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The following lessons were created by **Peggy Deichstetter**, a teacher participating in the National Endowment for the Humanities Summer Institute for Teachers entitled Touch the Past: Archaeology of the Upper Mississippi River Region.

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Science Is Science!

Grade Level: 9-10

Subjects: Biology

Objectives:
Student should understand that science is the same no matter if it is Biology or Archaeology. Science is based on facts (observations). However, with enough information within a context, it is possible to infer information from your data. These facts will lead to a hypothesis, an answer to a question that you have about your observations. That hypothesis is tested by experimentation, which means predicting the outcome of your hypothesis.

Standards:
Teaching Standard B
Teachers of science guide and facilitate learning. In doing this, teachers
Focus and support inquiries while interacting with students.
Orchestrate discourse among students about scientific ideas.
Challenge students to accept and share responsibility for their own learning.
Recognize and respond to student diversity and encourage all students to participate fully in science learning.
Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

Duration: Part 1: 2 weeks, Part 2: 1 week

Materials/Supplies:
Activities 3, 7, and 8 from "Intrigue the Past". Garbage from different people/rooms/etc. Video of Dr. Theler's lecture. Assessment sheet for the lecture

Vocabulary:

archaeology
artifact
chronology
classification
conclusion
context
culture
data
evidence
fact
hypothesis/hypotheses
inference
midden
observation
scientific method

Background: Teachers need to know and understand the science method.

Setting the Stage:
This lesson is a discovery lesson in that students become acquainted with the scientific inquiry method.

Procedure:
Part 1 of Inference: "Boy in the Water" pages 16-17 in "Intrigue of the Past"

1. Project the master of the "Boy in the Water." Project or distribute the "in the Water" activity sheet.
2. Read each statement and ask students to decide if it is a statement of observation or of inference. Ask them to give reasons for their answers.
3. How might one or more of the inferences (hypotheses) be tested?
4. Assist students to create a definition for observation, inference, and hypothesis.

Part 2 of Inference: "The Coins" page 18 in "Intrigue of the Past"

1. Project the master and explain that the "the metal circles" were found all over the world
2. Which statements are observations and which are inferences? Which observation is each inference based on?
3. Many different inferences are possible from one observation. What other inferences might be made from observing these coins?

Part 3 of Inference: Application

1. Distribute the "In Search of Early Artists" handout

Part 1 of Scientific Inquiry: page 30 in "Intrigue of the Past"

Procedure:

1. Distribute a copy of the "Archaeological Inquiry" sheet, which the students will fill in as they are led through the following inquiry.
2. The inquiry process begins with a question. Archaeologists want to answer questions about past human behavior and must use material remains to do so. Ask the students to consider the following - "Is the owner of the desk next to you a saver or a thrower-awayer?"
3. Formulate a hypothesis: If there is a large item not required for school work in the desk it is likely the owner is a saver.
4. Classify the data: The two categories are – essential items required for school work and items not required for school work. Discuss the differing ideas about what constitutes "required items" since this determines how objects are categorized.

Part 2 of Scientific Inquiry: Application

1. Distribute a copy of "A Problem of Immunity"
2. Students work to discover the real cause of the villager's immunity by asking what preliminary study might be done in Africa.

Closure:

Using "Intrigue of the Past" activity # 8 "It's in the Garbage", Students use hands on inquiry to develop their own science investigation.

Evaluation:

Using the video from Dr. James Theler's lecture on archaeological digs I will ask students to identify: observations, inferences, with what context were these inferences made, what hypotheses were made and how conclusions were developed.

Links/Extension:
After a unit Natural Selection students view "Nova: Becoming Human" and evaluate the observations, inferences, hypotheses and conclusions.

References:
Letts, Kelly, Moe, Jeanne, Paterson, Danielle and Smith, Shelley Intrigue of the Past; United States Department of the Interior, Bureau of Land Management. 1993

Biological Science Curriculum Study (BSCS) Green Version Workbook. 1990

PBS Nova video: Becoming Human

Attachments:
In Search of Early Artists worksheet
A Problem of Immunity worksheet

