

**Global Climate Change from Top to Bottom:
How our changing climate is affecting the Arctic, the Rainforest, and You!**

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“Evidence is mounting from many different scientific disciplines that Earth’s natural systems are already undergoing rapid change. We need to act now to reduce heat-trapping gas emissions, for the sake of our children and the other species with whom we share this planet.”

~ **Pamela A. Matson**

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Introduction:

I teach sixth grade Science at Carmel Middle School. Carmel Middle School serves over 1000 students in grades 6-8. Geographically, the school is located in an affluent suburban setting of Charlotte, NC in the Charlotte-Mecklenburg School District. 43% of our students qualify for free and reduced lunch. We are a racially diverse school of approximately 21% African American, 56% White, 14% Hispanic, 4% Asian, and 3% other students. 79% of our 8th grade students scored at or above grade level on the Science EOG and Carmel DID make Adequate Yearly Progress in 11-12. Our school is fortunate to have an active PTSA and exceptional parental support. I teach sixth grade science on a rotating A day B day schedule. I teach the same lesson to six different classes over the course of two days. My classes are a heterogeneous group of students of varying abilities and science backgrounds. I create differentiated activities and student products within the content objectives to meet the diverse educational needs of my students. I utilize a variety of instructional methods and strategies as well as varied assessment tools to engage my students and monitor their progress.

My science curriculum is based on the National 2009 Science Essential Standards which are fully implemented during the 2012-2013 school year. My school district adheres to the National Common Core Standards and I strive to incorporate the Reading, Writing, and Math Common Core Standards where applicable within my curriculum. I structure my school year according to my District’s quarterly and yearly pacing guides. In addition, I plan my lessons and content units with my grade level’s Professional

Learning Team of which I am the Chairperson. Content is structured so as to meet vertical planning goals within the various grade levels in my school's Science Department. Activities are chosen that will create an inquiry based science experience for my students. Most lessons are interactive and are divided into teacher input, guided practice or additional investigation, independent practice or group inquiry activity, explanation of results or investigation and finally additional questions or ideas to explore. I incorporate the use of a SmartBoard and video clips from Discovery Education, PBS, You Tube, and National Geographic on a daily basis. Students use the computer lab often throughout the year for additional research or web activities. Students also benefit from classroom computers for individual research. I was recently given an I Pad by my PTSA and look forward to its integration into my instruction. My students travel outside to investigate our environment as it relates to our curriculum. We have a new outdoor classroom which I am excited to utilize this school year during our environmental and life science lessons. I engage students by including hands-on activities, labs, and/or investigations during most class periods. Labs and activities include both teacher directed inquiry labs and student created labs which focus on a general inquiry question. Students frequently participate in learning stations consisting of both research and hands-on activities. Learning stations are organized with student teams to provide a source of consistent accountability among students and to maximize student's strengths and struggles within the team.

Rationale:

I would like to incorporate the study of global change into our Ecology unit to increase the rigor of this unit and prepare my students for environmental issues that are affecting our world. Students will also benefit from early exposure to the concepts of global change as they will be discussed in seventh grade and again in eighth grade. Students will delve deeper into weather issues in seventh grade and investigate how the atmosphere affects life on Earth. In eighth grade students explore how evolution is influenced by climate and weather factors. My school focuses on vertical planning and encourages the incorporation of future content goals into my grade level curriculum where applicable. Exposure to this topic at the sixth grade level will prepare my students for environmental concepts further developed in subsequent grade level curriculums. Engaging students in a dialogue about environmental responsibility and global change will increase the relevance of our study on ecosystems and the role we play in maintaining Earth's ecological balance. My unit "Global Climate Change from Top to Bottom: How our changing climate is affecting the Arctic, the Rainforest, and You!" will create a knowledge base from which students can draw in the future. My ultimate goal is to increase student awareness of environmental responsibility and appreciation of their power in improving the health of our planet.

The topic of global climate change appears to be a popular topic of media coverage; however according to the Center for Science and Technology Policy Research only 225 articles have appeared in written media across North America through September of 2012. In contrast over 550 such articles have appeared in European publications this year. Written interest in global climate change peaked in 2009-2010 with over 1000 articles printed in North America. Europe was still more in tune to public interest in global climate issues with well over 1800 articles focused on coverage of global climate change making it into written media.¹ This lack of overall coverage in written media in the United States is further reason to expose students to very real evidence of global climate change that exists within the science community. Inadequate public education and discussion further highlights the need to provide students with a sense of empowerment in the possibility of working to help correct the damage being done to our planet and methods to minimize future consequences for inaction. I plan to educate students in issues that are specific to the Arctic and the Rainforest and encourage students to apply this knowledge to issues that may affect them personally as well. By providing specific examples of global climate change, students may recognize and appreciate concrete evidence of how climate change is affecting the people, plants, animals, and landscape of these areas. We will also discuss the increased use of plastic bottles and how this use is impacting our environment. Students will study the village of Shishmaref, Alaska and the loss of permafrost and sea ice cover in the Arctic. In the Rainforest students will examine how deforestation has affected the ecosystem and the lives of people who make the Rainforest their home. Students will examine how both of these issues are affecting carbon dioxide levels in our atmosphere and how the increased levels of greenhouse gases are influencing Earth's global climate. The goal is for students to study these specific examples and connect the consequences to their personal life. How is global climate change affecting their daily lives either now or in the near future? If these specific issues go unchecked, how will our planet suffer? Students will use this knowledge to create a final culmination project on an Environmental Issue caused by global climate change. In connection with our exploration of plastic drinking bottles, students will collect the lids from bottles throughout the unit. Students will use these lids to create a handmade piece of art by filling in a famous painting or working with a free form template. The news on climate change isn't pleasant. By increasing student knowledge of what causes climate change, I can help them determine how they can make changes within their life and the lives of those around them to positively impact the current trends in our environment. Through a narrow scope of study, I will avoid overwhelming students with the multiple causes and effects of climate change. I plan to use our investigations of these specific biomes and issues as a basis for a broader exploration of global climate change.

