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A Planet Worth a Thousand Words: An English Teacher's Guide to Global Warming

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Introduction

Clouds of sulfuric acid fill the sky as winds race around the dry planet. Although there are traces of water vapor in the atmosphere, the high temperature boils away any water near the surface. There are no beaches, forests, or cities, as this land is dead and inhospitable. If oceans ever existed, they have entirely evaporated by now. The temperature on a nice day is hot enough to melt lead: it's a blistering 400 degrees C (about 750 degrees F). The atmosphere, consisting of 95% carbon dioxide, is so heavy that it crushes our bones before we ever get the chance explore the volcano-covered plains or fiery mountain ranges.

The scorching weather on Venus is attributed to the greenhouse effect. While energy from the sun penetrates the atmosphere, the heat is trapped on the surface. Carbon dioxide (CO_2), a greenhouse gas, plays a large part in keeping the surface at such a high temperature, and it is a component that exists in our own atmosphere here on Earth. Fortunately, our atmosphere is not 95% carbon dioxide, but our CO_2 levels are increasing at a faster rate than ever before in our human history. Our concentration of CO_2 is currently about 380 parts per million (ppm), an increase from 280 ppm prior to the Industrial Revolution.

The increase of CO_2 levels - and therefore an increase in temperature - is not just a problem for scientists. In fact, our individual and societal lifestyles actually contribute to the increase of CO_2, making global warming a problem for everyone - including the children in our classrooms today. The words "global warming" and "greenhouse effect" are part of our popular culture; however, if students listen to popular media, they receive information that often lacks in scientific fact and is enhanced by the opinions of a misinformed public.

As English teachers, we are able to help students wade through misinformation and reach a deeper understanding of a specific topic. We help students recognize cause and effect, develop the skills to make predictions based on prior knowledge, apply subject-specific vocabulary, accurately separate fact from Crichton, and support a thesis with sound research. We are also able to nurture the poet and the story teller, to create a space where unique voices can be heard, and to provide the literary resources students need in order to make connections with the world outside of the classroom. Global warming is an issue that involves us all, existing within and without bells and school buses. Why *shouldn't* an English teacher teach global

warming?

The science can be confusing, especially for those of us who - dedicated ruthlessly to our own field - stayed away from math and science in college, fearing that too many numbers would skew a blank verse poem. However, the urgency of global warming has encouraged the scientifically-minded to write books geared for the general public. Reading science does require a different kind of literacy than reading a novel - all the more reason for English teachers to teach it.

A Planet Worth a Thousand Words is a writing curriculum with a focus on global warming. It is primarily for high school seniors, although it could easily be adapted to fit other grade levels. Our New Mexico standards require that seniors research and present issues of public concern, and our school promotes a curriculum that encourages seniors to think about and contribute to the world outside of high school. Our English courses are year-long 50 minute classes; we emphasize writing for one semester and reading for the other, although both reading and writing are of course interrelated. The global warming curriculum will last for nine weeks (a teacher may adapt it for a shorter time-span) and explore poetry, short stories and speeches. Students will engage in journaling and 1-page essay writing throughout the quarter, and they will pursue a specific research question about global warming as they build and refine their writing skills.

As most of the course will cover the fundamentals of global warming, students will be able to use research to understand at least one aspect of the issue in depth. Rather than writing a typical research paper, students will write a creative story that is based on their findings. They will also work in groups to educate the community about one specific area of global warming. This final presentation will be a culmination of scientific knowledge, creative and comprehensive writing skills, and the ability to make a difference in one's community.

Before delving into specific aspects of global warming, it is important to understand the fundamentals. Although I have used books and articles as resources, the majority of scientific information presented in this unit is what I learned from Dr. Sabatino Sofia and my colleagues at the Yale National Initiative Global Warming seminar.

Fundamentals of Global Warming

Climate

Most people can easily identify changes in the weather. A bright, sunny day with a few thin clouds stretched across an otherwise blue sky can change into a cold day of rain and hail by tomorrow. The changes in climate, however, are too small to be detected by the daily weather-watcher. Climate is the *average* of weather over a long period of time. For example, a region may be typically humid, snowy, rainy or mild. According to the EPA (2004), climate is what you expect, and weather is what you get. Our climate temperature has increased about 1 degree F in the last century, warming at a faster rate over the last two decades.

When we speak about climate, we are speaking about the impact of solar energy. We know that the sun warms the air and that hot air rises. The air brings moisture from the sea, and as the air cools, the moisture condenses to make clouds. Some of the solar energy is re-radiated from Earth and back into space while other energy is trapped within our atmosphere.

