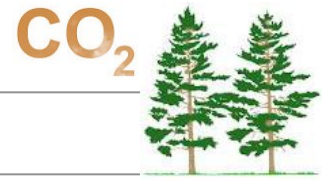




Task: Climate Change, Carbon, and Trees



PART 1: Research Student Directions

Your Assignment:

Scientists are concerned that the climate is warming from increased carbon in the atmosphere. You have been asked to explain what the relationship is among climate change, carbon, trees, and wood. You will explore several print and video sources to gather information. Then you will use this information to answer three research questions and write your essay. A notetaking template is provided for you to capture important information from each of the sources.

Steps You Will Follow:

To plan and write your essay, you will do all the following:

1. Watch three videos.
2. Read an article and a brochure.
3. Interpret data charts and diagrams.
4. Answer three questions about the readings and the videos.
5. Plan and write your essay.

Directions for Beginning:

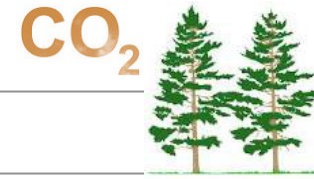
You will now watch the videos, read the articles, study the diagrams, and interpret the data charts. Take notes because you will want to refer to your notes while answering the three research questions and writing your essay. You may refer to any of the sources as often as you like.

Source Information:

Reading #1:	<i>Climate Change and Forests: Capturing Carbon Dioxide</i> Excerpt from Project Learning Tree, <i>Focus on Forests</i>
Reading #2:	<i>Sustainable Forestry Carbon Cycle</i> Washington Forest Protection Association
Video #1:	<i>Global Warming 101</i> (3:03) https://youtu.be/W7clNkzc6ao
Video #2:	<i>Forest Fast Breaks: Carbon Capture</i> (2:11) https://youtu.be/TzPPmwNFDkY
Video #3:	<i>What's the Deal with Carbon?</i> (3:04) https://youtu.be/M0ZiH4CmVmo
Data Charts:	Carbon Dioxide Concentration, NOAA Global Climate Change Website Global Surface Temperature, NASA Global Climate Change Website



Task: Climate Change, Carbon, and Trees



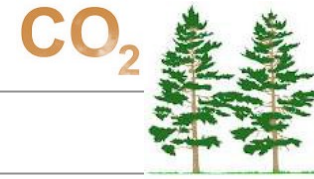
Climate Change, Carbon and Trees

Note -Taking Tool

Source	Climate Change: The Data	Problems with Carbon Dioxide	How Trees are a Solution
<i>Climate Change and Forests: Capturing Carbon Dioxide</i>			
<i>Sustainable Forestry Carbon Cycle</i>			



Task: Climate Change, Carbon, and Trees

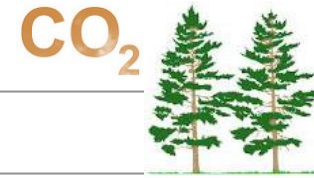


Climate Change, Carbon and Trees

Source	Climate Change: The Data	Problems with Carbon Dioxide	How Trees are a Solution
Video #1: <i>Global Warming 101</i>			
Video #2: <i>Forest Fast Breaks: Carbon Capture</i>			
Video #3: <i>What's the Deal with Carbon?</i>			



Task: Climate Change, Carbon, and Trees



Climate Change, Carbon and Trees

Source	Climate Change: The Data	Problems with Carbon Dioxide	How Trees are a Solution
Data Chart: <i>Carbon Dioxide Concentration</i>			
Date Chart: <i>Global Surface Temperature</i>			



Task: Climate Change, Carbon, and Trees

CO₂



CLIMATE CHANGE AND FORESTS

Capturing Carbon Dioxide

Understanding the changes in the Earth's climate is one of the biggest challenges facing scientists today! Carbon dioxide (CO₂) is a factor in climate change. It is one of the many greenhouse gases. Some greenhouse gases such as CO₂ occur naturally and are emitted to the atmosphere through natural processes, as well as by human activities. Greenhouse gasses and water vapor let in infrared radiation that is given off by the sun but prevent some of the radiation that is emitted (or radiated back) by the Earth from leaving the atmosphere. The process is similar to the way that the glass panes of a greenhouse trap heat. Without this heat-trapping mechanism-called the **greenhouse effect** – our planet would be too cold to support life as we know it.