Content Objectives:

Our school system has shifted science instruction to focus on the Essential Standards during the 2012-2013 school year. Designing goals and activities based on these standards will create a unit more focused on the national direction of science instruction. These objectives will add relevance to the incorporation of global change issues and environmental concerns throughout our Ecology unit.

During this unit I plan to address the following Essential Science Standards:

Overall Standard 6.L.2

Students will understand the flow of energy through ecosystems and the responses of populations to the biotic and abiotic factors in their environment.

Substandard 6.L.2.1

Students will summarize how energy derived from the sun is used by plants to produce sugars and is transferred within food chains and food webs from producers to consumers to decomposers.

Under this standard I will focus on the carbon cycle and the identification of greenhouse gases versus non greenhouse gases. We will investigate how greenhouse gases are necessary for survival but that the build up of these gases is damaging and changing our climate. We will compare the greenhouse gas level on Earth to that of Venus and hypothesize as to how Earth would change if greenhouse gas levels continue to increase. Students will investigate how carbon emissions affect the level of greenhouse gases in our atmosphere and identify major contributors to carbon emissions. Students will create an analysis of their carbon footprint through a web based activity.

Substandard 6.L.2.3

Summarize how the abiotic factors of freshwater, marine, forest, grassland, desert, and Tundra biomes affect the ability of organisms to grow, survive, and/or create their own food through photosynthesis.

Students will investigate all biomes but then focus on the two major biomes of the unit. Students will focus on the village of Shishmaref, Alaska and how climate change is affecting the level of permafrost in the land. Students will visit the village website and study photographs and personal stories about change in the landscape. Students will investigate the Rainforest of Brazil through both internet and reference based resources.

Students will apply knowledge gained by researching these two extreme ecosystems to the effect global climate change has on their personal lives or the lives of people they know. Students will divide into expert groups to research and explain change over time in temperature, water quality and availability, and soil properties. Students will describe how these changes have affected the plant and animal life within the ecosystem. Students will work with their learning team to identify any changes recorded, possible causes of these changes, and human's affect on the changes. Students will also investigate possible solutions to counteract these negative changes. Students will prepare an in class presentation to share the information learned with the rest of the class.

As all students do not come to me with the same science background it is important that I provide opportunities for science discovery during which students "fill in the gaps" of their science content knowledge. Incorporating learning teams to research objectives of the unit will increase rigor and student responsibility for learning outcomes. Students will be held accountable through a group evaluation process at the end of their research.

Common Core Standard Objectives:

Writing Standard W.6.1

Students will write arguments to support claims with clear reasons and relevant evidence.

Writing Standard W.6.2

Students will write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Through the completion of the culmination project students will incorporate writing standards from the Common Core into our curriculum. Students will create a written research paper and visual model about an environmental issue of the student's choice. Students will use the Common Core Writing Standards W.6.1 and W.6.2 while preparing and writing their final project. I will provide reference texts for students to explore in addition to web based research opportunities. Students will use these resources in addition to their personal research to prepare their final project. Students will be charged with writing a paper about their specific environmental issue which includes a description, contributing factors, current laws or legislation in place or pending, effects

on the environment and possible solutions. The project will also include a visual model. A description of the project and rubric are included in the activities section of this unit. (Figure 1)

Mathematics Standard 6.SP.5

Students will summarize numerical data sets in relation to their context such as the number and nature of observations and describe the nature of the attribute under investigation.

Students will analyze the connection of math skills in the science curriculum. I plan to incorporate math skills throughout this unit. As evidence of global climate change is data driven, I will rely on the use of graphs and charts throughout our discussion and investigations to clarify and illustrate important data. Students will graph their research findings in the culmination project and evaluate evidence presented in graph form during class. Students will also analyze data during the activity of carbon footprint mapping. In researching bottled water brands, students will calculate mileage from the bottling plant to Charlotte and estimate fuel costs and amounts. Students will also determine the amount of oil needed to make the bottle. This connection is essential in creating an interdisciplinary approach to science teaching and incorporating the Common Core Standards.

Strategies:

I love science and truly want to instill the love of discovery in my students. I consider myself a friend to our environment and again hope to share that philosophy with my students and encourage them to make changes that positively affect our environment. I plan to incorporate a variety of hands-on labs and demonstrations to excite my students for our study of ecology and the various ecosystems. We will start with the basic elements that comprise an ecosystem and investigate the roles of biotic and abiotic factors in an ecosystem. We will look at how abiotic factors can change and what effect this would have on the biotic factors of an ecosystem. Often during our discussion of climate, weather, natural disasters or environmental change my students assume that "We're all going to die!" when drastic changes are observed. I will lead students in an investigation of the known facts and often-spread rumors of global warming to illustrate that plant and human adaptability is not only possible but ever-present. To accomplish this goal I plan to focus on the Arctic biome and the Rainforest of Brazil. I will encourage students to make connections between the changes that are occurring in these extreme

ecosystems with how these changes are influencing their own lives and personal choices. We will also investigate the popularity of plastic drinking bottles and how this is affecting our environment. This exploration will allow students to recognize how their personal decisions and habits influence global climate change.

