Atmospheric Carbon Dioxide and the Greening of the Planet

A Carolina Essentials™ Activity

Student Worksheet

Overview

Atmospheric carbon dioxide (CO_2) levels have been changing globally since about 1785. Ice core samples indicate that prior to the late 1700s, CO_2 levels were around 280 parts per million (ppm). In 1885, CO_2 levels peaked at 293 ppm as a direct result of the Industrial Revolution, a period powered by coal combustion. As industrialization continued worldwide to include fossil fuel cars and electric power plants, CO_2 levels rose to 349 ppm. In 2014, CO_2 levels reached 400 ppm, and today, atmospheric levels are hovering around 416 ppm.

Carbon dioxide levels are often associated with climate change, but this is just one piece of the puzzle. How are changing atmospheric CO_2 levels impacting the cycling of carbon in the hydrosphere, geosphere, and biosphere? One method used to examine the interactions between atmospheric carbon dioxide and the biosphere is to measure global leaf cover. Since plants absorb CO_2 from the atmosphere during photosynthesis, it can be hypothesized that as CO_2 levels increase, leaf cover should increase. Using satellite imagery, scientists can study the relationship between atmospheric carbon dioxide and global leaf cover (as seen in the map below).

In this activity, you will use data from 2015 through 2020 to build on the model shown in the map below.

SAFETY REQUIREMENTS

No PPE is required for the activity.

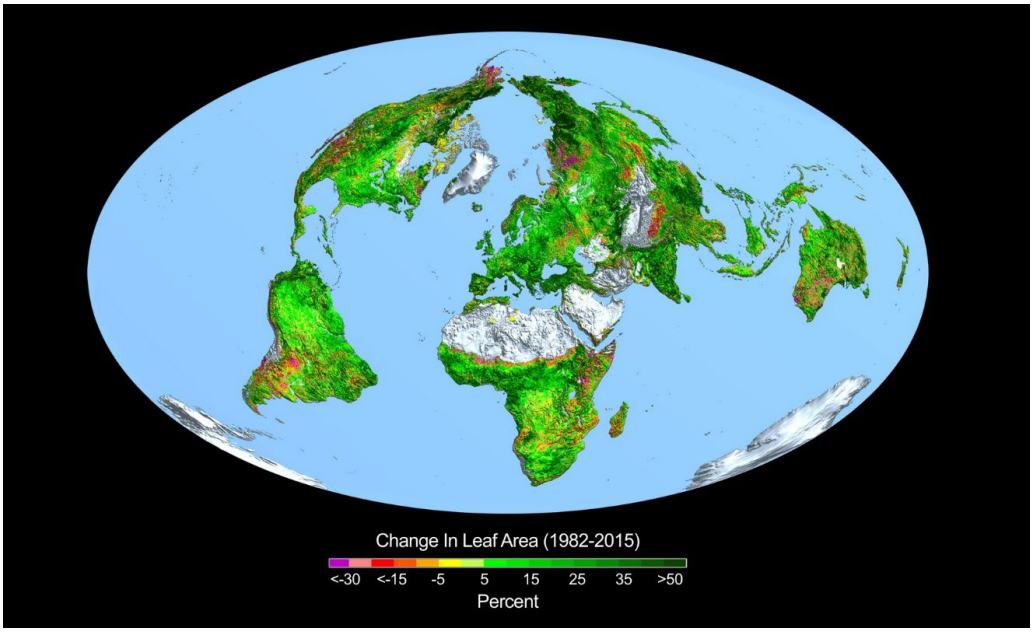
MATERIALS

Colored pencils or pens

Graph paper or graphing program

Phenomenon

Look at the image below. The scale indicates percent change in the amount of leaf area worldwide from 1982 to 2015. What patterns do you notice?



Boston University/R. Myneni

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Essential Question

How can global leaf cover and atmospheric carbon dioxide levels model interactions between the atmosphere and biosphere within the carbon cycle?

Activity Objectives

1. Use data to establish a relationship between global leaf cover and atmospheric carbon dioxide levels.
2. Using atmospheric carbon dioxide levels and the global leaf cover map above as a starting point, predict global leaf cover for 2020.

