



# Houston Gem and Mineral Society's Home Scavenger Hunt for Economic Minerals and Rocks

## Subset 2 of Minerals 8–14

The Houston Gem and Mineral Society assembles Economic Mineral and Rock sets for distribution free to teachers and homeschool groups (information on the set and how to request it are at <https://hgms.org/education/mineral-and-fossil-sets/>). This set consists of samples of minerals and some rocks that are important economically in our society. The set is a helpful teaching aid, but you do not have to have one to complete this scavenger hunt, which is specifically designed with activities that can be easily done at home or in the classroom with common school supplies and other ordinary objects. The activities are labeled for the grades they align to in the Texas Essential Knowledge and Skills for Science (TEKS).

**All activities in this scavenger hunt should be conducted with adult supervision.**

Minerals are defined as naturally occurring, inorganic solids with a definite chemical composition and an ordered internal structure. Minerals are the ingredients that make up rocks, and economic minerals and rocks are used to make things—whatever doesn't come from plants was made from economic minerals and rocks. This scavenger hunt will help you learn how economic minerals and rocks are used in our everyday life in our communities.

Minerals are dug from the Earth's crust within an ore deposit. Most of an ore consists of rock of no economic value, called "gangue." An ore is not mined from the Earth unless either the quantity or quality or both of its mineral content are sufficiently high to make a profit from extracting it, either by shaft or open-pit mining.

An economic mineral can be a metal or nonmetallic. Most ore minerals belong to three groups of nonsilicate minerals:

1. Native elements (examples: gold, silver, copper, sulfur, and graphite)
2. Sulfides (examples: galena, pyrite, chalcopyrite, and stibnite)
3. Oxides (examples: hematite, magnetite, rutile, cuprite, and corundum)

The native elements are each a single element, such as gold, which has the chemical symbol Au. The sulfides and oxides are represented by a chemical formula, such as galena, which is lead sulfide (PbS), and rutile, which is titanium dioxide (TiO<sub>2</sub>). Nonsilicate minerals are much less abundant in the Earth's crust than its major component of silicate (SiO<sub>4</sub><sup>2-</sup>) minerals.

## Contents

### Minerals in Subset 1

1. Galena (lead sulfide or PbS)
2. Copper (Cu)
3. Sphalerite (zinc sulfide or ZnS)
4. Chalcopyrite (copper iron sulfide or CuFeS<sub>2</sub>)
5. Halite (sodium chloride or NaCl)
6. Gypsum (calcium sulfate dihydrate or CaSO<sub>4</sub>•2H<sub>2</sub>O)
7. Sulfur (S)

### Minerals in Subset 2

8. Hematite (iron oxide or Fe<sub>2</sub>O<sub>3</sub>) ..... 3
9. Garnet (X<sub>3</sub>Y<sub>2</sub>(SiO<sub>4</sub>)<sub>3</sub> in which X can be Ca, Mg, Fe<sup>2+</sup>, or Mn<sup>2+</sup> and Y can be Al, Fe<sup>3+</sup>, Mn<sup>3+</sup>, V<sup>3+</sup>, or Cr<sup>3+</sup>).. 5
10. Magnetite (ferrous ferric iron oxide or Fe<sub>3</sub>O<sub>4</sub>) ..... 7
11. Fluorite (calcium fluoride or CaF) ..... 9
12. Pyrite (iron sulfide or FeS<sub>2</sub>) ..... 11
13. Barite (barium sulfate or BaSO<sub>4</sub>)..... 13
14. Limestone (calcium carbonate or CaCO<sub>3</sub>) ..... 15

### Minerals in Subset 3

15. Granite
16. Basalt and Diabase (plagioclase feldspars or (Na,Ca)(Si,Al)<sub>4</sub>O<sub>8</sub> and hornblende series minerals or (Ca,Na)<sub>2-3</sub>(Mg,Fe,Al)<sub>5</sub>(Al,Si<sub>8</sub>O<sub>22</sub>(OH,F)<sub>2</sub>)
17. Potassium Feldspar (potassium aluminum silicate or KAlSi<sub>3</sub>O<sub>8</sub>)
18. Quartz (silicon dioxide, SiO<sub>2</sub>)
19. Bauxite

## 8. Hematite (iron oxide or $\text{Fe}_2\text{O}_3$ )



Hematite is one of the common ore minerals of iron. Hematite is found in large sedimentary beds of Precambrian age, where it is mined by open pit methods. It also occurs in other environments, but not usually in quantities large enough for commercial mining. It can be reddish and earthy in appearance or have

silver-like reflective flaky crystals (called specular or micaceous hematite), but all varieties give a reddish-brown streak on an unglazed ceramic tile streak plate. Hematite has a hardness that is close to that of glass and has a density that is twice as high as granite or sandstone.

