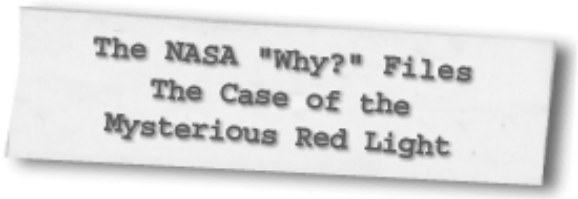


Segment 3

In this segment, the tree house detectives are curious about the colors of a rainbow and decide that the spectrum of light might be their next clue. Dr. D introduces them to the visible spectrum and dispels the misconception that there are seven colors in the spectrum. He enlightens the tree house detectives to the true colors of the spectrum: red, orange, yellow, green, blue, and violet.

To learn more about the electromagnetic spectrum, the tree house detectives visit a NASA researcher at the Portsmouth Science Museum in Portsmouth, Virginia. Doreen Neil explains the electromagnetic spectrum and discusses frequency and wavelength. The detectives learn about the primary colors of light and pigment and explore a shadow box where they split light into its various colors.

Back at the tree house, KSNN reports that a volcano has erupted in the Pacific Ocean. The tree house detectives think that this might be the clue they have been looking for. To learn more about volcanoes, they get a little help from a NASA "Why?" Files Kids Club in Hampton, Virginia, Dr. Textbook, and Dr. Pieri, a NASA Researcher at NASA Dryden Flight Research Center in California.

Objectives

The students will

- learn the colors of the visible spectrum.
- understand the difference between the primary colors of light and pigment.
- calculate distance using a map scale and ruler.
- be able to differentiate between a cinder cone, a composite volcano, and a shield volcano.
- understand the relationship between plate tectonics, volcanoes, and the Ring of Fire.

Vocabulary

cinder cone - a type of volcano in which tephra (cinders) piles up into a steep-sided cone

composite volcano - a type of volcano built of lava and ash layers that accumulate from repeated cycles of tephra and lava eruptions. Also known as a stratovolcano.

diffraction grating - "super" prism that separates light of different wavelengths with a high resolution.

electromagnetic spectrum - forms of electromagnetic radiation that include radio waves, microwaves, infrared radiation, visible light, ultraviolet rays, X-rays, and gamma rays.

hot spot - areas in the Earth's mantle that are hotter than neighboring areas

lava - melted rock from a volcano flowing onto Earth's surface

mantle - largest layer inside Earth, lying directly above the outer core

map scale - the relationship between the distances drawn on a map and actual distances on Earth

mid-ocean ridge - an underwater mountain range that extends through the middle of most oceans, formed when forces within Earth spread the seafloor apart, causing it to buckle

Mt. Luminous - a fictitious volcano created for this program

plates - in plate tectonics, sections of Earth's lithosphere (crust and upper mantle)

plate tectonics - theory that states that Earth's crust and upper mantle are broken into sections called plates

primary colors of light - red, blue, green

primary colors of pigment - red, blue, yellow

prism - a transparent body with triangular bases used to split light into its spectrum of colors: red, orange, yellow, green, blue, and violet

pyroclastic debris - solids which can range in size from the finest dust to boulders that are blasted into the air by explosive volcanoes

Pacific Ring of Fire - the area around the Pacific Plate where earthquakes and volcanoes are common

scoria - extrusive volcanic rock formed from molten lava that cools quickly

shield volcano - a broad volcano with gently sloping sides, built by quiet eruptions of runny lava, which spreads out in flat layers

tephra - lava that is blasted into the air by violent volcanic eruptions and solidifies as it falls to the ground as ash, cinders, and volcanic bombs

visible spectrum - the only part of the electromagnetic spectrum we can see that includes the colors of the rainbow: red, orange, yellow, green, blue, and violet

volcano - a mountain that forms when layers of lava and volcanic ash erupt and build up over time

Video Component

Before Viewing

1. Prior to viewing Segment 3 of "The Case of the Mysterious Red Light," discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Use the problem board to help sort the information.
2. Review the list of questions and issues that the students revised and/or created prior to viewing Segment 2. Determine which, if any, were answered in the video or in the student's own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 2. Use tools located on the web as previously mentioned in Segment 1.
4. Discuss the hypothesis that the students generated at the end of Segment 2 and decide if information learned supports their hypothesis. If not, discuss why and revise the hypothesis.
5. **Focus Questions** - Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the show to answer the questions.

View Segment 3 of the Video

For optimal educational benefit, view *The Case of the Mysterious Red Light* in 15-minute segments.

After Viewing

1. At the end of Segment 3 have students reflect on the "What's Up?" questions asked at the end of the segment.
2. Discuss the hypothesis that the students generated at the end of Segment 2 and determine if they can continue to support it (Validation Station). At the end of Segment 2, the tree house detectives created a stronger hypothesis. Now, in Segment 3 after a KSNN report, they think that it might be a reflection from lava erupting from a volcano. Ask the students if the tree house detectives changed their hypothesis too quickly. What did they learn about reflection in Segment 2? Did the tree house detectives think the problem through thoroughly? After learning more about volcanoes and finding out that Mt. Luminous is a cinder cone, the tree house detectives know that their hypothesis is wrong. They do not form a new one because they don't think they have enough information. Compare this decision to the one they made earlier in the segment when they changed their hypothesis very quickly. Ask the students why the tree house detectives think they need to wait.
3. Choose activities from the educator guide and web site to reinforce the concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced or revisited and use activities to bolster students' understanding in those areas. Use the activities to "help" the tree house detectives solve the mystery. Help students see the correlation between the information learned and the clues used to solve the mystery.
4. Continue working on the problem-based learning activity on the web site. Have students use the Research Rack and the experiments located in Dr. D's Lab. Visit the Media Zone to learn more about the experts that were interviewed in this segment. Check out some of the great web sites referenced.
5. Have students reflect in their journal what they have learned from this segment and their own experimentation and research. If needed, give students specific questions to reflect upon.
6. Continue to assess what students have learned by using the students' journal writings, checklists, rubrics and other tools that can be found at the NASA "Why?" Files web site in the "Tools" section.

