

Common Confusions about Climate Change

About Climate and Climate Change

Assumption or Confusion about Climate	More Adequate Conception
Weather anomalies can be used to prove or disprove climate change.	Weather describes the atmospheric conditions at a specific place at a specific point in time. Weather is related to, but is not the same thing, as climate. Climate is the long-term average weather conditions in a particular location or region at a particular time of the year. Climate is typically measured in long increments of time, often at least 30 years. Therefore, evidence of climate change is best assessed through long-term alterations to temperature, precipitation, and other climate factors—not through single weather events, such as a heat wave or a blizzard.
Carbon dioxide makes up a small percentage of the total gases in our atmosphere. We are not adding enough carbon dioxide to change the climate system..	There are several atmospheric gases, and many do not trap heat. Greenhouse gases, such as carbon dioxide and methane, occur naturally in small amounts, but they are very efficient at absorbing heat energy. For this reason, a small change in carbon dioxide can have large impacts on the climate system.
The carbon dioxide that humans add to the atmosphere through fossil fuel combustion increases the total amount of carbon on Earth.	Carbon naturally cycles through biological, physical, and geological systems over time. The amount of carbon on Earth is stable. However, human activities are transferring carbon that is stored in fossil fuels to the atmosphere at a faster rate than would occur naturally.
The hole in the ozone layer is a large contributor to global warming.	Both the ozone hole and global warming are influenced by human activities. However, the ozone hole and global warming are different issues. The ozone hole is a depletion of the atmosphere's ozone layer, which reduces the ability of the ozone layer to protect the Earth from the sun's ultraviolet radiation. The hole is caused by the release of CFCs, or chlorofluorocarbons. Unlike reflected radiation which is absorbed as heat, ultraviolet radiation is not a large contributing factor to the average increase in global surface temperature.
Aerosol spray cans are a large contributor to global warming.	Aerosol spray cans once contained CFC's as a propellant, but not since the 1980s when we became aware of the damage to the ozone layer.
If we stop rockets from making holes in the ozone layer, we could reduce global warming.	The major element for making holes in the ozone layer is a type of chemical called CFCs, chlorofluorocarbons. Rockets do not make holes in the ozone layer and the ozone layer holes are not the cause of global warming.

(Table Rows 1-3 adapted from CIRES, 2012; Table Rows 4-6 adapted from Yale Project on American Teens' Knowledge of Climate Change)

About Climate Future

Assumption or Confusion about the Climate Future	More Adequate Conception
We can completely reverse or solve climate change with the right solutions.	The residual time for carbon dioxide in the atmosphere leads climatologists to believe that global warming will continue to occur due to recent greenhouse gas emissions even if immediate and significant action is taken to curb these emissions.

If we can implement climate change mitigation strategies, we don't need to worry about adapting to projected changes. Or, if we focus on how to adapt to projected climate changes, we don't need to change our behaviors using mitigation strategies.	Solutions should consider both mitigation and adaptation strategies so that we can reduce climate change impacts as much as possible and prepare for projected changes that cannot be avoided.
If climate changes, forests can just move to the right spot.	While migration is a reasonable possibility for some species, others will be constrained by human-caused changes in the landscape that prevent plants and animals from extending their ranges. There are no guarantees that all of the organisms that make a functional forest (e.g., fungi, insects, microorganisms) will migrate together. In addition, seed dispersal varies by species and is fairly limited for most trees. Because trees grow slowly and may not reproduce for many years, they are less likely to be able to expand their ranges rapidly enough to escape negative impacts from climatic conditions. If climate changes occur quickly and variably, existing ecosystems will be less likely to adapt and some tree species may be lost. Even when successful migration occurs, it may be many decades before the forest achieves the same age and size distribution associated with a particular forest type.

(Table from Monroe and Oxarart, 2014)

About Carbon

Assumption or Confusion about Carbon	More Adequate Conception
Plants release oxygen, not carbon dioxide. Or if they do release carbon dioxide, they only respire in the dark.	Plants capture carbon dioxide from the atmosphere during the day, store it in sugar molecules, and then continually break down those sugar molecules to create energy in the form of a chemical compound called ATP (adenosine triphosphate). ATP is then used to build and maintain complex structures such as cellulose, lignin, bark, and leaves from the simple sugars made in photosynthesis. The process of metabolizing sugars (respiration) releases carbon, which returns to the atmosphere as carbon dioxide. This occurs throughout the day and night.
Animals need oxygen, and plants need carbon dioxide.	Plants require carbon dioxide, but they also need oxygen during the process of respiration. Generally, plants release more oxygen as a byproduct of photosynthesis than the amount they use to respire. Woody plants in particular use more carbon dioxide than they release.
Gases are not matter or they don't have mass.	Anything that has matter has mass. Frozen, compressed carbon dioxide is called dry ice and has mass. Gases have mass, too, just less than solids or liquids (by volume) because the molecules are farther apart.
The food broken down for energy leaves an animal's body entirely through its urine and feces.	Much of the substance of food leaves the animal as exhaled carbon dioxide, which is a byproduct of energy-producing cellular respiration.
Respiration produces energy, rather than converting energy.	Respiration converts energy from one form to another.
Energy is used up during biological processes.	Energy is used up during biological processes.
Gases such as carbon dioxide lack sufficient mass to lead to the development of biomass in plants. Plants get mass from the soil.	Gases such as carbon dioxide lack sufficient mass to lead to the development of biomass in plants. Plants get mass from the soil.

