,
p. 107, Girl Scout Badges and Signs Handbook

Overview

The girls will look at a satellite view of the United States, as well as a high altitude picture, and locate geological features.

Big Ideas

The girls will learn that photographs and maps are very important in studying geology. High altitude pictures let us see geological features in ways not possible from the ground. The United States Geological Survey has photographed and mapped the entire country making many different kinds of maps that scientists and engineers use.

Estimated Activity Time

30 – 45 minutes

Materials Needed

Your VSC provides:

- ☐"Catalog of Cartographic Data" posters
- ☐1990 US satellite photo map
- ☐Topographic mapping booklet
- ☐USGS maps booklet
- ☐Labeled maps of the United States

Items you provide:

For each girl:

- ☐Pencil
- ☐Paper

Safety

No special precautions are necessary.

Clean-Up

None

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How To Do It

1. Look at the booklet "Topographic Mapping" (particularly pages 7-10), and the "USGS Maps" booklet to learn something about the importance of high altitude photography in making maps, and about the many things maps can be used for. The "USGS Maps" booklet has samples of the many types of maps available, as well as a map of part of Antarctica on pages 12-13 that shows geological features such as glaciers.

Geologists use maps to show where rock formations, water, minerals, and other geological features are located. If you want more information, call the Earth Science Information Center at 1-800-USA-MAPS.

2. Look at the "Catalog of Cartographic Data" poster. It has an enhanced color photo taken by NASA of the Point Reyes, CA area, just north of San Francisco. Read the description of the photo found in the lower right corner. Make note of the coastline, the bay, and the Sacramento River, as well as the line of water that marks the San Andreas fault. The fault almost separates Point Reyes from the rest of California. Look to identify any other noticeable features.

3. Look at the US satellite photomap. Take note of the major geological features. Look for major ocean and land areas, mountain ranges, the area where you live, rivers, lakes, and inland waterways.

Before the Meeting

1. Study the US satellite photomap and the "Catalog of Cartographic Data" poster to locate geological features.

2. Using the mapping literature, learn about the different kinds of maps that geologists use.

Doing the Activity With the Girls

1. Arrange the girls into three groups. Give each group a copy of the "Catalog of Cartographic Data" poster.

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For a larger troop, split the girls into 2 teams before beginning this activity, and have an adult helper work with one team on a different activity, while the other team does this one. Then switch the teams when finished.

2. Tell them that this is a picture of Point Reyes, California that is just north of the Golden Gate Bridge in San Francisco.

Ask them: **How do you think this picture was taken?** If they don't guess that it was taken in orbit around the earth right away, have them think of where the camera would have to be to take this picture. A hint might be having them think about the color of the sky above them when a picture is taken inside the earth's atmosphere (blue). The color above the camera's position in this picture is not sky blue.

Ask the girls: **What are geological features? Name some of them.** Geological features include mountain ranges, valleys, glaciers, bay, volcanoes, canyons, lakes, rivers, and other natural features of the earth's surface. Cities and highways are not geological features.

3. Have the girls look for some geological features in the picture.

Help them to get oriented to directions in the picture. Guide them by asking:
Where is the Pacific Ocean on this photo?
It's at the bottom.
Where is north, at the top, bottom, left or right? To the left.
If San Francisco is just to the south of this photo, would you travel past the top, bottom, left or right of this photo to get there?
Off to the right side.
Where is the San Pablo Bay, the northern part of the San Francisco Bay area?
It is on the middle right.
Where is the Sacramento River?
It is on the upper right.

4. Challenge them to find the San Andreas Fault.

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Ask the girls: **Can anyone tell me what the San Andreas fault is?** The San Andreas Fault is where two large plates of the earth rub as they move past each other. This causes earthquakes in California when they move.

To help them find the fault, tell them that Point Reyes (the peninsula) is on one side of the fault and the rest of California is on the other side of the fault. If they still can't find it, tell them to look for the line of water on the middle left of the map which then runs along a line of mountains on the right middle. Make sure every girl can see the fault. It is okay to point out the features to the girls.

