

**SAFETY TIP:** Rocks can shatter and break if hit or dropped. . . take care when you handle them and view them. (And please don't try to break them, lots of other students want to use them, too!)

## **Getting Started - The Rocks and Minerals Kit**

1. In your kit you have almost everything you need to complete the activities. There is a Materials List for each activity and you'll want to check that before beginning anything. To help with planning, a time is shown for each activity, which may vary with student age.
2. Before you begin, look at all the items in the kit and familiarize yourself with them.
3. Read through the introductory information below to get a feel for what's ahead of you!
4. Some activities require you to collect a few at home items; most are probably already on your kitchen or bathroom shelves! Make sure you have the materials before starting anything.
5. You might want to cover your kitchen table or work desk with a cloth so that the top does not accidentally get scratched during your explorations.
6. The activities are meant to be done *in the order shown*, as what you discover will give you good background knowledge for the rest, and ready you to do your own explorations!
7. These are information-packed activities, and you may want to plan an entire week to explore them fully.
8. Thanks in advance for using the materials carefully and packing up and inventorying everything before returning it . . . other students will appreciate it!

### **What are rocks and minerals, anyway? Do we even use them for anything in our lives?**

In this kit you will complete eight (8) activities and begin to explore geology through the world of rocks and minerals! (That even includes eating some . . . really!) You'll learn about elements, the basic building blocks of everything, and how to identify physical properties of minerals. Exploring the Rock Cycle you'll discover how rocks form and you'll hold and identify some Arizona lava rock (cooled of course!) Complete the activities and you'll be well on your way to becoming a junior geologist!

Arizona is a great place to live if you like the shiny, sparkly, colorful, unique and useful physical properties you've discovered in rocks and minerals! From the Grand Canyon's layers and the volcanic San Francisco Peaks to the valuable copper mines and aggregate operations found all over our state, rocks and minerals are a BIG part of Arizona's past, present *and* future! In fact, if you find you like geology, you probably live in the best state in the USA!

## GEOLOGY KIT INVENTORY

**All of these items must be returned with the kit so that others may use them!**

- ✓ Inventory Sheet
- ✓ Set of evaluation forms
- ✓ Set of laminated instructions; Activities #1-8; Geology Vocabulary; Resource Information
- ✓ 1 bag containing numbered mineral samples with inventory grid
- ✓ 1 bag containing numbered rock samples with inventory grid
- ✓ magnifying hand lens; hardness testing kit w/nail, unglazed tile, glass, penny, magnet
- ✓ 1 Rock Odyssey video (MII) and poster
- ✓ 1 Blue Marble Periodic Chart (MII) (2-sided with Universe on back)
- ✓ 1 set of mineral bookmarks (MII) laminate them ?????? MAYBE
- ✓ 1 Volleyball Girl Poster with human body chemistry
- ✓ 1 From Mine to Market Copper Processing Poster
- ✓ 1 Minerals in your Home Poster
- ✓ 1 Copper the Mighty Metal booklet
- ✓ 1 From the Ground Up booklet
- ✓ 1 aggregate info. brochure/sheet for rock/mineral use\_\_\_\_\_TBA
- ✓ 1 bag building materials: e.g. drywall, copper pipe, Cu electric wire, marble/granite/travertine tile, ceramic tile, brick, bolt/nut/screw, stucco or plaster of Paris label, paint can label, mortar or concrete mix label (Xerox labels), adobe.
- ✓ 1 bag aggregate: sand, gravel, cement powder, landscape rock, concrete chunk, kitty litter.

**All of these items must be returned with the kit so that others may use them!**

**Inventory of things you may use (one copy) and keep:**

- ✓ 1 small Periodic Table (8x11), *not* the big poster! (Resources on the back)
- ✓ 1 Resources/Websites list (on back of small Periodic Table)
- ✓ 1 Scavenger Hunt checklist-2 sided- Mom I'm Hungry Challenge Activity 6
- ✓ 1 Scavenger Hunt checklist- Arizona Rocks! Activity 7

ACTIVITIES:

1. Physical Properties of Things (describing things in general, language arts, listing)
2. How the Cookie Crumbles: elements, minerals and rocks (taking apart a cookie/pizza to learn about elements, minerals and rocks-periodic table of elements intro.)
3. Rock Odyssey traveling around under and on top of the ground (MII video on rock cycle)
4. Physical Properties of Minerals-using test kit and mineral bag
5. Rock ID-categorizing by rock type using rock samples bag
6. Mom, I'm hungry, can you please fix me a rock? (Scavenger Hunt for food/toiletry items with elements in them-volleyball poster girl, periodic table of elements consum. WORKSHEET)
7. Arizona Rocks!! (and Minerals): you're standing on them and living in them! (Scavenger Hunt-building materials bag)
8. Copper in Arizona:: it's everywhere! ore ID and booklet/poster/field trip suggestions-newspaper business section for Cu price internet connections for more info.

