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The Consequences of Global Warming on Human Health

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Overview

This curriculum unit is being designed to provide a bridge between two very different content units taught as part of the North Carolina 7 th grade curriculum. North Carolina is one of the few states left that has an integrated science content curriculum in middle school. Students have a mix of physical, life, and earth science throughout 6 th , 7 th , and 8 th grade. 7 th grade students begin the year with a unit on atmosphere and weather and then move into a unit on human biology. This unit will help to make a meaningful connection between those two very different topics and to help students see the connections that exist between the various fields of science. I will make a connection between the Earth's climate and how certain diseases may be allowed to flourish and spread in an altered climate. Diseases are studied as a part of the study of human biology and I hope to show how a changing climate may have a direct impact on the health of humans.

The ultimate goal of this unit is to improve the scientific literacy of my students and make them better citizens who are able to make responsible choices about their environment. I also want them to be able to make informed decisions when voting on issues and for people who will determine the course our country takes on environmental issues. I want them to understand the impact all individuals have on the amount of greenhouse gases in our atmosphere and that continuing to produce as many as we do may have devastating implications for their futures. It's difficult to make middle schoolers see beyond their own little worlds, but I hope to move them towards making changes in their homes by encouraging family members to consider changes in the way they use energy. Students will learn about their personal impact on the environment, particularly in the amount of carbon dioxide produced by themselves and their families. I hope to motivate them enough to begin making immediate changes in their homes and communities and to help them see every little change individual citizens make goes toward the common good of their city, their country, and eventually, the world. This unit will try to differentiate between the facts and the fallacies about global warming while making students aware that climate change has uncertainties that are inherent to the system, but there are issues that are no longer uncertain and students need to be able to see the difference between what already is and what may be.

Introduction

The Science of Global Warming

"Climate change is a real thing" was the emphatic statement made by Konrad Steffen, the director of Swiss Camp, a research station on the Greenland ice sheet. Global warming and its effects on the Arctic ice are what keep researchers coming to this remote place. Konrad's statement is the current consensus of almost all scientists, and increasingly more of the general public as well. Global warming has been in the headlines for much of the past year. A hurricane season that was the most active and destructive ever recorded, melting Arctic ice, drowning polar bears, increased rates of certain diseases, droughts, fires, and rising sea levels are all pieces of evidence that give credence to the predictions made by scientists over 30 years ago. Scientists have been giving warnings about the consequences of unabated greenhouse gas emissions since the 1970s, but because of the uncertainties in climate modeling, the powers that would stand to lose the most, have created more confusion and doubt about the realities of climate change. There is absolutely no doubt at this point that carbon dioxide levels are up, the temperature is up, and human activities are the primary cause.

The terms "greenhouse effect" and "global warming" are very often incorrectly used as interchangeable terms. The greenhouse effect is the result of greenhouse gases in Earth's atmosphere holding onto some of the heat radiating from Earth after being heated by light waves from the Sun. The incoming solar radiation passes through the atmosphere to heat up the surface of the Earth. The Earth's atmosphere is mostly transparent to the incoming light waves, which means the radiation passes right through the atmosphere to the surface. Once the surface of the Earth is heated, infrared radiation is then emitted from the surface of the Earth. The greenhouse gases, which include water vapor, methane, nitrous oxide, and the one we will discuss at greatest length, carbon dioxide, are opaque to the infrared radiation, meaning that they do not allow the infrared radiation to pass through the atmosphere the way light waves initially came in. These gases trap some of the heat inside the atmosphere of the Earth and enable the Earth to be habitable for people and all other organisms. This greenhouse effect keeps the surface temperature of the Earth at approximately 10 degrees centigrade. Without the greenhouse effect, the average surface temperature of the Earth would be approximately -25 degrees centigrade, much too cold for life as we know it. The Earth would be frozen over!

Global warming refers to the increasing average temperature of the Earth for any reason whatsoever, but mostly due to increasing levels of greenhouse gases, most particularly, carbon dioxide. The vast majority of scientists agree that these rising levels of greenhouse gases are due to human activities, most notably, the burning of fossil fuels. Fossil fuels are called such because they are the remnants of millions of years of plants being buried in sediments that eventually became coal, oil, or natural gas deposits. Those plants contained trillions of tons of carbon that had been taken out of the atmosphere during photosynthesis. Photosynthesis is the chemical process by which plants use carbon dioxide in the presence of Sunlight to produce oxygen and sugar. In the past 200 years, humans have been using these deposits to produce energy and all that carbon is being reintroduced into the atmosphere at the rate of billions of tons a year.

