



## Earth's Features

### *A Classroom Adventure for Grades 1-6*

Investigate the features of Earth, such as volcanoes, and the forces that affect the surface, like earthquakes. Compare everyday items with their natural rock and mineral sources.

Think it.  
Try it.  
Explorit.

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## Welcome

Thank you for choosing Explorit Science Center's *Classroom Adventures* to supplement your ongoing science curriculum. Whether you use the program to kick off a new unit, wrap up a nearly completed unit, or purely to excite and interest your students in the wonderful world of science, advance preparation and follow up with your students are critical to achieving the greatest educational benefit from this unique science experience.

Explorit provides two resources to help prepare you and your students for *Classroom Adventures*. First, simple logistics of the program are detailed in the confirmation letter. Second, this **Teacher Enrichment Resource Packet** outlines appropriate science content and processes to help you:

- successfully prepare your students prior to Explorit's visit;
- participate fully in *Classroom Adventure* yourself; and
- follow-up with your students after Explorit staff leave.

## Learning Objectives

Learning objectives provide a broad overall guide to what students will begin to experience and understand through participation in Explorit's **Earth's Features Classroom Adventure** designed for Grades 1-6. During this program, students will:

- investigate the features of the Earth's surface;
- explore the materials that make up Earth's features; and
- identify everyday human uses of Earth's geologic resources.

## Science Standards

Explorit Science Center's *Classroom Adventures* programs address concepts teachers need to teach under the California Science Content Standards. The alignment of *Classroom Adventures* with the science standards allow you, the teacher, to bring exciting fun-filled science experiences to your students while at the same time fulfilling your requirements to teach particular science content and processes. For specific science standard concepts covered by **Earth's Features**, refer to Science Standard Alignment, page 8.

### Our Mission:

To involve people in science experiences that touch our lives.



## Background Information

The Earth provides a wonderful vehicle for the study of science. Younger students will investigate those aspects of Earth Science that are most apparent in their world - like **soil, rocks, and landforms**. Older students will learn concepts, like **plate tectonics**, that explain geologic events. Also important is appreciating the great spans of time - millions and billions of years - over which geologic processes occur.

### WHAT ARE THE INSIDES OF THE EARTH?

The interior of our planet is very different from the outer surface where we live. If we could cut the Earth in half, we would observe the several different layers which comprise the globe. These layers have been named the **inner core, outer core, mantle and crust**.

The inner core is solid metal and is very hot while the outer core consists of **molten** material, and is slightly cooler. The lower mantle is solid, in contrast to the upper mantle, which deforms over time like taffy. The Earth's crust consists of two parts, the continental crust, reaching down up to 50 miles, and the oceanic crust, reaching down about three miles. Think of the crust like the skin of a peach, since the Earth's crust is only 0.7% of Earth's mass.

### WHAT IS THE EARTH'S JIGSAW PUZZLE?

The theory of plate tectonics was developed in the 1960s. This theory provides one concept to explain many of Earth's geologic features. Plate tectonics involves the outermost layers of the Earth. The Earth's crust is not a continuous shell, but is broken into a dozen or more large, rigid plates. As heat rises from the core it moves these plates causing them to push and slide against each other. In some places, the crust splits open and molten rock rises to the surface forming new crust. Many geologic features occur at the boundaries of the plates. There are three boundary types: divergent boundaries (where plates separate, e.g. along the mid-Atlantic ridge), convergent boundaries (where plates collide, e.g. the Himalaya mountain range) and transform **fault** boundaries (where plates slip past each other, e.g. the San Andreas Fault system). At plate boundaries, events of great magnitude, such as **earthquakes and volcanic eruptions**, occur.

Plate tectonics theory describes movement of the continents, so we can surmise that world geography was different millions of years ago. About 200 million years ago the supercontinent Pangaea was comprised of all the continents. Today's continents can fit together like puzzle pieces. Look at a world map and see for yourself.

### WHAT ARE LANDFORMS?

On the Earth's crust we observe many different landforms. These landforms include such things as **mountains, valleys, beaches, and deltas**. Changes to these landforms occur both slowly over long periods of time through processes like **weathering and erosion**, and rapidly by events like **volcanic eruptions and earthquakes**.

### Earth's Features Trivia:

Plastic bags and nylon stockings come from natural materials found in the Earth's crust -- they are petroleum products.



