Dating Deep Blood Kettles name: _____

Introduction

By some estimates there were 60-75 million bison on the plains of North America before Europeans began settling there in the 1800s. Although the Plains Indians fished, gathered fruits, berries, and vegetables, and hunted other animals, they relied heavily on bison for food and for materials to make clothing, tools, and shelters.

Because of the bison's tremendous size and speed, Indians devised sophisticated strategies to kill large numbers of them simultaneously. One method was to stampede the bison over cliffs at locations known as "buffalo jumps", and then finish off and process the animals near the base of the cliff. Archaeologists refer to these as "kill sites". Many prefer the Blackfeet word "pishkuns," which (loosely translated) means "deep blood kettle".

Hundreds of kill sites are scattered throughout the northern plains. "The First Peoples' Buffalo Jump" (formerly known as Ulm Pishkun) and the "Madison Buffalo Jump" are two of the better-known ones in Montana, and the "Head-Smashed-In" site 40 miles north of Glacier Park is world famous. Archeologists have learned much about Indian cultures from evidence left at these sites.

A. Questions for Discussion

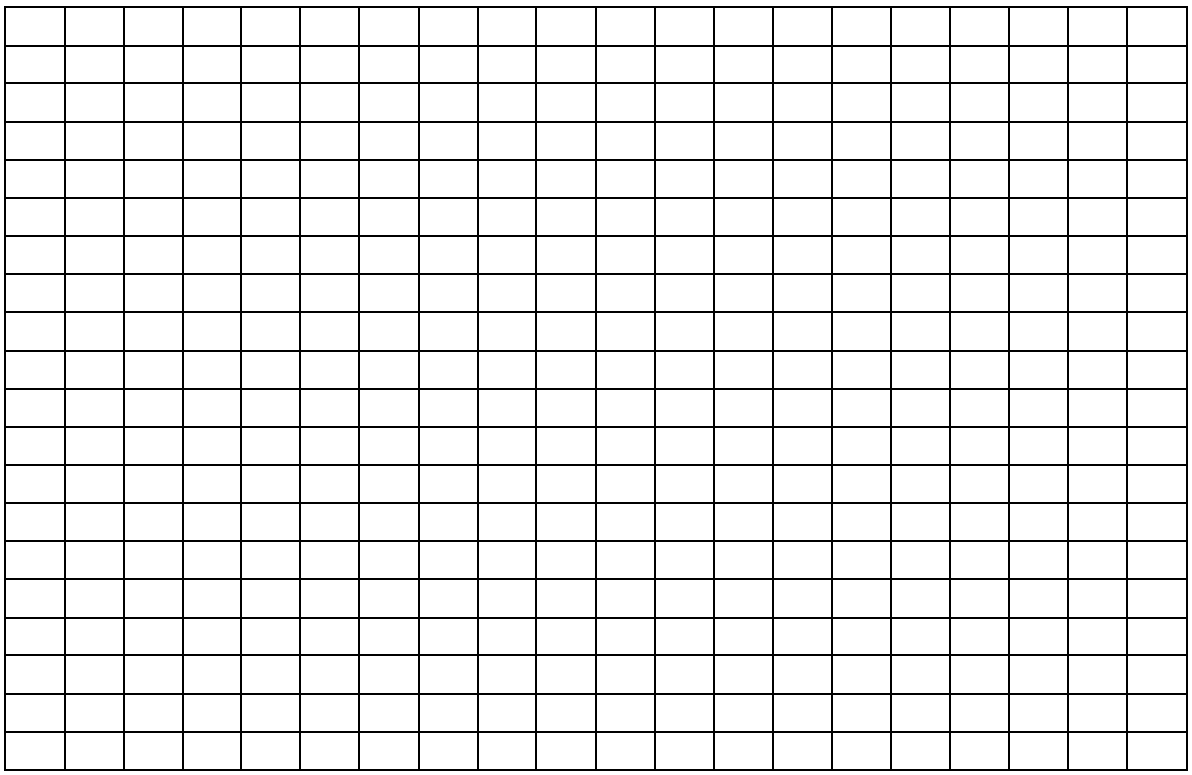
1. The most common type of carbon is Carbon-12, but another important type of carbon is a radioactive isotope called "Carbon-14". What is a **radioactive isotope**?