Students will formulate learning goals at the beginning of the unit by completing a KWL chart. This chart is broken into three sections and is student directed. The student will list what he/she **KNOWS**, what he/she **WANTS** to know, and what he/she has **LEARNED**. This chart encourages students to verbalize their prior knowledge of a topic and facilitates the recognition of learning gaps within the content. As a teacher, this chart is beneficial in organizing instruction as a function of student needs. During the unit students will be given the opportunity to respond to their learning goals. I feel that this graphic organizer allows students a sense of accomplishment at the end of unit and offers an informal assessment tool periodically during the unit lessons. At the beginning of the unit, each student will be charged with brainstorming what he/she already **KNOWS** about the subject of global climate change. This serves as a lesson and discussion starter. Students then use the chart to formulate questions or learning goals about the topic. These learning goals are formulated in the what I **WANT** to learn portion of the graphic organizer. I plan to stimulate the inquiry process with short video clips of life in the arctic and the rainforest. Short clips from www.discoveryeducation.com such as “The Loss of Sea Ice and the Lack of Diversity in the Arctic” (03:39 minutes) and “Air Pollution, Deforestation, and Global Warming” (02:58 minutes) will generate interest and encourage students to articulate full questions or points of interest. We will use these questions during our discussion and research throughout the unit. At the end of the unit each student will respond to their learning goals and complete the final piece of the organizer by stating what they have **LEARNED** during the unit. This completion serves as an informal assessment for me as well as a great accomplishment for the students. This serves as a visual reminder of how much knowledge they have gained during the unit. I often use the KWL chart during parent conferences as they serve as real data of learning taking place in the classroom.

A successful strategy in my classroom is Student Learning Teams. The use of teams creates a learning environment that encourages students to be accountable for their own learning. The Learning Team offers them opportunities to exercise their learning strengths and benefit from peers when facing their learning struggles. The Learning Team will work together during specific classroom activities and complete teacher directed learning outcomes. Students will work with the same team of students throughout the unit. This creates consistency and responsibility for all students in the classroom.

Students will establish roles within the Learning Team. The Team Monitor will track student participation within the team activities. At the end of each team learning activity, students will be required to complete a Cooperative Group Evaluation. During this reflective practice, students will be required to assess their own contributions as well as those of their teammates. Students will assign a grade for themselves and each of their team members. The grade must also be qualified with an explanation of why each team member received their grade. This evaluation serves to establish an atmosphere of mutual respect and responsibility. Student Learning Teams have served a dual purpose within my classroom. Students enjoy working with a partner or group, but often the discussion and activity load is less rigorous and evenly distributed than I would prefer. The Cooperative Group Evaluation (Figure 2) serves as an assessment for the teacher and also makes every team member accountable for their own contributions. In developing and using the cooperative group evaluation, I worried that students would go easy on their friends and give everyone an “A”. By requiring specific examples of contributions from each team member, I have increased the critical thinking component of the reflection and can further assess each student’s participation. I have noted that students are very honest and often grade each other more critically than I might have. Students see the value of their own contribution to the group and also expect the same level of participation from their teammates.

Students consistently use an interactive notebook in my science classroom. I provide key words or essential questions and students complete the notes during class instruction or individual research. The interactive notebook is a detailed product which I check multiple times per quarter as an assessment tool. The notebook is organized with teacher input on the right side of the notebook and student work or writing on the left side of the notebook. Students also include lab reports, graphic organizers, and written reflection on the left side of the notebook. Notes, worksheets, and diagrams as teacher guided practice are also entered on the right side of the notebook. This method of note taking provides the structure that my students need and also allows them to create notes that suit their learning needs. Students respond to essential questions and key words throughout the lesson. Generally I use hands-on activities and research based learning stations during teacher directed lessons. Students benefit from the alternation of methodology and instructional strategies. Students are given the opportunity to process knowledge gained during class in a practical setting. This allows time to meet the differentiated needs of my students.

In my science classroom I want to encourage students to establish a personal stake in their research and investigations. To this end, students will engage in a culmination