The climate system is a link between the atmosphere, oceans, ice sheets, rocks and sediments, and living organisms (Buchdahl, 1999). Nothing within the system operates independently. For instance, the Gulf Stream in the North Atlantic contributes to the warm weather in Western Europe. The stream is like a conveyor belt with warm water on top and cold water on the bottom. The cold water is saltier and sinks to the bottom at five billion gallons per second, pulling the warm water in the opposite direction. As the ice melts, fresh water dilutes the salinity and decreases the amount of water that sinks, halting the conveyor belt flow (Motavalli, 2004). The last time the Gulf Stream ceased to flow, about 10,000 years ago, Europe endured an ice age that lasted about 1,000 years (Gore, 2006).

Climate models show that global warming produces extremes in temperatures, so not only do summers become hotter, but winters become colder. Global warming can actually cause an Ice Age in some regions. With this in mind, it is important to remember that climate change is not about bad weather changing into a nice day, or even about finding relief after a long summer with the long-awaited cool temperatures of autumn. Climate change is about altering temperatures for hundreds or thousands of years.

Atmosphere

If we could strip Venus and Earth of their atmospheres and place them side by side, we might notice some similarities. They have the same origin, they are similar sizes, and they share a similar distance from the sun. Even as we add the primitive atmosphere of both planets, we notice what they have in common. Both atmospheres originally contained hydrogen, helium, methane, ammonia, nitrogen, neon, and a small amount of argon. A major difference between the two planets occurs when we note that Earth's original atmosphere has escaped. Our current atmosphere is influenced by volcanic eruptions, which contain large amounts of nitrogen, carbon dioxide, and water vapor.

The atmospheres of Venus and Earth both contain carbon dioxide. Fortunately, the rocks of our own planet were able to absorb a great deal of CO_2, whereas the rocks on Venus were never cool enough to do so. Venus has always been slightly hotter than Earth. The principles of CO_2, however, remain the same on both planets.

CO_2 is a greenhouse gas, along with water vapor, methane, nitrous oxide, ozone, halogenated fluorocarbons, perfluoronated carbons, and hydrofluoronated carbons. To understand the affect of greenhouse gases, we can imagine walking into a greenhouse full of plants. Here, we can look through the transparent glass and see the sun and everything else outside of the greenhouse, and we can feel the heat that is trapped inside. It is true that we need greenhouse gases to sustain life. Of course, an extreme excess of such gases would create an uninhabitable planet, perhaps one that resembled Venus a bit more closely. Without its current greenhouse effect, the average climate of Venus would be a balmy 20 degrees C (70 F) instead of the actual temperature of 400 C (750 F). Earth, in turn, would be -25 C without the greenhouse effect. In order for a planet to be habitable, the temperature must be between 0 and 100 degrees C. A healthy greenhouse balance gives Earth's climate an average temperature of 10 C (50 F).

The greenhouse effect acts as a kind of gateway for the sun's radiation. The high-energy short waves of radiation come from the sun and pass through our atmosphere. Earth re-radiates the absorbed portion of this energy back toward space as infrared radiation, or heat, but the greenhouse gases trap most of these long, low-energy waves in our atmosphere. This is why we can see visible light pass through the glass of a greenhouse while the heat stays inside. The windows in our homes also let in visible light in while trapping infrared radiation. If they didn't, we'd have to seal up all of our windows during the winter.

Not all of the radiation makes it close enough to the surface to become re-radiated heat. Some of the radiation is reflected back into space by clouds and ice. This reflectivity is known as albedo. Fashion experts have an intrinsic understanding of albedo - after all, this is why people wear white (or light-colored) clothes in the summer and black (or dark-colored) clothes in the winter. While the white shirt reflects the radiation from the sun and keeps us cooler, the black shirt absorbs the radiation and keeps us warmer.

About 39 % of radiation is reflected (the albedo is 0.39), while the remaining 61 % is absorbed by the surface and emitted as infrared radiation. With an albedo of 0, our planet would be a perfect black body. In other words, Earth would absorb all of the radiation and reflect absolutely nothing. Our albedo depends on clouds, snow and ice. The problem with clouds is that while they contribute to the planet's albedo, they also contribute to warming the planet. Clouds trap infrared radiation. As the planet warms, water evaporates and forms clouds that decrease absorption of solar energy. On the other hand, as the planet warms, the ice melts, increasing the absorption of solar energy. As the ice melts, the albedo decreases. As the albedo decreases, the planet warms. As the planet warms, the ice continues to melt. This is part of the cycle we know as global warming.

Fossil Fuels

CO_2, a greenhouse gas that traps heat, increases as our growing population depends more and more on the use of fossil fuels to run our machines. Not only is CO_2 increasing, it is increasing exponentially. This is the difference between 10 x 2 and 10 raised to the 2^{nd} power. CO_2 is a waste product of fossil fuels such as coal, petroleum and gas (Flannery, 2005). We rely on the remains of decomposed plants and animals to generate electricity, heat our homes, and provide transportation. It is difficult to imagine a life without fossil fuels, but to continue as we are will turn short-term gratification into long-term devastation.

