

Lesson Planning Tool for Climate Change

Title of Lesson: Using Data as Evidence of Climate Change

Grade Level: 7th, 8th

Subject: Climate Change, Environmental Science

Source(s) of the lesson:

1. British Antarctic Survey: <https://www.bas.ac.uk/data/our-data/publication/ice-cores-and-climate-change/>
 2. Carbon Dioxide Data from Mauna Loa Observatory: <http://www.esrl.noaa.gov/gmd/ccgg/trends/>
 3. Video of Atmospheric CO2 from NOAA and CIRES: <https://www.youtube.com/watch?v=UatUDnFmNTY>
 4. Graph of CO2 Over Last 1,000 Years: <https://i.ytimg.com/vi/UatUDnFmNTY/maxresdefault.jpg>
 5. United Nations Environment Program: Historical World Population Graph: http://na.unep.net/geas/getuneppagewitharticleidsript.php?article_id=71
 6. Relife Web Population Density Map: <http://reliefweb.int/map/world/global-population-density-estimates-2015>
 7. Union of Concerned Scientists: CO2 Emission by Country: http://www.ucsusa.org/global_warming/science_and_impacts/science/each-countrys-share-of-co2.html#.V7ORQD4rly4
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Essential Question(s): What is the relationship between world population and Carbon Dioxide

Massachusetts Curriculum Frameworks Science Standards:

NGSS: MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact earth's systems.

Content Objectives	Practice Objectives	Language Objectives
Students will analyze population growth data in order to write claims on how increases in human population impact earth's systems by drawing connections to population growth and carbon dioxide levels.	1. Asking questions (for science) and defining problems (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	Students will write a claim based on evidence presented.

Important Vocabulary: population growth, density, carbon dioxide, greenhouse gases

Materials Needed: Printed color Map of Population Density (Link 6), Printed Color Map of World (find appropriate one online), Printed graph of CO2 emission 2011 (link 7), Historical World Population Graph (Link 5) , Graph of CO2 of Last 1,000 years (Links 3 & 4)

Other Resources: (websites, videos, books, etc.)

Background Information for Teacher: The earth's population is currently at 7 billion. Estimates suggest that the world population will reach 9-10 by year 2050. As the population has risen so has the amount of carbon dioxide. Scientists explain that human activity through the burning of fossil fuels for the use of natural and man-made resources as well as needs such as electricity, water usage, transportation, agriculture/farming, and housing have produced carbon dioxide and other greenhouse gases. When these greenhouse gases become trapped in the atmosphere they trap heat causing earth's temperature to slowly increase. The data has been able to support this correlation has been essential in making the case and raising awareness that global warming and climate change are directly connected to human population and activity.

Background Information the Student Needs to Access the Lesson: Humans have not always lived on the earth, yet since their existence we have use more resources on earth than any other species. Has the earth's population always increased steadily or has there been a sharp increase over time? What has been the impact of this increase? What has caused this increase?

The industrial revolution is the time period in which human population began to increase in exponential amounts. This is when factories and machines replaced human labor increasing the production rate of many things. The burning of fossil fuels replaced wood and fire as sources of energy. Large leaps in scientific discovery, human health and medicine allowed human mortality rates to increase. However, all of this has impacted the earth we live on today. The need for more resources for more humans has caused an increase in the amount of greenhouse gases in the atmosphere. Carbon dioxide levels in parts per million has been measured over time showing this increase directly linked to human population growth.

Lesson Structure

Lesson Launch (Do Now)	In table groups or groups of 3-4 students, have them look at the Historical World Population Graph. Provide the following analysis questions to guide their thinking: <ol style="list-style-type: none">1. By how much did the world population increase 8000BCE and 5000BCE? What could explain the increase?2. Circle the portion of the graph which shows the sharpest increase in population.3. What stands out about this graph's information of world population?4. According the graph, what is the estimated current world population?
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	<ol style="list-style-type: none"> 5. What does the graph predict the world population will reach? 6. As a group, come up with an answer to explain the steep population rise.
Background Instruction (pre-activity)	Teacher should use this moment to hear answers from classes. Teacher next should explain the background information to in powerpoint or note taking form.
Activity	<ol style="list-style-type: none"> 1. Show the video of the Atmospheric CO2 from NOAA and CIRES. 2. Give each group the graph showing Atmospheric CO2 levels of last 1,000 years. Lay it out next to the Historical Population Graph. 3. Ask students to look at both maps and answer the following questions: <ol style="list-style-type: none"> a. What was the average CO2 level prior to the industrial revolution? b. What has happened to the CO2 levels over the past 100 years? c. At this rate, what would you predict the CO2 level to be in year 2020? d. What similarities do both graphs share? e. What differences do you in both graphs? 3. Making a Claim: What do you know? What claim can you make about CO2 levels and human population based on both graphs? 4. Provide Evidence to Support Your Claim: Why do you know that? Find at least 2 pieces of evidence to support your claim. Sentence starter: "The graph shows..." 5. Reasoning: Why does your evidence support your claim? 6. Present the Printed color Map of Estimated 2015 Population Density, Printed Color Map of World, Printed graph of CO2 emission 2011 next to each group. Note: the Printed color World Map is used as reference only to name countries that students may not be familiar with based on location alone. 7. Ask students to use the map and graph data to make their own Claim, Evidence and Reasoning based on the presented information. <p>Claims should be similar to the following: <i>Highly population places use or produce more CO2 than less populated places.</i></p>
Discussion/ Debrief	Hear answers back from groups. Explain to students that all information used is all based on real data in particular the Global Data taken at Mauna Loa produced by NOAA.

	<p>Show the Mauna Loa Graph Alone to the class: The Keeling curve is a graph based on continuous measurements of carbon dioxide (CO₂) in the atmosphere taken at the Mauna Loa Observatory (MLO) in Hawaii. This experiment began in 1958 under the direction of Charles David Keeling, and showed the first significant evidence of rapidly increasing levels of CO₂ in the atmosphere. With the advancing threat of changing climate due to human activity, the Keeling curve is often credited with bringing worldwide attention to the problems associated with increased levels of CO₂ in the atmosphere. Source: BPS Climate Science and Policy, written by Timothy Gay</p>
Formative Assessment	<p>Why is data important in science? Looking ahead: CO₂ is a greenhouse gas that gets trapped in the atmosphere. When greenhouse gases get trapped in the atmosphere they trap heat. What do you think has been happening to earth's global temperature over the past 100 years?</p>

Notes: It is suggested that the teacher print color class sets of the maps in order to best do this activity. You can preserve wear and tear of them over time by protecting them in a page protector.