Careers

volcanologist
geologist
marine geologist
geophysical technician
seismologist
cartographer

Resources

Books

Tomecek, Stephen M. and Justine Ciovacco: *Discovery Channel School Teachers A-Z Resource Books: Light*. Discovery Communications, Inc., 2000, ISBN: 1563319837

Lauber, Patricia: *Volcano: The Eruption and Healing of Mount St. Helens*. Aladdin Paperbacks, 199e, ISBN: 0689716796

Lewis, Thomas P. and Joan Sandin: *Hill of Fire (I Can Read Books, Level 3 Series)*. Harper Collins Children's Books, 1987, ISBN: 0060238046

Lynch, David K. and Livingston, William: *Color and Light in Nature*. Cambridge University Press, 2001, ISBN: 0521772842

Owen, Weldon: *Reader's Digest Pathfinders: Earthquakes and Volcanoes*. Reader's Digest Children's Books, 2000, ISBN 1575843803

Silverstein, Alvin, Virginia Silverstein, and Laura Silverstein Nunn: *Plate Tectonics (Science Concepts)*. Twenty First Century Books, 1998, ISBN: 0761332251

Simon, Seymour: *Volcanoes*. Mulberry Books, 1995, ISBN: 0688140297

Van Rose, Susanna and James Stevenson: *Eyewitness: Volcano and Earthquake*. DK Publishing, 2000, ISBN: 0789457806

Web Sites

Imagine the Universe
An award-winning site created by NASA Goddard Space Flight Center for students ages 4-14. Visit "Gamma-Ray Bursts" for math, science, geography, and language arts activities for students in grades 5-8 that help them understand the electromagnetic spectrum. Take a look in "Imagine Science" for a whole spectrum of activities for the young student!
http://imagine.gsfc.nasa.gov/

Volcanoes in Outer Space?
Earth isn't the only planet in our solar system with volcanoes. Learn more about volcanoes on other worlds in the kid's story "Volcanoes in Outer Space?" Download lesson plans that include Hot Lava Poetry, Volcano Jeopardy, and a giant planet Pizza Party!
http://www.thursdaysclassroom.com/03aug01/corner.html

About Rainbows
Visit this site to learn how a rainbow forms and what makes the colors in a rainbow.
http://www.unidata.ucar.edu/staff/blynds/rnbw.html

The Sun, UV, and You—A SunWise Program
This program was created by the United States Environmental Protection Agency (EPA) to help children, parents, and educators become aware of the importance of sun safety. Become a SunWise School partner and receive FREE educational materials for your classroom or school. Learn about UV radiation and stratospheric ozone depletion and how these affect you everyday.
http://www.epa.gov/sunwise

FEMA for Kids: Volcanoes
This site includes general information about volcanoes, provides a map of the active volcanoes around the world, explains how to map lava flows, and more!
http://www.fema.gov/kids/volcano.htm

FEMA for Kids: Volcano Photos
http://www.fema.gov/kids/p_vol.htm

Volcano World
This site provides opportunities to learn about volcanoes through images and movie clips of volcanoes from around the world. Check out the most current eruptions and review the archive list of questions that were previously answered by volcanologists.
http://volcano.und.nodak.edu/vw.html

Volcano World: Volcano Images Around the World
http://volcano.und.nodak.edu/vwdocs/volc_images/volc_images.html

Light and Color @ Franklin Institute
This site explains how we see, how light travels, and how white light produces color.
http://www.fi.edu/color/color.html

Activities and Worksheets

Over the Rainbow

Purpose

To discover the colors and order of the visible spectrum

Materials

clear plastic shoe box or glass baking pan
9 x 12 in. white poster board
small mirror
ruler
white art paper
marker or crayons
water
flashlight

Procedure

1. Place the mirror in the plastic shoe box and lean it against one end.
2. Slowly pour water into the box until the mirror is covered halfway.
3. Hold the poster board above the box at the opposite end of the mirror.
4. Shine the flashlight on the water just in front of the mirror where the air, mirror, and water touch.
5. Adjust the mirror's angle until a rainbow's reflection appears on the poster board.
6. On your art paper, draw the rainbow, making sure to place the colors in the correct order.

Conclusion

1. What are the colors of the rainbow? _____

_____

2. How did the light, water, and mirror make a rainbow? _____

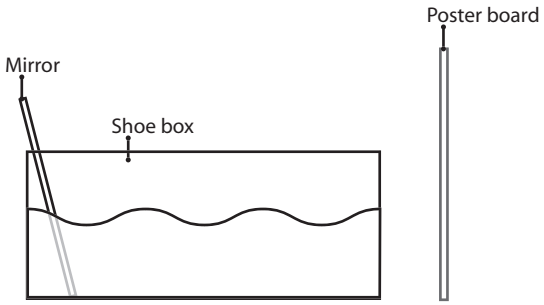
_____

3. Where have you seen other "rainbows"? _____

_____

Misconception

The visible spectrum has six colors: red, orange, yellow, green, blue, and violet. It was originally thought that the color indigo was between blue and violet. However, with more modern equipment, scientists now know there are only six colors. Therefore, Mr. ROY G BIV became Mr. ROY G BV.



Spinning White Light

Purpose

To blend the colors of the visible spectrum to make white light

Materials

compass
metric ruler
scissors
pencil
crayons or markers
1 m of string

Procedure

1. Use the compass to draw a circle with a diameter of 15 cm on white poster board. See diagram 1.
2. Cut out the circle.
3. Divide the circle into six equal pie-shaped sections.
4. Color each section a different color using red, orange, yellow, green, blue, and violet. See diagram 2.
5. Use the pointed end of the compass to make two small holes on opposite sides of the center of the circle. They should be about 3 cm apart from each other. See diagram 3.
6. Thread the string through the holes and tie the ends of the string together so that the thread forms a loop. See diagram 4.
7. Center the circle on the thread, wind up the circle, and make it spin by alternately stretching and relaxing the string.

