

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?

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.

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 Ingolia, 1989, Grosset & Dunlap

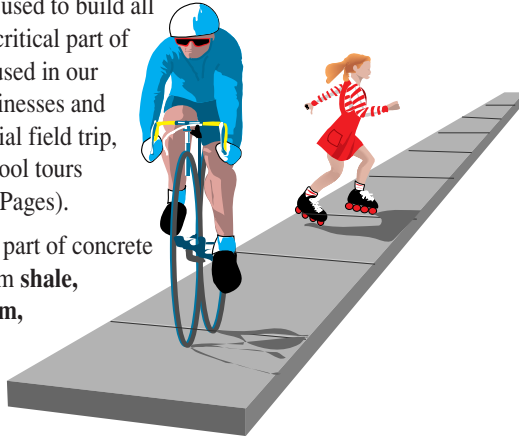
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 Dig A Little Deeper
 Find Out


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

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

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.

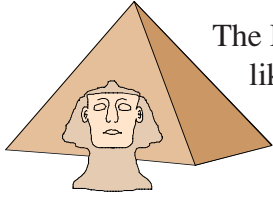
Art: Sidewalk drawings, prints

Poetry: Where the Sidewalk Ends.

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

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.

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 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:

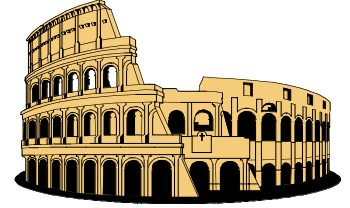
- Airport Design & Development, *Kansai International Airport, Japan*
- Dams, *Hoover Dam, Nevada-Arizona, USA*
- *The Interstate Highway System, USA*
- Long-Span Bridges, *Golden Gate Bridge, California, USA*
- Rail Transportation, *Eurotunnel Rail System, England and Europe*
- Skyscrapers, *The Empire 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.

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.



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.



How much concrete is in the Hoover dam?

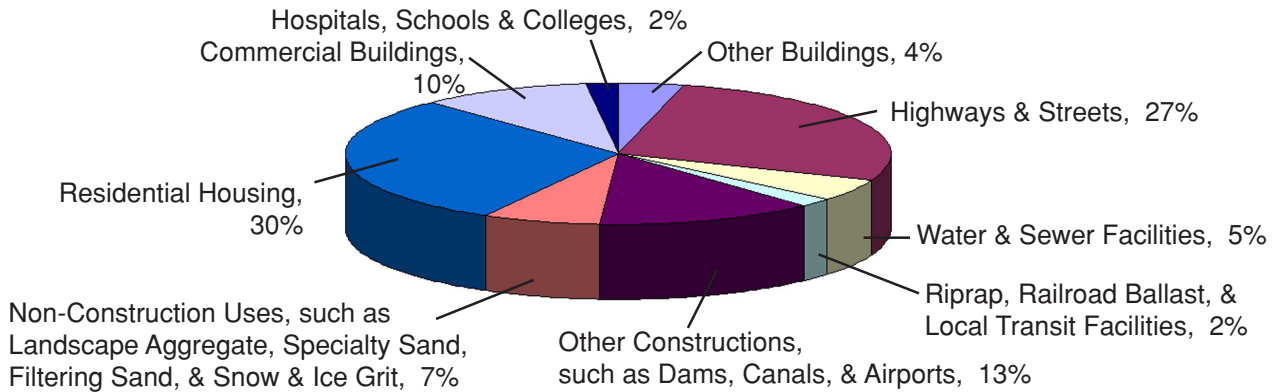
There are 4,360,000 cubic yards of concrete in the dam, power plant and other facilities.

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 ³/₄ 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 weighs 2 tons/cubic yard

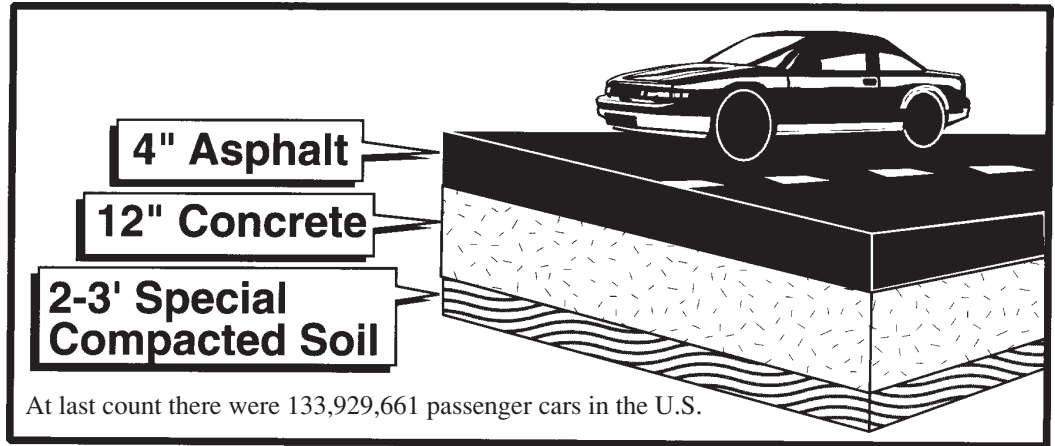
Roads & Highways

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.