So far, we have relied on oceans and trees to absorb our CO_2 emissions. Tim Flannery, author of *The Weather Makers* (2005), describes the problem occurring with our oceans today. The North Atlantic, he writes, contains almost a quarter of the carbon we've emitted, while it only constitutes 15 % of the ocean's surface. He also notes that as the ocean warms, it has less ability to absorb CO_2, much like a warm carbonated drink falls flat. The oceans also become more acidic as they take in more CO_2. The more acidic they become, the less CO_2 they can absorb.

Trees absorb CO_2 through photosynthesis. However, as forests are burned, more CO_2 is released into the air. This also occurs as trees die and decompose. Planting more trees is certainly better than burning them or cutting them down to rot, but this action will not resolve the long-term problem. While trees temporarily absorb CO_2, they unfortunately decrease the albedo.

CO_2 levels will double; it is not a matter of whether they will or won't, but a matter of when. If we take action now to decrease our use of fossil fuels, and therefore decrease the amount of CO_2 that we release into our atmosphere, the levels will double in two centuries. If we do nothing at all, the CO_2 levels will double in forty years.

Consequences

While some of us may think of warmer temperatures as not having to scrape so much ice off our windshields, we must come to terms with the destructive ramifications to our planet as a whole. We must also remember

that we are not talking about a few days of milder weather during winter, but about a major climatic shift that will considerably alter the planet in ways that span beyond our lifetime. It may be easy for certain members (and leaders) of our society to shrug apathetically when asked to consider the world we are leaving the children in our classrooms today, but as educators, we cannot afford such self-centered thinking.

To put it simply, the icecaps are melting, polar bears are drowning, people who depend on the ice are already struggling to maintain their lives, and animals are becoming extinct. We face rising sea levels, an increase in storms, and a change in rain distribution that could destroy the crops of Middle America along with other food-sources around the world. We are coming to a time when floods will displace large populations; survivors will migrate to drier areas while others drown or die from diseases that were once foreign to their homelands. Perhaps SUVs, like cockroaches, will persist, trampling over muddy lands where magnificent glaciers once stood.

It is overwhelming. It is also difficult to believe, especially when I can look out my window over high desert Santa Fe and see that the mountains are as brown as they ever were, or that the rain that never comes finally came days ago and is still splashing tufts of yellow grass into a bright shade of green. However, there is evidence today of the effects of global warming. Elizabeth Kolbert, author of *Field Notes from a Catastrophe* (2006), describes the gradual extinction of the golden toad due to climate change, the migration of birds and butterflies as temperatures increase, the thawing of permafrost just below the Arctic Circle, the acidity of oceans, the disappearance of sea ice, and the unavoidable relocation of villages due to melting ice and an increase of storms brought on by warmer weather. With all that we know, how is it possible to deny the existence of global warming?

Controversy

There are uncertainties. Scientists know that human activity is increasing the level of greenhouse gases, but they do not know where the increase will stop. They know that global temperatures will continue to rise, but it is not clear whether the increase will be 1.4 or 5.8 degrees C, or somewhere in between. They know that warm water causes an increase in hurricanes, but it is not possible to tell if specific hurricanes today are due to global warming. They know that the sea levels will rise, but they don't know exactly how high. Although scientists know that global warming will impact wildlife, natural resources and human health, they cannot predict the exact outcome, especially when looking at specific local regions (EPA, 2002).

However, there is no doubt among scientists that global warming exists, and that human activity is mostly responsible. Scientists use ice core samples and trapped air bubbles in amber to determine the atmosphere of our past, allowing comparative measurements to be made today. CO_2 measurements are made in the troposphere above a mountain in Hawaii, where the atmosphere is less contaminated. Scientific data gives us a low number and a high number insofar as possible outcomes. Even the lowest projected global temperature rise of 1.4 C by 2100 is a greater rise than seen in the last 10,000 years, according to the IPCC (EPA, 2002). There are degrees of uncertainty within each projection, but all scientific projections show some degree of global warming.

Some of the uncertainty involves the use of climate models. By their nature, climate models must simplify data. They are tested to determine past climate changes, and they are useful as estimation tools. Different researchers use different models to test different sets of data, and therefore create different results. Gradually, the climate models are beginning to converge, but for now they produce uncertainties. Something worth noting is that published scientific sources will include room for probable error. These are not mistakes;

they are uncertainties. If a source does not include uncertainties, but insists that, say, oceans will rise 80 feet, it is probably not a valid scientific source.

