

Views on an Individual's Moral Obligation to Limit Climate Change

By: Takeema Evans, 2019 CTI Fellow
Hawthorne High School

This curriculum unit is recommended for 9th and 10th grade
Earth and Environmental Science Climate and Energy Unit

Keywords: weather, climate, Köppen climate classification (temperate, tropical, polar), arid, humid, paleoclimate, latitude, altitude, el niño, la niña, sunspots, precession, nutation, and eccentricity, greenhouse effect, carbon cycle, photosynthesis, respiration, deforestation, plankton, ocean acidification, coral reefs, albedo, heat island, green roof, thermal expansion (of sea water), coal, petroleum, natural gas, acid rain, alternative energy, solar, wind, biofuel, photovoltaic, hydroelectric, hydrogen fuel, turbine, generator, nuclear fission, nuclear fusion, wave power, geothermal

Teaching Standards: See [Appendix 1](#) for teaching standards addressed in this unit.

Synopsis: This unit focuses on students' understanding of the climate, of climate change and student views on what a person's moral obligation is to limit climate change. Through various content resources, students will explore all the factors that affect the climate. They will study how climate itself affects the people and animals who live in those climates. Students will learn about the difference between legal and moral obligations. They will examine how their personal situations affect how they view moral situations. Students will apply what they learned about morals and climate to debate what, if any, moral obligation there is to limit climate change. Students will reflect on what they feel their own obligation is, what they feel other people are obligated to do, and if there are instances that exclude a person from having a moral obligation in regards to climate change.

I plan to teach this unit during the coming year to 115 students in 9th and 10th grade Earth and Environmental Science.

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Introduction:

This unit is for high school students in an Earth and Environmental Science class. Climate change is something I am very passionate about and it affects everyone, whether they realize it or not. This is a good topic for high students for a couple of different reasons. The climate is changing at a pace that is on track to effect current high school students when they are adults. Current high school students will also be the adults creating and implementing the strategies to limit climate change. This is something students should learn about now so that they have the background knowledge they will need in the future. This curriculum unit is based around a student debate. A debate format is good for my students. They are passionate and like to debate each other. However, they are mature enough to think about and assess a hot button issue given to them.

Rationale:

I picked the climate unit in my class to focus on because I am passionate about the issue and it is an issue that effects everyone. I am currently trying to limit my impact on the climate and want to impart some of my experiences to my students. Climate change has been proven to exist and has been proven to effect many different things, from the weather to people's health. There are current strategies being deployed to mitigate climate change, like the heightened focus on renewable energy sources to decrease the amount of carbon released into the atmosphere. The current generation will be the next generation to create and implement new strategies to tackle the climate change problem. I consider this as another way I can limit climate change- by imparting knowledge to the next generation.

Based on a study published in Earth Systems Dynamic journal, based on the current output of emissions, the year 2035 would be a point of no return for the Earth as far as increased temperatures go (Aengenheyster). There are things we can do to extend this date, but either way this is something that students will live with in the near future. It is a short 16 years away. Rising temperatures on the Earth will result in many negative events including rising seas, increased severe weather and droughts. This will affect many aspects of the world. Severe drought causes crop loss and profit loss for farmers and other food producers. It also limits the amount of food available, therefore increasing the prices of food for everyone and limiting the amount of healthy food available. Increased severe weather will result in more deaths from natural disasters. Extreme droughts will result in habitat loss for people and animals.

All of these things will be what my current students and my own child will deal with in the future. So, I picked the unit because I want to give my students the information about what causes climate change, what effects climate change have on people and the world and what can be done to mitigate climate change. Based on the conversations I have had with my students, climate change is not something that they think about often. They know the term climate change,

they know that people are talking about climate changes but climate change is not something they have thought a lot about. Some students recycle because their parents make them or because they do want to prevent pollution. There is some inkling of what is happening to the world, but they have not had the chance to connect some of the things they do to climate change so they are unaware that they are making an impact. Therefore, my goal is to talk about what we know about climate change, get students to think about how their own behaviors contribute to climate change, and what they can do to limit their impact.

The topic of moral obligation came about as the result of a class conversation about the theft of a pencil. Some students felt it was just a pencil so no big deal if someone takes it. However, other students thought it was still wrong to take it even if it was just a pencil. This led me to think about how my students view morals as a whole and based on what their life is like. Some of my students are transient or have very little adult guidance, so I have tried to be that guiding voice that some of them need. I picked the topic of moral obligation in climate change to try to broaden my student's views and to help them see how and why others view things differently than they do. I would like to put these two things, moral obligation and climate change, together to encourage my students to be mindful about the decisions they make and to be able to understand other views that differ from theirs.

School/Student demographics:

I teach at a magnet High school that focuses on Health Sciences and Military Leadership and Public Safety. Our school is unique in that there are two separate schools under one roof. The Military Leadership program is considered Title 1, while the Health Sciences program is not. Even though the Public Safety program is Title 1, the demographics are changing and we have less disadvantaged students than we have had in the past. Students in the two programs take different focus classes, but I teach the CMS required curriculum class to both sets of students. I teach both standard and honors Earth and Environmental Science with one class being half honors and half standard. I have a class of 12 students, a class of 20 students and a class of 16 students. 48% of the students at Hawthorne get free and reduced lunch. 95% of my students are minority students, mostly black or Hispanic. I have eight students who are currently in the ELL program and need translated material in class as well as modified assignments. Two of those do not have good verbal command of the language and have to use Google translate during most of the class. I have six students who are considered EC, get modified assignments, and modified testing.