KIT #2

(Optional) Advanced: Mining and Mineral Museum Rock & Mineral ID Lab

OTHER: ?? if doing processes, or maybe another kit at another time

Faulting-2 wood blocks with masking tape

Volcano/magma movement lab- blowing up a balloon under sand or flour

**SAMPLES TO GET ALONG WITH THE ROCK ID KIT STUFF:**

MINERALS	ROCKS	MYSTERY ROCKS(non-rocks)
Quartz MAGNETITE?	Sandstone/s	Asphalt
Gypsum	Limestone/s	Concrete
Halite (salt)	Shale/s	
Calcite	Conglomerate/s	AGGREGATE SAMPLES
Hematite	Basalt/ex-i	Concrete powder
Sulfur	Cinders/ex-i	Landscape gravel/granite
Chalcopyrite (S)	Obsidian/ex-i	Sand
Bornite (S)	Pumice/ex-i	Kitty Litter
Chalcocite (S)	Granite/in-i	Clay/brick
Chrysocolla (O)	Pegmatite/in-i	Adobe
Azurite (O)	Porphyry/in-i (Cu/Bagdad)	
Malachite (O)	Marble/m	
Native Copper	Quartzite/m	
ADD: TALC	Slate/m	
FLUORITE , FELDSPAR?	Gneiss/mSchist/m	

## Activity One      Physical Properties of Things

Time: 45 minutes

*Geology* is the study of the Earth (geo); *geologists* are scientists who study the Earth. The study of geology can also combine *chemistry*, *biology* and *physics*. Through these activities you will use your powers of observation to learn more about earth materials and the processes that are constantly changing our Earth!

ALL things have *physical properties* that allow us to classify, group and describe them. Characteristics such as color, texture, taste, smell, sound, size, weight, length and shape are just a very few properties you can consider. You can probably think of many more! In this activity you will describe the physical properties of six common objects. Don't be too concerned about the words you use, in later activities you will learn some of the actual terms geologists use when describing physical properties and how to apply them to what you see.

Materials list:                    (there is nothing needed from the kit in this activity)

- ✓ Pencil and paper for listing each item and its physical properties
- ✓ Something to eat and drink
- ✓ Family pet (or think of one you would like if you don't have one!)
- ✓ Favorite toy
- ✓ Mirror
- ✓ Anything electronic

Points to Ponder: What senses do you use to explore your world? How do words help us tell others about our world? What sense do you think will help you the *most* in this activity?

1. On your paper, write down the food item you have selected. (Don't eat it yet!) Using your senses, think of *as many words to describe its physical properties/characteristics* as you can. (Option: helpers can assist younger students in writing)
2. Do the same with your drink, and don't rush! Think about all the physical properties you are noticing about it. What special physical properties do *liquids* have?
3. In the same way, describe physical properties of your pet (or one you would like to have). Could someone tell what kind of pet it was just by reading or hearing your descriptive words?
4. Do the same with your favorite toy. As a test, read your physical properties description to someone and see if they can guess what it is. Use lots of words to tell about it!
5. What physical properties does a mirror have? What properties are *unique* to it?
6. End by describing the physical properties of an electronic item (unplugged!). You might want to peek inside (if possible) to get a full description. Can you think of a way to describe all the different parts you observe?

SO . . .

What sense did you find the most helpful to you? Which sense did you use the least?

Which item was the easiest to describe? Which was the most difficult?

How do you think learning about *physical properties* will help you in your study of geology?

**Now you are ready to move on to Activity Two!**

## Activity Two - How the Cookie Crumbles: elements, minerals and rocks

Time: 45 minutes

Everything in your home, neighborhood, state, planet---even *you*, is made up of the building blocks of the universe---*elements*! *Elements* are pure substances in their most basic (atomic) state and cannot be changed into a simpler form. Most form crystals, and they can be combined (as compounds) to form different substances. (Animal, vegetable or mineral!) Some *elements* are metals, such as gold (Au) or copper (Cu). There are 92 naturally occurring *elements*, and the Periodic Table lists them from the lightest in weight (Hydrogen-H) to the heaviest (Uranium-U). (There is a sample of this Table in your kit just explore it a bit today!) When certain *elements* combine (as compounds), *minerals* are formed, such as chalcopyrite, a sparkly copper mineral compounded from the elements Copper (Cu) and Sulfur (S). When *minerals* are bound, cemented or fused together (aggregated), you get *rocks*! The *rocks* you see in your front yard or in the world around you are made up of a number of different *minerals*! So we can say: first we have *elements*---combining to make *minerals*---a mixture or *aggregate* of separate minerals makes *rocks*!

Materials list:

- ✓ Periodic Table-just for exploring today! (kit) and hand lens (kit)

From home:

- ✓ Cookie with at least 2 ingredients such as chocolate chips, nuts, raisins in it
- ✓ 1 paper clip, paper plate or paper towel per student
- ✓ Paper and pencil

Point to ponder: How can you use this cookie as an example to show elements, minerals and rocks?

1. Unfold your paper clip, it's your tool!
2. Place one cookie on your plate or napkin wash your hands if you plan to eat it later!
3. On your paper, draw your cookie and label the things you see in it.
4. Using your tool, carefully break apart the cookie, dividing the parts into separate piles (such as chocolate chips, nuts, dough crumbs, etc.)
5. Under your cookie drawing, list what's in each different pile. Relabel your drawing if you need to.
6. Look at the cookie crumbs with your hand lens; try to divide it out even more, what do you see?

