‘With Great Power, Comes Great Responsibility’: Natural Disasters, Climate Change and Human Contributions

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Introduction

“Our new technologies, combined with our numbers, have made us, collectively, a force of nature.”

Al Gore

Natural disasters have become a huge part of our daily lives. Stories about storms, wild fires, other natural disasters or global warming can be found in the newspapers or on television every day. I want to develop a unit that will help students understand the important concepts that are presented in the news, so that they can prepare for the world they will inherit.

This unit will employ information we studied this school year in economics and a science unit on water. Most importantly, this new unit will address the upcoming Next Generation Science Standards that we will be required to teach in the upcoming years. We will read stories, fiction and non-fiction, about natural disasters and discuss key concepts and vocabulary having to do with natural disasters and their causes and effects on our society. Students will determine the implications that humans are having on the severity and frequency of natural disasters that occur around the world. Using information gained through our water unit and our study of economics, and that which is learned through this unit, the students will produce an end project to inform and/or serve the community. Hopefully, students will understand that as a “force of nature” we can have positive effects as well.

West Park Place Elementary School is a small suburban school in the Christina School District. We have about 325 students from kindergarten through fifth grade. Located in close proximity to the University of Delaware in Newark, Delaware, West Park is a diverse school, hosting the English as a Second Language (ESL) program, Delaware Autistic Program, and REACH –Realistic Educational Alternatives for Children with Disabilities. According to the annual report generated by the Christina School District, about a third of our students are English as a Second Language Learners (ESL), representing about 25 different countries. About 45% of our population are free/reduced lunch students. Our demographics are 20% African American, 26% Asian, 46% Caucasian and 4% Hispanic. I am a third grade, self-contained teacher and teach math, reading, writing, science, and social studies. A typical school year provides me with 22 students, a third of which are usually active or recently dismissed ESL.

A strength of our students is attendance and a desire to learn. Additionally, West Park is a mile from the University of Delaware, so we have many resources available. At times, we have many college students doing placements, tutoring and student teaching. Based on the data from the Christina School District annual report, the teachers at West Park are predominately Highly Effective and Highly Qualified and have many years of experience with most of the educators having obtained at least a Master’s degree. As a staff, we work in Professional Learning Communities to analyze data and provide appropriate instruction for our students.

The areas of struggle for West Park are no different than any other typical school. The most obvious concern is lack of funding. Additionally, a third of our students and their families are ESL: with many parents not able to speak English at all. As a result, we have low parental involvement. Finally, families are reeling from the current economic situation. Many of our families (about 45-50%) are of low socioeconomic status.

Rationale

My rationale for creating this unit is two-fold. First, I want to connect an economic and science unit we learn in third grade. Additionally, I want to expose the children to the idea of global warming and the impacts it has on climate and natural disasters. Educating students about this important topic will help prepare the students for the world they will inherit and hopefully inspire change. This unit will address a Next Generation Science Standard, which will be what our district should be moving to in the next few years. I want to establish some units for NGSS to get a head start on these concepts. The students will be introduced to the concept of interdependent relationships in ecosystems and how our weather and climate is impacted by climate change and population growth.

Common Core State Standards (CCSS) are addressed in this unit as well. Exposing the students to this material will help to make students 'college and career ready'. The new state test (Smarter Balance) will require difficult reading and comprehension skills for young elementary students. In this unit, students will have to read multiple fiction and non-fiction pieces and synthesize the information from multiple sources to answer questions and write. Exposing students to reading material and requiring them to utilize higher order thinking skills will benefit them through their schooling and their life, as well as, making them more successful on the state test.

This unit will be appropriate for any elementary grade, but is designed to fit the Christina School District third grade curriculum. The students will participate in three main components of the unit. First, the students will learn about the human impact on natural disasters through global warming and population growth. Secondly, we will learn about natural disasters and the vocabulary associated with them. Finally, the children will produce a project to inform or help our local community.

The unit fits perfectly into my curriculum in almost all subject areas. It addresses the majority of the reading and writing standards and the speaking and listening standards. The unit will cover many of the Common Core Standards essential for student success, but will focus on three main standards from Reading, Writing and Listening/Speaking. Lastly, this unit will be tied to the Next Generation Science Standards (NGSS) standards that we should soon be adopting for our Science curriculum.

The first standard, *Reading Informational Text 3.3* describe the relationship between a series of historical event, scientific ideas, or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence and cause/effect. The students will be playing games, reading stories and having discussions to achieve this standard. The second standard*, Writing 3.3* write narratives to develop real or imagined experiences or events using effective techniques, descriptive details, and clear even sequences. The students will be reading stories, answering questions, and writing to prompts to demonstrate this standard. Finally, *Speaking and Listening 3.1,* we will *e*ngage effectively in a range of collaborative discussions (one-on-one, in groups and teacher led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly. This standard will be addressed throughout our unit through collaborative group work and whole class discussions. The students will produce a product at the end of unit and present their product to the class.

Background Information/Content

Myths

Albert Einstein once said that one thing he had learned "in this long life: that all our science, measured against reality, is primitive and childlike- and yet it is the most precious thing we have." Science, although not always perfect, must be utilized in our fight against climate change. In a book called by John Berger, *Beating the Heat*, there are several myths surrounding the concept of climate change. The first is that the scientific foundations for concerns about climate change are uncertain and unproven and that the evidence is contradictory and inconclusive. This is not true, rather the uncertainties pertain to the exact rate of climate change and to the magnitude of its impacts. Very few scientists challenge that climate change exists.

The second myth is that climate varies naturally- we are merely in a warming cycle that has little to do with human influence. Over the past 100 years, the world's temperature has risen over one degree Fahrenheit. This is ten times faster than the typical warming period of the last millennia, suggesting that climate change is not natural.

The third myth suggests that the world is cooling rather than warming. This myth is ever increasingly becoming illegitimate. Fourth, some believe that there is no cause for alarm in regards to the climate. This myth perpetuates that the climate will regulate itself over time. The next myth states that climate change takes place slowly and that long-term solutions should be applied. We just need to "wait and see" what will happen long term.

Others support the myth that global warming is beneficial. They claim that climate change is beneficial to plant growth with fewer frosts and longer growing seasons. Or they assert that fish will grow faster and bigger and the like. These may be true, however, these modest benefits do not compensate for the devastating socioeconomic and environmental impacts of climate change, such as forest fires, severe storms and depletion to the coral reefs, just to name a few.

Additionally, others feel fighting climate change will be so expensive that it will devastate industry by raising energy prices, taxes, lowering incomes, reducing business investment and costing jobs. Another economically based myth is that protecting the climate places an unfair burden on developed nations to reduce emissions without holding developing nations accountable. In truth, the emissions from developed nations are far greater than developing nation's emissions. The United States alone produces approximately a quarter of the world's emissions.