An uncertainty about to what degree global warming occurs or what impact it will have is not the same as questioning *whether* global warming occurs or *if* it will have any impact at all. This would be like not knowing what a friend had for lunch today and therefore arriving at the conclusion that this friend *never* eats lunch.

Uncertainties are sometimes used by non-scientists to confuse and mislead the public. According to some of our policy makers, there is too much confusion about whether our friend had a sandwich or bowl of soup, so that means our friend never eats lunch and never will, and global warming does not exist. On the other hand, it is just as unrealistic to assume that our friend will explode from too much food. It is useless and incorrect to say that we are doomed.

Mitigation

One of the drawbacks of being aware of the world around us is that it becomes difficult to live life as usual. We may think about CO_2 levels as we fill our car with gas or drive by a power plant, but how can we turn our thoughts into actions - or even feel confident that our actions even make the tiniest dent in global warming?

On an international level, the Kyoto Protocol, an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), is an effort to mitigate the anthropogenic, or human created, greenhouse gases. Countries must commit to reducing their emissions of CO_2 and other greenhouse gases or engage in emissions trading. Countries that exceed the allotted emissions would have to buy emission credits from a country that stays below the set limitations.

Scientists have also considered renewable energy resources such as windmills, hydroelectric power, solar power, or nuclear power. Unfortunately, windmills require steady wind to work consistently, hydroelectric power involves risks in damming and redirecting waters, solar panels need reliable sunlight, and nuclear power produces nuclear waste. It is also difficult to transport wind, hydro and solar power over long distances. However, current development of renewable energy resources for large and small areas will help reduce our emissions of greenhouse gases.

As individuals, we have plenty of opportunities to do our small part. For instance, we can drive something other than SUVs. At home, we can use compact fluorescent lights rather than incandescent bulbs, as the latter bulb wastes more energy as heat and does not last as long as a compact fluorescent light. We can keep our thermostat slightly cooler in winter and warmer in summer in order to save energy, and reduce the amount of electricity and gas we use in general. Students and teachers can find more suggestions in the back of *An Inconvenient Truth* by Al Gore and in renewable energy books such as *Smart Power* by William H. Kemp. In fact, some students may find it interesting to pursue renewable energy resources as the focus of their research.

Strategies

Methods

Learning

Why do students want to learn? Why do they study so hard and pursue their education with so much passion? I ask these questions out of neither naiveté nor luck, but because these questions force me to think about education in a very different way. I am no longer asking what I can do to "hook" or convince my students that something is worth their attention - if they can just hang in there for the next few days. Perhaps these are the questions we should be asking ourselves, as educators, in order to understand how to engage students.

Why do students want to learn? Most likely it's not to pass a test - unless they are preparing for a placement or exit exam. They *get* something from those tests: a chance to either skip ahead or move on. What do they *get* from most of the tests that they take? Tests, especially standardized tests in the business of education, have a lot to do with the school and very little to do with the child. Students have to take them, but that's not why they learn.

Learning is not always an intellectual pursuit. Robert Sylwester writes that emotion "drives attention, which drives learning and memory" (1995, p. 72). If we don't care about something, we are not likely to give it our attention. Or, in the case of feeling alienated from the learning experience, we may choose to avoid learning altogether. It is possible to feel alienated in at least two ways; one type of alienation has to do with the topic or subject. We missed a step somewhere and now we are not able to connect the words or numbers in a way that constructs meaning. The second form of alienation occurs when we are acutely aware that nothing in the immediate environment has anything to do with us. We may feel deliberately ignored or blindly excluded. The first case of alienation is easier to overcome.

When we learn, we feel a sense of connection to something outside of ourselves. Sometimes we can feel ourselves change as we learn. Maybe we don't feel it until later, but a part of us knows it's coming. There's a click or a flash, and suddenly we're somewhere we've never been before, but no matter what, we're *connected*. Imagine the time you were touched by a poem that you finally understood. Or imagine learning how to drive a car (a hybrid with high gas mileage, of course), or how to solve a computer problem on your own. You arrived on the other side, and you were connected to the poem or the car or the computer. We want to learn so we can be a part of the world.

Why do students want to learn about global warming? Students are already a part of global warming, as we all are. To not understand the connection is to not understand global warming. It is up to us to show students how they are connected. Not to persuade them or bribe them, but to show them. Students, like us, feel that they are a part of the world when they have something to contribute. Now they will be able to offer their knowledge to their communities and make very important changes to the world where they belong.

Teaching

Of course, learning cannot depend on emotional connection alone. Once a connection is made, students must understand new information from expert sources, be able to apply their knowledge and practice new skills, and integrate the learning experience with their own lives well enough to make new connections. In other words, the new knowledge becomes prior knowledge. Students should be able to take what we teach them to

a new level and hopefully pass this knowledge to others. This cycle follows Bernice McCarthy's *4Mat* approach to learning and teaching.