Ask the girls: **Is it easy or hard to find things on a photograph that are not labeled?** While photographs can help us see the earth and its features in a way not possible from the ground, it can often be hard to tell what we are looking at. That is why people called cartographers make maps that make it easier to find the information we need.

Ask them: **Based on what we have just learned, what is cartographic data?** Cartographic data is geological information available in the form of maps. The front of the "Catalog of Cartographic Data" poster lists some of the types of information available, and the back give some examples.

Ask them to give you some examples of why scientists and engineers would need this kind of information. Allow them some opportunity to share their thoughts.

Some ways cartographic maps are used are in building roads and bridges, finding mineral deposits, studying how people use land, learning how to protect the environment, and in planning where to construct a new office building or factory.

5. Hand out the US satellite photomaps, blank paper, and pencils to the groups. Let the girls look at the US satellite photomap.

6. Have them find and record at least five geological features, such as:
   a) major oceans
   b) mountain ranges
   c) the area where they live
   d) rivers or lakes
   e) major land areas

It may be hard for the girls to find things because they are not labeled. That is okay. This is an exercise to help them develop their observation and thinking skills. They are supposed to try to find mountain ranges by how they look, not by reading the label on a traditional map.

You can keep a labeled US map to the side that the girls can use as a reference if they want to find the name of something they have located on the photomap.

7. Have the girls flip the map over and check some of the geologic features that are listed on this side, comparing them with what they had discovered themselves.

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Program Links for *Geology*

Junior Badge
Women Today, My Community, Geography Fun, Making Hobbies, Women's Stories, Science Sleuth, Science in the Worlds, Ecology, Dabbler the World of Today and Tomorrow

Resources:

The Science Resource Center
Bridging the Gap
Hornets' Nest Girl Scout Council
7007 Idlewild Road
Charlotte, NC 28212

Discovery Place, Inc.
301 North Tryon Street
Charlotte, NC 28202

U.S. Geological Survey
Information Services
P.O. Box 25286
Denver, CO 80225

Earth Science Information Center
U.S. Geological Survey
507 National Center
Reston, VA 20192
1-800-USA-MAPS

Public Information Center
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

American Association for the Advancement of Science (AAAS)
1333 H Street, NW
Washington, DC 20005

Archaeological Institute of America
675 Commonwealth Avenue
Boston, MA 02215

Math/Science Nucleus
4009 Pestana Place
Fremont, CA 94538
510-490-6284

American Geological Institute
4220 King Street
Alexandria, VA 22302

References:

Blueford, Dr. Joyce R. *Plate Tectonic Cycle Activities and Lesson Plans Book 3.* California: Math/Science Nucleus. 1992

Blueford, Dr. Joyce R. *Rock Cycle Activities and Lesson Plans Book 4.* California: Math/Science Nucleus. 1992.

Rhodes, Frank H. T., Herbert S. Zim, Paul R. Shaffer. *A Golden Guide, Fossils.* New York: Golden Press. 1962.

Zim, Herbert S., Paul R. Shaffer. *A Golden Guide, Rocks and Minerals.* New York: Golden Press. 1957.

NOTES

aterial List for *Geology* activities

Sorting Sand

Tub contents:

- ☐1 "Rocks and Minerals" Kit with guidebook
- ☐30 magnifying lenses in a sandwich bag
- ☐1 Sand Kit

You provide:

For each girl:

- ☐Copy of "Sorting Sand" worksheet
- ☐Copy of "Sand Chart" sheet
- ☐Pencil

Additional supplies:

- ☐Package of small cups (3-ounce)
- ☐Small bowls (1 for each planned station)
- ☐Roll of clear tape (1 for each planned station)

Rock Cycle

Tub contents:

- ☐1 "Rocks and Minerals" Kit with guidebook
- ☐1 "Rocks and Minerals" Golden Guide book

u provide:

For each girl:

- ☐Copy of "Identifying Rocks" worksheet
- ☐Pencil

Collecting Rocks

Tub contents:

