Rocks and Minerals Introduction

Rocks are aggregates, or combinations, of minerals. Most rocks contain two or more minerals, but a single mineral may be considered a rock if it exists on a large enough scale, such as sulfur, quartzite, and gypsum.

There are three basic types of rocks: igneous, sedimentary, and metamorphic. Igneous rocks are formed by the solidification of cooling molten materials. Sedimentary rocks are formed by processes on the surface of the Earth such as deposition, compaction, and cementation. Metamorphic rocks are formed from igneous or sedimentary rocks that have been subjected to extreme heat or pressure. The formation and breakdown of rocks are on-going and form what is called the **rock cycle**.

A mineral is a naturally occurring solid which has been inorganically formed. Minerals have definite chemical compositions and definite atomic arrangements. If a mineral is allowed to grow without interference, it will develop a characteristic crystalline shape. The crystal form reflects the arrangement of atoms in the molecule.

Minerals are the building blocks of rocks. The most common rock-forming minerals are those which contain silica, the simplest of which is quartz. Compounds containing carbon are also important rock-forming minerals, a common example of which is calcite.

According to the National Science Education Standards (1996), students in grades K-4 should develop an understanding that:

- Earth materials are solid rocks and soils, water, and the gases of the atmosphere. The varied materials have different physical and chemical properties, which make them useful in different ways...
- Soils have properties of color and texture, capacity to retain water...
- The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering...

Applicable standards for grades 5-8 state that students should develop an understanding that:

- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

- Some changes in the solid Earth can be described as the "rock cycle." Old rocks at the Earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

- Soils are often found in layers, with each having a different chemical composition and texture.

Introducción a Rocas y Minerales

Las rocas son uniones o combinaciones de minerales. La mayor parte de las rocas contienen dos o mas minerales, pero un simple mineral puede ser considerado como roca si éste existe en gran escala, tal como el azufre, cuarcita y yeso.

Hay tres tipos de roca básicos: Volcánica, sedimentaria y metamórfica. Generalmente las rocas volcánicas están formadas por la solidificación de materiales enfriados y fundidos. Las rocas sedimentarias son formadas por procesos en la superficie terrestre tales como sedimentación, cimentación y solidificación. Las rocas metamórficas son formadas de rocas volcánicas o sedimentarias las cuales han sido sometidas a presión o calentamientos extremos. Los procesos que afectan a las rocas son pasajeros y forman lo que se llama el "ciclo de la roca".

Un mineral es naturalmente un sólido casual el que ha sido inorgánicamente formado. Los minerales tienen composiciones químicas y estructuras atómicas definidas. Si un mineral se forma sin interferencia, obtendra características cristalinas. La forma de cristal refleja la disposición de átomos en la molécula.

Los minerales son las materias básicas de las rocas. Los minerales formados de roca más comunes son aquellos que contienen sílice, el más simple de los cuales es el cuarzo. Los componentes que contienen carbón son también minerales importantes que forman a la roca, del cual un ejemplo común es la calcita.

De acuerdo a las Normas de Educación Nacional de Ciencia (1996) [National Science Education Standards (1996)], los estudiantes en los grados K-4 deberán desarrollar el entendimiento de que:

- La Tierra esta formada de rocas sólidas y tierra, agua y los gases de la atmósfera. Los varios materiales tienen diferentes propiedades físicas y químicas, las cuales los hacen útiles en diferentes maneras...
- Las tierras tienen las propiedades de color y textura, la capacidad de retener el agua...
- La superficie de la Tierra cambia. Algunos cambios son debidos a lentos procesos, tales como erosión y daños por la intemperie...

Las normas aplicables para los grados 5-8 estatuyen que los estudiantes deberían desarrollar el entendimiento de que:

- Las formas de las tierras son el resultado de una combinación de fuerzas constructivas y destructivas. Las fuerzas constructivas incluyen la deformación de la capa terrestre, erupción volcánica, y depósito de sedimentos; mientras que las fuerzas destructivas incluyen la erosión y los daños causados por la intemperie.

- Algunos cambios en la tierra sólida pueden ser descritos como el "ciclo de roca." Viejas rocas sobre la superficie de la tierra son dañadas por la intemperie, formando sedimentos que son enterrados y luego compactados, calentados y, a menudo, recristalizados en una nueva roca. Eventualmente, esas nuevas rocas pueden ser traídas a la superficie por las fuerzas que causan el movimiento de placas, y el ciclo de roca continúa.