The lessons in *A Planet Worth a Thousand Words* follow this cycle with a conscious attempt to honor various learning preferences. The act of blending science with language arts may already engage some students who are more scientifically inclined, but the unit is not limited to lectures, research papers, or worksheets. As Sylwester points out, "Doing worksheets in school prepares a student emotionally to do worksheets in life" (1995, p. 77). One purpose of the various lessons is to empower students to be able to take the issues of global warming into their own hands. Nonetheless, this is a curriculum unit for English, and writing is at the core. In one way, the science of global warming is a vehicle for the mastery of writing; in another way, writing is a springboard for the mitigation of global warming.

Gardner's Multiple Intelligences are considered throughout the unit. Assessment tools include the linguistic intelligence through essay writing, poetry, speeches, journals, interviews and reports; logical intelligence through making predictions and calculations, analyzing data, and understanding climate models; spatial intelligence through visuals, illustrations and maps; kinesthetic through hands-on experiments; naturalist through demonstration of environmental sensitivity and research of nature topics; intrapersonal through personal reflections and independent work; and interpersonal through cooperative learning (Chapman and King, 2005). Students may also use rhythmic intelligence in poetry, and they may choose to include musical compositions and recordings in a final presentation.

Students will learn about the fundamentals of global warming as they write poetry, a short story based on research, a speech, and finally a creative presentation for their peers and community members. Throughout the unit, students will keep a journal and write one-page reflection papers to evaluate their learning. They will know ahead of time that the weekly reflections will serve as notes for their unit essay exam: a culminating personal response paper that discusses what the student learned over the quarter.

Implementation

The unit begins with the student. What does the student already know? How does global warming affect the life of the student? Why should he or she care? Rather than telling the student the answers to these questions, I begin the unit with a game of survival. The details of the game are outlined in the lesson plans below.

Once students make an initial connection, they receive expert knowledge about global warming (see Fundamentals of Global Warming) and learn specific writing skills. In each section, students apply what they've learned about global warming and practice new writing skills, beginning with climate and poetry.

Climatic Poetry

What is the ideal temperature? According to the student, which state has the best weather or climate? Which place has the worst? What is so ideal or terrible about specific weather conditions? Students begin by journaling about their own life preferences and opinions about weather. Students should also learn the difference between climate and weather—a discussion about the different climate conditions in various countries and states would help to illustrate weather versus climate.

Students may use the knowledge of their own climate conditions in an "I Come From" poem. The details of this poem are included in the lesson plans below. What makes the climate? Why does temperature change? Why do we have seasons? Students survey parents, teachers and peers and report on their findings. This would be

an excellent time to clarify that we do not have seasons due to the Earth's distance from the sun, but because of the tilt of the Earth on its axis. We are actually closest to the sun in January. Students should know that climate is a link between various elements on Earth, including clouds. An experiment that creates a cloud in a bottle will help students understand how clouds are made (this experiment can be found on several internet sites). Clouds do two major things that affect the temperature in opposite ways: they block out the rays of the sun (radiation) and they prevent the heat of the Earth (infrared radiation) from escaping.

Students expand their thoughts about nature in a lune and haiku. Lunes are three-line poems with three words in the first line, five words in the second, and three in the third. The words can be any length. Lunes are a great warm-up for a haiku, as lunes are similar but not as restrictive. Students begin a glossary of literary terms: they learn about personification by picking an object in nature and giving it human characteristics. They also include onomatopoeia by creating a sound that is connected to the object. Students are encouraged to use their five senses (imagery) to describe the object before they write the lune. They continue to expand their ideas about climate or nature as they write a haiku. Examples of the haiku may not always follow the five-seven-five syllable pattern, but they do tend to create a picture, and they often capture the beauty of a moment. Lunes and haiku teach students to be precise with their words.

At this point, students learn about the Gulf Stream. They learn about how it functions like a conveyor belt and how it affects the weather of Western Europe. Students predict what might happen if the water stopped flowing, and they learn how global warming can cause temperature to become more extreme: while summers become hotter, winters become colder. In their journals, students speculate what it might be like to live in an Ice Age. Viewing specific sections of movies like *The Day after Tomorrow* or *Ice Age* might help students visualize, although inaccuracies for the sake of entertainment should be addressed.

Students use a line from their journal to begin a pantoum. A pantoum demonstrates the use of a pattern: the first and third lines of the first stanza become the second and fourth lines of the second stanza, the first and third lines of the second stanza then become the second and fourth lines of the third stanza, and so on. It is an oral folk form from Malaysia, and it allows students to move forward by building on previous lines. Students can also explore the use of the end-stopped line, enjambment and caesura while writing about climate change.