SO . . .

If we pretend and say your *whole* cookie is a *rock*, what are the different cookie *minerals* it is made up of?

If you break these cookie *minerals* down even more from the basic chocolate chips, nuts or cookie dough crumb *minerals*, you would have cookie *elements*. Cocoa, sugar, cocoa butter, milk and salt could represent the separate most basic cookie *elements* from which cookie *mineral*?

Flour, sugar, salt, eggs and butter could represent the most basic cookie *elements* for which cookie *mineral* that binds and holds or *aggregates* all the other added cookie *minerals* together?

(Basic Cookie Math: Sugar=Element, Chocolate Chip=Mineral, Chips+Nuts+Dough=Rock!)

S-T-R-E-T-C-H: Let's say your favorite pizza represents a *rock*! What would the pizza *minerals* be? What would the most basic parts or *elements* of those pizza minerals be?

Hungry? Take a snack break, and you're ready to **move on to Activity Three!**

### Activity Three      **Rock Odyssey** *or* traveling around under and on top of the ground!

Time: 45 Minutes (video 30, review activity 15)

Materials list:

- ✓ Rock Odyssey video (kit) with Rock Groups Poster (kit)
- ✓ Laminated rock category worksheet and erasable marker (kit)
- ✓ Periodic Table for optional reference if you like!
- ✓ Paper and crayons or markers

We've destroyed a cookie, thought about pizza and learned that everything has *physical properties* and is made of *elements*. (*Elements* can combine (as compounds) to make *minerals*, which can be bound, cemented, or fused (aggregated) together to make *rocks*!) Now think of vegetable soup, the kind with lots and lots of good stuff in it . . . noodles, veggies, maybe chicken or beef chunks in a rich, red tomato-ey broth. If you dug deeeeep into the Earth, you would go through the topmost hardened *crust* until you reach the *mantle* layer (above the far deeper central molten *core*). This extremely hot *mantle* layer can be thought of as an elemental soup sort of like your rich red broth with lots of goodies (elements) floating in it! Except this superhot (900-7200<sup>o</sup> F) soup *isn't* a liquid, but it *is* a semi-solid that *can* flow under the extreme pressures of the Earth. When the topmost part of the mantle (as magma) breaks through the upper crust, you have a volcano with hot lava! The mantle contains *all* the Earth's elements in the mix, with some like iron (Fe), silicon (Si) or aluminum (Al) more common than others. (The Earth's naturally occurring elements are shown on the Periodic Table, starting with very lightweight Hydrogen (H) as number 1, with extremely heavy Uranium (U) getting a 92.) The soup changes elemental flavor depending on location and the mix of elements found in a certain area. That's why minerals and rocks are different!

This *Rock Odyssey* video will take you on a tour of the *Rock Cycle*. This ongoing cycle is key to *all* rock-making processes on Earth! Very recently Earth processes such as hurricanes (Katrina), tsunamis (Indonesia), earthquakes (California), volcanoes (Mt. St. Helen's/Hawaii) and floods changed Earth's landscape through weathering and deposition. You'll find out how these surface processes combine with ongoing processes deep in the Earth as part of the *Rock Cycle*. This produces the three major *categories* or groups of rocks! You'll meet Mica, Sir Sediment, Iggy, and Matty who will take you on a tour right now!

Points to ponder: Do you know the names of the three major categories of rocks?

Remember what minerals have to do with rocks?

Now . . . turn the video on and travel deep inside the Earth!

*After* the video . . . (watch it more than once if you like, or repeat any parts you want to see again!)

1. Using the erasable marker, complete the worksheet. (Or answer on your own piece of paper if you like.)
2. Draw a cross section of the Earth (what it looks like inside) and illustrate each one of the three processes that form rocks. Are you starting to recognize some rock names or physical properties?

SO . . .

Remember that the *Rock Cycle* is *NOT* like a clock that moves through the processes in an orderly manner!

Rocks can change any which way, and they're doing it *all the time*!

**You're ready to move on to Rock and Mineral Lab Activities Four and Five!**

### Activity Three      Rock Odyssey      WORKSHEET: The 3 Rock Processes

(Complete with an erasable marker or use your *own* paper to answer the questions.)

#### IGNEOUS (Remember Iggy ?)

How are igneous rocks formed? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

There are many kinds of igneous rocks, what are the names of some of them?  
\_\_\_\_\_  
\_\_\_\_\_

How can igneous rocks be used? \_\_\_\_\_

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#### SEDIMENTARY ( Sir Sediment !)

How are sedimentary rocks formed? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

There are many types of sedimentary rocks. What names can you remember?  
\_\_\_\_\_  
\_\_\_\_\_

How can sedimentary rocks be used in the real world? \_\_\_\_\_

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#### METAMORPHIC (with Matty !)

