Dig A Little Deeper

The Sound of Music Is the Sound of Metals at Work

Whether it's the musical instruments in a garage band or the string, wind, and percussion instruments of a symphony orchestra, they are all made of materials from our natural resources–And almost all of them contain some minerals and metals.

From the lute of the Ancient Egyptians to the Flying V of today...from animal horns to fluegelhorns...from the African slit drum to today's digital keyboards... the ingenious use of metals and minerals has made our appreciation of music a major part of our lives and readily available to people around the world.

Before It Was Rock 'n Roll It Was Just Rock

Copper is used in all electric instruments, all brass instruments, most of the string instruments and in many of the percussion instruments.

For information about minerals in society, visit:
www.mii.org

Science: *Discover raw materials in various instruments. What makes the instrument work.* ***Art:*** *Make musical instruments from recycled materials.*

Language Arts: *Bremas Town Musicians. Research & report on a favorite instrument.* ***Enrichment:*** *Invite local musicians to perform.*

Music: *Peter and The Wolf.* ***Geography:*** *Countries that mine the minerals that make your instrument.*

MINERAL INFORMATION INSTITUTE

Everything Is Made Of Something

If you can see it, touch it, taste it, smell it, or hear it, It's from our Natural Resources.

Rocks In Your Mouth

Science

What minerals are found in toothpaste? (Activity on Page 2) Which brands can you find that do not contain fluoride? Where does fluoride come from? What does it look like in its raw form? Read about or research fluoride. Find out the fluoride content of the drinking water in your area. What are the benefits of fluoride?

Health

Discuss dental hygiene and the beneficial ingredients of toothpaste. Draw, cut out pictures, or bring examples of a variety of toothbrush designs. List benefits of each design. Have a dentist or hygienist visit the class. —More on page 3.

Math

Survey class on brands of toothpaste used. Chart or graph the information.

P.E.

Stomp and squirt contest. Use toothpaste and butcher paper. Estimate and measure distance.

In the Olden Days . . .

- Toothbrush was wool moistened with honey or a twig with the end smashed and softened first by biting on it.
- Toothpaste was powdered bones of mice.
- Toothpicks were porcupine quills.
- Teeth didn't last very long.

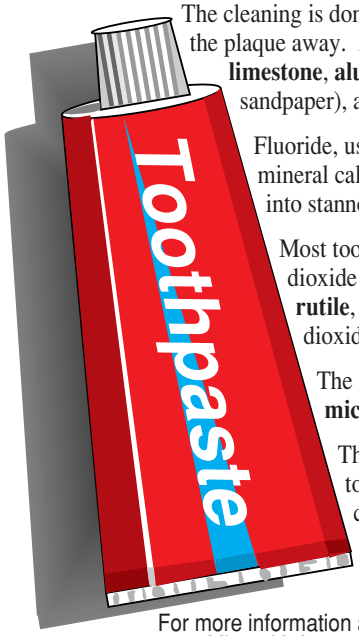
A Brighter Smile From Mining

Dig A Little Deeper

A Bright Smile

From Toothpaste and Minerals

Toothpaste cleans your teeth and keeps them healthy.



The cleaning is done with abrasives (from rocks) that rub the plaque away. Abrasives are minerals like **silica, limestone**, **aluminum** oxide (also used in sandpaper), and various **phosphate** minerals.

Fluoride, used to reduce cavities, comes from a mineral called fluorite. It is sometimes changed into stannous fluoride (**tin** fluoride).

Most toothpaste is made white with **titanium** dioxide which comes from minerals called **rutile**, **ilmenite**, and **anatase**. Titanium dioxide also is used to make white paint.

The sparkles in some toothpaste come from **mica**, a mineral common in many rocks.

The toothbrush and tube holding your toothpaste are both made of plastics that come from petroleum (petrochemicals) and other minerals.

For more information about minerals in society, go to: Mineral Information Institute, www.mii.org

Language Arts: *Read "Ira Sleeps Over." Let students bring PJs & toothpaste.*
Social Studies: *What was used before toothpaste was "invented."*

Science: *What minerals are found in toothpaste. Read about or research fluorite. Compare fluoride content in various brands.*

Math: *Survey class on brands used, chart or graph.* **Health:** *Discuss dental hygiene & special ingredients.* **P.E.:** *Stomp & squirt contest, use toothpaste & butcher paper.*

Language Arts

Read "*Ira Sleeps Over*". Have students bring toothpaste and toothbrush and PJ's. More ideas on page 4.

Social Studies

What was used before toothpaste and toothbrushes were invented? Did people really use a twig?

Read More About It

Dental Care, Life Guides Series, by Brian R. Ward, 1986 Franklin Watts

Smile! How to Cope with Braces, by Jeanne Betancourt, 1982, Alfred A. Knopf, Inc.

Arthur's Loose Tooth, by Lillian Hobar, 1985

Alligator's Toothache, by Diane DeGroat, 1977

The Princes' Tooth Is Loose, (K-1st), by Harriet Ziefert, 1990

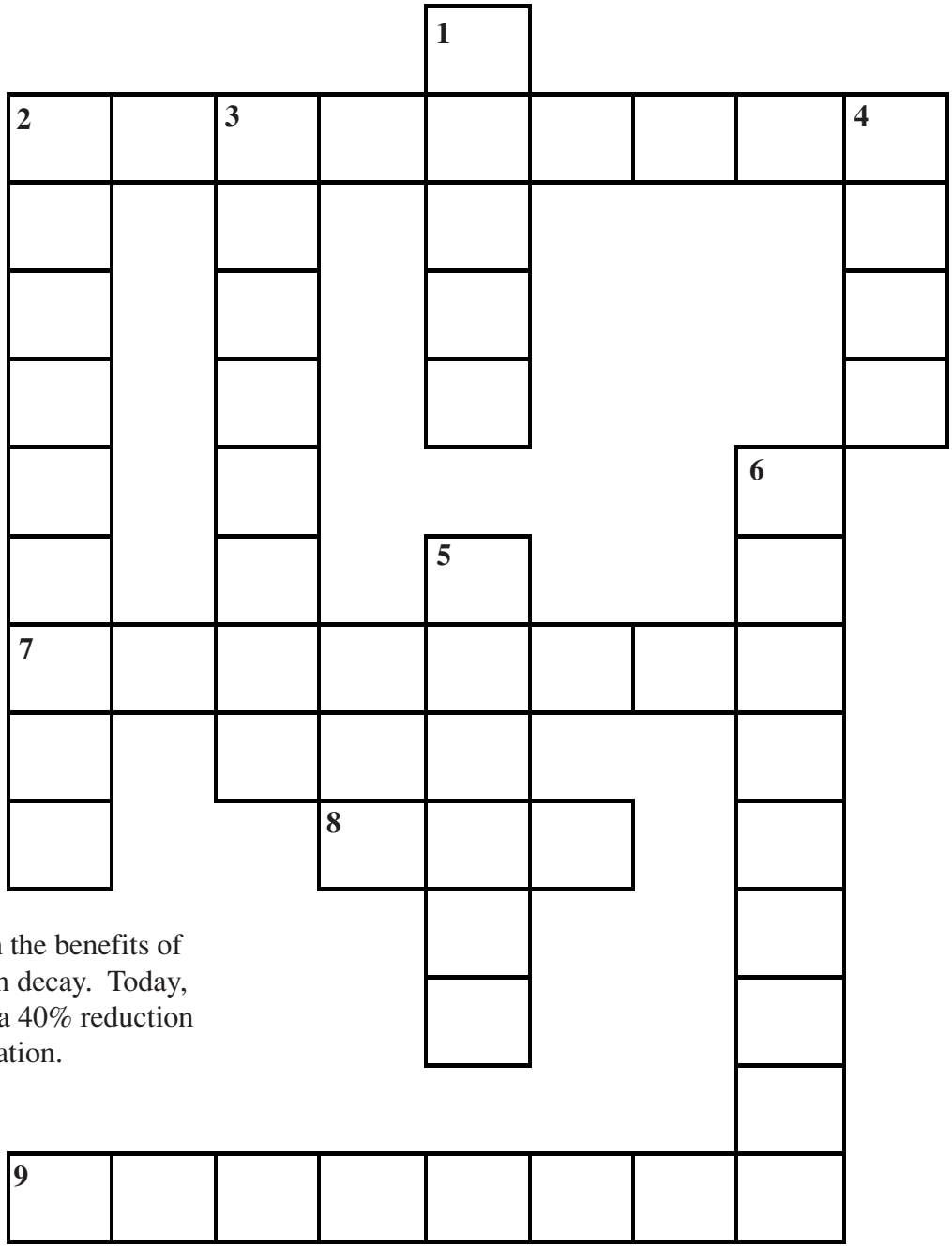
My First Dentist Visit (K), by Julia Allen, 1987

Crossword Puzzle: Rocks In Your Mouth

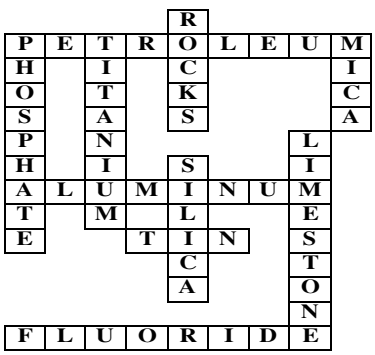
- The cleaning is done with abrasives, from **(1 DOWN)** .
- Abrasives are minerals like **(5 DOWN)** , **(6 DOWN)** , **(7 ACROSS)** , and various **(2 DOWN) .**
- **(9 ACROSS)** , used to reduce cavities, comes from a mineral called fluorite.
- Stannous fluoride is called **(8 ACROSS)** fluoride.
- Most toothpaste is made white with **(3 DOWN)** dioxide.
- The sparkles in toothpaste come from the mineral **(4 DOWN)** .

Rocks In Your Mouth

petroleum
aluminum
phosphate
limestone
titanium
fluoride
rocks
silica
mica
tin



In 1945, research began on the benefits of fluoride in preventing tooth decay. Today, researchers attribute up to a 40% reduction in cavities to water fluoridation.



Today, more than 150,000 U.S. dentists use about 13 tons of gold each year (more than 70 pounds every day) for crowns, bridges, inlays, and dentures. A typical crown may contain between 62% and 78% gold.

Care of Teeth and Gums

1. A Good Diet

   Eat well-balanced meals which include a variety of foods and provide nutrients needed by teeth and gums.

   Eat fewer sugary foods. Bacteria in the mouth digest sugar and produce an acid. This acid dissolves tooth enamel, forming a cavity.

2. Cleaning The Teeth

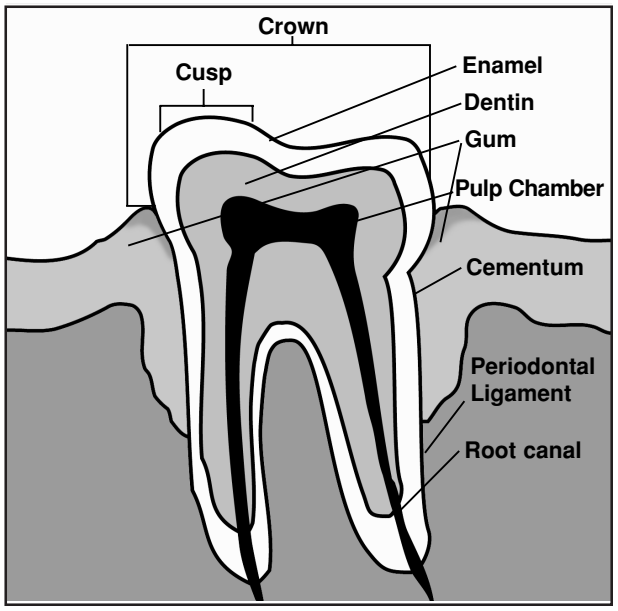
   Brush after every meal. Use dental floss once a day. This removes the plaque. Plaque is a sticky film made of saliva, food particles and bacteria.

3. Dental Check-ups

   Have a dental check-up at least once a year. A check-up and teeth cleaning will help prevent diseases of the teeth and gums.

Ages at Which Teeth Usually Appear

Deciduous Teeth	**Lower Teeth**	**Upper Teeth**
Central Incisors	6 months	7 months
Lateral Incisors	7 months	9 months
Canines	16 months	18 months
First Molars	12 months	14 months
Second Molars	20 months	24 months
Permanent Teeth	**Lower Teeth**	**Upper Teeth**
Central Incisors	6-7 years	7-8 years
Lateral Incisors	7-8 years	8-9 years
Canines	16 months	18 months
First Premolars	10-12 years	10-11 years
Second Premolars	11-12 years	10-12 years
First Molars	6-7 years	6-7 years
Second Molars	11-13 years	12-13 years
Third Molars	17-21 years	17-21 years



Parts of a Tooth

Crown—visible part of a molar tooth.

Cusp—projections in a molar tooth.

Root—extends into the bone of the jaw.

Pulp—innermost layer of a tooth. Made up of connective tissues, blood vessels and nerves. Two parts:
1. pulp chamber—lies in crown of tooth
2. root canal—lies in root. Blood vessels and hole at the tip of the root.

Dentin—hard, yellow substance surrounding the pulp. It makes up most of the tooth. Dentin is harder than bone. Made up of mineral salts, water and also has some living cells.

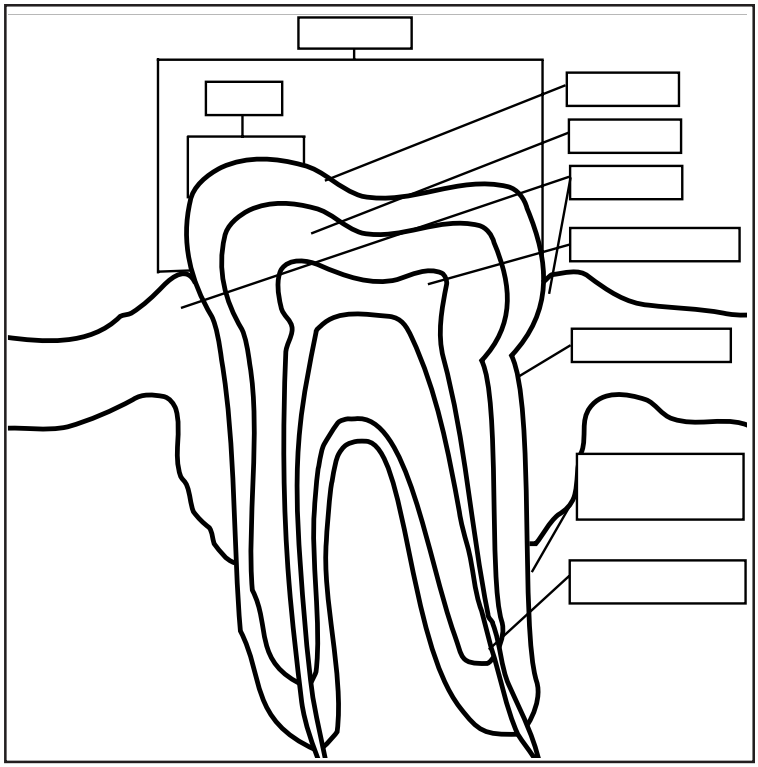
Enamel—outermost covering of tooth. It is the hardest tissue in the body. Made up of calcium phosphate and small amount of water, It is white and transparent. Fluoride in toothpaste chemically replaces some of the water in the enamel making the tooth decay resistant.

Cementum—overlies dentin in the root of the tooth. It is about as hard as bone. It is made of mineral salts and water.

Periodontal Ligament—Made of small fibers. It anchors the tooth and serves as a shock absorber during chewing.

A Cut-and-Paste Activity

Use old magazines. Look for pictures of healthy foods that are good for you. Cut out the pictures and paste them on a piece of construction paper.



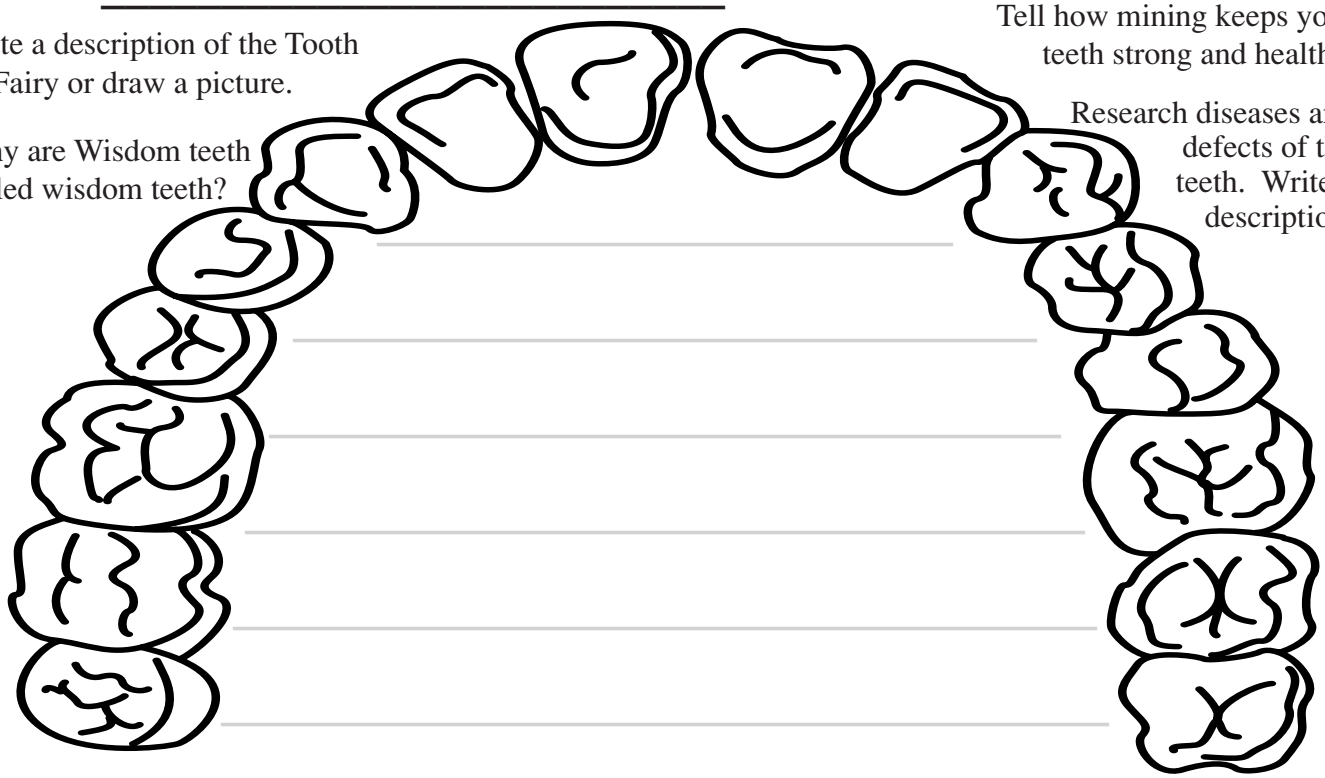
Name _____

Write a description of the Tooth Fairy or draw a picture.

Why are Wisdom teeth called wisdom teeth?

Tell how mining keeps your teeth strong and healthy.

Research diseases and defects of the teeth. Write a description.



Describe how to use dental floss in words and pictures.

Make a poster advertising good dental hygiene.

List other uses for dental floss and/or toothpaste.

If your teeth could talk, what advice would your primary teeth give to your secondary teeth?

Interview an orthodontist. How does mining help him do his job?

Draw a picture of a visit to the dentist or write about a visit to the dentist.

Find out what minerals are used to make the instruments the dentist uses.

Identify the teeth.
What is their purpose?

Which teeth do you have now?
Which of your teeth are healthy?

MINERAL INFORMATION INSTITUTE

Sidewalks Across the Curriculum
Hard Facts

Everything Is Made Of Something

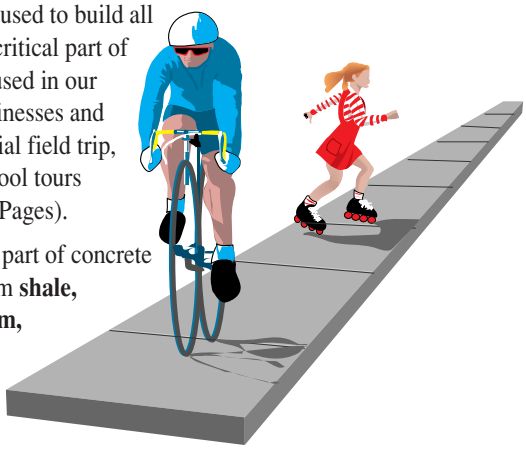
If you can see it, touch it,
taste it, smell it, or hear it,
It's from our Natural Resources.

Anybody can build a sidewalk. But can your community make a sidewalk?

Eleven states don't even produce cement, the essential ingredient to make concrete. Some communities do not have a sand and gravel mine nearby. How far away does your community need to go to find the materials to make a sidewalk?

Dig A Little Deeper
Find Out
Where The Sidewalk Begins

Virtually every community in America has a mine or quarry nearby, one that provides, sand and gravel— minerals we use everyday. Sand and gravel are used to build all our roads and are a critical part of the concrete that is used in our homes, schools, businesses and factories. For a special field trip, call to see about school tours (check your Yellow Pages).



The other necessary part of concrete is ***cement***, made from **shale, clay, quartz, gypsum, iron, alumina, manganese,** and- most important, **limestone**.

Each year, more than 4,700 pounds of concrete is produced for every person in the United States.

For information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Art: *Sidewalk drawings, prints* **Poetry:** *Where the Sidewalk Ends.*

Social Studies: *Can your community make (vs. build) a sidewalk by itself.*

Math/Science: *Develop a recipe & diagram for concrete pie (graph)*

SCIENCE

In cooperative groups research how concrete is made and how cement is made. What is the difference? Take a walking field trip to locate examples of how concrete is used in and around your school. Examine broken pieces to see what it looks like. Mix "concrete" using the recipe found on page 5. Limestone is the most important part of cement and, therefore, concrete. It's also in candy bars and toothpaste.

P.E.

Use sidewalk chalk to create sidewalk drawings and games.

LANGUAGE ARTS

Read *Where The Side Walk Ends*. Create your own sidewalk poems. Write short research papers on quarrying and aggregate mining (there is a difference), or the various kinds of concrete.

MATH

Using the information in the box above, determine how many pounds of concrete are produced each year for your class. Weigh samples of concrete using standard and metric measures. Calculate volume measurements on page 2.

Measuring by weight. Measuring by volume. How much concrete do you need to fly on an airplane?

HISTORY

Research: Romans and the development of cement and concrete used in buildings that still stand. Building of the Erie Canal. Georgia granite was used in the Panama Canal. Why? Find out about Joseph Aspden and Portland Cement, named after the Isle of Portland on the south coast of England.