Unit Goals

My first goal is to introduce the concept of climate change to my students, show them what it means to say that the climate is changing and present them with the data that shows the climate is changing. I would like to show students how human activity does not affect just their house, city, or town, but that it affects the world as a whole. There are things that naturally contribute to climate change and there are things that people do to increase the rate of change. I want them to understand that even though there are natural occurrences that contribute to climate change, the things people do are quickening the process. I want to present student with the data and claims

from both sides of the issue and let them decide for themselves what contributes most to climate change and what they feel they should do or can do to limit these changes.

My second goal is to get students thinking about what morals are. I want them to figure out what they think is morally right for them, but also have them to see the other side. I want them to understand that what is morally right or wrong for them may not be the same as someone else. Next, I would like students to figure out what their own moral obligations are and determine if we all have the same moral obligations in general. I would like them to apply that thinking to climate change and debate if people have a moral obligation to limit climate change for the sake of the planet, for our future selves and future generations. I would also like them to determine if someone else is not fulfilling their obligation, does that mean they themselves do not have to. I would like students to debate this issue using facts about climate change and what they feel is right given their current or future situations. My goal is that students think about what they learn about climate change, pollution and the negative health effects of each of those and be able to think consciously about how the decision they make will effect things bigger than themselves.

Content Research

What is climate change and what causes climate change?

Climate change is the long-term change in the Earth's average temperature. Long-term average temperature can rise and fall, but at this moment, it is rising. According to chart 1 from the EPA's "Causes of Climate Change", the global temperature have risen by more than 1 degree celsius compared to the pre-Industrial period of the mid-1800s. Temperature changes have natural causes and human causes. Temperatures can naturally change based on the variations in the sunlight reaching the Earth, changes in the reflectivity of Earth's snow and ice, and changes in the Greenhouse effect. Human activity also contributes to rising temperatures by directly decreasing the reflectivity of snow and ice and increasing the Greenhouse Effect. According to chart 1, natural causes alone would have produced about a 0.3 degree celsius increase in temperatures, but with the combination of natural causes and manmade causes, the temperature has risen more than 1 degree celsius since the mid-1800s.

Earth's temperatures can fluctuate based on the variations in sunlight it receives. The sun provides the energy that the Earth needs and the temperature of Earth is based on how much of the sun's energy reaches and stays in the atmosphere. The uneven heating of the Earth creates our weather patterns. Rays enter the atmosphere at different angles at different parts of the Earth creating local climates and biomes. An increase or decrease of energy received from the sun will raise or lower Earth's temperature. Volcanic eruptions are a natural occurrence that can affect how much sun reaches the Earth. During eruptions, the increase in carbon dioxide and water vapor can increase the greenhouse effect for a short time. Ash from eruptions can block out the sun for a short period and lower temperatures. Changes in the sun's intensity can also raise or lower temperatures when the intensity increases or decreases. The Little Ice Age from the 17th to 19th centuries is believed to be caused by a decrease in solar activity from 1645-1715(Epa.gov). This resulted in slightly cooler temperatures in North America and Europe.

The ability to reflect the sun's energy back into space also contributes to changes in the climate. Light colored objects, like snow and glacier ice, reflect energy back into space. The more snow and ice on the Earth, the more energy that will be reflected away. The amount of snow and ice varies naturally depending on the season. There is more ice in the winter than in the summer, which effects temperatures seasonally. Global warming effects reflectivity negatively. As the planet gets warmer, summer starts earlier and lasts longer. This provides more time for ice caps, glaciers and snow to melt. Losing these reflective surfaces creates more surfaces that will absorb heat and lessens the amount of heat reflected away from the Earth. This increases temperatures also. Alaska has seen an increase in glacial receding with the increase in temperatures as its climate has warmed by 4 degrees celsius (Markon), well beyond the measured increase in the global average. This increase in temperature has led to extreme melting. This extreme melting of glaciers and ice limits how much energy is reflected and increases how much is absorbed, raising temperatures.

The greenhouse effect plays a major part in increasing short term and long-term temperatures. When the sunlight reaches the Earth, some of it is reflected back into space and some of it is absorbed. This absorbed heat is re-radiated back into the atmosphere later. Naturally occurring greenhouse gases, like carbon and methane, absorb heat and keep it near the surface. This raises temperatures naturally. Humans have significantly increased the amount of greenhouse gases produced since the start of the industrial revolution. Burning coal in factories, industrial agriculture and other human activities have released significant amounts of carbon dioxide, methane and nitrous oxide into the atmosphere. This has significantly increased the greenhouse effect on the Earth, raising temperatures in the atmosphere as well as ocean temperatures. Independent Scientists in the Intergovernmental Panel on Climate Change released a report that found that in the last 150 years the carbon dioxide levels have risen from 280 parts per million to 400 parts per million (NASA.gov). They concluded that over the last 150 years, it is 95% probable that human activity is the reason the planet has warmed.

What effects do climate change have?

Climate change has effects on human health that range from allergies to death that are a result of changes in the climate. Gases released into the atmosphere, as well as gases trapped near Earth's surface create ozone near the ground. This ozone causes breathing problems in people or increase conditions people may already have. It can aggravate asthma and cause allergies in people. This type of ozone increases with the heat and decreases the air quality. Increasing temperatures will increase the number of days with low air quality that effects people who already have breathing problems. According to the EPA¹, an increase in ozone due to climate change may result in "tens to thousands of additional ozone-related illnesses and premature deaths per year by 2030 in the United States".