Greenhouse gases occur naturally in our atmosphere and are also created by man's activities. The problems with global warming are occurring because man's activities have caused the amount of greenhouse gases to increase much faster than the Earth can absorb them, so the natural balance has been terribly altered. Carbon dioxide has increased by 30% since pre-industrial times from 278 ppm (parts per million) to 378 ppm. Methane has more than doubled in the same amount of time. Nitrous oxide has increased by 15 %. Although methane and nitrous oxide are both much more potent in their heat trapping potential, their overall numbers

are significantly lower than carbon dioxide, so carbon dioxide is the greenhouse gas that the most attention is focused on. The infrared radiation that is coming from the surface of the Earth has a much longer wavelength than the energy coming from the Sun, which is what allows the carbon dioxide and other greenhouse gases to absorb the energy coming from the surface of the Earth rather than directly from the Sun.

Paleoclimatologists who have studied ice cores from Antarctica and the Arctic have found a direct correlation between the average surface temperature of the Earth and the amount of carbon dioxide in the atmosphere. They have been able to detect atmospheric data in the ice cores going back 650,000 years. At no point in the last 650,000 years has the carbon dioxide level been above 300 ppm. When carbon dioxide levels are up, the temperature of the Earth is up. They are able to create an ancient temperature record from the ice cores based on an isotope of oxygen, ^{18}O. "The Dutch geochemist Willi Dansgaard figured out that the ratio of heavy oxygen to lighter oxygen atoms in ice might be used to determine ancient temperatures. Cool temperatures will wring moisture out of the air, and because water molecules containing ^{18}O tend to be heavier, they condense first. As cold intensifies and continues, the oxygen atoms in precipitation tend to get lighter and lighter since most of the heavier ^{18}O has already fallen out of the water vapor in the air." (Linden, *The Winds of Change,* p. 129) Using the ratios of ^{18}O to lighter isotopes of oxygen, geochemists can compare the ratios from old water from ice and compare with known ratios of temperatures today and reconstruct a thermometer for past climate. According to these ancient temperature records, we are now in the warmest period in over a million years. There are still those who would contend that the climate naturally warms and cools and that we are just following the natural cycle. However, 20 of the 21 hottest years on record have all occurred in the past 25 years, with 2005 being the hottest year ever.

The average surface temperature of the Earth has gone up about 1 ◦ F in the past 50 to 100 years or so and if greenhouse emissions continue to be released at the current rate, the carbon dioxide levels are expected to double within the next 50 years and the average temperature is expected to increase between 2 ◦ and 8 ◦ F. If you look at any average day anywhere, a 2 ◦ to 8 ◦ F difference seems like nothing at all to worry about, but average daily temperatures have no comparison to the average of the whole surface temperature of the Earth. This average difference for the Earth means great changes in the average daily temperatures for cities. This average increase would also not be the same over the whole planet. The average may mean only a 1 ◦ F increase at the equator but up to a 12 ◦ F difference at the poles. Already the scientists see a larger warming trend at the poles than at other places on the planet. Also the extremes in temperatures are expected to be much greater on both ends of the thermometer, so some areas will have record cold snaps and some will have extended heat waves, as has already been seen in many places around the world in the past 5 years.

The rising temperatures, particularly at the poles, lead to the scary probability of rising sea levels due to the melting ice. There have been a multitude of studies at both of the poles for many years. The evidence is irrefutable that the sea ice and land based ice are melting at a faster rate than scientists had predicted. The loss of the Greenland ice alone doubled from 1996 to 2005. 80% of Greenland is covered by ice. It holds 8% of the world's fresh water supply. (Kolbert, *Field Notes from a Catastrophe*) In 2005, Greenland lost 50 cubic kilometers of ice. 85% of the world's glaciers are melting and many areas covered by snow and ice may be ice free in less than 50 years. The Arctic sea ice is not a large concern when it comes to rising sea levels, because floating ice has already displaced as much water as it is going to displace. The land based ice, however, such as that on Greenland and on Antarctica, has the potential to raise sea levels as much as 80 feet according to some estimates. When you consider that almost 50% of the world's population lives at or very close to sea level, you have to consider the possibility of millions of people being displaced from their homes permanently. I will discuss later the implications of rising sea levels on rates of disease.