Finally, complying with international climate agreements amounts to forfeiting national sovereignty to non-elected global authority. Proponents for this myth are willing to partake in the economic benefits of globalization, but not the responsibilities[1]. Science will be our method to debunk these myths. But science is a human enterprise. Like any human undertaking, it must contend with the realities of politics and power.

Politics

In a 2008 survey, it was revealed that 75% of college-educated Democrats believe global warming is happening because of human activity, while only 19% of college-educated Republicans agree[2]. More recently, Republicans are concurring with human induced climate change, however, they just disagree on policy along party lines. Al Gore, who won the Nobel Peace Prize in 2007, is probably the single individual who has done the

most to create greater world-wide understanding of the measures that need to be adapted in regard to the climate.[3] He has taught us that if we are interested in being ethical, climate change should be a real concern. Serious moral agents strive to protect themselves against rationalization, self-deception and moral manipulation.[4] If political leaders have one duty above all others, it is to protect the security of their people...and yet our long-term security is threatened by a problem at least as dangerous as chemical, nuclear or biological weapons, or indeed international terrorism: human-induced climate change.[5]

Herman Daly stated "there is something fundamentally wrong in treating the earth as if it were a business in liquidation." The rapidly expanding population is placing an ever-increasing demand on the local and regional water supplies and other natural resources and, in many areas, accelerating land and environmental degradation processes. We are witnessing an unprecedented and massive collision between our civilization and the Earth. This is due to a convergence of several factors: population explosion, advances in science, technology, attitudes toward resources and our fundamental way of thinking about climate change.[6]

Population Growth/Human Impact

First, let us look at population growth. In 1 AD, there were about 250 million people in the population. By 1776, we had about 1 billion people. In 1945, the population doubled to about 2.3 billion. In 2006, we skyrocketed to 6.5 billion. It is estimated that in 2050, the earth will have to sustain 9.1 billion people.[7] We now have a much more profound ability to transform the surface of the planet and the natural resources therein. Equally, we are transforming the atmosphere which surrounds our planet. We are responsible for the global warming, probably the most challenging environmental and public policy issue of the world.[8]

The slow and steady human impact on climate that characterized the ten millennia prior to 1750 was nothing compared with the changes brought about by the Industrial Revolution.[9] Today, societies are so complex, nearly everyone is exposed to the devastating shocks that climate change can bring.[10] More storms, increased severity of storms, more forest fires, depletion of coral reefs and many more repercussions are just some of the ways global warming is impacting our planet and people. Climate change, according to the leading international network of climate experts, is real and its impacts are present, accelerating, intensifying and inescapable.[11] So the first question that needs to be addressed is what exactly is climate change?

Global Warming/Greenhouse

Ninety-nine percent of the atmosphere is within eighteen miles of the earth's surface, like the rind of an orange. It is a veil of gaseous film surrounding the earth. We clearly have no influence over how much energy the sun radiates or over the tilt of the earth, the wobble of its spin or its orbit. But we can greatly affect the composition of our atmosphere, which also has a powerful influence on our climate. The temperature of the earth is controlled by the ratio of incoming and outgoing radiation. When they have a balance, the net heat loss and gain is zero. As the sun reaches the fringes of our outer atmosphere, it begins to encounter an obstacle course of gas molecules, dust and clouds. Most of the sun’s radiation is absorbed or scattered back into outer space or towards the earth by the atmosphere and clouds. The solar radiation that is left gets stored in “sinks”. Sinks are any process or mechanism which remove greenhouse gas, aerosol, or a precursor of a greenhouse gas from the atmosphere like a carbon pool, carbon stock or carbon flux.[12]

We have nibbled away at the quality of the atmosphere for centuries, and the accumulated damage has resulted in changing the world's climate at an ever-increasing rate. Carbon dioxide in our atmosphere absorbs infrared radiation much more readily than visible light. These gases intercept the outgoing energy, blocking its escape from earth. This warms the atmosphere.[13] We now face the possibility of higher average temperatures over most of our planet, changing patterns of rainfall, rising sea levels, aggravated storm systems and a myriad of social effects.[14]

There is a fable about a frog placed in a pan of water. If you tried to place a frog in a pan of boiling water, the frog would jump out. However, if you place a frog in a pan of water which is slowly put to boil, the frog becomes acclimated to the rising temperature and will gradually lose its reactive function and will eventually die. This fable may be used to describe what we are facing.

For hundreds of years, our ancient ancestors had little effect on the climate. They were hunter-gatherers, using only what they needed to survive. Humans had little effect until they began to live in permanent settlements and the dawn of agriculture. As they were able to grow more food, settlements grew. More food was needed to feed the larger population, so more land was cleared for planting, starting our negative impact on the planet.

We live in a simmering planet. Temperatures are gradually rising and there is increasing evidence of global warming. Climatic variations and extreme weather conditions are being experienced worldwide. Congruently, tensions have been growing between countries in regards to collaboration in dealing with climate change. Developing countries want the same opportunities to grow as developed countries had in the past. However, now that we know better, we try to do better. Developed countries see the error of their ways, the polluting and negative impacts we have had on the environment. As a result, new limitations and regulations are being put in place. Developing countries are resistant to these restrictions, as they are expensive and impede their growth.

Global warming is caused by emissions we produce and the greenhouse gas effect. Global warming is sourced from forty-three percent carbon dioxide, 27% from methane, about 12% from black carbon, and the rest from halo carbons, nitrous oxide, carbon dioxide and VOCs.[15] Carbon dioxide is more responsible for change in our climate than any other gas we produce. The burning of coal, oils and natural gas is not only the largest source of carbon dioxide, but far and away the most rapidly increasing source of global warming pollution.[16] Carbon dioxide is not destroyed in the atmosphere. It is redistributed to other carbon reservoirs, like plants. If we stopped producing excess carbon dioxide tomorrow, about half of the man-made carbon dioxide would fall out of atmosphere (to be absorbed by the ocean, plants and trees) within 30 years.[17] Scientists believe that more than 65% of the warming that has occurred on the earth over the past century has been caused by carbon dioxide humans have added to the atmosphere. It is the highest level in at least 42,000 years.[18]

The second most powerful cause of climate change is methane. Methane from garbage dumping is the second causes of emissions in the US.[19] Even though the volume of methane released is much smaller than that of carbon dioxide, over a century long period, methane is more than twenty times as potent as carbon dioxide in its ability to trap heat in the atmosphere.[20]

The amount of water vapor in the atmosphere depends mostly on the temperature of the surface of the oceans. If the temperature is hotter, more water evaporates as vapor.

This increased water vapor in the air serves as a blanket around the earth and warms the temperature, which increases evaporation. This evaporation increases the amount of water vapor, which in turn increases the temperature again. This causes the cycle to continue. Similar greenhouse effects also occur on Mars and Venus. Venus is about the same size as Earth, and Venus has a "runaway" greenhouse effect.[21] Meaning the atmosphere is getting hotter and hotter around Venus at an extreme rate.