- Las tierras a menudo se encuentran en capas, las cuales tienen cada una diferente composición y textura química.

CHOCOLATE CHIP COOKIE GEOLOGY

Grades		
1-3	2	50 min.

Description: Students will examine chocolate chip cookies as a model for rocks.

Materials for Each Group:
1 chocolate chip cookie to examine [the more stuff (nuts, oats, etc.) in the cookie, the better!]
1 chocolate chip cookie per student to eat
2 paper towels
2 toothpicks
2 hand lenses

Materials for the Whole Class:
an assortment of rocks which clearly show different minerals
mineral samples

Safety: Explain clearly to students that they are not to eat the "rock" cookie they will be examining; each student will receive a separate cookie to eat after the activity is completed. Check with parents about any food allergies.

Procedure:

1. Display the assortment of rocks. Allow students time to examine them and to notice the different materials they can see. Explain that these different materials (minerals) are like the different ingredients in a cookie.

2. Distribute the paper towels, cookies, toothpicks, and hand lenses. Have the students break open the cookies and use the toothpicks to separate out the different items they find. The different items represent the different minerals in a real rock. Students can group the items on a separate paper and label them.

3. Look at the mineral samples and try to match the samples to the crystals in the rocks.

Questions to Ask During the Activity:

1. How many different types of ingredients did you find? Name them.

2. Were the items in the cookie located in one place in the cookie? Do you think real rocks could be arranged the same way?

3. Did you see some of the same items on the inside of the cookie that were on the outside?

4. Was your cookie like everyone else's? Do you think all rocks are alike?

Why It Happens: Rocks are natural combinations of one or more minerals. Rocks can be identified by observing and identifying the various minerals within them. It is often difficult to separate all the components of a rock, so students use the cookie as a model of a real rock.

Adaptations for Participants with Disabilities: Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.

Extensions: Have the students bake the cookies as a lesson in measurement and a context for discussing chemical changes.

Use different kinds of cookies to represent different kinds of rocks.

Using a rock that will show different crystals or grains, such as granite or sandstone, wrap the rock in cloth, and hit it with a hammer. Give the students hand lenses to examine the pieces of broken rock and have them examine the shape, size, color of the fragments and describe the inside and outside appearances of the rock.

References: Project Storyline: Science, Primary Geology. The California Science Implementation Network, University of California, Irvine, 1992.

Lind, Karen K., ed. Water, Stones, & Fossil Bones. Washington, D.C.: National Science Teachers Association, 1992.

ROCK SALT

Grades		
2-6	2-3	30 min.

Description: Students will make and observe different crystals.

Materials for Each Group:
3 T soil
1 cup water
2 T salt
metal jar lid or saucer

Procedure:
1. Vigorously stir the salt in the water for several minutes until most of it dissolves. Let the remaining salt settle.

2. Spread the soil out in the jar lid or saucer. Pour some of the clear salt water on the soil. Set the mud-like mixture in a warm place. Allow the mud mixture to dry—do not disturb it.

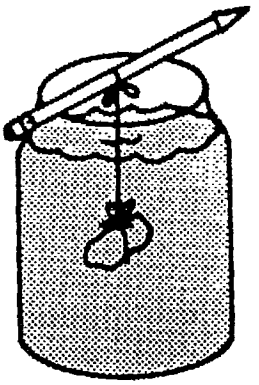
3. Once it is dry, have students examine the salt crystals on the soil carefully.

Questions to Ask During the Activity:
1. How do the salt crystals get on the soil? [The water evaporates, leaving the salt behind.]

2. What shape are the crystals? [cubes]

Why It Happens: Rock salt is formed when minerals are dissolved in water. The water evaporates into the air, leaving the salt behind. As the water evaporates, the molecules in the salt start to cling together and grow into larger crystals. Rock salt is the mineral halite. It forms after long periods of evaporation of sea and lake water in an arid climate.

Extensions: Students could make sugar, alum, and Epsom salt crystals. Start with a hot saturated solution of one of these chemicals. Hang a weighted thread into the solution and allow it to cool slowly. Crystals will form on the string.



References: Wood, Robert W. Science for Kids 39 Easy Geology Experiments. Blue Ridge Summit, PA: TAB Books, 1991.