The melting ice, whether it be land-based or sea-based ice, also has implications for overall global warming. Albedo is a term that refers to the reflectivity of Earth. On average, Earth has an albedo of .4. A perfect mirror that reflects all energy would have an albedo of 1, while a perfect black body, which absorbs all energy, would have an albedo of 0. As temperatures at the poles warm and polar ice is melted, the overall albedo will decrease which will lead to more absorption of energy because the ocean has a very low albedo and absorbs most of the energy it receives. This is one of the feedback mechanisms that leads to uncertainties in exact predictions of what the sea level rise might be. Another factor that leads to sea level rise is the basic thermal properties of water. As water warms, it expands. This isn't observable in small amounts of water, but in large amounts, the difference in the amount of space water can take up can be quite dramatic. So even without the melting ice, the warming sea can in itself lead to rising levels. The average sea level rise has been approximately 20 centimeters, but in some areas, the increase has been much more pronounced. For example, at Baltimore, the average rise has been 1.5 meters.

Climate change and disease

This unit, in addition to explaining the science of global warming, will give examples of how the increasing temperatures and resulting changes to the environment will have a direct impact on human health. The World Health Organization estimates that increasing temperatures since the 1970s are responsible for an extra 150,000 deaths per year and they conservatively estimate that number will double by 2030.

Diseases have been linked to observable natural phenomena since Hippocrates (460 - 377 BC). Throughout the first millennium, epidemics were explained by atmospheric, meteorological, and terrestrial phenomena. The earliest study of disease was the collection of data, both epidemiological and meteorological. Physicians in the late 18 th century measured temperatures, rainfall, and seasonal changes in disease patterns. France required physicians to collect meteorological data three times a day as part of their duties. The earliest US national weather bureau emerged from the effort to link weather and disease. (National Research Council, *Under the Weather)* Now in this new era of rapid climate change, there is once again a connection being made between weather and human health. In the IPCC's reports in the mid 1990s, there was only brief mention of climate change and health, but in their 2003 report, a whole chapter is devoted to the issue. As with the climate models, when predicting future health consequences based on global warming, there are many uncertainties because of so many variables when dealing with populations and their health.

The increased risk to human health comes from a wide range of problems. I will start with the carbon dioxide levels themselves. The increased carbon dioxide levels are a boon to ragweed and other plants that produce pollen (here's a brownie point for those who claim "Carbon dioxide *is* life"). While the extra pollen may be good for the plants, it is like poison to those who suffer from asthma, allergies, and other respiratory ailments. The National Center for Health Statistics listed that the 12 month prevalence of asthma increased by 74% from 1980-1996. Teachers who have been in the classroom for at least 10 years could probably attest to that number just from the increasing number of students in our classrooms who suffer from asthma and allergies. The rising temperatures alone will increase the amount of ground-level ozone which poses serious health risks for people with respiratory ailments, enough so that local governments usually issue ozone alerts telling people at risk to stay indoors. The number of ozone alerts can be expected to increase significantly. In addition, drought-driven brush fires and more dust storms will add to increasingly prevalent respiratory problems.

The next health issue is cholera, a waterborne bacterial disease. Cholera is one of the few bacterial diseases that still causes pandemics. Studies suggest that environment more than human migration is the primary

factor in the spread of cholera. During the last 35 years, cholera has been emerging outside its endemic home in Asia to Africa and South America where it had not been seen for almost 100 years. In 1991, an epidemic swept from Peru across the continent and into Mexico, killing more than 10,000 people. Cholera is dependent on environmental conditions. Warmer temperatures in combination with elevated pH and plankton blooms (more on blooms later) can influence the growth and multiplication of cholera. El Nino, also known as ENSO (El Nino, Southern Oscillation events), which is a phenomenon of warmer water in the Pacific Ocean, has been tied to outbreaks of cholera. With the onset of global warming, El Nino events are expected to increase in frequency and in intensity, which could lead to further outbreaks of cholera and other diseases. Rising sea levels will also intrude on fresh water supplies, raising the risk of contaminated drinking water in many areas. In addition to the rising sea levels, some areas of the world will see dramatic increases in precipitation. Other areas will be prone to drought. In areas where there is an increase in precipitation, there will also be increased likelihood of floods, which always lead to contamination of drinking water supplies. Even a heavy rainfall can lead to overloaded sewer systems, particularly in older cities. A heavy rainfall preceded the majority of waterborne-disease outbreaks in the US over the past 60 years.