Greenhouse gases are formed from emissions for fossil fuels, methane from agriculture and burning of forests. We emit carbon dioxide when we run any machines which are powered on fossil fuels. Forest fires and deforestation produce carbon dioxide when they burn. Much of the carbon dioxide we put into the atmosphere actually winds up dissolving in the oceans. These are called sinks, making the oceans more acidic, which in turn affects marine life, especially those that use calcium carbonate to make their shells.[22] The acidification of the ocean is having profound effects on coral reefs. Experts estimate that hundreds of millions of people rely on coral reefs for food. Billions of dollars in commercially valuable fish depend on reefs.[23] Climate change has economic effects. Externalities occur because countries can pass on some of the costs of increasing greenhouse gas emissions and cannot capture fully the benefit of prevention of those emission.[24] Global warming knows no geographical or national boundaries. Overheated climate affects all natural resources, all species, and all people everywhere.[25]

Global warming on sea level has enormous consequences for coastal wetlands. When water is heated, it expands and since the earth is 75% water, this process in combination with accelerated melting polar and glacier ice (which adds more water to the oceans) cause a rise in sea levels referred to as "eustatic sea-level rise".[26] As the number of human beings on the planet has risen, the population of coastal regions has climbed historically at an even faster rate. Half of the world's population live within 100 miles of the coast line. Eight out of ten of the world's largest cities are located on the coast.[27] Every nation on earth with a coast line should be worried about sea-level rise. Sea level has increased by about 4-10 inches since the 19th century due to global warming.[28] This is due to a sea-based ice shelf that melted. Once the sea-based shelf was gone, the land-based shelf that was being held back began to shift and fall into the sea.

By the time we are absolutely certain about the threat of rapid climate change, it will be too late to avert the dangers. We must adopt measures that we can enact to strengthen our infrastructures to mitigate the impacts of severe weather or work to stop global warming through the use of renewable energy sources and the like.

Ice Sheets/Melting and Sea Level Rise

About 97% of the climate science community believe that human activity has had a significant impact on climate change and the warming of the planet and its oceans, which is leading to increased rate of sea-level rise.[29] Storms and floods account for nearly 70% of the world's disasters.[30] About 61 million people today live in coastal countries that are vulnerable to hurricanes along the United States Gulf coast and South Atlantic and the number is increasing.

The West Antarctic ice sheet alone holds 10% of the world's fresh water and if melted, would cause a 17 foot rise in sea level worldwide. More water produces more greenhouse gas vapor. With the temperature increasing, the warmer ocean will provide more energy to the atmosphere and, therefore, raise the probability of more and larger storms in the future.[31] A growing number of new scientific studies are confirming that warmer water in the top layer of the ocean can drive more convection energy to fuel more powerful hurricanes. Scientists assert that global warming is even leading to an increase

frequency of hurricanes.[32] Sea-level rise and future increases in storm intensity threaten our coastal infrastructure. Nuclear power plants are built in coastal areas to take advantage of sea water cooling, a recipe for disaster as exhibited by the Fukushima accident in 2011.[33]

The East Antarctic ice shelf is the largest ice mass on the planet and has been thought to be still increasing in size. However, two new studies in 2006 showed first that the overall volume of the ice now appears to be declining, and that 85% of the glacier appears to be accelerating the flow toward the sea. Secondly, it showed that air temperature measured high above the ice mass appear to have warmed more rapidly than air temperatures anywhere else in the world. (As per this source) Scientists have not yet been able to explain why this is occurring.[34]

A huge ocean current appears to be the Achilles' heel of the global climate situation. As it flows north from Antarctica, the salinity increases. By the time the current reaches the North Atlantic, it is saltier and cooler, denser than the surrounding water, so it sinks, which pushes water up from the bottom of the ocean, about 19 billion liters/sec south to the equator. This engine drives the thermohaline circulation, the ocean's conveyor belt.[35]This movement on this conveyor belt causes the temperature of the oceans to increase.

If Greenland melted or broke up and slipped into the sea- or if half of Greenland and half of Antarctica melted or broke up and slipped into the sea- sea levels worldwide would increase between 18-20 feet.[36] Sir Davis King, a United Kingdom Science Adviser, states "the maps of the world would have to be redrawn." If anything like this were to happen, 60 million people would be displaced.[37]

Planning/Mitigation

Advances in literacy, technology, scientific knowledge, and the diminishing influence of an unquestioning belief in an omnipotent and punishing God has contributed to the awakening recognition that human settlements may be designed to be safer from natural perils.[38] The beginning of wisdom concerning disasters is the recognition that choices must be made, both in the original layout of new settlements in hazardous areas, and in the recovery after disaster strikes.[39] Developing countries will be worse off compared to developed countries. The developing countries are less flexible and have less responsive economies, making adaptation to any change more costly.[40] Apart from the gaps in terms of financial resources and ideologies, governance patterns differ strongly between the developed and developing countries. Institutions are built in totally different ways. Given weak institutions, corruption is rife in many developing countries, and many are in a state of constitutional crisis. Since they are continually trying to cope with domestic crisis, these states have not been able to keep pace with the developed nations on the international front.[41]

Developing countries contributed about twenty percent to the greenhouse gases over the last thirty years. Developed countries added fifty percent of the gases, yet make up only fifteen to twenty percent of the world population.[42] The negotiations have started that developed countries would reduce their own emissions and help the developing countries to leap into the 21st century with technology transfer and financial assistance for reducing their emissions and coping with climate change. However, as time passed, the paradigm of reducing their own emissions *and* helping developing countries change into reducing emissions via helping developing countries and themselves. This paradigm has made it easier to convince the domestic audience in the developed world, but has further annoyed the developing countries. The richest fifteen percent of the world's population

consumes more than one half of the world's energy.[43]

Water/Plastics

In 1907, the world's first synthetic plastic was invented in New York City. Today our lives revolve around plastic. We produced 160 tons of plastic annually in 2015. That figure was estimated to increase by 4% annually. Five hundred billion single use plastic bags are used every year. In 2012, 9.7 billion gallons of bottled water were sold.[44] One study calculated between 5-14 million tons of plastic ends up in the ocean each year, China being the largest single source.[45] Charles Moore discovered the Great Pacific Garbage Patch in 1997, in the North Pacific Subtropical Gyre.[46] It is 365,000 square miles of floating plastic. It is estimated that it would take 67 ships working 10 hours a day, a year to clean it up. Costing $112 million-$489 million. However, most of the plastic is too small to scoop up. From microscopic plankton to large marine mammals, it appears that all are being affected in some way by the plastic and other debris contained in the ocean. We need to do something to reduce our dependence on plastic. Ireland implemented a tax on plastic bags, charging 15 cents per bag. This resulted in a 90% reduction in use of plastic bags in the first year alone. Then they raised the tax to twenty-two cents.[47] When I was there this spring, the only individuals I saw with plastic bags were tourists.