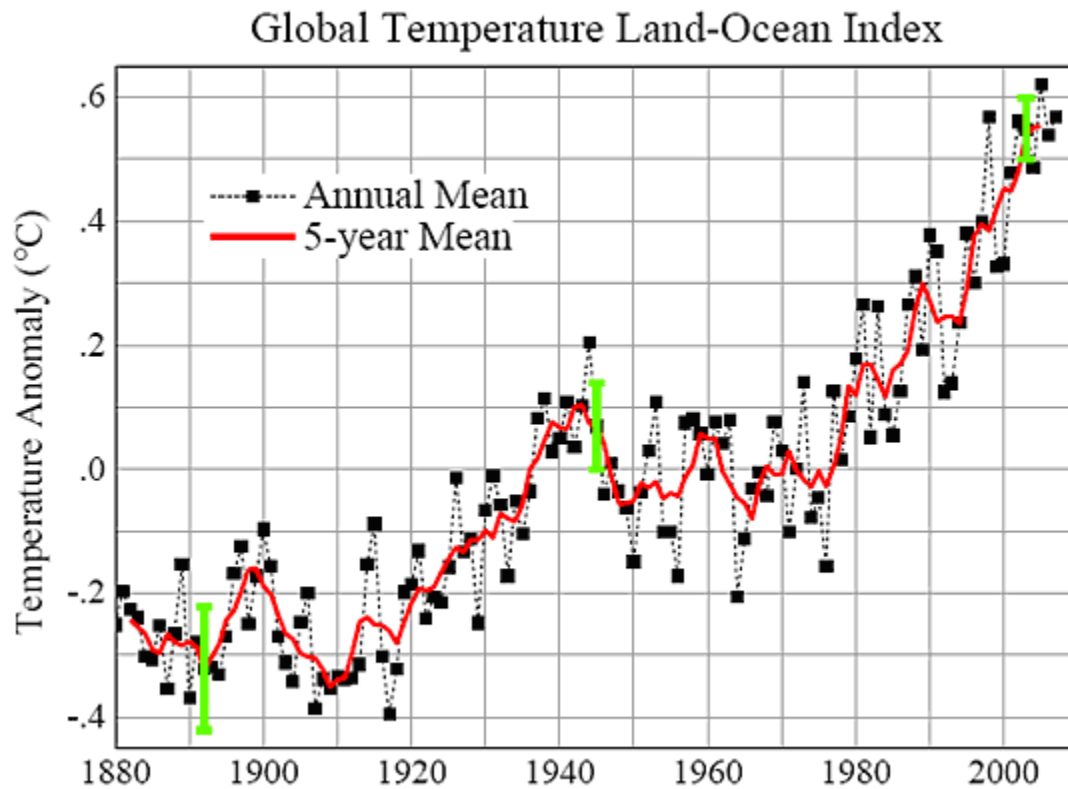
project focusing on an environmental issue of their choosing. By allowing students to select their topic and requiring them to present their research to the class, I am establishing an expert panel on a variety of issues. As time is always the enemy in education; not enough hours in the day to fully investigate all topics of concern; we will increase the number of issues addressed. This research and presentation requires my students to take responsibility for their own learning and encourages them to fully understand their topic. During each presentation, the audience will ask questions and challenge classmates to further explain their research and stance on the issue. This facilitates an in-depth understanding not always accomplished in the classroom. Students are assessed on their written research paper and model representation as well as their oral presentation and response to class questions. This method requires students to delve deeper into their chosen issues so that they are not only prepared to present their issue and solutions, but also respond to further examination from their classmates.

Teacher Background:

In order to share specific evidence of climate change with students, it is first necessary to ensure that they understand just what it means. Often students confuse a warm day in January or a cold snap in summer as the result of climate change. It is essential that students understand the basic idea behind climate change in order to research and make sense of its many impacts on our world. To avoid overwhelming my students, I plan to focus on my “Top to Bottom” theme and mainly engage students in discussion of loss of permafrost in the Arctic and Deforestation in the Rain Forest. These issues are not only results of our changing climate but will also continue to contribute to climate differences if left unchecked. Students will use knowledge gained during classroom research and instruction to formulate their final culmination project and apply this knowledge to issues that affect them personally. Students will be directed to select an issue for their final project about which they are personally concerned or interested.

Global Climate Change...What is it? How do we know it is occurring? These are some questions that I would like for my students to explore. According to NOAA, National Oceanic and Atmospheric Association, Global climate change is a long-term shift in the statistics of the weather.² This change in climate norms could be demonstrated by a change in average temperature or precipitation for a specific location over a specific period of time. Earth’s climate has changed over time due to our position in the solar system and in relation to our orbit around the Sun. Natural variations in Earth’s climate occur due to interactions between our atmosphere, our oceans and various landforms. We also experience variations due to the amount of solar radiation that reaches Earth’s

surface.² Changes in each of these factors contribute to global climate change. Earth's climate has experienced various changes in its history. The difference now is that the changes are occurring at rates far faster than ever before recorded.³ The average recorded global air temperature has increased nearly 1.4 degrees Fahrenheit (0.8 degrees Celsius) over the past century. While this may seem like a non-issue, it becomes much more threatening when you consider that the average world temperature has increased only 7 degrees Fahrenheit (4 degrees Celsius) over the past 200 centuries since the peak of the last ice age.³ Climate change scientists consider this rapid change due to human activities and the consumption of fossil fuels. The graph below from the NASA Goddard Institute for Space Studies, demonstrates a rise in global temperature since 1880. The trend is clearly upward even though at various times in history cooler temperatures have prevailed.⁴