The group of diseases that has been most studied in relation to climate change is the vector-borne diseases. These are diseases carried to humans by other organisms, most commonly mosquitoes and ticks. Malaria, the disease caused by a parasite called *Plasmodium* and spread to people by the bite of a mosquito, affects more people than any other disease in the world. There are over 300 million cases of malaria a year, resulting in over a million deaths. The vast majority of these cases are in Sub-Saharan Africa. . Outbreaks of malaria are favored by weather conditions that are hotter and more humid than usual. Temperature increases of 2 - 3 ◦ centigrade would increase the number of malaria cases around 3 - 5%, amounting to several million more cases a year. Studies are already showing an increase in malaria at higher elevations. Cities that used to be above the line where mosquitoes would come are now seeing malaria. Rwanda and Ethiopia are two countries that are beginning to see malaria in the higher elevations, as well as Kenya, Nairobi, and Zimbabwe. A World Health Organization Report in 2000 found that warming had caused malaria to spread from three districts in western Kenya to thirteen. Some studies show that some areas will actually become too hot and dry for mosquitoes to live, but other areas will become more suitable, including the southeastern part of the United States. Some areas where malaria is already endemic may see an increase in the seasonal duration of the disease.

Another mosquito-borne disease that is believed to have greatly benefited from global warming is West Nile virus. West Nile virus was first identified in the West Nile district of Uganda in 1937. The mosquito that most commonly carries West Nile virus is a common house mosquito, called *Culex pipiens* and most commonly thrives in drought. It lives in drainpipes and sewer puddles. While this mosquito thrives in drought, its predators do not. Following an unusually dry, hot spell, the West Nile virus showed up in New York. That was in 1999 and by 2003, West Nile virus had spread all the way across the United States to the West Coast and up into Canada, a country whose people probably would never have believed that they had to worry about tropical diseases. During that journey west and north, the virus has infected over 23,000 people and killed over 800.

Dengue fever, another mosquito-borne disease, has also been moving to higher altitudes and higher latitudes. Asian Tiger mosquitoes, the type that carry dengue fever, have been reported recently as far north as the Netherlands. There has also been a correlation between ENSO and the rates of dengue fever in South America.

Ticks are also carriers of multiple types of disease, such as Lyme disease and tick-borne encephalitis. With

milder winters and cooler nights, ticks will be able to flourish like never before. In my own area in the Carolinas, ticks remained a problem throughout the entire year, including the winter. It never got cold enough to disrupt their cycle. In Sweden, cases of tick-borne encephalitis have risen in direct correlation with warmer winters.

Another well-studied example of climate change leading to disease outbreaks was an outbreak of hantavirus in the American Southwest in 1993. That was the year of a fairly strong El Nino event and there has been a direct correlation made between the El Nino event and the outbreak of the hantavirus. El Nino related floods brought water to the normally very dry desert regions. This increased the food supply for deer mice, whose numbers exploded. The hantavirus lives in deer mice and the virus gets to humans through contact with mouse excrement. The excrement dries and then gets carried into human lungs as dust. The dramatic increase in the number of deer mice exposed more people to the mice because mice love the shelter of people's homes and thus more opportunity for the virus to jump to people.

Algal blooms, which are pretty familiar to people living on the Carolina coasts and those on the Gulf Coast, have been increasing in frequency and intensity, thanks to warmer sea surface temperatures and more pollution being poured into our oceans. Algal blooms, made up of millions of diatoms or dinoflagellettes, can very often be toxic to humans. When fish and shellfish eat these toxins, the toxins can build up in their systems, and then when humans eat the fish, they ingest the toxins, which can lead to a variety of illnesses, and sometimes even death. One species of algae is so tiny it can even become aerosolized and become airborne which can then be inhaled into the lungs of humans and cause respiratory problems.

New diseases continue to surface to create problems for humans and diseases once thought to no longer be a problem in some areas are now resurging, so we will need to find ways to mitigate these emerging problems as we continue to mitigate the effects of global warming.