Chemicals/Pathogens

As societies advanced and standards of living improved, advertising became a major industry, and consumption rose. The chemical and pharmaceutical industries developed thousands of compounds. Things such as DDT (dichlorodiphenyltrichloroethane) and PCBs (polychlorinated biphenyls) and other adverse contaminates were made. Domestic sewage, industrial pollution and agricultural run-off developed. Dead zones, 400 acres of hypoxia, have been identified around the world's oceans.[48] Pathogens, disease causing microorganism, primarily bacteria and viruses infiltrated the water. HIV/AIDS, malaria and other diseases spread world-wide. Thirty so-called "new diseases" have emerged over the last 25-30 years. Some "old diseases" that had been under control are now surging again, such as measles, mumps and chicken pox.[49] These are all catalyst for future disasters.

Natural Resources

Natural resources, in one way or another, are the foundations supporting all societies. The vulnerability of those resources are the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change. Many species around the world are now threatened by climate change. Some are becoming extinct; rates of extinction are a thousand times higher than the normal rate.[50] Agriculture and food supplies can be affected by global climate change. While farmed fish and shell fish are providing important supplements to our wild seafood supply, these farms cannot completely replace the diversity of wild fish and shellfish. Industrial agriculture now uses ten calories of energy from fossil fuels to produce one calorie in food. It takes more than seven pounds of plant protein to produce one pound in beef- and more than 6,000 gallons of water.[51] This is a huge tax on our planet's resources, and increasing the temperatures through emissions of greenhouse gases.

Coral reefs are the most diverse communities in the ocean. They are recognized as having many benefits and playing an important geological, biological and economic role throughout the tropical oceans of the world. Coral reefs are having their most deadly, rapid and unprecedented deterioration caused by the higher ocean temperatures. Coral

reefs provide revenue for many local communities, as well as, global fishing fleets. Perhaps a billion people around the world depend to some degree on coral reefs for food and for fishing income.[52] The coral reefs also serve to protect the coastal communities from storm waves, hurricanes and typhoons.

Watersheds are particularly vulnerable to climate change. Wetlands temporarily store potentially harmful floodwater, buffer and stabilize shorelines, help cleanse natural waters, reduce siltation and yield natural products for human use and consumption, all while providing fish and wildlife habitat. Habitat destruction and degradation by human actions are continuing problems for tidal wetlands. While laws and regulations have significantly reduced wetland losses in the United States, pollution remains as issue for resource managers. Human's effects on wetlands can be from filling, diking or leveeing, ditching, excavation, altered tidal and freshwater flows, nutrient enrichment, oil and gas exploration and contamination. Many of these concepts have been covered in our water unit for third grade. Tidal wetlands need to be protected and conserved. Conservation can be done through acquisition through government or private ownership or regulation by federal or state laws and providing land owners incentives.[53]

Fossil Fuels

In 1896, Arrhenius tried to show the relationship between fossil fuel burning and warming.[54] Fossil fuels, oil, coal and natural gas, still provide almost 90% of the primary energy we now use on earth. These are called fossil fuels because they form from long-dead, decayed bodies of ancient (fossil) organisms. Taken together, these three fossil fuels make up the single largest cause of global warming.[55]

Across the globe, we are becoming increasingly aware of the need to sustain, nurture and protect the planet on which we live.[56] The majority of fossil fuel and coal firms are either silent about climate change or have been subsidizing environmental organizations that fight against global warming. They give money to groups who warn against big business conspiracy.[57] The oil and coal industries, and some of their largest customers, are conducting a sophisticated multi-millions dollar campaign to convince the public that climate change is not a serious threat.[58] If these industries are able to discredit climate scientists, they destroy the rationale on which any sound public policy for combating climate change could be based. Once the industry has created enough doubt in the public's mind and has sown enough fears, they have won.[59] An example of this corrosive doubt is what Phillip Cooney, a lobbyists in charge of global warming disinformation, created during his time in Washington, D.C. He was hired as Chief of Staff for the White House. He was a part of the American Petroleum Institute. Upon leaving the White House in 2005, he was employed by Exxon.[60]

Everything in modern society is powered by fossil fuels. Societies will resist the economic and life style disruptions that abandoning fossil fuels would entail.[61] The single most important reason for our continuing dependence on fossil fuels for the great majority of our electrical is simple economics, which to a large extent, has been influenced by politics.[62] We can see this at play with our current president, through his resistance to develop renewable energy resources and his support of Big Oil.

Deforestation

This warming of the planet is predominately a result of deforestation. Scientists estimate that more than 40% of the excess carbon dioxide that has accumulated in our atmosphere has come from deforestation in the past centuries.[63] The warming of the planet has also affected insect populations. Fourteen million acres of spruce trees in Alaska and British

Columbia have been destroyed by a beetle whose rapid spread had been slowed by colder and longer winters in the past.[64] Thus resulting in the loss of more trees. Almost 30% of the carbon dioxide in the atmosphere each year is a result of the burning of brush land for agriculture and for wood used for cooking.[65] Forest fires, brush fires, and slash-and-burn agriculture fires are all examples of biomass burning. Additionally, wild fires are becoming more common as increased temperatures dry out soil and leaves. Warmer air leads to increased lightening. These factors have led to an increase in wild fires in North and South America over the last five decades. This similar pattern can be found world-wide.[66]

Types of Disasters

Climate change can exacerbate many types of hazards, leading to more devastating and more frequent disasters. In the past, our general perception of earth has been that natural disasters are acts of nature that affect us. There were called "acts of God". The implication is that affected countries and individuals are innocent victims, powerless to avoid their dismal fate, or worse, deserving of their fate.[67] Now, however, we understand that human behavior impacts natural disasters.[68]

One way of looking at disasters is that something impacts a society from the outside-like a hurricane or an earthquake- and the regular functions of that society are sharply disrupted. Another way of looking at disasters is that the damage and disruption, precipitated by outside forces, are equally a result of internal forces such as inequality, lack of investment in preparedness, and mitigation, and lack of political will. The impact of such disasters will likely increase to the following: land pressure, urbanization, climate change, political changes, economic growth, technology innovations, social expectations, and global interdependence.[69] Disasters are the result of poor science, engineering, planning, management, maintenance or operation.[70] Disasters are getting more expensive. More people are in harm's way. It is possible to protect our communities, our economy and our environment from thoroughly predictable natural disasters through community based adaptations from hazards and their effects. Human kind will never be able to prevent the occurrence of natural phenomena entirely; however, scientists are able to gain better understanding of the complex mechanisms of extreme natural events that cause the disasters, which helps disaster management agencies to help better prepare for these events.