ART

Using the recipe on page 5, create art objects such as garden stepping stones, paper weights, molded figures. Draw pictures or make a collage of items made of concrete.

Read More About It

The Magic School Bus Inside The Earth, by Joanna Cole

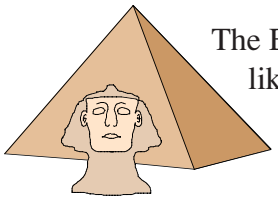
The Super Science Book of Rocks and Soils, by Robert Snedden

Mineral Resources, World's Resources Series by Robin Kerrod

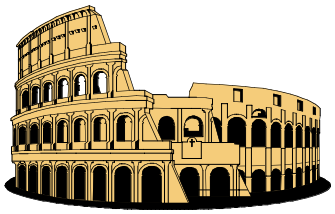
How We Build Dams, by Neil Ardley

The Big Book of Real Skyscrapers, by Gine Ingoglia, 1989, Grosset & Dunlap

What would life be like without concrete?
Visit a local mine and find out how it all begins



The Egyptians used a cement-like material (containing gypsum) to make the Great Pyramid in 2600 B.C.



The ancient Romans developed a special concrete that set up while underwater (a hydraulic cement). Their special mixture contained lime and volcanic ash. Their concrete was so strong that many of their buildings, bridges, and roads still exist today, 2,000 years after they were built.

Some of the world's smartest people don't know the difference between concrete and cement.

It's simple. *Concrete* is the finished product, such as sidewalks, foundations, and the surface of many roads. Concrete contains sand, gravel, and cement. *Cement* is the special hardening ingredient (the gray powder) that makes concrete harden. Cement is usually made of 60% lime (limestone), 25% silica, 5% alumina, and 10% other materials, such as gypsum and iron oxide.

Now you know!

The average American house contains 120,528 pounds of concrete, 15,300 pounds of concrete block, and 75,400 pounds of sand, gravel, and bricks. In total, more than a quarter of a million pounds of different minerals and metals are contained in the *average* American home.

Five states produce nearly 50% of all the cement made in America. They are (in order): California; Texas; Michigan; Pennsylvania; and Missouri.

The American Society of Civil Engineers (ASCE) named the 10 civil engineering achievements in the 20th century that had the greatest positive impact on the quality of life and well being of people worldwide. All of them required the extensive use of our natural resources, including a substantial amount of concrete.

The broad categories and individual projects selected were:

- Airport Design & Development, *Kansai International Airport, Japan*
- Dams, *Hoover Dam, Nevada-Arizona, USA*
- *The Interstate Highway System, USA*
- Long-Span Bridges, *Golden Gate Bridge, California, USA*
- Rail Transportation, *Eurotunnel Rail System, England and Europe*
- Skyscrapers, *The Empire State Building, New York City, USA*
- Wastewater Treatment, *Chicago Wastewater System, USA*
- Water Supply and Distribution, *The California Water Project, USA*
- Water Transportation, *The Panama Canal, Central America*
- Sanitary Landfills/Solid Waste Disposal

All of these monuments have created a positive change in the way people live and how they conduct business. They represent some of the most significant public works achievements of the past century and serve as a symbol of engineering's finest moments in history.

Find out more at http://www.asce.org

Find out how concrete and projects like those listed above affect you.

How much concrete is in the Hoover dam?

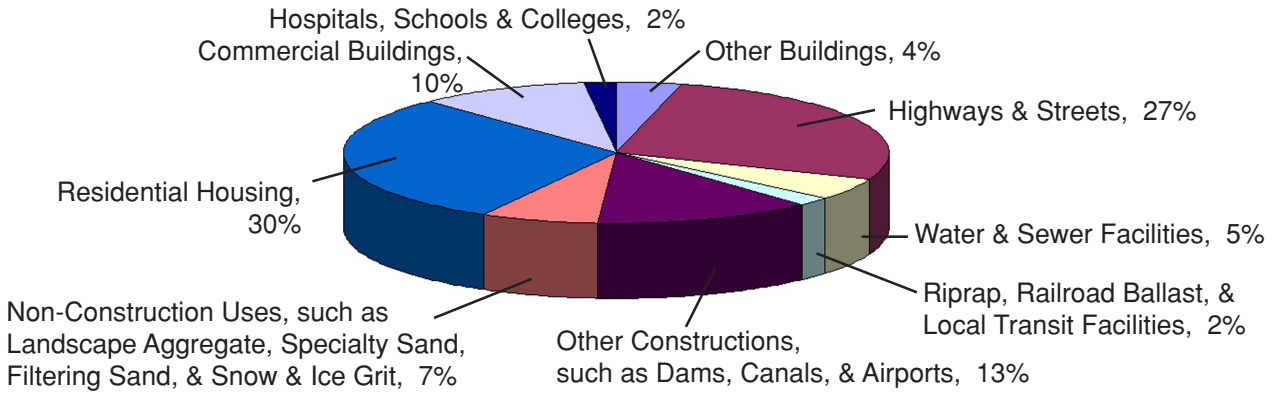
There are 4,360,000 cubic yards of concrete in the dam, power plant and other facilities.

This much concrete would. . .

- build a monument 100 feet square and 2-1/2 miles high;
- rise higher than the Empire State Building (which is 1,250 feet) if placed on an ordinary city block; or
- pave a standard highway 16 feet wide, from San Francisco to New York City.

In the U.S., we mine and use about 2 ¾ billion tons of aggregates every year . . . that's 10 tons (20,000 pounds) for every person in the USA.

We All Use Aggregates



Source: California Department of Conservation, Division of Mines and Geology

We all use rocks. . .
each of us need about 10 tons every year.

The average new house contains 120 tons of sand, gravel and stone (called aggregate). About 17 tons is used in concrete.

In the USA, there were 115,904,641 housing units counted in the 2000 Census. Each new house and its proportional share of the associated schools, libraries, shopping centers, recreational centers, and other facilities, requires more than 325 tons of aggregate.

Concrete is commonly used in the construction of all large buildings. Find out how much concrete is used where you live and go to school.

- 15,000 tons of aggregates are required for the construction of an average size school or hospital.
- 85,000 tons of aggregates are necessary to construct one mile of an interstate highway or 1/4 mile of a four-lane road.

Concrete is measured by the cubic yard—measuring three feet by three feet by three feet, or 27 cubic feet. One cubic yard of normal concrete will weigh about 4000 pounds.

One cubic yard covers an area 8 feet by 10 feet if the concrete is 4 inches thick. Four inches is generally enough for sidewalks, residential driveways, or garage floors.

1. How many cubic yards of concrete are in the sidewalk around your school? In the sidewalk around your house?
2. How much concrete is needed to place a floor in a two-car garage (normally 20 ft. by 20 ft.)?
3. How many cubic yards of concrete would be in the floor of your classroom? How much would it weigh if it is made of concrete?
4. If concrete costs $75 per cubic yard (delivered), how much does each of the above cost?

How *big* is a ton?

Rocks vary tremendously in weight and density, but a good **Rule of Thumb** for aggregates is—

1 cubic yard = 1 ton

Concrete normally weights 2 tons/cubic yard

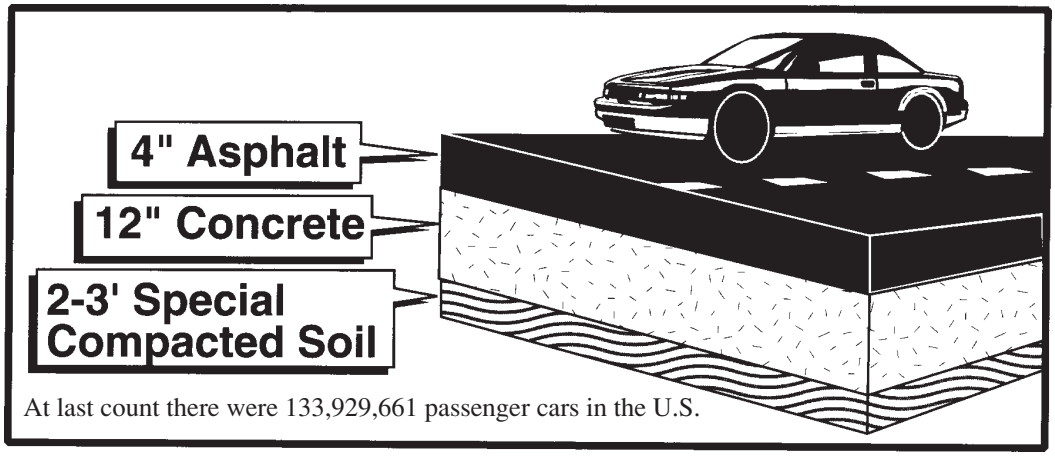
Roads & Highways

There are more than 2,336,000 miles of hard-surfaced roads in the United States. The majority of those roads do not have both asphalt and concrete surfaces, like the *ultimate* road shown below. However, a two-lane road is at least 24-feet wide, so you can begin to estimate the amount of materials that were mined to construct the roads we use everyday.

There are more than 1,571,000 miles of dirt roads in the U.S. And every year, they need more dirt put on top of them because driving makes the dirt disappear. It disappears as dust when the sand and rocks are worn finer and finer by the weight of cars.

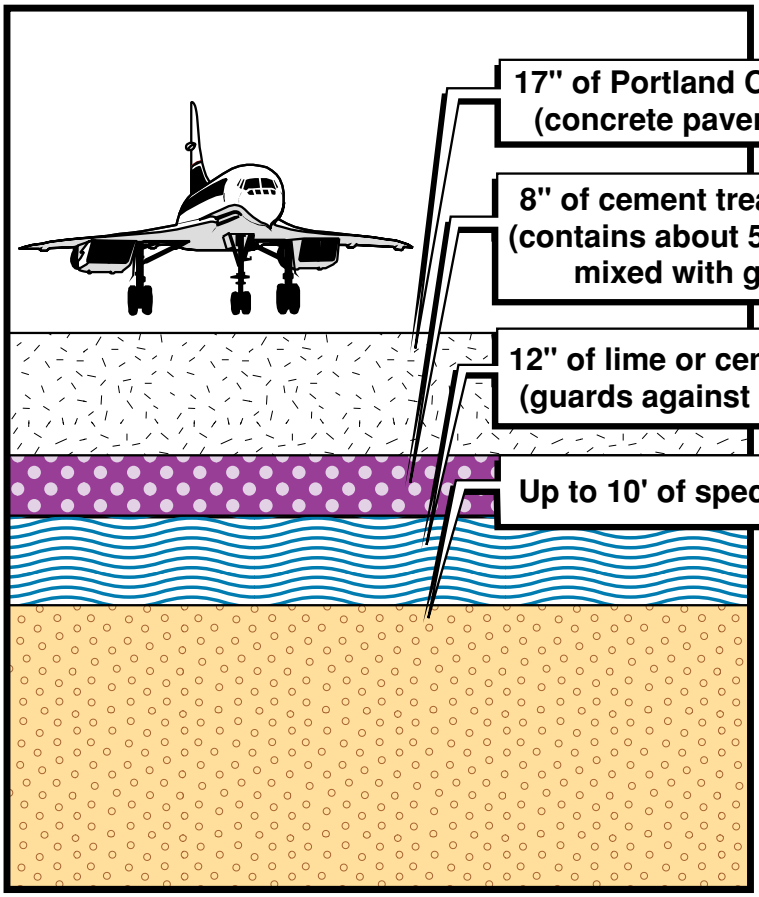
The construction of a typical interstate highway can require as much as 20,000 tons per lane mile. There are 583,000 bridges in the United States, the majority of them are made of concrete and steel.

Roads cover 31,701,760 acres of land. Passenger cars and small trucks consumed more than 110 billion gallons of fuel each year.



At last count there were 133,929,661 passenger cars in the U.S.

Airports and Runways



There are about 18,345 airports in the United States, covering more than 4 million acres of land. While it is virtually impossible to estimate the amount of sand, gravel, stone, and cement used to build those airports, this information can help you begin to appreciate the amount of mining that must occur so people can fly.

Just one new airport, Denver International Airport built in the 1990s, required more than 10 million tons of aggregates.

There are more than 281,000 non-military airplanes in the U.S., 7,400 of which are the commercial carriers (the airline companies).

The carriers travelled more than 5.5 billion miles each year, involving more than 8 million different trips, with 550 million passengers on those planes.

The amount of minerals and metals needed to build those airplanes is unknown, but they consume more than 13 billion gallons of fuel each year.

All the above information is for the USA only.

Travel is one of our greatest freedoms and forms of recreation.

Find out if your students, and their families, are average. Students can:

- Keep a log of their (and family) daily travel;
- Compare with other students;
- Find out what their most important trips are;
- Begin to appreciate the natural resources they are using to make those trips.

Discover the Facts of Travel
Who travels most.
What mode is used.
When most people travel.
Where the trips go.
Why the trips are made.
How they travel.

Passenger Travel in the United States: 1977 and 1995

	1977	1995
Avg. Number of Trips/Person/Year [1]	1,061	1,573
Avg. Total Miles Traveled/Person/Year [2]	11,266	17,244
Avg. Local Miles Traveled/Person/Year	9,470	14,115
Avg. Number of Daily Local Trips/Person (one way)	2.9	4.3
Avg. Local Trip Distance	8.9 miles	9 miles
Avg. Miles of Daily Local Travel/Person	26	39
Avg. Number of Daily Local Private Vehicle Trips/Household	4.0	6.4
Avg. Local Daily Miles/Household in Private Vehicles	33	57
Avg. Long-distance Miles Traveled/Person	1,796	3,129
Avg. Number & Length of Long-distance Travel/Person/Year	2.5 (733 miles)	3.9 (826 miles)

1 A trip is movement from one address to another by any mode. A round trip counts as two trips.
2 Local trips are those under 100 miles, one way (about 75% to 80% of all travel is local).

Mode of Travel in 1995

Local trips	% of Trips	% of Miles Traveled	Long-distance trips	Percent
Personal-use vehicle	89.5 %	92%	Personal-use vehicle	79.2%
Transit (includes commuter rail)	3.6 %	3%	Airplane	18.0%
Bicycle/walking	6.5 %	0.5%	Bus	2.1%
Rail	0.01%		Rail	0.5%
Other	0.3 %		Other	0.2%

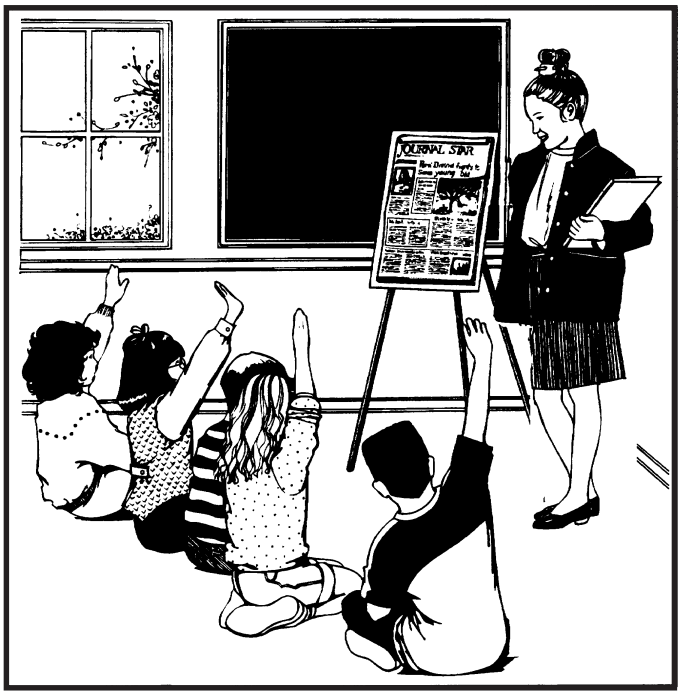
Sample **Travel Log**

Date	From	To	Distance	Purpose of Trip	Mode	Persons traveled with

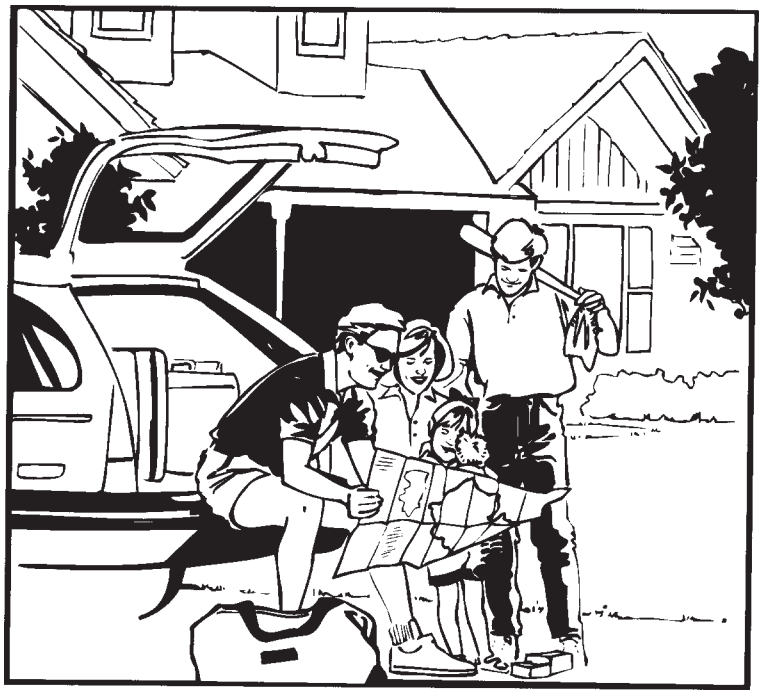
SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, American Travel Survey data, October 1997.
U.S. Department of Transportation, Federal Highway Administration, Summary of Travel Trends: 1995 Nationwide Personal Transportation Survey, draft, 1999.

Limestone is working for you, everyday.

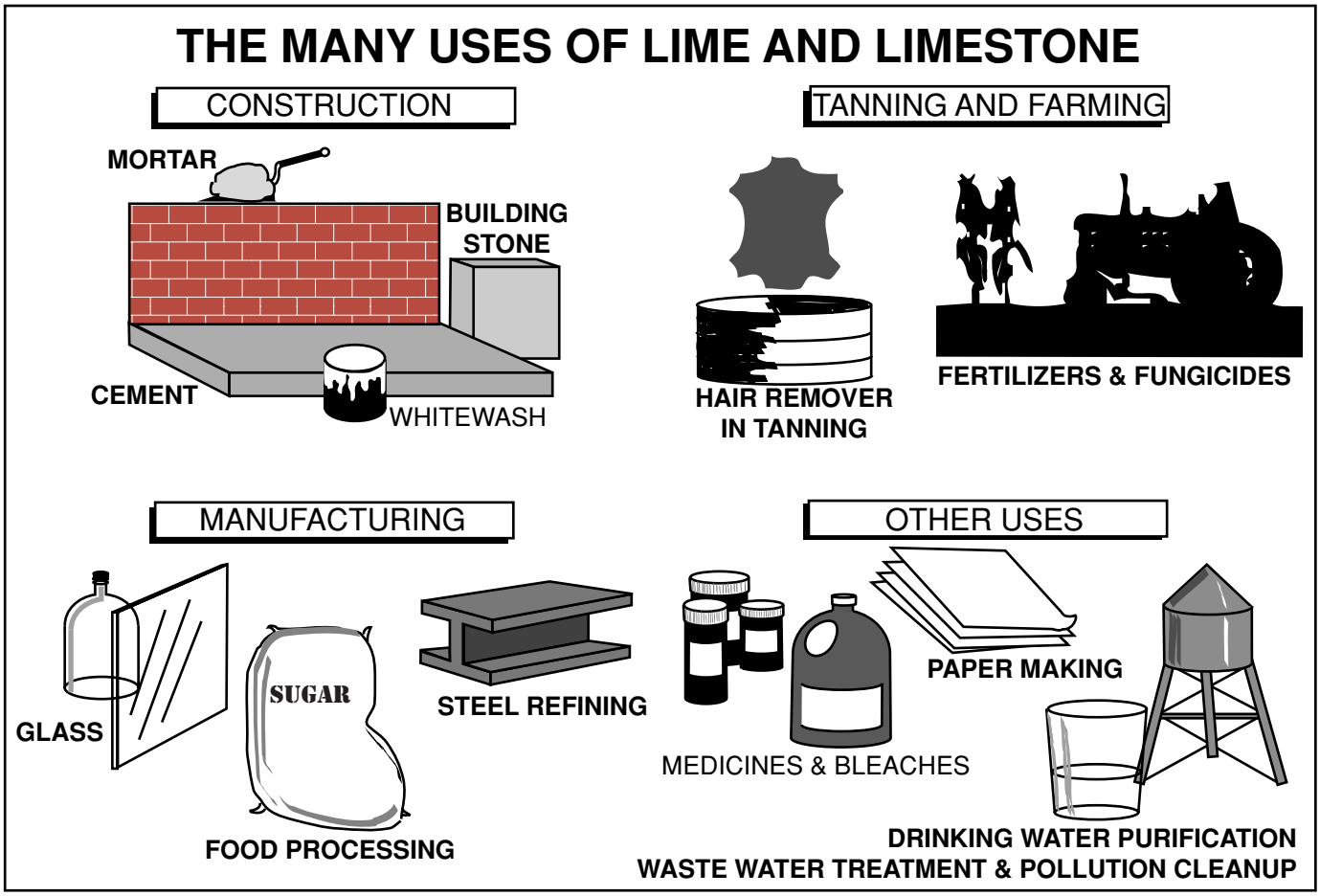
At your school



At your home



Can you find all the ways limestone is used?



Recommended concrete mix

This mix makes about 4 cubic feet (0.1 cubic meter) of concrete, enough to make 12 sq. ft. of sidewalk, 3 inches thick.

Material	By Volume	By Weight	By Ratio
Cement	1 bag, or 1 cu ft (0.03 cu m)	94 lbs (43 kg)	1 part
Water	5.5 gal (21 liters)	46 lbs (21 kg)	as needed
Sand	2 cu ft (0.06 cu m)	200 lbs (91 kg)	2 parts
Coarse aggregate*	3 cu ft (0.08 cu m)	260 lbs (118 kg)	3 parts

* Particles graded 1/4 to 3/4 inch (6 to 19 mm) in size

Cement is a caustic. It can burn skin and eyes, just like acid.

A safe way to demonstrate the making of concrete.

Substitute: 1 part of white glue mixed with 10 parts of water, instead of using cement.

Also try this white glue as a substitute in your other art projects. Instead of using plaster of Paris in your casting activities, try using this white glue recipe. It takes a little longer to set but you can now have textures from your molded projects and the glue dries clear.

Math Challenge

This sounds too large to be true, but it is

Every year more than 20,000 pounds of sand, gravel, and stone is mined for every person in the United States. These materials are used to make or repair roads and highways, sidewalks, houses, schools, offices, stores, factories, and other buildings that each of us use daily.