As one of the primary ores of iron, hematite is used in the manufacture of wrought iron and the alloy steel. Steel is used in our economy for many essential tasks, from structural supports in buildings to ships and automobiles, furniture, and household tools. Hematite is also used to make red pigments for paint and cosmetics.

The other common ore mineral of iron is magnetite. They can be readily distinguished because hematite is nonmagnetic whereas magnetite is magnetic and has a black streak.

Hematite is a truly out-of-this-world mineral: NASA discovered that hematite is one of the most abundant minerals on the surface of Mars. This is what gives the planet a reddish brown color in the night sky, earning it the nickname “red planet.”

### Activities:

**K-3:** Find a steel nail and put it in a cup of water for a few days. Did a reddish-brownish coating form on the nail. Circle your answer: Yes No

The coating is rust, which is caused by the iron in the nail combining with oxygen to form an iron oxide like hematite. However, many nails are coated with zinc to prevent rusting. This is called “galvanizing” and it typically like a bumpy, silvery gray-colored coating. If your nail didn’t rust, it must be galvanized.

**K-5:** Try to scratch the surface of a copper penny with a steel nail. Then try to scratch the nail with the penny. This is done to determine the relative hardness of one material to another. If the nail cannot scratch the penny, then the penny is harder. If the nail can scratch the penny, then the nail is harder. Circle which is harder (next page):

### 8. Hematite continued



Penny



Steel nail

**5:** Research the Mohs hardness scale for minerals. Would the steel nail scratch hematite? Yes No

**5-8:** If you have a strong magnet and the hematite sample from the HGMS rock set, check if the hematite is magnetic. Circle your answer: Magnetic Nonmagnetic

Does a weaker refrigerator magnet attract the sample? Circle your answer: Yes No. What does the weaker magnet's behavior tell you about how strongly magnetic the hematite is? \_\_\_\_\_

\_\_\_\_\_.

**9+:** Research whether Mars is visible in the night sky tonight. If it is, look to see if it deserves the nickname "red planet" compared with the other planets and stars. If Mars is not visible tonight, find an online image of it and check the planet's color. Is Mars red in the night sky: Yes No

9. Garnet ( $X_3Y_2(SiO_4)_3$  in which X can be Ca, Mg,  $Fe^{2+}$ , or  $Mn^{2+}$  and Y can be Al,  $Fe^{3+}$ ,  $Mn^{3+}$ ,  $V^{3+}$ , or  $Cr^{3+}$ )



The garnet group consists primarily of aluminum silicates with calcium, magnesium, iron, or manganese as part of the composition. Each of these chemical compositions, called species, has its own mineral name but their physical properties and crystal form are similar. Garnet is found in metamorphic deposits but it is usually not concentrated enough to be economic. Alluvial garnet sands are mined in some parts of the world. Most people think of

garnets as red gemstones, and they have a wide range of colors, with the most common brown to red to yellow and green. With its hardness ranging between 6.5 and 7.5 depending on the species, garnet is used as an abrasive, such as on sandpaper and for the optical and plate glass-grinding industries.

**Activities:**

**K-1:** Garnets used as gemstones have a very reflective surface that makes them sparkle in the light. This physical property is called a vitreous luster (from the Latin word *vitrum* for glass). Look at a wax candle or wax crayon and compare how shiny is it compared to window glass or a gemstone in a ring. Circle which one has a shinier surface:



Wax (waxy luster)



Window glass (vitreous luster)

**2-4:** Garnets can be many different colors. They can be red, brown, orange, green, black, gray, pink, or purple. Draw a circle and divide it into 8 even slices, like a pizza. Color each slice of the circle to represent the different colors of garnets. If you don't have all these colors, then use any colors that you have, because garnets can be just about any color!