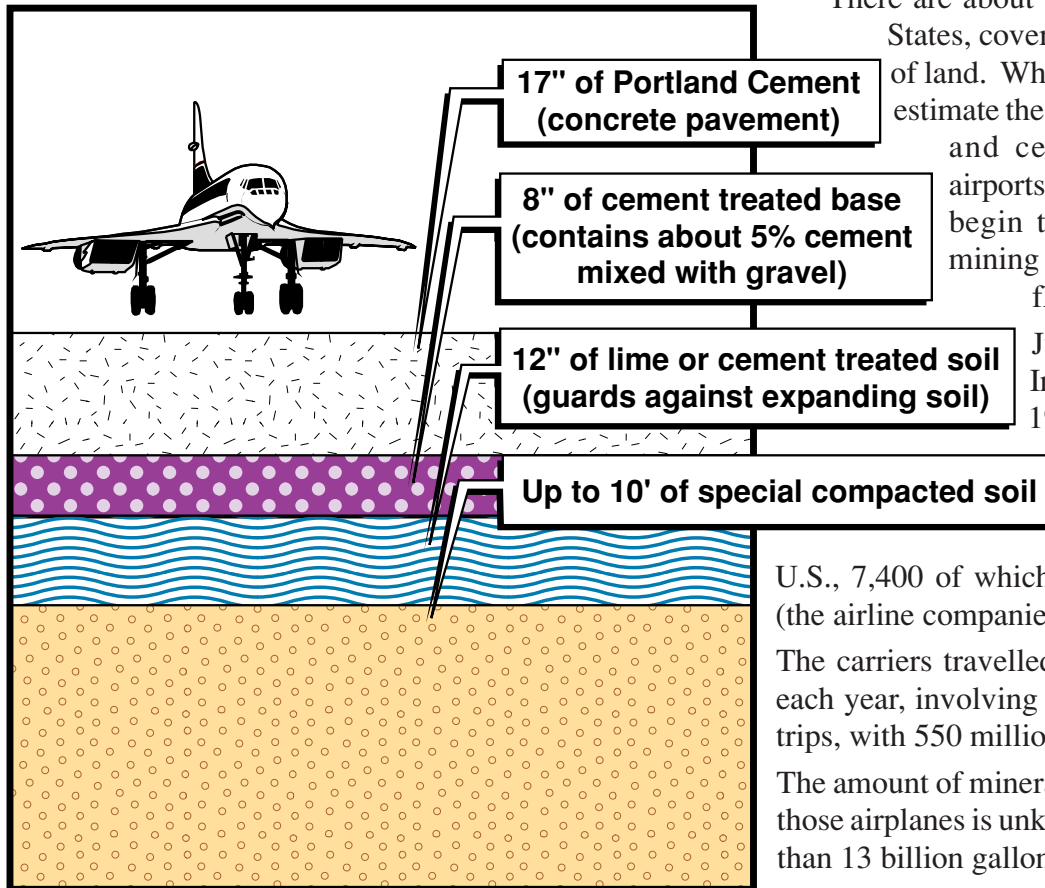
There are more than 1,571,000 miles of dirt roads in the U.S. And every year, they need more dirt put on top of them because driving makes the dirt disappear. It disappears as dust when the sand and rocks are worn finer and finer by the weight of cars.

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.



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

	% of Trips	% of Miles Traveled		Percent
Local trips			Long-distance trips	
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



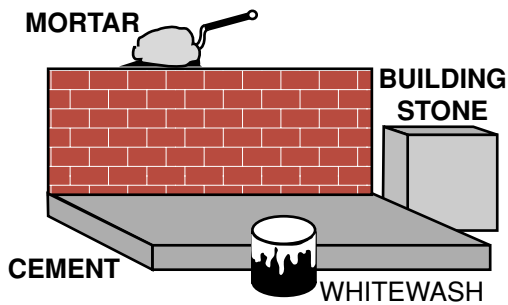
At your home



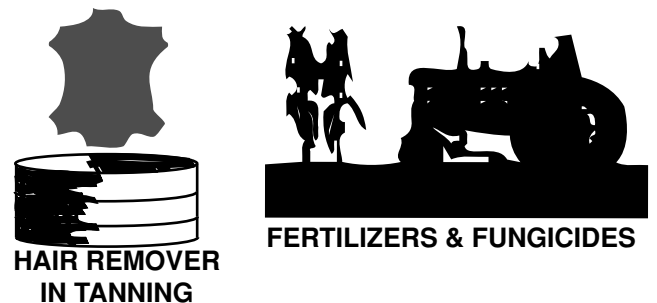
Can you find all the ways limestone is used?