## Background Information

*continued*

Weathering is the breakdown of Earth's features, often resulting from actions of water, ice, chemicals, plants and changing temperatures. There are two types of weathering: physical weathering, which breaks rocks apart; and chemical weathering, which breaks down the substances that make up the rock. Erosion is the movement of weathered materials. Water, wind and ice are agents of erosion.

Volcanoes and earthquakes are likely to occur where plates collide. Most of the world's volcanoes are found along the "Ring of Fire" which circles the Pacific Ocean where continental plates meet oceanic plates. California's famous volcanoes like Mt. Lassen and Mt. Shasta are part of the "Ring of Fire," as is Mt. St. Helens. Recent earthquakes like the Loma Prieta and Northridge quakes are evidence of California's susceptibility to earthquakes due to its position astride a major plate boundary.

### WHAT ARE THE EARTH'S BUILDING BLOCKS?

We often interchange the terms 'rock' and 'mineral,' but the two terms have distinct meanings. A mineral is a naturally occurring, inorganic, crystalline solid with a specific chemical composition. Rocks (like granite) are generally made up of several minerals. A few rocks, like limestone, are composed of many grains of one mineral. You can identify groups of minerals by their characteristic three dimensional crystals. To identify a specific mineral, geologists perform more tests on the mineral.

Geologists recognize three types of rocks, based on how the rocks formed. An **igneous rock** forms when magma solidifies. **Sedimentary rocks** derive from the accumulation and cementation of mineral grains from the action of wind, water or ice. **Metamorphic rocks** are rocks whose composition has been changed by the effects of temperature, pressure, or the gain or loss of chemical components. Metamorphic rocks could have started out as either igneous or sedimentary rocks.

The three rock types are part of a **rock cycle** in which each type can change over time into another form. Igneous rocks, formed from magma, are the "parent" rock from which all other rock types are formed. Igneous rock that is worn away by weathering creates small particles that are the basis for the creation of new rocks. Sedimentary rock can be formed when particles accumulate on the ocean floor and are compacted by additional layers and the ocean. If these rocks are deeply buried, they can be subjected to great heat and pressure, and become metamorphic rock. This metamorphic rock can then be buried deeper, and subjected to even higher temperatures and pressures so that it melts into magma, and the cycle can repeat.

### CONCLUSION

With the enormous amount of fascinating geology to learn in our ever changing world, participating in Explorit's **Earth's Features** will only scratch the surface. Be sure to encourage ongoing study of our Earth by your students.

### Earth's Features Trivia:

The toothpaste you put in your mouth everyday contains several minerals -- fluoride, barite, & calcite.

### Earth's Features Trivia:

Ilmenite, a titanium containing mineral, makes a spacecraft strong and the white "m" on M&Ms.



## Vocabulary

### Earth's Features Trivia:

Earth materials that make up a skateboard include aluminum, calcium carbonate, clay, coal, iron, mica, sulfur, silica, talc, and wollastonite.

### Earth's Features Trivia:

When you write with a pencil, you write with a mineral -- not lead, but graphite.

This list includes words that may be used during Classroom Adventures. Specific vocabulary used depends on students' grade level and prior knowledge.

**Core** - innermost, hottest layer of Earth, probably consisting of iron-nickel alloy; can be divided into the solid inner core and the molten outer core.

**Crust** - thin, outermost, coolest layer of the Earth

**Crystal** - solid formed by regularly repeating arrangement of atoms of a chemical element or compound. Examples: halite, calcite, and quartz.

**Earthquake** - a series of elastic waves in the Earth's crust caused by sudden relaxation of strains along faults and/or by volcanic action.

**Erosion** - gradual wearing away of rock by action of water, wind and ice.

**Fault** - break within the Earth's crust along which the resulting rock bodies on either side slide past each other.

**Geology** - study of the origin, history and structure of the Earth.

**Igneous rock** - rock formed when molten material in or on Earth's surface cools and hardens. Examples: granite, pumice and obsidian.

**Lava** - molten rock that reaches Earth's surface.

**Magma** - molten rock material beneath the surface of the Earth.

**Mantle** - semi-molten interior of the Earth between the core and the crust.

**Metamorphic rock** - rock that is formed when existing rocks undergo pressure and heat for extended periods of time.

**Mineral** - a naturally occurring, inorganic, crystalline solid substance with a specific chemical composition.

**Plate tectonics** - Movement of sections of the Earth's crust (plates) relative to each other.

**Rock** - matter formed in Earth's crust composed of one or more minerals.

**Rock cycle** - the sequence of changes Earth materials pass through when influenced by geologic and climatic processes.