How are metamorphic rocks formed? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

There are many types of metamorphic rocks. Name some of them!  
\_\_\_\_\_  
\_\_\_\_\_

What are some uses of metamorphic rocks? \_\_\_\_\_

SO . . .

Rocks are identified by their composition (the *minerals* they are made of); texture, the *form* the minerals take; and mode of origin *or* one of 3 rock processes, such as \_\_\_\_\_,  
\_\_\_\_\_ and \_\_\_\_\_!

## Activity Four Physical Properties of Minerals Identification Lab Time: 60+ minutes

You have used a lot of different words to describe things; you know that objects can be grouped by characteristics or properties. Now the fun begins! You are going to identify mineral specimens (samples) by their unique physical properties. No matter *where* you go in the world, all geologists (and rock hounds!) use the same vocabulary when describing mineral properties. So whether you are in Arizona or Australia or the Alps of Austria (all great sites for geology!), you'll be able to identify and talk about minerals like the experts do!

Materials: (kit)

- ✓ Bag of mineral samples and inventory grid (note that they all have a *letter* on them for ID)
- ✓ Magnifying hand lens and Hardness Testing Kit (nail, unglazed tile, glass, penny, magnet)
- ✓ Cloth to cover worktable or desk (optional but suggested)

Ready? Here we go! Physical (and chemical) properties of minerals are a useful and dependable way to identify them. Geologists use a special vocabulary for this; some words will sound familiar, others will be totally new to you! They include: color, streak, luster, transparency, hardness, fracture/cleavage, crystal structure, specific gravity, and tenacity. (You can also test to see if a mineral is magnetic, fizzes in acid, has a taste or odor, is radioactive or fluoresces/glows under ultraviolet light.) We'll take these one by one and explore each property!

1. **Open** your mineral bag! Take a minute to ohhh and ahhh , handle them, check them out with the hand lens! Do you have any favorites already? Why? (Don't use any of the other tools in the test bag yet!)
2. **COLOR!** It's the first thing you notice, right? But it's not always best for identification. Always check for a fresh/*unweathered* surface. **Now group your minerals by color alone.** Based *only* on color, would some minerals fit in more than one group? Could this present a problem? **Now group them from lightest to darkest.** Make your best guess if some are close. Now you know about mineral *color!*
3. **STREAK!** This is the actual color of the powdered mineral and may vary a lot from the color you see on the surface. **Take out the tile from the test kit.** Turn it to the side that is unglazed/not shiny. Press down and draw the mineral sample across the tile a bit (to get a streak ) and notice the color. (If the mineral is harder than the tile, you won't get anything, that's OK!) **Try them all, be very gentle** with the ones that are crumbly (Samples D and L). Use a *dry* brush to clean the streaks from the tile. A wet tile will not work! Did you notice a *streak* that was different than the *color* of the mineral sample? What do you think about that? You have learned that *streak* is one mineral property to help identify a sample.
4. **LUSTER!** Shampoo ads promise lustrous hair; it just means the way something *looks* as it reflects light! Geologists divide luster into two categories: (1) *metallic* and (2) *non-metallic*. A *metallic luster* looks shiny like a metal and may show metal colors of gold, silver, steel, brass, copper, etc. **Now find and group** any mineral samples that you think have a *metallic luster*. The rest of your samples have a *non-metallic luster!* There are also great words to describe non-metallic luster: \**Adamantine* sparkly, brilliant like a diamond; \**Dull*--flat, non-reflective; \**Earthy* dried mud or dirt-like; \**Glassy or Vitreous* glasslike shine, very common; \**Greasy* oily; \**Pearly* like inside a shell or a pearl's shine/*iridescence*; \**Pitchy* tarlike; \**Silky or fibrous*-- like a bundle of threads; \**Sub-metallic*: very low sort of metallic luster that doesn't reflect much light; \**Resinous* like pine tree pitch, dried glue or chewing gum; \**Waxy* waxlike. Don't worry, they're just new vocabulary words for things you already know and notice . . . now try to **match your non-metallic samples to some of the words** you've just learned. Don't worry about being exact, this is just practice right now!

5. **TRANSPARENCY!** (Another word for this is diaphaniety .) It just means what happens with light when it shines on your sample. *Transparent* means your sample *can* be seen through and light goes through it. *Translucent* means *you* can't see through it, but *light* goes through it. *Opaque* *can't* be seen through at all, and light does *not* go through it. **Now test and divide your samples** into these three groups. If you have a little flashlight, it's fun to shine the light on the sample and check this out!
6. **HARDNESS!** Minerals are grouped by hardness according to Moh's Hardness Scale . One (1) is the softest, with talc being the mineral representative of that. Number ten (10) is the hardest mineral, the diamond! All minerals fall somewhere on Moh's Scale! You can do a rough but fairly accurate test for these at home! **Open your Test Kit** and take out the nail, the piece of glass (careful!) and the penny.