Water related illnesses as well as vector borne illnesses are likely to increase with increased global temperatures and climate change (EPA.gov). Water related illnesses come from bacteria, algae and other pathogens that survive in certain types of water. Higher temperatures in the ocean allow pathogens and bacteria to grow. The higher temperatures lead to more dissolved oxygen in the water that algae can use and thrive. Pathogens, viruses, bacteria can be either spread by drinking the contaminated water or through eating the wildlife that lives in the water.

Algae blooms can kill fish and limit the amount of food for people to eat. Vector borne illnesses come from insects like mosquitos. Insects live in brackish type water with little circulation. Rain increases circulation of water sources and as droughts increase the amount of brackish water increase, which increases the reproduction of insects that carry diseases. These insects can spread diseases to people, which can cause birth defects or death.

Climate change also leads to an increase in the number and intensity of weather events (EPA.gov). Droughts in Mid-Western US will increase even though increased evaporation occurs since winds carry the water vapor away from where it evaporated. Increased drought will contribute to crop loss and limit the availability of certain foods for people. Increased ocean temperature leads to increased evaporation from the ocean, which fuels hurricanes. Increased evaporation will lead to stronger storms that have a deadly impact when they hit population islands and states. People will lose their lives, property and crops. When hurricanes come ashore, they cause other waterways to flood, transporting chemicals, contaminants and indigenous wildlife to other areas. Increased evaporation also leads to stronger thunderstorms and tornadoes. Stronger storms and tornadoes can kill or hurt people through flooding. Crops and livestock can be destroyed and waterways can be contaminated from flooding. Flooding from severe weather can also lead to the spread of insects that carry diseases that can be transmitted to people.

What are we doing to limit climate change?

Currently the world as a whole is working to limit carbon emissions to help slow climate change. The effort to make vehicles that are more efficient is one way of limiting how much carbon is put into the atmosphere. According to the Department of Transportation's 2018 Statistics Report, the average fuel economy for cars increased from about 20 mpg in 1980 to about 35 mpg in 2015 and from about 17 mpg to about 27 mpg for light trucks. In the same, report, the use of petroleum for transportation energy, saw a dip starting about 2008 and the use of electricity, biofuels and natural gas has increased in usage. This increase in fuel efficiency and increase in the use of renewable energy helps to limit the amount of carbon emitted into the atmosphere.

According to the US Energy Information Administration, then number of coal power plants have decreased by about 30% from 2006 to 2014 and the number of renewable plants (solar, wind and water) have increased by over 200% in the same period. The shift from coal plants to renewable energy plants is one global effort to limit climate change. While these statistics are for the US, these efforts are happening globally. The Qinghai Province in China has expanded its renewable energy for one week the entire province ran on 100% renewable energy in June of 2017. The province of 6 million people used 1.1 billion kilowatts hours, which is the equivalent to 535 thousand tonnes of coal.

Climeworks², a company in Switzerland, has been removing carbon dioxide from the atmosphere since 2017. The company captures carbon dioxide from the atmosphere, stores it initially and then use it in greenhouses or plant growth and to make synthetic fuels. Carbon Engineering is a British company that has been working to actively pull carbon dioxide from the air since 2015. The goal is to turn it into synthetic fuels also. They are using Direct Air

Capture that can pull carbon dioxide from the air on an industrial level. Pulling carbon dioxide from the air is a relatively new way to decrease the amount of carbon in the atmosphere. The combination of capturing CO₂ from the atmosphere and limiting how much is released will lessen the increases in global temperatures.

Moral obligation discussions related to climate change

Moral obligation with respect to climate change is new to me and the research has shown the same difference of opinions that I would have expected. Having a conversation with different people always give the same mixed results. Some people pay no attention to global warming and do what they want to do. Some people only recycle because they are required to and others are fanatics about the environment and global warming. Since each of us contributes to global warming through various activities, we should each do a part in limiting climate change. According to Almassi³, since global warming is a global issue then taking a drive once in an SUV does not directly contribute to global warming. If you think about the emissions from that one drive compared to Power plants and bigger sources of pollution it is of little significance. Therefore, the question that comes to mind is if people have differing levels of responsibility based on their contribution to global warming. The argument that one afternoon drive in a gas-guzzling car will not be the instance that tips the scale is not a very good argument. When you factor in that afternoon drive combined with trips to work, from work, to other commitments and other leisure drives that adds up to a lot more emissions. Even though one person's combined driving and other emissions may not cause the scales to tip, combining that with many other people's emissions could one day tip the scale. With the tipping point being so close, I feel that even knowing that there is a tipping point proves that one person's emissions do contribute to global warming. In addition, since there is a tipping point, everyone who contributes to it should be responsible to help fix it.

According to Vanderheiden⁴, a problem that exists is that people are ignorant of the effects of their intentional behavior. If someone reasonably does not know the harm they are doing, then can you assign them a moral obligation to the consequences? If a person does not believe what they are doing is wrong, can you still assign a moral value to the outcomes. This issue comes up a lot in developed countries. People do not think about what goes into making things like paper and food. They cannot see the forest cut down for paper and agriculture, except through pictures, so that reality is not real to them. They do not know the products they use hurt the environment, so can you make them morally responsible? I think yes, because ignorance is no excuse. Education regarding climate change is readily available to anyone who wants to review it. There is also the misinformation that does exist and some people choose to believe the false information because it does not make them wrong and they do not have to change. These are all questions I would like students to address together.