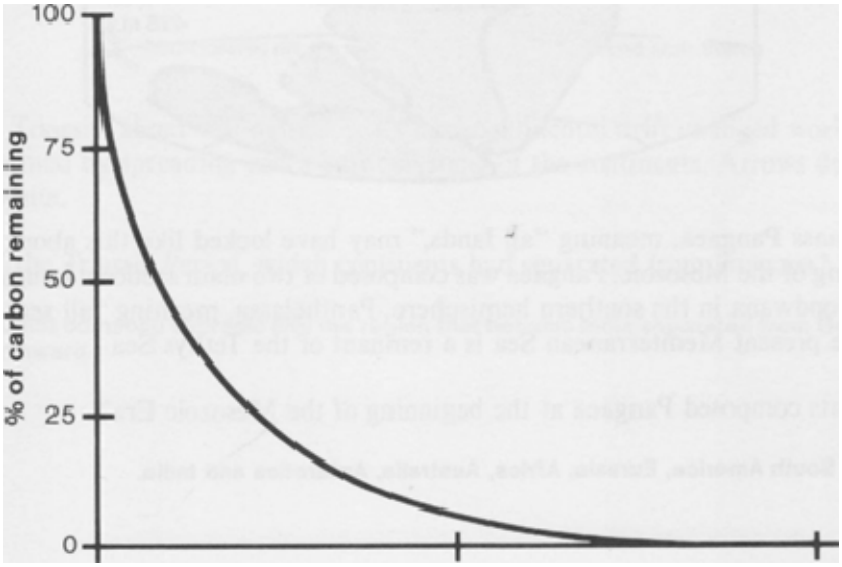
In Search of Early Artists

On the walls and ceilings of a cave near Lascaux, France, are magnificent paintings. Some are far underground. In a great chamber, called the Hall of Bulls, the paintings are of gigantic bulls. In adjoining passages are paintings of horses, deer, wild cattle, and bison. Paintings in other parts of the cave show a man, a rhinoceros, cats, and other animals.

To determine who the artists were and when they lived, scientists studied the things the artists left behind. Stone palettes and lumps of pigments were some evidence they left, as well as the remains of meals. Because they had to paint in the dark, they used lamps made of stone. Tallow probably was the fuel, and the wicks were made of lichen or twigs of juniper.

Ashes and soot found with the lamps have provided carbon for radiocarbon dating. As any organism takes in carbon during its lifetime, it takes in a certain proportion of carbon-14 (14C), a radioactive element that is formed in the air. When the organism dies, the 14C begins to decay to nitrogen at a definite rate: about every 5730 years, half of the 14C originally present has been converted to nitrogen. (In other words, the half-life of 14C is 5730 years.)

By measuring the amount of 14C in an artifact and comparing it to the amount that would be expected (based on the amount of ordinary carbon that is present), a scientist can determine the artifact's age. Draw a graph showing the breakdown of 14C that occurs over the years.



50,000

After how many years is less than 1% of the original 14C left in a fossil?

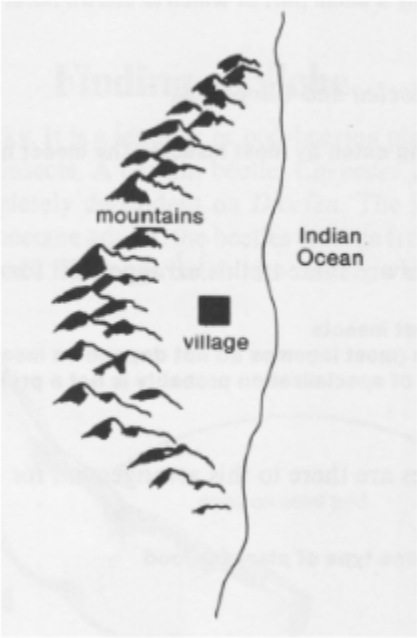
The charcoal found with the lamps contained about 13% of the 14C that was in the original fuel. How old are the paintings?

A Problem of Immunity

A scientist read a journal article about a village near the east coast of Africa. A parasite that lives symbiotically with 70% of Africans is never found in the villagers. The villagers are very fond of drinking a beverage they make from a local plant that grows only there.

The scientists made a tentative inference about the villager's apparent immunity to the parasite. What was it?

Another scientist read another article about the disease. The article said nothing about the beverage, but with the article was a rough map of the village and the surrounding area.



That scientist also made a tentative inference about the villager's immunity to the parasite. What was it?

The two scientists met each other at a conference and they discussed their inferences about the village. They decided to travel there together to discover the real cause of the villager's immunity. What preliminary study might they do in Africa?

