

Homework Assignment 21: Due at the beginning of class 11/16/01

In the classical theory of the human colonization of North and South America, people started arriving in (what is now) the United States approximately 12,000 years ago. These people have become known as the “Clovis Culture” because many of the archaeological discoveries made in North America have yielded ancient stone tools very similar to ones found at a major archaeological dig in Clovis, New Mexico. According to the classical theory, these early colonists were probably from (what is now) Mongolia, Siberia and Northern China.

In recent years, the discovery of several unusual skeletons has brought this classical theory into question. One of the major tools in modern archaeology is radiocarbon dating. Carbon-14 is a naturally occurring, radioactive isotope of carbon with a half-life of 5730 years. A fresh 100 g sample of organic matter will normally contain 0.0001 μg of carbon-14.

In Questions 3 and 4, use logarithms to interpret the results of radiocarbon dating tests.

1. Use the information provided to create a function that will give the amount (in micrograms, μg) that would be expected to remain in a 100 g sample of organic matter. The independent variable in your equation should be T , the age of the organic matter in years.

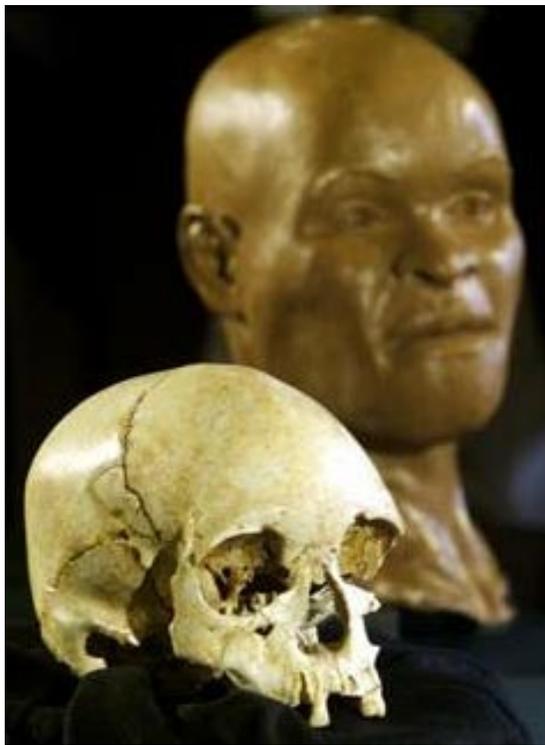


Figure 1: A replica of Luzia's skull, and a facial reconstruction based on the skull.

2. Use the equation that you found in Question 1 to predict the amount of carbon-14 that would remain in a 100 g sample of organic matter that is 12,000 years old.
3. The oldest human remains found in the Americas were discovered in 1975 in Lapa Vermelha, Brazil. The remains consisted of the skeleton of a woman in her 20's. The discovery was made Annete Emperaire, and the skeleton was nicknamed “Luzia.” “Facial reconstruction” is a technique often used in police work. Clay is applied to a skull to create an approximation of the person's physical appearance when still alive. The facial reconstructions that have been made for Luzia are controversial and remarkable, because they suggest that Luzia may have more strongly resembled a person from Africa or Australia than the people living in South

America today. Tests showed that a 100g sample from Luzia contained 0.0000249 μg of carbon Use Logarithms to calculate the age of Luzia.

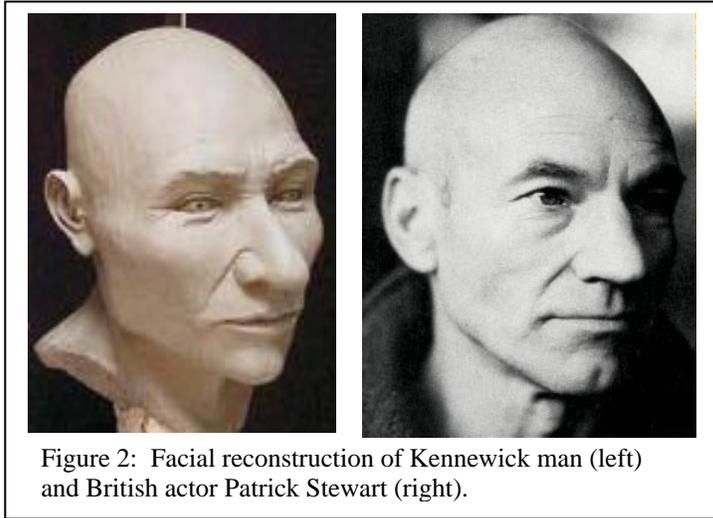


Figure 2: Facial reconstruction of Kennewick man (left) and British actor Patrick Stewart (right).

4. The name “Kennewick man” refers to a skeleton that was discovered in 1996 near the Columbia river in Washington State. This skeleton was found by a group of college students who were vacationing in the area. When discovered, Kennewick man was thought to have been the victim of a recent homicide. Forensic investigation¹ quickly revealed that the skeleton

had been buried beside the river for a considerable period of time. A facial reconstruction performed on the skull of Kennewick man suggested that his appearance may have been more typical of European/Caucasian people than Native American people. (One facial reconstruction of Kennewick man bore an uncanny resemblance to British actor Patrick Stewart, who played Captain Picard on “Star Trek: The Next Generation.”) These observations gave rise to a theory that Kennewick man may have been an early European settler who died at some time during the 1800’s. Tests showed that a 100g sample from Kennewick man contained 0.0000327 μg of carbon-14. Use Logarithms to calculate the age of Kennewick man. Could Kennewick man have died during the 1800’s?

In question 5, the two functions f and g refer to the functions defined by the following equations:

• $f(x) = \log(x)$

• $g(x) = \log(100 \cdot x)$

5. If you were to graph the two functions $y = f(x)$ and $y = g(x)$, what sort of transformation (horizontal stretch, vertical shift, reflection, etc.) would you expect to see? If you do graph this functions then you will see that $y = g(x)$ is actually a vertical shift of the graph of $y = f(x)$. Use the laws of Logarithms to explain why this is so, and to determine the size of the vertical shift.

¹ Examination of the skeleton revealed the presence of a stone spear point lodged in the bone of the pelvis. The investigators realized that in recent years, there had been very few reports of stab wounds to the pelvis involving stone-age weapons. They cited this as strong evidence to suggest that the skeleton was not the victim of a recent homicide.