Instructional Implementation

Teaching Strategies

This unit is the last unit in the Earth and Environmental Science curriculum. It will be taught over the course of two weeks, but content and class debate structure will be scaffolded

throughout the semester. I will employ a variety of teaching strategies to teach the unit. Students will receive direct classroom instruction on the content necessary to understand how the climate is changing, why it is changing and things that can be done to limit pollution and climate change. Students will learn about the atmosphere, water composition and how it interacts with other things, biomes on the Earth, previous climates and other background information. Students will also learn about current events like increases in severe weather, droughts, flooding and other natural occurrences that are being magnified by the changing climate. Students will apply all of this information to how the climate is changing and how this change effects other systems on the Earth.

Students will receive guided notes and power points that will give them the necessary information that the curriculum requires. Students will use online resources like YouTube, CK12.org, National Geographic, NASA, etc. to watch videos of natural events like hurricanes, storms, etc. Students will engage in laboratory exercises to teach them about the disadvantages of the use of certain types of energy, like oil. Students will receive both standard and non-standard forms of assessments. Students will complete formative assessments to determine their level of content knowledge. Students will be required to complete common formative assessments to determine students' preparedness for the state final exam. Students will have a multiple-choice assessment at the end of each unit along with an essay assessment that will allow students to use their own words to show what they learned. Students will be required to complete a short project on Biomes to gauge their understanding of how biomes work. They will also have a research project that compares and contrasts the different types of energy we use. Students will hear a guest speaker speak about making ethical choices in the food we eat.

Students will participate in classroom debates that include the science curriculum as well as student and adult behaviors that deal with morals and right and wrong. We will have a short debate with most of the units to get students used to supporting their claims with evidence and rebutting another person's claims. Students will practice researching and finding information that supports their stance and information that rebuts their stance so they have information from all sides of the issue. Once students have all of the background information, content knowledge and expected behaviors, the final debate will ask students to debate what they believe is morally correct when it comes to climate change. Students will debate what steps should be taken to combat climate change, if people should be morally obligated to limit climate change, how much of a moral obligation is there and if there should be tangible consequences for not doing anything. They will be given scenarios to determine if a moral obligation applies to that scenario. Then students will determine if there is an obligation, how big the obligation would be. This debate will ask students to use their critical thinking skills, content knowledge and personal experiences to express their views on an issue that affects everyone.

Classroom Lessons and Activities

Prior to teaching the unit, students will participate in classroom debates to prepare them for the proper way to research their information and learn how to properly conduct a debate. During the unit on Plate Tectonics, students debate whether earthquakes or volcanoes cause more damage to people's lives. During the water unit, students debate if the best way to limit pollution is to reduce our consumption, reuse things for different jobs or to make everything recyclable. In the

meteorology unit, students debate if people should be allowed to live in flood zones. After the guest speaker on ethical eating choices, students debate if people should be made to eat in a way that limits the impact on the environment.

Day 1: 90-minute lesson

Students receive all of the vocabulary words for the unit and complete vocabulary exercises. Students will receive the following vocabulary words: weather, climate, Köppen climate classification (temperate, tropical, polar), arid, humid, paleoclimate, latitude, altitude, el niño, la niña, sunspots, precession, nutation, and eccentricity, greenhouse effect, carbon cycle, photosynthesis, respiration, deforestation, plankton, ocean acidification, coral reefs, albedo, heat island, green roof, thermal expansion (of sea water), coal, petroleum, natural gas, acid rain, alternative energy, solar, wind, biofuel, photovoltaic, hydroelectric, hydrogen fuel, turbine, generator, nuclear fission, nuclear fusion, radioactive, radioactive decay, wave power, geothermal.

Students will define all of the words prior to the start of the unit and will complete several activities with the words. I will explain all of the words to the students and allow them to ask for clarification if needed. Students will complete 4-5 frayer models using the words they think will be the hardest to remember. Students will complete a vocabulary cartoon (directions below) for at least two words. Students will sort words into categories picked by the students.

Day 2: 90 minute class

Warm Up: Students will pick two words that seem similar, like El Nino and la Nina and describe how they are similar and different. They will also pick two words that seem different, like solar and wind and describe how they are similar and different. As a class, we will go over some of them and make sure the explanations of the similarities and differences are correct.

Direct Instruction: Students will receive notes about Biomes. I will give students information on Biomes including temperature and rainfall for each biome as well as the animals that live in that biome and how they survive in that Biome.

Student Practice: Students will complete a graphic organizer that describes the different Biomes and adaptations that animals have in order to live there. Students will group together and discuss the following questions about Biomes. Question 1: What would happen to the rain amount if the temperature in the Biome increases or decreases? Question 2: What would happen to the animals who live in biome if temperature increases or decreases? Would they be able to live there, would they leave, would other animals come?

Day 3: 90 minute class

Warm Up: Students will pick a biome and describe what they remember about it without looking at their notes. I will pick several students to tell me what they remember and we will briefly discuss correct and incorrect responses.

Direct Instruction: Students will review Biomes and ask any questions they may have. They will receive all instructions for the class poster and ask any questions they may have. This and the warm up will allow students time to clarify anything they find confusing before they begin the class project.

Student Practice: Students will complete a Biome poster that will show information about a particular biome and what would happen to the biome if the temperature changes. Students will have to show the animals and plants that are currently living in the biome, the temperature and precipitation in the biome and what happens to the plants, animals and people who live in the biome if temperature changes.