The concentration of many greenhouse gases has fluctuated during the history of the planet. However, air samples from ice cores representing the past several thousand years indicate that until the 19th century, CO₂ levels in the Earth's atmosphere had been fairly stable at about 280 parts per million.

Around 1860, at the beginning of the Industrial Revolution, CO₂ levels began to rise. By 1958, CO₂ levels were up to 317 parts per million. In 2010, CO₂ levels topped 392 parts per million for the first time-- a 40% increase since 1860. Many scientists believe that such increases will lead to changes in the Earth's climate referred to as **global warming** or **global climate change**.

What Causes Increasing Atmospheric CO₂?

The Intergovernmental Panel on Climate Change (IPCC) states that the consensus of scientific opinion is that the Earth's climate is being affected by human activities. Most human related increases in CO₂ emissions come from burning fossil fuels to run automobiles, industrial equipment, and power plants. However, the second largest source of CO₂ is **deforestation** in the tropics through land use change primarily in the Southern Hemisphere, mainly clearing forest for agriculture or development.

Researchers have noted that the rise in greenhouse gases coincides with the rises in overall global temperatures. The overall global climate has been steadily warming over the past century. According to National Oceanic & Atmospheric Administration (NOAA), 2000-2010 included nine of the 10 hottest years on record. A number of scientists are convinced that the average temperature levels on Earth will rise by several degrees Celsius if greenhouse gases are not significantly reduced.

One-way people hope to reduce or reverse the buildup of CO₂ in the Earth's atmosphere-- and thus, reduce global climate change-- is to increase the amount of carbon stored in forests.

Carbon Sequestration, Forests and Wood Products

Growing trees remove carbon dioxide from the air, store carbon in the tree biomass (trunks, branches, foliage, and roots), and release oxygen through the process of photosynthesis. Trees are unique in their ability to lock up or sequester large amounts of carbon in their wood. In fact, 50% of the weight of wood products from trees is stored carbon. Through carbon sequestration, the planting and harvesting of trees and use of sustainable wood products can help reduce the amount of greenhouse gas concentrations in the atmosphere.





Task: Climate Change, Carbon, and Trees

CO₂



Forests store some 289 million metric tons of carbon in trees and plants alone (FAO, 2010 “World Deforestation Decreases, but Remains Alarming in Many Countries” and “The Global Forest Resources Assessment 2010” <http://www.fao.org/news/story/en/item/40893/icode/>). The total carbon stored in forests including the deadwood, litter, plants, soil, and trees is more than all the carbon in the atmosphere. Forests store more carbon than do any other land-based ecosystems, and they store more carbon than contained in all of the Earth’s remaining oil stocks. Peat stores more than all of the forests in the world (Intergovernmental Panel on Climate Change --- IPCC).

By storing carbon, forests slow the rate at which CO₂ accumulates in the atmosphere. Oceans store the most CO₂. One-way people hope to reduce or reverse the buildup of CO₂ in the Earth’s atmosphere- and thus, reduce global climate change- is to increase the amount of carbon stored in forests.

Testimony of a Family Forest Owner: “The Future of the Nation’s Forests”

The following is an excerpt from a testimony by Clint Bentz, a family forest owner, on behalf of the Oregon Tree Farm System and the American Forest Foundation before the House Agriculture Committee’s Subcommittee on Department Operations, Oversight, Nutrition, and Forestry.

June 3, 2009 *Project Learning Tree Focus on Forests* (pg. 140 E 142) ©2015 American Forest Foundation

“Family forests that are sustainably managed are critical to our daily lives. Across the nation, these family forests supply the bulk of the wood for wood products, clean water and air, wildlife habitat, and recreational opportunities. And, without forests, we would be sliding even closer and faster into climate change. Because trees absorb carbon, our nation’s forests are effectively reducing 10 percent of all harmful carbon dioxide pollution in the United States ever year.”

“The U.S. EPA (Environmental Protection Agency) predicts that with the right incentives to encourage good forest management practices like planting trees, replanting cut trees or trees damaged by disasters, lengthening cut rotation, and avoiding deforestation (the permanent removal of trees from a forested area), forests could actually do more to combat climate change-capturing and storing up to 20 percent of all U.S. carbon emissions.”

“This is important-we have 20 percent of the solution to our nation’s climate challenges right here in our backyard today-in the nation’s forests. This is a climate mitigation tool that we can put to work immediately.”