## 9. Garnet continued

**3-5:** Garnets are very hard, which makes them good gemstones because they are hard to scratch. Garnets are harder than steel, so they can scratch steel. Collect a glass jar (one that you are going to recycle), a steel nail, and sandpaper, if you have that handy. Try to scratch the glass jar with the nail. Try to scratch the nail with the sandpaper. Examine the nail closely—you will see grains of the abrasive from the sandpaper on the nail, but that does not mean the abrasive is relatively softer, only that they came loose. List the materials you compared for relative hardness from softest to hardest:

Softest \_\_\_\_\_ Hardest

**6-8:** Garnets are unusual for gemstones because some of them respond to a strong N52 magnet. The chemical formula for garnet species is different for each color. For the five most common garnet species, circle which ones have a metal component that would be attracted to a magnet?

Almandine garnet,  $\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ , is bright red colored

Pyrope garnet,  $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ , is deep red colored.

Spessartine garnet,  $\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ , is bright orange.

Grossular garnet,  $\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$ , can be multicolored, depending on impurities.

Uvarovite garnet,  $\text{Ca}_3\text{Cr}_2\text{Si}_3\text{O}_{12}$ , is rare and forms bright emerald green crystals.

**9+:** Garnets crystalize in the isometric system, which means that the crystal axes are perpendicular to each other and same length in each of the three directions, like a cube. Many garnets crystallize in the dodecahedral (12 faces) and trapezohedron (24 faces) crystal habits. Draw a dodecahedron, which is essentially a 12-sided crystal with diamond-shaped faces on each side. Some dodecahedrons are 12-sided with a pentagon on each side, known as pentagonal dodecahedrons.

## 10. Magnetite (ferrous ferric iron oxide or $Fe_3O_4$ )



Magnetite occurs in all types of depositional environments in the Earth, from igneous to metamorphic to sedimentary. Its distinguishing characteristic is its attraction to a magnet. Magnetite itself is used as an abrasive, pigment in paints, and heavy media in specific gravity operations used in mining and other industries to separate less dense materials, which rise to the top. It is a primary ore of iron. Iron is one of the most common elements on the Earth's

surface, but must be found in high concentrations such as large deposits of magnetite ore to make it economically favorable to mine. Iron is an important industrial metal used to make wrought iron and steel, as mentioned previously for the other common ore of iron, hematite. Iron is used to make and build everything from the nails and screws that hold buildings together, to cars, to major appliances in your home. Iron is almost always mixed with other elements to make it into the alloy steel. The other added elements, such as vanadium, chrome, and molybdenum, give the steel higher strength and help reduce corrosion.

### Activities:

**K-2:** Magnets attract metals that have iron in them. Take a refrigerator magnet and find some things around your home that the magnet is attracted to. Things made of metal or with metal parts that you can test include paper clips, aluminum foil, nails, pots and pans, different parts of a car, and cans with food and drinks in them. Draw or write the things the magnet was and was not attracted to:



\_\_\_\_\_ Attracted to the magnet \_\_\_\_\_



\_\_\_\_\_ Not attracted to the magnet \_\_\_\_\_

**3-5:** Some metals can be turned into magnets. Take a screwdriver or a metal nail file and touch it to some small pieces of steel, such as paperclips or staples. If the screwdriver magnetically picks up these things, it is because it was already magnetized to prevent the annoyance of dropping a screw. If your screwdriver is not magnetized, rub a strong magnet (a refrigerator magnetic will not work for this) several times on the screwdriver in the same direction. Now try to pick up the same small pieces of steel. Did the screwdriver behave magnetically: Yes No

## 10. Magnetite continued

Rubbing the magnet along the screwdriver in one direction aligned the magnetic elements in it to behave as magnets. This effect will last about three months. If you were able to magnetize the screwdriver, try demagnetizing it by rubbing with the strong magnet in the opposite direction from before. Is the screwdriver demagnetized now: Yes No

**6+:** Some foods are naturally rich in iron and others are enriched or fortified with iron, which is used by the body to produce red blood cells. You carry enough iron in your body to make two small nails! To find evidence of this added iron take a few pieces of Cheerios (12.6 mg/serving) or Total breakfast cereal—or some other cereal that has a high iron content as listed on the nutrition label, typically providing 100% of the recommended daily intake of iron—and float them in a bowl of water. Get a strong magnet and move it close to the floating piece of cereal. What is the effect on the cereal:

---

If you don't have a strong enough magnet, search for "magnetic Cheerios" on [YouTube](#) and watch what happens to answer.