For convenience, when converting pounds and tons to cubic yards, assume that one ton of these materials occupies 1 cu. yd. of space.

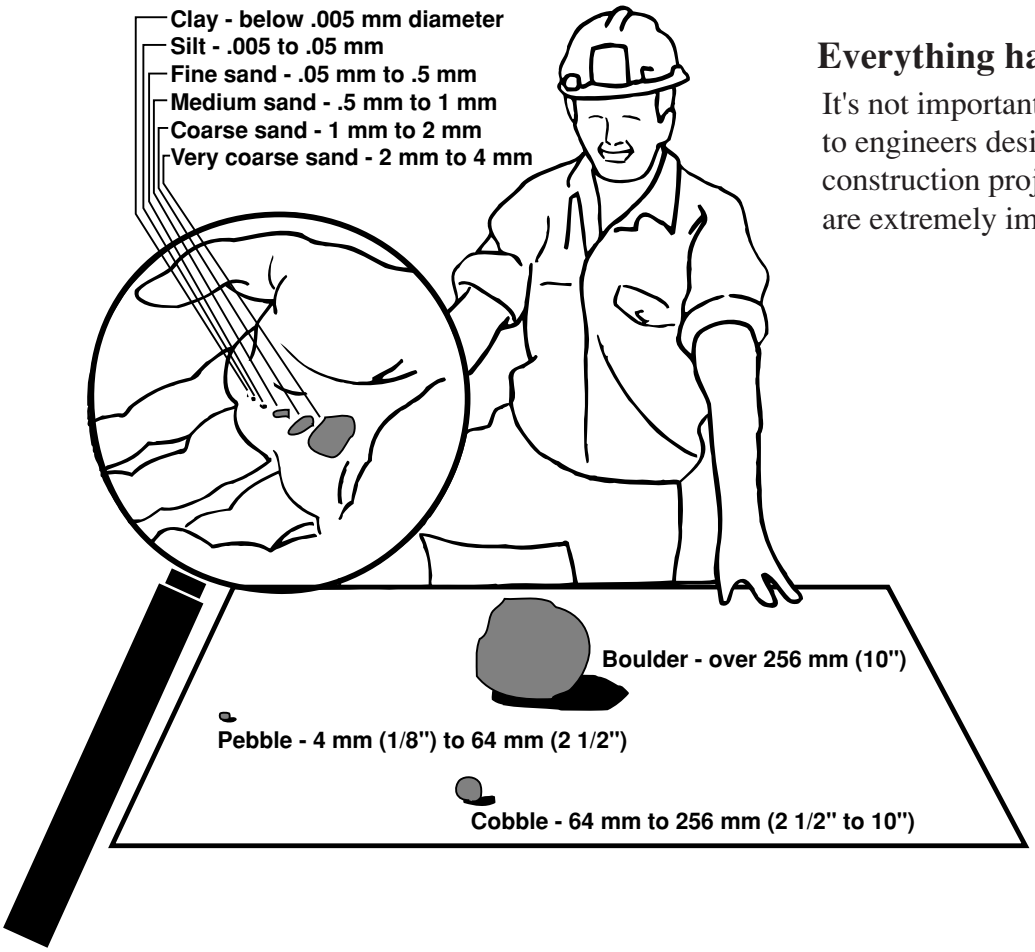
Figure out:

How many pounds of sand, gravel, and stone will be needed by each of your students during their lifetime?

How big of a hole needs to be dug somewhere to provide the things they use? For the sidewalk around the school? For the road from their house to school?

How many pounds of sand, gravel, and stone are needed by all the students in your class in one year. Compare this (in volume) to the size of your classroom.

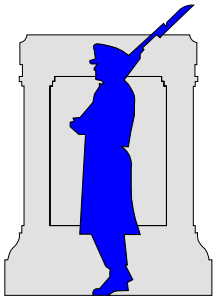
If your students live to be 75 years old (a good average), how many pounds and cubic yards of sand, gravel, and stone must be mined to support their needs during their lifetime?



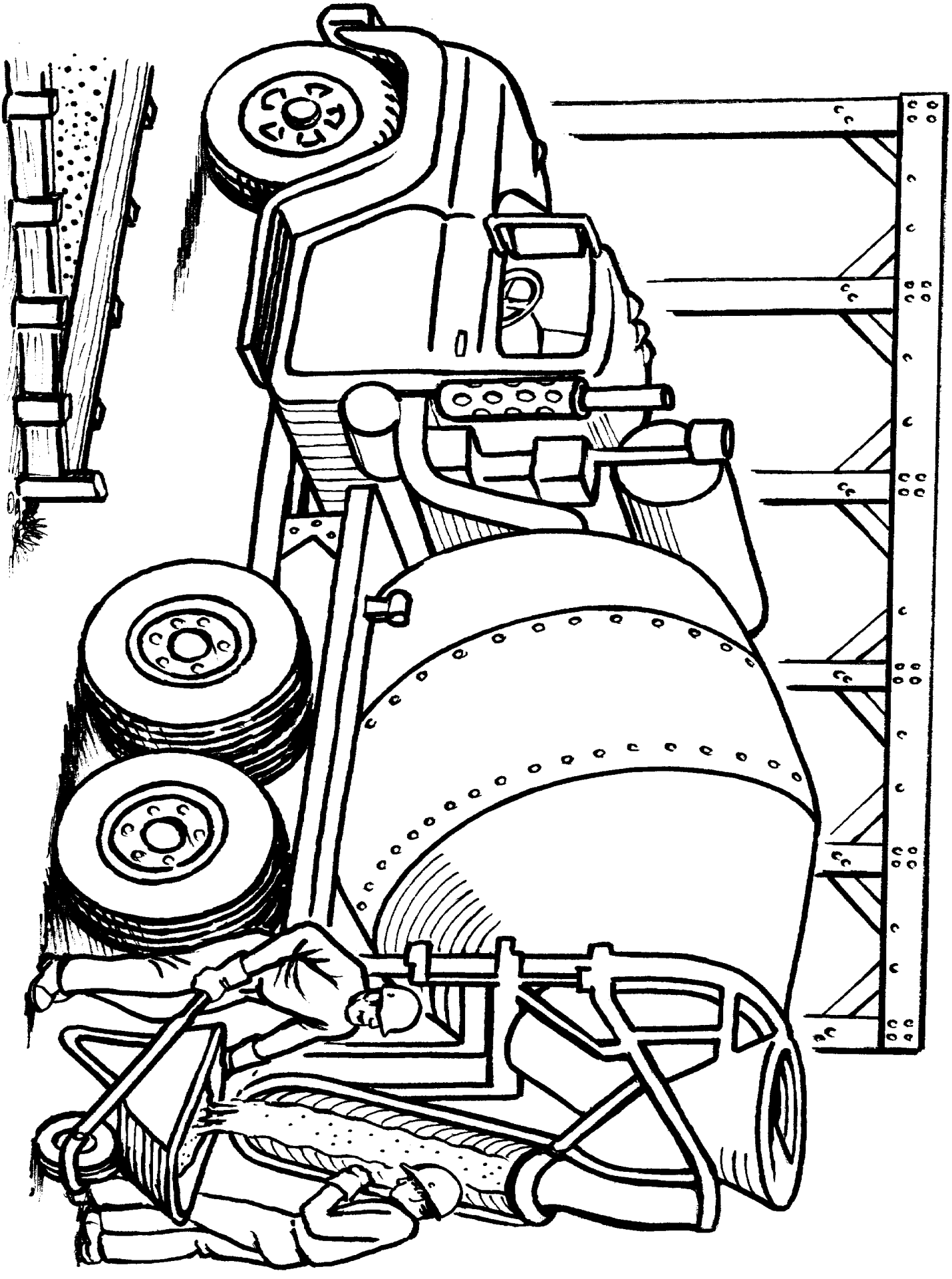
Everything has a proper name

It's not important to most of us, but to engineers designing special construction projects, proper names are extremely important.

How One Boulder Was Used



The world's largest single block of marble ever quarried came from Marble, Colorado. The original block weighed 100 tons and now marks the Tomb of the Unknown Soldier in Arlington National Cemetery outside Washington, D.C.

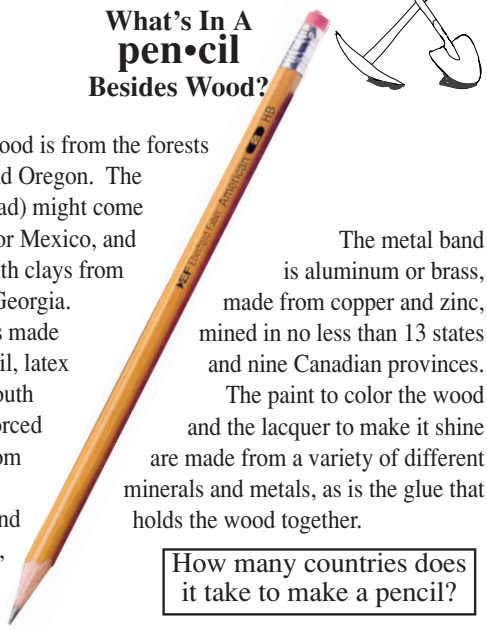


**If you can see it, touch it,
taste it, smell it, or hear it,
It's from our Natural Resources.**

It's only a pencil

Dig A Little Deeper

What's In A pen•cil Besides Wood?



The cedar wood is from the forests in California and Oregon. The graphite (not lead) might come from Montana or Mexico, and is reinforced with clays from Kentucky and Georgia.

The eraser is made from soybean oil, latex from trees in South America, reinforced with pumice from California or New Mexico, and sulfur, calcium, and barium.

The metal band is aluminum or brass, made from copper and zinc, mined in no less than 13 states and nine Canadian provinces.

The paint to color the wood and the lacquer to make it shine are made from a variety of different minerals and metals, as is the glue that holds the wood together.

How many countries does it take to make a pencil?

Geography: *Create raw materials origin map.*

Social Studies: *Research development of pencil.*

For information about minerals in society, contact:
Mineral Information Institute at www.mii.org

Math/Science: *Count measure, classify, graph classroom pencils.*
Writing: *Acrostic poem "pencil pal" biography.*

SOCIAL STUDIES

Research the development of the pencil. Create a timeline on the development of the pencil or writing tools. Research the development and production of the pencil, from China to the modern age. (See Pencil Facts, page 2). Research written languages, such as Cuneiform, Hieroglyphics, Rune, and the cultures using these forms.

MATH

Count, classify, measure, and graph the pencils in the classroom. How many pencils are used by your students, the school, their families? Make a Venn diagram of the pencils in the classroom.

LANGUAGE ARTS

(see page 4 pencil pattern)

Story Starters: Day in the Life of a Pencil ... If I Were A Pencil ... If My Pencil Could Talk ... Autobiography of a Pencil ... Pencil Poetry. (Include factual information in the stories. This could be an assessment tool as well as a creative writing activity).

ART

Using the pencil pattern (page 4) create a decorated pencil, bookmark, puppet, etc. Make pencil rubbings, fingerprint people or animals.

GEOGRAPHY/SCIENCE

See pages 2 and 3 for Map skills and Science tie-ins.
For a good site, visit www.pecilpages.com

READ MORE ABOUT IT

From Graphite to Pencil, A Start To Finish Book, by Ali Mitgutsch

Young World, ***How Things Are Made,*** A Child's First Encyclopedia

Mineral Resources A-Z, by Robert L. Bates, Environment Reference Series

Dig A Little Deeper

Mini-research project

What is graphite? What physical characteristics of graphite cause it to be a good tool for making fingerprints (see page 2 Activity)? What other products can graphite be used to make? Are there different resources that could be used to make other parts of a pencil? Where are these materials found? Do they have other uses?

Pencil Parts Have Other Uses

Major copper producing countries: United States, Chile, Canada, Poland, Zaire, Zambia.

Major copper producing states in U.S.: Arizona, New Mexico, Utah, Michigan, and Montana.

Uses of Copper: 41% in building construction, 24% in electrical and electronic products, 13% in industrial machinery and equipment, 12% in transportation, and 10% in other general products.

Major zinc producing countries: Australia, Canada, China, Mexico, Peru, United States.

Major zinc producing states in U.S.: Tennessee, New York, Alaska, Missouri. Minor production in Colorado, Idaho, Illinois, Montana. The U.S. imports approx. 30% of the zinc it uses.

Uses of zinc: 46% in construction, 20% in transportation, 11% in machinery, 11% electrical uses, and 12% in other uses such as paints, batteries, rubber, medicines, lubricants.

Clays are produced in most states, except: Alaska, Delaware, Hawaii, Rhode Island, Vermont, and Wisconsin.

Main types of clay: kaolin, ball clay, fire clay, bentonite, fuller's earth, and common clay.

Uses of clays: paper making, glass, dinnerware, floor & wall tile, bathroom fixtures, kitty litter and other absorbents, medicines, and various foods.

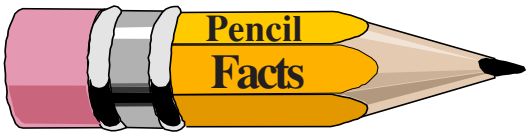
Activity: Fingerprints from graphite

Materials
- one sheet of scratch paper
- a soft graphite pencil (No. 2)
- five pieces of cellophane tape (2" long)
- damp, soapy paper towel and dry paper towel
- trace each student's hand for recording sheet

Experiment:

1. Use the side of a soft graphite pencil to apply a thick coating of graphite to a small section of the scratch paper. Rub the fingertip to be printed over the graphite. Make sure that the graphite covers the entire first joint of the finger—from the tip to the joint line.
2. Firmly press the graphite-coated fingertip on a piece of cellophane tape that has been placed adhesive side up on a desk or table. Slowly peel the tape from the finger. Place the tape in the correct space on the recording sheet.
3. Before printing each fingertip, apply more graphite.
4. After printing, each fingertip should be wiped clean with a soapy paper towel and dried to prevent graphite residue from smearing the next fingerprint.

You will also learn that graphite is a lubricant. Why is that?



Lead pencils contain no lead.

Graphite is extremely soft and smudges anything with which it comes in contact. Graphite feels greasy or slippery to the touch.

The less clay mixed with graphite, the softer and blacker the *lead* will be.

Wood cases for most pencils are made of incense cedar, a North American tree of the cypress family.

The word pencil comes from the Latin penicillus, which means little brush. The English made the first graphite pencils in the mid-1500's.

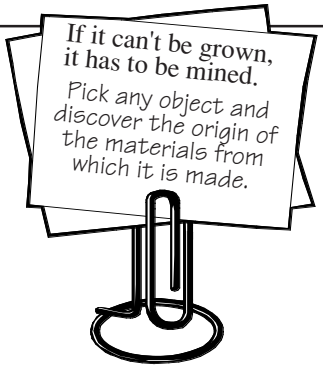
The Germans were the first to enclose the graphite in a wood case, about 1650.

In 1795, Nicolas Jacques Conte of France developed a pencil-making process that manufacturers still use today.

In 1812, William Monroe of Concord, Mass., sold the first American-made pencils to a Boston hardware dealer.

Eberhard Faber, an American businessman, built the first mass-production pencil factory in the United States in 1861.

More than 2 1/2 billion pencils are sold each year in the United States alone—about 11 pencils for each person in the country.



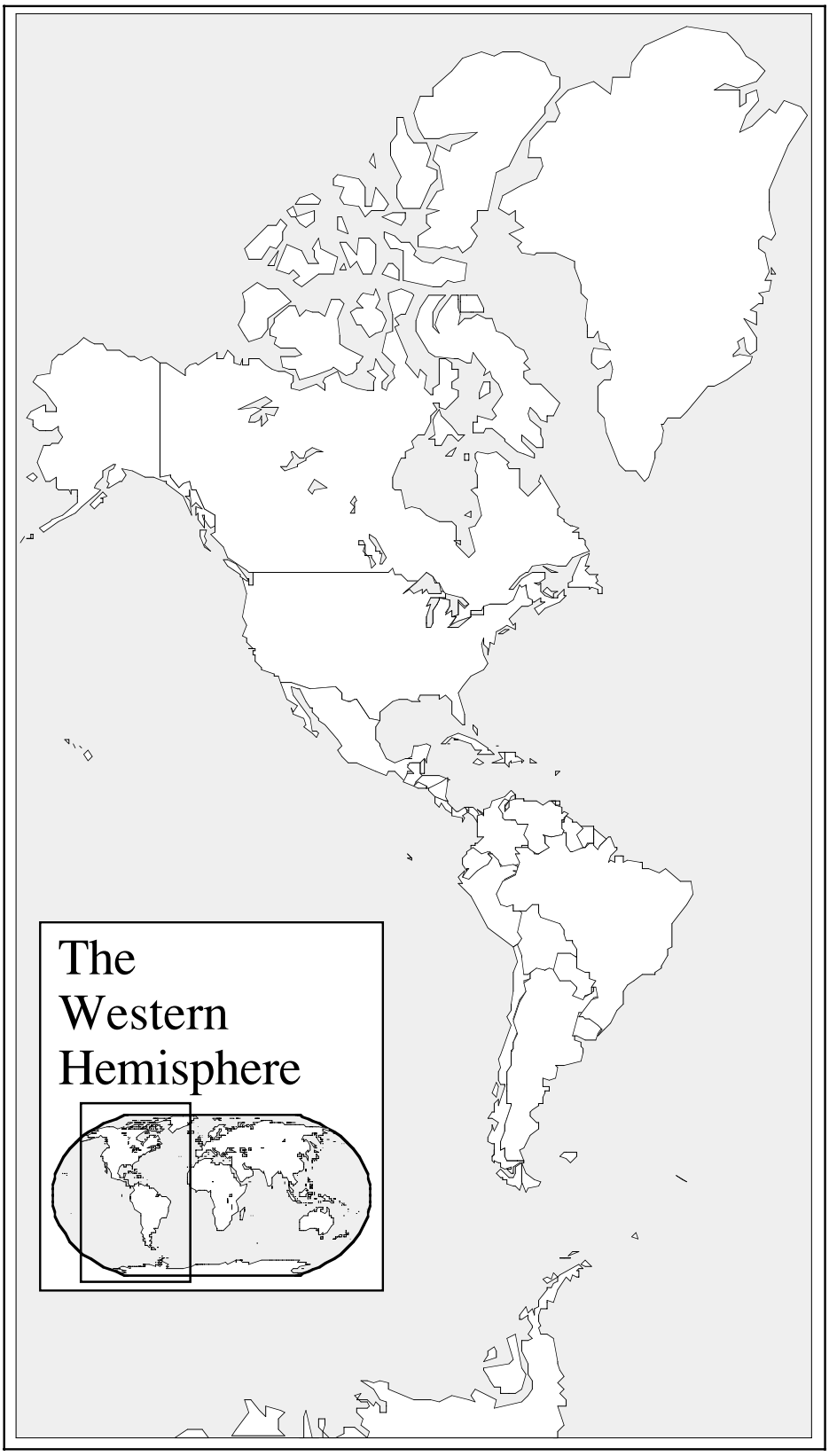
Pieces Parts of a Pencil

What's important when making a pencil?

Parts Are Cheap — Parts Are Expensive
Parts Are Easy to Find — Parts Are Hard to Find
Materials Are Soft — Materials Are Hard
Parts Easy to Make — Parts Hard to Make
Materials Are Smooth — Materials Are Rough
Materials Found Near You — Materials Far Away

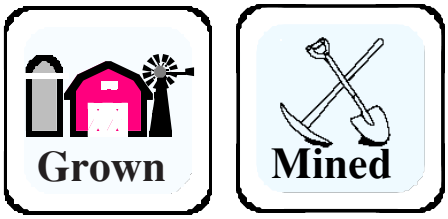
What machine would you design to make a pencil? What tools can you use instead of a pencil?

Does any country have all the natural resources necessary to make a pencil?



Activity 1

Using the information from page 1, determine which raw materials used to make a pencil are mined and which are grown. This can be a cooperative group activity.



Activity 2

Each student will need a sharp pencil. Identify the following parts of the pencil

wood	*metal*	*graphite*
paint	*eraser*	*glue*

Explain to your students that each part of the pencil comes from a different state or country. Use the support material (descriptions and map). Count the different locations and raw materials.

Activity 3

Create a Key for the pencil parts. Indicate the origin of the resources on the map.

sulfur	*calcium*	*aluminum*
clay	*latex*	*pumice*
zinc	*copper*	*graphite*
barium	*wood*	*soybean oil*

Research specific parts of the pencil. How is the natural resource obtained? Where this resource is found? Other uses for this resource. This could be a cooperative group or partner activity. Find out that aluminum (from the mineral *bauxite*) is not mined in the U.S. or Canada.

Wood for pencils must be straight-grained and of a texture that can be cut against the grain with a pencil sharpener. A cedar forest in northern California provides the wood for pencils made in the U.S.

Name _____ **Grade** _____

Title _____

Writing
is a natural experience . . .

made possible by the people
who develop our natural resources.

Dig A Little Deeper
What's Really in Paper
Besides Wood

The word paper comes from "Papyrus," the writing material of ancient Egyptians (around 3500 BC).

The invention of paper is credited to a young Chinese official, who used bamboo stalks, mulberry bark, and old silk garments in AD 105.

About 700 AD, an Arab army swept across Persia and learned the secret. The process spread west and entered Europe through Spain (c 1150).

In 1719 a French scientist first made paper from wood fibers.

The Gutenburg Bible, used the skins of 300 sheep.

Magazines are printed on paper that contains **trona, limestone, gypsum, kaolin (clays), sulfur, magnesium, chlorine, sodium, titanium, carbon, calcium, and a few other special minerals.**

World-wide, more than 250,000,000 tons of paper are produced every year.

In the U.S. and Canada, each of us consumes about 675 pounds of paper a year.

For information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Geography/Writing: Use a world map to trace the route of papermaking. ID paper producing states in U.S. & Canada. Research papermaking process.

Social Studies: Timeline the development of paper. Discuss your life and a world without paper. **Art:** paper mâché activities; collages.

Math/Science: Categorize kinds of paper in class (graph, Venn diagram, chart). Why do paper airplanes "fly?"

MINERAL INFORMATION INSTITUTE

Minerals and Metals Mean Good Health

Everything Is Made Of Something
If you can see it, touch it, taste it, smell it, or hear it, It's from our Natural Resources.