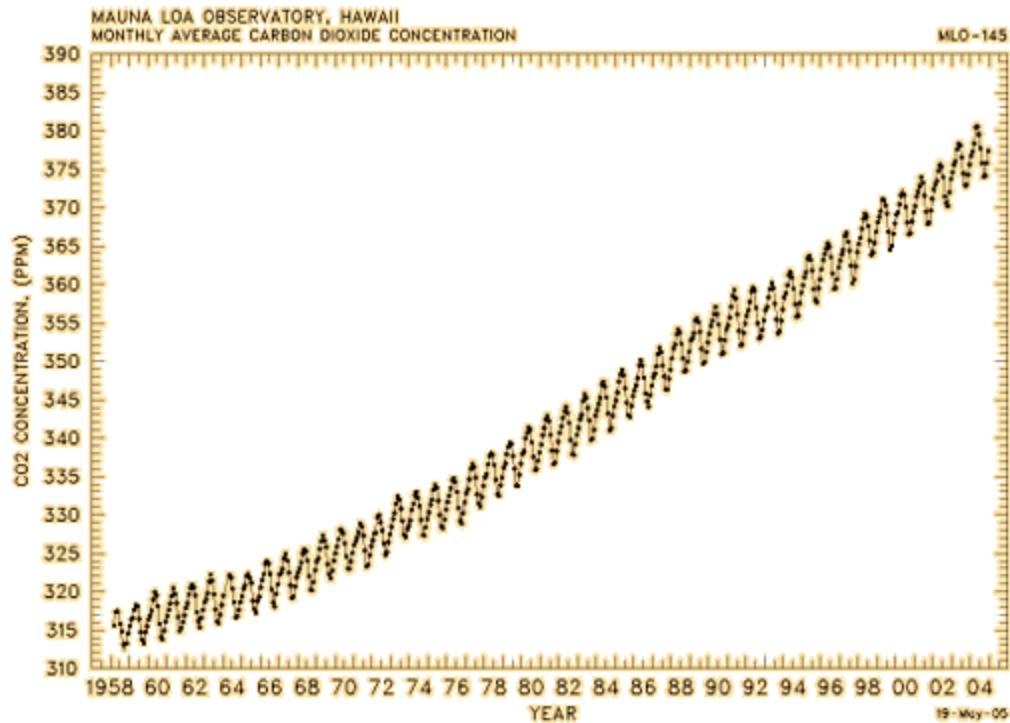


The IPCC, Intergovernmental Panel on Climate Change, cite this rise in temperature and the increased frequency of retreating mountain glaciers, thinning ice caps, rising sea level, heavy precipitation events and increased drought conditions in certain areas of the world as further evidence of the very real existence of global climate change.⁵ Presenting

students with visual data provides another source of evidence supporting the existence of a changing climate.

The role of Carbon and the Greenhouse Effect... What will happen when previously frozen or trapped carbon is released into our atmosphere? How does this carbon affect global climate change? Students must have an understanding of Earth's atmospheric makeup before a conversation regarding positive and negative changes and variations can take place. Carbon dioxide is an important component of Earth's atmosphere. Earth's Greenhouse Gases are necessary for life to exist on our planet. Gases such as water vapor(H_2O), carbon dioxide(CO_2), methane(CH_4), ozone(O_3), and nitrous oxide(N_2O) absorb heat and contribute to the Greenhouse Effect on Earth. This Greenhouse Effect establishes a stable environment for life to exist on Earth. Not only does the presence of these gases in our atmosphere block some harmful radiation from the Sun but they also act as an insulator by keeping in heat and water vapor essential for a sufficiently warm atmosphere. This insulates Earth from the cold of outer space. A dramatic increase in these gases will lead to the absorption of more heat than is desirable for a stable climate. This is a simple explanation of how global warming occurs. When sea ice melts and permafrost thaws, carbon that has been trapped for millions of years will be added to our atmosphere. Carbon is also released by the burning of carbon based fuels such as coal, oil, and natural gas, called fossil fuels.³ When this carbon combines with oxygen it becomes carbon dioxide and when combined with hydrogen, methane results. An overabundance of either of these gases has a negative effect on our atmosphere.

The graph below shows the monthly average carbon dioxide concentration as recorded at the Mauna Loa monitoring station in Hawaii from the years 1958-2004.⁶ This graph shows the level of carbon dioxide in the atmosphere today as about 380 parts per million compared to 315 ppm in 1958 when modern measurements were initiated. Measurements of air bubbles trapped in the Greenland ice sheet indicate concentrations of 270 ppm in preindustrial times.⁶



The addition of excess carbon into the atmosphere will increase the absorption of heat thus warming our planet. This continuous warming affects many aspects of Earth's ecosystems: melting sea ice results in higher sea levels and decreased albedo of Earth's surface. A decreased albedo effect from reduced sea ice means less radiation reflected from Earth's surface and more absorbed into our oceans and lands. As the surface temperature increases, permafrost thaws thus resulting in less stable ground and soil loss. Ocean acidity increases due to the ocean's absorption of carbon dioxide and damages fragile marine ecosystems. Understanding carbon's role in climate change enables students to decipher the scientific evidence surrounding the topic.

