The Grand Canyon
Somewhere "Grand" does not tell how truly incomprehensible this canyon is. Most people use such words as "marvelous", "stupendous", or "fantastic", but no word is really adequate to describe this amazing creation of nature. The scene continually changes as light plays off the rocks and clouds, creating shadows and contrasts. The world seems larger here with sunrises, sunsets, and storms taking on an added dimension to match the landscape. The permutations are unceasing, and the moods are without end. This is a land to humble the soul.

The Geologic Story at Grand Canyon
Grand Canyon attracts the attention of the world for many reasons, but perhaps its greatest significance lies in the geologic record that is so beautifully preserved and exposed here. The rocks at Grand Canyon are not inherently unique; similar rocks are found throughout the world. What is unique about the geologic record at Grand Canyon is the great variety of rocks present, the clarity with which they're exposed, and the complex geologic story they tell.

There are really two separate geologic stories at Grand Canyon:

The older story is the one revealed in the thick sequence of rocks exposed in the walls of the Canyon. These rocks provide a remarkable (but incomplete) record of the Paleozoic Era (550-250 million years ago), as well as scattered remnants of Precambrian rocks as old as 2000 million years. The story these rocks tell is far older than the canyon itself. Mesozoic and Cenozoic rocks (250 million years old to the present) are largely missing at Grand Canyon (they've either been worn away or were never deposited).

The rock record at Grand Canyon is summarized in the geologic cross section below.

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The second geologic story at Grand Canyon concerns the origin of the canyon itself:
When and how did it come to be?

On one level the answer is simple: Grand Canyon is an erosional feature that owes its existence to the Colorado River (which is largely responsible for the depth of the canyon). Of equal importance are the forces of erosion that have shaped it and continue to shape it today—mainly running water from rain, snowmelt, and tributary streams which enter the canyon throughout its length. The climate at Grand Canyon is classified as semi-arid (the South Rim receives 15 inches (38 cm) of precipitation each year; only 8 inches (20 cm) each year reach the canyon bottom). But what rain received comes suddenly in violent storms, particularly in the late summer of each year, and the power of erosion is therefore more evident here than in places which receive more rain.

How old is the canyon itself?
The early history and evolution of the Colorado River (of which Grand Canyon is only a part) is the most complex aspect of Grand Canyon geology and far beyond our scope here. We do know, however, that the erosion which has shaped the canyon has occurred only in the past five to six million years—only yesterday, considering the age of the rocks through which the Canyon is carved.

Grand Canyon continues to grow and change. As long as rain and snow continue to fall in northern Arizona, the forces of erosion will continue to shape the Grand Canyon of the Colorado River.

Why does it look the way it does?
Grand Canyon owes its distinctive shape to the fact that the different rock layers in the canyon walls each respond to erosion in different ways:

some form slopes,
some form cliffs,
some erode more quickly than others.

The vivid colors of many of these layers are due mainly to small amounts of various minerals, most containing iron, which impart subtle shades of red, yellow, or green to the canyon walls. Climate plays an important role, too. If the climate at Grand Canyon were wetter, the planes and trees that grow there would be very different, and the canyon walls might be covered with lush vegetation.

Are the Oldest rocks in the world exposed at Grand Canyon?
No. Although the oldest rocks at Grand Canyon (2 billion years old; ie. 2,000,000,000) are fairly old by any standard, the oldest rocks in the world are closer to 4 billion years old. The oldest exposed rocks in North America (which are among the oldest rocks in the world) are in northern Canada.

How old is the Canyon?
That's a tricky question. Although rocks exposed in the walls of the canyon are geologically old, the Canyon itself is a fairly young feature. The oldest rocks at the canyon bottom are close to 2 billion years old. The Canyon itself—an erosional feature—has formed only in the past five or six million years (6,000,000). Geologically speaking, Grand Canyon is very young.

How big is it?
That depends on how you look at it. The park includes over a million acres of land—(1,218,375.54 acres; 493,077 hectares, to be exact; or 1,904 square miles; 4,931 square kilometers). But most people measure the canyon in river miles, along the course of the Colorado River at the bottom of the canyon. By that standard, Grand Canyon is 277 miles (446 km) long. It begins at Lees Ferry (mile 0)-and ends at the Grand Wash Cliffs (mile 277 (km 446).

The Colorado River is longer, of course (1450 miles (2333 km) long ) from the Rocky Mountains of Colorado to the Gulf of California in Mexico. Grand Canyon is only one of many beautiful canyons which the river has
carved. Others include Cataract Canyon and Glen Canyon—the latter now beneath the waters of Lake Powell. Most people agree, however, that Grand Canyon is the most spectacular: there’s simply no other place in the world that looks quite like it.

Width and depth of the Canyon vary from place to place. At the South Rim, near Grand Canyon Village, it's a vertical mile (about 5000 feet/1524 m) from rim to river (7 miles/11.3 km by trails if you're walking). At its deepest, it is 6000 vertical feet (1829 m) from rim to river. The width of the Canyon at Grand Canyon Village is 10 miles (16 km) (rim to rim), though in places it is as much as 18 miles (29 km) wide.

Here's another way to look at size: a trip to the bottom of the Canyon and back (on foot or by mule) is a two-day journey. Rim-to-rim hikers generally take three days one-way to get from the North Rim to the South Rim. A trip through Grand Canyon by raft can take two weeks or longer, and experienced backpackers have spent weeks in the more remote areas of the Canyon.