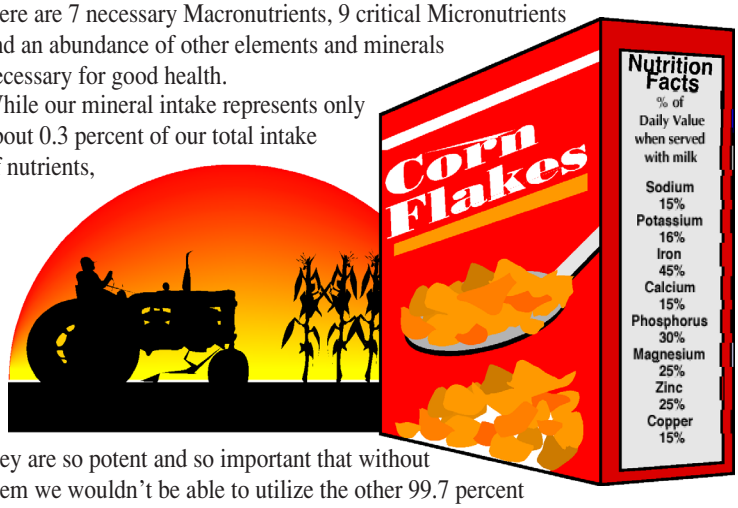
Dig A Little Deeper
Eat Your Broccoli

It contains Selenium, the *Brain Food*

All Living Things Need The Fuel Provided by Minerals and Metals
Life processes cannot occur without our world of inorganics.

There are 14 necessary mineral nutrients for plant growth. For human life, there are 7 necessary Macronutrients, 9 critical Micronutrients and an abundance of other elements and minerals necessary for good health.

While our mineral intake represents only about 0.3 percent of our total intake of nutrients,



they are so potent and so important that without them we wouldn't be able to utilize the other 99.7 percent of foodstuffs, and would quickly perish.

For more information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Math/Science: *Use food labels to ID & analyze minerals. List/chart.*

Language Arts: *Research mineral deficiencies (anemia, scurvy, rickets).*

Social Studies: *Foods you had for lunch —where did they come from?*

You Are What You Eat

Science/Math

Use cereal labels to identify and analyze minerals. Where are these minerals found? How do these minerals help our bodies function? Make circle or bar graphs showing the breakdown of minerals in a box of cereal. Do the Iron in cereal experiment—page 3. Decimals—using MII's poster, *Elements Comprising the Human Body*, have students determine the mineral composition of their body. Write these as decimals and fractions.

Grow Plants From Seeds

Experiment with your existing seed and growing activities—With and without water, soil, sunlight, nitrogen, potassium, phosphate. What do you get? Plants—nutrients needed in soil—page 4. There are 16 valuable nutrients for plant growth. Where do they come from and why are they needed for healthy plants?

Language Arts

Research mineral deficiencies (anemia, beriberi, scurvy, rickets). Find out the difference between minerals and metals. Conduct a classroom survey on favorite cereals and record the results. Write a letter to cereal companies asking for information about their products. Write a story—My favorite food, Biography of a grain of wheat. List foods that come from plants and foods that come from animals.

Write and perform an advertisement or a short skit for minerals and how they keep you healthy.

Social Studies/Geography

Make a list of foods you had for lunch. Using a map, locate where these food are produced. Create a map key. How many states were needed to "grow" your lunch? Could your state "grow" your lunch by itself? Find out about the Kellogg Brothers—write a summary of their lives. Using the facts from page 2—make a timeline of food production. Research food production of the Egyptians, Greeks, Romans, and the Middle Ages.

Art

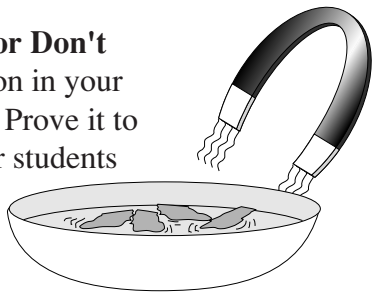
Use magazines to make a collage of foods containing iron, calcium, etc. Create a poster showing how mining helps us stay healthy. Draw a picture of a healthy snack, lunch, dinner, etc. Draw a picture of your favorite food. Explain how this food keeps you healthy.

Health

Nutrition—Using a daily food chart find out what minerals in each group keep us healthy. How do minerals aid the Digestive System, Circulatory System (blood), and the Skeletal System? See MII's human body poster.

Believe it or Don't

There really is iron in your breakfast cereal. Prove it to yourself and your students (page 3 activity).



INTERESTING FACTS ABOUT FOOD

Frankfurters were named after Frankfurt, Germany. Experts believe these sausages were first made in Germany during the Middle Ages. About 1900, an American vendor selling cooked frankfurters supposedly called them "hot dachshund sausages" because they resembled the long-bodied dog. Later, hot dog came to be used.

Pizza, an international favorite, originated in Italy. Pizza is the Italian word for pie.

Pancakes are probably the oldest prepared food. The first pancakes were a mixture of pounded grain and water spread on a hot stone. Today, people enjoy such pancake variations as French crepes, Hungarian palacintas, Indian dosai, Italian cannellone, Jewish blintzes, and Mexican tortillas.

Pretzels were first made by monks in southern Europe as a reward for students who learned their prayers. The crossed ends of a pretzel represent praying hands.

Sandwiches were named after the Earl of Sandwich, an English nobleman of the 1700's. While playing cards, he ordered a servant to bring him two slices of bread with a piece of roast meat between them.

Dumplings are eaten in various forms around the world. Chinese wan ton, Italian ravioli, Jewish kreplach, and Polish pierogi are types of dumplings filled with meat, cheese, or vegetables.

Facts About Nutrients in Foods

Carbohydrates are the starches and sugars in foods. They serve as the main source of energy. Starches are found in bread, breakfast cereals, flour, and potatoes.

Fats, another source of energy. There are visible and invisible fats. Visible fats include butter, oil, and shortening, and are added to foods. Invisible fats are already present in foods. They include butterfat in milk and the fats in eggs, fish, meat, and nuts.

Proteins are necessary for the growth and maintenance of body structures. The bones, muscles, skin and other solid parts of the body are made up largely of proteins. Animal proteins are found in cheese, eggs, fish, meat and milk. Vegetable proteins are found in beans, grains, nuts, and vegetables.

Minerals are needed for the growth and maintenance of body structures. *Calcium, magnesium*, and *phosphorus* are essential parts of the bones and teeth. In addition, *calcium* is necessary for blood clotting. *Iron* is an important part of hemoglobin, the red coloring matter in blood. Minerals are also needed to maintain the composition of the digestive juices and the fluids that are found in and around the cells.

Food through the Ages

8000 BC.—people had begun to raise plants and animals for food.

Between 3500 and 1500 BC.—First great civilizations developed. Because Egypt had fertile soil and favorable climate, they could grow barley, wheat, beans, lettuce, and peas, cultivated grapes and melons, and raised livestock including cattle, goats, and sheep.

Greeks and Romans enjoyed cherries from Persia, apricots, peaches, and spices from the Orient, and wheat from Egypt.

Between 1000 and 1300 Europeans developed a taste for spices and Middle Eastern foods. This opened international trade and stimulated exploration of new lands.

1492—Columbus sailed west from Spain, seeking a shorter sea route to the spice lands of the Indies.

1600's— American colonists learn to raise corn from the Indians, also how to cook lobsters and wild turkeys. Colonists brought seeds and such livestock as cattle and hogs to the New World.

Elements In the Human Body

Each Element Fulfills A Critical Purpose

Element	Percent
Oxygen	65%
Carbon	18%
Hydrogen	10%
Nitrogen	3%
Calcium	1.5%
Phosphorus	1%
Sulphur	0.25%
Potassium	0.20%
Chlorine	0.15%
Sodium	0.15%
Magnesium	0.05%
Fluorine	0.02%
Iron	0.006%
Zinc	0.0033%
Silicon	0.0020%
Rubidium	0.00170%
Zirconium	0.00035%
Strontium	0.00020%
Aluminum	0.00014%
Niobium	0.00014%
Copper	0.00014%
Antimony	<0.00013%
Lead	0.00011%
Cadmium	0.000043%
Tin	0.000043%
Iodine	0.000040%
Manganese	0.000030%
Vanadium	0.000030%
Barium	0.000023%
Arsenic	0.000020%
Titanium	<0.000020%
Boron	0.000014%
Nickel	<0.000014%
Chromium	<0.000009%
Cobalt	<0.000004%
Molybdenum	<0.000007%
Silver	<0.000001%
Gold	<0.000001%
Uranium	3×10^{-8}%
Cesium	$<1.4 \times 10^{-8}$%
Radium	1.4 x 10 -13%

Eaten Any Iron Lately?

An interesting experiment you can do at home or in your classroom.

Many cereals are fortified with iron as well as other minerals and vitamins. The iron (chemical symbol Fe) used in cereal is a metallic form that is oxidized (burned) in the stomach and eventually absorbed by the body during the digestive process.

Although there is only enough iron in your body to make up a couple of small nails, it is an essential part of our diet. Iron is necessary in the formation of hemoglobin, the compound in red blood cells that carries oxygen from our lungs to other parts of the body. Iron is what gives blood its red color. Too little iron in your diet can result in fatigue and a reduction in its ability to resist diseases.

Most people are familiar with the term "hard as nails." Nails are hard because they contain iron. So do the huge girders in bridges spanning rivers around the world. But, iron is also important to your health. That's why some breakfast cereals are more than just corn or wheat, they have been "FORTIFIED WITH IRON."

The next time you pour yourself a bowl of your favorite brand, read the nutritional information on the box. You'll likely find that it contains iron as well as other minerals such as calcium, sodium and potassium. All come from rocks that must be mined from the earth.

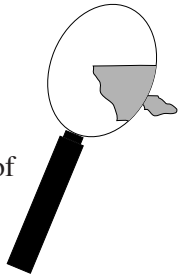
The supplies you need:

1. A good, strong magnet.
2. A 1-quart size zip-lock bag
3. Enough 'FORTIFIED WITH IRON' cereal to fill the bag
4. A plate or small bowl
5. Water
6. Clear plastic cup
7. Plastic stir stick
8. Hand lens

Who ever heard of *magnetic* cereal?

STEP I:

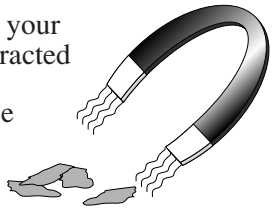
Examine a single flake of the cereal closely. You will probably not find any visible traces of iron. But, they are there.



STEP 2:

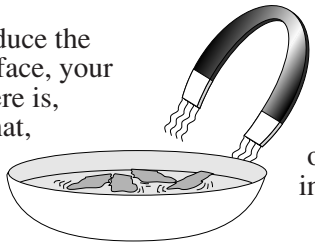
Place a few flakes on the table. Bring your magnet near them and see if they are attracted or repelled by its magnetic field.

You will probably get no reaction since the friction between the flakes and the surface of the table will likely be too great to be overcome by the attraction of the iron in the cereal for the magnet.



STEP 3:

However, if we could find a way to reduce the friction between the flakes and the surface, your magnet might produce a reaction if there is, indeed, iron present. To accomplish that, fill your plate or bowl with water and float a few flakes of cereal in it.



Now, hold the magnet close to the flakes and see if you can make them move. Any movement that occurs will be slight so be patient. With practice, you will be able to make the flakes rotate or, you can move them around and arrange them in all kinds of patterns.

Do you think there is really iron in the flakes that allows you to accomplish this astonishing feat?

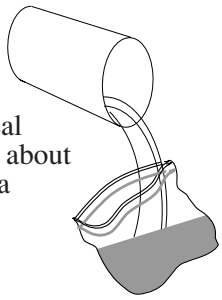
STEP 4:

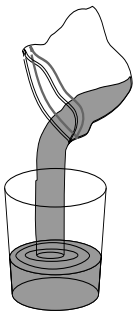
Fill your zip-lock bag half-full of cereal. Remember, you must use a brand that is '"FORTIFIED WITH IRON."

Seal the bag and crush the cereal as finely as possible by squeezing the bag. This is similar to the process used by miners when they crush the rock from their mine in order to release the iron from it.

STEP 5:

Now, pour enough water into the bag to make a thin cereal paste. It should be about the consistency of a thick soup.

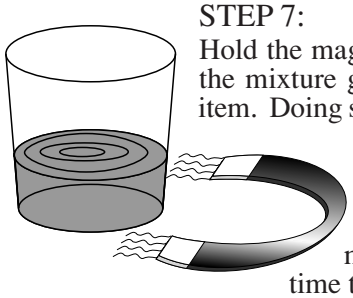




STEP 6:

Pour your cereal soup into a clear plastic cup.

We recommend Total cereal to find the most iron.



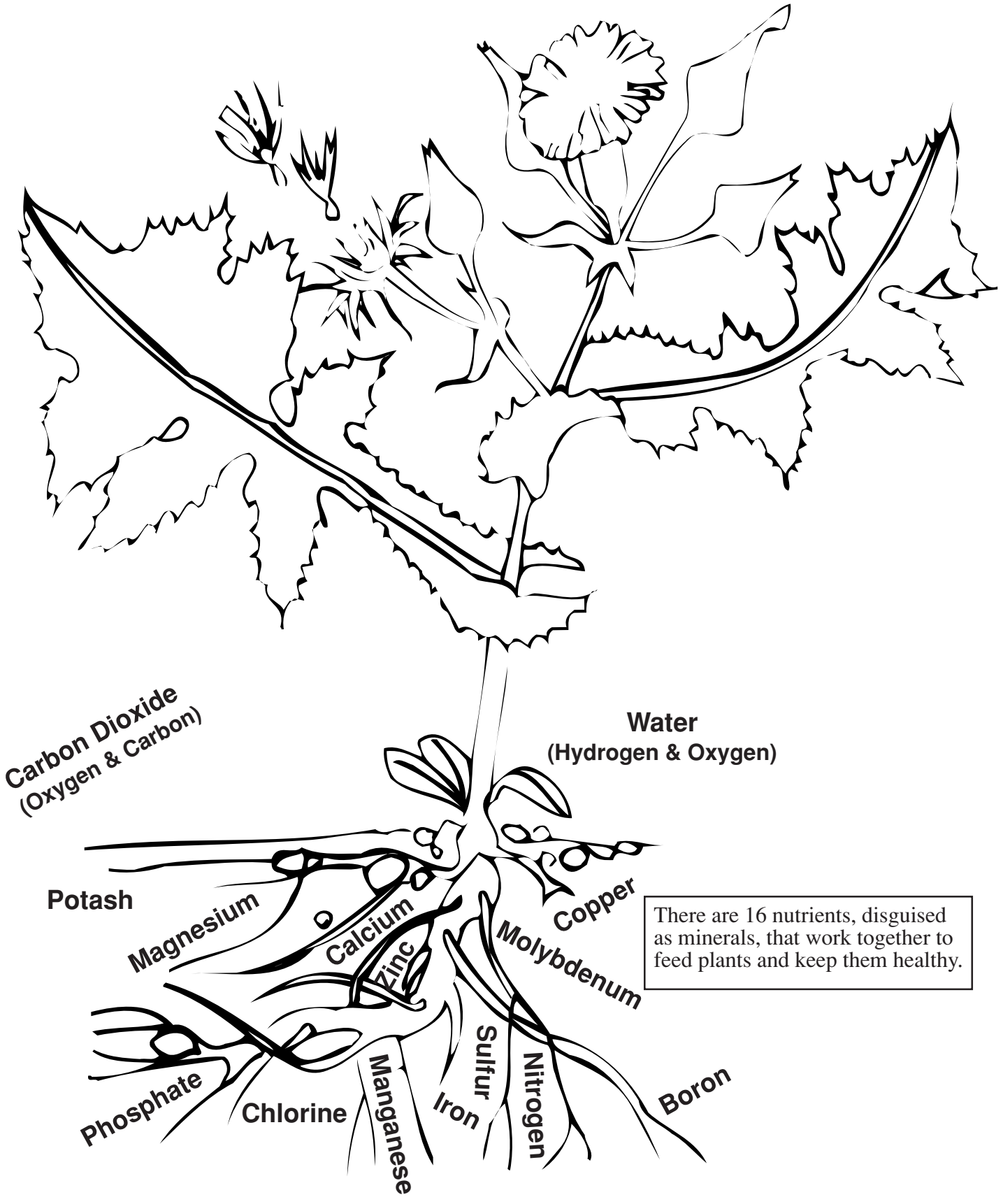
STEP 7:

Hold the magnet against the outside of the cup while you stir the mixture gently with a straw or some other non-magnetic item. Doing so will cause the microscopic iron particles to pass through the magnetic field of your magnet. The tiny black particles of iron freed during the crushing process will begin to accumulate—or concentrate—at the side of the cup near your magnet. Two or three minutes should be sufficient time to attract enough iron to be visible.

Use a hand lens to see the particles better. Can you see them?

Label this plant or write an essay that uses all the words that you have learned about plants.

Stem	Flower	Seeds	Leaf	Water
Roots	Minerals	Sunlight	Vein	Carbon dioxide
Photosynthesis	Soil	Nutrient	Root Hairs	Sugar



There are 16 nutrients, disguised as minerals, that work together to feed plants and keep them healthy.

Dig A Little Deeper

The Sound of Music Is the Sound of Metals at Work

Whether it's the musical instruments in a garage band or the string, wind, and percussion instruments of a symphony orchestra, they are all made of materials from our natural resources–And almost all of them contain some minerals and metals.

From the lute of the Ancient Egyptians to the Flying V of today...from animal horns to fluegelhorns...from the African slit drum to today's digital keyboards... the ingenious use of metals and minerals has made our appreciation of music a major part of our lives and readily available to people around the world.

Before It Was Rock 'n Roll It Was Just Rock

Copper is used in all electric instruments, all brass instruments, most of the string instruments and in many of the percussion instruments.

For information about minerals in society, visit:
www.mii.org

Science: *Discover raw materials in various instruments. What makes the instrument work.* ***Art:*** *Make musical instruments from recycled materials.*

Language Arts: *Bremas Town Musicians. Research & report on a favorite instrument.* ***Enrichment:*** *Invite local musicians to perform.*

Music: *Peter and The Wolf.* ***Geography:*** *Countries that mine the minerals that make your instrument.*

MINERAL INFORMATION INSTITUTE

Money is

anything that people agree to accept in exchange for the things they sell or as payment for the work they do.

Everything Is Made Of Something

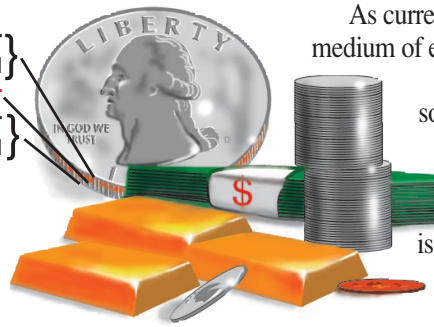
If you can see it, touch it, taste it, smell it, or hear it, It's from our Natural Resources.

Dig A Little Deeper

Money

Made of Metal & Promises

Money is one of the greatest inventions of all time. Almost everything can be, and has been, used as money. Without it, modern societies would be impossible.



Until 1964, Quarters were 90% silver and 10% copper. Today, they are made of copper and nickel.

As currency (a convenient medium of exchange), money allows us to trade something we have for something we need. Most currency is made of different metals, special paper, and inks.

Until World War I, most currency was made of or could be exchanged for gold, silver, or other valuable metals. Today, the value of most currency is supported by a promise from the government who issued it.

Gold was eliminated from common coinage in the U.S. in 1933; **silver** vanished in 1965, although the 50 cent piece contained some silver until 1971.

For information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Science: Discover the raw materials used to make U.S. currency.
Reading: *How much Is A Million?* **Writing:** If I won the lottery.

Geography/Math: Worldwide currency—compare value, name, appearance, etc. Convert, graph different currencies. Where & How is money made?

Social Studies: History of money. Coin collecting, hobby or speaker. **Money Unit:** Coins and bills of the U.S., and their values.

All U.S. coins are made of alloys (mixtures of metals). Pennies are an alloy of zinc and copper. Nickels are a mixture of copper and nickel.

Dimes, quarters, half dollars, and dollars are made of three layers of metal sealed together. The core is pure copper, and the two outer layers are an alloy of 75% copper and 25% nickel.

Circulation coins produced by the US Mint in an average year.

	Philadelphia	Denver
1¢	5,411,440,000	7,128,560,000
5¢	774,156,000	888,112,000
10¢	1,125,500,000	1,274,890,000
25¢	1,004,336,000	1,103,216,000
50¢	26,496,000	26,288,000

How much money did the Denver Mint make?

How much money did the Philadelphia Mint make??

It's only money

WHAT!!
$600,000 for a coin smaller than a Quarter!!

Coin of Emperor Constantine, A.D. 330

In 330, Roman Emperor Constantine the Great moved the capital of the Roman Empire from Rome, already facing attacks from Huns, to Byzantium in Turkey—and changed the city's name from Byzantium to Constantinople.

To commemorate the occasion (May 11, A.D. 330), Constantine himself handed out coins specially struck to honor the move. The coin was made of pure silver and weighted about 1/2 ounce.

What makes the coin so valuable? *"It can actually be placed in the hand of a key world leader on a specific date for a ceremony that helped shape future world history,"* says coin dealer, researcher, and author Harlan Beck of Chicago.

"Nobody struck a coin when Romulus and Remus supposedly founded Rome. Nor did any coin commemorate Alexander the Great's conquest of Macedonia—and its far-reaching historical consequences."

Constantine established Christianity as the official religion of the Roman Empire, two decades before the move.

Uniform metal coins of equal value were first made in ancient Greece around 300 B.C. to replace irregular money like shells and stones.

Congress first authorized striking one-cent coins in 1787. The Lincoln penny dates to 1909—when it replaced the "Indian head" penny that had been made since 1859.

The U.S. Mint produces about 13.5 billion pennies each year. Since 1982, "copper" pennies have actually been 97.6 percent zinc, with just a copper coating.

Three mints make all of the coins in the U.S. They are in Denver (coins are marked with a small d), San Francisco (usually marked with a small s), and Philadelphia (no mint mark).

The Origin of "Two Bits"

Before the American Revolution, the large Spanish dollars (pieces of eight) were commonly used. To make change, a person could chop the coin in eight pie-shaped pieces called bits. Two bits were worth a quarter of a dollar.

More than 100 Million Pounds of Money Produced Each Year

Denomination	Production Units	Metal Contained	Weight of Materials Delivered (lbs.)
One Cent	12,487,190,000	97.5% zinc, 2.5% copper	69,304,343 lbs.
Nickel	1,638,174,110	75% copper, 25% nickel	18,364,639 lbs.
Dime	2,378,518,110	91.67% copper, 8.33% nickel	12,215,719 lbs.
Quarter	2,097,954,110	91.67% copper, 8.33% nickel	12,773,314 lbs.
Half-dollar	47,248,210	91.67% copper, 8.33% nickel	1,476,673 lbs.

The Sacagawea Golden Dollar is made or 88.5% copper, 6% zinc, 3.5% manganese, 2% nickel

---

The first coins were made in the 600's B.C. in Lydia (now western Turkey). The coins were bean-shaped lumps of a natural mixture of gold and silver, stamped with a special design to show that the king of Lydia would guarantee their value in spite of their irregular sizes.

