

# Wyoming Minerals

## Bentonite

Wyoming mines more bentonite than any other state in the United States and has 70 percent of the world's known supply of bentonite. Almost 5 million tons of bentonite is produced in Wyoming each year. Wyoming Bentonite is mined in the northeast corner of the state, and along the east and west parts of the Big Horn Range.

The bentonite mined in Wyoming has unique characteristics that are rarely found anywhere else. Bentonite is a brownish-gray clay that can swell up to 16 times its original size and absorbs up to 10 times its own weight in water. These characteristics are mostly due to the presence of sodium instead of calcium, which is normally found in bentonite. Geologists believe that the sodium in Wyoming's bentonite is from the sodium in the sea that covered Wyoming 120 million years ago. Wind blew ash from erupting volcanoes into the sea, and chemical changes in the volcanic ash created bentonite.

The deposits of bentonite in Wyoming average a depth of 25 feet, and it is surfaced mined. Once mined, the bentonite is cleaned and then tested to confirm its quality. It is then dried in the field before it is taken to be processed.

Bentonite has been called the mineral of 1,000 uses. It is used for absorbents, animal feed, drilling fluids, and sealants. Wyoming bentonite is particularly in demand for pet litter because of its ability to absorb many times its volume in water and control odors. Among other uses, bentonite is found in crayons, medication, and cosmetics, such as shampoos, lotions, face creams, and lipstick. Originally, Wyoming bentonite was used by local Indians as a bleaching clay and a washing agent. Pioneers used it as a substitute for axle grease to cure inflamed horses' hooves and to waterproof roofs.



### **BY THE NUMBERS**

- Wyoming is the nation's leader in bentonite production.
- 3.3 million tons of bentonite were produced in Wyoming in 2016.
- 631: The number of people bentonite mining employed in 2016
- 16x: Wyoming Bentonite can swell up to 16 times its original size



Information adapted from <https://www.wyomingmining.org/minerals/bentonite/>

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# Wyoming Minerals

## Coal

Coal is an organic sedimentary rock. Coal isn't technically a mineral; it's a black, burnable rock and is considered a fossil fuel. When burned, the coal produces a high, white flame. Bituminous coal, is so-called, because it contains a tar-like substance called bitumen.

Wyoming, the nation's leading coal producer since 1986, provides about 40% of America's coal through the top 10 producing mines located in the Powder River Basin. Most Wyoming coal is sub-bituminous, which makes it an attractive choice for power plants because it has less sulfur and burns at around 8,400 to 8,800 BTUs per pound. Wyoming coal is considered clean burning, which means it is better for the environment. Wyoming coal has steadily gained a growing share of the nation's total electricity over the past few decades for a variety of reasons.

- It's more affordable than eastern coal and other fuels.
- There are huge reserves in the state.
- Wyoming's supply of coal is reliable.
- Wyoming's low-sulfur coal can be produced and used in compatibility with the nation's environmental objectives.

The majority of Wyoming's coal formed between 50 and 58 million years ago from peat that collected in vast swamps that often covered a thousand square miles and lasted for thousands of years. Peat is woody plant material that falls into the swamp, which soon decays into a blackish, carbon-rich gel layer at the bottom of the swamp. The thicker the gel layer, the thicker the coal seam will be. To become coal, the gel layer must be heated.



### BY THE NUMBERS

- 40%: Amount of America's coal that comes from Wyoming
- 297,501,894: tons of coal that Wyoming mines produced in 2016
- 5,682: Number of people Wyoming coal mines employed in 2016
- 162 billion: Amount of recoverable coal in tons contained in the Powder River Basin
- 20 lbs: The amount of coal each person in the U.S. uses every day



Information adapted from <https://www.wyomingmining.org/minerals/coal/>

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# Wyoming Minerals

## Coal (continued...)

Wyoming's peat collected in freshwater swamps, so it has very little sulfur, resulting in our valuable low-sulfur coal. Currently, most Wyoming coal is mined from coal seams 100 feet thick. These are some of the world's largest and thickest coal seams. Coal in Wyoming is uncovered and removed by large machines in a process called surface mining.

Coal supplies more than half of the electricity in the nation. Consider the following statistics: Each person in the U.S. uses 20 pounds of coal every day, and 8 out of 10 tons of coal are used to produce electricity. How does coal make electricity? Trains and trucks take coal to power plants. At the plant, coal is burned to boil water which creates steam. Steam turns turbines, which generate the electricity. A pound of coal supplies enough electricity to light ten 100-watt light bulbs for one hour. Coal is also widely used in U.S. industries and manufacturing plants to make chemicals, paper, ceramics, and a variety of metal products. It is an important source of coke for the steel industry, and coal by-products are used to make linoleum, medication, detergents, perfumes, food flavorings, fungicides, insecticides, solvents, and wood preservatives.