Creating Change

Virtually all of the distinguished science groups have concluded that humans have contributed to the observed changes in our climate. A few of these groups include the International Panel on Climate Change, the American Meteorological Society, the American Geophysical Union and the American Association for the Advancement of Science. (Oreskes, *Science, 2004)* According to *An Inconvenient Truth*, there have been over 900 peer reviewed research articles written about global warming in the past 10 years, and not one of them stated any doubt about the reality of global warming.

So, with all these potential problems that could result from global warming, something obviously needs to be done and done soon. The scientific community has been in consensus that action to reduce our greenhouse emissions should have started already. A decade or two has already been wasted because of the focus on uncertainties with global warming. There is a fear that we may have already reached or may soon reach a tipping point beyond which we do not know the full consequences. The time to act and begin making major changes in the way we conduct our lives is now. Ever since the 1950s when Wallace Broecker of Lamont-Doherty Earth Observatory first published his speculations that climate might be subject to more rapid swings than was commonly believed at that time, scientists have been conducting studies to create models of climate based on past records found in the ice cores of Antarctica and Greenland. In 1979, a memo prepared for President Carter addressed the threat of human-caused climate change and predicted "a warming that will probably be conspicuous within the next twenty years." That prediction came true before the end of the next decade and James Hansen, an atmospheric chemist working at NASA's Goddard Institute for Space Studies asserted, "Global warming is now sufficiently large that we can ascribe with a high degree of confidence a

cause and effect relationship to the greenhouse effect." (Linden, *The Winds of Change,* p. 273).

In 1989, based on Hansen's and others' warnings, the Intergovernmental Panel on Climate Change (IPCC) was created and convened 2,500 scientists from around the world to examine the links between greenhouse-gas emissions and climate change. In response to this, a group of energy companies, including automakers and other industry giants, formed the Global Climate Coalition in an effort to prevent taking action on climate change. This began a decade of deliberate efforts to confuse the public into believing scientists were in disagreement about global warming. When signs of global warming started to become obvious and it became harder to discredit the science, the Global Climate Coalition lost many of its members and finally disbanded in 2002.

Many developed countries have begun taking the steps necessary to combat global warming. The Kyoto Treaty was an effort to control greenhouse gas emissions around the world and has been signed by 132 nations in the developed world. The only 2 advanced nations not signing the Treaty, now known as the Kyoto Protocol, are the United States and Australia. While there are some problems with the Kyoto Protocol, it is a step in the right direction. Nations are making commitments to reduce their greenhouse gas emissions in order to slow down global warming. The United States is the single biggest producer of greenhouse gas emissions by far than any other country. It is responsible for over 30% of greenhouse gas emissions of the whole planet and it has made no commitment to reduce those emissions. Fortunately, many US cities have ratified the Kyoto Treaty on their own and are implementing policies to reduce greenhouse emissions in their own cities and thus slow down global warming one city at a time. As part of this unit, I will be initiating an effort to have my own city sign on to this nationwide effort and will be incorporating this effort into my curriculum unit.

Steps that the government needs to be taking include investing in clean and renewable power. Our country has the technology, the money, and the brain power to improve the gas mileage of cars, the efficiency of power plants, and to begin the transition to energy sources that do not rely on fossil fuels. The data on using biodiesel, which is produced using corn or soy plants, shows a significant decrease in the amount of CO_2 produced, will create a whole new industry for jobs in our country, and will significantly decrease our reliance on foreign oil. Other options for us include the use of nuclear power, which produces no CO_2, but does involve considerable care in disposing of the hazardous waste. No nuclear power plants have been built in our country in over thirty years, primarily because of the fear of a nuclear accident and also because of the continued disagreement about disposal of wastes. Wind power and solar power would be ideal solutions in that there are no harmful effects to our environment and the energy is completely renewable, but the wind does not always blow and the Sun does not always shine, and the land area needed to provide these options is sometimes not available, but they are wonderful options on a small scale. The United States truly needs to be taking the lead in developing these technologies, not only for ourselves, but also to encourage the rapidly developing countries, such as China and India, to start with the infrastructure of clean, efficient energy as they are developing. Currently, China has plans to build hundreds of new, coal-fired power plants, using the same technology we used here fifty years ago. We need to be helping them create cleaner technologies right now.