**Sediment** - material that is transported and deposited by wind, water or ice.

**Sedimentary rock** - rock formed by the settling or deposition of sediment. Examples: limestone, sandstone and shale.

**Soil** - loose mineral material on Earth's surface that is so modified by erosion and weathering that it can support plant and animal life.

**Volcano** - opening in Earth's crust through which rock, ash, dust, gases, and/ or magma are expelled.

**Weathering** - processes that physically and chemically break apart and change rocks.



## Classroom Activities

For your convenience, the following activities can be used as you deem appropriate to integrate Explorit's Earth's Features into your curriculum. The activities are grade-level appropriate, but note that this program is designed for a broad grade range (1-6) and thus all activities may not be appropriate for every group of children. Choose activities that will work for your students.

### Materials:

- powdered milk
- creamy peanut butter
- honey
- jam
- chocolate chips
- sesame seeds
- large bowl
- spoon
- measuring cups
- waxed paper
- dull knife/knives

### Science Standards:

- Focus on Earth Science
- Sixth: 1 b
- Investigation & Experimentation
- K-Second: 4
- Third: 5
- Fourth/Fifth: 6
- Sixth: 7

### Materials:

- samples of minerals (halite, quartz, gypsum, graphite, galena, pyrite, hematite, calcite, and mica)
- porcelain bath tiles (at the local hardware store)
- glass jars
- paper bags containing one of each mineral sample

### Science Standards:

- Earth Science
- Fourth: 4 b
- Investigation & Experimentation
- Fifth: 6 a, g

### ACTIVITY #1: "EDIBLE EARTH LAYER MODEL"

**Objective:** To create a model of the Earth that shows the layers it contains.

**CAUTION:** Assess your students' FOOD ALLERGIES before you begin.

\*\* Remember to wash hands before and after this activity. \*\*

#### Procedure:

- Mix 1.5 cups peanut butter and 3/4 cup powdered milk in a bowl. Mix in a tablespoon of honey to make the dough feel like play dough. You may need to add more or less honey depending on the consistency of the ingredients.
- Roll spoonfuls of dough into small balls. This recipe should make about 20 balls. If necessary to store dough, it can be refrigerated.
- Place a ball on wax paper and CAREFULLY cut the ball in half.
- Make a small hole in the center of each half of the ball, about the size of the tip of your finger. Place some jam in each hole. Place a chocolate chip in only one half of the ball. You have just created an Earth model, with the chocolate chip being the solid inner core, the jam being the molten outer core and the peanut butter mixture being the solid to semiliquid mantle.
- Place the halves of the ball together and seal the seam by rolling it around.
- Place sesame seeds on your wax paper and roll your ball in the sesame seeds, creating the Earth's rocky crust.
- Once again, cut your ball in half. Carefully examine all the Earth's layers: inner core, outer core, mantle and crust. Think and talk about the Earth's layers. Enjoy eating your creations.

*Adapted from Geology Crafts for Kids by A. Anderson, G Diehn & T. Krautwurst.*

### Activity #2: MINERAL IDENTIFICATION

**Objective:** A simplified version of a few of the identification tests that geologist conduct to observe characteristics of minerals.

#### Procedure:

\*Mineral samples can be obtained inexpensively from many sources such as Geoprime Minerals ([www.geoprime.com](http://www.geoprime.com)) 1-800-440-9992 or Carolina Biological Supply Company ([www.carolina.com](http://www.carolina.com)) 1-800-334-5551.

- Discuss rocks and minerals. Make sure students understand the difference between rocks and minerals.
- Talk about how identification of minerals depends on the key characteristics of the mineral. Discuss how looking at one characteristic may not be enough.
- Have the students pick out the three clear minerals from their bags. These



