

How Science Works

as you read

What You'll Learn

- **Explain** the science of archaeology.
- **Compare and contrast** science and technology.

Why It's Important

Science and technology are important parts of your everyday world.

Review Vocabulary

artifact: object of historical interest produced by humans, such as a tool or weapon

New Vocabulary

- science
- technology

Groundbreaking News

It was Friday morning, and the students in Ms. Garcia's science lab were waiting eagerly for class to start. Unlike most days in science class at York Middle School, this meeting would be a field trip to the north end of the school. Students were eager to observe work that would result in the long-awaited, new gymnasium. The students in group 4—Ben, Emily, Maria, and Juan—peered out the windows. They saw construction equipment, including bulldozers and trucks much like the ones shown in **Figure 1**, pull up to the school. With pencils and notebooks in hand, the interested students hiked out to the site. They watched as massive shovels moved hundreds of kilograms of dirt from one spot to another.

Buried treasure? All of a sudden, the power-shovel operator stopped the giant scoop in midair. He looked curiously into the hole he was making, and then he climbed from his seat high above the ground. He called some of the other workers over. They all stared into the pit. One of the workers motioned for Ms. Garcia and her students to come a little closer. Everyone was surprised at what they saw. A piece of broken pottery was sticking out from the loosened soil.

Figure 1 Construction efforts sometimes unearth prehistoric sites.

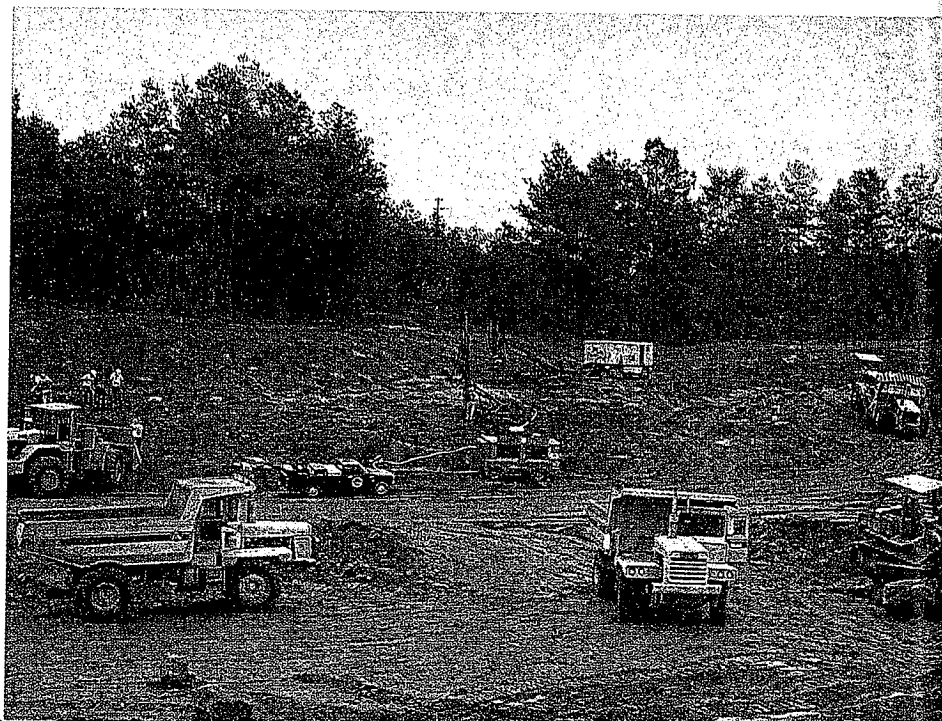


Figure 2 Much can be learned about ancient cultures from materials they left behind.

Archaeologists study pottery and other items to learn more about ancient humans.



Archaeologists work in the field to gather data.



Science in Action One worker suggested that the pottery might be only one of thousands of pieces of trash that were buried long before the school was built. Another worker, however, wasn't so sure. He thought that the pottery could perhaps be an ancient piece of art, such as the one shown in **Figure 2**. Nonetheless, a decision was made to stop the excavation, at least for the moment.

Back in the classroom, the students talked excitedly about the find. This, they all agreed, was real science. **Science**, they knew, is the process of trying to understand the world.

Calling in the Experts Although the discovery was exciting, Ms. Garcia reminded the students that the piece of pottery might be something that was thrown out only decades ago. To be sure, however, the school's principal called an archaeologist at the local college. Archaeologists, such as the two shown in **Figure 2**, are scientists who study the cultural remains of ancient humans. Cultural remains, known as artifacts, might be tools, weapons, rock drawings, buildings, or pottery, such as that found at the school. Dr. Lum, the students were told, would be at the school on Monday to examine the pottery.