“Forests have long provided traditional benefits like wood, wildlife, and recreation. Now, we are also depending on forests to provide ecosystem services like clean drinking water, carbon sequestration, and biomass for clean fuel. Family forests will play an essential role to help our nation with its most pressing environmental issues like climate change. But family forests need supportive policies and market incentives if their forests are going to do all they can to survive as healthy forests, thereby providing all the “free” benefits the public now enjoys.”

“Thank you again for the opportunity to speak to you.”

Source: *Project Learning Tree Focus on Forests*, pg. 131-132,140-143:

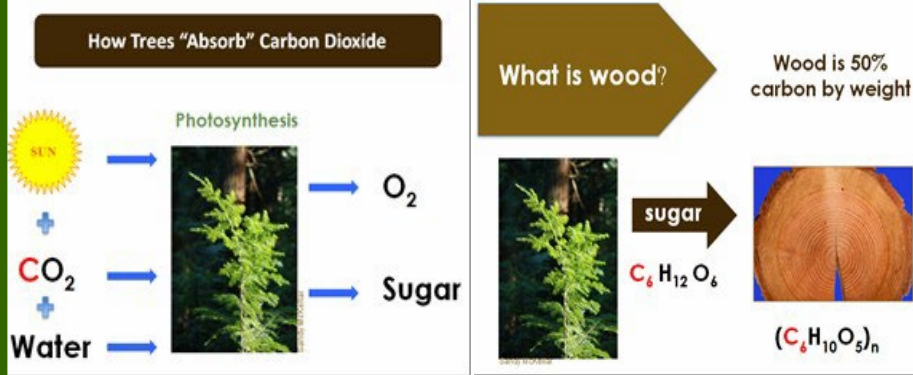
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Task: Climate Change, Carbon, and Trees



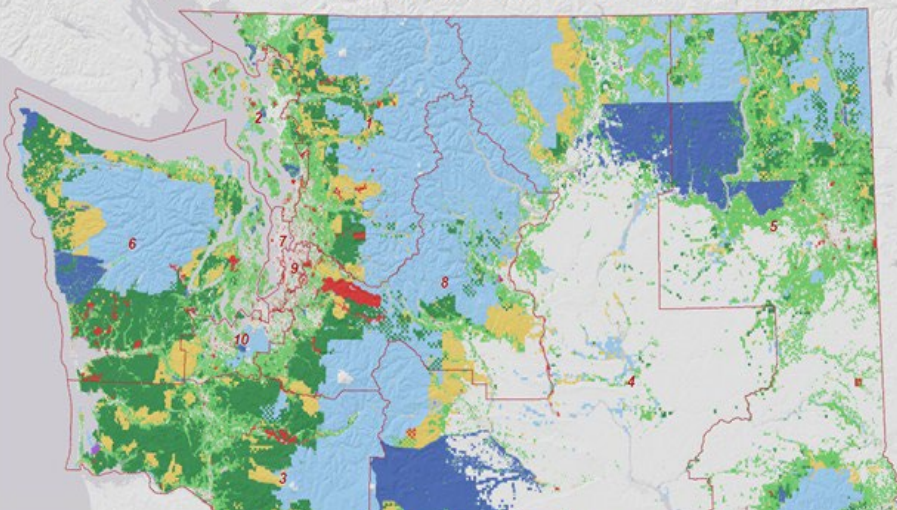
How Trees Store Carbon



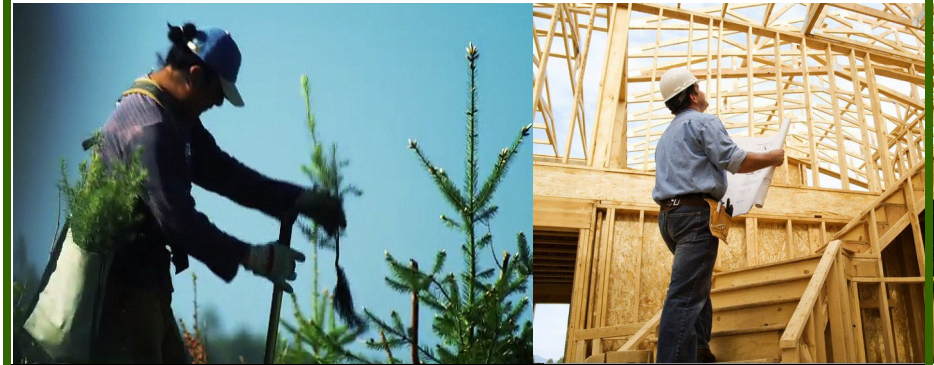
"You can think about a tree as kind of a solar panel. I mean it's taking the energy from the sun and through photosynthesis it is converting the carbon dioxide that it absorbs from the atmosphere into the sugars it needs to grow and in the process, in that chemical reaction, it is releasing the oxygen that we need to breathe."