### FUN FACTS ABOUT COAL

- Composition: Carbon, hydrogen, sulfur, oxygen, nitrogen
- Wyoming's coal is low-sulfur and more environmentally friendly than other forms of coal.
- Coal isn't technically a mineral. It's a black, burnable rock and is considered a fossil fuel.
- The coal deposits in the Powder River Basin are among the largest in the world.
- A pound of coal supplies enough electricity to light ten 100-watt light bulbs for one hour.



Information adapted from <https://www.wyomingmining.org/minerals/coal/>

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# Wyoming Minerals

## Rare Earths

Northeast Wyoming is home to one of the highest grade rare earths deposits in North America, currently under development. Despite their name, rare earth elements are actually commonly found on the earth, but most do not occur in large enough quantities and high enough concentrations to mine easily. They need to be separated from one another using a variety of mining and processing techniques.

These 17 minerals include: Scandium, Yttrium, Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Holmium, Dysprosium, Erbium, Thulium, Ytterbium, and Lutetium. These minerals have unique chemical and physical properties that allow them to interact with other elements.

Rare earth elements were discovered in 1787 by Swedish Army Lieutenant Carl Axel. They were first mined in the 1880s in Sweden and Norway, Brazil in 1887, and India in 1911. Until the 1980s, the U.S. was one of the world's largest producers. China has increased production by more than 500% since 1990 because of its large deposits and cheap labor.

Rare earth elements make up key components of cellphones, televisions, weapons systems, wind turbines, MRI machines, and the regenerative brakes in hybrid cars.



### **FUN FACTS ABOUT RARE EARTHS**

- There are 17 rare earth elements.
- Rare earth elements aren't actually that rare.
- China is the world's dominant producer of rare earth elements, with more than 95% of production.
- Only one rare earth mine, at Mountain Pass, CA has ever been developed in the United States. The one in WY is under development.
- The cost of putting together a rare earth element mine can cost up to a half a billion dollars or more.



Information adapted from <https://www.wyomingmining.org/minerals/>

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# Wyoming Minerals

## Trona

Trona is a sodium carbonate compound that is processed into soda ash or bicarbonate of soda, or baking soda, as it is commonly known. It is a fairly soft material, with a hardness of 2.5 - 3 on a scale of 10. It can be gray, colorless, white, pale brown or yellowish. The crystals are transparent to translucent. Trona is soluble in water, and it effervesces (bubbles) in acids.

Wyoming has the world's largest deposit of trona, supplying about 90% of the nation's soda ash. This mineral is Wyoming's top export, and is shipped to markets around the globe. Wyoming mines produced over 17 million tons of trona and employed 2,284 people in 2016.

A large freshwater lake, Lake Gosiute, covered an estimated 15,000 square miles in a basin in southwestern Wyoming. All the minerals and mud settled in the bottom of the lake, and sodium, alkaline and bicarbonate were transported to the lake by runoff water. The mixture of all these elements formed the trona deposits we mine today. Large trona deposits are found in the Green River formation, with 42 beds that cover about 1,300 square miles.

All trona is mined underground, and then processed into soda ash or baking soda. An underground trona mine is like an underground city. There are maintenance shops, bathrooms, electricity lines, and streets.

In the 1st century, the Romans used soda ash for making bread, glass, and medicine, uses which continue today. Baking soda and baking powder both come from soda ash, so most Americans have a product of Wyoming trona right in their own kitchens. Soda ash is also used to manufacture many chemicals used in industry including sodium bicarbonate, sodium chromates, sodium phosphates, sodium silicates, and sodium cyanide. It can also be added to adjust the pH of water and reduce acidity. Cattle feed, swimming pool products, medicines, paper, textiles, and toothpaste all use soda ash.



### FUN FACTS ABOUT TRONA

- 17.5 million tons: Amount of trona mined in 2016
- 2,284: Employees in 2016
- The Federal Reserve Board uses soda ash as a national economic indicator.
- 5,000 years ago, the Egyptians used soda ash for making glass ornaments and vessels.
- Trona is Wyoming's top international export.
- At the current rate of operation, Wyoming's trona reserves will last over 2,000 years.