**8+:** Take a bowl of Cheerios or Total or another iron-fortified dry breakfast cereal and crunch the cereal up with a potato masher or rolling pin until it is a fine, even powder. Put the powdered cereal into a gallon-sized self-sealing plastic food storage bag, and add some water to make it the consistency of soup. Lay the bag flat on the table and push a strong magnet around on top of the bag, without lifting it at all. Finally, move the magnet to one corner of the plastic bag and then lift the magnet. If you are using a sufficiently strong magnet, describe anything unusual that you see where the magnet was:

---

Any dark eyelash-like objects that you see attracted to the magnet are iron filings!

**8+:** Lodestone is a type of magnetite with a distinct north-south polarity. The Chinese were the first to make a magnetic compass using lodestone, not for determining the cardinal directions of north, south, east, and west for navigation but initially for harmonizing the organization of their buildings and objects by using the principles of feng shui. Research how you could construct a simple compass using a lodestone, a piece of wood, water, and bowl: Sketch and briefly describe your answer:

Is the lodestone aligning with the north geographic pole or the north magnetic pole. What is the difference between the two? \_\_\_\_\_

---

---

## 11. Fluorite (calcium fluoride or CaF)



Fluorite, commercially called fluorspar, is mined from deposits in sedimentary rocks around the world. The US and England had considerable reserves, but most world production comes now

from enormous deposits in China. Fluorite has a very important commercial use as a flux in the making of steel and aluminum. Flux is used as a flowing and impurity-cleaning agent. This use consumes the majority of world production. The remainder is used in the chemical industry to produce fluorine, which is then used to produce hydrofluoric acid (HF) for industrial purposes and also to fluoridate water, which prevents cavity formation in teeth.

### Activities:

**K-1:** Fluorite is usually blue, green, yellow, or clear. It makes cubic crystals, the six sides of which look like squares, like a dice cube or a wooden toy block. Draw four squares, and color them different colors like fluorite.

**2-4:** Many communities add fluoride to the water that comes out of the tap. When you drink that fluoridated water or eat food cooked with it, the fluoride content helps prevent cavities. For the same reason, there is also fluoride in many brands of toothpaste. Look at a tube of toothpaste in your home or at a store or online retailer. Do you see the word fluoride on your toothpaste tube or box? Circle your answer: Yes No

**K-5:** Fluorite is transparent. Minerals demonstrate three types of light transmission:

- Opaque means that light does not pass through it. A piece of steel is opaque because no light passes through it.
- Translucent means that light passes through but not detailed shapes. Wax paper and a single layer of facial tissue or tissue paper allow light to pass through, but you cannot see images from the other side.
- Transparent allows light to pass through and you can see images from the other side. Ordinary window glass and water are transparent.

## 11. Fluorite continued

Find one example of each type of light transmission in your home and write or draw your answers:

Opaque

Translucent

Transparent

**6-8:** Fluorite is used in some optical microscopes because of its index of refraction, which is the ability of a material to change the direction of a beam of light. The higher the index of refraction, the more a beam of light changes direction. You can demonstrate the index of refraction with a glass pitcher or vase full of water and a pencil. Hold the pencil halfway into the water. Look through the pitcher from the side at the pencil above and below the water. Describe anything unusual you notice about the pencil:

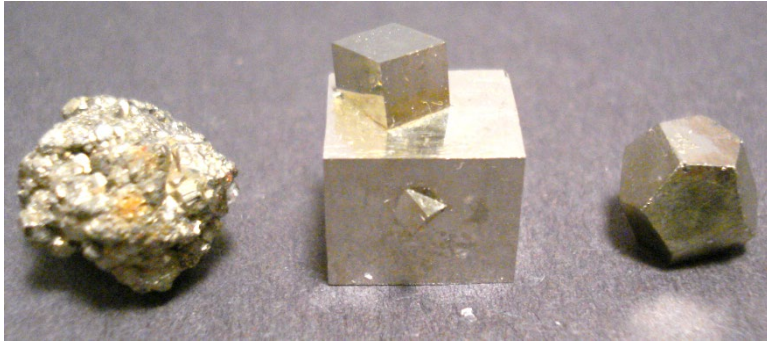
\_\_\_\_\_.

**9+:** Fluorite crystallizes in the isometric crystal system, which means that all three axes (X, Y, and Z) are perpendicular to each other and they are all the same length. This makes fluorite crystallize in cubes or octahedrons, which look like two four-sided pyramids joined at the base. Sketch this structure in 3D:

For a crystal with an octahedron structure of two four-sided pyramids joined at the base, how many crystal faces are there? \_\_\_\_\_.