The Story of Atmosphere, Fossil Fuels and Consequences

In this section, students work toward writing a short story about global warming. Unlike most short stories, these stories include a works cited page. The research they do may contribute to their final presentation, but for now they gather scientific information about global warming and use it as the foundation of their creative story. Hopefully, by writing a story instead of a typical research paper, students will see that the point of research is to develop further understanding, not simply to write a research paper for class.

Before beginning the story, students conduct another jar experiment - only instead of creating clouds, they create a greenhouse and an albedo. The details of this activity are included in the lesson plans. Why is Earth habitable while Venus is not? Students compare the atmosphere of Venus and Earth and learn about the origins and current similarities and differences. What are the different levels of the Earth's atmosphere? What are the periodic elements that make up the atmosphere? It may be useful for students to keep notes on periodic elements and some of their "practical" uses. Students also learn how windows let in the sun's radiation while trapping infrared radiation, and why white clothing is cooler in the summer than black clothing.

As students continue to learn about atmosphere, they examine the uses of plot, characterization, setting,

dialogue, and theme by reading short story examples. Students use what they've learned about the effects of global warming to describe the setting of their original stories. They write down ideas for plot: exposition, inciting incident, rising action (conflict, complications, dramatic climax, and crisis), technical climax, falling action, and denouement.

Students take a carbon footprint survey and other online assessments that estimate the amount of carbon they are emitting into the atmosphere. Students learn what fossil fuels are and how levels of carbon dioxide increase due to the use of fossil fuels. Students also discuss how we might decrease our CO_2 emissions.

In the meantime, students create a character. They examine elements of characterization: developed characters (direct & indirect presentation) & stock characters (caricature, dynamic character, static character, protagonist, and antagonist) and add various characters to their story. They describe how their characters are affected by global warming. Following characterization, students focus on creating a theme for their story and including elements such as a flashback and foreshadowing. While a flashback may allow the reader to understand how a character ended up in a certain situation, foreshadowing allows a reader to make predictions. Both elements of writing may be connected to consequences.

As students learn about the consequences of global warming, they reflect on what individuals can do to help mitigate climate change. They describe climate change from the point of view of an animal, migrating person, plant, melting ice, or anything else that is affected by global warming. Students learn about different points of view (omniscient, limited omniscient, first person, and objective) and choose a point of view to use for their story. In another writing exercise, students write a dialogue between the character from the point of view exercise and another character who contributes to global warming. What would they say to each other? How would they say it? Students learn about colloquialism and dialect. They apply dialogue techniques to the characters in their story.

Students continue to research global warming as they engage in exercises that focus on specific elements of the short story. Once they have the information they need, they write a story from the beginning to end (according to the teacher's specifications, such as length and format). Students workshop the story with their peers and read excerpts to the class. The research they've completed is a step toward their final presentation. However, information is useless unless they know how to present it.

Speaking of Controversy and Mitigation

Why do some people deny that global warming exists? What might motivate their opinions? Some people believe we are doomed. What motivates the opinions of these people? Students begin again with their own opinions and experiences. They will understand that politicians do not always consult with scientists before forming opinions, and that the general public may also form opinions without having correct information. Students will look at the Kyoto Protocol and discuss the decisions of the United States and Australia not to ratify it. They will also view the cities in the U.S. who have decided to "ratify" it in spite of the nation's decision.

Students will also look at climate models and interpret meanings. They will understand what a scientific error really means, and how it's been misconstrued in order to confuse the public. Students may come to a clearer understanding of how the increase of the average temperature is significant, even at its lowest projection, by thinking about how their bodies feel with only an increase of a couple of degrees. Although 99 and 101 are only two numbers apart, we can feel the difference in our bodies. An increase of a couple of degrees may determine whether or not we are able to get out of bed. Imagine if we projected an increase in body

temperature that was even higher - perhaps a mere four or five degrees higher than 99 F. Who wants to feel that sick?

If possible, students view *An Inconvenient Truth* and analyze Al Gore's presentation techniques. They examine his rhetorical appeals: ethos (character of speaker), pathos (quality that stimulates pity or sorrow in the reader), logos (the speaker's use of logic), and nomos (the identification with the audience). Students also read example speeches. *Speaking of Earth*, edited by Alon Tal, is an excellent collection of environmental speeches. In order to practice giving speeches, students choose one speech from the book, analyze the rhetorical appeals, and determine how the speech should be presented. They work with a partner and practice reading the speech effectively. The teacher may present a rubric in order to clarify an effective presentation.