While governments have to begin the big steps, such as investing in the research of renewable and clean energy, individuals can begin taking the tiny steps towards protecting the future of our planet's health. Making wise transportation choices is probably the biggest step individuals can make toward reducing their own carbon emissions. Driving cars that are more energy efficient and using public transportation whenever possible when motorized transportation is necessary will reduce individual emissions significantly. The Environmental Protection Agency's website provides a calculator that allows individuals to determine his or

her own carbon emissions number. I will be doing this activity with my students and their families and try to begin the process of decreasing those numbers throughout the school year.

Objectives

The state standards this unit will address include: designing and conducting investigations to demonstrate an understanding of scientific inquiry, demonstrating an understanding of technological design, conducting investigations to build an understanding of the atmosphere. This unit will specifically address evaluating how humans impact air quality and the financial and economic trade-offs involved with that. We will also be conducting investigations to explain the effects of environmental influences on human development and explaining how understanding human body systems can help make informed decisions regarding health.

My particular school is a 6 th - 8 th grade middle school with approximately 1200 students. I teach on an A day/B day block schedule and I typically have 26-32 students in a class, for an average total of 160 students. Middle school science classes in my district are heterogeneously grouped, which means that I can have the highest achievers, the learning disabled, and ESL (English as a Second Language) students all in the same class. This requires a great deal of creativity, differentiated instruction, and lots of planning. (A little bit of insanity helps, too.) This unit will utilize strategies that can be differentiated, used in small groups, and will lend themselves to whole class discussions easily.

The emphasis in middle school in our state has always been on math and language arts instruction. End of the year testing is focused on those two subjects. While we test in science and social studies, the scores on those tests do not count toward our accountability goals, so while there is less pressure on science and social studies teachers, we sometimes feel like we are teaching elective classes. The focus on math and language arts is also in the elementary schools, so science is taught "if there is time." Very often students come to middle school with little to no science background. Science content we used to assume middle school students would have when coming to middle school is no longer part of their prior knowledge. We now have to assume zero background in science content. One of the strategies I have employed in the last few years in an effort to make science more relevant in middle school is to create interdisciplinary units. I have learned how to engage other teachers in this and it has been successful for most of us. This unit will include several lessons that cut across the disciplines and will include: using inquiry, creating graphs, analyzing graphs, writing persuasive letters, conducting research, and conducting investigations.

Lesson Plans

The following lessons may not necessarily be taught consecutively. In order to generally follow the district pacing guide, other lessons may be taught in between the unit lesson plans. My student tables are arranged in groups of four, so most activities are designed for groups of four, but some activities will include five to six students. When I group the students, there will always be a combination of all levels of students.

Lesson 1

Objective: Students will identify and describe the layers of the Earth's atmosphere and the properties of the gases that make up those layers.

Warm-up

Students will look at temperature graphs of the different layers of the Earth's atmosphere in their science textbooks and on an overhead transparency. Students will first be asked to individually write down their thoughts on why the different layers of the atmosphere may have different temperatures. After a few minutes of writing down their own thoughts, they will then share with the other students at their table and try to come up with a group idea that will be shared with the class. After each group has shared their ideas about why the layers have different temperatures, I will build on their ideas or correct misconceptions to lead them to understand that different gases absorb heat differently and that the layers of the atmosphere are divided according to the different temperatures.

Activity

Students will be put into groups of approximately six and given materials to build their own model of the atmosphere.

Materials: 6 pages of laminated sheets with 10 each of 10 km markings on each page, for a total of 600 km; various space vehicles, such as rockets, satellites, space station, telescopes, shuttles, etc., with a chart showing orbiting altitudes of each, science textbooks

Students will be given vis-à -vis markers to draw in each layer of the atmosphere and must draw the various properties of each layer showing things such as the various clouds, (students will have prior knowledge of the types of clouds and their average height in the atmosphere from previous lessons), the ozone layer, the ionosphere, the percentage of gases etc. and will also tape on the various space vehicles in the altitudes they typically travel.

Once all groups have finished with their atmosphere models, they will be hung up in the room for students to see each other's models and make comparisons and make corrections on their own models if needed.

Questions

What layer of the atmosphere do we live in?

Where does all weather occur?

Are gases the same in all layers?

Are all layers the same depth?

What makes each layer unique?

Lesson 2

Objective: Students will be able to differentiate between the greenhouse effect and global warming.