What is the shape of the crystal faces on the octahedron? \_\_\_\_\_.

## 12. Pyrite (iron sulfide or FeS<sub>2</sub>)



The mineral pyrite is common in all environments—sedimentary, igneous, and metamorphic—and is a common constituent of ore deposits. Deep-sea oceanic vents have been found to eject fine particles of pyrite-generated iron that provide trace nutrients to bacteria, plankton, and other sea life. When it is shiny and

brass-yellow it can be mistaken for gold and hence is called fool's gold. However, pyrite does not have a gold streak but a black one of an unglazed ceramic streak plate. It is rarely mined for its iron content because the sulfur in the mineral is a contaminant that makes the resulting iron weak and brittle. It is mainly used today to produce sulfur dioxide (SiO<sub>2</sub>), which is used in the paper industry as a whitener and for the production of sulfuric acid, which has a great many uses in the chemical industry.

### Activities:

**K-3:** Pyrite can be identified by its metallic luster. That means that it is very shiny, usually silver or gold colored and reflects light. Non-metallic luster is usually not as reflective and can be dull or waxy or even vitreous, like glass. Find some things around the house that have a metallic and non-metallic luster.

Metallic: \_\_\_\_\_. Non-metallic: \_\_\_\_\_.

**K+:** Pyrite is also known as “fool’s gold” because it has a yellowish color like gold, but it is not quite the same. If you have the Economic Rock and Mineral set, compare the color of pyrite against a piece of gold jewelry. Do you see a difference in the color? Circle your answer: Yes No

**K-5:** Pyrite is very hard, about the same hardness as steel. Try to scratch the copper surface of a US penny coin with a steel nail. Then try to scratch the nail with the penny. This is done to determine the relative hardness of one material to another. If the nail cannot scratch the penny, then the penny is harder. If the nail can scratch the penny, then the nail is harder. Circle which is harder:



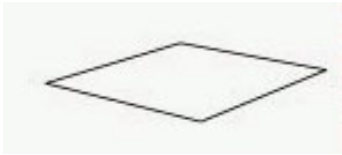
Penny



Steel nail

## 12. Pyrite continued

**K-5:** When pyrite breaks, it breaks along curved surfaces, which is called a conchoidal fracture. This behavior is very different from that of some other metallic minerals, such as galena, that break along flat surfaces. To show the difference between a conchoidal fracture breaking along cleavage surfaces, stack some same-size cubic objects such as dice or wooden blocks into a larger 3D block structure. When you gently nudge the block structure, it separates into smaller pieces along smooth, parallel surfaces. To demonstrate conchoidal fracture, put on safety glasses and put an ice cube on the driveway or sidewalk outside and gently tap it with a hammer until it breaks. Are the broken surfaces flat and smooth (like breaking along cleavage surfaces) or curved and jagged? Circle your answer:



Smooth cleavage face



Conchoidal fracture

**1-3:** Pyrite crystallizes in the isometric crystal system. Some of the best-formed crystals of pyrite in the world come from Spain and form perfect cubes. Find some things around your home that are also cubes. Write or draw your answers:

**4-5:** Look at the driveway or sidewalk for some concrete with pebbles embedded in it. Use a steel nail to try to scratch a pebble. The pebbles are usually made up of quartz, which is rated 7 out of 1–10 on the Mohs relative hardness scale. Pyrite is about the same hardness as a steel nail. Is the pebble harder than the nail? Circle your answer: Yes No On the basis of your result, which is relatively harder, pyrite represented by steel or quartz represented by the pebble? \_\_\_\_\_

**6-8:** Pyrite is made from iron and sulfur. Find iron on the periodic table of the elements. What is its atomic number? \_\_\_\_\_. What is the atomic number of sulfur? \_\_\_\_\_. How many atoms of sulfur are there per atom of iron in pyrite? \_\_\_\_\_.

**9+:** Research the physical properties of pyrite and gold before you go mining to avoid being fooled by fool's gold. Summarize how to distinguish them: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_.

### 13. Barite (barium sulfate or $\text{BaSO}_4$ )



Barite occurs in sedimentary rocks as veins or lenses, and where these form sufficiently large deposits, they are mined commercially. It is also a by-product of metal ore mining, because it is a common gangue mineral in sulfide veins (see [1. Galena](#), [3. Sphalerite](#), and [4. Chalcopyrite](#)). Barite is an unusual mineral in that it is very

dense for a nonmetallic mineral. Barite is usually white or clear but can be brownish yellow or pale blue.