Ms. Garcia suggested that her students research more about the history of their area. This would help the students evaluate how this pottery might have originated from ancient cultures that once lived in the area. Ben and the others in his group quickly began their research. Maria thought that it would be a good idea to take notes on their findings. That way, they could compare what they found with what Dr. Lum told them on Monday. The others in the group agreed and put their science notebooks into their backpacks before heading to the library.

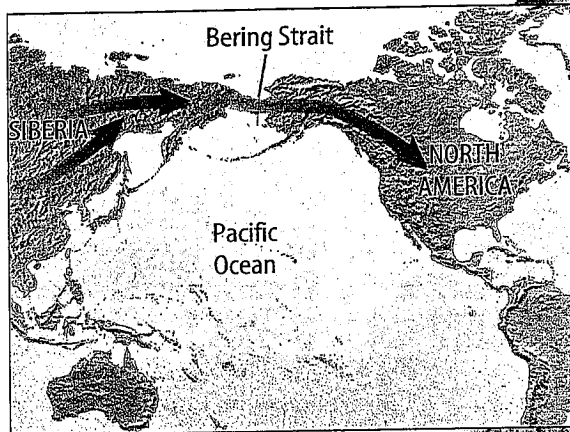
ScienceOnline

Topic: Artifacts and Human History

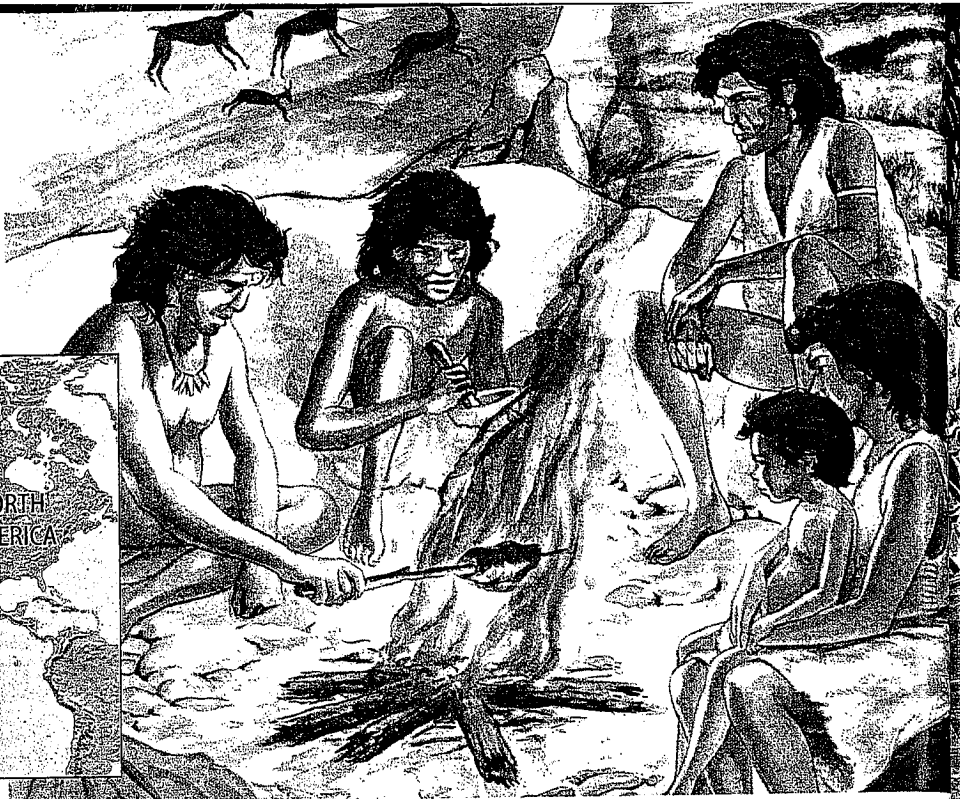
Visit green.msscience.com for Web links to information about how artifacts provide clues about human behavior and history.

Activity Select a human artifact, such as a tool, art piece, or waste material. List three specific examples of this type of artifact, and include the location where each was found. Summarize the knowledge gained about the humans who produced the artifacts.

Figure 3 Archaeologists study artifacts of ancient people like those from ancient Egypt or like those who came to North America about 12,000 years ago.



One branch of archaeology studies the cultural remains of people who lived before history was written.