Activity Procedures

1. Based on the global CO_2 levels from 2015 to present, construct a graph of CO_2 levels in parts per million (ppm).

January and July CO_2 Levels (ppm)

Year	January	July
2015	400.36	402.24
2016	402.25	403.07
2017	405.98	407.35
2018	407.70	408.29
2019	408.96	410.10
2020	413.65	414.04

2. Calculate annual average and percent change for each year from 2015 to 2020.

Year	Annual Average	Percent Change
2015		
2016		
2017		
2018		
2019		
2020		

3. Using your data for percent global CO_2 change in parts per million since 2015 and the global leaf cover map for 2015 as a starting point, construct a global leaf cover model for 2016, 2018, and 2020. Based on your teacher's instruction, sketch or use appropriate digital tools to create these three models.

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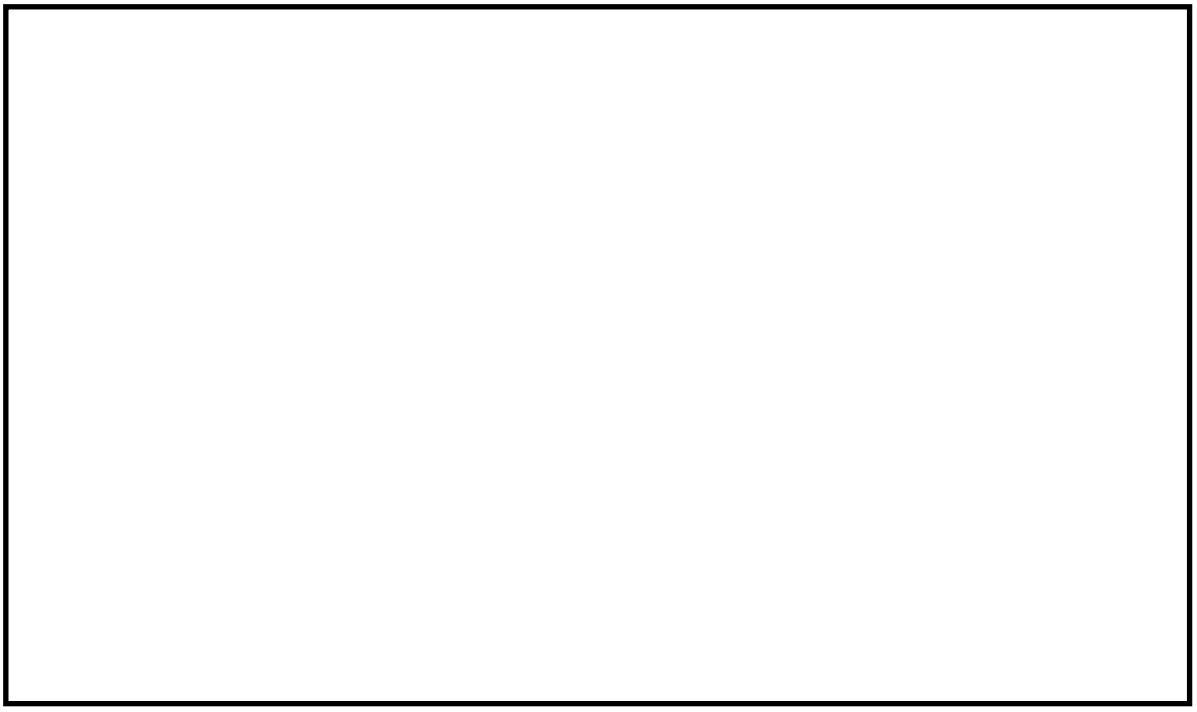
2016 Global Leaf Cover