Planning/Building for Disasters

At the present time, few marked mechanisms are available to reward communities and businesses that plan and build smarter. Local and state governments assume that the national government will bail them out of a national disaster.[71] Few local governments, of their own accord, pay much attention to hazards before disaster strikes. We saw an example of this in the early 2000s with the level of attention to the levees in Louisiana. Government officials were aware that the levees were damaged and weak, but the United States Army Corps of Engineers did not improve or correct them prior to the Katrina storm. The federal government, and a few states, realize the importance of proactive programs to decrease risks, but they have been reluctant to force local governments to employ land use planning and management techniques.[72] By planning for management land use to enhance sustainability, we can reduce our vulnerability to disasters, if not eliminate them.[73] Communities can be proactive. They can require regulatory techniques for building codes and stand-alone ordinances. Non-regulatory techniques can be employed too. Public information, training and low cost loans may be offered to the community for those willing to be proactive.[74]

Governments traditionally try to contend with disasters using warnings before disaster strikes, emergency relief after the disaster occurs, and hazard redirection or mitigation measures to reduce the likelihood of a future disaster. Warnings are an essential ingredient in any strategy to cope with a disaster. People need to be informed of the risks they face so they can make well-considered decisions based on their own calculations of costs and benefits. But warnings have their weaknesses, some people do not heed warnings for various reasons. Some do not have the economic means to evacuate, others have weathered storms in the past and do not feel the need to leave. Others worry about looting, despite evidence that looting is rare in such events, or have pets or elderly family members that they cannot leave behind. Sometimes there is insufficient time to give a warning. So warnings cannot be relied upon as the sole means of coping.[75]A variety of engineering methods have been used to keep hazards such as coastal flooding away from people and damaging property. These might include dams, flood storage reservoirs, levees, dikes, pumps, seawalls and the like.[76] But social methods are important as well, including helping people better understand risks and more stringent building codes.

The third sector, also known as the non-profit/non-governmental/independent or voluntary sector, has had an explosive growth in the last three decades.[77] This third sector has been especially efficient on simultaneously supporting community based planning programs. These groups can help overcome obstacles through its ability to mobilize public and political support, shape public opinion, attract diverse funding and leverage scarce resources.[78]

Environmental Education

Today, while far more science and mathematics is known and available, ironically, less and less of it, including some of the greatest human achievements in history, are known. Many educated people are scientifically and mathematically illiterate because science and math have all but disappeared.[79] Environmental education is a means by which we can assist students to develop a greater understanding of their ever changing world through science and math.[80] Education must lead to understanding and to development of attitudes and skills that enable effective action. Many environmental problems- including natural disasters- can be attributed in part, to sheer ignorance or to misconceptions we develop about the environment because we are largely removed from it.[81]

Objectives

The objectives in my unit are cumulative. First, we will set a foundation, learning important vocabulary and concepts about natural disasters. Secondly, we will learn about the human impact of global warming and population growth as it contributes to natural disasters. Finally, the children will participate in a project to inform or serve our local community as it pertains to natural disasters.

Classroom Activities/Teaching Strategies

Books

Here are some of the books I plan to utilize in my unit: *What You Can do to Stop Global Warming* by Laurie David and Cambria Gorda, *Magic School Bus and the Climate Change Challenge* by Joanna Cole and Bruce Degen, *Magic School Bus Inside a Hurricane* by Joanna Cole, *Magic School Bus Weathers the Storm by Joanna Cole, Magic School Bus Blows Its Top* or *Voyage to the Volcano* by Joanna Cole, *Magic School Bus to the Rescue: Earthquake*s, *Magic School Bus Twister Trouble* by Joanna Cole, *Magic School Bus to the Rescue: Forest Fire* by Joanna Cole or *Wildfires!* By Seymour Simon,

Global Warming by Seymour Simon, *Super Storms* by Seymour Simon, *Earthquakes* by Seymour Simon, Tornadoes by Seymour Simon, *Hurricanes* by Seymour Simon, *Volcanoes* by Seymour Simon, *I Can Read About Earthquakes and Volcanoes* by Deborah Merrians.

Videos can be selected from YouTube. I am using SciKid videos and Crash Course videos for my students. The videos are listed within the daily lessons.

Unit Starter

I will show the students a clip of President Trump denying the existence of climate change or show a newspaper article (November 2018) where he states "I don't believe it!". Then allow them to watch the reporters questioning him about the scientific support for global warming. Then ask the students... "What is climate change?" and "Is global warming real?" We will fill out a KWL chart to see what the children know and revisit it throughout the unit.

Classroom Lessons

Day One- What happened during cooler climate changes?

I will begin the unit with a video from Crash Course from YouTube called *Climate Change, Chaos, and the Little Ice Age- Crash Course World History 206*. This 10 minute video reviews what the world was like when there was a time of cooler temperatures. John Green covers the 13th to the 19th centuries and how these cooler temperatures had an affect harvests, starvation, disease, crime, civil unrest, migration, and political unrest. This video shows how people in the past felt bad weather was a result of human sinfulness. People were being punished. But now we know that we have some control over how we deal with natural disasters through better engineering, land management planning, and warning systems. We also may have some impact on global warming through the implementation of renewable energy resources such as hydro-power, solar power and the like, decreasing our greenhouse gas emissions.

So, "those who do not learn about history are doomed to repeat it" is a quote that comes to mind. Following the video about the cooler climate change, I will ask the students what they think might happen if our climate heats up?

We will brainstorm our ideas and make a list to revisit throughout the unit. We will be able to see if our predictions were correct as we go through the lessons. Then we will read and discuss one of our books about climate change: *Magic School Bus and the Climate Challenge*. This book covers <u>everything</u> I wish the kids to learn over the entire unit. This will be the introduction to all the content and then we will break in down and delve deeper into the topics with each upcoming lesson.

Day Two-What is climate change and what causes it?

Next, I will show a video from Bill Nye found on YouTube. It is called, *Bill Nye: Climate Change 101*. It is four minute video that explains climate change. Nye explains that since the Industrial Revolution, we have utilized our natural resources, burned fossil fuels and increased our greenhouse gases at a great rate. These have increased the global temperature which has devastating effects on the ocean, organisms living in the oceans or relying on the protein from the oceans, rising sea levels, weather, and natural disasters. We are part of the cause, but we can also be part of the solution. We will discuss the following key topics/vocabulary:

What is the difference between weather and climate?
What problems does global warming cause?
What is the greenhouse effect?
What are greenhouse gases?
What are some things that produce carbon dioxide?
What is climate?
What is global warming?
What causes global warming?
What is climate change?

Today will be a day heavy in vocabulary. We will be introduced to key words: climate, climate change, global warming, greenhouse gas, greenhouse effect, carbon dioxide, methane, atmosphere, emissions, sinks, fossil fuels, carbon footprint, and review a few other words key to the unit that the students have learned through other units (acidification, resources, green technology, renewable energy...). One could develop a SMART Board lesson with these words for the children to learn this vocabulary, possibly a Jeopardy Game on the SMART Board.