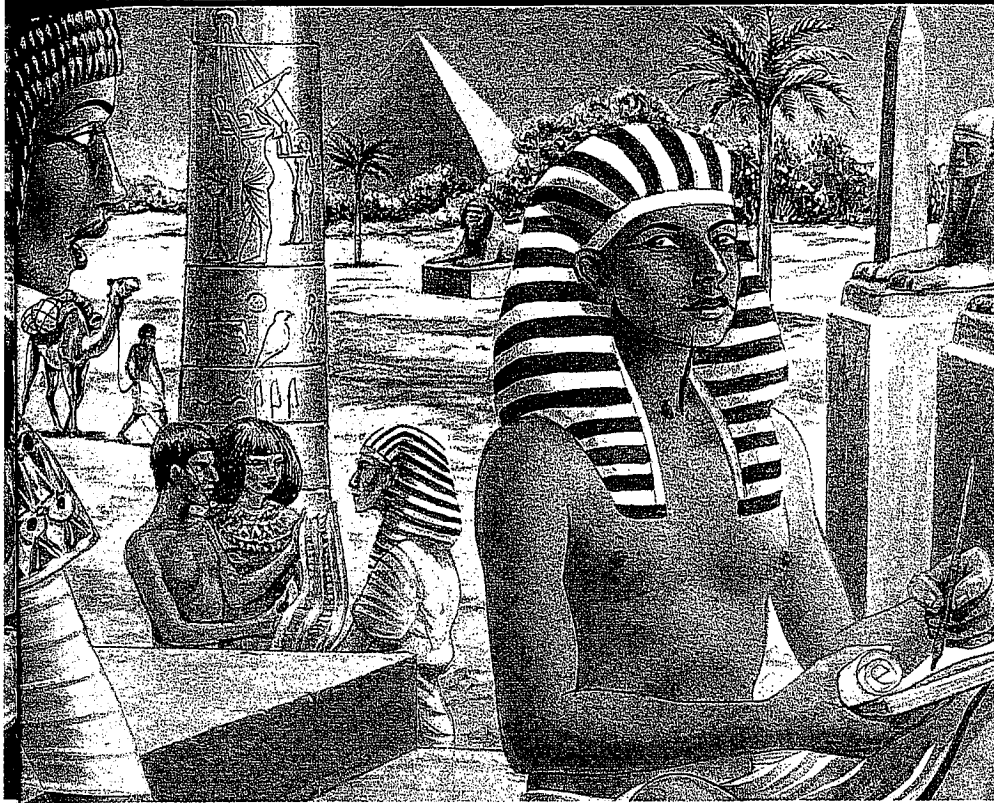
Researching the Past

At the library, Juan used an encyclopedia to begin his research. He found out that archaeology is a branch of science that studies the tools and other cultural remains of humans. There are two major branches of archaeology, as shown in **Figure 3**. One focuses on groups of people who lived before history was written. The other studies civilizations that developed since people began writing things down. To his surprise, Juan also discovered that archaeology covers a time span of more than 3 million years. About 3.5 million years ago, he read, the first ancestors of humans are thought to have appeared on Earth.

Reading Check

What are the two major branches of archaeology?

The other students took turns finding out about the history of their area. Ben found that many scientists hypothesize that the first people came to North America from Asia about 12,000 years ago. Over thousands of years, these people migrated to different parts of the continent. Emily and Maria discovered that the area around their city was settled about 2,000 years ago. After locating a few more sources of information, the students took notes on all the information they had gathered. Emily suggested that they also write any questions they had about the pottery or the science of archaeology. Juan, Ben, and Maria agreed, and each wrote a few questions. The group left the library eager to hear how its findings would compare with what Dr. Lum would tell them on Monday.



Another branch of archaeology studies civilizations that have developed since written history began.

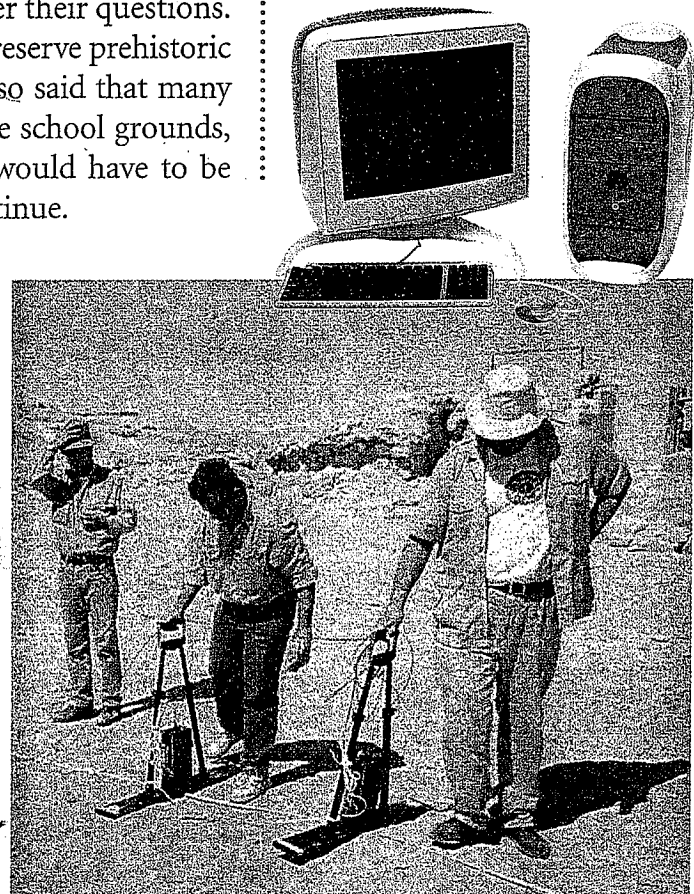
Think Critically How would you define written history when distinguishing rock drawings from hieroglyphics?