~Dr. Tom Bonicksen, America's Ancient Forests

2012 State Congressional Districts and Major Forestland Owner Types¹ in Washington



A Healthy Forest Products Industry promotes responsible forestry, creates green jobs and produces renewable green building materials



Washington plants 52 million seedlings each year

Washington is the nations 2nd largest softwood lumber producer

"A healthy and prosperous America relies on the health of our natural resources, and particularly our forests. America's forests supply communities with clean and abundant water, shelter wildlife, and help us mitigate and adapt to climate change. Forests help generate rural wealth through recreation and tourism, through the creation of green jobs, and through the production of wood products and energy."

~ United States Secretary of Agriculture,
Tom Vilsack



WFPA

WASHINGTON FOREST PROTECTION ASSOCIATION

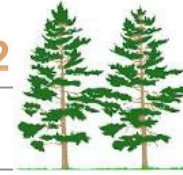
WFPA.org

(360) 352-1500



Task: Climate Change, Carbon, and Trees

CO₂



Wood Products Are Renewable Green Building Materials

The Obama administration endorsed wood as a green building material. This endorsement acknowledges that growing trees take carbon out of the atmosphere, storing it first in the forest, which when harvested continues storing this carbon in wood products.

~ USDA News Release March 30, 2011

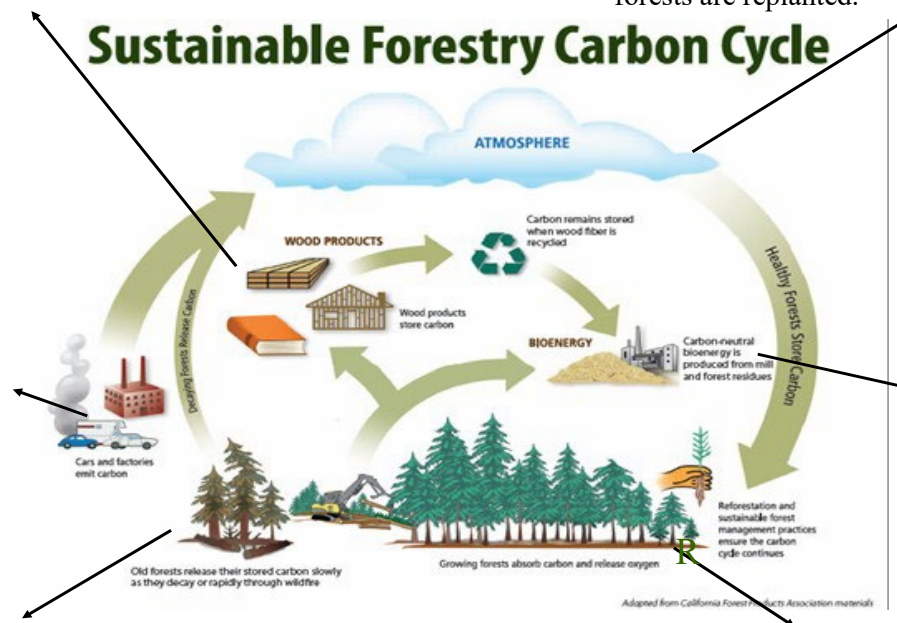
Wood Products Are Energy Efficient

- Wood building materials produce less air and water pollution, require less energy and generate less CO₂ emissions than other common building materials.
- Concrete creates 51% more solid waste than using wood to build a typical house.
- Steel requires 400% more water than using wood to build the same structure.
- Two tons of carbon emissions are offset for every dry metric ton of wood used.

Bioenergy Emissions Are Different Than Fossil Fuel Emissions

Fossil fuels add carbon to the atmosphere that would otherwise remain trapped underground.

- Bioenergy emits CO₂ that is in a natural carbon cycle and would be released anyway through decay or wildfire.
- The CO₂ released when the biomass is burned is reabsorbed when forests are replanted.