Day 4: 90 minute class

Warm Up: Students will write what they know about El Nino and La Nina. We will create a poster chart that shows the correct information students have about El Nino and la Nina. This poster will be posted in the classroom and students will add information to it as they learn.

Direct Instruction: I will explain El Nino and La Nina to students. Students will learn how they either cool or warm areas in the Pacific. Students will watch a you tube video that diagrams each of them. I will explain the greenhouse effect and students will read an article on NASA's climate kids that explains the greenhouse effect and how it increases ocean acidification. I will show students how volcanic eruptions can change climates.

Student practice: Students will draw diagrams of how volcanic eruptions effect climate, the greenhouse effect and how acid rain effects the environment in their interactive notebooks. Students will work in groups to describe what would happen if El Nino and La Nina did not exist. They will use this time to add to the El Nino/La Nina poster in the room.

Day 5: 90 minute class

Warm Up: Students will explain how volcanic eruptions effect climate. Several students will have the chance to explain what they wrote and then we will go over the information, as a class to make sure everyone understands the information.

Direct Instruction: Students will learn about climate change, the evidence for climate change and effects of climate change through a power point. This information will be posted onto Google classroom for students to use outside of class also. Students will have a set of guided notes to use for this content.

Students practice: Students will use the notes for this content to create higher-level questions for other students to answer. Students will complete a NASA web quest on climate change to explore and learn about the basics of climate change. Students will create a climate change poster that describes and pictures causes of climate change, effects of climate change and ways humans negatively affect the climate. Students will do a gallery walk to look at all the posters and make comments on all of the ways humans effect the climate negatively.

Day 6: 90 minute class

Warm Up: Students will look at all the factors that negatively affect the climate and decide which one does the most damage. They will explain why they picked the one they picked.

Direct Instruction: Students will discuss the factors they think hurt climate the most and discuss the reasoning behind the different responses and views. I will explain sources of renewable and non-renewable energy like petroleum, Natural gas, coal, hydropower, biomass, nuclear, wind and geothermal.

Student practice: Students will research and create a chart of pros and cons for each type of energy. Students will pick which way they think that does the most damage to the environment and write a report to support their claim.

Day 7: 90 minute class

Warm Up: Students will pick three vocabulary words and describe how they affect our daily lives. For example, photosynthesis creates oxygen that we breathe and coal is used to power the plants that give us electricity.

Student practice: Students will present their report on the most damaging type of energy to the class. Students will have the chance to ask questions after each presentation and the class will discuss which arguments presented their case better. This will give students an idea of what types of arguments they could use for their formal debate.

Day 8: 90 minute class

Warm Up: Students will free write about how the use of energy can be curbed in their daily lives. They will be asked to think about how they waste resources each day and how they could waste less.

Students Practice: Students will complete an ecological footprint quiz to determine how many Earth's they would need based on their current habits of water consumption, food consumption, etc. This gives students a good idea of their impact on resources as it shows how much earth is we would need if everyone had the same habits as the student. Students will make a poster of ways they can limit their effect on the environment based on their footprint quiz.

Day 9: 90 minute class

Warn Up: Students will have 5 minutes to ask any last minute questions before they take their formal assessment.

Student Practice: Students will take formal assessment of knowledge. It will be a short answer assessment that allows the students to tell what they have learned in their own words. After the assessment, students will pick a debate stance and begin their research.

Days 10: 90 minute class

Students will research and prepare evidence for their debate. Students will pick a stance: People do or do not have a moral obligation to do their part to limit climate change. They will need to answer the following questions. Question 1: Do people have to recycle? Question 2: Do people have to limit their impact of climate change? Question 3: Do certain people have a bigger obligation to limit their climate change? For instance if I drive more, do I need to do more than people who do not drive a lot. Question 4: If one person is not doing their part to curb climate change, does that mean that other people do not have to? Question 5: Should a person be punished if they are not doing their part to limit climate change? In addition, who would be responsible for deciding the punishment? Question 6: Can you make a person limit their climate change impact if it places an undue burden on them? In addition, who decides what constitutes an undue burden?

Day 11: 90 minute class

Warm Up: Students will have 10 minutes to get their work together for the class debate.

Student Practice: Students will debate their stance on the moral obligations people have to limit climate change answering the guided questions given to them. After the debate, the class will do a reflection on the debate topics and how their feelings may or may not have changed after listening to other information.

Appendix 1: Implementing Teaching Standards

EEn.2.6.1. Explain major climate categories (Köppen climate classification system – temperate, tropical, and polar). Compare weather and climate.

For example, students have to compare and contrast the differences in weather in the different biomes.

EEn.2.6.2. Summarize natural processes that can and have affected global climate (particularly El Niño/La Niña, volcanic eruptions, sunspots, shifts in Earth's orbit, and carbon dioxide fluctuations). Explain the concept of the greenhouse effect including a list of specific greenhouse gases and why CO₂ is most often the focus of public discussion.

For example, students have to diagram the greenhouse effect and tell how processes like volcanic eruptions contribute to it.

EEn.2.6.3. Outline how deforestation and the burning of fossil fuels (linked to increased industrialization) contribute to global climate change. Explain how large-scale development contributes to regional changes in climate (i.e. heat islands in large cities like NY, Chicago, Beijing, etc.). Analyze actions that can be taken by humans on a local level, as well as on a larger scale, to mitigate global climate change.

For example, students have to present information to the class on how specific human activities contribute to climate change.

