

Global Warming 11th Grade Project

Over the years the derivation of global warming has become evident, a genesis that began when the world was ushered into an era of industrialization. Global warming is a product of industrialization because in order to operate machinery, fuel was required to produce energy, which when burnt generated superfluous greenhouse gases as byproducts. Fossil fuels, such as petroleum, in particular produce carbon dioxide (CO₂), which is the most commonly found greenhouse gas in the atmosphere. It is formed in any combustion chemical reaction such as $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$. Other man-made origins of greenhouse gases include “landfills, coal mines, oil and gas operations, and agriculture,”¹ which releases the gas methane (CH₄). In nature, methane is produced from decomposers known as Methanogens in the decomposition reaction $\text{HC}_2\text{H}_3\text{O}_2 + 4\text{H}_2 + \text{CO}_2 \rightarrow 2\text{CH}_4 + 2\text{H}_2\text{O} + \text{CO}_2$.³ To exacerbate the effects of burning fossil fuels, it can also generate the greenhouse gases nitrous oxide (N₂O) and sulfur dioxide (SO₂), which cause acid rain. Nitrous oxide is created when ammonium nitrate is gently heated,² written in the decomposition chemical reaction as $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2\text{O} + 2\text{H}_2\text{O}$. Conversely, sulfur dioxide is formed in the single replacement chemical reaction $\text{SO} + \text{O}_2 \rightarrow \text{SO}_2 + \text{O}$. In terms of the natural causes of these gases, carbon dioxide is produced as a natural gas from the decomposition of deceased plants and animals, and respiration, however not in such substantial quantities as from fossil fuels; sulfur dioxide can be created as a result of volcano eruptions, and nitrous oxide can be emitted by temperate and tropical soils.

The greenhouse effect works on earth analogously to a real greenhouse, the atmosphere being the greenhouse. This effect has much to do with the electromagnetic spectrum, which displays all forms of radiation relative to their frequency: radio waves, microwaves, infrared, visible light, ultraviolet, x-rays, and gamma-rays.⁵ Ultraviolet radiation deriving from the sun has a relatively small frequency, thus its

wavelength is smaller than infrared radiation, which has a higher frequency. The greenhouse effect works thusly: first ultraviolet radiation either passes through earth's atmosphere, or is deflected off the atmosphere due to greenhouse gases and clouds; subsequently, the radiation that penetrates the atmosphere is absorbed by greenhouse gases and transmitted upon earth in all directions as sensible heat, increasing the specific heat or amount of heat required to raise the temperature of earth one degree centigrade; next, the soil is heated through conduction, and the earth turns into a radiator of energy in the long waveband, thus infrared light is emitted from earth towards space by convection; this trapped energy is either reciprocated back onto earth to be once again recycled, or propelled into space.

One staggering effect of global warming called acid rain is formed in two ways, the first being "when [the greenhouse gas] sulfur dioxide reacts with moisture found in the atmosphere."⁶ This causes sulfur dioxide to oxidize, forming the sulfite ion SO_3 in the combination reaction $\text{SO}_2 + \text{O}_2 \rightarrow \text{SO}_3$. This ion then "becomes sulfuric acid (H_2SO_4) when it reacts with hydrogen atoms in the air"⁶ in the single replacement reaction $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$,⁶ which then gets precipitated as acid rain. The second method of forming acid rain is from nitrous oxide, which reacts with water in the atmosphere to form nitric (HNO_3) and nitrous acid (HNO_2) in the single replacement reaction $\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$; it is thereafter rained down. The ramifications of acid rain are severe, for it has been known to destroy agriculture, minerals, and plants, subsequently warping the food chain and destroying terrestrial ecosystems; marine ecosystems are also affected when acid rain is precipitated into water, raising water's pH to uninhabitable conditions. By acid rain destroying plants, photosynthesis, or the process by which plants subsist, cannot work. Photosynthesis is written as $6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$, thus plants recycle carbon dioxide in the atmosphere, and produce the oxygen which animals require. With photosynthesis, it is possible to reduce the amount of greenhouse gases in the atmosphere due to the recycling of carbon dioxide, which diminishes the amount of excessive heat trapped.

The greenhouse effect keeps earth habitable, although by more greenhouse gases being produced additional heat becomes trapped in the atmosphere, thus heating earth. This enhanced greenhouse effect has raised the average global temperature “0.5-1.0°F since the late 19th century,”⁷ and is expected to raise the mean temperature at an accelerated rate to even higher heights in the next century. This increase in temperature causes global climate change, so areas of earth on tundra latitudes would ultimately experience the melting of the polar ice caps, which would eventually raise the sea level, and decrease the amount of habitable land. In fact, “Globally, sea level has risen 4-8 inches over the past century.”⁷ Not only is sea level rising, but ocean water’s salinity is being distorted, for fresh water’s salinity is increasing, while salt water’s salinity is decreasing. This is due to how global warming is intensifying the evaporation of water near lower latitudes (freshwater), consequently elevating salinity there, altering the evaporation and precipitation cycle. Moreover, global warming is causing an increase in tornadoes and hurricanes. The excessive heat in the atmosphere in combination with springtime’s pressing of hot air upwards “causes a much more intense release of energy. This release takes the form of rapid transfer of hot air upward and cold air downward,”⁸ forming tornadoes and hurricanes.