Almost everything has value but that value is different from one person to the next. To prove it, try an experiment with your class.

Do You Wanna Trade?

Make your own rules but—

Allow your students to trade small things they have with them with other students. Sometimes an auction format is better than individual trading at the student's desks, but not always.

Purpose

To prove that different people place different values on the same thing. (Your choice whether or not money is allowed.)

Make a list of the actual value of what the students are offering for the different items.

Caution

The students have to believe that they will really lose what they are trading, otherwise they will offer imaginary bids and ruin the experiment. Make sure that everyone gets their original item back.

Really Bartering

What if a student offers something the owner doesn't really want? Suggest they trade with someone who has something the owner does want.

Conclusion

Establish a real value on the items that were traded. How many items went for far more than their actual value? Or less? Why?

OR the Easy Way Out

You provide candy, special pencils, or other items desired by your students. Although you better have enough for everyone, tell them that you only have five. And in order to get one, they will have to bid. How much do the offers increase when there are only two left, then only one left?

Student & Home Activity

Bring foreign currencies to compare. Two things will always be common:

(1) all will have a value stamped on them; and,

(2) all will have a government-approved design, usually with the name of the country.

Higher Math

Almost all major newspapers have a business section that carries a daily Foreign Exchange table. Assign countries and amounts to different students for conversion to U.S. dollars.

Forecasting

Look at the Futures market and have students graph what the "experts" think the future prices will be for food, metals, fuels, and money. Come back to this exercise once a month and find out if the experts were right or wrong.

MINERAL INFORMATION INSTITUTE

Imagine A World Without Glass or Paper or Music

Everything Is Made Of Something

If you can see it, touch it, taste it, smell it, or hear it, It's from our Natural Resources.

A World of Glass

Dig A Little Deeper
Find Out What's Beyond the Looking Glass

Glass has been made and used for more than 5,000 years. Almost any molten mineral can form glass, provided it's cooled rapidly enough to prevent crystallization (obsidian from lava). No fewer than 6 minerals and metals are used to make today's variety of modern glass products. Such as soda-lime glass, containing **silica**, **soda**, **limestone**, **magnesium**, **alumina**, and **boric acid**.

Soda-lime glass is used for windows, mirrors, and flat glass of all kinds; for containers such as bottles, jars, and tumblers; for light bulbs and many other purposes.

Adding **Lead** produces fine crystal glass. **Gold** makes ruby-colored glass. **Copper** or **Selenium** make red glass, **Manganese** makes purple, **Copper** & **Cobalt** makes blue, **Chromium** or **Iron** make green, **Iron** & **Sulfur** make brown.

More than 400 million sq. ft. of mirrors are made every year in the U.S. Mirrors have been backed with **silver**, **diamond dust**, and **aluminum**.

More than 40 billion glass containers are produced in the U.S. each year. 35% are recycled.

For information about minerals in society, go to.

www.mii.org

Science: *What is glass made of? What can replace glass? Properties of glass.* **Enrichment:** *Glassblower speaker.* **Art:** *Stained glass project*

Math: *Count, measure, chart or graph the windows in classroom, school or home.* **Language Arts:** *Describe the world without glass*

Social Studies: *When was glass first used? What was used before glass?*

How does a mirror work

When light falls on any object, the light will be absorbed or be reflected, or the light can pass through the object like glass.

Any polished surface that forms an image by reflecting can be considered a mirror. In ancient times, people used polished pieces of metal such as tin, silver or bronze as mirrors. During the settlement of the American West, the rich liked to brag about having "diamond dust" mirrors.

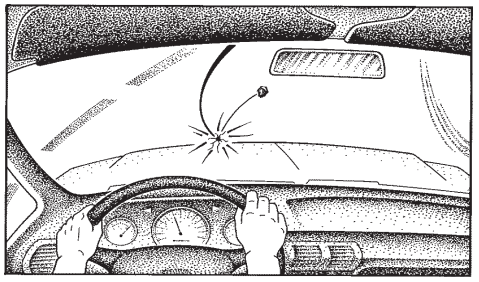
Today, most mirrors are sheets of glass coated on the back with aluminum or silver paint—a process discovered by Justus von Liebig in 1835.

There are three types of mirrors: plane; concave; and convex.

Plane mirrors are flat, like most mirrors you would find on a wall in your house. They reflect the light (and image) at the same angle that the light hits the mirror. This makes the image the same size as the object being reflected.

Concave mirrors, such as shaving and makeup mirrors, curve inward. These mirrors cause the light they reflect to come to a focus, and they magnify the image.

Convex mirrors curve outward and spread out the light they reflect. Like, some rearview mirrors that make objects appear smaller and farther away than they really are.



Thanks to Dean Brown, Colorado State University

Dig A Little Deeper

What's Really in Paper

Besides Wood

The word paper comes from "Papyrus," the writing material of ancient Egyptians (around 3500 BC).

The invention of paper is credited to a young Chinese official, who used bamboo stalks, mulberry bark, and old silk garments in AD 105.

About 700 AD, an Arab army swept across Persia and learned the secret. The process spread west and entered Europe through Spain (c 1150).

In 1719 a French scientist first made paper from wood fibers.

The Gutenburg Bible used the skins of 300 sheep.

Magazines are printed on paper that contains **trona, limestone, gypsum, kaolin (clays), sulfur, magnesium, chlorine, sodium, titanium, carbon, calcium, and a few other special minerals.**

World-wide, more than 250,000,000 tons of paper are produced every year.

In the U.S. and Canada, each of us consumes about 675 pounds of paper a year.

For information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Geography/Writing: Use a world map to trace the route of papermaking. ID paper producing states in U.S. & Canada. Research papermaking process.

Social Studies: Timeline the development of paper. Discuss your life and a world without paper. **Art:** paper mâché activities; collages.

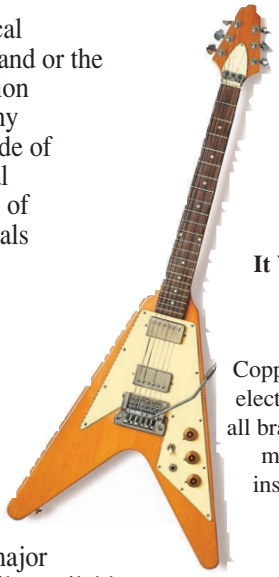
Math/Science: Categorize kinds of paper in class (graph, Venn diagram, chart). Why do paper airplanes "fly?"

Dig A Little Deeper

The Sound of Music
Is the Sound of Metals at Work

Whether it's the musical instruments in a garage band or the string, wind, and percussion instruments of a symphony orchestra, they are all made of materials from our natural resources–And almost all of them contain some minerals and metals.

From the lute of the Ancient Egyptians to the Flying V of today...from animal horns to fluegelhorns...from the African slit drum to today's digital keyboards... the ingenious use of metals and minerals has made our appreciation of music a major part of our lives and readily available to people around the world.



Before It Was Rock 'n Roll It Was Just Rock

Copper is used in all electric instruments, all brass instruments, most of the string instruments and in many of the percussion instruments.

For information about minerals in society, visit:
www.mii.org

Language Arts: *Bremas Town Musicians. Research & report on a favorite instrument.* ***Enrichment:*** *Invite local musicians to perform.*

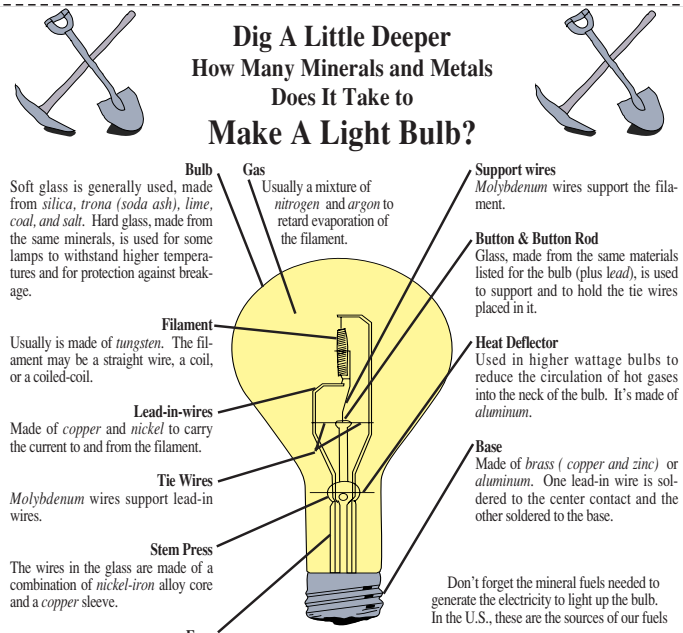
Music: *Peter and The Wolf.* ***Geography:*** *Countries that mine the minerals that make your instrument.*

Science: *Discover raw materials in various instruments. What makes the instrument work.* ***Art:*** *Make musical instruments from recycled materials.*

MINERAL INFORMATION INSTITUTE

A LITTLE LIGHT Opens a World of Knowledge

Dig A Little Deeper
How Many Minerals and Metals Does It Take to Make A Light Bulb?



Don't forget the mineral fuels needed to generate the electricity to light up the bulb. In the U.S., these are the sources of our fuels

Coal	Nuclear	Hydro	Natural Gas	Oil	Other
54 %	22 %	10 %	9%	4 %	1 %

For information about minerals in society, go to:
Mineral Information Institute, www.mii.org

Geography: *Research & ID the states and countries producing these minerals.*

Science: *What makes the bulb work?* **Predict:** *Design light bulbs for the future.*

Math/Art: *Explore shapes & sizes. Light bulb picture collage.*

Math

Find out how much electricity it takes to light your classroom. How much does it cost? How many tons of coal have to be mined to help you see in the dark?

Read More About It

Material Resources, World's Resources Series, by Robin Kerrod

Industrial Minerals: **How They Are Found and Used,** by Robert L. Bates

***COAL*: How It Is Found and Used,** by Michael C. Hansen

From Swamp to Coal: A Start To Finish Book, by Ali Mitgutsch

Natural Resources, Young Geographer Series, by Damian Randle

Mama Is A Miner, by George Ella Lyon and Peter Catalanotto

The Challenge of Supplying Energy: Environmental Issues Series, by Gail B. Haines

A Light In the Attic, by Shel Silverstein

Everything Is Made Of Something

If you can see it, touch it, taste it, smell it, or hear it, It's from our Natural Resources.

Enlightening Studies

Science/Technology

The study of electricity. What makes the bulb work? It took Edison two years to find the right material to make the filament (carbonized thread). Sources of electricity in your community. Study alternative energy sources such as Solar, Hydro, Geothermal. Discover the sources of energy throughout history. Why were new sources discovered? What have been the benefits of each new energy source? What do you think will be the next source?

Geography

Discover that the whole world contributes to making a light bulb. Map activities and matching exercises, pages 2 and 3.

Art/Drama

Explore the shapes and sizes of different light bulbs. Construct a light bulb picture collage. Design a light bulb to provide light for a special new use. Make silhouette pictures. Do shadow plays and activities.

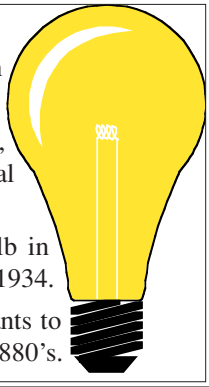
History

What did people do for light before the discovery of electricity and invention of the light bulb? How would your life be different if you had to use candles, torches, or kerosene lanterns instead of light bulbs? What else would be different today if electricity hadn't been invented?

Language Arts

Writing Ideas and Story Starters on page 6, along with a light bulb pattern to combine with art projects.

Light Facts



Incandescent light bulbs are the most common source of electric light.

Every incandescent light has a filament, bulb, and base. Fluorescent lights contain a special mercury vapor gas instead of a filament.

Edison invented his incandescent light bulb in 1870. Fluorescent lights were developed in 1934.

Edison developed one of the first power plants to generate & distribute electricity in the early 1880's.

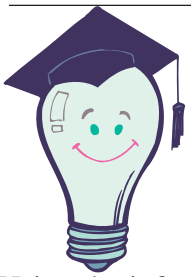
Make a symbol key or color key for each of the resources listed. Place the symbol or color in the appropriate country producing this resource.

Where In The World Are The Resources To Make A Light Bulb

Raw Material	Major Countries Supplying the U.S.
Silica (sand)	USA— quarries throughout the U.S.
Limestone	USA— numerous mines in the U.S.
Trona	USA— soda ash (85% from Wyoming)
Nitrogen	USA— manufactured from liquid air
Argon	USA— manufactured from liquid air
Manganese	Russia; South Africa; Brazil; China
Tungsten	China; Russia; USA (Calif. & Colo.)
Copper	Canada; USA; Chile; Russia; Zambia

Raw Material	Countries Supplying the U.S.
Molybdenum	Canada; USA
Aluminum	Australia; Guinea; Jamaica
Zinc	Canada; Russia; Australia
Coal	USA; Russia; China
Salt	USA; China; Russia
Nickel	Canada; Australia; Russia
Lead	USA; Russia; Australia

Russia is used for all former Soviet Union countries.



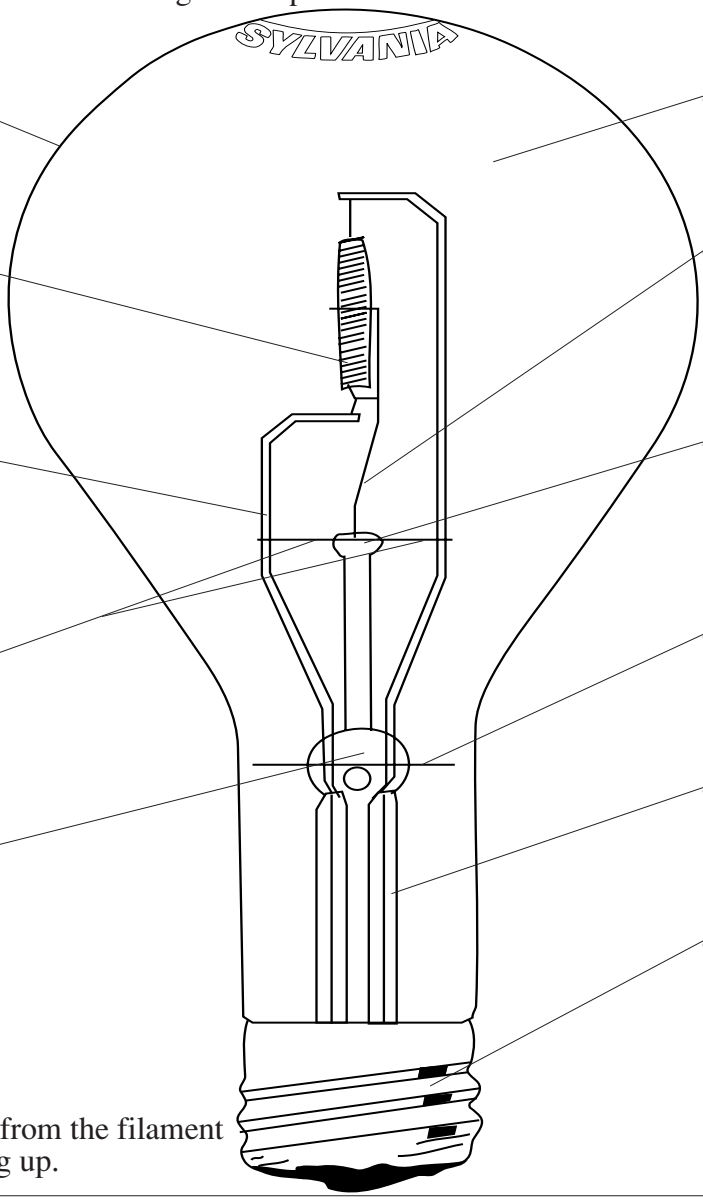
Knowledge Is Enlightening

What's the purpose of the different parts
What minerals are they made of
Which countries produce the resources in a bulb

Parts from all over the world

Using the information from page 1, fill in the blanks by the light bulb with the name of the states or countries producing the resource needed for each light bulb part.

What do you think would happen if one of the parts was removed from the bulb?



Bulb

Filament

Lead-in-wires

Tie wires

Stem Press

Gas

Support Wires

Button and Button Rod

Heat Deflector

Fuse

Base

The bulb keeps air away from the filament to prevent it from burning up.

Tungsten melts at about 6,100˚ F; most rocks melt at about 2,800˚ F.

Molybdenum is an extremely strong metal and has a high melting point.

Bauxite to make aluminum is not mined in North America.

The world supplies of soda ash are practically inexhaustible. Almost all U.S. trona comes from Wyoming.

Copper is an excellent conductor of electricity and heat. Incandescent means *glowing with heat*.

Lithium, a metal, is also used in the glass to keep heat from turning it black.

Electricity doesn't come from the light switch on the wall, is comes from power generating plants. More than half of the electricity that is used in the United States is provided by burning coal.

How much coal does your family need to provide the electricity you use everyday? And where does it come from? One ton of coal can produce 2,500 kilowatts (kwh) of electricity. One ton equals 2,000 pounds.

Examples of how much coal is used each year by a family of four to produce the electricity needed to operate various appliances.

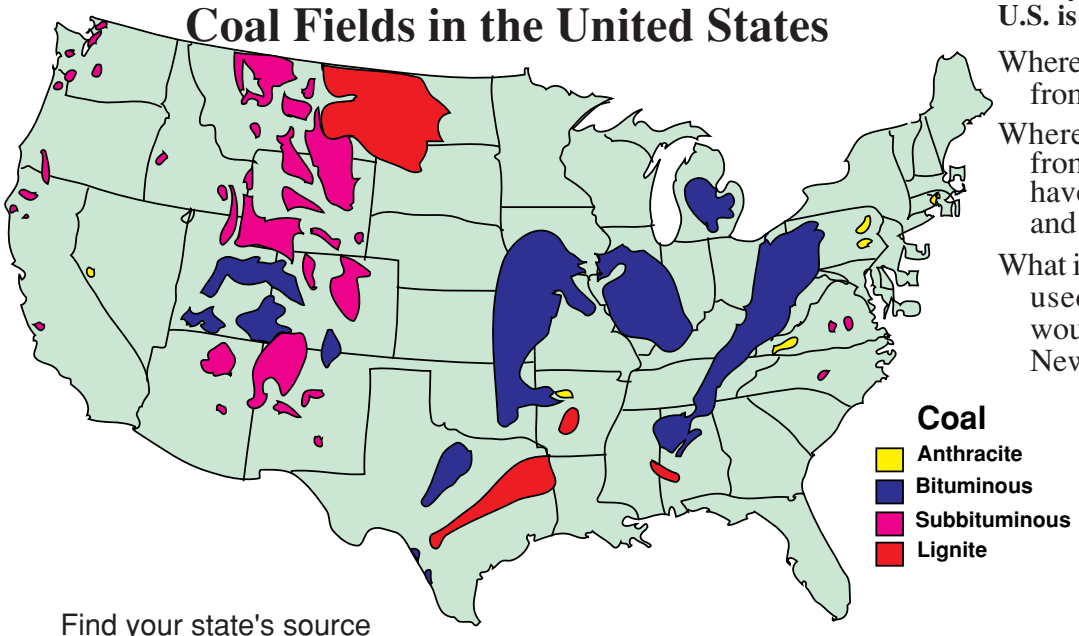
Electric water heater	3,375 pounds	Hairdryer	20 pounds
Electric stove and range	560 pounds	Vacuum cleaner	37 pounds
Color television	256 pounds	Clock	14 pounds
Iron	48 pounds		

About 7,000 pounds of coal is mined every year for every person in the U.S., most to produce electricity.

About75,000 pounds of natural gas is used every year for every person in the U.S. to make electricity or is burned for heating.

About 1/4 of a pound of uranium is used every year for every person in the U.S. to make electricity.

Coal Fields in the United States



Nearly 60% of all electricity in the U.S. is produced by burning coal.

Where does your electricity come from?

Where does the electricity come from for those states that don't have coal? That don't have oil and gas?

What if Pennsylvania coal was only used in Pennsylvania? What would happen to the rest of the New England states?

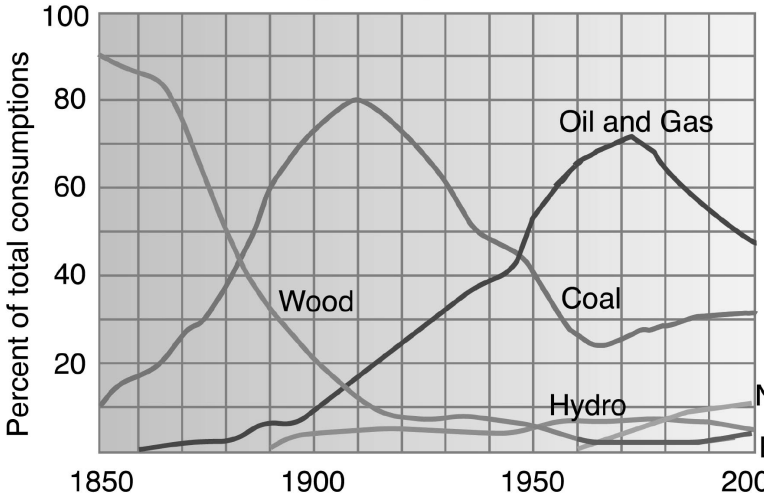
How does the Pacific Northwest produce electricity? Can other states do the same?

Why don't more states use nuclear power plants to make electricity?

Find your state's source of electricity from the Energy Information Administration www.eia.doe.gov/emeu/reps/states/maps/

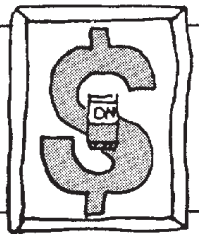
In 1850, the average frontier American house needed 17.4 cords of wood each year for heat and cooking. What would you spend most of your time doing if you lived then?
A cord is a stack of wood 4 ft. high by 8 ft. wide by 4 ft. deep.

Energy History of the U.S.



Reading Graphs

- What is the major source of energy today?
- What was the major source of energy 100 years ago?
- What was the major source of energy during the Civil War?
- What do you think will be the major source of energy 50 years from now? Why?
- Edison invented his light bulb in 1870. What source of energy did he use to generate electricity to make it work?
- How do different types of energy affect your life?

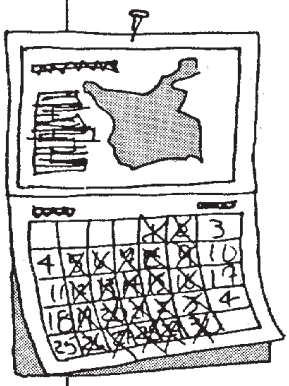


How much does it cost to light your school?

