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CRITICAL TOPICS

about *CLIMATE CHANGE* that every student should know

1 Weather, Climate, and Climate Change

Students need to understand the relationship between weather and climate. Weather is a snapshot of day-to-day conditions at a location. Climate is the long-term average of weather conditions over 30 years or more. Knowing how climate data are generated and what those data actually represent are essential to understanding the concepts of climate variability and climate change.

2 Earth's Climate System

Students must understand the components of Earth's climate system – atmosphere, oceans, land, vegetation and ice – and their interactions. Interactions go beyond simply cause and effect, and should be viewed in terms of interdependence and feedbacks. A change in any one component alters conditions throughout the entire system, affecting the climate.

3 Earth's Energy Budget and the Greenhouse Effect

Students must understand that some of the heat radiating from Earth's surface toward space is absorbed by greenhouse gases in Earth's atmosphere, thereby increasing the atmosphere's temperature. This process, known as the greenhouse effect, is responsible for making the wide variety of life on Earth possible. However, the greenhouse effect is intensified as humans add carbon dioxide (CO₂) to the atmosphere, resulting in global warming.

4 The Carbon Cycle

Students must understand how carbon moves through the Earth's climate system, how society uses fossil fuels, and the major sources of CO₂ emissions. The driver of human-caused climate change is our use of fossil fuels, and to mitigate (reduce) global warming this usage must be understood and addressed.

5 The Scientific Perspective About Climate Change

The scientific community strongly agrees and concludes that human activities are causing global warming, which in turn causes climates to change. Educators need to teach the scientific perspective about climate change. The debate and controversy lie in the social, economic, and political approaches to mitigate and adapt to global warming and climate change.

Content adapted from Shepardson and Hirsch (2019), published in American Educator, available online at www.tinyurl.com/teachclimate



The more greenhouse gas in the atmosphere, the more terrestrial radiation is absorbed and the warmer the Earth will be.

Solar radiation (yellow lines) is energy from the sun. It passes through the atmosphere without interacting with greenhouse gases. Most solar radiation is reflected back to space, but some solar radiation is absorbed by land and water, warming the Earth's surface.

 The greenhouse effect is not the problem. Actually, life on Earth wouldn't survive without it. But human activity is significantly altering the balance of this natural process by adding extra greenhouse gases to the atmosphere, and that's the problem.

Earth radiates heat energy (orange wavy lines) outward toward space. This heat energy is called terrestrial radiation. Greenhouse gases absorb heat that is radiated from the Earth. The warmed greenhouse gases then radiate some of that heat back toward the Earth, keeping the planet warm. The rest of the heat gets radiated out to space.

Humans burn fossil fuels (which are mostly carbon) as one source of energy. This releases ancient, stored carbon into the atmosphere as carbon dioxide (CO₂), a greenhouse gas, and it cycles carbon (black dashed lines) through Earth's climate system, enhancing the greenhouse effect.