2018 Global Leaf Cover



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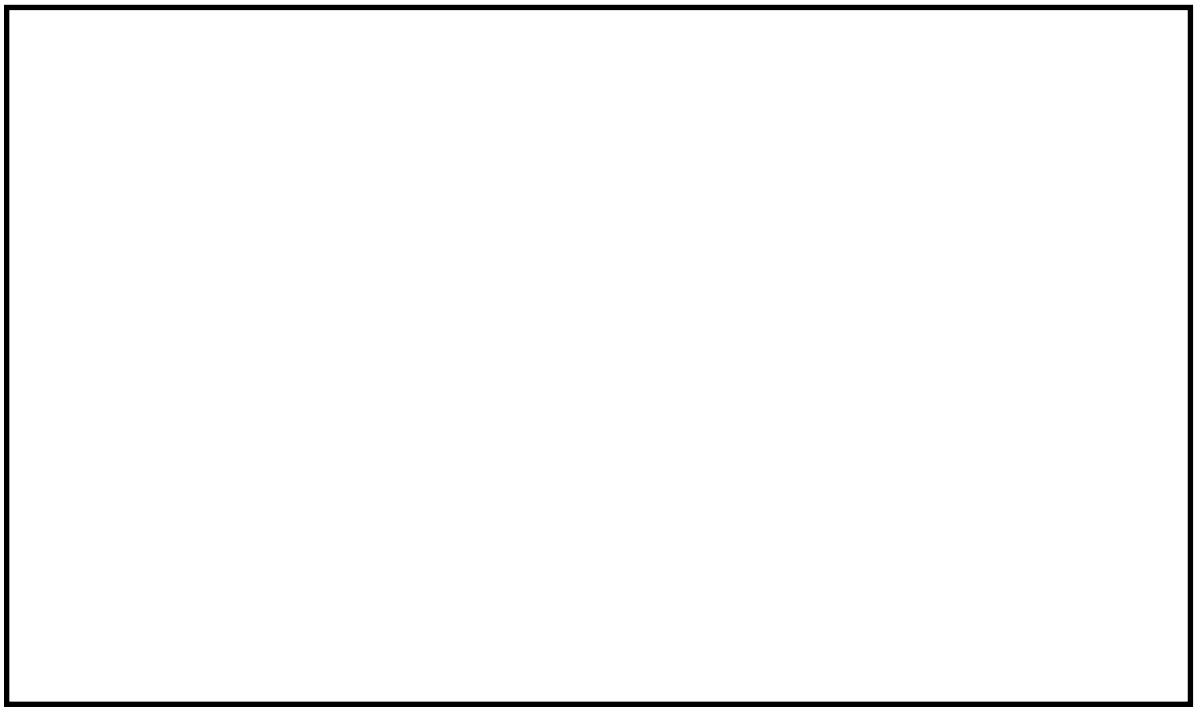
2020 Global Leaf Cover

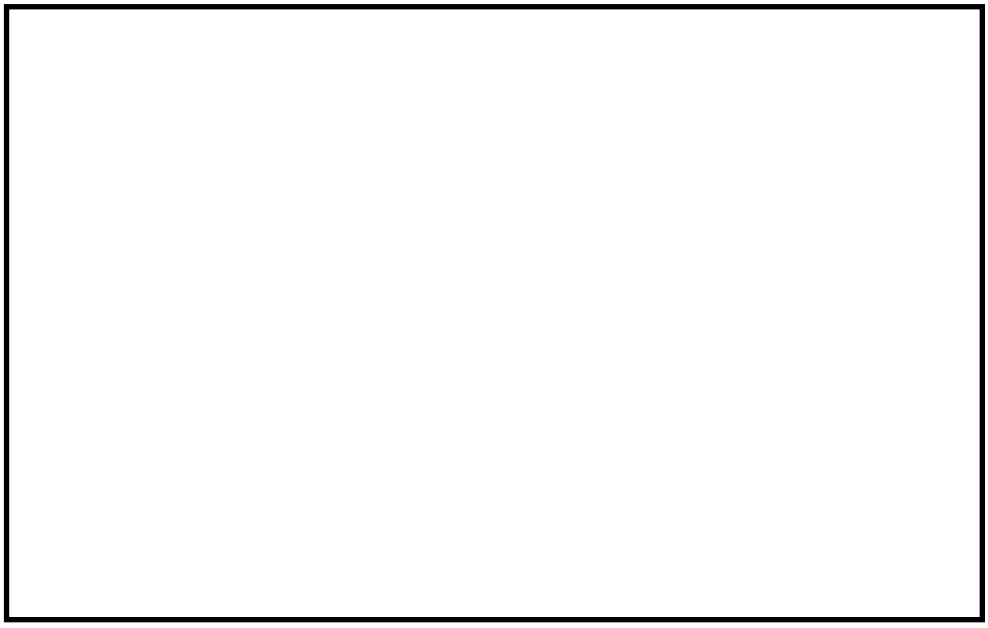


Analysis and Discussion

1. Use the historical and current data to propose a model for the cycling of carbon through changes in atmospheric CO_2 levels and global leaf cover. Your model may be a graphic, flow chart, or written explanation.

   Explanation

   Graphic



2. Compare your model to the one described in the 2016 article "Carbon Dioxide Fertilization Greening Earth, Study Finds," which represents changes from 1982 to 2015. Are the models consistent for explaining the phenomenon of leaf cover change? Explain.

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