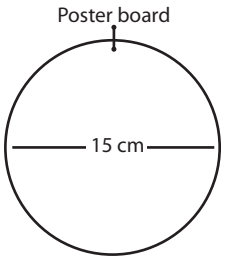


Diagram 1

Extensions

1. Sometimes spinning the circle on a string is too difficult for younger students. To make it easier to spin, use the compass to punch a hole in the center of the circle and put the circle on the end of a sharpened pencil. Use tape to help hold it in place. Have students rub the pencil between their two palms to make the circle spin back and forth.
2. Make multiple circles. Divide one circle into three sections and color it red, blue, and green. Divide another circle into three sections and color it red, blue, and yellow. Divide other circles into various numbers of sections and try different combinations of colors.

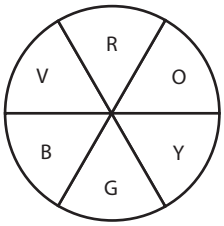


Diagram 2

Conclusion

1. How is color related to white light? _____

_____

_____

2. What was the purpose of spinning the circle? _____

_____

_____

3. What would happen if you put only red, blue, and yellow on the circle and spun it? _____

_____

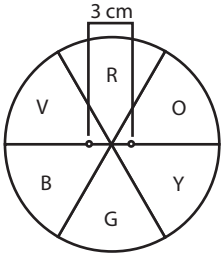


Diagram 3

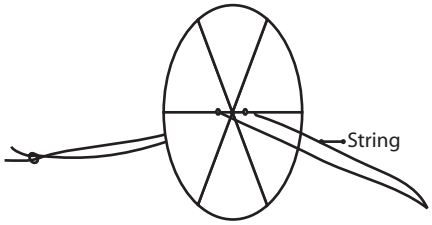


Diagram 4

Primary Colors of Light

Purpose

To blend the primary colors of light to make white light

Materials

three flashlights
red, blue, and green cellophane
tape
white poster board
paper and pencil
scissors
journal

Procedure

1. Make a template by placing flashlight bulb-side down onto a piece of paper and tracing around the outer edge.
2. To slightly enlarge the circle, cut around the outside edge of the circle.
3. Use this circle as a template to cut out circles from the cellophane paper. Cut one of each color.
4. Tape the red cellophane circle to one flashlight, the blue cellophane circle to the second, and the green cellophane circle to the third.
5. In a darkened room, shine each flashlight onto the poster board.
6. Mix the colored lights in various combinations.
7. Record your observations in your science journal.

Conclusion

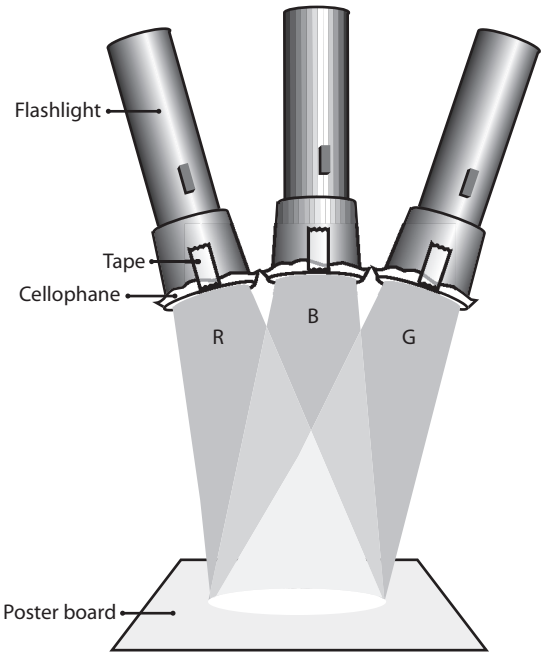
1. What combination of colors made white light? _____

_____

2. What are the primary colors of light? How do you know? _____

_____

_____



Primary Colors of Pigment

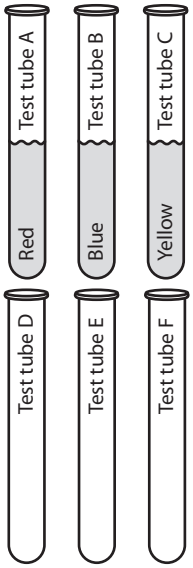
Purpose

To use the primary colors of pigment to discover the secondary colors

Materials

food coloring (red, blue, and yellow)
6 test tubes or jars
test tube rack
water
pencil
marker or grease pencil