Warm-up: Students will review list of gases discussed in previous class and how some gases absorb heat differently than other gases.

After reviewing list of gases, we will discuss what a greenhouse is.

Questions

What is the purpose of a greenhouse?

How does it work?

Where else might you find the same conditions as a greenhouse?

Using overhead transparencies and the science textbook, students will begin to look at how the Earth receives energy from the Sun. We will review the electromagnetic spectrum and how light energy from the Sun comes to the Earth. After the light energy is absorbed, it is reemitted as infrared energy to heat the lower atmosphere. Discuss that infrared energy is absorbed by gases in the troposphere to keep the Earth warm just as a greenhouse holds heat in to keep plants inside the greenhouse warm. The glass allows light to pass through, but not heat. This warming of the Earth by greenhouse gases is called the greenhouse effect and is necessary to keep Earth habitable. Without the greenhouse effect, the Earth would be frozen over instead of the average 59?F that we now enjoy.

Begin discussion of global warming by asking what might happen to Earth's temperature if there were more greenhouse gases in the atmosphere.

Give students copies of a graph (See Figures 1 and 2) showing the levels of carbon dioxide in the atmosphere in the past 100 years and a graph showing the average temperature over the past 100 years. Ask students in groups of four to compare and analyze the data in the graphs and make a hypothesis about a connection between the two sets of data. What do rising levels of CO_2 mean for the temperature? Where is all the CO_2 coming from? Should we worry about it? Can we do anything about it? How is global warming different from the greenhouse effect? What difference will a couple of degrees in average temperature make?

Lesson 3

Objective: Students will make observations about a series of demonstrations concerning the Sun's energy.

Demonstrations

1. Using a water thermometer, students will observe that water expands as it warms and will infer what can happen as the oceans continue to warm.

2. Using a variety of mediums, including water, sand, soil, and grass, students will observe the heating rate of each of the items under a light. They will then infer how this relates to the albedo of the Earth.

3. Students will observe the heating rates of 2 jars, one with a white bottom and one with a black bottom and infer how the different heating rates relate to the albedo of the Earth.

Lesson 4 (2 days)

Objective: Students will research possible problems associated with global warming.

Warm-up: Students will first brainstorm possible problems that might result from a changing climate. List students' ideas on overhead and begin brief discussion of what the problems might be.

Lists of problems should include: melting ice caps and glaciers, rising sea levels, drought and fires, increased precipitation and floods, stronger storms, human health concerns, animal migrations and extinction, crop failures, increased ground level ozone

After discussing the possible problems, students will be grouped into groups of 5 to 6 and assigned one topic that may be a possible problem due to global warming. Each group will then have the rest of the block to research their assigned problem on the computer.

During the next class period, groups will present their information on whiteboards.

Whiteboards are 2 ½ x 4 foot boards that students can write on with dry erase markers to present information. Each group will give a brief 10-15 presentation on the problem that they researched.

Lesson 5

Objective: Students will research and discuss ways to slow down greenhouse gas emissions.

Warm-up: Students will brainstorm ideas for slowing down greenhouse gas emissions as individuals and then ways our country can slow down greenhouse gas emissions.

Activity: Students will make the global warming wheel card provided by the Environmental Protection Agency. (instructions for completing wheel card provided on website in teacher resources) The wheel card provides a way for students to calculate their own greenhouse gas emissions and also provides suggestions for what they can do to slow down greenhouse gas emissions. After completing construction of wheel card, students will calculate their own greenhouse emissions. For homework, students will take the cards home and calculate the greenhouse emissions as a family and will discuss with their families ways to reduce emissions in their own homes. Students will be asked to come back with the score from their family's current emissions and ways their family agreed to cut down emissions.

I plan to hold onto each student's scores and come back to this in a couple of months to see if students and their families have made changes and then recalculate the scores. We will create bar graphs to show how changes in individual families combine to make big changes within our community.

The next 2 lessons will be done as interdisciplinary plans with other teachers at some point during this curriculum unit.

Art Lesson

Students will create posters showing the possible consequences of global warming as well as a way to help mitigate that consequence. Posters will be displayed in school hallways. I may create a judging team and award prizes.

Language arts lesson

Objective: Students will write persuasive letters to convince the mayor of our city to sign onto the US Mayors Climate Protection Agreement.