Barite is primarily used in industry as a weighting agent in drilling fluid (called “mud”) for oil and gas well drilling. The density of the mud is increased to control the higher pressures that occur with depth in underground reservoirs. Other uses of barite are as a pigment in paints and as weighted filler for paper and cloth. Because it is a strong absorber of X-rays, barite is used in the medical field to picture the digestive system by contrast.

#### Activities:

**K-1:** Barite is usually white or clear, but can have many colors. Its pure crystals are in the orthorhombic system and look like rectangular boxes: Color the one on the left light blue, one of barite’s colors. Barite can also form flatter crystals in a circle pattern to look like the petals on a flower. When this form is colored red by iron stains, it is called “desert roses.” Color the barite rose on the right red.



Blue barite crystal



Red desert rose

**K-5:** With a high density for a nonmetallic mineral of  $4.5 \text{ g/cm}^3$ , a piece of barite would weigh about twice as much as a same-size piece of a typical silicate rock. To demonstrate how density can be used to identify minerals, take two 500-mL plastic water bottles. Leave one bottle full but take the cap off the second bottle and use a graduated liquid measuring cup to pour 250 mL of water out of it, leaving 250 mL in the bottle. Put the cap back on the second bottle and put each bottle into a clean sock so that you cannot see which is the full bottle. Now, compare the weight of the two bottles. One bottle is noticeably heavier, even though both bottles are the same size. Remove the bottles from the socks to see which bottle is heavier. Circle the answer:

13. Barite continued



Full 500-mL bottle



250-mL bottle

**5-6:** Barite is a very useful mineral because of its high density. Although elemental barium and all soluble salts of barium are highly toxic, barium sulfate is nontoxic because it is extremely insoluble in water. To examine solubility, which is the ability to dissolve in water, take two glasses of water and add one teaspoon of salt to one and one teaspoon of pepper into the other. Stir each glass for about 30 seconds. What do you see that is different between the two? \_\_\_\_\_

Which is soluble in water, salt or pepper? \_\_\_\_\_ Which is not soluble in water? \_\_\_\_\_

**6+:** Barite crystallizes in the orthorhombic crystal system. The most common crystal pattern has the shape of a trapezoidal prism. Make a 2D view by drawing two trapezoidal prisms, one on top of the other, with the widest parts of the trapezoids sharing the same border (one trapezoid is right side up, the other is upside down, touching each other). Color it yellow.

**7+:** Just from your current knowledge, which do you think is heavier, iron or barium? \_\_\_\_\_. Now, look at the periodic table of the elements and find both elements. What is the atomic weight of each: Barium: \_\_\_\_\_. Iron: \_\_\_\_\_. Now that you know their atomic weights, which one is heavier? \_\_\_\_\_.

**9+:** Barite strongly absorbs X-rays and gamma rays. Although it is notably dense for a nonmetallic mineral, it is also less dense than the lead conventionally used for X-ray shielding in medical applications, such as the apron you wear at the dentist. Barite has a density of  $4.5 \text{ g/cm}^3$  and lead has a density of  $7.6 \text{ g/cm}^3$ . X-ray imaging of the digestive tract may require the patient to drink a solution of barite and crushed barite. Lead absorbs X-rays better than barite, so research why barite would be used for radiology instead (see 1. Galena): \_\_\_\_\_

## 14. Limestone (calcium carbonate or $\text{CaCO}_3$ )

Limestone is a common sedimentary rock. Water may dissolve lots of holes in it. The caverns of West Texas were created by water dissolving large open areas below the surface of the Earth. If there is not enough support for the land surface above a cavern, it can collapse to create a sinkhole.



Limestone is one of the most important economic materials obtained by quarrying in the US. The limestone rock is ground to powder and used in the production of cement, which is an essential ingredient of concrete. Concrete is widely used in buildings, for the foundation, and for roadbeds, driveways, and airport runways. Many quarries are dug for limestone rock

to use only in cement manufacture. Limestone is also used to make the “lime” used in the mortar that holds building materials such as brick and stone together and for manufacturing paper, plastics, steel, glass, and paint. It can be quarried for road gravel and as a dimension stone—many important buildings have facings of limestone, including the Empire State Building.