Loss of Permafrost...Why is permafrost so important to soil and landform stability in the arctic? What impact will the release of carbon trapped in permafrost have on Earth's atmosphere? Most students understand that as atmospheric temperature rises, ice will melt. Likewise as ocean temperatures increase, sea ice levels will decrease. The melting of this ice in the Arctic and Antarctic carries inland into permafrost on both continents. Permafrost consists of a layer of frozen soil and another layer of active soil which is seasonally frozen. This permafrost is found most frequently in the highest altitudes of the north and south poles although it is also found in other areas of the Northern hemisphere. Approximately 37% of the permafrost in the Northern Hemisphere is found in Alaska and Northern Canada.⁷ Temperatures within the uppermost part of the permafrost layer have shown an increase by up to 3 degrees Celsius since the 1980s in the Arctic.⁸ This

increase in land temperature leads to loss of soil stability and allows microbial activity to continue during the winter when it previously would have stopped. Due to the frozen or very cold conditions decomposition is extremely slow and soil formation takes much longer than in warmer climates. The permafrost base in Alaska has been thawing at a rate of up to 0.04 meters per year since 1992.⁸ This thawing of frozen soil increases the effects of erosion as sea levels rise and shore waves become more intense. The village of Shishmaref, Alaska has seen homes and lands wash into the ocean as its shoreline decreases. Land that was previously permanently frozen is thawing sooner and re-freezing later due to climate change. The loss of sea ice which acted as a barrier protecting this village has contributed to erosion and soil loss. Currently the village is contemplating relocation to an area further inland called Tin Creek as a result of land loss and change to its ecosystem.⁹ This site is not optimal as it also sits on permafrost and thawing of permafrost and the threat of unstable land is ever-present. Though further away from the threat of erosion due to unstable shoreline and intense wave action, Tin Creek is also susceptible to thawing permafrost and its land will eventually be unable to support village life.

Another negative impact resulting from thawing of permafrost is the release of carbon dioxide and methane from previously frozen sources. As this land is thawed and decomposition speeds up, these gases enter the carbon cycle and an atmosphere already affected by excess greenhouse gases. This may lead to increased atmospheric temperature and a continuation of the warming trend.

Deforestation...What role do trees play in global climate change? Why can't we all just plant more trees to combat an increase in greenhouse gases? It is necessary for students to understand that contributing to the Greenhouse Effect is the loss of vast amounts of green plants due to deforestation and desertification. Both of these are impacted by human activity such as farming and clear cutting for human growth and industrial expansion. The World's rainforests are currently being destroyed at a rate of about 80,000 acres per day or nearly 30 million acres per year.¹⁰ Scientists agree that if nothing is done to halt the destruction of our rainforest, all will be lost in 50-100 years.¹⁰ Deforestation is the cutting down of trees for a variety of reasons, most of them based on economic need. The people of the rainforest cut down trees to create open land for farming or grazing cattle. Forests are also cut down to make room for housing developments as populations increase and indigenous people work to establish a more modern way of life. Forests are being destroyed to sell as timber or wood pulp to make paper. How trees are cut down has also changed over the years. Originally trees were cut down by hand with saws and machetes. This was a slow, labor intensive process. With modern equipment and technology, the clearing process is much quicker and therefore much more destructive. Often farmers choose to burn the wood in order to add the tree's nutrients to the soil before planting a crop. This is a short-term solution with long-term negative impacts on the environment. The burning itself results in a rapid

release of carbon dioxide into the atmosphere. The nutrients that enter the soil through decomposition are quickly depleted through farming and an increase in drier conditions.

As tree cover decreases, so does the rainforest's impact on recycling carbon dioxide out of Earth's atmosphere. Over the years scientists have debated the rainforest's role as a "carbon sink" versus the possibility of it as a "carbon source". The largest carbon sink on Earth are our oceans, but the rainforest also absorbs and sequesters large amounts of carbon dioxide. A carbon sink absorbs carbon dioxide from the atmosphere and either recycles it back into the atmosphere or keeps it sequestered for a period of time.¹¹ The ability of the rainforest trees to absorb carbon dioxide from the atmosphere is inevitably lessened as trees disappear. As deforestation increases, the rainforest could easily tip from carbon sink to carbon source.¹¹

These forests play a large role in creating rain as well. With the reduction of forests we will see less water vapor released through transpiration and therefore a reduction in atmospheric water vapor. This will result in drier conditions and increased desert areas where lush tropical forest once reigned. Tropical rainforests play a large role in the carbon cycle. A destruction of the rainforest has a negative impact on our ecosystems in a variety of ways. Over 170,000 different species of plants can be found in the tropics.¹² Many valuable species have become endangered and scarce. Once these species are gone or their ecosystem destroyed beyond recognition, they cannot be replaced.

Plastic Bottles...What's wrong with using a plastic water bottle? If I recycle aren't I helping the environment? I want my students to consider what affect the making of water bottles has on our environment. Students think that if they recycle, they have done their part. In reality, bottled water is expensive in monetary terms as well as environmentally. For every ton of PET, polyethylene terephthalate, produced, 3 tons of carbon dioxide is released¹³. National Geographic states that Americans purchase approximately 29 billion bottles of water per year. 17 million barrels of crude oil are used to produce those plastic bottles. This is the equivalent amount of fuel needed to operate one million vehicles for over a year.¹⁴ Bottle production as well as transportation require the use of energy resources which results in increased carbon emissions. Add to the fact that although approximately 5.1 billion pounds of polyethylene terephthalate (PET) bottles were available in the U.S. for recycling in 2009, only 2,456 million pounds were actually recycled in 2009.¹⁵ Although this represents a historical high, the difference between the bottles available for recycling and those actually recycled is remarkable. Combined with the fact that plastic bottles do not decompose and therefore take up space in landfills for many years, a situation is created that harms our environment on several fronts. In addition to the use of fossil fuels to create and transport water bottles, the lack of consistent recycling after use, concerns about contaminants leaching into the bottle and questions about water purity provides sufficient argument against the use of plastic drinking bottles.¹³ Students will be able to relate to this very real environmental hazard

and use their knowledge during the “Pesky, Yet Pretty Plastic” classroom activity described below.