- ☐1 "Rocks and Minerals" Kit with guidebook
- ☐1 "Rocks and Minerals" Golden Guide book
- ☐"Collecting Rocks" leaflet
- ☐30 rivets in a sandwich bag
- ☐30 magnifying glasses in a sandwich bag
- ☐1 geological map

You provide:

For each girl:

- ☐Copy of "Identifying Minerals" worksheet
- ☐Paper
- ☐Egg Carton (or another box to hold collected rocks)

Additional supplies:

- ☐White-Out Correction Fluid (1 bottle for every 3-4 girls)
- ☐1 Pack of index cards (minimum of 100)

Fossils

Tub contents:

- ☐1 "Rocks and Minerals" Kit with guidebook
- ☐15 sets of 2 different fossils
- ☐1 sleeve of medicine cups
- ☐1 "Fossils" Golden Guide book

You provide:

Dough recipe for 30 girls

- ☐5 cups of flour
- ☐1 cup of salt
- ☐2 tablespoons of alum
- ☐2 tablespoons of oil
- ☐3 cups of hot water

Additional supplies:

- ☐Plaster of Paris (2-ounces per girl)
- ☐1 can of no-stick cooking spray (Pam or similar item) –**or**- 1 container of petroleum jelly
- ☐Package of paper plates
- ☐1 large box (economy size) of quart-size freezer bags
- ☐Scissors (1 pair for every 3-4 girls)
- ☐Markers (one large set)
- ☐Table coverings
- ☐Shells (optional)

Shake, Rattle, and Roll

Tub contents:

- ☐8 earthquake placemats
- ☐8 bags of marbles
- ☐8 twelve-inch square boards
- ☐8 plastic lids (from frozen whipped topping)
- ☐1 "Rocks and Minerals" Golden Guide book

You provide:

Items for building structures. Listed below are some suggestions, but this is up to you.

- ☐Box of toothpicks
- ☐Styrofoam or paper cups
- ☐Box of straws
- ☐Egg cartons
- ☐White glue
- ☐Masking tape
- ☐Craft sticks

Photographs and Maps

Tub contents:

- ☐3 "Catalogue of Cartographic Data" posters
- ☐8 US Satellite photomaps
- ☐1 "Topographic Mapping" booklet
- ☐1 "USGS Maps" booklet
- ☐8 US Map placemats

You provide:

For each girl:

- ☐Pencil
- ☐Paper

Bridging the Gap
Geology
Troop Leader Survey

Today's Date: _____ Number of Girls Participating: _____

1. Approximately how long did you spend on each of the following activities?

Sorting Sand	_____ **minutes**	**Fossils**	_____ **minutes**
Rock Cycle	_____ **minutes**	**Shake, Rattle, and Roll**	_____ **minutes**
Collecting Rocks	_____ **minutes**	**Photographs and Maps**	_____ **minutes**

2. What activity did you or your girls enjoy the most, and why?

3. What activity did you or your girls like the least, and why?

4. Were your girls interested in exploring any of the activities further? Yes ☐ No ☐

5. Which one(s)?

6. What did you do to fulfill that interest?

7. What can be done to make this more successful for your girls?

Thank you for your help and for your opinions!!!

Please return all forms to:

_____

_____

_____

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Co-Principal Investigator Jerry Reynolds, Discovery Place, Inc.
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Pilot Test Councils:
Bluebonnet Girl Scout Council Waco, Texas
Mid-Continent Girl Scout Council, Kansas City, Missouri
Catawba Valley Girl Scout Council Hickory, North Carolina
Tanasi Girl Scout Council Knoxville, Tennessee

Field Test Councils:
Land Of Lakes Girl Scout Council, Waite Park, Minnesota
Gateway Girl Scout Council Jacksonville, Florida
Gulf Pines Girl Scout Council, Hattiesburg, Mississippi

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Discovery Place, Inc.
Attn: Bridging the Gap
301 North Tryon Street
Charlotte, NC 28202

Hornets' Nest Girl Scout Council
Attn: Bridging the Gap
7007 Idlewild Road
Charlotte, NC 28212

We encourage you to visit our website at www.bridginggap.org. *Let us hear from you!*