Materials

Pencil and paper
Classroom with fluorescent bulbs
Chalkboard and colored chalks
OR
Newsprint pad and felt-tipped markers

First determine how much electrical energy it takes to light your classroom for 1 hour, then compute the cost. Record this amount on the table below.



Number of tubes in your classroom	×	3¢*	=	Cost per hour to light your classroom

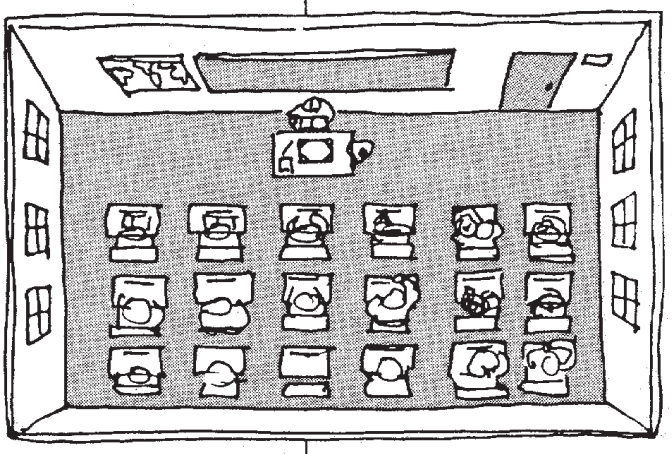
Then, compute how much it costs to light your classroom for 1 day. Record below.

Cost per hour to light your classroom	×	Hours per day classroom is lit	=	Cost per day

*Note

Fluorescent tubes cost approximately 3¢ per hour for the electricity needed to light them. The cost ranges from 2¢ to 4.5¢ per hour, depending on where you live.

How much does it cost to light your classroom for 1 week? 1 month? 1 year? How many kilowatt hours (kwh) of electricity were used?
How many fluorescent tubes are there in your school? How many classrooms? How much does it cost to light your entire school for 1 hour? 1 day? 1 week? 1 month? 1 year? How many kwh of electricity were used? Record your calculations below.

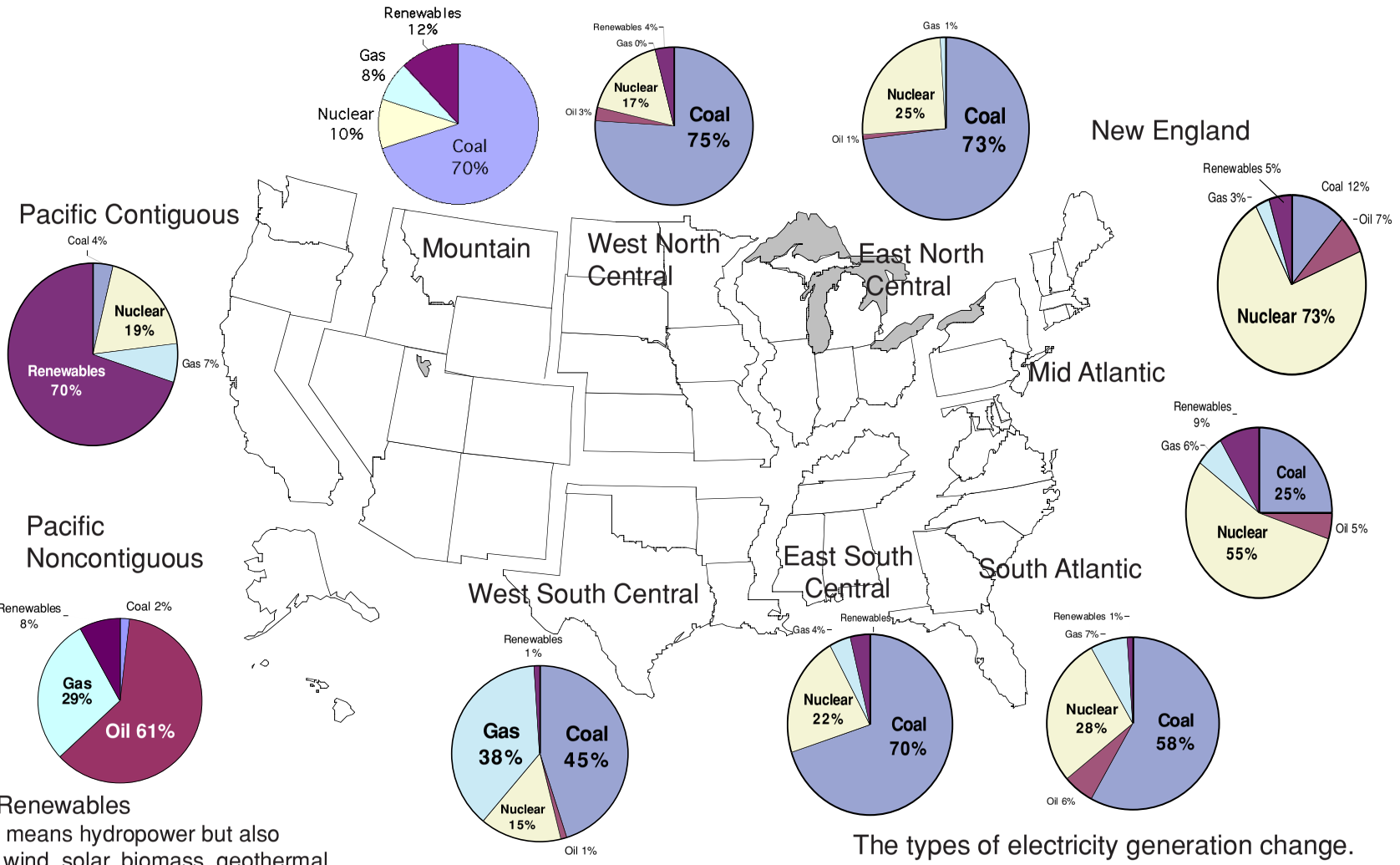


	Classroom	School
Cost per hour		
Cost per day		
Cost per week		
Cost per month		
Cost per year		
Kilowatt hours used		
Tons of coal used		

An average 2500 kwh of electricity are produced by burning 1 ton of coal. How many tons of coal would it take to light your classroom? Your school?

Provided by
American Coal Foundation
1130 17th Street N.W.
Suite 220
Washington, D.C. 20036
202/466-8630

Different Regions of the Country Rely on Different Generation Mixes for Electricity



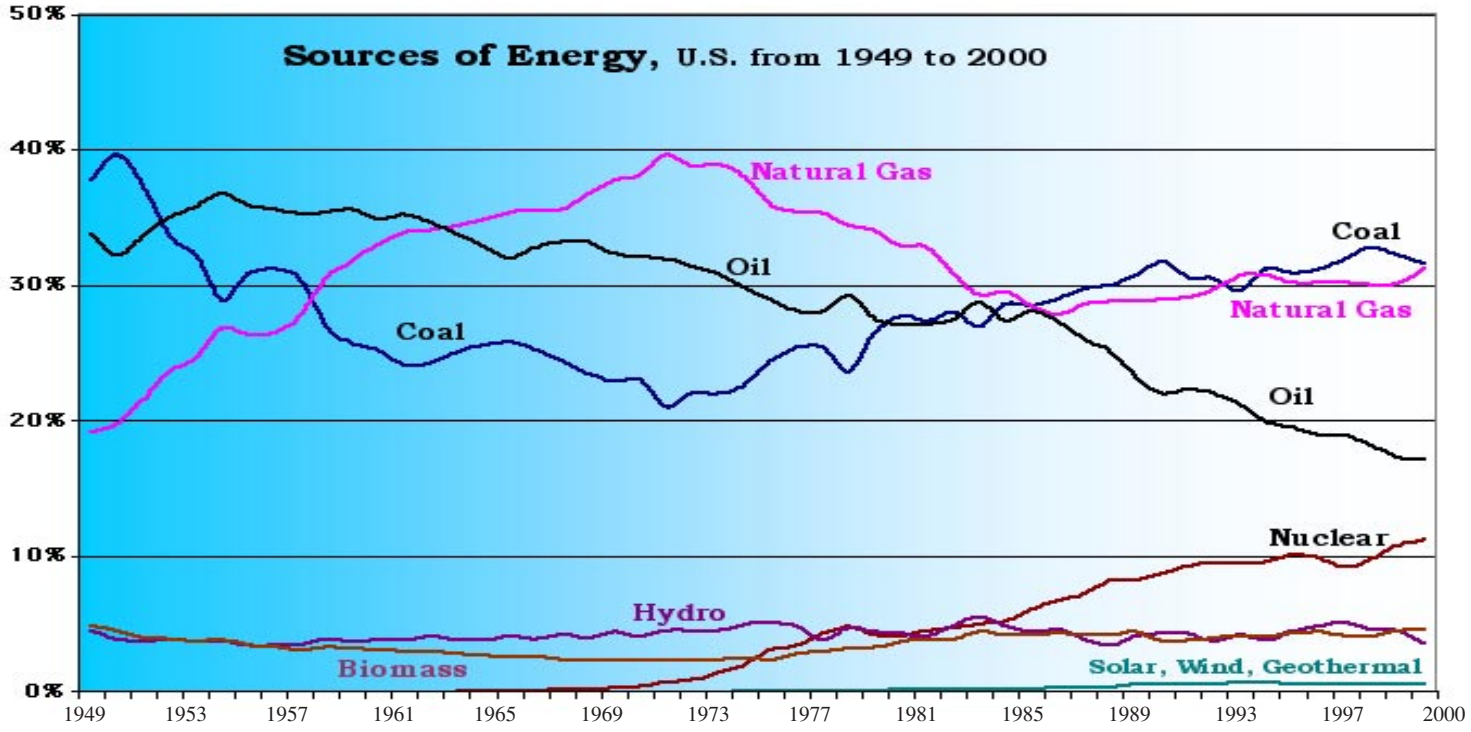
Renewables primarily means hydropower but also includes wind, solar, biomass, geothermal, and others.

The types of electricity generation change. Also with the national power grid, electricity is shared among the regions and even across country borders.

Source of statistics: Energy Information Administration; *Electric Power Monthly*. www.eia.doe.gov/emeu/reps/states/maps/

How is your electricity created?

Sources of Energy in the United States



Name _____

1. In what year did Nuclear energy first provide 10% of total energy _____

2. In that same year, what percentage of our total energy did Coal provide? _____

3. In 1999, what percentage of our total energy did each of the following provide?
   Coal _____ Nuclear _____ Oil _____ Natural Gas _____
   Hydro _____ Solar, Wind, Geothermal _____ Biomass _____

4. What were the three largest providers of energy in 2000?
   _____
   _____
   _____

5. In what year did Natural Gas provide the lowest percentage of total energy?_____
   The highest? _____

U.S. Daily Per Capita Consumption of Energy by Type, 1995— nearly 1 million Btu per day per person

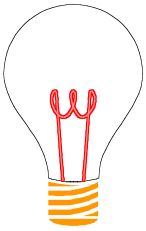
Type of Energy	Type of Unit	1995
Petroleum Products	gallons	2.8
Motor Gasoline	gallons	1.2
Natural Gas	cubic feet	225
Coal	pounds	19.6
Hydroelectricity	kilowatt hours	3. 1
Nuclear Electricity	kilowatt hours	7.0
Total Electricity	kilowatt hours	31 .2
Total Energy	**thousand Btu**	**945**

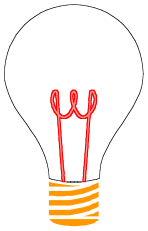
Source: Statistics from Energy Information Administration

Answers: **1-** 1996; **2-** 33%; **3-** Coal- 32%, Nuclear- 11%; Oil- 17%; Natural Gas- 30%, Hydro- 5%, Solar, etc.- 1%, Biomass- 5%; **4-** Coal, Natural Gas, & Oil; **5-** 1949, 1971.
Biomass usually means wood, wood wastes, trash, alcohol— things that are burned other than the fossil fuels.

Name _____ **Topic** _____

Grade _____





Write a story about a cave-man who finds a light bulb.

Make up an appropriate light bulb joke, cartoon or riddle.

Write 5 or more interesting facts about one of the following: Thomas Edison, Nicholas Tessla, Benjamin Franklin, Michael Faraday, James Watt.

Research one of the resources used in the light bulb. Write a short report about this resource. Where it is found, how it is mined, other uses for this resource.

Find out about other lighting devices such as fluorescent, mercury vapor lamps, sodium vapor lamps, neon.

List all the ways a light bulb has helped you this week. Think about work, safety and leisure activities.

Draw a picture of how a light bulb has helped you this week.

Write about what your life would be like without the light bulb.

Write a creative story from the point of view of a light bulb.

Acrostic poem—use student's name to identify objects that use electricity.

Example: **T**oaster
Oven
Motor

Write about the best idea you have ever had.

MINERAL INFORMATION INSTITUTE

GOOD AS GOLD

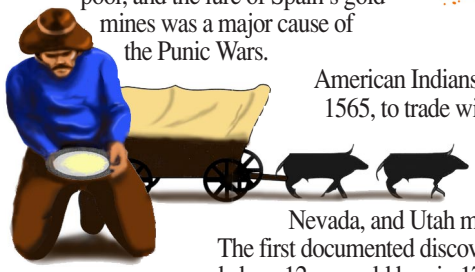
Everything Is Made Of Something
If you can see it, touch it,
taste it, smell it, or hear it,
It's from our Natural Resources.

Dig A Little Deeper
Find Out That
The History of Gold is The History of the World

The ancient western world learned from Egypt how to mine and refine gold. Egypt's incredible gold wealth came from granite hills on both sides of the Red Sea.

One of the greatest gold hunters of all time was Alexander the Great. When he died at the age of 33, he had conquered more lands than any general before him.

The famed Roman Empire was gold poor, and the lure of Spain's gold mines was a major cause of the Punic Wars.



American Indians mined gold as early as 1565, to trade with Spanish explorers in Florida. Without the Gold Rush of 1849, California, Nevada, and Utah might be part of Mexico.

The first documented discovery of gold in America was made by a 12-year-old boy in 1799, in North Carolina.

Nearly 50 pounds of gold is used every day by dentists, requiring the mining of 18,500 tons of ore each day.

For information about minerals in society, contact:
Mineral Information Institute at www.mii.org

Science: How & why is gold mined. Create list of uses.

Reading: Legends, fairy tales, folk tales, myths about gold. "Snow Treasure "Meaning of gold cliches and idioms. **Social Studies:** Timeline of gold thru history.

Math: Different measurements. An ounce (Troy) of gold is heavier than an ounce of feathers. Graph price over time. Find out about "Karats."

Experience the *Gold Rush*

Social Studies

See pages 2 and 6 for timeline and map activities. Research how immigrants affected the Gold Rush in this country. What is the meaning of "Pikes Peak or Bust"? Research gold and the westward expansion. Discuss the uses of gold as a monetary standard.

Math

Explore various measurements for gold such as Troy ounces, and Karats. Check the newspaper for current gold prices and make bar graphs to show how prices fluctuate over time. Discuss the factors that affect prices and the implications of price fluctuations for jewelers and other gold buyers.

Discuss the difference between 18K and 24K gold. Have students clip jewelry advertisements from the newspaper, noting the different karat values and prices. *(A karat is a unit of fineness for gold equal to 1/24 part of pure gold in an alloy. Thus, 24K denotes pure gold, whereas 18K indicates a mixture of 18 parts gold with 6 parts other metals.)*

Reading

Read legends, fairy tales, folk tales, or myths about gold— Midas Touch, Rumpelstiltskin, the search for the seven cities of gold, Jason, Blackbeard's Treasure, Treasure Island, Snow Treasure, stories about Leprechauns.

Language Arts

See page 3 for activities on expressions linked to gold, writing newspaper articles, vocabulary.

Music/Drama

Develop and/or perform skits based on gold. Ideas for the skits could come from the reading activities. Sing mining songs such as Clementine or The Fools of Forty-Nine. Have students interpret the meaning of these songs.

Art

Create posters advertising the "Gold Rush". Make a collage of items that use gold. Create a visual dictionary.

Careers

Investigate mining-related careers—metallurgist, geologist, mining engineer, chemical engineer, surveyor, driller, blaster, environmental scientist, cartographer. Invite these professionals to speak to your class. Invite a jeweler with goldsmithing experience to demonstrate the craft.

Science

See page 4 for science activities.

Recreate the Thrill of the Gold Rush in Your Classroom

Pan for gold to demonstrate density for science
Experience Gold Rush fever in American History

Contains some materials previously provided by BLM, *A Golden Opportunity* for Science, and The Gold & Silver Institute.

Timeline
Gold through recorded history

4000 B.C.
A culture, centered in what is today Eastern Europe, begins to use gold to fashion decorative objects. The gold was probably mined in the Transylvanian Alps or the Mount Pangaion area in Thrace.

2500 B.C.
Gold jewelry is buried in the Tomb of Djer, king of the First Egyptian Dynasty, at Abydos, Egypt.

1500 B.C.
The immense gold-bearing regions of Nubia make Egypt a wealthy nation, as gold becomes the recognized standard medium of exchange for international trade.

1350 B.C.
The Babylonians begin to use fire assay to test the purity of gold.

1200 B.C.
Sheepskin is used to recover gold dust from river sands on the eastern shores of the Black Sea. The practice is most likely the inspiration for the "Golden Fleece."

560 B.C.
The first gold coins made purely from gold are minted in Lydia, a kingdom of Asia Minor.

300 B.C.
Greeks and Jews of ancient Alexandria begin to practice alchemy, the quest of turning common metals into gold. The search reaches its pinnacle from the late Dark Ages through the Renaissance.

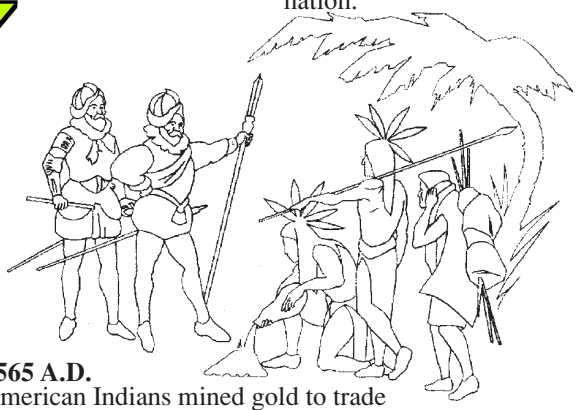
58 B.C.
After a victorious campaign in Gaul, Julius Caesar brings back enough gold to give 200 coins to each of his soldiers and repay all of Rome's debts.

742-814 A.D.
Charlemagne overruns the Avars and plunders their vast quantities of gold, making it possible for him to take control over much of Western Europe.

1250-1299 A.D.
Marco Polo writes of his travels to the Far East, where the "gold wealth was almost unlimited."

1511 A.D.
King Ferdinand of Spain says to explorers, "Get gold, humanely if you can, but all hazards, get gold," launching massive expeditions to the newly discovered lands of the Western Hemisphere.

1565 A.D.
American Indians mined gold to trade with Spanish Conquistadors in Florida.



1700 A.D.
Gold is discovered in Brazil, which becomes the largest producer of gold by 1720, with nearly two-thirds of the world's output.

1799 A.D.
A 17-pound gold nugget is found in Cabarrus County, North Carolina, the first documented gold discovery in the United States.

1803 A.D.
Gold is discovered at Little Meadow Creek, North Carolina, sparking the first U.S. gold rush.

1848 A.D.
Flakes of gold are found while building a sawmill for John Sutter near Sacramento, California, triggering the California Gold Rush and hastening the settlement of the American West.

1859 A.D.
Comstock lode of gold and silver is struck in Nevada.

1868 A.D.
George Harrison, while digging up stones to build a house, discovers gold in South Africa—the source of nearly 40% of all gold mined since then.

1898 A.D.
Two prospectors discover gold in Klondike, Canada's Yukon Territory, spawning the last gold rush of the century.

1903 A.D.
The Engelhard Corporation introduces an organic medium to print gold on surfaces, this becomes the foundation for microcircuit printing technology.

1927 A.D.
An extensive medical study conducted in France proves gold to be valuable in the treatment of rheumatoid arthritis.

1935 A.D.
Western Electric Alloy #1 (69% gold, 25% silver, 6% platinum) finds universal use in all switching contacts for AT&T telecommunications equipment.

1942 A.D.
President Franklin D. Roosevelt closes all U.S. gold mines, so that all mining activity would go toward producing the raw materials necessary to win World War II.

1947 A.D.
The first transistor is assembled. The device uses gold contacts pressed into a germanium surface.

1960 A.D.
The first patent is granted for the invention of the laser. It uses carefully positioned gold-coated mirrors.

1970 A.D.
The charge-coupled device is invented; it was first used to record the faint light from stars. The device (which used gold to collect the electrons generated by light) is the basis for video cameras.

1981 A.D.
The first space shuttle is launched, using gold-coated impellers in its liquid hydrogen fuel pump.

1990 A.D.
United States becomes the world's second largest gold producing nation.

True or False

Test Your Gold IQ

1. One ounce of gold is heavier than one ounce of almost anything else.
2. Pure 24K gold is more durable than 18K gold.
3. The main reason gold is so valuable is because it is very rare.
4. In the USA, any gold described as real gold must be at least 14K.
5. Most white gold is made by mixing pure gold with silver.
6. If a jewelry piece has scratches, it's of poor quality.
7. A good way to clean gold jewelry is to spread toothpaste on it and rub it clean with a brush.

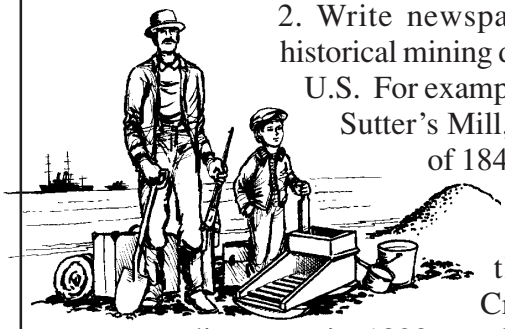
1. **T:** Gold is measured in troy weight while almost everything else is in avoirdupois. Troy ounces are heavier than avoirdupois ounces.
2. **F:** When pure gold is alloyed (mixed) with other metals to form 18K gold, it becomes stronger and harder.
3. **F:** There are metals more rare than gold that sell for less because the demand is lower.
4. **F:** It must be at least 10K (10/24ths gold).
5. **F:** Most white gold is made by alloying pure gold with copper, nickel, and zinc.
6. **F:** Because gold scratches easily, well-made pieces get scratched.
7. **F:** Toothpaste is an abrasive, and the brush could scratch the metal.