Tolman, Marvin N. and James O. Morton. Earth Science Activities for Grades 2-8. West Nyack, NY: Parker Publishing Co., Inc., 1986.

SHAKE and SETTLE

Grades		
1-5	2-3	2/50 min. periods

Description: Students will observe the sedimentation of different materials.

Materials for Each Group:
1 quart Mason jar with lid
water
different soils (i.e., potting soil, sand, clay), pebbles, leaves, etc.
Note: for younger students, use soil and pebbles only

Safety: Caution students to be careful in shaking the jar so as not to drop it.

Procedure:
1. Cover tables with newspaper to help with clean-up.
2. Have students follow the procedure on the Student Activity Sheet.
3. Be sure jars are labeled (per group) and are placed in an area where they will remain undisturbed overnight.
4. Arrange jars the following day, so students can compare their results.

Questions to Ask During the Activity:
1. How could the materials you put in your jar have been created in the natural environment where they were found? [Soils can be formed through erosion and weathering processes.]
2. What could cause the moving water in a stream or river to stop to allow the sediments carried in the water to settle? [when it meets a standing body of water such as a lake or ocean, intermittent streams, or flash floods]

Why It Happens: Rivers and streams carry sediments which are the products of weathering and erosion. When the river meets a lake or sea, the river slows down and many of the particles settle out. The heavier (usually coarser) sediments settle out first, followed by the smaller, lighter sediments. As a result, these bodies of water may become shallow due to the deposition of these sediments. Sediments can also be deposited by rivers when they slow down through curves and meanders. Examination of the sediments reveals layers. Through time, additional layers accumulate to form great thicknesses of

sediments. The pressure of the upper layers may be sufficient to compact the lower layers into sedimentary rocks.

Adaptations for Participants with Disabilities: Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.

Extensions: Simulate fossil formation while studying sedimentation. Use quart (paper) milk containers instead of the glass jars. Add organic materials such as leaves, insects, shells, etc. to the soils and place in the container to make fossils. Repeat the procedure for the above lesson, except before adding the water, add about 3 tablespoons of plaster of Paris. After about 1 hour, drain off the excess water. Allow the cartons to set overnight. Once the plaster of Paris is hardened, students can peel back one side of the carton and observe the plastered layers.

References: Project Storyline: Science, Primary Geology. The California Science Implementation Network, University of California, Irvine, 1992.

Shake and Settle
Student Activity Sheet

Description: You will observe the sedimentation of different materials.

Materials for Your Group:
1 quart Mason jar with lid
soil, pebbles, leaves, etc.
water

Safety: Use care in shaking the glass jar to avoid dropping it.

Procedure:

1. Fill the jar about 1/2 full with the soil and other materials available. It does not matter what order materials are placed in the jar.

2. On the following data sheet, use pictures and words to describe what is in the jar and how the materials are arranged.

3. Add water to the jar until it is about 3/4 full. Close the top of the jar tightly and shake it vigorously for a few minutes. On the data sheet, predict how the materials in the jar will appear after they have settled.

4. Allow the jar to stand, undisturbed, overnight. On the following day, use hand lenses to observe the layers in the jar. Again, use pictures and words to describe the appearance of the materials in the jar.

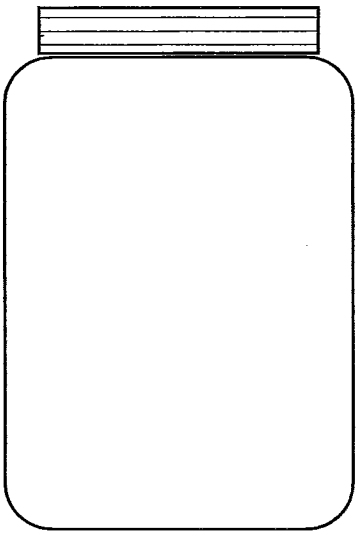
Questions:

1. How did shaking the jar change the order of the layers?

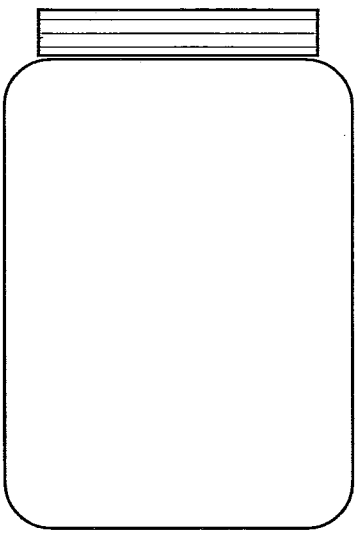
2. How are the materials which settled on top different from those which settled on the bottom?