I will use the Guess Who board game and call this vocabulary lesson "Guess What?". I will write vocabulary words on each of the flip up doors of the game. On the flip up doors I will write: climate, weather, climate change, global warming, greenhouse gas, greenhouse effect, carbon dioxide, methane, atmosphere, emissions, sinks, fossil fuels, carbon footprint, acidification, resources, renewable energy, Industrial Revolution, natural disaster, temperate climate, tropical climate, polar climate, hydroelectric, geothermal, nuclear power, and biofuels. Then I will give clues for each vocabulary word. The students will work in small groups to try and figure out which word I am describing. They eliminate the vocabulary words until we have only one word left. I will have climate change as our last word on the board game. We will develop a workable definition for climate change and post it up in the room.

Day Three- What is the difference between weather and climate?

We will watch two Crash Course videos on YouTube. The first is *Weather vs. Climate: Crash Course Kids #28.1*. This is just a general video about the difference between weather and climate. Weather is defined as the condition of the air or the atmosphere on the planet. Weather is the temperature, humidity, wind speed and the like, minute by minute. Climate is defined as what the weather is like over a long period of time in a specific area. We will make a Venn Diagram showing how they are alike and how they are different. Weather- measured over the short term, day to day, state of the atmosphere, reported as a forecast, looks at a day or maybe a week. Climate- measured over a long period, state of the atmosphere over 30 years of collected data, reported as averages, looks at charts and data for 30 years. They overlap and are the same in that we are looking at temperature, precipitation, humidity, and wind direction or speed. Again, we will develop a working definition for these two key words and post them in the room.

The second is called *Severe Weather: Crash Course Kids #28.2*. This video will help us define severe weather: tornadoes, blizzards, hurricanes/typhoons, floods/droughts, heat waves, extreme weather, disaster, evacuation, vulnerability, and we will review vocabulary already introduced. We will create a picture detailing what one of the severe weather disasters would look like and write a summary to go along with the illustration. Each child will pick a different one, and we will share our illustrations at the end of class and review what we know about each weather disaster. I will post vocabulary cards for each of the natural disasters in the room.

Day Four- What is a tornado?

We will watch a SciShow Kids video on YouTube called *What is a Tornado?* or Crash Course, H*ow Does a Tornado Form?* We will follow this video with some discussion and

then read *Magic School Bus Weathers the Storm* or *Magic School Bus Twister Trouble* by Joanna Cole or *Tornadoes* or *Super Storms* by Seymour Simon. Again, we will focus on vocabulary and key concepts.

Following this heavy content, we will play a version of the children's board game Candyland called, Evacuation from Disasterland! Each game piece will be assigned a socio-economic level. As the students play the game and try to evacuate to safer areas, when they land on the Disasterland spaces, individualized directions will be presented to the players. As the children play the game, they will realize that being economically challenged makes the journey much more difficult. Here are the keys resources to make the game:

- Use Monopoly Money or gold coins to start the game. The King starts with $15, the Princess gets $10, the Fairy gets $5 and the Man gets $2.
- The King's car is new and in good condition (his SES is $150K), Princess has an Ok car (SES is $110K), The Fairy has a broken down car (SES is $50K) and the Man has no car (SES $20K)
- The Fairy has to fix her car before starting the game. She loses a turn. The Man has to wait three turns for public transportation.
- Orange spot- fill up gas tank pay $1 (except the man who does not have a car)
- Gingerbread spot- purchase supplies for journey pay $2
- Candy Cane spot- Car breaks down pay $2 or miss a turn (except man who does not have a car)
- Gum Drop spot- purchase supplies on the road pay $2 or miss a turn
- Lollipop spot- cell phone breaks and you need it to coordinate lodging, getting information, filling out FEMA forms, etc. Pay $2 or miss a turn
- Ice Cream spot- Hotel charges pay $2 or miss a turn
- Licorice spot- You are sick, you need medical attention/meds pay $2 or miss a turn
- Peanut spot- pay day! King gets $8, Princess $6, Fairy $3, Man $2
- Peanut card- loan from friends King $4, Princess $3, Fairy $2 and Man $1
- Bridge- your friend lends you some money (King $5, Princess $3, Fairy $1 Man your friends can't afford to lend you money

Following the game, we will debrief and discuss what the children experience and felt during the game. When I played, I felt stress and fear that I would not be able to pay my bills as I was the Man (lowest SES). Each character should share their experiences with the other players. Then we will discuss how this translates to real life situations. Having a disability, age, income level, level of education, bridging capital (friendships and social connections), and many other factors come into play when dealing with a disaster. We will discuss the many scenarios which occurred during the playing of the game. If you do not have a Candyland board game, you can make a version of the game with the game of Life or some other board game. Just make the necessary adaptations.

Day Five- What is a hurricane or typhoon?

We will watch a SciShow Kid called *What is a Hurricane?* Following the video will we discuss what we learned from the video. Then we will read *Hurricanes* by Seymour Simon. We will focus on vocabulary and key concepts. I make up comprehensions questions with vocabulary word work to go along with the stories that we read so I can use the work for ELA grades too. Following all this, we will play a simulation game.

This game picks a few children from the class and assigns them a role. The roles are people of various economic status, education, age, physical abilities. The simulation is

an evacuation drill from an arriving hurricane. The scenario needs to depict the various barriers that people face in the time of a crisis. Lack of financial resources makes it difficult for people to evacuate. Physical disabilities and age pose a hardship. Owning pets presents a dilemma. Following the game, we will debrief. Here is how you play the scenario: Warning and Evacuation Lesson Material: Developed by Tricia Wachtendorf, Disaster Research Center, University of Delaware.

Activity

Students will engage in an activity designed to emphasize a key social science finding on the warning process leading up to evacuation. The objectives of the activity include:

1. Students will understand that the warning process is sequential. The idea of sequential processes could be integrated into other science activities such as chemistry.
2. Students will understand the terms and order of the warning process.
3. Students will understand the social factors that may generate delays in progressing through the sequence and thus delaying evacuation.

The exercise draws on Mileti and Sorenson's (1988) stages of the warning process. People must hear, understand, believe, personalize, and confirm the warning before they react. More information can be found in chapter 12 of the Handbook of Disaster Research, 1st edition. Mileti, D., & Sorensen, J. (1988). Planning and implementing warning systems. In M. Lystad (Ed.), *Mental health and care in mass emergencies: Theory and practice* (pp. 321–345). New York: Brunner/Mazel.
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Seven squares should be set up on the floor in a line, well-spaced so the students have room to move. Six squares should have #1-6 on them. The final square should have an "S." Child mats with detachable number and letter squares can be used for this activity. Alternatively, pieces of paper can be used with the numbers written on them. Five students are required for this activity, although more scenarios can be developed to include more students. One student is assigned the position of emergency manager. Props, such as a vest or sash or hat, can be used to designate the emergency manager. The four remaining students are assigned a character (Person 1-4). The emergency manager will stand at the "S" or "Safety" end of the line. The remaining students will stand at the beginning of the line, but not yet at square #1. The emergency manager will introduce the scenario and read the first statement. Persons A-D will then each read their statement #1 and follow the directions to move up a certain number of squares or remain put. The emergency manager will then read their statement #2 and persons A-D will take turn doing the same until all the statements have been read.