Procedure



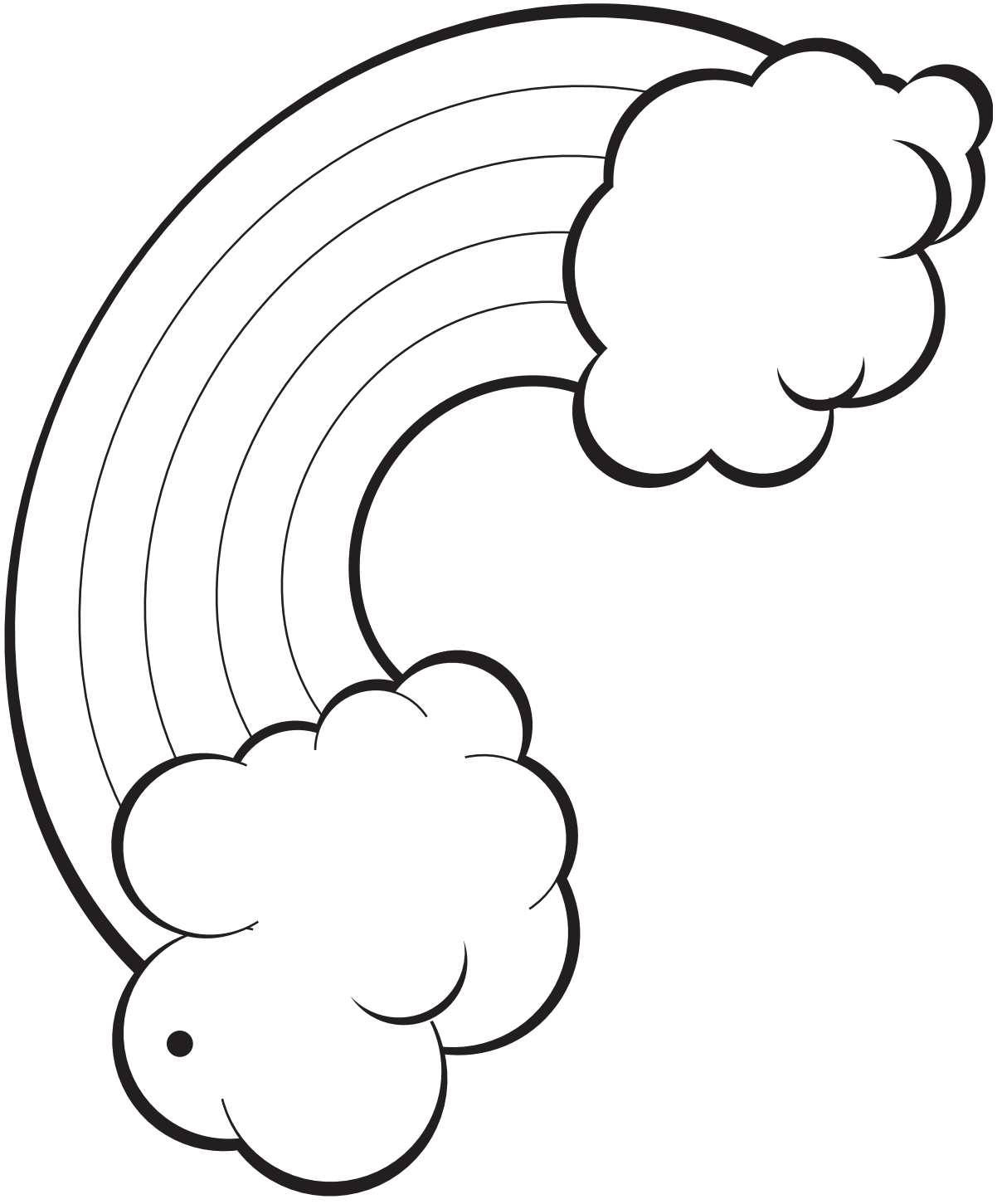
1. Fill three test tubes half full with water.
2. Use the marker and label each test tube "A," "B," and "C."
3. Place 5 drops of red food coloring in test tube "A."
4. Place 5 drops of blue food coloring in test tube "B."
5. Place 5 drops of yellow food coloring in test tube "C."
6. Allow the color to mix thoroughly. A gentle shake will help to mix them faster.
7. Use the marker and label the remaining three test tubes "D," "E," and "F."
8. Pour1/2 the water from test tube "A" into test tube "D."
9. Pour 1/2 the water from test tube "B" into test tube "D."
10. Place thumb over the opening of the test tube and gently shake.
11. Record your observations on data chart.
12. Pour remaining water from test tube "A" into test tube "E."
13. Pour1/2 the water from test tube "C" into test tube "E."
14. Gently shake and record observations in data chart.
15. Pour remaining water from test tubes "B" and "C" into test tube "F."
16. Gently shake and record observations in data chart.
17. Draw conclusions and discuss.

Data Chart

Test Tube D	Test Tube E	Test Tube F
Red + Blue = _____	**Red + Yellow =** _____	**Blue + Yellow =** _____

Rainbow of Knowledge

Depending on the number of pages you need, cut out several rainbows. Punch a hole at the circle indicated in the cloud and connect with string or fastener to create a book. In your book explain the visible spectrum.



Going the Distance

Purpose

To use a map scale to measure and calculate distance

Materials

map sheet
atlas
globe
metric ruler
pencil
journal

Procedure

1. Study the map and locate the compass rose and map scale.
2. Look at the map scale and determine the number of kilometers per centimeter.
3. Calculate the distance "as the crow flies" between Miami and Houston and record in your journal. Determine the direction that you "flew" and record.
4. Determine the length of time that it would take to fly from Miami to Houston if flying at a speed of 150 km per hour. Record in your journal.
5. Estimate the distance between Miami and Hawaii and record.
6. Repeat step 3 for the distance between Miami and Hawaii and compare to your estimation.
7. If Mt. Luminous was located near the Hawaiian Islands, how long would it take for dust and ash to reach Miami if it traveled at 100 km per hour? How many days would it take?
8. Use a globe and find the map scale. Measure the distance between Miami and Hawaii on the globe. Calculate and record.
9. Is it the same as the distance on your map? Explain why or why not.
10. Use an atlas or other map with a scale to calculate the distance between Miami and Hawaii. Record. Is the distance the same as the globe or your map? Why or why not?