3. Were your results the same as those found by other groups? What could account for any differences?

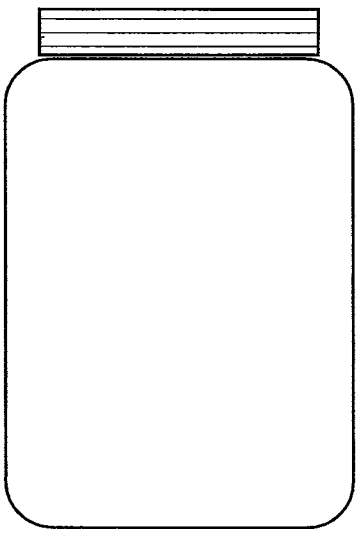
Shake and Settle Data Sheet



1. How are the materials arranged in your jar at the beginning?



2. Predict how the materials will be arranged after they settle.



3. How are the materials arranged in your jar after they settle?

Agitarse y Asentarse
Hoja de Actividades para el Estudiante

Descripción: Se observará la sedimentación de diferentes materiales.

Materiales para Su Grupo:
1 frasco Mason de un cuarto, con tapadera
tierra, piedrecillas, hojas, etc.
agua

Medidas de Seguridad: Tener cuidado al agitar el frasco de vidrio para no dejarlo caer.

Procedimiento:

1. Llenar el frasco con la tierra y otros materiales disponibles hasta aproximadamente la mitad.

2. En la siguiente hoja de información, usar dibujos y palabras para describir lo que hay en el frasco y la manera de cómo están acomodados los materiales.

3. Agregar agua al frasco hasta que esté aproximadamente a tres cuartos de su capacidad. Cerrar el frasco bien apretado y agitarlo vigorosamente por algunos minutos. En la hoja de información, predecir cómo se verán los materiales en el frasco después de asentarse.

4. Dejar el frasco por toda la noche. Al siguiente día usar lupas para observar las capas en el frasco. Nuevamente, usar dibujos y palabras para describir la apariencia de los materiales dentro del frasco.

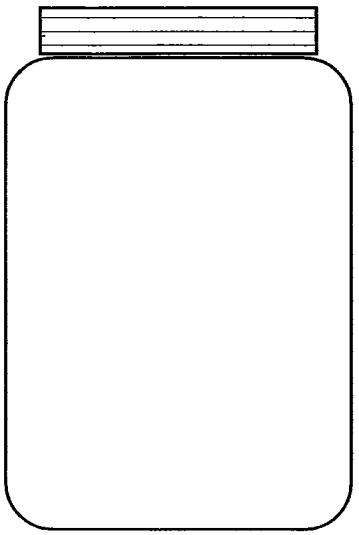
Preguntas:

1. ¿Cómo cambió el órden de las capas al agitar el frasco?

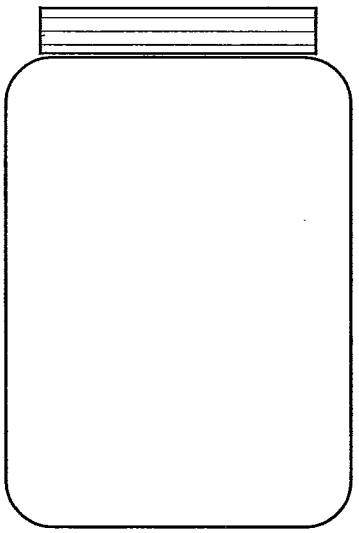
2. ¿Cuál es la diferencia entre los materiales que se asentaron arriba con aquellos que se asentaron en el fondo?

3. ¿Sus resultados fueron los mismos a aquellos encontrados por otros grupos? ¿A qué se deben las diferencias que fueron encontradas?