HARDNESS	MINERAL	TOOL FOR TESTING
1	Talc	Easily scratched with a fingernail.
2	Gypsum	Can be scratched with a fingernail.
3	Calcite	Can be scratched (press hard!) with a penny.
4	Fluorite	Can be easily scratched with a steel nail.
5	Apatite	Can be scratched with a steel nail.
(5.5)	(Glass)	(Your piece of glass = 5.5 hardness)
6	Orthoclase Feldspar	Can be scratched with a nail; it will scratch glass.
7	Quartz	Can scratch glass, can scratch minerals #6, 5, 4, etc..
8	Topaz	Can scratch glass. (Topaz is a gemstone in jewelry)
9	Corundum	Can scratch glass. (Ruby & Sapphire are corundum)
10	Diamond	Can scratch glass and all other minerals!

Set aside samples D and L. DO NOT test them! Their hardness is 1.5-2.0 and they crumble easily, so we'll tell you ahead of time what they are! Go ahead and test the other samples using your tools. First try your fingernail, and if your fingernail doesn't work, try the penny, then the nail. Please be careful with the samples, other students need to use them, too! Then try scratching the glass. Any mineral that scratches the glass will be *harder* than 5.5! (Make just *small* test scratches on the minerals and the glass.) You can write down the hardness on pieces of paper and place that under each sample *OR* arrange them from softest to hardest! Hmmm . . . will there be gemstones in the bag? (You'll discover the names of the minerals at the end of the activity!)

7. **FRACTURE!/CLEAVAGE!** Describes how a mineral *breaks*. *Cleavage* means the mineral breaks along a *plane*. (A *plane* is a two-dimensional flat form without a curve.) This shows the mineral's crystal structure, which

## ACTIVITY FIVE Identifying Rock Types Lab

Time: 60++ minutes

You've just completed the most challenging activity in the entire geology kit . . . the Mineral ID Lab! With the practice you had learning about a mineral's physical and chemical properties you are ready for the next step. Now you'll look for the features that identify the three groups of rocks: igneous, sedimentary and metamorphic.

From watching the *Rock Odyssey* video you have a pretty good idea of rock origins, or how a certain rock comes to be. You know that minerals *aggregate* to form rocks. Sometimes only a few minerals are present in a rock, sometimes you'll have a lot. But *all* rocks will give you clues whether they were born of fire, changed form or layered together of fragments/sediments of other rocks.

Materials: (kit)

- ✓ Rock sample bag with Identification grid-notice the letters ID'ing the rocks!
- ✓ Magnifying Hand Lens
- ✓ (Optional but suggested) cloth to cover work area

You have 16 rock samples (notice that they all have a *number* on them!) **Take them out of the bag** and look at them, turn them over, check them out, get familiar with them!

Here is your challenge!

## Activity Six - Mom, I'm hungry . . . please fix me a rock!

Time: 60 minutes

Every day you eat lots of rocks . . . well. . . minerals. *Really!* Do you like pretzels? How about potato chips? That tangy taste comes from the mineral halite (NaCl-Sodium Chloride). It's also known as *salt*! You've discovered that the building blocks of the universe are *elements*, which naturally combine (as compounds) to form other substances (remember animal, vegetable or mineral?) Pull out the *Periodic Table* that you looked at earlier and find Sodium (Na-11) and Chlorine (Cl-17). These two *elements* combine as a *compound* to make the *mineral* salt you taste in many foods. Look at the *Nutrition Facts* on any package of food, and you might find 'sodium' listed, or it may be listed as 'salt'. (You've already identified a halite/salt crystal in your mineral lab!) Since we are made of elements, it's only natural that we need some of them to stay healthy (like Iron-Fe or Calcium-Ca for healthy bones and teeth). These are just some of many useful minerals that come from the Earth! (Look at the Volleyball Girl poster to see what other elements and minerals are present in your body!)

In this activity you are going on a *scavenger hunt*! Your challenge (and this is a tough one!) is to locate and identify as many *elements* and *minerals* in your collection of everyday items as you can!

Materials list:

- ✓ Periodic Table (kit), Volleyball girl poster (kit) and Scavenger List (kit-you can keep this list!)

At home items you'll need to locate: (it's not imperative to find *all* of them)

- ✓ Yellow or other bright color highlighter pen, pencil
- ✓ Box of any kind of cereal -*more* than one is great if you want to compare!
- ✓ Box of crackers or bag or can of snack chips
- ✓ Box of jello or pudding or muffin or cake mix (1 or all-compare!)
- ✓ Box of baking soda and a container of table salt
- ✓ Can of tuna *or* sardines (for fun, compare the two!)
- ✓ Milk (any kind), try mayonnaise or salad dressing if you like!
- ✓ Toothpaste; the box it comes in is even better
- ✓ Laundry detergent (box or liquid), laundry softener, bleach (powder or liquid)
- ✓ Shampoo or conditioner
- ✓ Baby powder or talcum body powder; deodorant; shaving cream
- ✓ Outer package\* of *any* kind of makeup (eyeshadow, face powder, lipstick, etc.) \*has best list

1. Look at each item and *highlight* any words you see on the *Nutrition Facts* or *Ingredients* list that looks like an element or mineral. (If it says 0% it doesn't count!) Your posters will help; remember some will be compounds that will only have *part* of an element's basic name listed . . . like laurel *sulfate* = sulfur is contained in the compound or *monocalcium phosphate* = a form of calcium and phosphorus are in it.
2. On your worksheet list the item you are researching and any elements or minerals you find. Start with cereal, you'll be amazed! Remember to check the entire *Nutrition Facts* from top to bottom!