Currently, several measures are being taken by scientists in order to cease the production of excessive greenhouse gases. Devices such as catalytic converters are being installed in automobiles, which turn exhausted greenhouse gases into less harmful substances such as oxygen, nitrogen, and water. Other means of lessening global warming include pollution control devices such as solar cars, which harness solar energy to operate, and phytoplankton. Phytoplankton is a marine organism that responds hastily to changes in the environment. These organisms perform photosynthesis ($6\text{H}_2\text{O}+6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6+6\text{O}_2$), consequently recycling carbon dioxide for oxygen. Carbon dioxide is then incorporated into the marine food chain as Phytoplankton is consumed, which ultimately makes its way to the ocean floor as organic matter. Therefore, carbon dioxide is reduced in the atmosphere and discarded to the

depths of the ocean indefinitely. Recycling is another innovative means of controlling global warming, for unlike the manufacturing of materials, recycling of paper, plastic, glass, and other materials “reduces greenhouse gases... by reducing methane emissions, saving energy, and increasing forest carbon sequestration.”⁹ The recycling of materials can also be performed in other unique ways, such as instead of throwing out unwanted items they can be sold, or reused in other ways by the owner.

Internationally many attempts are being made to decrease global warming, especially by nations in Europe and Asia. In Britain and Japan, research workshops are being held in order to provide further insight into global warming. International treaties are also proving useful for finding a solution to global warming, such as the Kyoto Accord, which was formed to decrease the amount of greenhouse gases a nation emits.¹⁰ It is apparent that America is not profusely trying to prevent global warming through these treaties, for America refused to sign the Kyoto Accord. As a world leader it America’s role to take a stand global warming, and use its resources to prevent it, for unlike many countries it has assets that can combat global warming, such as finance, advanced technology, and a strong educational system.

As a controversial issue, there are many opinions about the origin global warming. One idea states that global warming is a result of human processes and industrialization. This opinion is very widely accepted, for in the past century a plethora of evidence substantiating this theory has been procured via frequent testing. It is suspicious that there has been a fluctuation in the production of greenhouse gases after industrialization began, and these gases trap heat. Moreover, these scientists argue that El Niño, a “large scale climatic fluctuation of the tropical Pacific Ocean,”⁴ has been attributed to global warming, for times of El Niño raise climate temperatures. The second opinion states that global warming has naught to do with greenhouse gases, but is a natural cyclic pattern of earth. This belief is based on the fact that since earth’s genesis it has undergone normal cyclic patterns that alter climate. The “ice age” is an example of a normal cyclic pattern, for global temperature plunged. The ice age theory is

substantiated through “ice core samples” taken at Antarctica, which illustrate different levels of salinity over time. The salinity was higher, which denotes less evaporation and precipitation occurred during a period of time, qualities of an ice age. Consequently, the ice age could have been the first half of earth’s cycle pattern, and global warming may be the prelude to the latter half. Another cyclic pattern is with “La Niña, a similar climatic fluctuation [to El Niño], involves the abnormal cooling of the waters,”⁴ the opposite of El Niño. Each of these anomalies occur at different times, indicating the presence of one of earth’s cycles, proving that the earth does undergo cyclic patterns, and global warming may be one. In my opinion, the soundest theory is that global warming is a result of industrialization, for it all boils down to fact and conjecture. It has been proven that greenhouse gases trap heat, thus an excessive amount of greenhouse gases would cause global warming, whereas the idea of earth undergoing normal cyclic patterns is simply an assumption founded on past events. It is impossible to associate global warming to the theory of cyclic patterns without tangible, quantitative substantiations. Regardless, if the problem of global warming is not addressed the future of the world may be unfavorable. As more greenhouse gases are produced, global warming will hasten, potentially making the earth an arid wasteland. All of the water would evaporate, subsequently destroying all life on the planet. Are global warming’s effects a harbinger of plagued imminent future? Only the future will tell.

Experiment

Problem Statement: How does global climate change affect sea level?

Hypothesis: The ice exposed to a higher temperature will melt faster in one hour than ice exposed to room temperature.

Materials: 2 Containers, 6 Ice Cubes, Water, Lamp, Scale

Variables and Controls: In this experiment the variable will be container A, or the container exposed to high light intensity, and the control be container B, or the container exposed to room temperature.

Procedures: This experiment was performed over one hour. To begin this experiment, three ice cubes were placed in two containers respectively, one called A and the other B. Each container was then filled with 200.00 mL of water, determined by using a scale. Subsequently, container A was situated under a lamp whose mean temperature was 43.7°C , and container B was placed in a closet which had a temperature of 22.22°C . These containers were left untouched and inert for one hour. Every ten minutes, the volume of the solution was taken, and thus after one hour had elapsed, the containers' final volumes were measured, and the difference between the initial and final volume was calculated. The rate of melting over one hour was then recorded.

Results: (On Following Page)

Conclusion: The purpose of this experiment was to illustrate the effects of global warming relative to melting the polar ice caps. In this experiment, the light represented the sun, and the ice embodied the polar ice caps. The results were intriguing, as the container exposed to high levels of heat melted at a much quicker rate over one hour than the container at room temperature. In fact, the difference between the rate of melting between container A and B was 11.7 mL/10 minutes, a substantial difference. This result thus illustrates that if the temperature of earth were to increase, the melting of the polar ice caps would accelerate, consequently raising sea level by great quantities and making some lands uninhabitable.

One result that I found interesting was that the ice's rate of melting was not constant throughout the experiment for both containers, even if the intensity of light remained constant within each container respectively. In container A, within the first thirty minutes of the experiment the volume appeared to be at a constant and relatively quick increase, but then leveled out near the end. Conversely, container B's rate was erratic, first accelerating at a constant rate for twenty minutes, then leveling out for thirty minutes, and increasing again for the last ten minutes. This unpredictability may simply be a characteristic inherent to ice, nevertheless, it can be connected on the global scale. Globally, this result implies that the polar ice cap's rate of melting will not be constant over time, for it could change sporadically as it did in the aforementioned experiment.

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