Are there dams in Grand Canyon? No, although several dams bordering the park have a profound effect on Grand Canyon. At the upper end of the Canyon, 15 river miles (24 km) above Lees Ferry, is Lake Powell, formed by the waters behind Glen Canyon Dam. At the lower end of the canyon is Lake Mead, formed by the waters behind Hoover Dam.

The controlled release of water from Glen Canyon Dam at the upstream end affects the water that flows through Grand Canyon. Waters from Lake Mead flood the lower 40 miles (64 km) of Grand Canyon when the lake is full. Hoover Dam was completed in 1936. Glen Canyon Dam was completed in 1963.

How does one see the canyon? Nearly five million people see Grand Canyon each year. Most of them see it from their car at overlooks along the South Rim (this includes Grand Canyon Village, Hermits Rest, and Desert View). The South Rim – 60 miles (97 km) north of Williams and 80 miles (129 km) northwest of Flagstaff, Arizona – is the most accessible part of the park and is open all year.

A much smaller number of people see the Canyon from the North Rim, which lies just 10 miles (16 km) (as the raven flies) directly across the Canyon from the South Rim. The North Rim rises a thousand feet higher than the South Rim, and is much less accessible. Heavy snows close the North Rim from late October to mid May of each year. Even in good weather it's harder to get to: it's 220 miles (354 km) by car from the South Rim, or 21 miles (34 km) by foot across the Canyon by way of the North and South Kaibab Trails.

The inner canyon includes everything below the rim and is seen mainly by hikers, mule riders, or river runners. There are many opportunities here for adventurous and hardy persons who want to backpack, ride a mule to Phantom Ranch, or take a river trip through the Canyon on the Colorado River (which can take anywhere from a few days to three weeks—there are no one-day river trips through Grand Canyon).

How do people get across the canyon? If you’re walking, the South Kaibab Trail crosses the Colorado River on a narrow footbridge 70 feet (21 m) above the water. There is only one way to cross by automobile, and that is via Navajo Bridge, just a few miles downstream from Lees Ferry, where the Canyon is still only 400 feet (122 m) wide.

When and Why did Grand Canyon become a National Park? Grand Canyon is unmatched throughout the world in the incomparable vistas it offers to visitors on the rim. It is not the deepest canyon in the world (both the Barranca del Cobre in northern Mexico and Hell’s Canyon in Idaho are deeper, just to name two), but the Grand Canyon is known throughout the world for its overwhelming size and its intricate and colorful landscape. Geologically it is significant because of the thick sequence of ancient rocks that are beautifully preserved and exposed in the walls of the canyon. These rock
layers record much of the early geologic history of the North American continent. Finally, it is one of the most spectacular examples of erosion in the world.

The history of the Grand Canyon region is just as interesting. Grand Canyon was largely unknown until after the Civil War. In 1869, Major John Wesley Powell, a one-armed Civil War veteran with a thirst for science and adventure, made a pioneering journey through the Canyon on the Colorado River. He accomplished this with nine men in four small wooden boats (only six men completed the journey). His party was as far as we know, the first ever to make such a trip.

In the late 19th Century there was interest in the region because of its promise of mineral resources (mainly copper and asbestos, as it turned out). The first pioneer settlements along the rim came in the 1880s. Early residents soon discovered that tourism was destined to be more profitable then mining, and by the turn of the century Grand Canyon was a well-known tourist destination. Many of the early tourist accommodations were not so different from the mining camps from which they developed, and most visitors made the grueling trip from nearby towns to the South Rim by stagecoach.

In 1901 the railroad was extended from Williams, Arizona to the South Rim, and the development of formal tourist facilities at the South Rim increased dramatically. By 1905 the El Tovar Hotel stood where it does today, a world class hotel on the canyon’s edge. The Fred Harvey Company, known throughout the west for hospitality and fine food, continued to develop facilities at Grand Canyon (including Phantom Ranch, built in the inner canyon in 1922). Although first afforded Federal protection in 1893 as a Forest Reserve and later as a National Monument, Grand Canyon did not achieve national park status until 1919, three years after the creation of the National Park Service. Today Grand Canyon National Park receives close to five million visitors each year – a far cry from the annual visitation of 44,173 which the park received in 1919.

Grand Canyon became a national park in order to give it the best protection we, as a nation, have to offer. The mission of the National Park Service, here and elsewhere, is to preserve the park and all of its features, including the processes that created them, and to provide for it’s enjoyment by park visitors in a way that will leave the canyon unspoiled for future generations. Now, more than ever, we recognize how complex and difficult a task that can be.
Go to http://www.nature.nps.gov/geology/parks/grca/index.cfm and answer the questions below:

1. Why are there not any Mesozoic and Cenozoic rocks (250 million years old to the present) found in the layers of the Grand Canyon?

2. What role does the Colorado River play in relation to the Grand Canyon?

3. How old is the Grand Canyon?

4. How would the Canyon look if there was more rainfall?

5. What is the widest measurement of the Grand Canyon, how long would it take to hike from rim to rim?

6. What is the deepest measurement of the Grand Canyon?

7. Why is the geology of the canyon so important?

8. What mineral resources were of importance in the 19th century before tourism took off?

9. Compared to the first year that Grand Canyon became a national park, how many more visitors are there?