Once the students have had practice reading a speech out loud, they prepare to write a speech of their own that touches on aspects of the controversy or suggestions for mitigation. As they prepare to write their original speech, they learn about mitigation through books (see bibliography) and online resources. Students make individual changes in their own lives to help mitigate global warming, whether it involves changing light bulbs, using green energy, driving less, or other suggestions they find in their research. They work in groups to report on various suggestions for mitigation, and, through analysis of the benefits and drawbacks, determine which form of mitigation is best for the country and for the specific state. This activity may lead to a classroom debate. Students will have to use evidence to support their opinions.

Although students write and deliver individual speeches, they work with a partner as they did for the earlier practice speech. They may use note cards and visuals. This speech prepares students for the final presentation.

Climate Change Competition

The final presentation allows students to synthesize new information and show what they know by educating others. They should be thinking about what they will do throughout the unit, and understand that assignments along the way may be applied to the final presentation. However, rather than an overview of global warming, students should focus on one research question in order to increase the depth of their knowledge. Suggested research questions are included in the appendices and divided by sections. It may be beneficial to present the questions throughout the unit (for instance, present suggested questions on climate at the end of the Climatic Poetry section) so students can begin to refine their ideas.

The presentation is a collaborative effort: students work in teams to compete against others. It is similar to a poetry slam, although this competition has only one round. A group of judges - perhaps members of the community - evaluate each team's accuracy, clarity, and creativity. Students must use scientific facts as a foundation for their presentation. They must be able to communicate their message in a way that is understood by their audience, and they must do so in a creative and engaging manner.

Students may choose to narrate a short video, give a slide-show presentation, create a presentation through computer graphics, give a dramatic reading of original poetry with visual displays or art, or use any medium that combines verbal and visual skills. They should be encouraged to be as creative and original as possible.

Each team should focus on a different research question. This way, there will be no duplicate presentations and the competition as a whole will show a broader range of global warming issues. The competitive aspect of the presentation will allow students to get involved in something that goes beyond the classroom. Awards contributed by local business would involve the community and increase the incentive for the students.

In the end, students will understand how their own lives are intricately connected to global warming. They will be able to use writing to communicate coherently and creatively, and they will be able to take these skills with them as they exit the doors of high school. Our students will know that the Earth is their planet, too, and they will show the rest of us how to live on it.

Sample Lessons

Human Needs Game

Essential Questions

What do I need in order to live?

Learning Targets

I can, reacting to selections and reflecting on personal experience, develop an argument to support a position; I can explain my ideas in a clear, logical and comprehensive manner; and I can analyze concepts and perspectives and relate these to my own life.

The Game

The following activity is based on a leadership game I played when I was a student. Of all the things I learned in high school, this is one of the activities that I remember most. The game was originally geared to promote international relations, but I am adapting it to help students understand what they need to live both a personal and universal level. The game is simply a first step that leads to more in depth discussion and exploration.

This exercise may do more than introduce students to the global warming curriculum, as it also promotes community-building in and out of the classroom. Students are asked to take care of their team mates while working together to achieve a common goal. If this activity is done at the beginning of the year, it may serve as an impetus for classroom bonding.

Goal: Everyone on the team must have enough food.

Obstacle: All teams are pre-equipped with food, utensils, plates, cups, etc., but the distribution is uneven. For instance, one team has all the cups but nothing to put in them. Another team has plenty of at least one kind of food, but no way to eat it. One team has very little of anything while another has more than they need.

Materials: Enough cups, beverages, plates, plastic-ware, napkins, and food for the class. It doesn't have to be anything fancy. It may be possible to arrange for a class potluck, where students can contribute. It is worth noting that symbolic items such as cards or chips do not elicit as much emotional attachment as food.

Rules:

1. The whole team must have enough food within 15 minutes.
2. Only one person from each team may negotiate for food. The negotiator is responsible for

communicating the needs of his or her team to the other negotiators.

Procedure:

1. The desks are arranged in clusters and allotted food is distributed prior to the arrival of students. (In the case of a potluck situation, arrange for "Distributors" to distribute specific items to each team.)
2. Students sit in teams.
3. The teacher explains the rules and objectives.
4. Students choose a negotiator and begin the game. The teacher helps students keep track of remaining time.

After the game, students discuss and assess what happened. Did everyone get enough food? In other words, were basic lunch (or snack) needs met? How do people feel after the experience? Did the negotiators have a hard time taking care of their team? If so, what were the difficulties? What changes could be made to make the experience better? The discussion will change based on the overall experience, as the results of the game will vary with different groups. Some participants will aggressively go after the food while others seem to easily give up their share. The class may want to observe how different teams, particularly the team that had more than they needed, responded to the experience. In some cases the team is generous. Usually, however, this team does not see a need to even negotiate with the others, as they already have what they want.

This game parallels different nations. The U.S. is typically represented by the team that has more than it needs. Later in the unit, during a lesson on the Kyoto Protocol, it would be wise to refer back to this activity. How does the U.S. handle international negotiations regarding global warming? Why might the U.S. respond as it does?