Emergency Manager:
Good afternoon. We are lucky to be living in a wonderful coastal community along the

Atlantic Ocean. I am your local emergency manager. I work for an agency that coordinates disaster response. I have been working with other local, state, and federal organizations because of a storm developing. Things have worsened! Here's what happens next.

1. The Governor of our state has just issued an evacuation order for some areas of our community. Everyone in those areas is supposed to leave immediately. She holds a press conference and announces it on television in English.
2. Evacuation information is shared on the radio in English, as well as on government web pages and news websites. Emergency agencies say it will be the worst storm in 100 years and be very dangerous.
3. Officials specify all areas that will experience widespread flooding.
4. Officials stress that people should get in their cars and leave now or their life will be at risk. Video on the news shows how the hurricane has already struck Caribbean islands. There is a great deal of damage.
5. The storm is nearing. We organize a few busses to help get people who don't have cars out of the community. We stress that people need to leave right away. The storm is approaching a state much further south. We hear a story about a person relying on an oxygen tank passing away because the power went off and medical workers could not reach him in time. It's a very sad story that receives a lot of news attention.
6. The storm is coming. We move all public transportation and everyone should have left the area. The weather starts to turn dark and rain begins to fall.
7. The storm hits and there is severe damage to the community, hospitals, emergency organizations, businesses and houses. Supplies and rescue crews can't get in for several days and the power is out for several weeks in many areas.

Person A

1. I speak English and get my information from television. I get to move up two squares to #2.
2. This storm sounds serious. I trust the government when they say it will be bad. I move up one square to #3.
3. I have a friend who has been through a bad hurricane and I remember how bad the stories were about the damage. I live in the evacuation area and I don't want that to happen to me. I need to leave. I move up one square to #4.
4. I see my neighbors backing and talk to them. They think the storm is serious. The images from areas already hits confirms this for me. This is going to affect us and it is serious. I move up one square to #5.
5. I have heard, understood, believed, personalized, and confirmed the warning. I am ready to respond, pack up, get in my car, and go. I move up to one square to #6 and then move on to safety!
6. I'm still safe!
7. I'm glad I'm still safe!

Person B

1. I have a hearing impairment. Signing or close captions were not used in the announcement. I have to stay put.
2. I read about the evacuation order on the Internet news, but it has too much technical information that I don't understand it. I move up one square to #1.

3. I find more straightforward information on the Internet, but the government always makes a big deal over nothing. I don't trust them. I move up one square to #2.
4. I go to my community center and they are talking about how the storm will be bad. I believe it this time, but I have been through disasters before. I'll be fine. I move up one square to #3.
5. My neighbor is packing up to go, but they have never been through a hurricane. I'll be ok. I stay put.
6. I eventually read the story about the person passing away in a US state further south from us. I used to live in that state and see the damage to places I know. I also think about the fact that the person had a medical issue. I wonder if I might be putting myself at risk by staying. I move up one square to #4.
7. Although I heard, understood, believed, and personalized the warning, I did not have time to confirm or response before the hurricane struck. I did not reach safety.

Person C:

1. I am a tourist from Japan on vacation in this community. I speak very little English. Although I sometimes have the TV on in my hotel house and people in the lobby seem concerned about something, I understand little English. I move up one square to #1.
2. People still seem very concerned about something and there is a lot of activity going on, but still don't understand what's happening. I stay put.
3. I start to get concerned as well, so I email my parents back in Japan. They find out some information, finally, in Japanese and tell me about the evacuation. I look outside and it's beautiful. I don't believe it will be that bad and I don't want to cut my vacation short. I move up one square to #2.
4. I see the images from the Caribbean on the television. I don't understand everything they are saying but it looks very bad. My parents call and tell me that they are very worried for my safety. They tell me I should change my flight tickets and come home before it is too late. The owner of the beach house stops by and says I must leave. Move up to #5.
5. I have heard, understood, believed, personalized, and confirmed the warning message. I am ready to respond and move to #6. I pack my suitcase, drive my rental car to the airport, change my tickets and fly home. I move to safety!
6. I'm still safe!
7. The hurricane has hit the area. I'm happy I made it to safety!

Person D.

1. I understand English, but I am an elderly person who cannot afford cable. I don't watch TV that much anyway. I have to stay put.
2. I hear the news about the evacuation on the radio. I move up two squares to #2.
3. I have been living in this area for a long time. I don't believe that that the storm will be that bad. I stay put.
4. The news keeps talking about damage countries, but they always do that. We have stronger buildings and they just want to make a big news story. I stay put.
5. The coverage of the storm continues, but I'll be fine. I still think this storm is overblown. Besides, I don't have a car to leave anyway. I stay put.

6. It's starting to get stormy outside. I start to believe that this might be a big storm after all, but I'll be fine. I've been through storms before. I move up one space to #3.
7. Although I heard, understood, and believed the warning, I did not have time to personalize, confirm or response before the hurricane struck. I did not reach safety.

Questions for the activity discussion:

1. Whose fault was it that some people made it through to safety and some did not?
2. Why was important for people to first hear before they could understand or believe before they could personalize? In other words, why was the order of the process important?
3. What were some of the reasons people had difficulty moving from one square or one part of the process to another?
4. What were some things that could have been done to help them?
5. How does understanding this way that people process warnings – the social science – help us better understand the natural science or planning parts of hurricanes and hurricane response?

Day Six and Seven- What are earthquakes and volcanoes?

We will watch a video from Bill Nye called *Plate Tectonic, Volcanoes and Earthquakes.* Bill Nye explains plate tectonics and how the plates separated to form the continents. Where there are the splits in the plates we have volcanoes. Finally, he discusses earthquakes and the Richter scale.

We will do a hands-on lesson to discuss convergent and divergent plates. The children will have actual plastic plates with Monopoly houses placed on top and will see what happens to the homes when the plates bump together (convergent) or are drawn apart (divergent). We will make vocabulary cards to display the words convergent and divergent plates to display in the classroom.

Following the video the class will read books about volcanoes and earthquakes. You can take a few days to read them or assign the various books to smaller differentiated groups and the children can jigsaw the content they have learned. The books are: *Magic School Bus to the Rescue: Earthquakes*, *Magic School Bus Voyage to the Volcano* or *Magic School Bus Blows It's Top*, *Earthquakes* or *Volcanoes* by Seymour Simon or *I Can Read About Earthquakes and Volcanos* by Deborah Merrians. Again, there will be comprehension assignments for each book for ELA.