Conclusion

1. Explain why various maps and globes differ in the number of kilometers between Miami and Hawaii. _____

   _____

   _____

2. Explain why approximating distance is valid in some instances, but not in others. _____

   _____

   _____

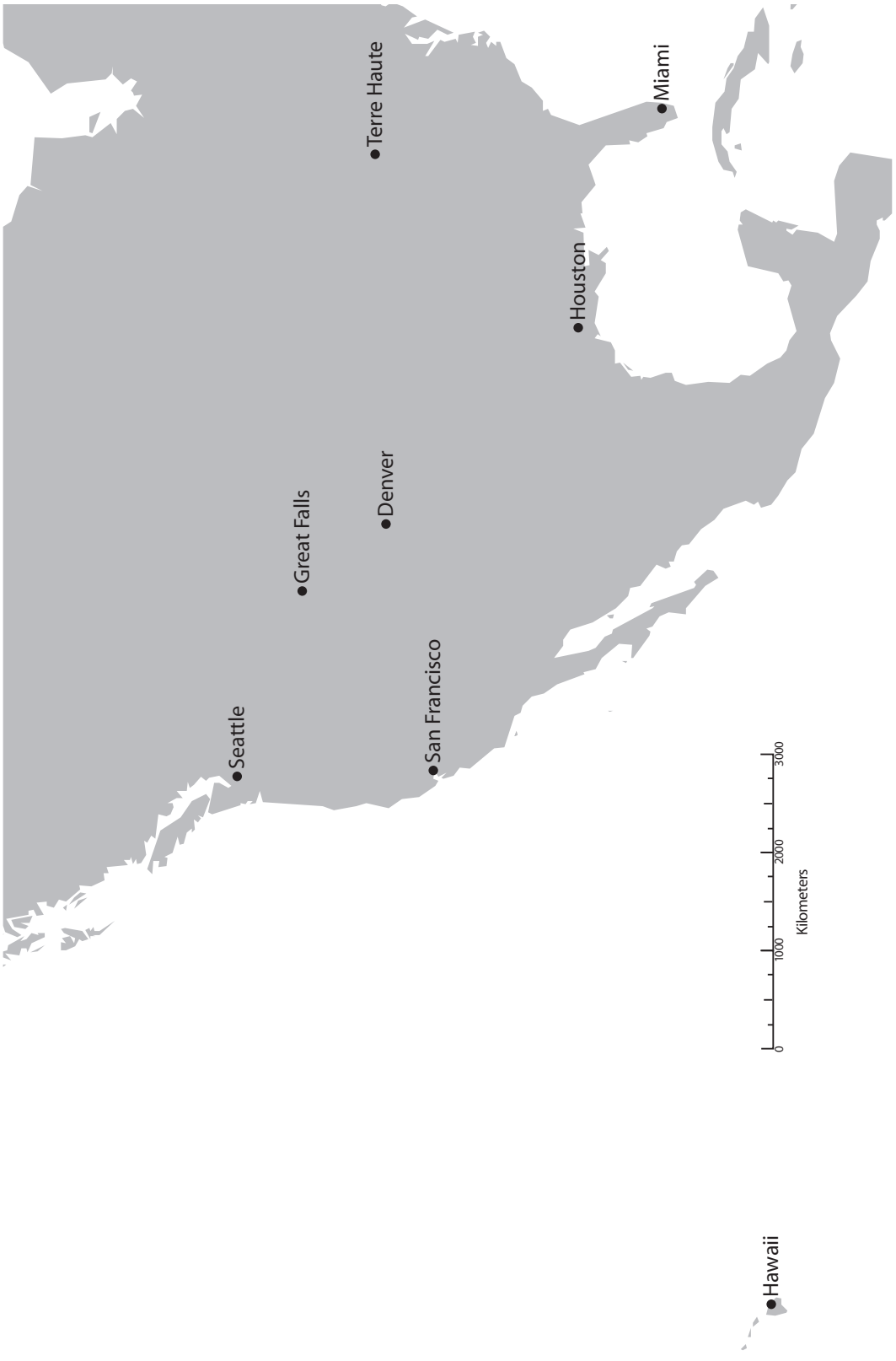
3. Is Hawaii closer to Houston or Great Falls? _____
4. Which city is the most northern? _____

   southern? _____

   eastern? _____

   western? _____

Going the Distance



You've Got the Whole Egg in Your Hands

Purpose

To learn the layers of our Earth
To learn the types of plate boundaries

Materials

hard-boiled egg
paper towels
plastic knife
activity sheets

Procedure

1. Have students examine the hard-boiled egg and discuss that it is a model of the Earth.
2. Discuss that the outer shell of the egg represents the crust of our Earth. Explain that our crust is broken into several large pieces and that there are seven major plates of the lithosphere. To create plates on the egg model, have students gently tap the egg on a hard surface.
3. Have the students examine the egg and count the number of plates created. Use a marker to outline the plates.
4. Discuss with the students that the plates are always moving. Ask students to demonstrate three ways that they can make their eggs' plates move. They should derive that they can push them together, pull them apart, and twist them. Introduce the three types of movement that occur at the plate boundaries or zones. The level of discussion will depend upon the level of your students.

   divergent boundary - boundary between two plates that are moving apart from one another. The Mid-Atlantic Ridge is an example of a divergent boundary. Demonstrate by gently pulling on the ends of the egg, causing the plates to spread apart.

   convergent boundary - boundary where two plates collide. Have students gently push on each end of the egg to demonstrate. There are three types of convergent boundaries:

   The first is an area where a **heavier ocean plate goes under a lighter continental plate**, creating a subduction zone. Volcanoes occur at subduction zones. The Andes Mountains were formed in this manner.

   The second is an area where **two ocean plates collide** and one bends and slides under the other, creating a subduction zone that forms a deep-sea trench. Volcanoes form underwater at this boundary forming islands such as Japan.

   The third is an area where **two continental plates collide** and crumple up forming mountain ranges such as the Himalayas.

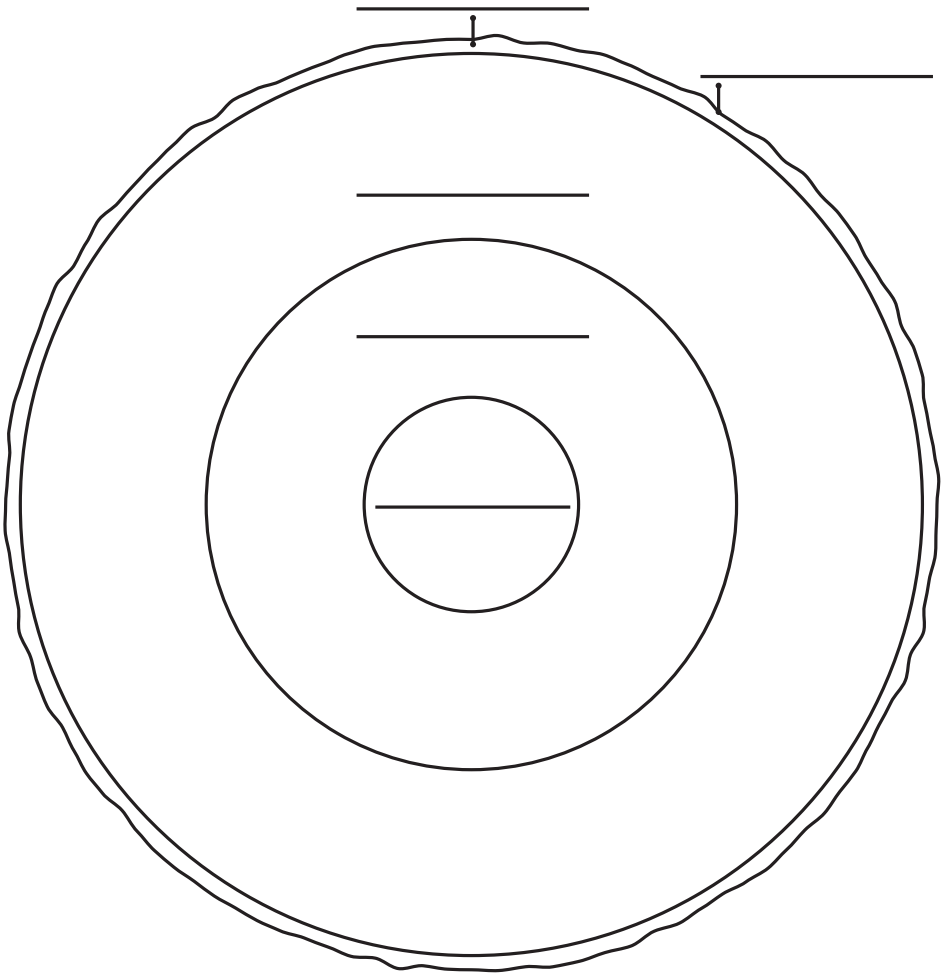
   transform fault boundary - occurs when two plates slide past one another moving in opposite directions or in the same direction at different rates. Gently twist the ends of the egg to demonstrate transform faults. A famous transform fault boundary is the San Andreas Fault in California.

