Name_____ Date_____

Literacy Lab #4 - What"s A Mineral? Earth Science - Breed - 2012/2013

Directions: Take a few minutes to read the article below either online (or on the back of this page.) Write responses to the statements or questions below. Cut/copy/paste is not allowed – use your own words and thoughts, based in research if needed.

Read more: http://geology.com/minerals/what-is-a-mineral.shtml

Fact-finding: List three facts that you learned in this article.

1.

2.

3.

Vocabulary: List and define three unfamiliar words in the space below.

Implications: What are your feelings about this "discovery"? Express your feelings (tactfully) about whether this is an advancement of science or a bad idea.

What are Minerals?

by Hobart King

We Use Minerals Many Times Every Day!

Every person uses products made from minerals every day. The salt that we add to our food is the mineral halite. Antacid tablets are made from the mineral calcite.

It takes many minerals to make something as simple as a wooden pencil. The "lead" is made from graphite and clay minerals; the brass band is made of copper and zinc, and the paint that colors it contains pigments and fillers made from a variety of minerals. A cell phone is made using dozens of different minerals that are sourced from mines throughout the world.

The cars that we drive, the roads that we travel, the buildings that we live in, and the fertilizers used to produce our food are all made using minerals. In the United States, about three trillion tons of mineral commodities are consumed each year to support the standard of living of 300 million citizens. That is about ten tons of mineral materials consumed for every person, every year.

To meet the definition of "mineral" used by most geologists a substance must meet five requirements:

- naturally occurring
- inorganic
- solid
- definite chemical composition
- ordered internal structure

"Naturally occurring" means that people did not make it. Steel is not a mineral because it is an alloy produced by people. "Inorganic" means that the substance is not made by an organism. Wood and pearls are made by organisms and thus are not minerals. "Solid" means that it is not a liquid or a gas at standard temperature and pressure.
"Definite chemical composition" means that all occurrences of that mineral have a chemical composition that varies within a specific limited range. For example: the mineral halite (known as "rock salt" when it is mined) has a chemical composition of NaCl. It is made up of an equal number of atoms of sodium and chlorine.

"Ordered internal structure" means that the atoms in a mineral are arranged in a systematic and repeating pattern. The structure of the mineral halite is shown in the illustration at right. Halite is composed of an equal ratio of sodium and chlorine atoms arranged in a cubic pattern.

Did You Know? Although liquid water is not a mineral, it is a mineral when it freezes. Ice is a naturally occurring, inorganic solid with a definite chemical composition and an ordered internal structure. Learn more.

The Word "Mineral"

The word "mineral" is used in many different ways. The definition given above is a formal definition preferred by geologists.

The word also has a nutritional meaning. It is used in reference to the many inorganic chemicals that organisms need to grow, repair tissue, metabolize and carry out other body processes. Mineral nutrients for the human body include: iron, calcium, copper, sulfur, phosphorus, magnesium and many others.

An archaic use of the word "mineral" comes from the Linnaean taxonomy in which all things can be assigned to the animal, vegetable and mineral kingdoms.

The word "mineral" is also used inconsistently in geology. In mining, anything obtained from the ground and used by man is considered to be a "mineral commodity" or a "mineral material". These include: crushed stone, which is a manufactured product made from crushed rocks; lime, which is a manufactured product made from limestone or marble (both composed of the mineral calcite; coal which is organic; oil and gas which are organic fluids; rocks such as granite that are mixtures of minerals; and, rocks such as obsidian which do not have a definite composition and ordered internal structure.

Mineral Commodities in Industry

The construction industry is the largest consumer of mineral commodities. Crushed stone is used for foundations, road base, concrete, and drainage. Sand and gravel are used in concrete and foundations. Clays are used to make cement, bricks and tile. Iron ore is used to make reinforcing rods, steel beams, nails and wire. Gypsum is used to make drywall. Dimension stone is used for facing, curbing, flooring, stair treads, and other architectural work. These are just a few of the many uses for these commodities in construction.
In agriculture, phosphate rock and potash are used to make fertilizer. Lime is used as an acid-neutralizing soil treatment. Mineral nutrients are added to animal feed.