SO . . . ponder this:

Would you like to live without elements and minerals? *Could* you live without them? Why or why not?

How do elements and minerals connect with rocks and the study of geology?

**S-T-R-E-T-C-H:** Research the healthy minerals found in fruits and vegetables or meats and fish!

**Move on to Activity Seven!**

# ACTIVITY SIX - Mom, I'm Hungry! Scavenger Hunt Challenge Worksheet

(You may keep this worksheet when you are finished . . . happy hunting!)

copy front and back, same sheet this is a consumable in kit.

ITEM	Elements or Minerals I Found Listed:	How Many?
Cereal name:		

Turn the page over and keep going!

(Pair up with younger students to help them out, this is tough!)

Total Score: \_\_\_\_\_ of *different* elements or minerals. (Don't count them twice!)

0-3 Turn on your alarm clock-wake up!

4-9 You've got the idea-keep going!

10-14 Great! How many more can you discover?

15 ++ Geo-chemist extraordinaire! Way to go!

**Hints:** base words hydrogen, carbon, nitrogen, oxygen, sodium, magnesium, aluminum, silicon, phosphorus, sulfur, chlorine, potassium, calcium, titanium, manganese, iron, copper, zinc, selenium, iodine, barium, bismuth. SO. . . .

Which item had the *most* different elements? Which elements were most *common* in food? In non-food items?

What would a day without elements and minerals look like in your house?

## Activity Seven - Arizona Rocks!! (and Minerals):

### You're Standing *on* them and Living *in* Them!

Time: 60+ minutes

Materials list:

- ✓ Zip lock bags of building materials and aggregates (wait to open it!) (kit)
- ✓ Rock and Mineral samples bags and hand lens (have it ready!) (kit)
- ✓ Minerals in your Home poster (don't peek at it yet!) (kit)
- ✓ Your home! (and yard and neighborhood)
- ✓ Scavenger Hunt Worksheet (kit--you may keep this when you are finished), pencil

Those of us fortunate enough to live in the Grand Canyon state are used to having rocks all around us! Virtually anywhere we go we can see mountains, valleys, canyons and road cuts with wonderful rock and mineral specimens just waiting to be explored! You have already learned a lot about them, and now you are going to discover some of the many uses of earth materials (rocks and minerals) and the products that can be manufactured from them. . . . and many of them are mined right here in Arizona!

Point to ponder: can you make the connections from the natural resource to the finished products?

1. Walk around inside your home with your Scavenger Hunt Worksheet. Look all around, each and every room! Using what you have learned, list some things you saw that you think might be made from rocks and minerals (earth materials) from Arizona or elsewhere.
2. Go outside and walk the neighborhood near your house and do the same. What are you standing on? Check out your yard and that of your neighbor's. List items as you did in #1.
3. Open the Minerals in your Home poster and the building/aggregates materials bags and read through it and sort through the items. Walk through your home and neighborhood again and make any additions and changes to your scavenger hunt list with your new information.
4. Which rocks or minerals from your ID lab (Activities 4-5) were used to manufacture some of the items you found in your home or neighborhood? Try to ID them again from the sample bags. (Careful! Don't mix the building/aggregates materials bags with the other rock/mineral bags! ) Find the copper (electricity/plumbing) minerals again. Can you remember the minerals gypsum (drywall), calcite (cement powder), quartz (glass/as silica) or rocks such as granite (countertops, building, landscaping)?
5. Carefully put the building samples and aggregates back in the bags. Put the minerals and rocks in the correct bags. Use the ID grids to help you. Other students will appreciate the care you take. . . thanks!

SO. . .

What did you discover? Anything surprise you?

If you had *no* earth materials in your home or neighborhood, how would it be different?

What specifically did you find in the kitchen or bathroom that required earth materials?

How about in the house itself? (Walls, ceiling, floors and roof, furnishings.) In the garage?

What did you notice outside in the yard, or on the sidewalk or street?

S-T-R-E-T-C-H: What *careers* are possible within the earth materials industry? Research it!

**You are ready to move on to Activity Eight!**



## Activity Eight - Copper in Arizona: It's Everywhere! Time: 15-30-45++

By now you've discovered that life without rocks and minerals would be pretty difficult. Now think about life without *copper*! Did you know that chocolate is a great source of nutritional copper? So not only do we need it for the electricity that powers our homes, computers, i-pods and cell phones, we need it for plumbing, radiators in our cars and definitely in the chocolate pudding and chocolate kisses we enjoy!

You might already be suspecting that Arizona is *the* Number One copper state, and you'd be correct! Look at an Arizona map and locate Graham County . . . now look for the tiny mining community of Morenci. It is site of the biggest open pit copper mine in North America! You can even tour this mine with your family! (See Resource List.)