Clean Energy From Forests

- Liquid biofuels created from wood products, like cellulosic ethanol, reduce greenhouse gas emissions by 91% from emission produced by fossil fuels.
- Liquid biofuels created from wood are also among the most efficient new transportation fuels. For example, it takes 4.6 gallons of corn ethanol to displace the emissions of one gallon of gas, but only takes 1.1 gallons of cellulosic ethanol to do the same.

Unmanaged Forests Release Carbon

"A legacy of fire suppression has resulted in our forests that are over-stocked and much more susceptible to catastrophic fire and disease. Restoring forest ecosystems, particularly in fire-adapted forests, will make our forests more resilient to climate-induced stresses and will ensure that our forests will continue to provide ample, abundant, clean water."

~ United States Secretary of Agriculture, Tom Vilsack

Responsibly Managed Forests Absorb Carbon

- Sustainable forestry increases CO₂ absorption from the atmosphere as a result of young trees absorbing higher levels of carbon dioxide than older trees, making the forest act as a carbon sink.
- Responsibly managed forests provide drinking water, a healthy climate, wildlife habitat, and green jobs in rural economies.
- Managed forests increase CO₂ absorption and prevent catastrophic fire, disease and insects that kill trees and emit carbon dioxide.



Task: Climate Change, Carbon, and Trees

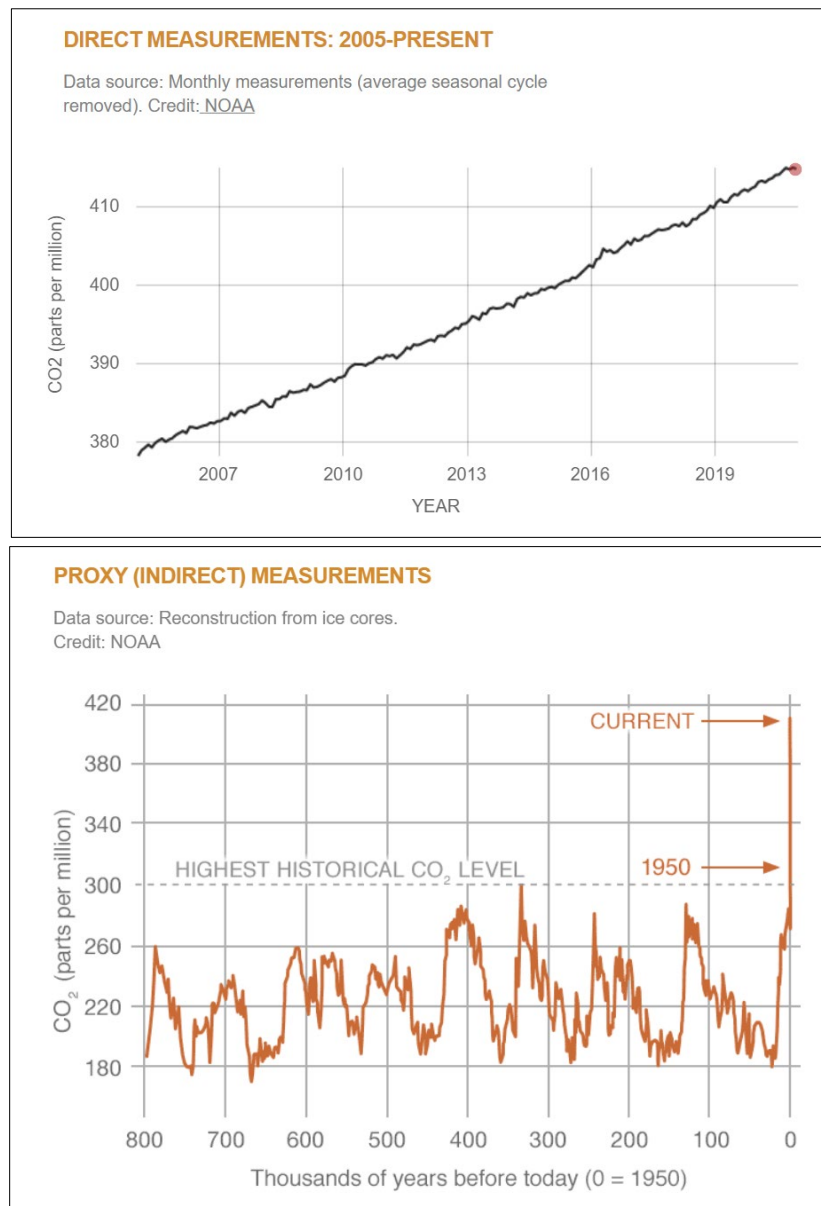
CO₂



Carbon Dioxide Concentration: WHAT DOES THIS MEAN?