**Limestone consists of calcium carbonate ( $\text{CaCO}_3$ ) with various impurities. The mineral name for  $\text{CaCO}_3$  is calcite.** One variety of calcite is called Iceland Spar, which looks like clear blocks of ice. It is used for prisms in some microscopes. The element calcium (Ca) in calcite and limestone is the fifth most abundant metal in the Earth’s crust, but it does not occur as pure deposits in nature, only in combination. In our bodies, calcium is mainly stored in our bones and teeth, but your body does not make its own calcium. If you do not get enough calcium in your diet or from nutritional supplements, your bones and teeth will not grow properly and weaken. Calcite has many uses as a neutralizer for acids. Crushed limestone is applied to soil to neutralize acid. High-purity calcite is used as an acid neutralizer in the chemical industry and in over-the-counter antacids such as Tums. It reacts with acid in your stomach to neutralizes some of it, which produces carbon dioxide ( $\text{CO}_2$ ) as a byproduct.

### Activities:

**K-5:** Get some vinegar and baking soda. Take 1 teaspoon of baking soda and put it into a bowl. Pour 1 teaspoon of vinegar on top of the baking soda. Draw or write what happened:

The bubbles that form when you add vinegar (acetic acid or  $\text{CH}_3\text{COOH}$  diluted in water) to baking soda (sodium bicarbonate or  $\text{NaHCO}_3$ ) is carbon dioxide ( $\text{CO}_2$ ), the same gas that is used in soda pop to give it fizz. You can also use a crushed Tums tablet, which is made from calcite, instead of baking soda.

## 14. Limestone continued

**K-5:** Get a small amount of vinegar, about 1 teaspoon. Find some concrete in a non-conspicuous location. Place a few drops of the vinegar on the concrete and observe the results. Did small bubbles come up from the concrete where you dropped the acid? Circle your answer: Yes No

This is a similar chemical reaction as in the previous activity, liberating carbon dioxide from the carbonate ion ( $\text{CO}_3^{2-}$ ) in both the baking soda and the calcite in the concrete.

**9+:** Read through the two previous activities (you are welcome to conduct them also!) Write the chemical reaction that occurred for each one:

**3-8:** Calcium carbonate is commonly used as an abrasive in toothpaste to help remove debris, plaque, and surface stains from teeth in combination with the scrubbing motion of brushing. Collect the following ingredients to make your own toothpaste:

- Calcium carbonate antacid tablets, such as Tums
- Baking soda (sodium bicarbonate or  $\text{NaCO}_2$ )
- Artificial sweetener of your choice
- Liquid food colorings
- Liquid food flavorings, such as peppermint

Combine  $\frac{1}{2}$  teaspoon calcium carbonate and  $\frac{1}{4}$  teaspoon sodium bicarbonate in a small bowl or cup. Add just enough water (ideally, use an eye dropper to add about a dozen drops of water) to make a paste. Then add about  $\frac{1}{8}$  teaspoon of powdered artificial sweetener or 1–2 drops of liquid sweetener.

Taste test your toothpaste by putting a small amount on a spoon tip. Then, experiment with mixing in different amounts of sweetener and/or small amounts of coloring and flavoring (again, use a dropper if available) to make two or more varieties. Record the different ingredients added to the basic paste in each toothpaste variety. Have other family members or classmates taste test your different toothpastes. Make a bar or pie chart displaying how many people picked each toothpaste as their favorite:

Variety 1 added ingredients: \_\_\_\_\_

Variety 2 added ingredients: \_\_\_\_\_

Variety 3 added ingredients: \_\_\_\_\_

(list more as necessary)

Draw your chart here:

## 14. Limestone continued

**5-8:** Calcite crystallizes in the hexagonal crystal system, usually forming large masses of small crystals, but sometimes it forms clear blocks that look like ice. It breaks on smooth surfaces called cleavage surfaces, with rhombohedron shape for the resulting crystals. Unlike a cube, which has rectangular faces, the six sides are parallelograms, with each pair of opposite sides parallel to each other. Draw this 3D crystal shape:

**6+:** Acid rain can form from mixing moisture in the air with carbon dioxide emitted from the burning of fossil fuels. Review the first two activities for limestone. What effect would acid in the rain have on buildings and roads that are made from concrete or limestone: \_\_\_\_\_

---

---

What do you think the effects on your teeth would be from drinking a lot of acidic beverages, such as most soda pops, or prolonged sucking on highly sour candies (note that "sour" candies decrease the pH in your mouth to form an acidic environment): \_\_\_\_\_

---

---