Dr. Lum's Visit Dr. Lum arrived before nine o'clock. When the bell rang, Emily's hand shot up. She was hoping to be the first to ask about the pottery. However, before calling on her, Dr. Lum said she wanted to give the students some background information and then she would answer their questions.

Dr. Lum explained how important it is to preserve prehistoric sites for present and future generations. She also said that many archaeological sites, like the possible one on the school grounds, are found by accident. More scientific work would have to be done before construction on the site could continue.

Technology Several kinds of technology would be used to study the area, such as computers and cameras. **Technology** is the use of knowledge gained through science to make new products or tools people can use. **Figure 4** shows some common types of technology. Dr. Lum told the students that a radar survey would be conducted to help study the find at the school. This type of technology, Dr. Lum explained, helps scientists "see" what's beneath the ground without disturbing the site. Experts from other fields of science probably would be called upon to help evaluate the site. For instance, geologists, scientists who study Earth processes, might be contacted to help with soil studies.

Figure 4 Computers and radar are two examples of technology used in archaeological research. **List at least three other forms of technology.**





Relative Ages Archaeologists and geologists determine the relative ages of layers of sediment and artifacts by examining where they lie in comparison to other layers. For example, in undisturbed sediment, the bottom layer is the oldest and the layer on top is the youngest. Model this concept with a stack of books.

Working Together Dr. Lum ended her talk by suggesting that the students go back to the site with her. There, she would examine what had been found. She also would try to answer any questions the students might have about the find.

Maria and Emily led the group of curious students toward the north end of the school yard. Dr. Lum used her hand lens to observe the piece of pottery carefully. After examining the piece for awhile, she announced that she thought the pottery was old and that an archaeological dig, or excavation of the site, was in order. The students asked if they could participate in the dig. Dr. Lum said she would welcome all the help they could give.

Digging In

Weeks passed before the radar surveys were complete. The students in Ms. Garcia's class spent most of their time learning about how an archaeological excavation is done. Maria reported to the class that the holes and ditches that were being dug around the site would help determine its size. She also added that it was important that the site be disturbed as little as possible. By keeping the site intact, much of its history could be retold.

Finally, the day came when the students could participate in the dig. Each was given a small hand shovel, a soft paintbrush, and a pair of gardening gloves. Each student was paired with an amateur archaeologist. All of those involved were instructed to work slowly and carefully to excavate this important piece of their city's past. **Figure 5** shows a piece of pottery recovered from a similar archaeological dig site.

Artifacts are carefully mapped before they are excavated.



Figure 5 This paint brush, along with other tools, such as dental probes and toothbrushes, are commonly used to remove artifacts.

Explain why ancient sites must be excavated carefully.

Clues to the Past Many pieces of pottery, along with some tools, were found at the school site. Before the artifacts were removed from the soil, college students working with Dr. Lum took pictures or made drawings of each piece. These were used to make maps showing the exact location of each artifact before it was removed. The maps also would be used to show vertical and horizontal differences in the site.

Lab Work Each artifact was given a number and its location and orientation in the soil was recorded. After the artifacts were cataloged, they were removed from the site. Dr. Lum told the students that she would take the finds back to her lab. There, they would be cleaned, studied, and stored for future analysis, as shown in **Figure 6**.

Chemical analyses of certain artifacts would be used to determine their approximate age. Based on her knowledge of the area, Dr. Lum thought that the site was at least several thousand years old.



Figure 6 After artifacts are mapped and excavated, they're taken to a laboratory where they are cleaned and tagged for further study.

section 1 review

Summary

Groundbreaking News

- Science is the process of trying to understand the world.
- Important discoveries in science sometimes happen by accident.
- Discoveries must be subject to scientific testing in order to be validated.

Researching the Past

- Background research is an important part of any scientific study.
- Technology applies knowledge that is gained from doing science.

Digging In

- Both field and lab methods are used during scientific studies.

Self Check

1. **Explain** what archaeology is.
2. **Describe** several common forms of technology used in science.
3. **Explain** why scientists conduct radar surveys of archaeological sites.
4. **List** some examples of cultural remains studied by archaeologists.
5. **Think Critically** Why are maps of prehistoric sites often made before removing the artifacts?

Applying Skills

6. **Compare and contrast** science and technology. Include a discussion of how progress in science can lead to progress in technology, and vice versa.