Points to ponder: How did mining play a part in Arizona's past? What does copper bring to Arizona's economy? What kind of careers are possible throughout the mining industry? What kind of technology is necessary for modern mining and processing? How is the environment protected? How would Arizona change without mining? You can find the answers to these questions and more in the materials and resource links.

Materials list: (kit)

- ✓ Minerals Sample Bag (the copper minerals)
- ✓ Copper: From Mine to Market Processing Poster
- ✓ Copper the Mighty Metal Booklet
- ✓ From the Ground Up: Stories of Arizona's Mines & Early Mineral Discoveries Booklet
- ✓ (Optional: your own Arizona map) and (Optional: chocolate. . .it's good for you!)

**Educator alert!** These suggestions include enriching open-ended activities that involve language arts, and are a good way to teach science while your students improve their reading and writing skills! See the Resource sheet.

Decide with your instructor, family or other students which of the following activities most interest you. Select at *least two* . . . you geology superstars will probably try them all! *Or*, think of some ideas of your own to explore!

**From the Ground Up Booklet** Select stories that look interesting and discover which mineral was being mined. Is it one you can identify and find in your sample bags? These are great tales, and all are true parts of Arizona's mineral-rich history! You can make a time line of Arizona mining history: just read the stories, make notes on a 3x5 card then arrange them from oldest to the most recent. Which location would you like to visit now that you've read about it? Research it on the Internet! Write and illustrate a brochure about it!

**Copper the Mighty Metal Booklet:** Good one stop shopping to learn about Arizona's copper and the mining and manufacturing processes that take it from a mineral state as ore to finished products! You can research more about uses, careers, mining and the environment, and deepen your understanding of geology and Arizona's history! Could you design and illustrate your own Copper in Arizona poster now? Write a newspaper article or blog about something new you learned and are interested in. Use the Resource list, too!

**Copper: From Mine to Market Poster** Take out the chalcopryrite and bornite *sulfide* ores from your mineral bag. Find the azurite, malachite and chrysocolla *oxide* ores. Place them on top of the poster and follow down the process that matches your ores. Find your chalcocite *sulfide* ore. There is a brand new process that *leaches* this ore (rather than smelting it) that was developed right here in Arizona! It uses a lot less energy than smelting, and the Phelps Dodge Morenci Mine (now Freeport McMoRan) is home to lots of chalcocite and this new process. This *sulfide* ore can follow the *leaching* stream (but the new process is special and *different* than what's shown). Technology and research are always modernizing mining! Today's geology students are tomorrow's geoscientists!

## RESOURCE INFORMATION

This Arizona Science Center *Home School Connections Kit* is designed to give your students an introductory taste for the exciting science of geology! (You already know about the wonderful interactive geology displays we have at ASC!) You will want to expand and extend your lessons with some of the following resources. All of them have been reviewed and used by teachers and are high quality non-profit sites. Let us know if you find some other great resources that would help Arizona's kids learn more about science!

**United States Geological Survey (USGS):** wonderful educational resource with easy-to-use website. Many K-12 lessons, links to state maps and related information, a site for commonly asked questions, and even live volcano pictures! Unique *Ask a Geologist* link for your young scientist's questions.  
[usgs.gov](http://usgs.gov) and [Ask-A-Geologist@usgs.gov](mailto:Ask-A-Geologist@usgs.gov)

**Mineral Information Institute (MII):** you'll find many lessons for PDF download, along with a terrific *Homework Help* link featuring rock and mineral pictures with information that will rival any field guide book; interactive Periodic Table and many more easy to navigate high quality student and educator resources.  
[mii.org](http://mii.org)

**Copper Development Association (CDA):** super research resource for students and educators with lots of links. Virtually everything you could want to know about copper. . . uses, the industry, in your home, even features crafts and how to re-wire a lamp! Easy-to-use site with excellent links.  
[copper.org](http://copper.org)

**Chem4Kids:** (and others): Great place to start for basic, fun, accurate and interactive science information!  
[chem4kids.com](http://chem4kids.com), [geography4kids.com](http://geography4kids.com), [physics4kids.com](http://physics4kids.com) (SUPER Periodic Table of Elements!)

## ARIZONA RESOURCES

### **Arizona Department of Mines and Mineral Resources/Arizona Mining and Mineral Museum:**

Located near the Capitol at 1502 West Washington, this popular Museum features great displays and a store with reasonable prices for the budding young rock hound. Friendly and knowledgeable staff with lots of information on *mineral shows* and *rock hound clubs* (See: [www.azminerals.com](http://www.azminerals.com) for rockhound info!); their website will link you to good information about Arizona's mineral resources. A must for field trips! (Check for their Family Weekends fun!) (602)255-3777 [admmr.state.az.us/](http://admmr.state.az.us/) (follow links to Museum)

**Arizona Geological Survey (AzGS):** They have plans for an Outdoor Information Center check out the site for new educational opportunities! (And great Arizona geologic information, too!) [azgs.state.az.us](http://azgs.state.az.us)

**Phelps Dodge/Freeport McMoRan Copper & Gold:** Discover careers in the earth materials industry, explore this worldwide company, check out environmental news in mining and click on the map to visit Arizona copper mine sites in Bagdad, Morenci and Safford! (You can take a tour of the Morenci Mine, too--largest open pit in North America!) Mine Tour information: (877) 646-8687 on Fridays and Saturdays, Graham County, AZ.  
[fcx.com](http://fcx.com) (then follow links and maps to Phelps Dodge Arizona information)

## BASIC GEOLOGY VOCABULARY

**Aggregate:** one or more minerals come together--*aggregate* (bond, fuse or cement) to form a rock; also *aggregates* are sand, gravel or crushed stone used to make concrete, roads, mortar, plaster or for landscaping.