Language Arts Activities

1. Create an illustrated dictionary of the following gold mining terms. Students may work alone, with partners, or in small groups. The dictionary should be colorful and imaginative, but show what each term means. Students may bind their "dictionaries" and share with the class.

prospector	sluice box	mother lode
placer	panning	orebody
rocker	Forty-niners	Klondike
Eureka	vein	arrastra

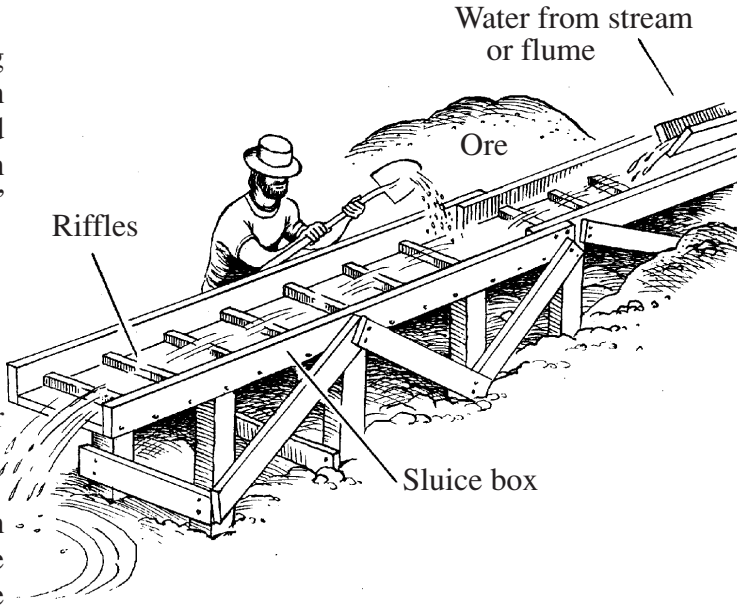
These are only suggestions. Any mining or gold terms could be used for the dictionary.



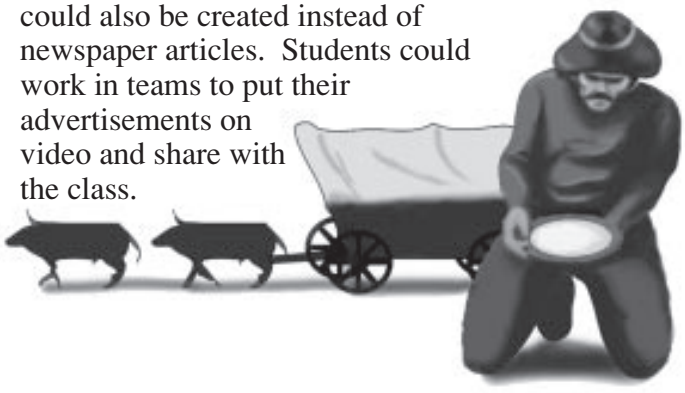
2. Write newspaper articles on historical mining discoveries in the U.S. For example, announce the Sutter's Mill, California, find of 1848; the Comstock Lode in Nevada in the 1860's; the Cripple Creek, Colorado, discovery in 1892; or the Anvil Creek, Alaska, lode found in 1898. Other major gold strikes could be used also, including the major new gold discoveries occurring today.

3. Have students prepare and present reports (including maps) on gold rushes in the U.S., Canada, Australia, South Africa, West Africa, Malaya, Mexico, and Siberia. The report should include how the discovery of gold changed the history of these areas.

Again, students could work in small groups to prepare and present these reports.



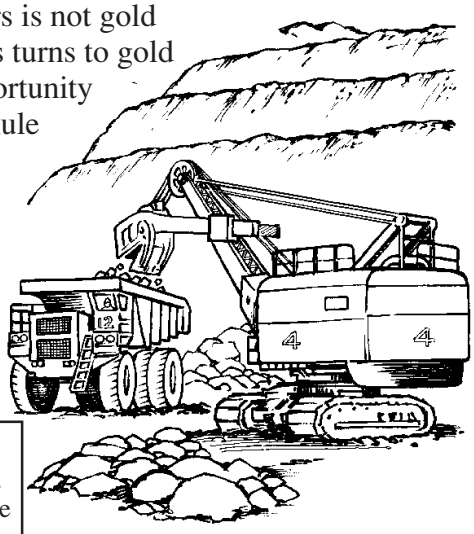
Posters, "TV" or "radio" advertisements could also be created instead of newspaper articles. Students could work in teams to put their advertisements on video and share with the class.



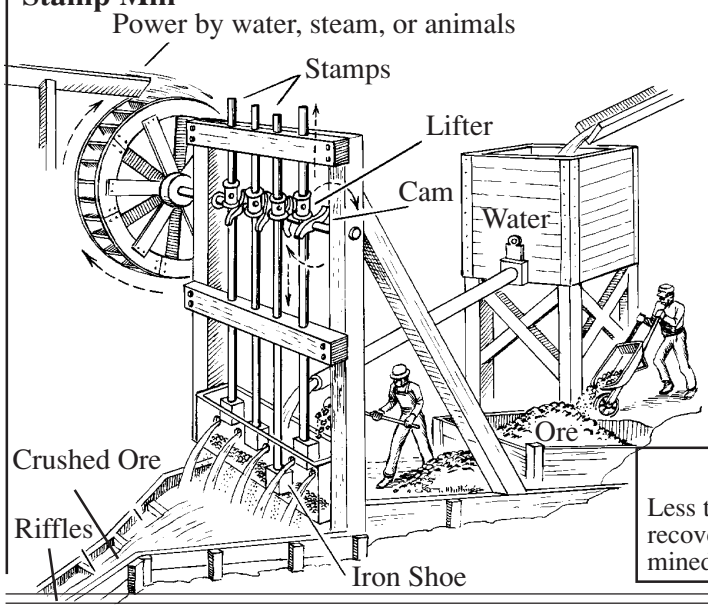
4. Expressions linked to gold. Have students brainstorm and research metaphors or expressions linked to gold. Students could illustrate and then explain what each phrase means.

Examples:

Worth your weight in gold
All that glitters is not gold
All he touches turns to gold
A golden opportunity
The Golden Rule
Heart of Gold
Good as gold
Gold standard
Gold-bricking
Fools Gold



Stamp Mill



Rule of Thumb

Less than 1/2 ounce of gold is recovered from each ton of ore mined in today's gold mines.

Social Studies Activities

1. Using a world map locate and label the major gold producing countries.
2. Using the timeline information in the packet, reproduce and enlarge the information for each student (or group of students). Cut the events apart and mix them up. Using cash register tape, the students create a timeline for the history of gold, then locate and label each event on a world map.
3. Chart the routes of the following explorers: Columbus, Coronado, deSoto. How did gold influence their explorations?
4. Pick one event from the timeline (page 2) then research and report on how this "golden" event influenced world history. The report should include people and places for each event. Students can create visual aids and give an oral presentation.

Annual Production of Gold Before 1848 in Thousands of Ounces

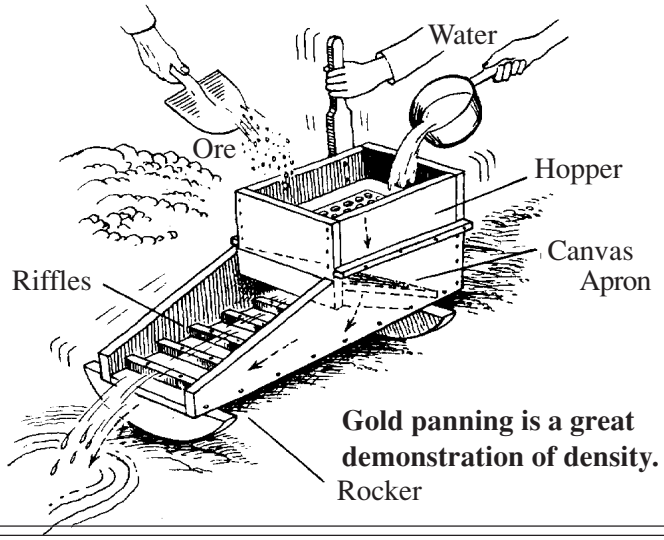
	Production	Source
Egyptians from 2000 BC	32	Egypt/Sudan/Saudi Arabia
Roman Empire	193 - 289	Mainly from Spain and Portugal
500 - 1100	96 - 161	Germany/Austria/South America (local use)
1100 - 1400	161 - 193	Germany/Austria/West Africa/South America (local use)
1400 - 1500	161 - 257	West Africa/South America
1500 - 1600	161 - 322	West Africa/South America
1600 - 1700	322 - 386	West Africa/South America
1700 - 1800	482 - 804	West Africa/Brazil and other South American countries/Russia
1800 - 1840	804 - 1,608	West Africa/Brazil and other South American countries/Russia
1847	2,476	Russia over 1 million oz. plus Africa/South America

Science Activities

1. Make a list of the unique physical properties of gold.

Gold is highly reflective, an excellent conductor, and is highly malleable (it can be hammered into a new shape). It is also ductile (it can be drawn or molded into wire or threads). Gold does not rust, tarnish or corrode, nor does it dissolve in water or most acids.

2. Illustrate the properties of malleability and ductility. Collect such items as clay, putty, pastry dough, cheese, kneaded erasers, marshmallows, aluminum foil, or taffy, and ask students to manipulate them, then to order them from most to least malleable, and from most to least ductile. Relate these properties to the properties of gold.
3. Discover density. Density = weight ÷ by size. Gold has the greatest density of any mineral—it's heavy for its size. That's why gold accumulates in streams.



Gold panning is a great demonstration of density.

Questions & Answers:

Gold is a mineral. What does that mean? *A mineral is something found in nature that is neither a plant nor an animal. Most rocks contain two or more minerals.*

Gold is also a metal. Are all minerals also metals? *All metals are not minerals. For example, the metal zinc is not a mineral—it is not found as a pure metal in nature. Most minerals are nonmetallic. Graphite, gypsum, and halite are all nonmetallic minerals.* What properties does gold share with other metals? *Like all metals, gold is shiny, a conductor of heat and electricity, and can be hammered without breaking.*

Silver conducts electricity better than gold and costs less. Why, then, is gold used to plate electrical contacts in high-quality switches and in computers? *Silver tarnishes when it combines with impurities in the air and loses its conductivity.*

Speculate why jewelers would prefer to work with an alloy of copper and gold rather than either gold or copper alone. *Pure gold is a soft metal that scratches, bends, and breaks easily. Jewelry made from it would not last very long. Copper, on the other hand, is an inexpensive, harder metal that dulls rapidly and turns green when exposed to air. When copper and gold are melted together, the alloy formed is sturdier than the pure metals and has most of the brilliance of gold.*

Don't just read about the greatest migration in American history or watch a video about density.

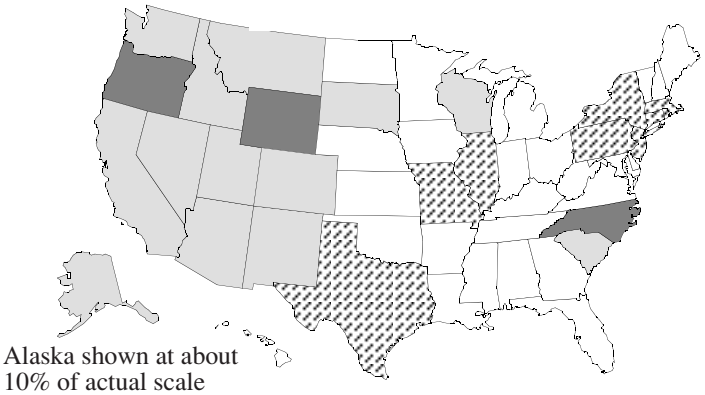
Experience *Gold Fever*

Pan for Gold in Your Classroom

For a classroom panning experience, obtain some fine copper beebee pellets or iron filings from a hardware store. Mix one-quarter cup of the "gold" with about 10 liters of sand. Put the mixture in a bucket and add water to make a slurry. Have students use small shallow bowls or old pie pans to scoop up a bowl of slurry and swirl it over another bucket or large tub. Tell them not to tip the pan too far and to continue adding plain water while swirling until only the pellets or filings remain in the bowl. Discuss how this activity relates to what the Prospectors experienced during the Gold Rush.

Order a *Gold Panning Kit* from MII and experience the *Real Thing*. And your students can keep the Gold!

America's Gold States



Alaska shown at about 10% of actual scale

Gold Mining States | Exploration | Involved in Refining Fabrication & Trading

Alaska is one-sixth of the U.S.
It's as big as: 540 Rhode Islands
289 Delawares
117 Connecticuts
89 Hawaiis
2 Texases

MII
501 Violet Street
Golden, CO 80401 USA
303/277-9190 Fax 303/277-9198 On-line at www.mii.org

Gold is used in a lot more than jewelry

Automobile

Gold is used in the trigger deployment system of automobile airbags, now in more than 10 million cars. It is also used in other electronic parts.

Gold is the best reflector of infrared energy which is used by auto manufacturers to dry the paints on their cars, saving time and lowering the energy use and cost.

Gold-plated connectors and contacts that operate in a car's engine require materials that can withstand the high-temperature and corrosive environment under a car's engine hood.

Aircraft Engines

The majority of jet engines on the new Boeing 777 are made by Pratt & Whitney. P&W uses nearly two pounds of gold as a brazing alloy in each engine and there are two engines on each plane.

Many aircraft use gold-coated acrylic windows in the cockpit to help windows stay clear of frost and fogging. Gold's reflectivity helps keep the cockpit cool on hot runways and gold's thermal conductivity helps maintain the heat of the cabin while in flight at high, cold altitudes.

Gold reflectors are used on Air Force One for defense, to confuse an incoming missile's heat-seeking signal, making it difficult for the missile's guidance system to focus on its target.

Computers

40 million personal computers are manufactured worldwide each year and gold is an integral part of the semiconductor circuits. Each key on the keyboard strikes gold circuits that relay the data.

Telephones

Inside the mouthpiece is a miniature transmitter that contains gold in one of its central components, the diaphragm. Telephone wall jacks and connecting cords also use gold for the contacts.

Electronics

Gold is the best material to use in almost all microcircuits in electronic equipment.

Dentistry

More than 26,000 pounds are used by dentists every year.

Food

Gold is a critical part of the equipment that assures packaged fruits and vegetables will resist spoiling.

Healthcare

Gold is extensively used in medical diagnosis and monitoring equipment, as well as medicines and implants.

Pollution Abatement

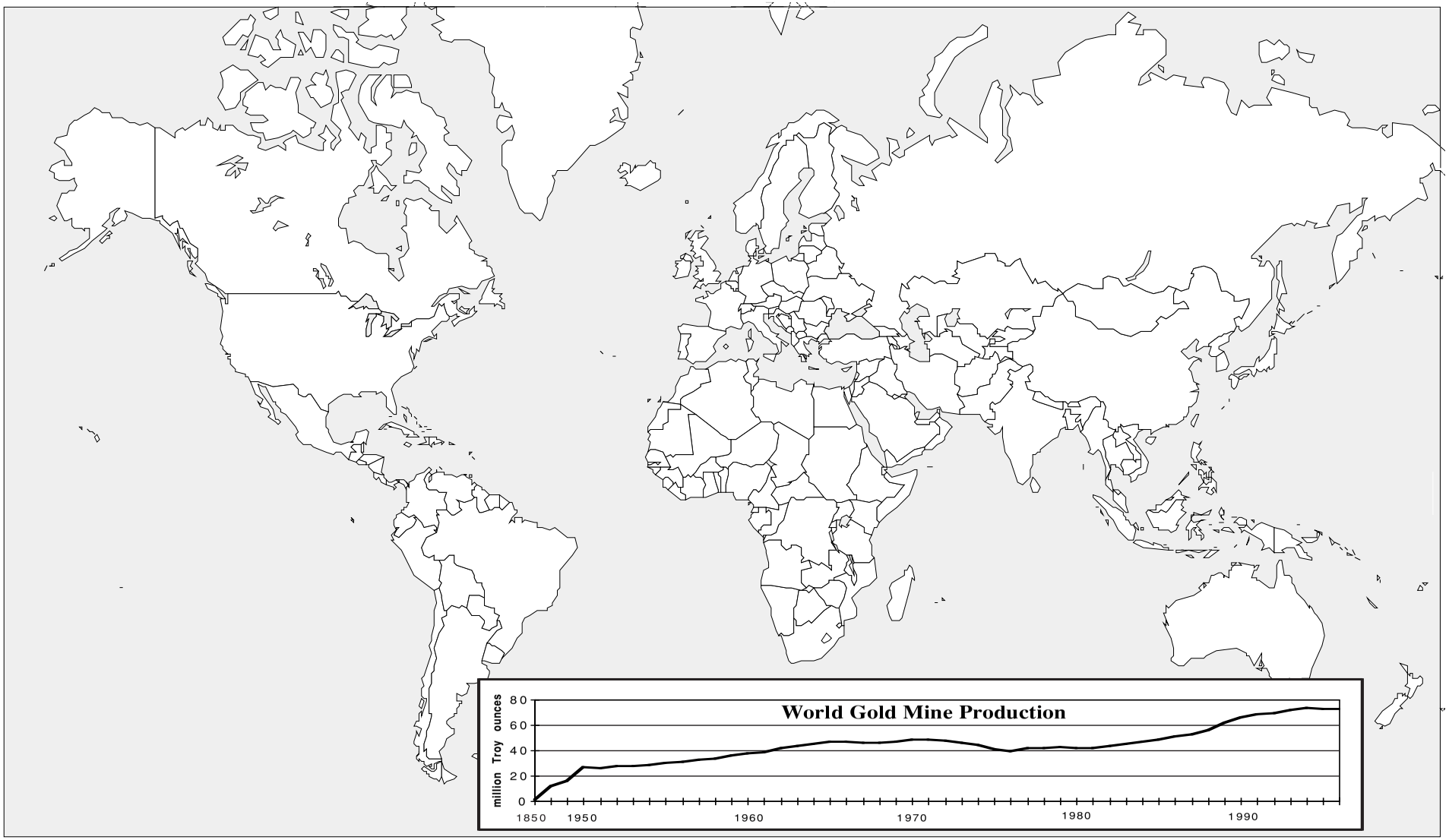
As a catalyst, gold helps convert CO to CO_2 and nitric oxide to harmless nitrogen.

Astronomy

The world's largest telescopes, located at the Keck Observatory, use pure gold to coat the 21-inch secondary mirrors on both of its twin telescopes.

Space

Gold protects the onboard computers in the Galileo space probe. It is used throughout the electronic circuitry in satellites and the Space Shuttle, and in the visors in space suits worn by astronauts.



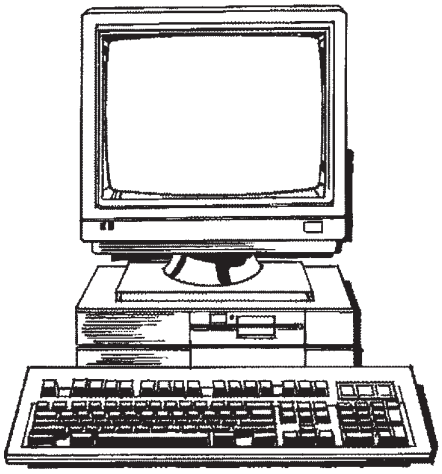
World Gold Mine Production in tonnes (major countries only)

multiply tonnes by .032151 to convert to million Troy ounces

PRIMARY MINE PRODUCTION (metric tonnes)

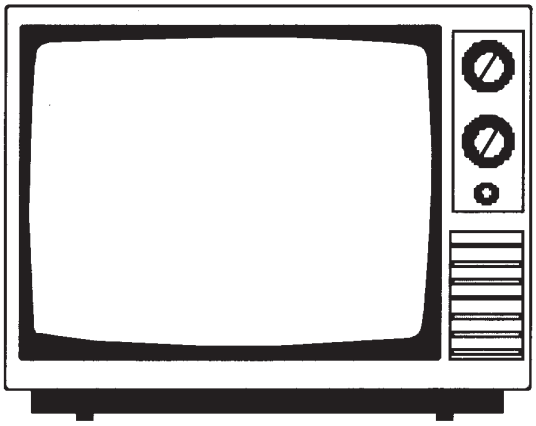
	RSA	USA	AUS	CAN	China	Russia	Peru	Uzbek	Indo	Braz	Ghana	Chile	PNG	Phil	Mex	Zimb	Venz	Columb	Other	WORLD	
1995	523.8	317.0	253.5	152.0	140.0	132.2	57.7	70.0	62.9	64.4	53.1	44.6	53.4	27.1	20.3	24.0	7.1	21.2	225.6	2,250.0	**1995**
1996	497.6	326.0	289.5	166.4	145.0	123.0	64.8	72.0	65.0	60.0	49.2	53.2	51.1	31.8	24.5	24.8	11.7	22.1	250.4	2,328.0	**1996**
1997	483.4	362.0	311.4	169.1	175.0	115.0	76.8	75.0	68.0	59.0	52.0	49.5	47.5	33.8	26.0	25.0	19.7	18.8	305.1	2,472.0	**1997**
1998	465.0	366.0	320.0	155.0	150.0	105.0	89.2	100.0	145.8	60.0	73.3	45.0	63.2	34.9	26.1	27.1	---	---	329.5	2,555.0	**1998**
1999	449.5	341.0	301.3	155.0	150.0	126.0	128.0	80.0	155.0	50.0	---	---	---	---	---	---	---	---	633.2	2,569.0	**1999**
	RSA	USA	AUS	CAN	China	Russia	Peru	Uzbek	Indo	Braz	Ghana	Chile	PNG	Phil	Mex	Zimb	Venz	Columb	Other	WORLD	

Gold is in Computers



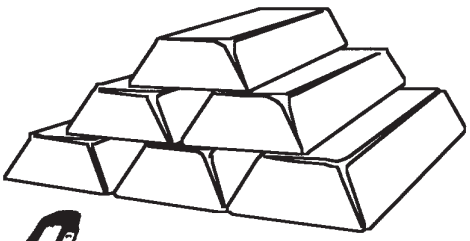
Gold is in Airplanes

Gold is in Televisions and Telephones

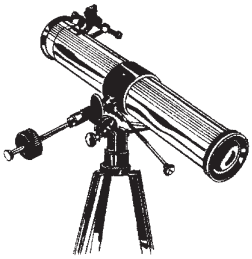


Gold is in Medicine

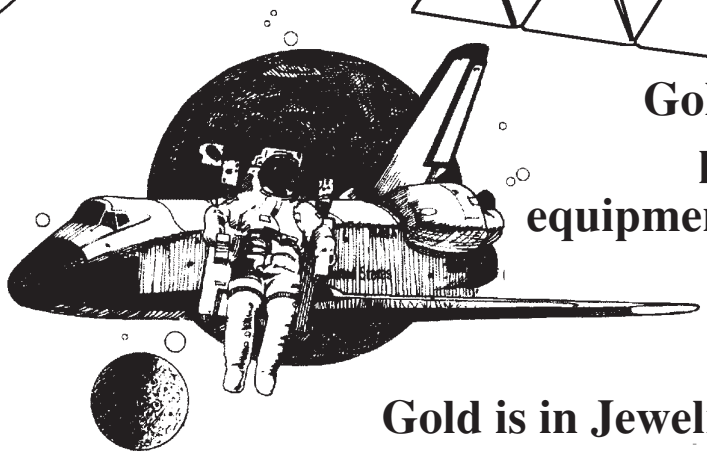
Gold represents wealth



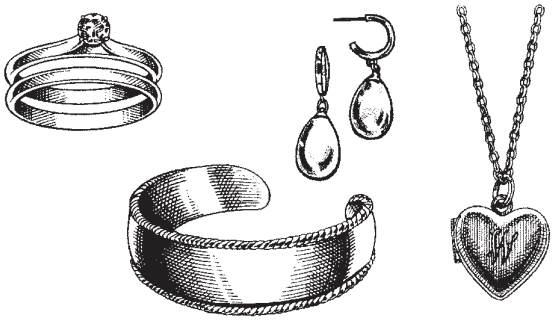
Gold is in Telescopes



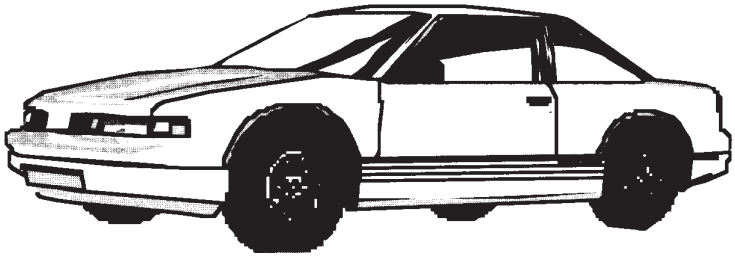
Gold protects people and equipment in space



Gold is in Jewelry



Gold is in Cars and Trucks



The prospector and his faithful burro helped to settle much of the western half of North America.