(Table adapted from Hartley, Wilke, Schramm, D'Avanzo, & Anderson, 2011)

Resources

Climate Change: Evidence and Causes

National Academy of Sciences and the Royal Society. 2014. Washington, DC: The National Academies Press. http://www.nap.edu/catalog.php?record_id=18730. This booklet provides clear answers to 20 common questions and basics to climate change science.

Climate Change: Evidence, Impacts, and Choices: Answers to Common Questions about the Science of Climate Change

National Research Council, 2012
http://nassites.org/americasclimatechoices/files/2012/06/19014_cvtx_R1.pdf

This booklet summarizes the current state of knowledge about climate change, explains some impacts expected in this century and beyond, and examines how science can help inform choices about managing and reducing the risks posed by climate change.

Climate Literacy and Energy Awareness Network (CLEANET)

<http://cleanet.org/index.html>
CLEAN is a small digital collection of teaching resources aligned with the Essential Principles of Climate Literacy. Each teaching resource is reviewed by scientists and educators for alignment with these principles first, and then for scientific accuracy, pedagogic effectiveness, and usability.

Climate Literacy Guidelines: The Essential Principles of Climate Science

www.globalchange.gov/resources/educators/climate-literacy
This guide presents information that is important for individuals and communities to know about climate, impacts of climate change, mitigation, and adaptation.

Global Warming: It's All about Carbon

Robert Krulwich, National Public Radio, 2007
<http://www.npr.org/news/specials/climate/video/>
As part of the Climate Connections Special Series, these five short videos teach basic concepts about carbon and its role in climate change.

Skeptical Science: Getting Skeptical about Global Warming Skepticism

John Cook, Global Change Institute at the University of Queensland
www.skepticalscience.com
This website reviews scientific, peer-reviewed literature to help explain climate change and to address common misconceptions about climate change.

Teaching Controversy

Mark McCaffrey, 2012. *The Earth Scientist* 28(3): 25-29.
<http://www.nestanet.org/cms/sites/default/files/journal/Fall12.pdf>

The author discusses why teachers should not present climate change as a "theory" open for debate, but instead should focus on helping students understand climate change and the supporting scientific research.

Trend and Variation (Weather vs. Climate video, 1:04)

<http://www.youtube.com/watch?v=e0vj-0imOLw>
A short video clip explains the difference between weather and climate

Yale Project on Climate Change Communication

Yale University
<http://environment.yale.edu/climate>
This website provides several reports, videos, and other resources that help explain research related to public knowledge and perceptions of climate change.

References

- Cooperative Institute for Research in Environmental Sciences (CIRES). (2012). Common misconceptions about climate and climate change. *Making climate hot: Effective communicating climate change*. Retrieved from <http://cires.colorado.edu/education/outreach/climateCommunication/CC%20Misconceptions%20Handout.pdf>
- Hartley, L. M., Wilke, B. J., Schramm, J. W., D'Avanzo, C., & Anderson, C. W. (2011). *College students understanding of the carbon cycle: contrasting principle-based and informal reasoning*. *BioScience*, 61, 65-75.
- Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate change 2007: Synthesis report. Contribution of working groups I, II, and III to the fourth assessment report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (Eds.)]. Geneva, Switzerland: IPCC.
- Leiserowitz, A., Smith, N., and Marlon, J.R. (2011). *American Teen's Knowledge of Climate Change*. Yale University. New Haven, CT: Yale Project on Climate Change Communication.
<http://environment.yale.edu/climate-communication/files/American-Teens-Knowledge-of-Climate-Change.pdf>
- McCaffrey, M. (2012). Teaching controversy. *The Earth Scientist* 28(3), 25-29. Retrieved from www.nestanet.org/cms/sites/default/files/journal/current.pdf
- Monroe, M. C., & Oxarart, A. (Eds.). (2014). *Southeastern forests and climate change: A Project Learning Tree secondary environmental education module*. Gainesville, FL: University of Florida and American Forest Foundation.
<http://sfrc.ufl.edu/extension/ee/climate>