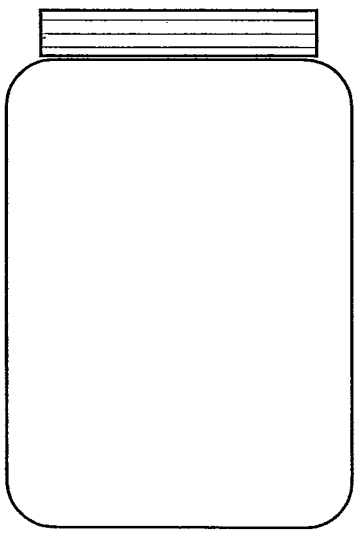
Agitarse y Asentarse
Hoja de Información



1. Al empezar, ¿Cómo están acomodados sus materiales?



2. Predecir cómo se acomodarán los materiales después de asentarse.



3. ¿Cómo están acomodados los materiales después de asentarse?

EROSION BY WATER

Grades		
3-8	3-4	40 min.

Description: Students will use plaster of Paris "rocks" to investigate how moving water can erode rocks.

Materials for Each Group:
1 large jar or other container with lid
8 index cards
16 plaster of Paris rocks (plaster of Paris, egg carton or ice cube tray)
water

Safety: Have students take turns shaking the jar to avoid having an over-tired student dropping the jar. Caution students to be careful with the glass jars.

Procedure:
1. Prepare the plaster of Paris rocks by mixing the plaster of Paris according to the instructions on the packet and pouring it into ice cube trays or egg cartons. Try to make all the rocks the same size and shape. Make the rocks small enough for 16 of them to fit into the jar with water.
2. Have students follow the instructions on the Student Activity Sheet.
3. When cleaning up, be sure no large particles of the plaster of Paris go down the drain.

Questions to Ask During the Activity:
1. Have students predict what changes will occur before they begin shaking the jar.
2. Do you notice any change to the water as you shake the rocks more and more?
3. How is shaking the rocks in the jar like what happens to rocks in a river?

Why It Happens: Moving water exerts a large amount of force on the materials with which it comes in contact. The force of the water can wear away parts of rocks and can cause the rocks to tumble against each other and break apart. Rocks become smooth as they are eroded by moving water. Small pieces from the rocks can become sediment which travels with the moving water of a river and is deposited.

Adaptations for Participants with Disabilities:

- Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.
- Students with visual impairments can feel changes in the rocks.

Extensions: You can use this activity in conjunction with the activities in the Water unit as well as with the Stream Model in the Maps and Models unit.

Instead of plaster of Paris rocks, use real limestone rocks and observe any changes in the water after the increasing number of shakes. Test the pH level of the water before and after shaking to detect changes.

Sing the following song:

Erosion (sung to the tune of Jingle Bells)
Running down a hill
Or coming down as snow
Water causes much
Erosion this we know;
Wave action moves the beach;
A river carves the land
Everywhere that water goes
It carries dirt or sand. Oh

Chorus:
Wind and rain, snow and ice, water running free;
These all cause land to erode with changes we can see.
Wind and rain, snow and ice, water running free;
These all cause land to erode with changes we can see.

Wind blowing in a gale
Or as a gentle breeze
Wears the rock away
And carries sand with ease;
A hurricane last year
And glaciers long ago
Are ways that natural forces use
To change the earth we know.

Chorus

-Written by Ann K. Dunn and Karyn Crocker
AIMS Newsletter, Volume IX, Number 5, Dec., 1994

Erosion by Water
Student Activity Sheet

Description: You will use plaster of Paris "rocks" to investigate how moving water can erode rocks.

Materials for Your Group:
1 container with lid
8 index cards
16 plaster of Paris rocks
water

Procedure:
1. Label the index cards as follows: 0 shakes, 25 shakes, 50 shakes, 75 shakes, 100 shakes, 125 shakes, 150 shakes, 175 shakes.
2. Put 16 plaster of Paris rocks in the container, fill the container with water and close the lid tightly.
3. Let the container stand for one minute. Remove two of the rocks and place them on the index card marked 0 shakes.
4. Replace the lid of the container tightly and shake the container 25 times. Remove two more rocks and put them on the card marked 25 shakes.
5. Repeat step 4 for totals of 50, 75, 100, 125, 150 and 175 shakes.
6. Observe the rocks. On a separate paper, use pictures and words to describe any changes you notice each time you remove rocks from the container.

Questions:
1. Were the rocks which are on the 0 shakes index card in still or moving water?
2. How did the rocks change with more and more shakes?
3. What happened to the tiny bits which broke off the rocks?
4. How is shaking the rocks in a jar like what happens to rocks in a river?

Erosión Causada por el Agua
Hoja de Actividades para el Estudiante

Descripción: Se necesitará de yeso blanco "rocas" para investigar como puede erosionar las rocas el agua en movimiento.

