

How do we know what the climate was like in the past?

For those who know how to interpret them, pond sediments can provide important records of the past. Information from layer after layer of sediments can be put together to construct a timeline of the history of a pond site. In the early 1990s, a group of scientists and students went to Allamuchy Pond in northern New Jersey (Warren County) (see Figure 1.1). They collected a 10 m long cylinder of sediments called a *core* by inserting a long metal tube vertically into the bottom of the pond. The recovered sediments included fragments of rocks, mud, and organic material. The scientists removed pollen from each layer of the sediments and studied their samples under a microscope (see Figure 1.2). They identified each type of pollen in order to learn what types of plants were living in the area at different times in the past. They also described the overall type of sediment present in each section of the core. What can you learn about past climate by looking at the pollen record from the bottom of a pond? And how does climate in the early 21st century differ from past climate in that same area?

Figure 1.1

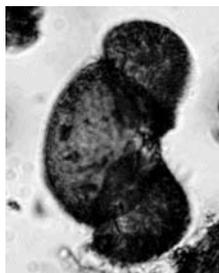
Location of Allamuchy Pond (See*)



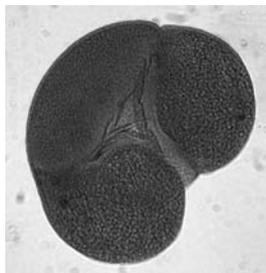
Source: Created by Linda Pistolesi using data publicly available from www.census.gov.

Figure 1.2

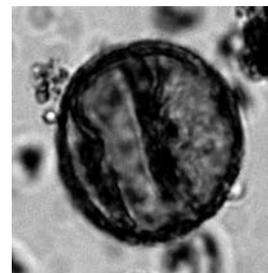
Grains of Pine, Spruce, and Oak Pollen



Pine Pollen



Spruce Pollen



Oak Pollen

Source: Courtesy of Dorothy Peteet.

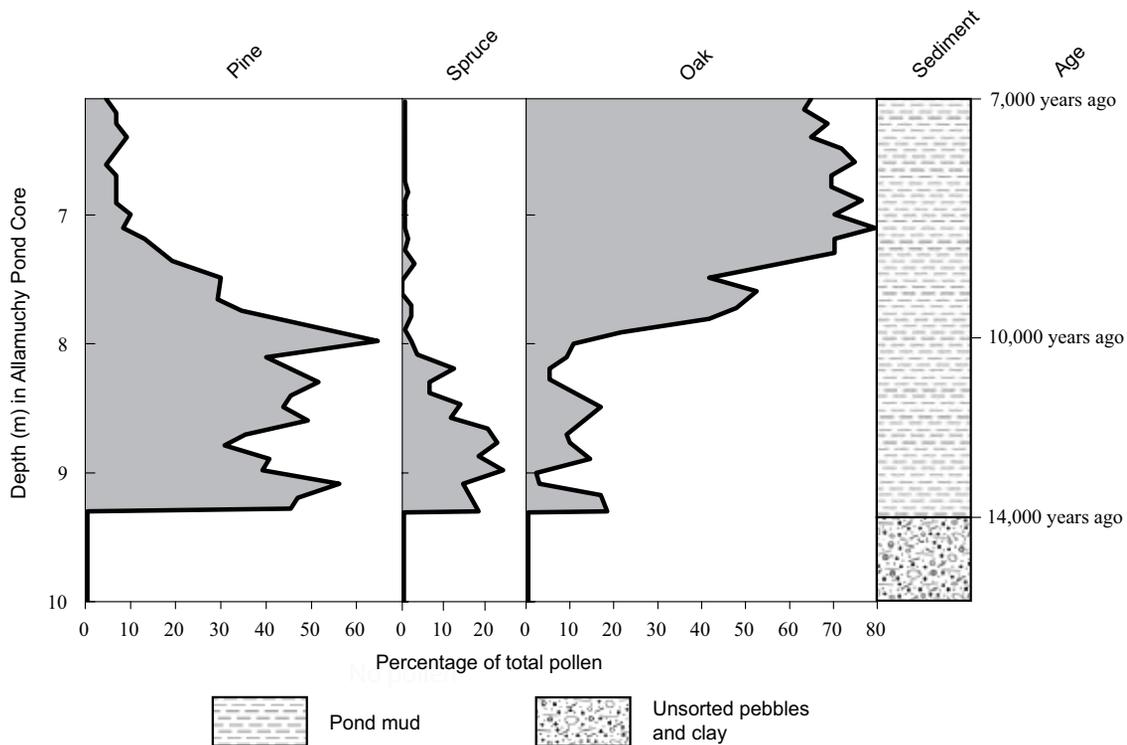
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Directions: Follow steps 1 through 9. Use additional sheets of paper as needed and answer in complete sentences.

- 1a. Draw two horizontal lines across the graph in Figure 1.3: one at 14,000 years ago and one at 10,000 years ago. Each line should go all the way from the right-hand axis (Age) to the left-hand axis (Depth).