Then, we will review the vocabulary and key concepts from the readings. I will make a Jeopardy Game to review these words along with the other from the unit so far. Categories will be East Coast, Midwest, West Coast, Coastal Areas and Hawaii. The clues will be weather related disasters which occur in those locations and other vocabulary words that can fit into those categories. I will try to overlay the game on to a map so the students can see where these disasters happen. (The information for this game is at the end of this unit.)

Day Eight- What is a drought?/What is a flood? OR What are wild fires? (Optional)

We will watch a video to review the water cycle and concepts we learned in our water

unit. It is call *Water Fight: Crash Course Kids #36.1*. This video discusses the drought experienced in places like California. We will read the story, *Magic School Bus to the Rescue: Forest Fires* by Joanna Cole or *Forest Fires* by Seymour Simon.

Or we will watch a SciShow Kids called *Why Do Floods Happen?* This explains a flood and how to be prepared for a flood. We will visit the DenRec.gov website to see sea level rise predicted for Delaware. We will discuss how that impacts those areas and what that means for us in the future.

At the end of this lesson, we will watch the next episode called *Water Fix!: Crash Course Kids #36.2* which talks about solutions people had when dealing with a limited water resource. This reviews many ideas covered in our water unit and makes connections to our economics unit, while still addressing the impacts of climate change.

Then we will play one more game that I have adapted. I will use *Chutes and Ladders* to make a game. The students will have various socio-economic status to start and will begin with various levels of money to start the game. Player One has high SES and starts with the most money (about $30). Player Two is middle to high SES, and has a little less money that player One (about $24). Player Three is middle SES and has a quite a bit less that Player Two (about $18). Finally, Player Four in low SES and has little money to start (about $12).

The children may purchase items that may benefit them throughout the game. They may purchase the following: A car for $4, Earthquake Insurance for $3, Flood Insurance for $3, Advanced Education for $4, Retro Fitting their Homes for $4, and Bridging Capital (family, friends and social connections) for $2. These must be purchased prior to starting the game. Obviously, they may only purchase what they can afford.

The game board should have spaces marked with things such as:

- Call your civic leader for help (must have Bridging Capital) or pay $2/slide down
- You need medicine, pay $2
- PAYDAY- place several of these throughout the board (player One gets $4, Two get $3, Player Three gets $2 and Player Four gets $1 on each payday spot)
- Staying at a Hotel, pay $1
- Car repairs $1 (only if they own a car)
- Fill our FEMA forms (need Advanced Education for this, if not you pay $2/slide)
- Tornado Strikes (must pay $2/slide unless you have Retro Fit at start of game)
- Stay with Friends (Can only stay if you have Bridging Capital or else slide down)
- Flood (if no insurance pay $2 and slide down)
- Earthquake (if no insurance pay $1 and slide down)

We will play the game, stopping at each event and discussing the benefits and downfalls of each play. Those with higher SES, bridging capital, preparedness, and a little luck, may make out better in the game.

Day Nine- End of Unit

We will review the many concepts and vocabulary terms we have learned throughout this unit. We will read the story *Global Warming* by Seymour Simon. Then we will revisit our President Trump clip or newspaper article. I will ask again, “What is climate change? And “Is global warming real?”

Hopefully, the students will see that global warming and climate change are scientifically proven phenomena. We will refer back to our KWL from the beginning of

the unit. Following that discussion, we will talk about who might need to know about climate change and global warming? How might we get that information out to those people/groups?

Then we will decide about our end of the unit projects. The students will produce a means by which they will demonstrate what they have learned throughout the unit. The children will be permitted to select how they wish to demonstrate mastery of the Science content and vocabulary. Some of the students may wish:

- to make a brochure that teaches information about a weather disaster
- to research an organization that helps in disasters and produce a brochure, power point or report about that group (FEMA, Red Cross, ASPCA, Habitat for Humanity…)
- to develop a safety plan for their families (where do we go, what do we take, a map)
- to write a children's book or make a play to present to the younger children at school
- make a safety poster with pertinent information and illustrations
- make their own board game like what we have played with throughout the unit
- make a diorama or mobile with pertinent information
- to create a project of their own

I plan to use all my ELA block and Science/Social Studies block for these lessons. Once the students have some general knowledge, I will provide prompts for them to work on during writing. The students will be fully immersed within this unit.

Jeopardy Vocabulary Game (Day 7) (and some from Guess What? Game)

You can make a game on a Smart Board or just make one from paper.
The categories are: East Coast- West Coast- Midwest- Coastal Areas- Hawaii and Alaska.

Under East Coast are:
100 Blizzard- Storms with blowing or falling snow, high winds and cold temperatures.
200 Fossil Fuels-Prehistoric plants that decayed under the earth: oil, coal, natural gas.
300 Carbon Dioxide-A gas in our atmosphere, also is emitted by animals and machinery.
400 Greenhouse Effect-Heat-trapping gases act like glass and make the earth warmer.
500 Atmosphere- Layer of gases surrounding the earth that is hundreds of miles thick.
600 Bridging Capital-Friends, family and connections with others in society.
Under West Coast are:
100 Resources-A reserve supply of materials, come from nature: air, water, fuels, trees…
200 Forest Fires-When areas are in a drought and fires begin and burn uncontrolled.
300 Emissions-Pollution given off by something like cars, machines, factories.
400 Renewable Energy-Sources of energy that may be used over again: solar, wind…
500 Greenhouse Gas-Gases such as CO2, methane, carbon…that trap heat.
600 Earthquake-Shaking and trembling of earth due to moving of plates and volcanoes.
Under Midwest are:
100 Tornado- A fast spinning column of air stretches from the sky to the earth's surface.
200 Methane-A gas produced from cattle and the like which adds to global warming.
300 Weather- The condition of the atmosphere/air (temperature, humidity, wind speed)
400 Drought-When an area does not get enough rain drying this up, ruining crops.
500 Industrial Revolution-A time of rapid growth in the economy due to power driven machinery.
600 Sinks-Places that absorb CO2 like oceans, plants…
Under Coastal Areas are:

100 Hurricane- Storms with high winds & heavy rains; form over the warm ocean (USA)
200 Typhoon- Storms with high winds 7 heavy rain; forms over ocean (Asian term)
300 Floods- Act of nature when too much rain forces streams, lakes & rivers to overflow.
400 Climate Change-The change in the overall temperature of the oceans and land.
500 Acidification-An increase in the acid level of water which results in organisms dying.
600 Sea Level Rise-Increase in water levels due to melting of the glaciers from global warming

Under Hawaii and Alaska are:

100 Climate- What the weather is like over a long period of time in a specific area.
200 Volcano-A vent, or hole, in the earth's crust from which molten rock is released.
300 Recycle-To treat waste materials so that they can be used again.
400 Tsunami-The name of a large wave caused by an earthquake.
500 Global Warming-Rise in the average temperature of the land and water on earth.
600 Carbon Footprint-The total amount of greenhouse gases produced to support human activity (directly or indirectly).

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This book demonstrated some of the economics of global warming and climate change.

Note

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