GOLD PANNING IN NEW MEXICO

LEVEL: UPPER ELEMENTARY TO HIGH SCHOOL

LEARNING OBJECTIVES:

- Students will distinguish between different sediment sizes (gravel, sand, silt) and observe how they respond to panning in water.
- Students will learn about the property of specific gravity and how it can be used as a means to separate minerals.
- Students will observe that most of the minerals concentrated and retained in the pan and are dark and discuss the reason for this.
- Students will explore the magnetic property of some minerals and how it can be used as another tool to separate minerals.
- Students will explore the concept of weight percent by estimating the weight percent of magnetite in the black sand.

MATERIALS

Gold pan (even pie pans will work)	Hand lens
Maps, especially land ownership	Magnet
Comfortable clothes	Tweezers
Shovel or trowel	Small sample containers
Buckets or pails	Water proof gloves (optional)
Sieves or sorting screen (optional)	Lead pellets (optional)

Scale for weighing black sand concentrate (Classroom Activity, optional)

Plastic dish washing tub or sink (larger and deeper than gold pan, cement mixing pans are great)

WHAT IS GOLD?

Gold is an element and a metal with the symbol Au. It has a metallic luster, a pale to deep yellow color, and a ***hardness*** of 2.5-3. Gold is unaffected by oxygen and thus does not tarnish. Other important properties of gold include its great degree of ***malleability*** and ***ductility***, and its high ***specific gravity*** which makes it heavier than most minerals. Gold is considered the most malleable metal. It can be rolled or hammered into a translucent sheet 3/1,000,000 of an inch thick. Gold is also so ductile that a single ounce of gold can be drawn into a fine wire fifty miles long. In its native state gold is rarely pure, but is usually associated with silver and often mercury. The observed color variation from bright to pale yellow reflects a relative increase in the percentage of native silver combined with the gold. Gold quality is determined by ***carat*** content or ***fineness***. Pure gold is 24 carats. As it is alloyed with other metals the carat content decreases. For example, 14 karat gold is 14 parts gold/10 parts ***alloy*** metals. The specific gravity of gold is 19.3 when pure and decreases with the presence of other metals to as low as 14. Gold's high specific gravity makes the concentration of gold by gravity and thus gold panning possible.

WHERE TO FIND GOLD

Gold found "in place" such as concentrated in veins or disseminated within rock is known as ***lode*** gold. By contrast, ***placer*** gold has been weathered from its original source and has either accumulated in place or been transported, generally by water. Because gold is so heavy (three times heavier than typical black sand), it tends to be dropped from the sediment load in areas where a swift stream current slows appreciably. The gold particles works its way downward through ***alluvium*** and is commonly found close to bedrock. Specific areas to look for gold include:

- Along rivers, creeks, and arroyos that drain gold mining districts
- Sand bars, especially near the base
- Crevices within bedrock forming creek bottoms
- Underneath boulders, tree roots
- The inside curve of sharp bends in creeks
- In old river deposits
- Potholes
- At the base of waterfalls
- Anywhere the stream loses velocity
- Drain pipes or culverts under roadways
- Old mining dumps, especially where gold has been produced
- Talus slopes below old gold mines
- Above caliche layers on hillslopes and in arroyos
- In the desert, after heavy rains

DIFFERENT SEDIMENT SIZES (GRAVEL, SAND, SILT)

Sediment (the material found in rivers and beaches) is found in different sizes. Gravel refers to sediment greater than 2 mm in diameter. Sand refers to material 1/16 to 2 mm in diameter. Silt is 1/256 to 1/16 mm in diameter. Since gold is typically small, the gravel is quickly discarded when panning.