EEn.2.6.4. Analyze how changes in global temperatures affect the biosphere (ex. agriculture, species diversity, ecosystem balance). Explain how changes in atmospheric composition contribute to ocean acidification. Analyze its effect on ocean life and its connection to global climate change. Explain how changes in global temperature have and will affect sea level. Analyze how other earth processes such as glaciations and tectonic movements have affected sea level. Consider long- and short-term changes.

For example, students will have to diagram the ocean composition and analyze how different things change the ocean.

EEn.2.8.1. Critique the benefits, costs and environmental impact of various alternative sources of energy for North Carolina (solar, wind, biofuels, nuclear fusion, fuel cells, wave power, geothermal). Evaluate which sources of alternative energy may work best in different parts of the state and why. Extension: Examine for region, country, continent, hemisphere, and world.

For example, students will have to compare and contrast the types of energy sources and the pros and cons of each one.

EEn.2.5.5. Explain how acid rain is formed and how human activities can alter the pH of rain. Infer other human activities that impact the quality of atmospheric composition. (e.g. aerosols, chlorofluorocarbons, burning, industrial byproducts, over farming, etc.) Exemplify methods to mitigate human impacts on the atmosphere.

For example, students will have to summarize how human activities effect the air and how they can limit those activities.

EEn.2.2.2. Compare the methods for obtaining energy resources: harvesting (peat and wood), mining (coal and plutonium), drilling (oil and natural gas), and the effect of these activities on the environment.

For example. Student have to describe each method of energy generation and describe the negative and positive impacts.

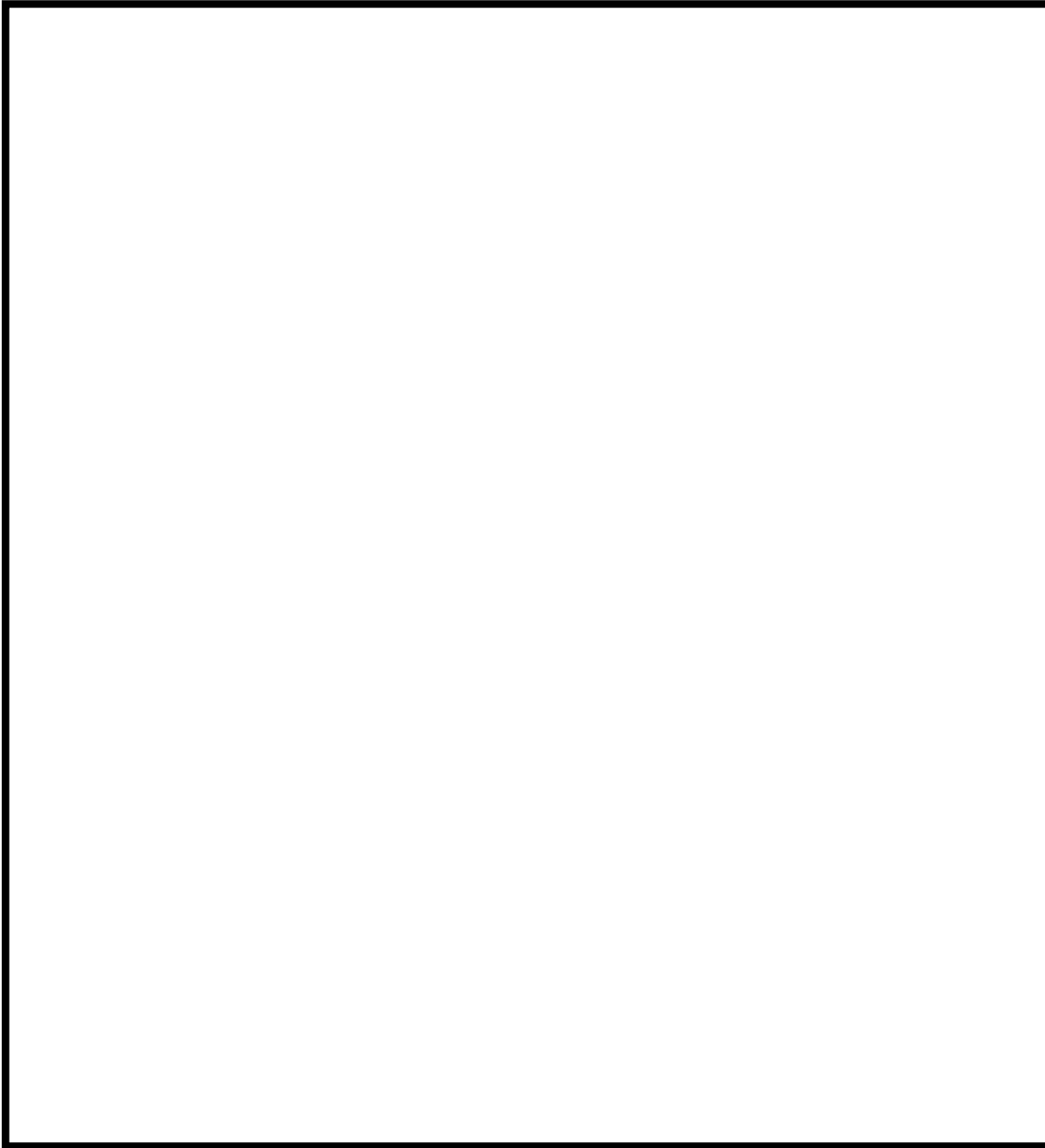
Appendix 2: Vocabulary Cartoon

NAME: _____ DATE: _____

Vocabulary Cartoons

Vocabulary Term:

Definition:



Use it in a sentence:

Appendix 3: Biome Graphic Organizer

Köppen Climate Classification

Köppen Climate Classification	Köppen Sub-classification	Biome	Adaptations (2 each)	Location (2 each)
Humid Tropical	Wet Tropics			
	Tropical Wet & Dry			
Humid Mid-latitude (mild winters)	Dry-Summer Subtropical			
	Humid Subtropical			
Humid Mid-latitude (severe winters)	Humid Continental			
	Subarctic			
Dry	Steppe or Semiarid			
	Desert or Arid			
Polar	Tundra			
	Ice cap			
Highland	Highland			

Using the websites below:

1. Find the biome that matches each Köppen Climate Classification.
2. Find two typical locations for each Köppen Climate Classification/Biome by analyzing the climograph.
3. Find two adaptations that allow plants and/or animals to live in that Classification/Biome.

Type your responses in the chart, and print your assignment (**chart only**, not instructions) when you are done. On the back, answer the following questions:

1. What are the main differences between tundra and taiga?
2. What are the main differences between grasslands and chaparral?

Appendix 4: Biomes Poster

Instructions: On a large sheet of paper, you need to develop a background drawing that includes key features of your biome. Your background should include:

- A drawing of what the biome looks like, including
 - types of trees
 - other plants that grow
 - animals that may be seen
- Color
- A key that labels the names of your features

Instructions: A section of your display must include information about the weather that occurs in your biome. This section must include:

- the average temperature in the summer months
- the average temperature in the winter months
- the amounts of rainfall received in a year
- a paragraph (5-7 sentences) explaining the typical climate: hot, cold, wet, dry, snow, ice, sand, etc.

Instructions: A section of your display must include information about five specific plants and animals that are particular to your biome. This section must include:

- a drawing/picture of each of the 5 plants and animals
- a paragraph (5-7 sentences) about each plant and animal in which you 1) tell the species name, 2) describe why it is significant to that particular biome, and three explain its adaptations that allows it to survive in this particular biome.

Instructions: A section of your display must include a paragraph (5-7 sentences) of how temperature changes can affect your biome. Items to include are:

- what happens to the animal and plant life
- what happens to the people who live there
- what can cause the temperature to change

Appendix 5: Climate Change Poster Rubric

Climate Change Poster Project Rubric	0 points	3 points	5 points
Definition of Climate Change	No definition present	Definition present but not completely accurate (1 pt)	Definition present and accurate (2 pt)
Picture of Greenhouse Effect	Internet Picture (1 pt)	Picture (not copied and pasted from internet) present but little to no detail is included (2 pt)	Picture is original (not copied and pasted from internet) with much detail included (3pt)
3 causes of Climate Change	No causes present or causes without details	1-2 causes present with details	3 causes present with details
5 effects of Climate Change (Named & Explained)	No effects present or effects without details	3-4 effects present with details	5 effects present with details
Pictures on Front of poster	No pictures present	Pictures of causes <u>or</u> effects	Pictures of both causes <u>and</u> effects
Footprint results	No results present	Results present but with little detail	Results present with much detail

Pictures of protection of Earth	No pictures present	2-3 pictures present	4-5 pictures present
3 human impacts with explanation	No impacts present or impacts without explanation	1-2 impacts present with explanations	3 impacts present with explanations
Pictures of man's impact on back of poster	No pictures present	1-2 pictures present	3+ pictures present
Attractiveness	The poster is distractingly messy or very poorly designed. It is not attractive and lacks color and creativity.	The poster is attractive in terms of design, layout and neatness. Some color and creativity present. (6 pts)	The poster is exceptionally attractive in terms of design, layout and neatness. Color and Creativity are evident (10 pts)

Appendix 6: Debate Rules and Etiquette

Rules for Classroom Debate

1. Each group is to agree on two to three significant points of argument.
2. The “pro” group will read the first point of argument. A debate on the validity of that particular point will ensue, providing others in the group opportunities to elaborate and the “con” group opportunities to counter.
3. One person speaks at a time. No side discussions!
4. All comments **MUST** address the previous student **comment directly**. You may not simply ignore a comment and shift the argument to an unrelated point.
5. Each person will credit the source of any statistic, quotation, survey, or other research information **AT THE TIME** that source is mentioned during the debate.

Structure for Classroom Debate

Total Time Allowance: 15 minutes

“Pro” Point #1	“Con” Objection to Point #1	“Pro” Rebuttal to Point #1
“Pro” Point #2	“Con” Objection to Point #2	“Pro” Rebuttal to Point #2
“Pro” Point #3	“Con” Objection to Point #3	“Pro” Rebuttal to Point #3

Total Time Allowance: 5 minutes

Questions from Audience

Total Time Allowance: 15 minutes

“Con” Point #1	“Pro” Objection to Point #1	“Con” Rebuttal to Point #1
“Con” Point #2	“Pro” Objection to Point #2	“Con” Rebuttal to Point #2
“Con” Point #3	“Pro” Objection to Point #3	“Con” Rebuttal to Point #3

Total Time Allowance: 5 minutes

Questions from Audience

Total Time Allowance: 3 minutes

“Pro” Concluding Remarks

“Con” Concluding Remarks

Debate Etiquette

1. Team members must meet together in preparation for the debate, so they can work together as an effective team. Practice, practice, practice!
2. All members of each side must participate in the debate.
3. Do not read your materials.
4. You may bring some brief notes, but you may not read them.
5. Maintain good eye contact with the audience.
6. Use proper language and be polite in referring to your opposing team.
7. The pro team should write the topic on the board before class begins, listing the names of each pro and con debater in a clear fashion.
8. Audience members must remain quiet so that all speakers can be heard. No clapping, speaking out or causing a disruption. If you do not agree with something, we will discuss it during reflection time.