Classroom Activities:

Introduction: KWL Chart and Learning Goals

I intend to begin the unit with a video clip from Discovery Education focusing on the Alaskan village of Shishmaref, Alaska which has been directly affected by global change. I plan to engage students in a class discussion about global change and how they think it is affecting our Earth. From this dialogue we will create a class list of environmental issues that are directly related to climate change. Students will discuss the negative impact global climate change is having on this village and relate that to overall issues of climate change. We will also discuss possible solutions that can be established at the student level. Students will engage in an activity classifying specific factors within an ecosystem as either biotic or abiotic. We will discuss how these factors influence an ecosystem’s activity and viability within our changing climate. Students will identify which factors are affected by climate change and how far reaching the influence might be within the ecosystem. During these introductory activities, it is important that as we investigate the severity of global climate change and its effects on our planet that we also offer hope and the possibility of change and improvement. During this activity students will create a **KWL** chart described during the strategies section of this unit. Students will use this graphic organizer chart to establish personal learning goals and objectives within the unit.

Classroom Activity #2: Permafrost Model

During our exploration of permafrost, students will be guided through a hands-on activity creating a model. Students will identify material that makes up permafrost and then create a simulated batch which may include soil, water, and organic matter. Students will place their basin in the cafeteria freezer and allow it to freeze for several days. Students will again collaborate with their learning team for this activity. Students will remove the basin and allow it to thaw. Students will examine the reaction of the frozen matter after it has been allowed to thaw. Students will relate this model to the actual permafrost researched in the Arctic. Students will respond to critical thinking questions regarding the permafrost simulation. Students will offer observations and reactions to the loss of permafrost activity.

Classroom Activity #3: *Carbon Cycle and Deforestation*

In the investigation of our *Objective 6.L.2.1* on energy transfer through the ecosystem I will introduce the carbon cycle and explain that greenhouse gases exist and must exist in the atmosphere. After researching the carbon cycle and the role played by humans, plants, animals, atmospheric conditions, and ecosystem locale; we will investigate deforestation in the rainforest. Students will compare the rainforest ecosystem to North Carolina and infer how damage caused by deforestation could occur in North Carolina. Students will examine the rainforest as a carbon sink as well as a carbon source. Students will diagram a carbon cycle specific to either the rainforest or North Carolina. Students will be responsible for including sources of carbon emission as well as carbon recyclers within the ecosystem. Students will include producers, consumers, and decomposers unique to their chosen ecosystem. Students will complete this activity with their learning team and ideally use this as a resource when conducting research for their final project on an environmental issue. Students will be expected to identify their role within the created carbon cycle.

Classroom Activity #4: *Carbon Footprint*

Students will examine the carbon cycle they have created and identify sources of carbon. We will identify greenhouse gases and investigate how they are unique to Earth and necessary for our survival. Students will examine how these molecules are different than other molecules in their ability to absorb heat. We will compare the existence of greenhouse gases on Earth to those on Venus and how the levels of greenhouse gases affect global climate change. Students will calculate their carbon footprint at www.epa.gov/climatechange/ghgemission.com. This website allows students to calculate their family's carbon emissions as well as suggests simple changes that will reduce those emissions. The website includes dollar savings for each change that students indicate they will make in their home. Students are given a bar graph at the end of the exercise which allows students to compare their emissions to those of the average family in the United States. The graph also includes a visual for how the family's emissions would be reduced if the simple changes are put into action. This exercise reinforces the use of mathematical skills in science and provides a visual representation for students to analyze. I will use this activity to introduce the use of plastic drinking bottles and their position in our personal carbon footprint.

Classroom Activity #5: *Pesky, Yet Pretty Plastic*

At the beginning of the unit students will be charged with saving the lids from all plastic bottles used in their homes. We will keep these in a large bin in the classroom to be incorporated into art projects at the end of our unit. I plan to work with my school's art teacher in selecting a variety of templates for students to fill in with plastic lids. I will choose paintings from famous artists for students to re-create as well as free-form designs. This incorporation of the arts will serve as a differentiation strategy to meet the varied learning strengths of my students. I will share a teacher created Power Point about plastic bottle facts and discuss how plastic bottles could impact climate change. Students will explore a variety of water bottle brands with their learning team. Students will examine and chart the bottling locations of the various brands of bottled water. Students will identify where the water is bottled, how many miles that location is from Charlotte, estimated fuel required to transport the water, and the possible effects from carbon emissions. Students will use a variety of online resources as well as written texts highlighted in this unit's bibliography. Students will respond to critical thinking questions in response to their research on bottled waters. Students will brainstorm possible alternatives to plastic bottles for their daily lives. Concluding this unit by creating a beautiful art project from something usually tossed in the trash will demonstrate the existence of hope and possibility for our Earth. I will encourage students to identify other everyday materials that can be recycled or re-purposed.