MINERALS THAT ARE CONFUSED WITH GOLD

Two minerals are found in gold placer deposits that can be confused with gold, by even the most experienced panners. Pyrite or "fool's gold" is a heavy, brassy yellow to white-yellow, typically cubic mineral that is a common ***gangue*** mineral in gold deposits. It has a hardness of 5-6 which is much harder than that of gold. Pyrite is brittle and breaks when hammered, becoming a black powder when ground. Mica is a flat, platy mineral also common in rocks that host gold deposits. Due to its iron content it weathers to a bright bronze color, which can be mistaken for gold. Although it is relatively light in weight, static electricity allows it to sometimes be concentrated in the heavy, ***black sands***. Mica is easily crushed with your fingers. Other less-common minerals may also be confused with gold in some areas.

GOLD PANNING PROCEDURE

Before proceeding with gold panning it is important to familiarize yourself with the concerns highlighted in the CAUTIONS section.

For the classroom exercise you can use local soils in your backyard. You can add a few lead pellets to see if you are panning correctly. The lead pellets will remain in the pan after panning, just as the gold will.

The purpose of gold panning is to get the heavy gold particles to settle in the bottom of the pan by vigorously shaking the sediment-water mixture and to remove the excess sediment from the pan by gently washing off the top lighter layer.

1. Collect material you wish to pan.

2. Fill gold pan ¾ to completely full of sediment. Sediment will be of varying sizes (gravel, sand, silt). Ask students to predict which sediment will most likely be washed out and which will be retained in the pan.

3. Submerge completely under water and stir or knead with fingers to allow clay and other fine particles to float away and to break up lumps of dirt. All of the material must be saturated with water. Larger stones and pebbles should be cleaned in the water and discarded, allowing the finer material to settle in the pan. Vigorously shake the pan back and forth several times. The gold has already worked its way to the bottom of the pan. Periodically, shake the pan back and forth as you stir the material.

4. Hold pan with both hands under water and shake it back and forth or in a clockwise/counterclockwise motion. This allows the gold and other ***heavy minerals*** to continue to settle to the bottom of the pan as the clay and other ***light minerals*** are washed away. Occasionally, tap the edge of the pan forcibly with the palm of your hand to allow the gold to settle to the bottom of the pan. Take your time!
5. Continue shaking the gold pan to allow the lighter minerals (quartz, feldspar, rock fragments) to wash over the edge of the pan. Ask the students why the heavy minerals retained in the pan tend to be dark in color, while the lighter minerals are generally light colored.

6. When the pan is approximately ½ full, take the pan out of the water and give it a few hard circular motions clockwise or counterclockwise to resettle the gold and other heavy minerals. Then continue shaking and allow the light minerals to wash over the edge. Gold is not dark colored, yet it is retained along with the black sands. Ask the students why. Discuss the concept of specific gravity.
7. As you continue shaking, less and less material remains in your pan and the black sands (and lead pellets if you added them) begin to dominate the material. Continue shaking and removing the light minerals; stop occasionally and remove larger pebbles/grains with your fingers or tweezers. Do not wash out the black sand!
8. Once most of the undesired material is removed and only black sand is left, the gold will be concentrated underneath the black sand. Circular motions of the pan will concentrate the gold along the edges of the black sand. The black sand will trail the lighter colored sand and the gold trails the black sand. This step takes experience, practice, and patience. Coarser gold flakes and nuggets can be picked out using tweezers or the tip of a knife. An eyedropper or gold snuffer may also be useful in picking out larger flakes of gold.
9. At this point, the less experienced panner may want to recover the black sand in a container for separation at home under controlled conditions. The more experienced panner may continue to remove the lighter-colored minerals and some of the black sand to obtain a purer gold concentrate. A magnet can be used to extract the magnetite and other magnetic minerals. Put the magnet in a plastic bag so that you will not have to continually clean the magnet. Many gold panners will clean the black sands using a second, safety pan underneath, so as not to lose any of the fine gold.