Appendix 7: Unit Exam

Name

Block

Unit Test- Biomes/Climate

1. 45 points

Describe the greenhouse effect in words and pictures:

- a. Accurate picture with labels- 20 points
- b. Accurate explanation- 15 points
- c. Greenhouse gases- 10 point

2. 25 points

Explain how biodiversity is affected by the following

- a. The removal of a species from an ecosystem- 10 points
- b. The addition of a species to an ecosystem- 10 points
- c. Low genetic diversity within a species- 5 points

3. 30 points

List three causes of climate change and how it affect the climate

- a. Cause 2 points, how it affect the climate 8 points
- b. Cause 2 points, how it affect the climate 8 points
- c. Cause 2 points, how it affect the climate 8 points

Classroom Resources

Chromebooks for researching and completing assignments

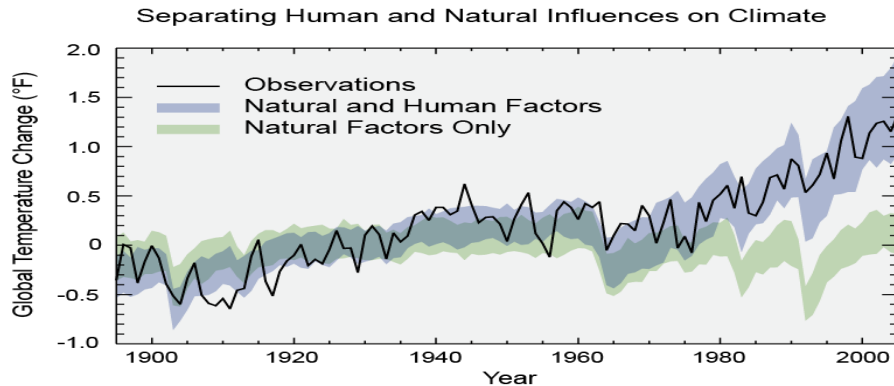
Art supplies: poster paper, pencils, color pencils, markers and pencils for posters

Student Resources

1. Brainpop videos: Land Biomes, Greenhouse Effect, Climate Change, Biofuels
2. Ck12.org Climate Zones and Biomes reading and practice questions-
<https://www.ck12.org/book/ck-12-earth-science-concepts-for-high-school/section/15.19/>
3. Ck12.org Climate Change in Earth History reading and practice questions-
<https://www.ck12.org/book/ck-12-earth-science-concepts-for-high-school/section/19.11/>
4. NASA website for Greenhouse Effect- <https://climatekids.nasa.gov/greenhouse-effect/>
5. Personal Ecological footprint quiz: <https://www.footprintcalculator.org/>
6. Quizlet.com for vocabulary words and practicing vocabulary-
<https://quizlet.com/411556304/climate-and-energy-vocabulary-flash-cards/>
7. YouTube for videos: El Niño and La Nina video-
https://www.youtube.com/watch?v=tyPq86yM_Ic&t=51s

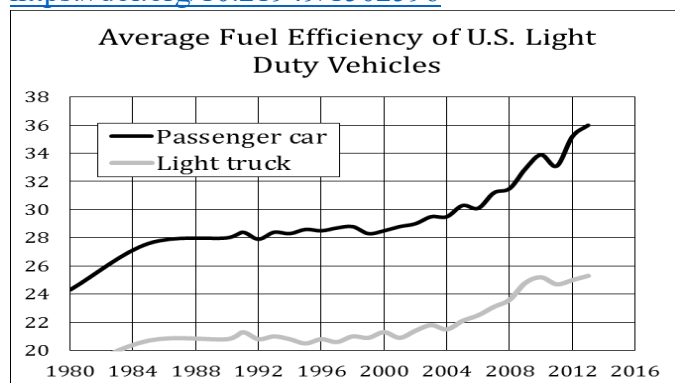
Teacher Resources

1. From Chapter 34 of the Third Annual Climate Report:
<https://www.globalchange.gov/browse/multimedia/%EF%BF%BCseparating-human-and-natural-influences-climate>



This shows the temperature change of the earth from before 1900. It breaks down the temperature change that would have happened without human factors and combined natural and human factors.

2. Carbon Capturing website: <https://carbonengineering.com/about-dac/>
This website describes what carbon capturing is as well as the process and equipment used to capture carbon directly from the atmosphere.
3. Climate Reanalyzer to show how different biomes would look if the climates changed-
<https://climatereanalyzer.org/clim/ecm/>
This website is a really good visual website for students. It will let you change the global temperature and then will illustrate what will happen to different biomes if the temperature goes up or down. For example, if you increase the temperature you will see the amount of ice reduced and if you reduce the temperature you will see the amount of ice increase.
4. U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2018* (Washington, DC: 2018).
<https://doi.org/10.21949/1502596>



This website document shows annual transportation statistics for the US. It include information on the number of different types of cars sold, like heavy duty. It includes information on how many miles traveled by car, plane and how many drivers over 65 were driving. It has a lot of information on fuel economy and other things

related to what we are doing to limit impact on the environment.

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