Information adapted from <https://www.wyomingmining.org/minerals/trona>

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## Uranium

Uranium is a silvery-white metallic element that is a solid at room temperature. It is a naturally radioactive element. Uranium is the second heaviest metal on the Periodic Table.

Uranium is one of the most common elements on earth and occurs in most rocks. In ancient times, it was used in pigments and glazes, but since 1950, the primary use for this mineral is fuel for nuclear power plants.

Wyoming is America's leader in uranium production with an estimated 2 million pounds produced in 2016. This is about 78% of American production. Wyoming has an estimated 456 million pounds available for mining. About 1 pound of uranium can produce the same amount of power as 20,000 pounds of coal. Presently, the uranium produced in Wyoming is mined in-situ (meaning "in place").

Uranium is used in the military to build high-density projectiles (missiles), including ones used to pierce armored targets; in armor plating for vehicles, such as tanks; in containers that store radioactive materials; and as a power source for submarines and ships. The main use for uranium is in nuclear power plants. However, it is also used in smoke detectors and x-ray machines.



*Yellow cake processed from Uranium.*

### **FUN FACTS ABOUT URANIUM**

- The element was discovered in 1789 by Martin Klaproth, a German chemist.
- Uranium was formed in supernova about 6.6 billion years ago, and provides the main source of heat inside the Earth.
- Uranium is so dense it is used in the keels of yachts and as counterweights for aircraft control surfaces, as well as radiation shields.
- More than 13% of the world's electricity is generated from uranium in nuclear reactors.