FOLLOW-UP ACTIVITY: (IN CLASSROOM)

1. Weigh a piece of paper or zero scale with paper on it.
2. Spread your black sand concentrate (collected in vial) on to the paper to dry.
3. Weigh the dried concentrate.
4. Run a magnet under the paper. What happens? What color is the material separating out from the rest of the concentrate? Discuss the idea that the heavy mineral magnetite has the additional property of being strongly magnetic which allows it to be separated from the other heavy minerals.
5. Weigh the fraction of magnetite.
6. Determine the weight percent of magnetite $\text{wt.\% magnetite} = \frac{\text{Wt. magnetite (gm)}}{\text{Wt. black sand concentrate (gm)}} \times 100$
7. What percentage of the concentrate was made up of magnetite? Discuss that the concentrate represents only a small portion of the total material panned. What percent of how much material was panned to obtain.

CAUTIONS

There are three major concerns while gold panning. First, be absolutely sure that you are panning on public land or have permission from the private landowner or in the case of state lands, the State of New Mexico. If you pan on an active mining claim (i.e. public land that has been claimed by an individual), you must have the owner's permission. Permits from state or local government environmental regulatory agencies may be required before gold panning in some areas. Also remember gold panning is not allowed in National Parks and some other state and federal lands. It is your responsibility not to trespass.

Second, be prepared for the outdoors and especially for sudden changes in the weather. Wear sturdy shoes or boots (sandals are not recommended) and loose comfortable clothing. Use sunscreen. Wear clothing in layers; as the temperature changes throughout the day, layers can be removed and added. Carry water; on a hot day in New Mexico, as much as a gallon or more of water per person may be needed for a days work. Hypothermia is a major threat as gold panners frequently become wet and then the air temperature cools. The body temperature also drops and this condition, called hypothermia, can be deadly. Watch out where you put your hands and feet and especially watch out for less friendly wildlife, especially rattlesnakes. Stay out of mine adits and shafts; these are very hazardous. Watch out for sudden storms; flash floods are common in many typically dry arroyos. Let someone know where you are going and when you plan to return. Use common sense.

Third, do not litter. Remember, if you pack it in, pack it out. Sometimes you may even have to clean up after prior users.

GLOSSARY

alloy—an elemental metal combined with any other metal or metals. Alloys are typically superior in strength and durability or have other qualities that make them more desirable than their individual constituents

alluvium—sand and gravel deposited by stream and other environments with flowing water

assay—the determination of the amount of gold, silver, or other element in a sample
black sand—a concentration of the heavy, darker colored minerals (see heavy minerals)
carat—a measure comprising 24 units used to specify the proportion of pure gold in an alloy
color—term used by gold panners that refers to the traces of yellow to golden colors in the black sand
ductility—capable of being drawn into wire. Brittleness is the opposite of ductility
fineness—the proportion of pure gold in bullion or natural alloy, expressed in parts per thousand. For example, gold which contains about 10% other metals is said to have a fineness of 900.
gangue—waste material from the process of separation and concentration of ore minerals
hardness—a property of minerals describing their relative resistance to scratching
heavy minerals—minerals with high specific gravity (dense), including magnetite, ilmenite, garnet, zircon, hematite, chromite, epidote, olivine, rutile, amphiboles, pyroxenite, monazite,and pyrite. Many of these minerals are rich in iron and magnesium or other dark elements, hence their color and the term black sand
light minerals—minerals of low specific gravity (low density) which are typically light colored, quartz and feldspar
lode—vein or other type of deposits where gold is bound up in the rock in place
malleability—property that allows a metal to be worked by hammering or pressure without crumbling. Ductility and malleability are similar properties, but some malleable metals, such as lead, cannot be drawn into wire by any means.
pay streak—a concentration of gold in sand and gravel
placer—gold or other minerals that occur as grains in typically loose sand and gravel accumulations after being weathered from lode deposits
specific gravity—the weight of a substance as compared to the weight of an equal volume of water
tailings—waste material after processing an ore deposit
Troy ounce—unit of weight, 480 grains, or 1/12 part of a pound of 5760 grains (1 troy ounce=31.1035 grams)

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