5. Have students use the plastic knife to cut the egg in half.
6. Discuss the layers of the Earth as represented by the layers of the egg. The white part of the egg represents the mantle and the yolk is the core. The inner core and the outer core can be differentiated by the darker color around the outer part of the yolk. Point out the thin membrane between the shell and the yolk. This part is representative of the asthenosphere. It is on this plastic-like layer that the plates of the crust move.
7. Have the students complete the activity sheet "Layers of the Earth" and perform the research suggested.
8. Have the students complete the activity sheet "Plates and More Plates" and conduct the suggested research.

You've Got the Whole Egg in Your Hands

Activity Sheet: The Layers of the Earth

Look at the diagram and label the layers of the Earth using outer core, inner core, mantle, crust, and asthenosphere.

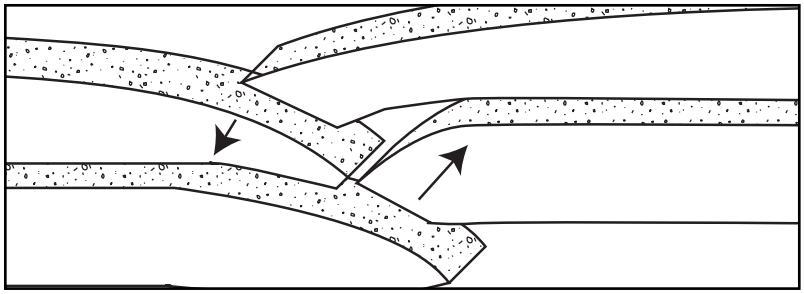


Research for more information about the layers of the Earth. On the back of this sheet, list three facts about each layer and share with your class.

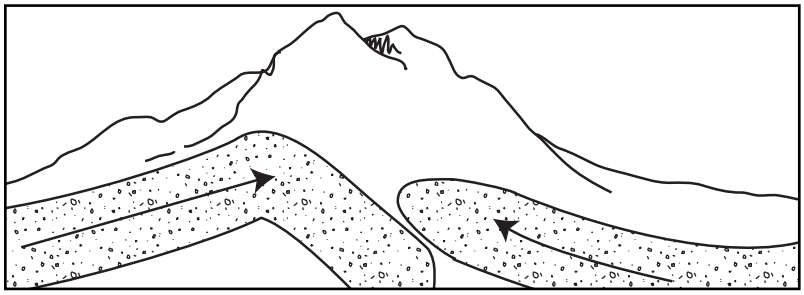
You've Got the Whole Egg in Your Hands

Activity Sheet: Plates and More Plates

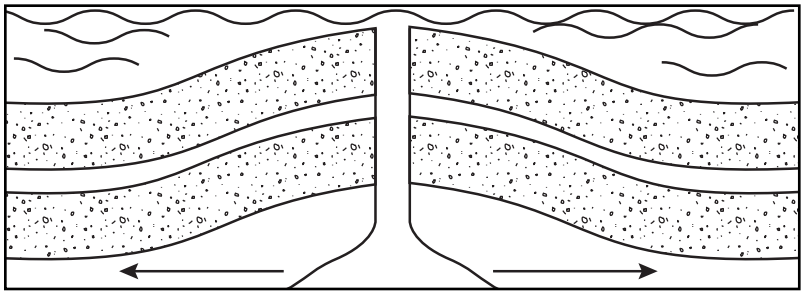
Look carefully at the diagrams below. With the information you have about plates and their movements, identify each of the plate boundaries using divergent, convergent, or transform faults.



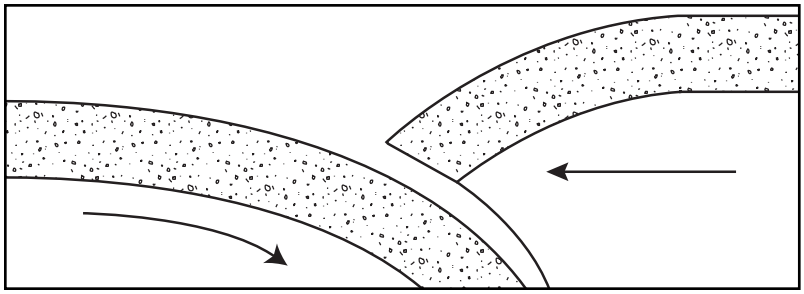
1. _____



2. _____



3. _____



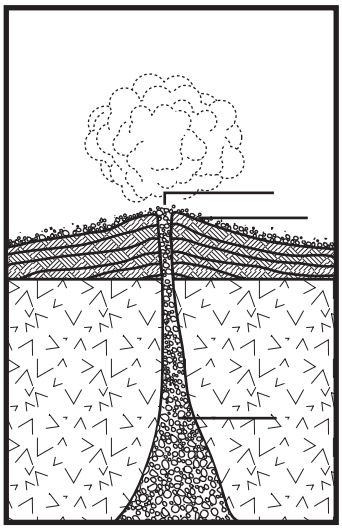
4. _____

Research plate boundaries to discover how volcanoes are formed.