## Classroom Activities

*continued*

- should be the quartz, halite and gypsum. Discuss whether all three are the same mineral since they are the same color.
- Next scratch each of the three minerals with a fingernail. Can any be scratched in this way? Next use each mineral to scratch the glass jar. Do any of the minerals scratch the jar? (If you wish, you may have your students lick their fingers and then rub each mineral and then touch their finger to their tongue. Do any of the minerals taste funny?) After the students have completed the hardness tests (and taste test), discuss the three minerals. Gypsum is a soft mineral used to make sheetrock. Halite is the mineral form of table salt and probably tasted like salt. Quartz is a hard mineral that is used in the making of glass. So three minerals that are same color are not the same at all.
  - Go on to test other minerals. You can use the porcelain tiles for another test by rubbing each mineral on the unglazed side of the tile. Geologists call this the streak test. Some minerals leave streaks when rubbed on the tile. There may be surprises, like a gray piece of hematite leaving a red streak. Pyrite, another mineral that might weigh about the same as hematite, would not leave the same streak. So again things like weight, alone, would not be definitive tests for mineral identification. Galena is especially heavy however, and weight can help to identify it. Galena would leave a dark gray-black streak.
  - Mica has a very characteristic way of splitting into sheets. Calcite will bubble when placed in vinegar. Talc is soft and feels soapy. Graphite is also soft.
  - Use a rock and mineral guide to help you investigate as many minerals as you wish. Remember that carefully investigating the characteristics of the minerals is much more important than identifying every mineral.
  - Recording all the data about your minerals can be done on a chart, with columns labeled for things like color, hardness, streak, etc.

### Activity #3: "INVESTIGATING PLATE TECTONICS"

**Objective:** To investigate plate tectonics and observe frequency of earthquakes in different parts of the world.

**Procedure:**

- Have your students, as a class, plot ongoing earthquake activity onto a world map. Earthquakes happen everyday and information about the location of these earthquakes can be obtained from the USGS National Earthquake Information Center, [www.neic.cr.usgs.gov](http://www.neic.cr.usgs.gov) and Incorporated Research Institutions for Seismology's Seismic Monitor, [www.iris.washington.edu](http://www.iris.washington.edu).
- Your students could also plot volcano locations which can be obtained from the Smithsonian's Global Volcanism Program, [www.volcano.si.edu](http://www.volcano.si.edu) and the USGS, [vulcan.wr.usgs.gov](http://vulcan.wr.usgs.gov).
- As your students continue to plot these locations throughout your Earth Science unit or throughout the year, you will begin to see patterns of earthquake and volcano locations. These patterns generally fall on plate boundaries. What do you notice about California? Are there any volcanoes or earthquakes that do not seem to fit the pattern?

### Materials:

world map  
internet access  
push pins

### Science Standards:

Focus on Earth Science  
Sixth: 1 a, b, c, d, e, f, g  
Investigation & Experimentation  
Fourth/Fifth: 6  
Sixth: 7



## Supplemental Resources

### BOOKS

- Anderson, Alan, et. al. **Geology Crafts for Kids: 50 Nifty Projects to Explore the Marvels of Planet Earth.** Sterling Publishing Co., 1998. *Designed for grades 4-7; includes crafts and more scientific activities.*
- Cole, Joanna. **The Magic School Bus: Inside the Earth.** Scholastic, Inc., 1995. *See also The Magic School Bus Blows Its Top: A Book About Volcanoes.*
- Dixon, Dougal. **The Practical Geologist.** Simon & Shuster, 1992. *Provides an introductory guide to Earth Science for you, the teacher.*
- Farndon, John. **How the Earth Works: 100 Ways Parents and Kids Can Share the Secrets of the Earth.** Reader's Digest Ass'n., 1992. *Full of ideas and activities to learn about the earth.*
- GEMS Series. **Stories in Stone.** University of California at Berkeley, Lawrence Hall of Science. *For grades 4-9. See River Cutters (grades 6-9).*
- Lauber, Patricia. **Volcano: The Eruption and Healing of Mount St. Helens.** Bradbury Press, 1993. *Literature for intermediate grades; great photos.*
- McNulty, Faith. **How to Dig a Hole to the Other Side of the World.** Harper-Collins Publishers, 1990. *Trip to Earth's center; grades K-3.*
- Midgely, Ruth (ed.). **The Visual Dictionary of the Earth.** Dorling Indersley, 1993. *Good pictures with brief text.*
- Ranger Rick's NatureScope. **Geology: The Active Earth.** Washington, D.C. National Wildlife Federation, 1997 revised.
- Simon, Seymour. **Mountains.** Morrow Junior Books, 1994. *Also by this author, Deserts, Icebergs and Glaciers, Volcanoes, Earthquakes; great photos.*
- VanCleave, Janice. **Earth Science for Every Kid: 101 Easy Experiments that Really Work.** John Wiley & Sons, Inc., 1991. *Check out other VanCleave books on volcanoes, earthquakes and rocks and minerals.*