2. C-14 has a half-life of 5,730 years. Explain what this means.

3. Radiocarbon dating can be used to date materials that lived during the past 50,000 years. What types of materials found at bison kill sites could be dated using the Carbon-14 technique?

B. Design a graph to show how Carbon-14 decays over time.

Carbon -14 Decay Graph



C. Follow-Up Questions

1. According to your graph, approximately what percentage of the original Carbon-14 would be present in the bones of wooly mammoth that died 20,000 years ago?

2. Analysis of charcoal (burned wood) from a kill site shows that it contains 95 % of its original Carbon-14. What has happened the other 5 % of the Carbon-14?

3. Bison bones at the base of a cliff in south-central Montana are found with arrows made by Shoshone Indians. The bones contain 90 % of the their original Carbon-14. According to your graph, how long ago were the Shoshone using this kill site?

4. Go to **www.formontana.net** and then select picture # 103. What are the two things archaeologists want to know about the people that used a particular kill site?

5. Why can arrowheads and spear tips be used to determine who used a site?

6. Carbon-14 experiences "radioactive decay" over time. Explain what this means.

7. Why is radiocarbon dating only useful for things that lived in the past 50,000 years?

8. This is a tough question. You will need to think! After 11,500 years the ratio of N-14 to C-14 present in a bone would be 3:1. What would the ratio be if the animal had died 17,190 years ago (3 half-lives for C-14)?

9. What two types of materials were used for C-14 dating at the First Peoples Buffalo Jump?

10. Why did the use of buffalo jumps start to decline in the 1700s?

11. Go to this web site: **www.formontana.net/jump.html** and select "**Unique Pishkun in Central Montana**". Look at the photos and read the explanation. What two things did scientists hope to learn from the obsidian arrowheads found in the Belt Meteor Crater?

12. Why can't scientists use radiocarbon dating on the arrowheads?

13. Go to **www.formontana.net/jump.html** and select "**Interactive Radiocarbon Decay Curve**". Use your mouse to manipulate the slider beneath the graph to learn how it works. The "HL" stands for half-life. Move the slider from left to right. What do the purple dots in the large square represent?

14. Why does the number of purple dots decrease as you move the slider to the right?

15. Move the slider so that the column labeled 4 HL is highlighted on the table above. What percentage of the original Carbon-14 is still present in a bone after 4 half-lives?

16. How many years ago did the organism that this bone belonged to die?

17. The graph ends at 9 half-lives, which is about the limit of C-14 dating. How many years is this?

18. Return to the previous web page (**www.formontana.net/jump.html**) and select one of the "**Carbon-14 Calculators**". Materials found at the First Peoples Buffalo jump near Great Falls indicate that the site was first used around 900 AD (about 1100 years ago). According to the calculator, how much of the original Carbon-14 would have been present in those materials? (Do not include comas when you enter the number of years.)

19. Testing of a more recent bison bone from the First Peoples site revealed that it contained 94 % of its original Carbon-14. In what year did this bison go over the cliff?

20. Go to **www.formontana.net/crosscut.html**. How can geologists know that the sandstone shown in this road-cut is older than the igneous dike?

21. Radiocarbon (Carbon-14) dating cannot be used to date the igneous rock. What radiometric techniques can be used?

22. Select the Hot Link titled "More About Radiometric Dating." Look at the photos and read the text beneath them. Why doesn't the K-Ar "clock" start until the magma hardens? (Tough question!)

23. There are many different radiometric dating techniques. What are the two most important differences between the C-14 technique and the K-Ar technique? (Do NOT say that one uses C-14 and the other uses K and Ar.)