In March 2005, Mayor Greg Nickels of Seattle sent letters to mayors of over 1100 cities to urge them to sign the US Mayors Climate Protection Agreement. This agreement is an attempt to have cities begin to reduce greenhouse emissions in their own cities as a nationwide effort to meet the Kyoto Protocol standards. The United States is one of only two industrialized nations that has not signed onto the Kyoto Protocol. Mayor Nickels has launched an effort to meet the greenhouse emission reductions in our country at the local level since the federal government will not make a commitment to do so. As of July 2006, 272 mayors have signed onto the agreement and have pledged to make reductions in their own cities. Charlotte, NC is not one of those cities that has signed onto the agreement. After learning about ways communities can reduce greenhouse emissions, my students will write letters to our mayor urging him to sign onto the Mayors Agreement and suggesting ways that the whole community can reduce emissions in an effort to reduce global warming. Hopefully, we will get a response from the mayor and my students can lead the way in getting our city to do its part in reducing greenhouse emissions.

Lesson 6

Objective: Students will determine categories for human diseases.

Warm-up: Students will be given 4 to 5 minutes to make a list of all diseases they can think of.

Activity: After each student has compiled his or her own list, we will create a master list on chart paper. After compiling a list of 30 to 40 different diseases, students will get in groups of 4 to create categories of disease using the diseases listed. Students will have approximately 20 minutes to complete this portion of the activity. After completing the category list, I will then ask students (within their groups) to identify categories or individual diseases that they think may be affected by global warming. Student groups will then share the categories they created and give a brief explanation of why they put diseases in the categories they did.

As student groups share the categories they created, I will begin introducing disease and immune system related vocabulary, such as bacteria, viruses, contagious, vector-borne, parasite, etc. As this vocabulary is introduced and discussed, I will have students begin revising the categories, combining or eliminating, as we go.

This will be the students' introduction to the disease research report we will begin.

Disease Research Report

The disease research report will be done in conjunction with the language arts department. Science teachers will focus on research skills and content while the language arts teachers will focus on writing, citing sources, writing a bibliography, and good paragraphing. Students will have 2 different rubrics to follow, one focused on content and the other focused on the writing, and students will receive 2 different grades for the same paper. (Most students find this to be a great incentive!)

Students will have a list of diseases from which to choose for the research report. Each student in a class must choose a different disease, so there will be at least 40 to choose from. All diseases on the list will be ones that scientists have identified as possibly being affected by global warming.

The research report will include the following information:

1. The cause of the disease and how it is spread to humans
2. Prevention, treatment, or cure for the disease

3. Locations in the world the disease occurs
4. How global warming is already affecting or may affect the disease
5. The body system or systems affected by the disease

Students will have 3 to 4 weeks to work on this project and will have at least 2 days of class time to conduct research.

Students will present reports on the due date and students will compile information about each other's diseases. When all students have presented their reports, we will once again look at categories the diseases may fall into and will have a whole class discussion once again about how we might mitigate the effects of global warming, particularly its effects on human health.

Figure 1

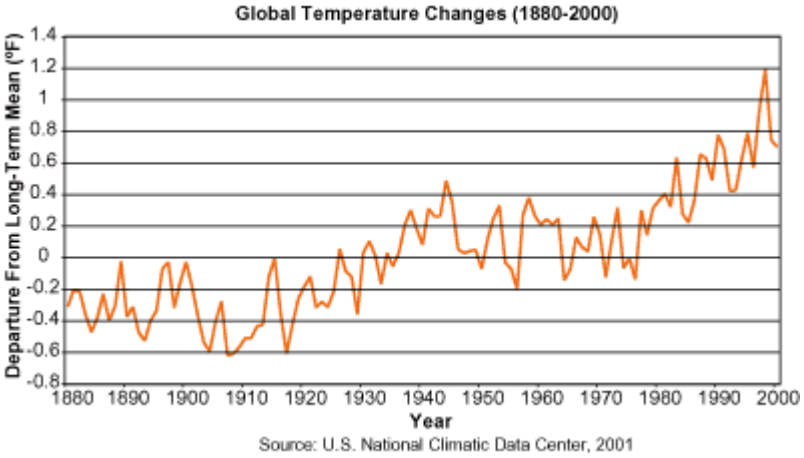

Figure 2

The Keeling Curve