Culmination Activity: Environmental Issue Project

At the beginning of the unit, students will be introduced to our final culmination project focusing on a student chosen environmental issue. To wrap-up our unit students will each create a written research project and presentation model of an issue related to global climate change (Figure 1). This activity will satisfy overall *Objective 6.L.2*. I will provide students with a complete rubric for the project, but each student will determine the issue they wish to investigate as well as how to best represent their issue visually. The visual could be a poster, art project from recycled objects, diorama, video or website, or another creation of the student's choice. Students will also create a graph or chart depicting evidence of global climate change within their selected issue. Students will graph or chart the data they collect during their research. This use of graphing establishes a mathematical connection to the research. The goal for the student chosen project is to encourage a personal investment in an environmental issue about which the child is particularly interested. This also allows for personal accountability and differentiation within the project parameters. The written project will examine a variety of objectives

within the overall environmental issue. Students will focus on describing the environmental issue, establishing a time frame for when this issue became a widespread problem that attracted scientific attention, discussion of what parts of the world are affected by the problem, prognosis for further effect on the environment, human impact, and possible solutions or changes that could slow the continuation of the problem. The students will work individually on this project as it is geared to be of personal interest. Each student will present their written project and visual model to the class. Students must be prepared to not only present their research, but have developed a deep understanding of the issue as to answer questions from their classmates.

My unit “Global Climate Change from Top to Bottom: How our changing climate is affecting the Arctic, the Rainforest, and You!” will enable students to examine the vast concept of climate change through a specific focus. This narrowing of the scope accomplishes content objectives without allowing the vastness of the topic to overwhelm my students. The examination of solutions for reducing an individual’s carbon footprint will empower students with the idea of enacting a positive change on their surroundings. Working to create beautiful art from disposable items encourages students to see possibility in the everyday while researching an issue of personal interest instills a sense of one’s responsibility in maintaining our planet. Raising and educating environmentally conscious students is essential for Earth’s climate health. My goal is for my unit to serve as a vehicle to do just that!

¹ www.sciencepolicy.colorado.edu/media_coverage

(Mansfield n.d.)

² (www.ncdc.noaa.gov 2007)

³ (Woodward 2008)

⁴ (NASA Goddard Institute for Space Studies 2008)

⁵ (Department of Ecology State of Washington n.d.)

⁶ (www.hyperphysics.phy-astr.gsu.edu n.d.)

⁷ (www.wunderground.com/climate/permafrost n.d.)

⁸ (IPCC.ch/publications_and_data n.d.)

⁹ (www.cnn.com/2009/TECH/science 2009)

¹⁰ (McLeish 2007)

¹¹ (Lindsey 2003)

¹² (Puay 2004)

¹³ (The story of the water bottle. 2012)

¹⁴ (Fox 2011)

¹⁵ (Facts about Plastic Bottles n.d.)

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IPCC.ch/publications_and_data. n.d. www.IPCC.ch/publications_and_data (accessed October 27, 2012). Thorough document on global climate change. This is a resource more suited for teacher information, but sections could be copied for use in the classroom or research stations.

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www.waterwideweb.org (accessed October 27, 2012). Student-friendly article that can be printed and used in the classroom for research.

Woodward, John. *Eyewitness Climate Change*. New York: Dorling Kindersley Limited, 2008. Informative and engaging book on climate change. Offers a brief history of Earth's changing climate and suggests causes for recent global climate change.

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www.wunderground.com/climate/permafrost. n.d.
www.wunderground.com/climate/permafrost (accessed October 27, 2012). Student-friendly website offering information on a variety of global climate change issues.

Environmental Issue Culminating Project ***(Figure 1)***

Name: _____

Issue: _____

Detailed description of the issue. (2 paragraphs)

Include areas of the world affected, how long it has been an issue, what are the effects on our planet, etc.

1. _____
2. _____
3. _____

Current Policy/Actions(1-2 paragraphs)

Include government and private agencies working to help solve this problem, any laws in effect, etc.

1. _____
2. _____
3. _____

Personal thoughts(1-2 paragraphs)

Include how you feel about this problem and why you think it is important.

1. _____
2. _____
3. _____

Possible solutions (1-2 paragraphs)

Include solutions currently being used, what you can do to help, what will happen if we don't correct this issue.

1. _____
2. _____
3. _____

Graph Your Data: Your Choice! Include a graph, chart, or data table to represent a portion of your research.

Visual Representation: Your Choice! Options include Poster, Diorama, Model, Power Point, Photographs, etc

Bibliography: You must cite at least three sources.

1. _____
2. _____
3. _____

Environmental Issue Culminating Project

Grading Rubric

	<u>Possible Points</u>	<u>Earned Points</u>
Paper and Visual on time:	10 Points	_____
Class Presentation:	10 Points	_____
Bibliography:	5 Points	_____
Visual Representation:	25 Points	_____
Written Informative paper:	50 Points (total)	
Paragraph form:	5 Points	_____
Chart/Graph:	5 Points	_____
Description:	10 Points	_____
Current policy:	10 Points	_____
Personal thoughts:	10 Points	_____
Solutions:	10 Points	_____
TOTAL	100 points	_____

Cooperative Group Self-Evaluation (Figure 2)

Name: _____ Block: _____

Comprehension

1. Explain the topic of the lesson?
2. What did you learn about the topic?
3. What additional questions do you have about the lesson topic?
4. What was your favorite part of the lesson?

Reflection

1. Why were you a good team member? What did you do or say to help your group?
2. What strategies could your team use next time to help you work together better ?

Evaluation

1. I think that I deserve the following grade_____.

I deserve this grade because_____.

2. List your group member's names and the grade you think they deserve. Give specific examples of participation or contribution that justify this grade.

Member #1

Member #2

Member #3

Member #4