Journal

Ask students to describe what they need in order to live in a journal. We saw what teams needed in order to satisfy basic lunch needs. What do students need in their own lives? After they've written for a few minutes, ask students to pick one or two things and describe *why* they need them. What makes these things so important?

Discussion

Ask volunteers to discuss what they need in order to live. As a class, discuss basic human needs. Mention things such as food, air, water, crops, sun and rain.

Imagine

What if we knew that floods were going to wipe out certain cities while other places suffered droughts with no hope of rain, and even others froze in a sudden Ice Age? What if we knew that people were going to suffer from new diseases, that polar bears and other animals were going to become extinct, and that storms and hurricanes like Katrina were going to become more frequent? What if we knew all of this, and we knew that we could stop it, or at least slow it down? What would students do? What if they knew that they, like every other person in their city, were putting something in the air to make such a life a reality? What would they do then?

Explain that the world we just imagined illustrates the possible effects of global warming. Ask students what they know about global warming and examine any misconceptions they may already have. Let students know that global warming is caused by an increase of greenhouse gases, and that they will learn more about how to

keep some of the basic things that we need in order to survive on this planet.

Assessment

Assessment is based on discussion and journaling. The student shares what he or she already knows and perceives about essential elements of survival, community attitudes, and global warming.

"I Come From" Poem

Essential Question

How does my environment affect my identity?

Learning Targets

I can reflect and respond to texts for complexity, self-significance, and cultural perspectives; I can apply appropriate metaphorical, grammatical and rhetorical devices to my writing; and I can evaluate how well I use facts, ideas, tone, and voice.

Procedure

Students think of a weather condition (hurricane, snow, drought, hail, etc.) or a place with a specific climate that they are most like. They write, "I am like…." and finish the thought, creating a simile. Show how to change simile to metaphor by changing the line to "I am…" Students then use write five lines, one for each sense, to show how they are like the weather condition. In this way, they are using imagery. They should be encouraged to use their imagination.

The class reads example poems about identity. "Where I Come From" poems can be found through an internet search. Poems about identity (along with nature and place poems) are also included in *From Totems to Hip-Hop*, edited by Ishmael Reed. Note any reference to the influence of music, language, food, family members, environment, history, or expectations of society. Students make a list of things that exist in their own lives.

The use of anaphora by repeating "I come from" at the beginning of each line may help students write. They also use words and lines from both the metaphor exercise and their list to construct a longer poem. Once the poem is complete, students read them out loud while the teacher listens for specific literary elements such as alliteration, rhyme, or tone. The teacher may return to specific student poems to point out how various literary elements were used. Students take notes and begin to construct a glossary of terms.

Assessment

Students use specific techniques to write a poem. They also describe the purpose of literary elements in a glossary of terms.

Greenhouse Jar

Essential Question

How does a greenhouse work?

Learning Targets

I can identify and answer a research question; I can gather and analyze information and synthesize ideas; I can make a claim, list my reasons for supporting my claim, and support my claim with evidence.

Procedure

The necessary materials include three glass jars, three thermometers, one black cloth, and one white cloth. Students put thermometers in each jar and seal only the first and second jar, leaving the third open. They cover the bottom of first sealed jar with white cloth and the bottom of the second sealed jar with black cloth. Place all three jars under direct sunlight for ten minutes.

Students predict what will happen. Will the temperature of one jar be higher than another? Why? They write a lab report that includes a description of the exercise, the procedure they follow, and their observations. They also include an analysis of their results.

The sun's glass will be transparent to the sun's radiation, allowing visible light to pass through. Glass also traps infrared radiation, thus heating the inside of the jar, more so in the sealed jars than in the open jar, where the infrared radiation is able to escape.

The sealed jar with the black cloth on the bottom will trap more infrared radiation than the others, as dark colors absorb more infrared radiation. If the jar were a perfect black body with an albedo of 0, it would absorb everything and reflect nothing. In this case, the jar does reflect some radiation, but not as much as the jar with the white cloth. The white cloth at the bottom of the other jar represents an albedo. White or light colors reflect radiation, so less heat is absorbed.

The atmosphere of the Earth is very much like these jars. The greenhouse effect is like a sealed glass jar that is transparent to visible light while it traps infrared radiation. The Earth is warm due to the greenhouse effect. Oceans tend to function like the black cloth: they absorb more solar radiation and thus add to the heat. The ice, snow, and clouds are like the white cloth. They reflect the sun's radiation. The greenhouse effect increases as we emit more carbon dioxide, and as a result of this increase, the ice is melting. As the ice melts, the albedo decreases, and this contributes to global warming.

Assessment

Students write a lab report that records their observations and findings. Students describe how the glass jars represent the Earth's atmosphere.