THE MANY USES OF LIME AND LIMESTONE

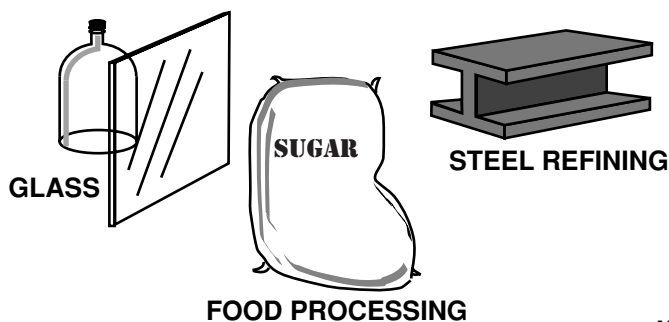
CONSTRUCTION



TANNING AND FARMING



MANUFACTURING



OTHER USES



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

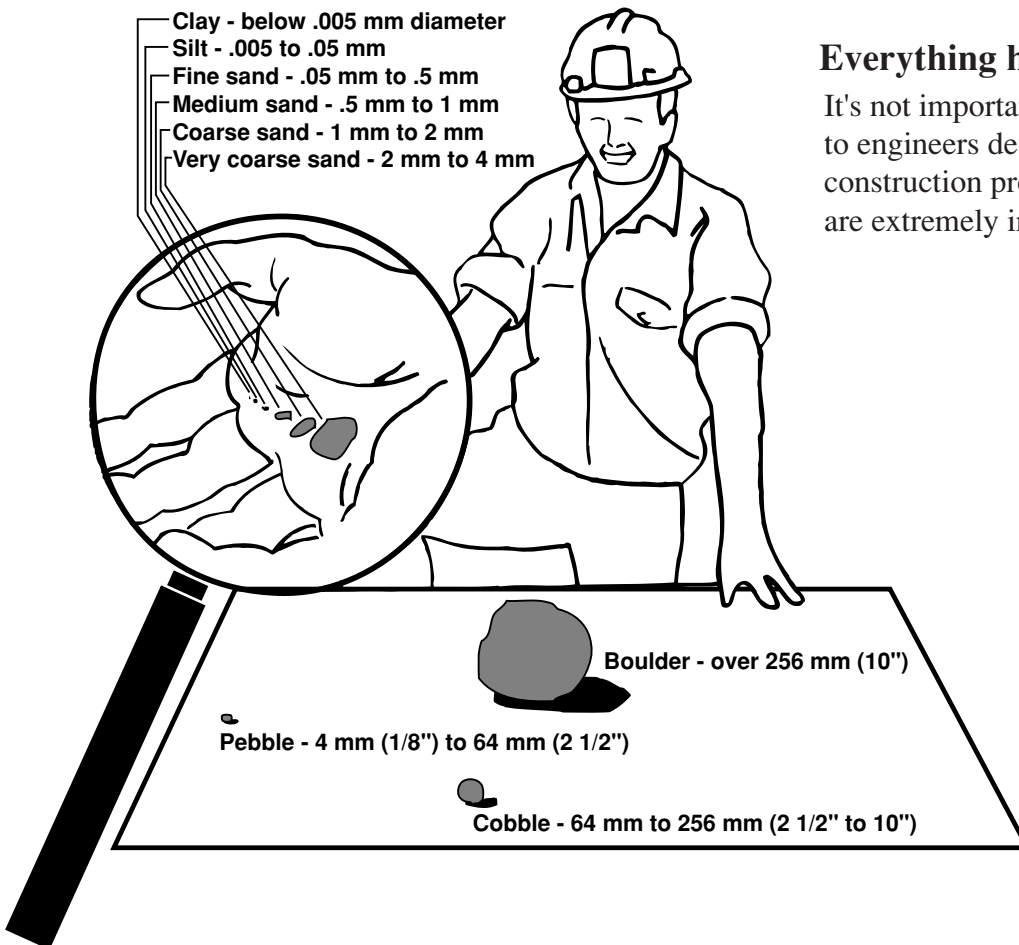
This sounds too large to be true, but it is

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:

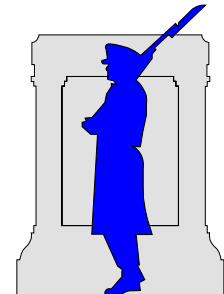
How many pounds of sand, gravel, and stone will be needed by each of your students during their lifetime? How big of a hole needs to be dug somewhere to provide the things they use? For the sidewalk around the school? For the road from their house to school? How many pounds of sand, gravel, and stone 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.

