Please answer the following questions as you read the document titled: *What is Paleoclimatology?*

1. What is paleoclimatology? Why do you think this subject is important when studying climate change?

2. What are proxies used for?

3. Choose **1** of the 3 proxies from the article and explain how it is used:

What causes Climate Change?

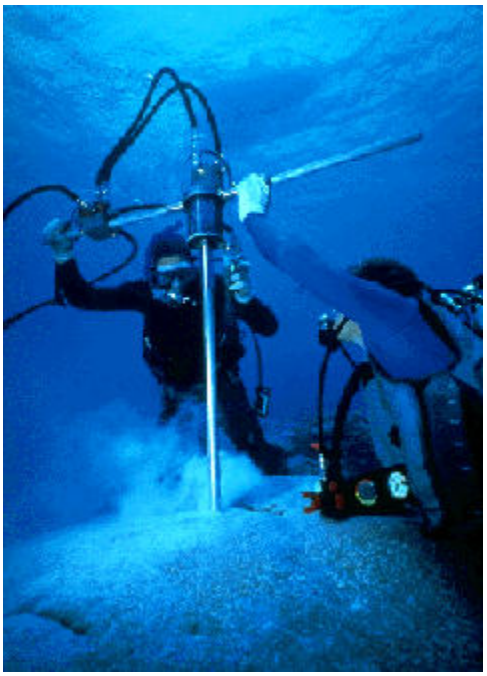
4. What factors affect the climate system? Name all 4.

5. What is the Milankovitch Theory?

6. In the last paragraph the author suggests that ice ages are on which time scale?

7. What time scale do you think we should use to describe today's climate change? Why?

What is Paleoclimatology?



Paleoclimatology is the study of past climates. Since it is not possible to go back in time to see what climates were like, scientists use imprints created during past climate, known as proxies, to interpret paleoclimate. Organisms, such as diatoms, forams, and coral serve as useful climate proxies. Other proxies include ice cores, tree rings, and sediment cores (which include diatoms, foraminifera, microbiota, pollen, and charcoal within the sediment and the sediment itself). Past climate can be reconstructed using a combination of different types of proxy records. These records can then be integrated with observations of Earth's modern climate and placed into a computer model to infer past as well as predict future climate.

How Are Other Proxies Used?

Combinations of proxy data are generally used to reconstruct records for past climate. In addition to forams and diatoms, common proxies and their respective analytical methods include:

Ice core records- deep ice cores, such as those from Lake Vostok, Antarctica, the Greenland Ice Sheet Project, and North Greenland Ice Sheet Project can be analyzed for trapped gas, stable isotope ratios, and pollen trapped within the layers to infer past climate.

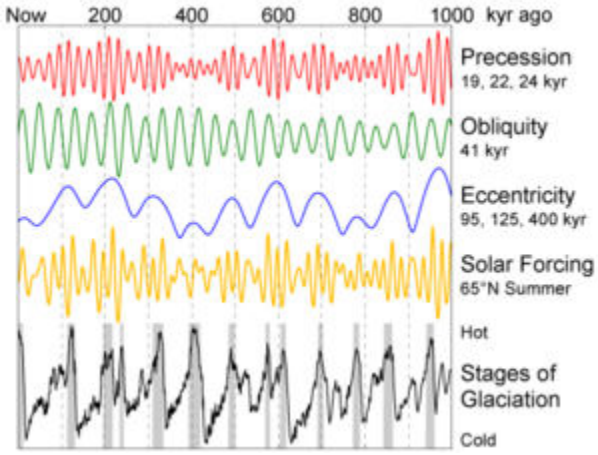
Tree rings- can be counted to determine age. The thickness of each ring can be used to infer fluctuations in temperature and precipitation, since optimal conditions for the particular species will result in more growth, and thus thicker rings for a given year. Scars and burn marks can indicate past natural events such as fire.

Sediment cores- can be analyzed in many ways. Sediment layers, can indicate sedimentation rate through time. Remains of organisms such as diatoms, foraminifera, microbiota, and pollen within sediment can indicate changes in past climate, since each species has a limited range of habitable conditions. When these organisms and pollen sink to the bottom of a lake or ocean, they can become buried within the sediment. Thus, climate change can be inferred by species composition within the sediment.

What Causes Climate Change?

The causes of climate change are complex. There are several major factors that can affect the climate system, including:

- Changes in solar output
- Changes in Earth's orbit
- Changes in the distribution of continents
- Changes in atmospheric content of greenhouse gases.



The Milankovitch Theory states that variations in Earth's orbit causes climate to change through time. According to this theory, changes in the shape of Earth's orbit around the sun (eccentricity), variations in Earth's axial tilt (obliquity), and the tendency for Earth to 'wobble' with respect to the direction of its rotational axis (precession) affect climate. This wobble can lead to fluctuations in the amount and distribution of incoming solar radiation, resulting in dramatic changes in climate over long time scales. Wobble may cause ice ages.

It is important to consider scale when interpreting climate change through time. Four major time scales are generally considered, which include:

- *Long term*- Hundreds of millions of years;
- *Medium term*- One million years;
- *Short term*- ~160,000 years;
- *Modern period*- Hundreds of years.

Time scale affects interpretations of climate change. Climate has both long term trends and short term variability. In looking at longer time scales, major shifts in climate such as the ice ages are easily recognizable, and viewing a long-term data set can provide the observer with a sense of the "big picture" of the climatic trends. Short term variations, like a colder than average month, can exist within longer term patterns such as the warming trend over the past 1000 years. The coexistence of short and long term trends occurring simultaneously through time complicates our ability to unravel climate change.