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# What Are “Proxy” Data?

In paleoclimatology, or the study of past climates, scientists use what is known as proxy data to reconstruct past climate conditions. These proxy data are preserved physical characteristics of the environment that can stand in for direct measurements. Paleoclimatologists gather proxy data from natural recorders of climate variability such as tree rings, ice cores, fossil pollen, ocean sediments, corals and historical data. By analyzing records taken from these and other proxy sources, scientists can extend our understanding of climate far beyond the instrumental record.

## Historical Data

Historical documents, which are one type of proxy data, can contain a wealth of information about past climates. Observations of weather and climate conditions can be found in ship and farmers' logs, travelers' diaries, newspaper accounts, and other written records. When properly evaluated, historical documents can yield both qualitative and quantitative information about past climate. For example, scientists used historical grape harvest dates to reconstruct summer temperatures, between April and September, in Paris from 1370 to 1879.

*Observations on the weather Philadelphia 1776*

July	hour	Therm.	day	h. m.	Therm.
1.	9-0 A.M.	84½	9	5-30 A.M.	75
	7- P.M.	82		9	77½
2.	6. A.M.	78.		6-30 P.M.	81½
	9-40 A.M.	78		9-45	78.
	9. P.M.	74	10.	8. A.M.	75.
3.	5-30 A.M.	71½		9-15.	76½
	1-30 P.M.	76		2-0 P.M.	80.
	8-10.	74.		4-45	82.

## Corals

Another type of proxy data, corals build their hard skeletons from calcium carbonate—a mineral extracted from seawater. The carbonate contains isotopes of oxygen as well as trace metals that can be used to determine the temperature of the water in which the coral grew. Scientists can then use these temperature recordings to reconstruct the climate when the coral lived. See [Picture Climate: How We Can Learn from Corals](#) to learn more about how scientists determine climate conditions from these beautiful ecosystems.



## Pollen

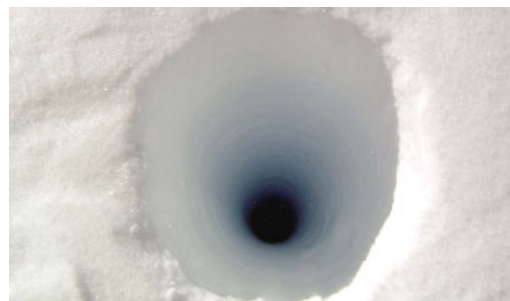
All flowering plants produce pollen grains, which are another type of proxy data. Scientists can use the distinctive shapes of pollen grains to identify the type of plant from which they came. Since pollen grains are well preserved in the sediment layers in the bottom of a pond, lake, or ocean, an analysis of the pollen grains in each layer tells scientists what kinds of plants were growing at the time the sediment was deposited. Scientists can then make inferences about the climate of the area based on the types of plants found in each layer. See [Picture Climate: How Pollen Tells Us About Climate](#) to learn more about how scientists learn about



climate from these tiny grains.

### Ice Cores

Located high in the mountains and near the poles, ice—another type of proxy data—has accumulated from snowfall over many millennia. Scientists drill through the deep ice to collect ice cores, which often have distinct layers in them. These layers contain dust, air bubbles, or isotopes of oxygen, differing from year to year based on the surrounding environment, that can be used to interpret the past climate of an area. Ice cores can tell scientists about temperature, precipitation, atmospheric composition, volcanic activity, and even wind patterns. See [Picture Climate: What Can We Learn from Ice?](#) to learn more about how scientists study climate using ice cores.



### Tree Rings

Trees and their unique rings also serve as proxy data. Because climate conditions influence tree growth, patterns in tree-ring widths, density, and isotopic composition reflect variations in climate. In temperate regions where there is a distinct growing season, trees generally produce one ring a year, recording the climate conditions each year. Trees can grow to be hundreds to thousands of years old and can contain annual records of climate for centuries to millennia. See [Picture Climate: How Can We Learn from Tree Rings?](#) to learn more about how scientists study climate using tree rings.



### Ocean and Lake Sediments

Another type of proxy data can be found on the floors of the Earth's oceans and lakes. Billions of tons of sediment accumulate in ocean and lake basins each year, providing a vast amount of information about the environment in them. Scientists drill cores of the sediments from the basin floors and examine their contents, which include tiny fossils and chemicals, to interpret past climates.



These are just a few examples of the environmental recorders scientists can use to learn about ancient climates. Learn more about the science behind the study of ancient climates at [What is Paleoclimatology?](#) and [How Do Scientists Study Ancient Climates?](#) Or visit NCDC's [Paleoclimatology Data](#) page to access the Center's proxy data holdings.



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