Carbon dioxide (CO₂) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions. The first graph shows atmospheric CO₂ levels measured at Mauna Loa Observatory, Hawaii, in recent years, with average seasonal cycle removed. The second graph shows CO₂ levels during the last three glacial cycles, as reconstructed from ice cores.

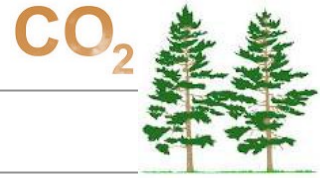
Over the past 170 years, human activities have raised atmospheric concentrations of CO₂ by 47% above pre-industrial levels found in 1850. This is more than what had happened naturally over a 20,000-year period (from the Last Glacial Maximum to 1850, from 185 ppm to 280 ppm).



Source: <https://climate.nasa.gov/vital-signs/carbon-dioxide/>

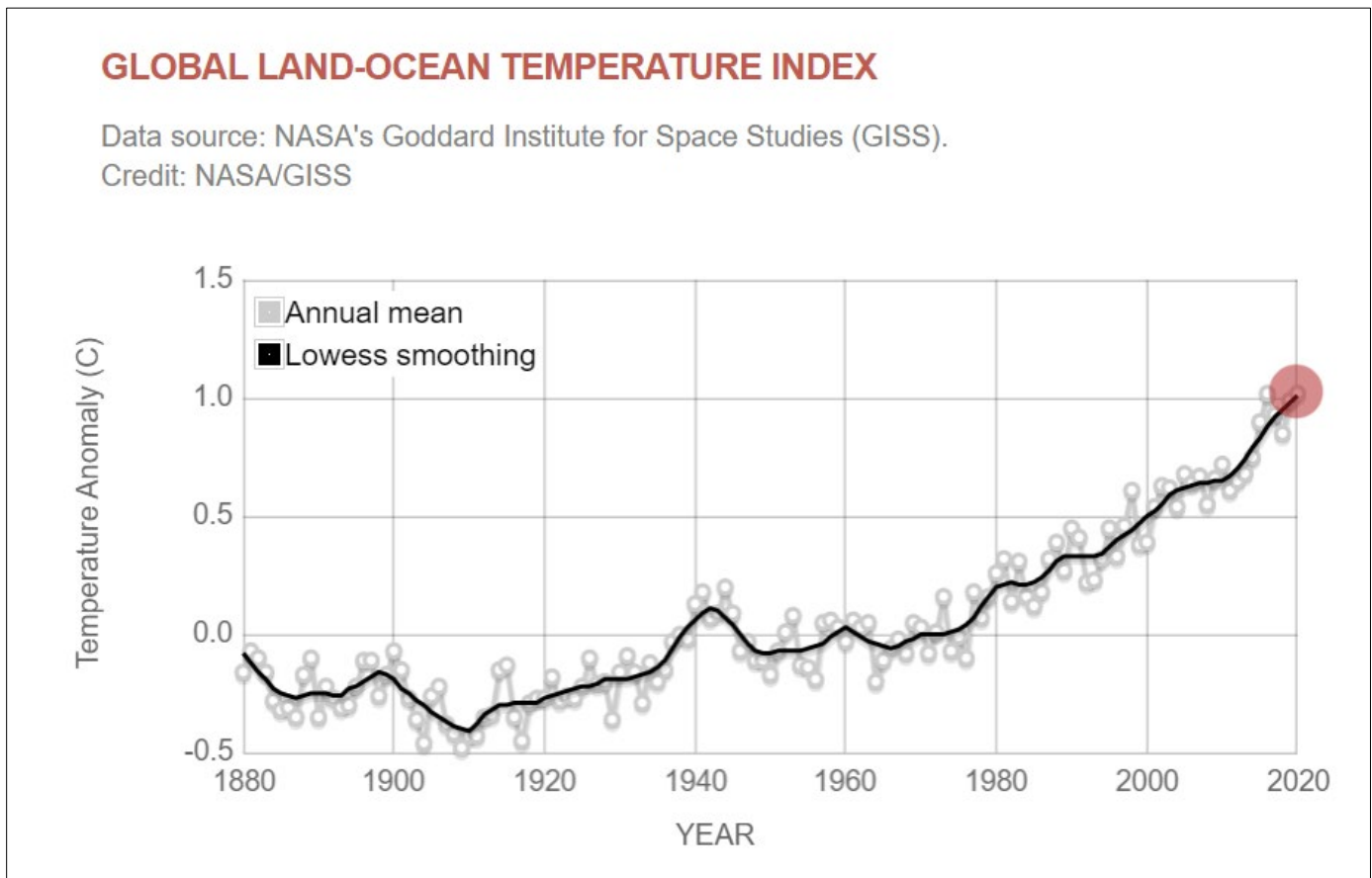


Task: Climate Change, Carbon, and Trees



Global Surface Temperature: WHAT DOES THIS MEAN?

This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures. Nineteen of the warmest years have occurred since 2000, with the exception of 1998. The year 2020 tied with 2016 for the warmest year on record since record-keeping began in 1880 (source: NASA/GISS). This research is broadly consistent with similar constructions prepared by the Climatic Research Unit and the National Oceanic and Atmospheric Administration.



Source: <https://climate.nasa.gov/vital-signs/global-temperature/>



Task: Climate Change, Carbon, and Trees

CO₂



Part 2: Field Investigation

Students can measure trees to calculate the amount of carbon in a tree and how much is sequestered per year. Teachers can find information on calculating carbon at the following website:

Tree Benefits www.treebenefits.com

Discussion questions might include the following:

- What is the relationship among climate change, carbon, and trees?
- Why might we be concerned about clear cutting without a plan to re-forest the area?
- What is happening worldwide regarding managing our forests?
- Why might people be concerned about the cutting down of the rain forests?
- How are we affected by actions in another part of the world?
- What, if anything, is happening locally and internationally to create plans that include reforestation areas that are harvested?
- What actions might individuals take to address the issue of cutting trees without replacing them??

In addition, teachers may want to consider one or more of the following field investigations:

- PLT-Focus on Forests-Climate Change and Forests PLT Website with both lbs. and kgs of carbon charts: <https://www.plt.org/activity-resources/focus-on-forests-activity-8-climate-change-and-forests/>
- Tree Benefits: www.treebenefits.com

Other ideas for field investigations:



Task: Climate Change, Carbon, and Trees

CO₂



Part 3: Essay

Student Directions:

You will now review your notes and sources, plan, draft, and revise your essay. You may use your notes and refer to the sources. You may also refer to the answers you wrote to questions at the end of Part 1, but you cannot change those answers. Now read your assignment and the information about how your essay will be scored, then begin your work.

Your assignment:

Data shows that the amount of carbon dioxide in the atmosphere is increasing over time. Carbon Dioxide is a “greenhouse gas” that traps heat causing the temperatures in our atmosphere to rise. A key natural way to reduce carbon dioxide is to plant trees. Trees absorb the carbon and store it in wood, keeping the carbon out of the atmosphere.

You have been asked to research the issue of climate change, carbon, and trees. Your job is to explain how carbon is affecting our environment and the role that trees and wood products play in countering global warming. Use information from both print and video sources in your essay, citing your sources. Your essay will be published in a local journal used to educate the public about this important environmental issue.

How your essay will be scored:

1. **Statement of Purpose/Focus** – how well your response is fully sustained and consistently and purposefully focused.
2. **Organization** – how well the ideas progress from the introduction to the conclusion using effective transitions.
3. **Elaboration of Evidence** – how well you provide support evidence for your topic and includes effective use of sources.
4. **Language and Vocabulary** – how well you effectively express ideas using precise language that is appropriate for your audience and purpose.
5. **Conventions** – how well you follow the rules of usage, punctuation, capitalization, and spelling.

Now begin work on your essay.

- Review your notes.
- Plan your essay using the template provided.
- Write your essay.
- Revise and edit for a final draft.





