Who was Charles David Keeling?

Active Listening Questions:

- According to the Dr. Cox, what made it challenging for Charles David Keeling to maintain a continuous observational record of carbon dioxide in Earth's atmosphere?
- What does the "Keeling Curve" show?

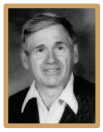
WHAT: In this clip from a 2006 public lecture, "Will the Living Climate Save Us From Climate Change?", climate scientist Peter Cox describes the scientific heroism and pioneering measurements of Charles David Keeling. By 1958, Keeling had established an observatory for the continuous monitoring of atmospheric carbon dioxide at Mauna Loa - a remote site on the slopes of a Hawaiian volcano. Carbon dioxide turned out to play a huge role in determining Earth's climate, and the "Keeling Curve" that Cox presents shows the rise of carbon dioxide concentrations measured at Mauna Loa between 1960 and 2005.

"It's quite heroic, this, because most of the people that make a big difference in science must have been considered to be nuts..."

HOW: Keeling gathered his data by using gas detectors placed at a remote Mauna Loa site. Since carbon dioxide (CO_2) is a trace gas, comprising less than 1 % of the atmosphere, measuring it requires very sensitive instruments.

WHY: Keeling was a scientist with a reputation for careful scientific measurements. One sign that his instruments were successfully measuring carbon dioxide (CO_2) is that concentrations went up and down in a seasonal pattern (the wiggles in the graph). This fits logical expectations that plants in the northern hemisphere would use more CO_2 during the spring/summer growing season, and thus *atmospheric* concentration of CO_2 would go down at those times.

SO WHAT: The measurements made by Charles David Keeling were responsible for awakening scientists to the fact that carbon dioxide is increasing in Earth's atmosphere. Keeling was dedicated to this work before others commonly recognized how important atmospheric carbon dioxide concentration is to determining Earth's climate. This is why Dr. Cox states, "This record sets the stage for today's concerns about climate change. Some people consider this to be the most important environmental record that's been taken in the 20th century."



BIO: Charles David Keeling was a scientist who developed a more precise method for measuring atmospheric carbon dioxide than had been available in previous decades. He went on to use this method to measure atmospheric CO_2 at Mona Loa, in Hawaii, for a period of several decades. This long term monitoring data became (and still is) crucial in understanding how human activities may be increasing the concentration of CO_2 in the Earth's atmosphere.

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TAKING THE REINS

Discussion Questions:

Discuss with a friend or record your thoughts in a journal.

- As Dr. Cox says, the Keeling Curve "tells us a massive amount about how the physical world interacts with the biological world." What is he referring to?
- Why do modern scientists still refer to Keeling's work and his curve? What made him and his work remarkable?
- Based on the data from Keeling's curve, would you expect CO2 levels today to be higher, lower, or the same as concentrations in 2006, when Dr. Cox presented?

Quiz Questions:

Quiz 1. According to Dr. Cox, three of the statements below describe challenges to maintaining a continuous observational record of carbon dioxide in Earth's atmosphere. Which one is NOT a challenge he mentions?

a) Other people may have felt that the observations were unimportant.
b) It was difficult to maintain funding.
c) It was relatively unglamorous to monitor the environment.
d) Keeling lost interest in maintaining the observational record.

Quiz 2. The Keeling Curve shows changes with time in the....

a) concentration of carbon dioxide in the oceans.
b) concentration of carbon dioxide in the atmosphere.
c) temperature of the atmosphere.
d) temperature of the oceans.

Glossary Term: Greenhouse Gas

an atmospheric gas that absorbs and emits infrared radiation. Because of the ability of greenhouse gases to interact with infrared radiation, they have the capacity to increase the temperature of Earth's atmosphere by increasing the amount of time infrared radiation spends in Earth's atmosphere before being lost to space.

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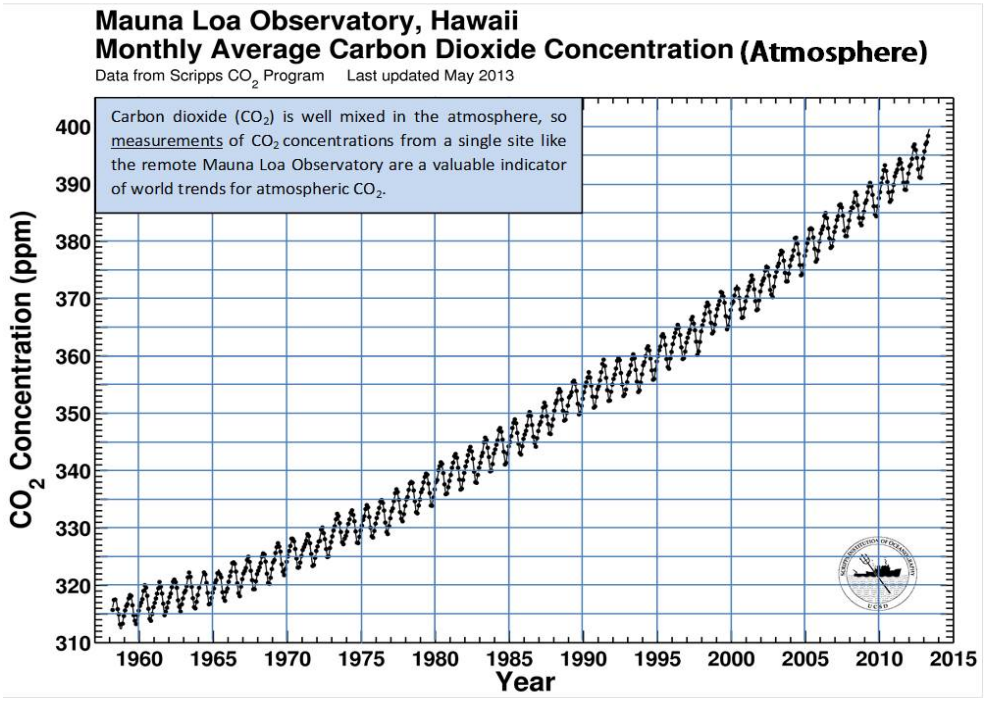
Taking the Reins: Further Activities

Clip Activity: Reading the Graph

The graph below is an updated version of the one shown by Dr. Cox. According to the trend in the graph of measurements from Mauna Loa, how did the concentration of carbon dioxide change in the 40 years between 1960 and 2000?

The CO_2 concentration (measured in ppm=*parts per million)* has...

a) stayed the same except for annual variations.
b) increased by about 365 ppm.
c) increased by about 75 ppm.
d) decreased by about 300 ppm.



Further Reading:

"The History of the Keeling Curve." The Keeling Curve: A Daily Record of the Atmospheric Carbon Dioxide from Scripps Institution of Oceanography at UC San Diego, University of California, San Diego.