Figure 1.3

Pollen Data From Allamuchy Pond (to be completed by student)



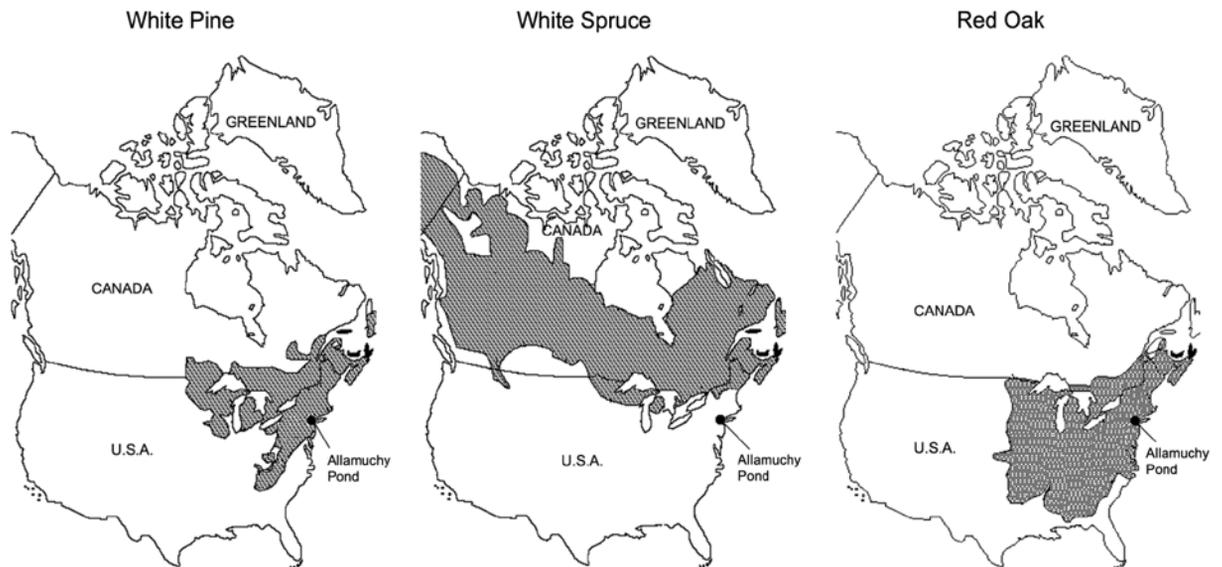
Source: Created by David McGee using data from Peteet, D. M. et al. 1993. Late-Glacial pollen, macrofossils and fish remains in northeastern U.S.A.: The Younger Dryas oscillation. *Quaternary Science Reviews* 12: 597–612. http://pubs.giss.nasa.gov/docs/1993/1993_Peteet_etal.pdf

- 1b. Label the oldest sediment and the youngest sediment on the graph.
- 2a. According to the data, what types of trees were present in the region between 14,000 and 10,000 years ago?
- 2b. Now look at the data from a more recent interval of time. According to the data, what types of trees were present in the region between 10,000 and 7,000 years ago?

- 2c. Describe the major changes in tree types in the region from 14,000 years ago until 7,000 years ago.
- 3. According to the data, what were two specific changes that occurred approximately 14,000 years ago?
- 4. Scientists use the present climates in which trees live to help them understand past climates. Figure 1.4 shows the areas of North America where the three tree types represented in the sediment core are abundant in modern forests.*
 - 4a. Which tree species lives in the coldest locations?
 - 4b. Which tree species lives in the warmest locations?

Figure 1.4

Present-Day Range Maps for White Pine, White Spruce, and Red Oak*



Source: Adapted from www.eFloras.org. Courtesy of the Flora of North America Association.

*You might wonder why the data shown in Figure 1.3 are for pine, spruce, and oak pollen, while the data in Figure 1.4 are specifically for white pine, white spruce, and red oak trees. That is because the pollen grains are grouped together by genus, while the range maps for trees in Figure 1.4 are for representative individual species within each genus.

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5. Looking at the range maps in Figure 1.4, you can see that there are no spruce trees near Allamuchy Pond. The pollen data in Figure 1.3 show that there were spruce in the area between 14,000 and 10,000 years ago. Based on this observation, how do you think the temperatures in the region of Allamuchy Pond between 14,000 and 10,000 years ago compare with present-day temperatures?
6. Based on your answers to the questions in step 2, which period was colder in the region of Allamuchy Pond: from 14,000 to 10,000 years ago or from 10,000 to 7,000 years ago? Explain your answer using evidence from the data.
- 7a. Which of these processes are most likely to deposit sediments that are an unsorted mix of pebbles and clay (choose two): running water, glaciers, ocean waves, landslides, or wind?
- 7b. Which of the sediment-transport processes do you think deposited the unsorted mix of pebbles and clay at the base of the Allamuchy Pond core? Use your knowledge of Earth science as well as evidence from the core. Explain your answer.
8. Why do you think the sediments older than 14,000 years have no pine, spruce, or oak pollen?
9. Based on your knowledge of Earth history, what event in geologic history do you think is recorded in the Allamuchy Pond sediments? (*Hint: Think about what was happening in North America at this time in geologic history and the changes that you documented in your answers to questions 2c, 3, 5, 6, and 8.*) Explain your answer.