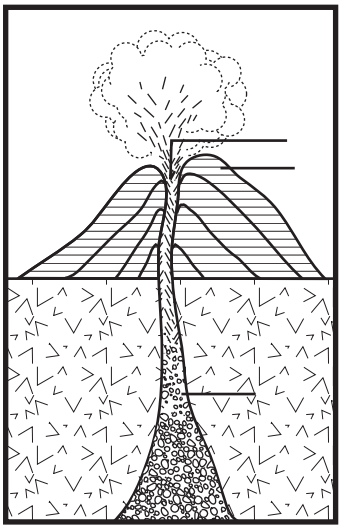
Research to discover the name of the seven major plates.

Research to discover what makes the plates move.

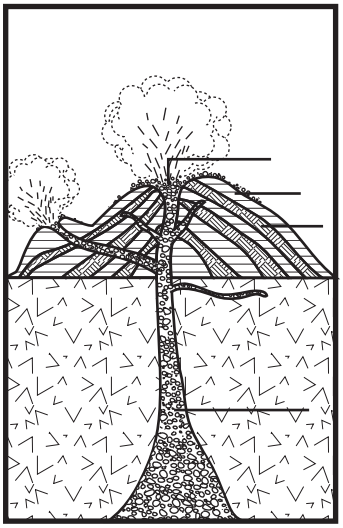
The Three Little Volcanoes



Shield volcanoes are shaped like shields and have very gentle, sloping sides. They are made of many layers of a kind of volcanic rock (basalt) that flows very easily when melted. The melted rock is called magma, and when it flows out the vent it becomes lava. The lava forms thick layers that slope away from the vent. These layers then cool and harden over time. Shield volcanoes can be very large. The volcanoes of Hawaii are shield volcanoes that have formed over a hot spot in the crust. Label the diagram using letters to represent vent (A), magma (B), and lava (C). Color the lava and magma red, the layers of hardened lava yellow, and the preexisting rocks brown.



Cinder cone volcanoes are made of pieces of rock called tephra. Tephra may be tiny like dust and ash or large like gravel. Tephra blows out the vent and cools so quickly that it hardens before hitting the ground. When tephra falls to the ground, it piles up around the vent, forming a steep cone. Cinder cones are often smaller than shield volcanoes, and they can erode very easily. In a Mexican corn field, a cinder cone called Parícutin grew several hundred meters high in just a few days! Label the diagram using letters to represent vent (A), magma (B), and lava (C). Color the tephra orange, the layers of tephra gray, the magma red, and the preexisting rocks brown.



Composite volcanoes are formed when eruptions vary between quiet and explosive. These eruptions create alternating layers of lava and tephra. During explosive eruptions, tephra is released. During quiet eruptions, lava is released. The layers of tephra make the sides steep, and the layers of hardened lava help keep the volcano from eroding quickly. Composite volcanoes are found mostly at convergent plate boundaries. Mt. St. Helens is an example of a composite volcano. Label the diagram using letters to represent vent (A), magma (B), lava (C), and tephra (D). Color the magma and lava red, the tephra layers gray, the hardened lava layers yellow, the gas and dust orange, and the preexisting rocks brown.

The Ring of Fire

There are more than 1,500 active volcanoes in the world. An active volcano is one that has erupted at least once in the past 10,000 years and is likely to erupt again. Because most of the Earth's volcanoes are hidden under the oceans, people have not been able to witness their eruptions. Every year about 50-60 volcanoes erupt on land where people might be able to see them. Scientists estimate that there are about 200 volcanic eruptions under the oceans. The shaded area on the map is called the "Ring of Fire." Do the exercise below and you will discover why.

