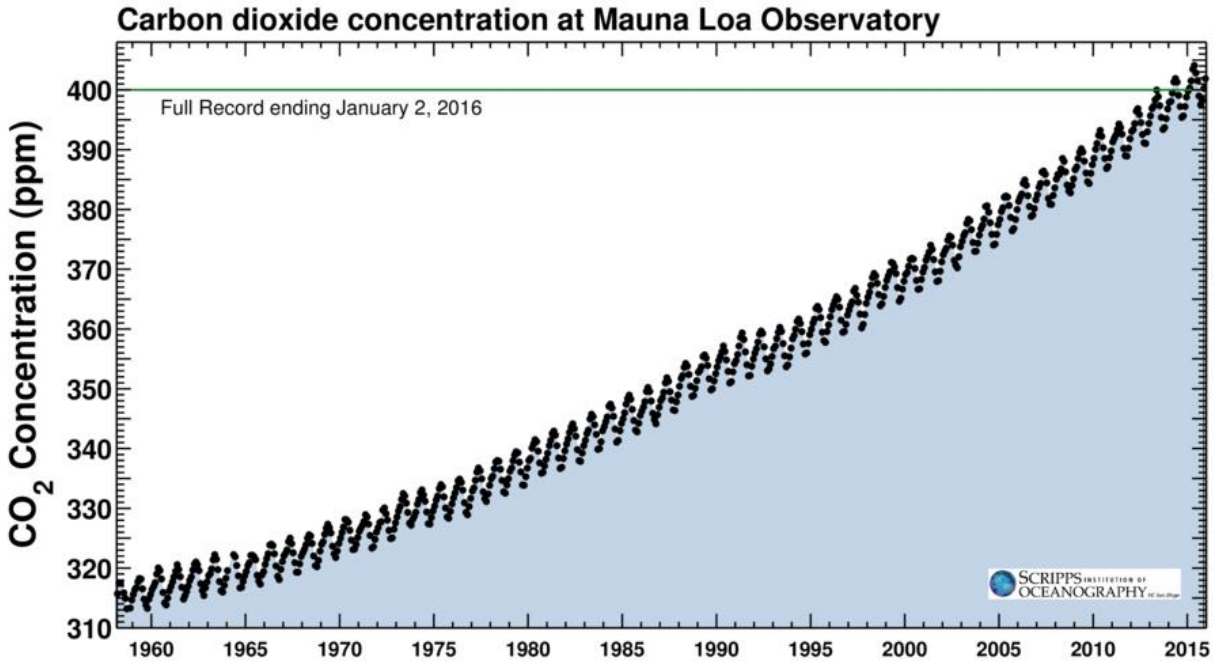

Caption: Atmospheric carbon dioxide concentration in parts per million (ppm) by volume from 1958 to 2016. Image courtesy of Scripps Institution of Oceanography, UC San Diego.

BACKGROUND INFORMATION

Carbon dioxide (CO_2) is a gas critical to life on Earth because it helps regulate climate. Natural processes—mainly photosynthesis and respiration—serve to maintain concentrations of CO_2 in the atmosphere within a certain range. Driven by energy from the sun, photosynthesis takes carbon from CO_2 in the atmosphere to produce sugar molecules and oxygen. Photosynthesis thus serves to remove CO_2 from the atmosphere. Cellular respiration and respiration driven by the decomposition of living matter, on the other hand, convert sugar molecules into CO_2 and water, returning CO_2 to the atmosphere.

$$6CO_2 + 6H_2O \underset{\text{Respiration}}{\overset{\text{Photosynthesis}}{\rightleftharpoons}} C_6H_{12}O_6 + 6O_2$$

Records from polar ice cores show that the natural range of atmospheric CO_2 over the past 800,000 years was 170 to 300 parts per million (ppm) by volume. In the early 20th century, scientists began to suspect that CO_2 in the atmosphere might be increasing beyond this range due to human activities, such as burning fossil fuels and changes in land use, but there were no clear measurements of this trend. Charles David Keeling began measuring atmospheric CO_2 in 1958 at the Mauna Loa observatory on the big island of Hawaii. This data set (shown in the figure) has become the longest study of its kind in the world and is so iconic that it is now most commonly referred to as the Keeling Curve.