Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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Learning Modules

What is field geology?
Field geology plays an important role in the continued study of the planet, as only a small amount of the planet's navigable surfaces have ever been formally surveyed by geologists. In addition to researching and understanding the history of Earth as it was before humans evolved, geology can also give a clear picture of the structure of Earth today. A field geologist typically performs surveys on specific areas of land in order to create detailed pictures of the contained geology. These pictures, often seen as geological maps, can be of great benefit to human industry and existence, as well as give clues to the formation of the planet and the rules of planetary evolution.

A field geologist is a scientist who studies geology outdoors and is an expert at interpreting landscapes and rocks to deduce geologic processes and histories. Many field geologists also work as a researcher or professor in their time away from the field. By combining educational work with field research, geologists have a chance to work year-round in their field, constantly finding new sources of interest or experiencing the joy of bringing new minds into the field.

While working in the field, a field geologist uses a hammer, a compass for taking orientations, a field notebook, and a mineral testing kit. Rugged clothes and sturdy hiking boots are also helpful. Field geologists often create maps with the aid of satellites and GIS (Geographic Information Systems).

Some of the topics studied by geologists:
- Astrogeology
- Caverns and caves
- Earthquakes, volcanoes and tsunamis
- Ecosystems
- Geomagnetism
- Groundwater
- Land use and changing landscapes
- Plate tectonics
- Rocks and minerals

Sources
- Harriman State Park, Rutgers University http://harrimanrocks.rutgers.edu/meet_the_geologist.html
- U.S. Geological Survey http://education.usgs.gov/
- WiseGEEK http://www.wisegeek.com/what-is-a-field-geologist.htm

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What is the Moon made of?

While scientists know a lot about the surface of the Moon from collecting samples and using invisible X-rays reflecting off the surface of the Moon, they are only able to guess about what the inside of the moon is like. The outermost layer of the Moon is called the crust, which extends below the surface to a depth of 50 km. According to astronomers, the crust of the Moon is composed mostly of oxygen, silicon, magnesium, iron, calcium, and aluminum.

Inside the crust is the largest region of the Moon, called the mantle. Scientists believe that the mantle of the Moon is largely composed of the minerals olivine (a yellow-green color mineral), orthopyroxene (green/brown or green/balack) and clinopyroxene (green/brown). It's also believed to be more iron-rich than the Earth's mantle.

The innermost layer of the Moon is the lunar core, which only accounts for about 20% of the diameter of the Moon. Astronomers think that the lunar core is composed of metallic iron, with a little sulfur and nickel, and is partially molten.

By mapping the distribution of a range of elements over a wide area of the Moon, researchers hope to test theories on how the Moon was formed. You can listen to a very interesting podcast about the formation of the Moon from Astronomy Cast, Episode 17: Where Did the Moon Come From?

Sources

- Universe Today http://www.universetoday.com/20583/what-is-the-moon-made-of/
- Discovery Channel http://dsc.discovery.com/news/afp/20030929/moon.html
- Astronomy Cast, Episode 17: Where Did the Moon Come From? www.astronomycast.com/astronomy/episode-17-where-does-the-moon-come-from/

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What is the history of human exploration in space?
The easiest way for us to study the solar system would be to go out and collect pieces of it, but this is very difficult due to many factors, such as time, money, training, and dangerous conditions. Astronauts brought a few rocks back from the moon, and some pieces of Mars and the Asteroid Belt have fallen to the Earth as meteorites. Beyond that, scientists have had to devise other ways to study the universe, such as the use of satellites orbiting other plants, robots traversing them, probes entering their atmospheres, and other instruments.

Some Key Points in the history of space exploration by the U.S.

- **1958-1963:** The first U.S. satellite orbits the Earth as part of Project Mercury
- **1961:** Alan Shepard is the first American in space
- **1962:** John Glenn is the first American to orbit Earth as part of Project Gemini
- **1967:** Dr. William R. Muehlberger designed and implemented the first highly successful astronaut field geology training program
- **1969-1972:** 6 moon landings, 12 astronauts walk on the moon
- **1981-2011:** 135 missions by space shuttles into low Earth orbit
- **2000-2020:** International Space Station, located in orbit 400km above the Earth, now big enough for 6 people, has had continuous occupation now for 11 years

Since the last Apollo mission in 1972, we have made many advances in remote sensing, 3D modeling and simulation, and planetary robotics. All these advances mean that the way we explore the Moon and conduct surface science in the future will be different than in the past.

Sources

- The notes of Dr. Mark Helper
- Aerospace http://www.aero.org/education/primers/space/history.html
- NASA http://spaceflight.nasa.gov/history/
- Cornell University, Curious About Astronomy? Ask an Astronomer http://curious.astro.cornell.edu/question.php?number=708

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How are astronauts trained?

The word "astronaut" comes from a Greek word that means "sailor among the stars". While all astronauts must speak English and pass the same spaceflight physical examinations, there are three different types of astronauts:

- Pilots – command and pilot the spacecraft, usually from the US Air Force, Navy, or Marines.
- Mission specialists – perform spacewalks, launch satellites, and activities particular to that mission
- Payload specialists – conduct scientific experiments with the cargo on the spacecraft, usually scientists approved by NASA.

Basic training for an astronaut's first flight occurs near Houston, Texas and lasts for about two years. This training includes basic science (including math, astronomy, physics, geology, meteorology, and oceanography), technology (navigation, orbital mechanics, materials processing), survival techniques (including overcoming extreme atmospheric pressures, swimming tests, and changes in gravity), flight training and parachute jumping, and the details of their space shuttle system and instruments.

At least ten months before their mission, astronauts are trained for their specific objectives and are immersed in mock-ups and simulations to help prepare them for every kind of emergency or contingency from launch to landing. They even practice meal preparation, equipment stowage, trash management, and other equipment usage. Astronauts end up spending more hours in simulators than they do in space.

During the final eleven weeks before their flight, the astronauts train with the flight controllers in the Mission Control Center, linked by computer in the same way as they would be during a mission, so that they can learn to work as a team when solving problems and sticking to timelines. Many technical meetings are held and medical tests ensure their health and fitness.

Sources

- Curious About Astronomy? Ask an Astronomer. Cornell University http://curious.astro.cornell.edu/question.php?number=494
- Space Travel Guide, Oracle ThinkQuest http://library.thinkquest.org/03oct/02144/text/travel/training.htm and http://library.thinkquest.org/J0112188/astronauts_in_training.htm
- PBS: Space Station http://www.pbs.org/spacestation/station/training.htm