Task: Climate Change, Carbon, and Trees

CO₂



Planning My Essay

Essay Components

Introduction: Capture the reader's attention

Statement of purpose or controlling idea:

How carbon affects the environment:

The role trees play in countering the carbon affect:

What we can do to reduce the impact of carbon on the environment:

Conclusion:

Informative / Explanatory Writing Rubric (Grades 6-11)

Scoring Version



Score	4	3	2	1
Statement of Purpose/Focus	<p>The response is fully sustained and consistently and purposefully focused:</p> <ul style="list-style-type: none"> consistent or main idea of a topic is clearly communicated, and the focus is strongly maintained for the purpose, audience, and task 	<p>The response is adequately sustained and generally focused:</p> <ul style="list-style-type: none"> controlling or main idea of the topic is clear, and the focus is mostly maintained for the purpose, audience, and task 	<p>The response is somewhat sustained and may have a minor drift in focus:</p> <ul style="list-style-type: none"> controlling or main idea of a topic may be somewhat unclear, and the focus may be insufficiently sustained for the purpose, audience, and task 	<p>The response may be related to the topic but may provide little or no focus:</p> <ul style="list-style-type: none"> controlling or main idea of the topic may be somewhat confusing or ambiguous; response may be too brief or the focus may drift from the purpose, audience, and task
Organization	<p>The response has a clear and effective organizational structure creating unity and completeness:</p> <ul style="list-style-type: none"> consistent use of a variety of transitional strategies to clarify the relationships between and among ideas effective introduction and conclusion logical progression of ideas from beginning to end; strong connections between and among ideas, with some syntactic variety 	<p>The response has an evident organizational structure and a sense of completeness, though there may be minor flaws and some ideas may be loosely connected:</p> <ul style="list-style-type: none"> adequate use of transitional strategies with some variety to clarify the relationships between and among ideas adequate introduction and conclusion adequate progression of ideas from beginning to end; adequate connections between and among ideas 	<p>The response has an inconsistent organizational structure, and flaws are evident:</p> <ul style="list-style-type: none"> inconsistent use of transitional strategies with little variety introduction and conclusion, if present, may be weak uneven progression of ideas from beginning to end; and/or formulaic; inconsistent or unclear connections between and among ideas 	<p>The response has little or no discernible organizational structure:</p> <ul style="list-style-type: none"> few or no transitional strategies are evident introduction and conclusion, if present, may be missing frequent extraneous ideas may be evident; ideas may be randomly ordered or have an unclear progression
Elaboration of Evidence	<p>The response provides thorough and convincing support/evidence for the controlling idea and supporting idea(s) that includes the effective use of sources, facts, and details.</p> <ul style="list-style-type: none"> comprehensive evidence from sources is integrated; references are relevant and specific effective use of a variety of elaborative techniques* 	<p>The response provides adequate support/evidence for the controlling idea and supporting idea(s) that includes the use of sources, facts, and details:</p> <ul style="list-style-type: none"> adequate evidence from sources is integrated; some references may be general adequate use of some elaborative techniques* 	<p>The response provides uneven, cursory support/evidence for the controlling idea and supporting idea(s) that includes uneven or limited use of sources, facts, and details:</p> <ul style="list-style-type: none"> some evidence from sources is weakly integrated, imprecise, or repetitive; references may be vague weak or uneven use of elaborative techniques*; development may consist primarily of source summary 	<p>The response provides minimal support/evidence for the controlling idea and supporting idea(s) that includes little or no use of sources, facts, and details:</p> <ul style="list-style-type: none"> evidence from the source material is minimal or irrelevant; references may be absent or incorrectly used minimal, if any, use of elaborative techniques*
Language	<p>The response clearly and effectively elaborates ideas, using precise language:</p> <ul style="list-style-type: none"> vocabulary is clearly appropriate for the audience and purpose effective, appropriate style enhances content 	<p>The response adequately elaborates ideas, employing a mix of precise with more general language:</p> <ul style="list-style-type: none"> vocabulary is generally appropriate for the audience and purpose generally appropriate style is evident 	<p>The response elaborates ideas unevenly, using simplistic language:</p> <ul style="list-style-type: none"> vocabulary is uneven or somewhat ineffective for the audience and purpose inconsistent or weak attempt to create appropriate style 	<p>The response is vague, lacks clarity, or is confusing:</p> <ul style="list-style-type: none"> vocabulary is limited or ineffective for the audience and purpose little or no evidence of appropriate style

Score	2	1	0
Conventions	<p>The response demonstrates a command of conventions:</p> <ul style="list-style-type: none"> adequate use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates partial command of conventions:</p> <ul style="list-style-type: none"> limited use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates little or no command of conventions:</p> <ul style="list-style-type: none"> infrequent use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling

NS	Unintelligible, in a language other than English, off-topic, insufficient evidence (incomplete) or copied text. (Off-purpose writing will still receive a score in Conventions.)
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*Elaborative techniques may include the use of personal experiences that support the controlling idea.