The chemical industry uses large amounts of salt, lime and soda ash. Large amounts of metals, clay and mineral fillers/extenders are used in manufacturing.

Physical Properties of Minerals

There are approximately 4000 different minerals and each of those minerals has a unique set of physical properties. These include: color, streak, hardness, luster, diaphaneity, specific gravity, cleavage, fracture, magnetism, solubility and many more. These physical properties are useful for identifying minerals. However, they are much more important in determining the potential industrial uses of the mineral. Let's consider a few examples.

The mineral talc, when ground into a powder is perfectly suited for use as a foot powder. It is a soft, slippery powder so it will not cause abrasion. It has the ability to absorb moisture, oils and

odor. It adheres to the skin and produces an astringent effect - yet it washes off easily. No other mineral has a set of physical properties that are as suitable for this purpose.
The mineral halite, when crushed into small grains is perfectly suited for flavoring food. It has a salty taste that most people find pleasing. It dissolves quickly and easily, allowing its flavor to spread through the food. It is soft, so if some does not dissolve it will not damage your teeth. No other mineral has physical properties that are better suited for this use.

The mineral gold is perfectly suited for use in jewelry. It can be easily shaped into a custom item of jewelry by a craftsperson. It has a pleasing yellow color that most people enjoy. It has a bright luster that does not tarnish. Its high specific gravity gives it a nice "heft" that is preferred by most people over lighter metals. Other metals can be used to make jewelry but these properties make gold an overwhelming favorite. (Some people might add that gold's rarity and value are two additional properties that make it desirable for jewelry. However, rarity is not a property and its value is determined by supply and demand.)

Physical Properties: Determining Factors

The primary characteristics of a mineral that determine its physical properties are its composition and the strength of the bonds in its ordered internal structure. Here are some examples:

Galena, a lead sulfide, has a much higher specific gravity than bauxite, an aluminum hydroxide. This difference is because of their composition. Lead is much heavier than aluminum.

Diamond and graphite both consist of pure carbon. Diamond is the hardest natural mineral and graphite is one of the softest. This difference occurs because of the types of bonds connecting the carbon atoms in their mineral structures. Each carbon atom in diamond is bonded to four other carbon atoms with strong covalent bonds. Graphite has a sheet structure in which atoms within the sheets are bonded to one another with strong covalent bonds but the bonds between the sheets are weak electrical bonds. When graphite is scratched the weak bonds fail easily, making it a soft mineral.

The gemstones ruby and sapphire are color variations of the mineral corundum. These color differences are caused by composition. When corundum contains trace amounts of chromium it exhibits the red color of a ruby. However, when it contains trace amounts of iron or titanium it exhibits the blue color of sapphire. If, at the time of crystallization, enough titanium is present to form tiny crystals of the mineral rutile a star sapphire may form. This occurs when tiny crystals of rutile align systematically within the crystalline structure of the corundum to give it a silky luster that might produce a "star" that aligns with the primary crystallographic axis.

Specimen of rhodochrosite from the Sunnyside Mine, San Juan County, Colorado. Rhodochrosite is a manganese carbonate mineral ($MnCO_3$) that is used as an ore of manganese and is also cut as a gemstone. USGS image.

Most of the things that we use in our daily life are either made from minerals or produced using mineral products. Antacid tablets are made from calcite, table salt is crushed halite, several

minerals are used to make a wood pencil and dozens of minerals from many different countries are used to make a cell phone.

The mineral "halite" has a chemical composition of NaCl. That means it contains equal numbers of sodium and chloride atoms. In this case they are electrically charged atoms, known as ions. Those ions are arranged in a cubic pattern that repeats in all directions. The small sodium ions are positioned between the larger chloride ions.

Most rocks are aggregates of minerals. This rock, a granite pegmatite, is a mixture of mineral grains. It contains pink orthoclase, milky quartz, black hornblende and black biotite.

Did You Know? The white "m" on a piece of M&M's candy is a titanium oxide pigment, most likely produce from the mineral rutile.