Materiales para Su Grupo:
1 recipiente con tapadera
8 tarjetas o fichas
16 rocas de yeso blanco
agua

Procedimiento:

1. Rotular las tarjetas o fichas de la siguiente manera: 0 agitadas, 25 agitadas, 50 agitadas, 75 agitadas, 100 agitadas, 125 agitadas, 150 agitadas, 175 agitadas.

2. Poner 16 rocas de yeso blanco en el recipiente, llenarlo con agua y cerrarlo bien apretado.

3. Dejar asentar el recipiente por un minuto. Retirar dos de las rocas y ponerlas en la tarjeta rotulada como 0 Agitadas.

4. Cerrar de nuevo el recipiente bien apretado y agitarlo 25 veces. Quitar dos rocas más y ponerlas en la tarjeta rotulada como 25 Agitadas.

5. Repetir el paso 4 para las 50, 75, 100, 125, 150 y 175 agitadas.

6. Observar las rocas. En una hoja de papel por separado, usar dibujos y palabras para describir cualquier cambio que se haya notado cada vez que se quitaban rocas del recipiente.

Preguntas:

1. Las rocas que están en la tarjeta rotulada como 0 Agitadas, ¿Estaban en agua tranquila o en agua en movimiento?

2. ¿En qué forma cambiaban las rocas a medida que más se movían?

3. ¿Qué pasó con los diminutos trocitos que se desprendieron de la roca?

4. ¿Les pasa lo mismo a las rocas cuando son agitadas en el recipiente que lo que les pasa en un río?

ROCK CYCLE WEB

Grades		
5-8	10-15	30 min.

Description: Students will use their previous knowledge about rock types and rock cycle processes to model possible alternate paths of the rock cycle. Note: this is a culminating activity which requires that students have already had considerable experience with the components of the rock cycle.

Materials for Each Group:
1 index card per student
markers or crayons
1 piece of 24 inch yarn per student
1 large ball of string
examples of 3 types of rocks (optional)

Procedure:

1. Give one index card and piece of yarn to each student. Have students poke holes in the card and attach the yarn so the card can be worn around their necks.

2. Assign each student a process or rock type [see sample list below]. Students label their cards accordingly and draw an applicable picture or symbol on the card.

3. Have students stand in a circle wearing their index cards.

4. Give the ball of string to one student. That student says what process or rock type he/she represents. Any student who represents a possible next step in the rock cycle can then ask for the string and explain why their card indicates that they could be next in the rock cycle. The first student holds on to the end of the string and passes the ball of string to one person who qualifies as a "next step."

5. Step 4 is repeated as many times as you choose. A student may receive the ball of string more than once; some may ask for the string frequently.

Sample List of Cards to Make

You can have students generate a list of processes based on their previous knowledge or use the following:

Plutonic Igneous Rock	Volcanic Igneous Rock	Sedimentary Rock
Metamorphic Rock	Melting	Cooling
Uplift	Weathering	Erosion
Deposition	Compaction	Cementation
Subduction	High Pressure Applied	Eruption

Questions to Ask During the Activity:

1. Each student must explain why he/she qualifies to have the string next. If students do not appear to recognize when they could represent a next step, ask the whole group, "What are all the possible next steps?"

2. Are there paths or connections which are impossible? [Yes] For example, are there any conditions under which the person representing sedimentary rock could pass the string directly to the person representing metamorphic rock? [No, there would need to be some process to bring about that change.]

Why It Happens: The rock cycle is a continuous process which changes the surface of the Earth over millions of years. The three classes of rock—igneous, sedimentary, and metamorphic—can change into each other through several processes including weathering, erosion, melting, cooling, and the other processes listed on the cards. From any given step in the process, there are alternative paths depending on environmental conditions and geologic activity. For example, a metamorphic rock might melt to become magma or, if it is exposed, might weather and become sediment.

Adaptations for Participants with Disabilities:

- Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.
- Students with visual impairments may need access to a list of the different cards in a format legible to the student.

Extensions: Have students write a story to demonstrate their understanding of the rock cycle, such as, "My Life as a Rock: the First Million Years."

Have students represent the various paths possible on the rock cycle in a flow chart.

References: Dixon, Dougal and Raymond L. Bérnor, Ed. The Practical Geologist. New York: Simon & Schuster/Fireside, 1992.