MINERAL INFORMATION INSTITUTE

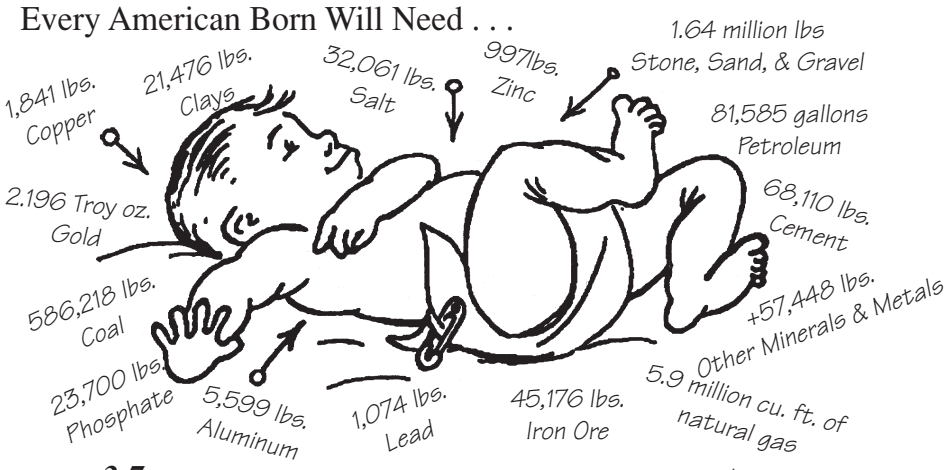
WHY DO WE MINE?

Because people want, and sometimes demand, the products made from minerals, metals, and energy that comes from the Earth.

Everything Is Made Of Something And That Something Comes From Our Natural Resources

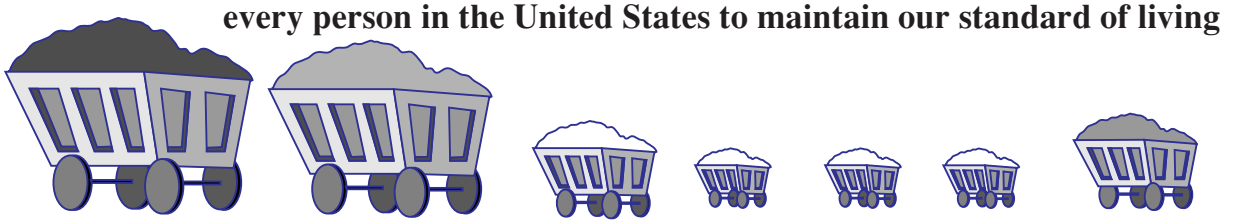
When a person wants something, rarely does he think about the source of materials that are necessary to make that product.

Everything you want or buy that is tangible has to be made of something, and that something is materials from our natural resources. Most of it is made from minerals, metals and petrochemicals.



3.7 **million pounds of minerals, metals, and fuels in his/her lifetime**

Every year, more than 48,148 pounds of new minerals must be provided for every person in the United States to maintain our standard of living



12,528 lbs. Stone

9,385 lbs. Sand & Gravel

888 lbs. Cement

418 lbs. Salt

309 lbs. Phosphate

280 lbs. Clays

729 lbs. Other Nonmetals (estimated)

589 lbs. Iron Ore

73 lbs. Aluminum (Bauxite)

24 lbs. Copper

14 lbs. Lead

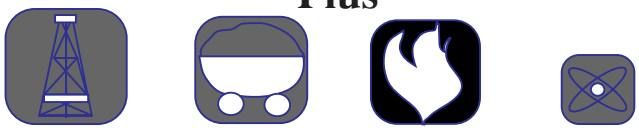
13 lbs. Zinc

6 lbs. Manganese

.0285 T oz. Gold

20 lbs. Other Metals (estimated)

Plus



7,578 lbs. Petroleum

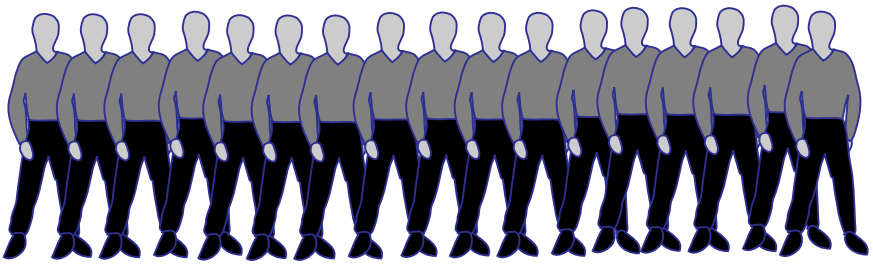
7,643 lbs. Coal

7,985 lbs. Natural Gas

1/4 lb. Uranium

To Generate

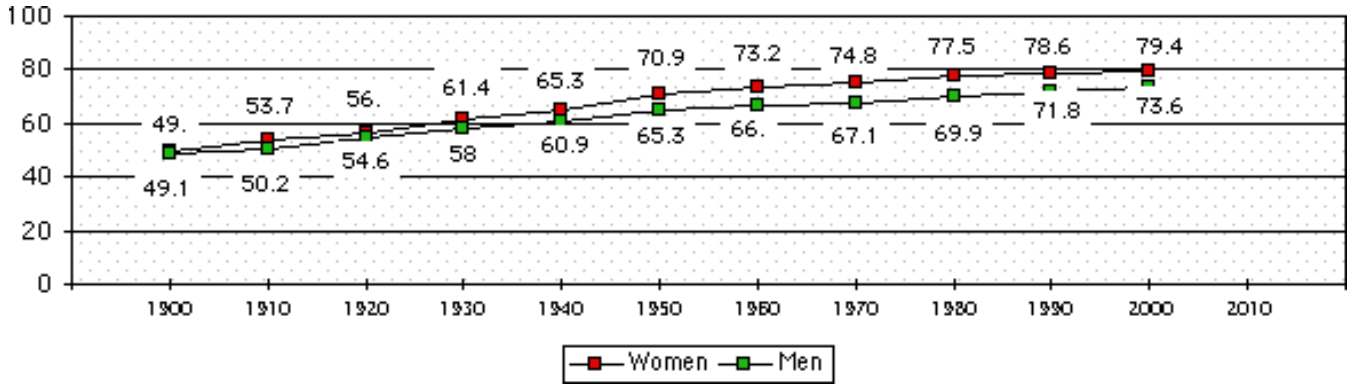
the energy equivalent to 300 persons working around the clock for each U.S. citizen



Based on 2000 consumption and population

Life expectancy for males and females

People born today can expect to live nearly 50% longer than people born at the turn of the century.



Survey Your Students—What do they think they must have, or can do without.

For the average, middle-class American child born in the 1990s, here's the personal toll of common products they will consume during his or her lifetime:

- Drive 700,000 miles in a dozen cars, using more than 28,000 gallons of gasoline.
- Read and throw away 27,500 newspapers, a rate of seven trees a year.
- Add 110,250 pounds of trash to the nation's garbage heap.
- Wear and throw away 115 pairs of shoes.

Source: Life's Big Instruction Book

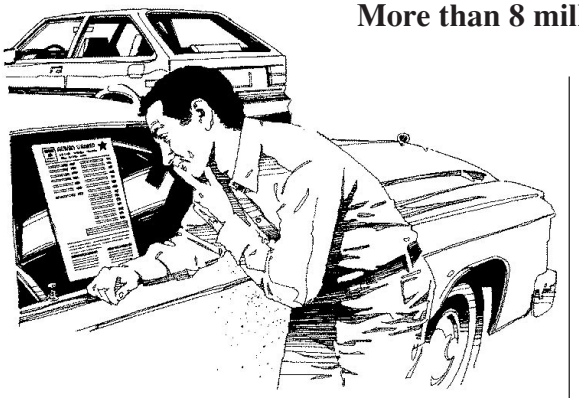
Must Have

In polling 1,000 Americans, an MIT study found these *essential inventions* that people said they could not do without.

Automobile	63%
Light bulb	54%
Telephone	42%
Television	22%
Aspirin	19%
Microwave oven	13%
Hair-dryer	8%
Personal computer	8%

There are more than 130,000,000 passenger cars in the United States

More than 212 million motor vehicles (of all types) travel our roads.
More than 8 million new cars are made every year for use in the U.S.



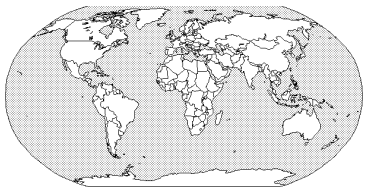
The average weight of an automobile is 2,600 to 3,000 pounds. It is made by combining at least 39 different minerals and metals, each performing a special function when used in combination with the other.

Aluminum and steel figures overlap in such applications as the frame or engine, thus the total weight of all components may exceed 3,000 pounds.

Plastics	250 pounds
Rubber	140 pounds
Aluminum	240 pounds
Antimony	trace
Asbestos	.66 to 1.2 pounds
Barium	trace
Cadmium	trace
Carbon	50 pounds
Cobalt	trace
Copper	42 pounds
Chromium	15 pounds
Fluorspar	trace
Gallium	trace
Gold	trace
Graphite	trace
Halite	trace
Iron & Steel	2124 pounds
(cast iron	435 pounds)
(steel*	1,382 pounds)
(HSLA** steel	263 pounds)
(Stainless steel	45 pounds)

* Conventional steel
** High Strength Low Alloy

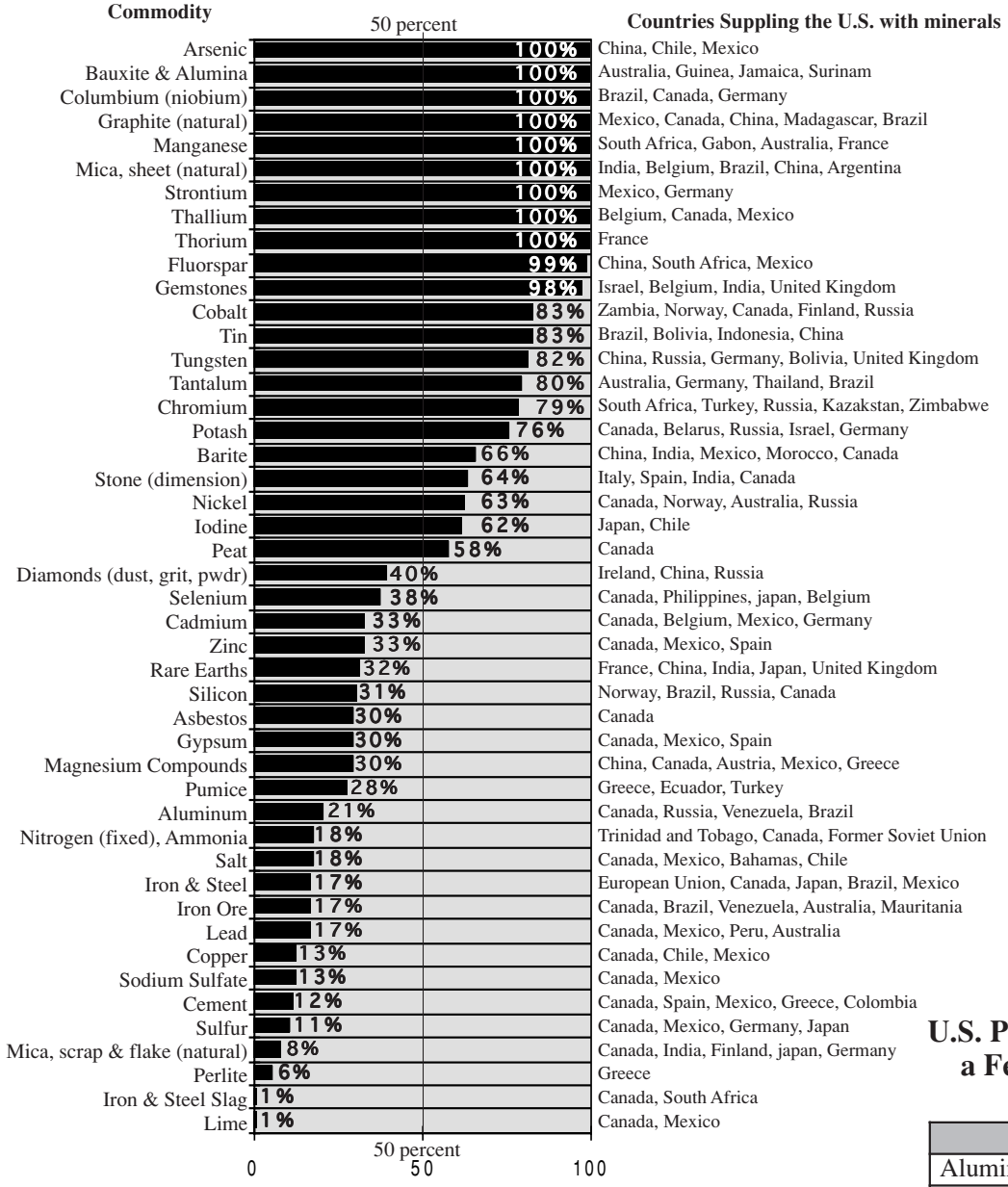
Lead	24 pounds
Limestone	trace
Magnesium	4.5 pounds
Manganese	17 pounds
Molybdenum	1 pound
Mica	trace
Nickel	9 pounds
Niobium	<.5 pounds
Nitrogen	trace
Palladium	trace
Platinum	.05 to .1 troy ounce
Phosphorus	< 1 pound
Potash	trace
Sand	89 pounds
Silicon	41 pounds
Strontium	trace
Sulfur	2 pounds
Tin	trace
Titanium	trace
Tungsten	trace
Vanadium	< 1 pound
Zinc	22 pounds
Zirconium	trace



Minerals Imported by the United States

In spite of its size and mineral wealth, the United States is not able to produce all of the minerals it needs to be self-sufficient. To maintain our life-style and provide all of the consumer products and infrastructure we use everyday, various amounts of the following minerals must be imported from foreign countries.

United States Imports of Selected Nonfuel Minerals & Metals



What do you think has created the need for more minerals and metals today than when our country was founded? Why?

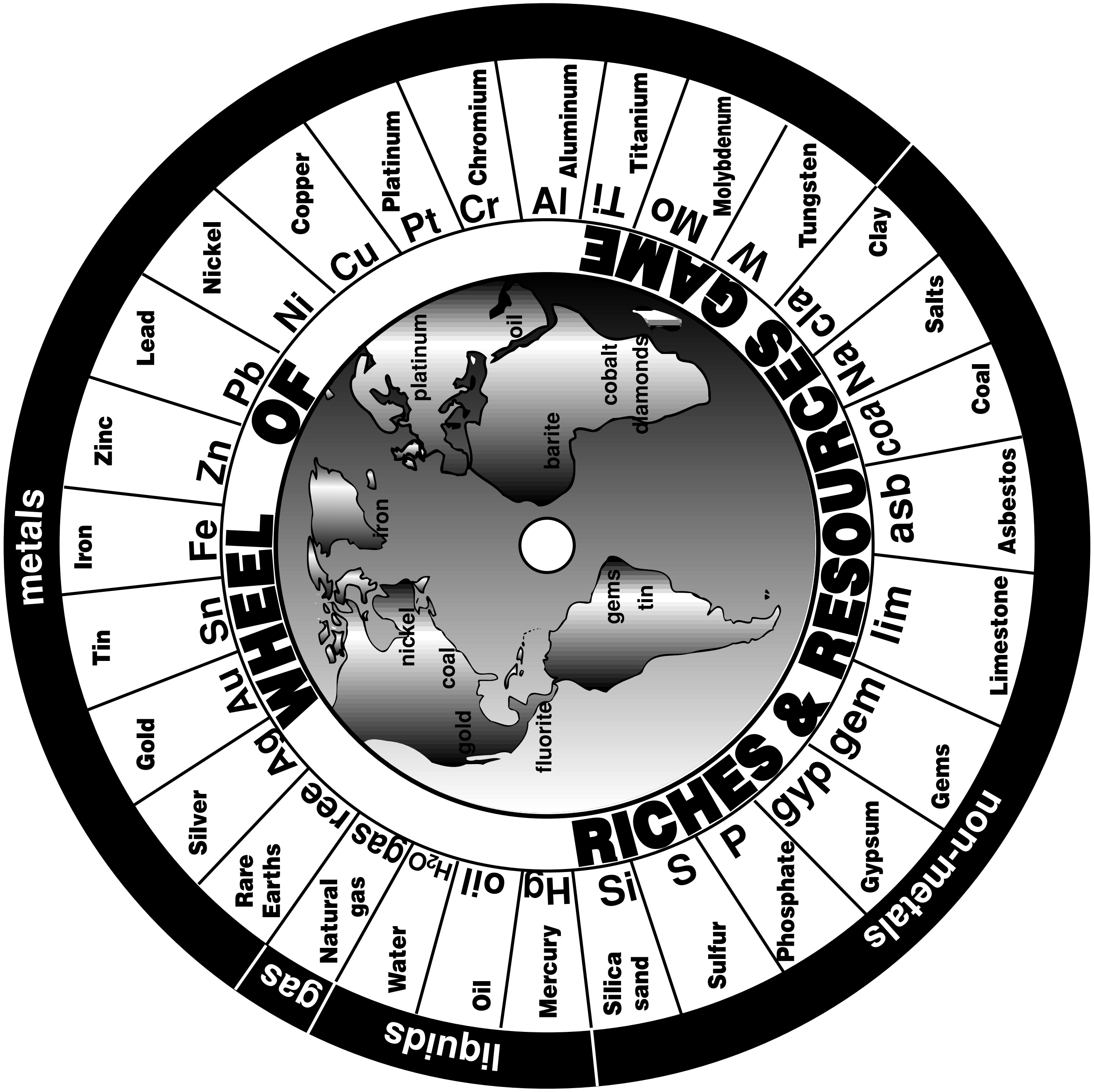
U.S. Per Capita Consumption of a Few Minerals and Metals
(In Pounds)

	1776	1999
Aluminum	0	77
Cement	12	895
Clay	100	304
Coal	40	7,662
Copper	1	25
Glass	1	150
Iron Ore	20	553
Lead	2	14
Phosphate	0	340
Potash	1	44
Salt	4	395
Sand, gravel, stone	1,000	21,640
Sulfur	1	111
Zinc	0.5	13

From Earth Science for Everyone Activity Book, **What's Under Your Feet?**, U.S. Geological Survey

PEOPLE PRODUCTS GAME

TO PLAY, Make a working spinner & copy the column of prizes for each player. Each turn, spin and then color that RESOURCE in all the prize boxes. (Example; spin "IRON" and color in all the prize squares with "Fe") The first box to have all the items colored, completing the product is your PRIZE.



STEREO
- ◯ case - oil
- ◯ tape - Cr, Fe, oil
- ◯ record - oil
- ◯ paint - Ti, oil
- ◯ needle - Cr, gem

COMPUTER
- ◯ case - oil, Fe
- ◯ wires - Cu, Au
- ◯ circuit boards - cla
- ◯ monitor - ree, Si

DINNERWARE
- ◯ dishes - cla, Si
- ◯ glasses - Na, Si
- ◯ silverware - Fe or Ag
- ◯ casting - Si, H_2O

TOASTER OVEN
- ◯ wiring - Cu
- ◯ case - Al, Fe, oil
- ◯ heating elements - W or Ni, Cr
- ◯ glass - Si

NEW CAR
- ◯ engine - Fe or Al
- ◯ exhaust system - Pt
- ◯ trim - Cr, Zn
- ◯ gasoline - oil
- ◯ battery - Pb

FREE CASH
- ◯ coins - Fe, Zn, Cu
- ◯ paper - cla
- ◯ ink - oil
- ◯ molds - Fe, Cr, Ni

NEW HOUSE
- ◯ foundation - lim, H_2O
- ◯ root - asb, oil
- ◯ walls - gyp
- ◯ siding - Al
- ◯ pipes & wire - Cu
- ◯ thermostat - Hg

REFRIGERATOR
- ◯ body - Fe or Al
- ◯ wires - Cu
- ◯ molding - oil
- ◯ paint - Ti, oil
- ◯ light - W

FREE FOOD
- ◯ preservatives - Na
- ◯ fertilizer - P, S
- ◯ machinery - Fe, Cr
- ◯ cans - Fe, Sn, Al
- ◯ irrigation - H_2O

AIRPLANE TRIP
- ◯ airplane - Al, Ti
- ◯ wiring - Cu
- ◯ fuel - oil
- ◯ engine - Fe, Cr, Mo

JEWELRY
- ◯ metal - Au, Ag, Pt
- ◯ molds - Si, Cr
- ◯ stones - gem
- ◯ heat - oil, gas, coal

CAMERA
- ◯ film - Ag, oil
- ◯ body - Al, Fe
- ◯ strap - oil
- ◯ lenses - Si, Na
- ◯ paper - cla