### WEB SITES

NASA: Earth Science Enterprise Web Site

<http://www.earth.nasa.gov>

*Contains activities and teacher resources. Excellent images of earth and space.*

University of North Dakota

<http://volcano.und.nodak.edu/>

*Detailed information and photos of volcanoes; including current volcanic activity.*

U.S. Department of Interior, U.S. Geological Survey Web Site

[www.usgs.gov/education](http://www.usgs.gov/education)

*Lessons, activities and class projects about the Earth. Contains excellent images.*

National Science Foundation

<http://www.nsf.gov/news/overviews/earth-environ/index.jsp>

*Great background info, and links to further information.*



## Science Standards Alignment

Below is the exact language of California's science standards that Explorit's **Earth's Features** program addresses either during our visit to your classroom or through materials in this Teacher's Packet that you may use.

### **CALIFORNIA SCIENCE CONTENT STANDARDS**

#### **Earth Sciences**

**Grade K:** **3.** The Earth is composed of land, air and water. As a basis for understanding this concept, students know: a. characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms. c. how to identify resources from the Earth that are used in everyday life...

**Grade 2:** **3.** Earth is made of materials that have distinct properties and provide resources for human activities. As a basis for understanding this concept, students know: a. how to compare the physical properties of different kinds of rocks and that rock is composed of different combinations of minerals. b. smaller rocks come from breakage and weathering of larger rocks. c. soil is made partly from weathered rock and partly from organic materials, and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants. e. rock...and soil provide many resources including food, fuel, and building materials that humans use.

**Grade 4:** **4.** The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept, students know: a. how to differentiate among igneous, sedimentary, and metamorphic rocks by their properties and methods of formation (the rock cycle). b. how to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals using a table of diagnostic properties. **5.** Waves, wind, water, and ice shape and reshape the Earth's land surface. As a basis for understanding this concept, students know: a. some changes in the Earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes. b. natural processes, including freezing/thawing and growth of roots, cause rocks to break down into smaller pieces. c. moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, deposition).

#### **Focus on Earth Sciences**

**Grade 6:** **1.** Plate tectonics accounts for important features of Earth's surface and major geologic events. As a basis for understanding this concept, students know: a. evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones. b. Earth is composed of several layers: a cold, brittle lithosphere; a hot, convecting mantle; and a dense, metallic core. c. lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle. d. that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface. e. major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions. f. how to explain major features of California geology (including mountains, faults, volcanoes) in terms of plate tectonics. g. ...that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region. **2.** Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept, students know: a. water running downhill is the dominant process in shaping the landscape, including California's landscape. b. rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns. c. beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves. **6.** Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students know: c. the natural origin of the materials used to make common objects.

#### **Investigation and Experimentation**

**Grades K-2, Concept 4 / Grade 3, Concept 5 / Grades 4-5, Concept 6 / Grade 6, Concept 7:**

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content in the other three strands, students should develop their own questions and perform investigations.

*Explorit's Classroom Adventures involve students' use of many science process skills. For specific skills, see California Science Content Standards at [www.cde.ca.gov/board](http://www.cde.ca.gov/board).*

# Explorit Programs for Schools and Groups

## At Explorit's Site

**Discovery Lessons & Labs** Visit one or more of the Changing Exhibitions throughout the year  
**Nature Safaris & Labs** Visit Explorit's outdoor spaces at Mace Park Branch

## Explorit in Your Classroom

**Classroom Adventures** Explorit educators visit your classroom for hour-long presentations  
**Young Scientist Series** Science investigations through multiple visits

## For the Whole School

**Health in Your World** Learn about keeping your body and the world healthy and safe  
**Science in Your World** The ultimate family science night  
**Science Assembly** A multimedia presentation for the whole school

Reservations required.  
For information please call  
530.756.0191

Think it.  
Try it.  
Explorit.

### HOW TO CONTACT US

The Explorit logo features the word "explorit" in a lowercase, sans-serif font. The letter "o" is stylized with a white swirl that loops around itself, creating a sense of motion or a spiral.

EXPLORIT SCIENCE CENTER

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