Materials

compass
metric ruler
scissors
pencil
crayons or markers
1 m of string

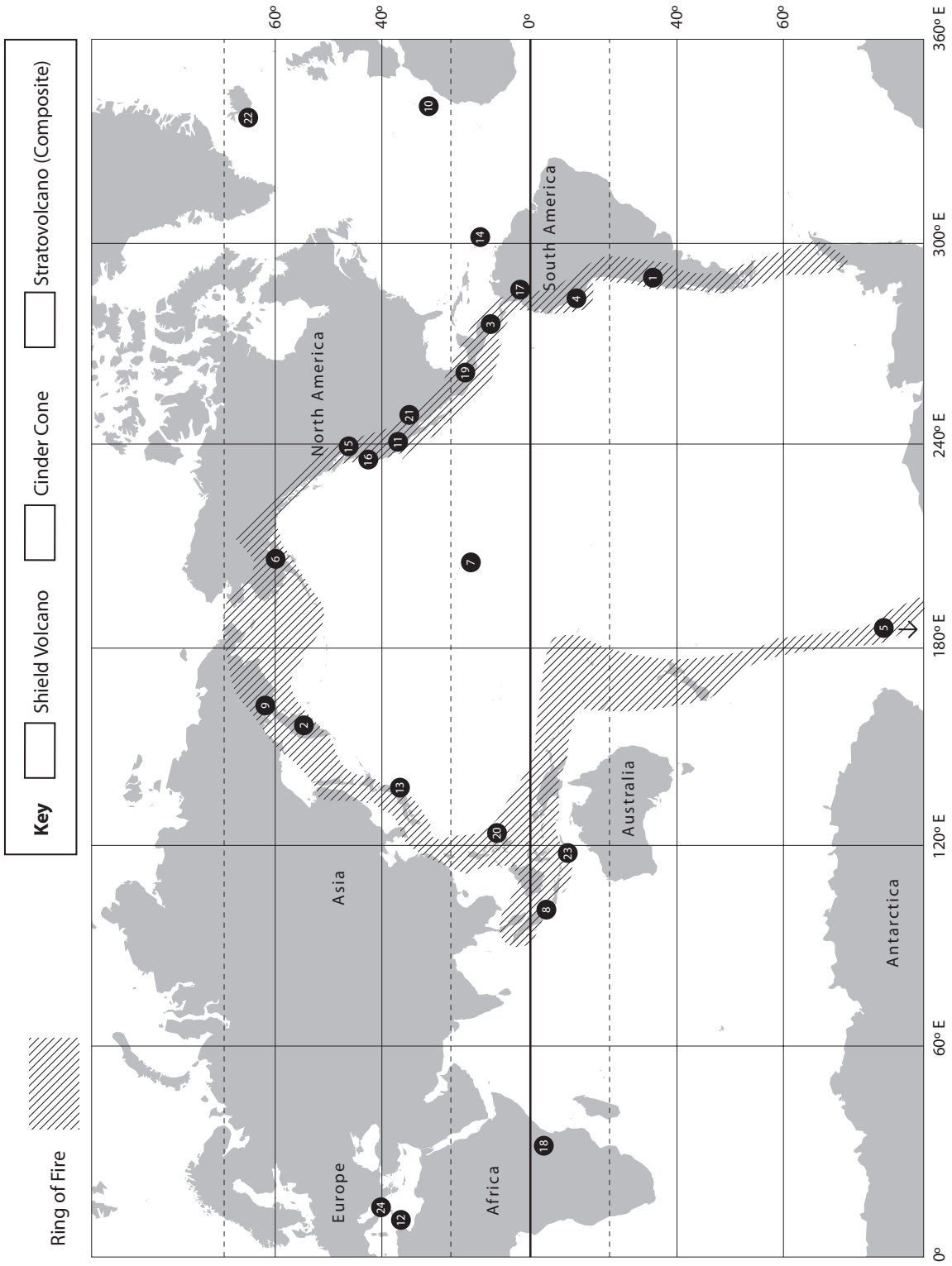
Directions

Locate and label each of the volcanoes listed on the blank map. Make a key and use a different colored marker for stratovolcano (composite), shield, and cinder cone volcanoes.

This is a list of some active, or recently active, volcanoes.

Name	Type	Last Erupted
1 Azul	Stratovolcano	1967
2 Bezymianmy	Stratovolcano	1993
3 Cerro Negro	Cinder cone	1971
4 Cotopaxi	Stratovolcano	1942
5 Erebus	Stratovolcano	1980
6 Katmai	Stratovolcano	1912
7 Kilauea	Shield	1995
8 Krakatau	Stratovolcano	1894
9 Ksudach	Shield	1907
10 La Palma	Stratovolcano	1954
11 Lassen Peak	Stratovolcano	1914
12 Mt. Etna	Shield	1993
13 Mt. Fuji	Stratovolcano	1709
14 Mt. Pelée	Stratovolcano	1932
15 Mt. Rainier	Stratovolcano	1894
16 Mount St. Helens	Stratovolcano	1986
17 Nevada del Ruiz	Stratovolcano	1991
18 Ol Doinyo Lengai	Stratovolcano	1993
19 Parícutin	Cinder cone	1952
20 Pinatubo	Stratovolcano	1992
21 Sunset Crater	Cinder cone	1065
22 Surtsey	Shield	1967
23 Tambora	Stratovolcano	1967
24 Vesuvius	Stratovolcano	1944

Ring of Fire


Key
Shield Volcano
Cinder Cone
Stratovolcano (Composite)
Ring of Fire
North America
South America
Europe
Asia
Africa
Australia
Antarctica
60° E
120° E
180° E
240° E
300° E
360° E
0°
40°
60°

Ring of Fire

Conclusion

1. Are most of the volcanoes located in the Ring of Fire? _____
2. What percentage of the volcanoes is located in the Ring of Fire? To find out, use the following formula:

   $\frac{\text{\# in shaded area}}{\text{total \#}} \times 100 =$ _____% of volcanoes in the Ring of Fire

3. What percentage of the volcanoes is located outside of the Ring of Fire? To find out, use the following formula:

   $\frac{\text{\# not in shaded area}}{\text{total \#}} \times 100 =$ _____% of volcanoes not in the Ring of Fire

4. Types of Volcanoes in the Ring of Fire.
   # of stratovolcanoes _____
   # of shield volcanoes _____
   # of cinder cones _____

5. What type of volcano is the most common in the Ring of Fire? _____
   Least common? _____

Answer Key

Over the Rainbow

1. red, orange, yellow, green, blue, and violet (purple)
2. The light hit the wedge of the water between the mirror and the water's surface, causing the light to bend (refract). Since each wavelength of light bends at a different angle, the colors are refracted in slightly different directions, and the colors are spread out or split, creating a rainbow.
3. Rainbows may have been seen in the sky, on bubbles, CDs, dish soap, or many other places.

The Edible Spectrum

1. The wavelengths should have been determined by determining each color's frequency. Red has the slowest frequency; therefore, it has the longest wavelength. Violet has the highest frequency; therefore, it has the shortest wavelength. The other colors would fall in between, graduating from longer to shorter, as determined by their order in the spectrum.
2. The relationship is that the longer the wavelength, the slower the frequency and the shorter the wavelength, the faster the frequency.
3. The candy pieces represent the photons.

Spinning White Light

1. White light is the combination of all the colors of light.
2. When the circle was not spinning, your eye could tell the colors apart. The only way to get the colors to blend is to spin the circle so that the colors move so fast that it becomes impossible for the eye to tell them apart. The six colors blend and appear yellowish white.
3. You would have gotten a different color and not white light because those are not the colors of light nor are they the complete colors in the spectrum.

Primary Colors of Light

1. White light was produced when red, green, and blue were combined.
2. The primary colors of light are red, green, and blue because they were the three colors that produced white light. None of the other color combinations worked.

Going the Distance

1. Maps will vary slightly in distance because it is very difficult to calculate accurately on very large-scale maps such as globes. The smaller the map scale, the more accurate measurements will be.
2. It is valid to approximate distance if you just need a rough estimate. However, if you are a pilot, for example, and need to know when you will be landing at your destination, a more accurate measurement of distance is required.
3. Hawaii is closer to Great Falls.
4. Northern—Seattle, Southern—Miami, Eastern—New York, Western—San Francisco

Magnificent Magma

1. The squeezing of your hand represented the pressure inside the Earth that builds up to force magma out onto the surface of the Earth (lava).
2. The space between your fingers represented the cracks in the Earth's crust that allow the magma to erupt onto the surface of the Earth.
3. The wider the crack, the more magma can erupt. The more force applied, the more violent the eruption.
4. No, because it is a cinder cone, and cinder cones do not erupt magma, just cinders.