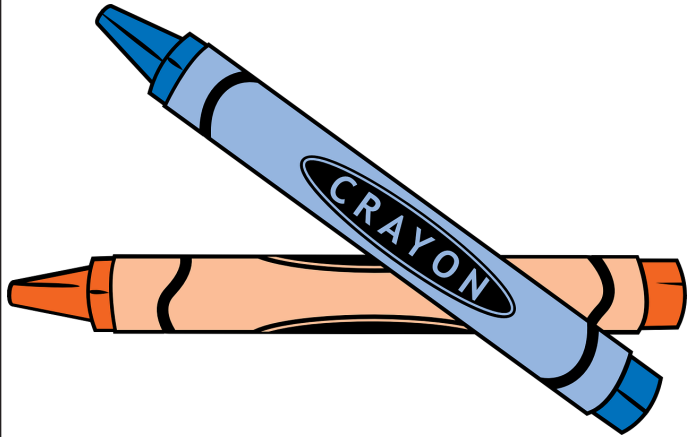


# Mineral Mystery Bag Items

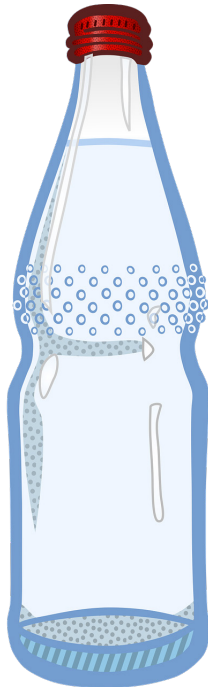
Kitty Litter



Crayons



Mineral Water



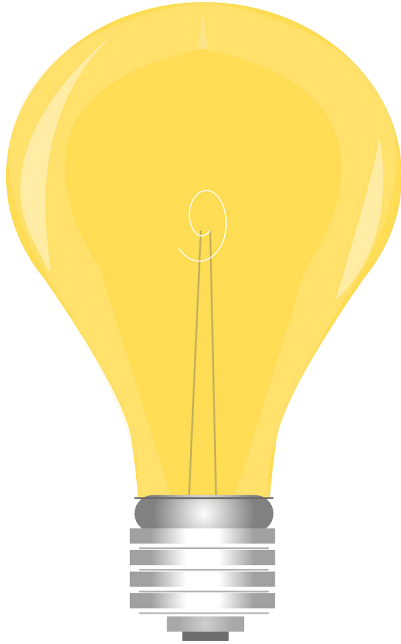
Lipstick





# Mineral Mystery Bag Items

**Light Bulb**



**Cement Mixer**



**Electric Generator**



**Refineries**





# Mineral Mystery Bag Items

Smoke Detector



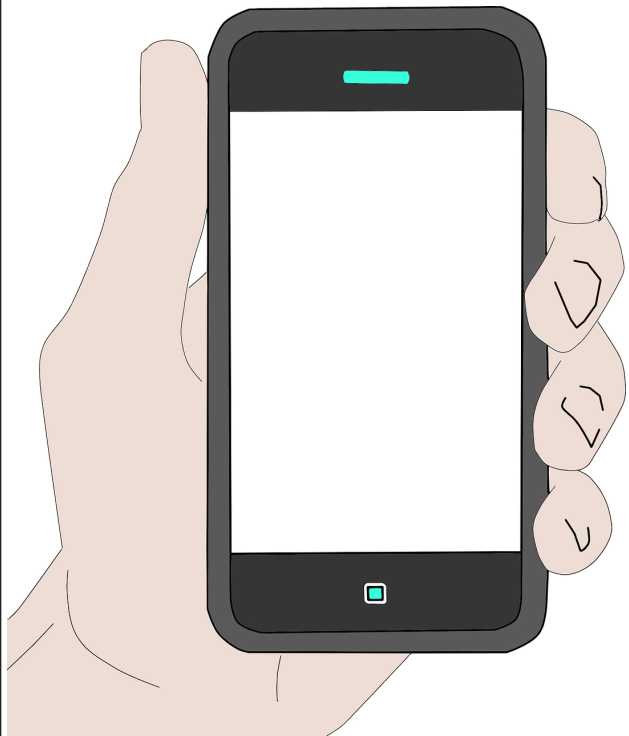
Camera



Welding Visor



Cell Phone







# Mineral Mystery Bag Items

**Cattle Feed**



**Tank**



**Nuclear Power Plant**



**X-Ray Machine**





# Mineral Mystery Bag Items

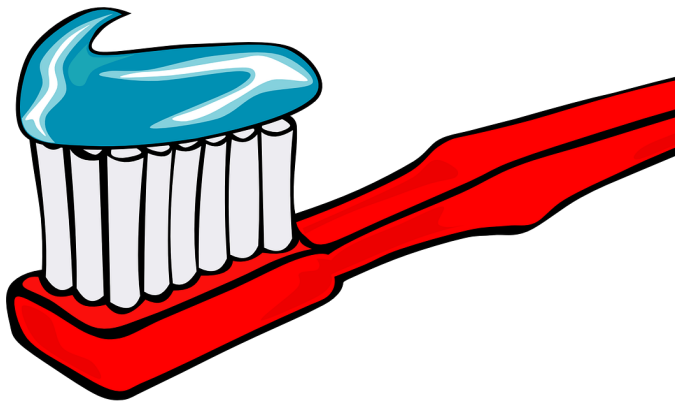
**Baking Soda**



**Glass**



**Toothpaste**



**Cookie**





# Mineral Mystery Bag Items

Calamine Lotion



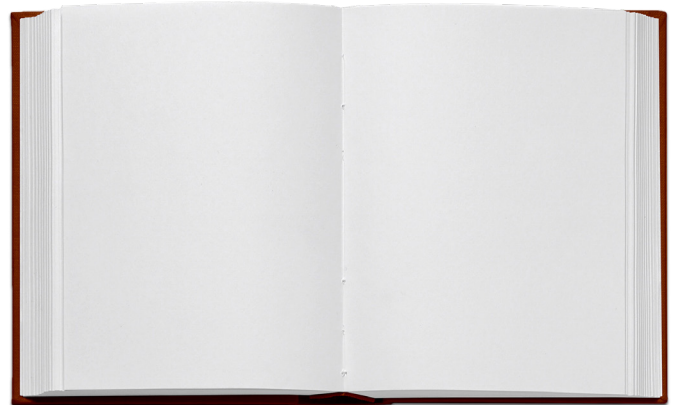
Mud Mask



Laundry Detergent



Paper







# Wyoming's Minerals - Graphic Organizer

Coal	Bentonite	Trona	Uranium	Rare Earth Elements





Name: \_\_\_\_\_

Date: \_\_\_\_\_

# Wyoming's Minerals Property Sort Sheet

## Directions:

Read the following statements, and decide what mineral they correspond to then highlight the statement to match the mineral color.

**Coal**

**Bentonite**

**Uranium**

**Trona**

**Rare Earth Elements**

- Includes 17 minerals
- Organic sedimentary rock
- Silvery white
- Formed 50-58 million years ago from peat
- Gray, colorless, white, pale brown, yellowish
- Used in nuclear reactors
- Minerals need to be separated
- Brownish-gray clay
- Very absorbent
- Minerals that don't occur in large quantities
- Second heaviest metal on the Periodic Table
- Produces a white flame when burned
- Soluble in water
- Radioactive
- Mineral that has a hardness of 2.5-3
- Contains sodium or calcium
- Made of crystals





# Answer Key

## Wyoming's Minerals Property Sort Sheet

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