Answer Key

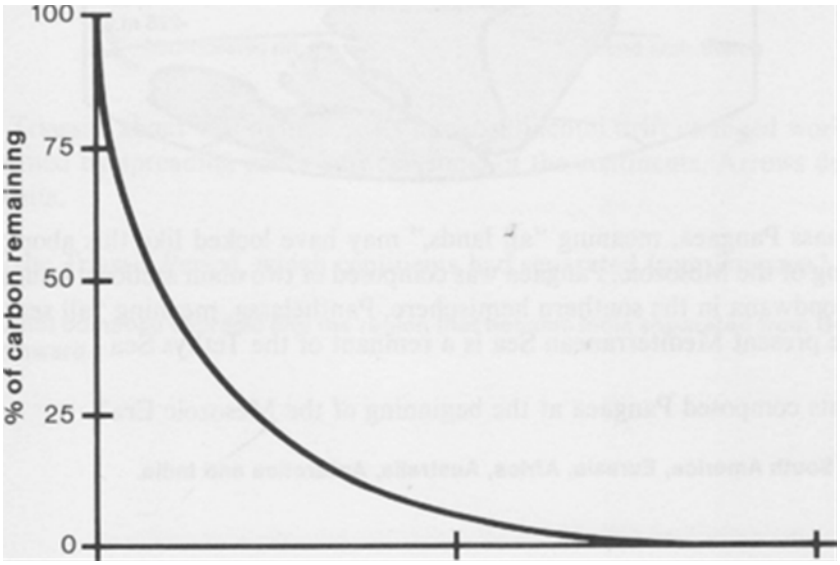
In Search of Early Artists

On the walls and ceilings of a cave near Lascaux, France, are magnificent paintings. Some are far underground. In a great chamber, called the Hall of Bulls, the paintings are of gigantic bulls. In adjoining passages are paintings of horses, deer, wild cattle, and bison. Paintings in other parts of the cave show a man, a rhinoceros, cats, and other animals.

To determine who the artists were and when they lived, scientists studied the things the artists left behind. Stone palettes and lumps of pigments were some evidence they left, as well as the remains of meals. Because they had to paint in the dark, they used lamps made of stone. Tallow probably was the fuel, and the wicks were made of lichen or twigs of juniper.

Ashes and soot found with the lamps have provided carbon for radiocarbon dating. As any organism takes in carbon during its lifetime, it takes in a certain proportion of carbon-14 (14C), a radioactive element that is formed in the air. When the organism dies, the 14C begins to decay to nitrogen at a definite rate: about every 5730 years, half of the 14C originally present has been converted to nitrogen. (In other words, the half-life of 14C is 5730 years.)

By measuring the amount of 14C in an artifact and comparing it to the amount that would be expected (based on the amount of ordinary carbon that is present), a scientist can determine the artifact's age. Draw a graph showing the breakdown of '4C that occurs over the years.



50,000

After how many years is less than 1% of the original 14c left in a fossil? **40 000**

The charcoal found with the lamps contained about 13% of the 14C that was in the original fuel. How old are the paintings? **17 000 years**

Answer Key

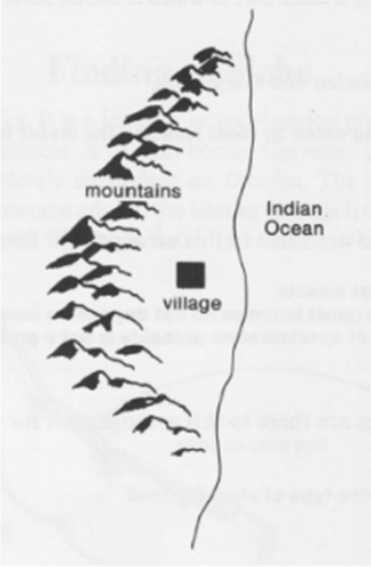
A Problem of Immunity

A scientist read a journal article about a village near the east coast of Africa. A parasite that lives symbiotically with 70% of Africans is never found in the villagers. The villagers are very fond of drinking a beverage they make from a local plant that grows only there.

The scientists made a tentative inference about the villager's apparent immunity to the parasite. What was it?

The beverage might somehow protect them.

Another scientist read another article about the disease. The article said nothing about the beverage, but with the article was a rough map of the village and the surrounding area.



That scientist also made a tentative inference about the villager's immunity to the parasite. What was it?

The mountain range might prevent contact between the villagers and other Africans, so they would not be exposed to the parasite.

The two scientists met each other at a conference and they discussed their inferences about the village. They decided to travel there together to discover the real cause of the villager's immunity. What preliminary study might they do in Africa?

They could try the beverage on non-villagers who did not yet have the parasite. Talking some of the villagers into infested areas, although possibly providing useful information, it would obviously be an unethical practice. If you wish to have students carry this further, have them consider appropriate hypotheses and experimental design.