**Cement:** manufactured powder made from limestone/Calcium Carbonate. Mixed with sand, gravel (*aggregates*) and water, it hardens to form *concrete*. (Minerals are said to be *cemented* together to form rocks, but not with real cement!)

**Characteristic:** special quality or identity that serves to define an object or person. Ex. crystal structure.

**Classify:** to organize or put in categories/classes/groups by similar properties. You can *classify* rocks as sedimentary by their layers; melted and stretched looking minerals in rocks classify them as metamorphic.

**Crystal:** a solid chemical element with regularly repeating atomic structure; there are 6 basic crystal forms. Crystals in mass form minerals and may be microscopic or huge. A diamond is a Carbon (C) crystal! Sand is quartz crystals!

**Concrete:** a mix of *cement* powder, *aggregates* and water, it hardens into a rocklike building material. (Sidewalks!)

**Deposition/deposited:** fragments of rocks, minerals, plants and animals are placed by wind, water and ice.

**Earth Materials:** natural resource--minerals and rocks that can be mined and processed into useful products.

**Earth Products:** the goods made from *Earth materials* such as concrete, bricks, drywall, cosmetics, wire, medicine.

**Economics :** the study of the production, consumption and cost of goods humans need and want.

**Element:** most basic state of a pure substance made from atoms, cannot be changed into a simpler form. 92 naturally occur, and each take a unique and distinctive form. Elements form crystal structures. See PTE.

**Erosion:** wearing away of soil, rocks and minerals (*sediments*) by weathering (water, wind action).

**Fracture:** the way in which a mineral breaks that is *not* along a crystal plane. If a mineral breaks along a crystal plane, which reflects and shows its crystal structure, it is called **cleavage**.

**Geologist:** one who studies the Earth (geo). *Paleontologists* study ancient (paleo) plants and animals/*fossils*.

**Geology:** the study of (geo) the Earth and its materials (minerals and rocks) and processes that act upon it.

**Igneous:** *igni = fire* One of the 3 main *classes or groups* of rock types; rock hardened from molten lava/magma. Surface/extrusive (lava) igneous rocks: basalt, pumice. Interior/intrusive (magma): granite, gabbro.

**Mantle:** immensely hot semi-solid interior layer of Earth below hardened surface *crust*, above molten *core*.

**Manufacture:** to make a product or good from raw materials/natural resources; also: process, fabricate.

**Metal:** a class of *elements* with special properties, such as conducting electricity. Ex. copper, gold, lead.

**Metamorphic:** *meta=change, morph=form* A rock class made from existing rocks that are *changed* through heat and pressure. Ex. sedimentary limestone *metamorphoses* into marble; granite *metamorphoses* into gneiss.

**Minerals:** one or more *elements* compound naturally to make a solid structure with unique physical properties that allow us to ID them, including: color, luster, hardness, streak, specific gravity, cleavage/fracture, crystal form and others such as magnetism, odor and fluorescence. We can test these and identify each unique mineral.

**Natural Resource:** materials supplied by nature, such as rocks, minerals, soil, trees, plants, water, animals, air.

**Ore:** a rock or mineral that has *economic* value, it may be processed or manufactured into useful products.

**Periodic Table of Elements (PTE):** all chemical *elements* arranged according to their special properties.

**Property/Properties:** a special quality common to a class of things; unique trait to help define or organize.

**Rock Cycle:** the constantly active Earth processes and events that form, change, destroy and reform rocks.

**Rocks:** made of one or more *aggregated* minerals; there are 3 basic rock classifications or groups.

**Sediment:** solid fragments of material (soil, rocks, minerals, plants, animals) moved by wind or water/ice.

**Sedimentary:** A rock class or group made of sediments that are eroded and deposited, often forming in layers. Ex. sandstone, limestone. Frequently ancient plants or animals (fossils) can be observed in these rocks.

### MINERALS BAG INVENTORY LIST

- Double check that you return them all!
- Match the mineral sample to the boxes below.
- When you have them all, please fold this and put it all together into the bag! Thanks!

A	B	C	D
E	F	G	H
J (No I )	K	L	M
N	P (No O )	Q	R
S	T	U	W (No V )

### ROCKS BAG INVENTORY LIST

- Double check that you return them all!
- Match the mineral sample to the boxes below.
- When you have them all, please fold this and put it all together into the bag! Thanks!

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20

Last page of work.

To do #4, #5, finish #8 and do #9 (optional AzMMMM Lab)