



Promoting a Sense of Global Awareness using Air Pollution and Air Quality Index

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This curriculum unit is recommended for:
Science/Grade 7

Keywords: Air pollution, air quality, pollutants, fossil fuels, environment

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

Synopsis: Promoting a sense of global awareness is critical to help students become globally responsible young people. Identifying sources of air pollution and analyzing their effect on the air quality is critical to understanding the hazards to our environment. The background information discusses where this air pollution is coming from and explains how each of the most common pollutants is not only impacting the environment but also human health. Students will use a variety of strategies and activities to understand air pollution and the Air Quality Index. Students also will understand through this unit where the pollution is coming from by gaining knowledge of renewable and nonrenewable energy sources with a focus on the burning of fossil fuels and their environmental impact. Using what they know about air pollution and air quality, students will be able to analyze the air quality in a variety of places. This unit is particularly helpful for exposing students to a more global view, which will ultimately help engage students in learning about the environment if they feel a sense of ownership of the realities of air pollution in our world. To conclude, students will complete a culminating project giving them the opportunity to learn more about one alternative source of energy and how it can benefit their everyday lives.

I plan to teach this unit during the coming year in to 60 students in Science/Grade 7.

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Rebecca George

Introduction:

I teach 7th grade math and science at Randolph Middle School. Randolph Middle School is located in Charlotte, North Carolina, and is a part of the Charlotte-Mecklenburg School System. Randolph educates about 1100 students in grades 6-8. Randolph has been through various transitions in the last 10 years. Randolph was once a Title I school that provided services for students in the surrounding neighborhood. However, when Randolph became a full-magnet and full-IB (International Baccalaureate) program, it made the transition to a high-performing school. Students wishing to enroll in Randolph must apply and be accepted through a lottery. According to the Randolph website, the student population is one of the most diverse in the district, representing more than 32 nationalities. Based on our school's profile, 39% of our students are African-American, 33% are white, 8% are Asian, and 16% are Hispanic, culminating in a diverse population of students. According to the NC Report Cards website, we are recognized as an Honor School of Excellence based on our students' performances on previous End-of-Grade tests in Reading and Math. Based on this recognition, at least 90% of our students are performing on grade level and the school met its Annual Measurable Objectives.

I teach Math 7 for two blocks every day and Science 7 on an alternating A/B-day schedule for one block. I teach math to about 60 students in my two blocks, and science to about 60 students in my two blocks; however about 20 of the students in one of my math classes are also in one of my science classes. In my two science classes (3A and 3B), I teach a heterogonous mix of students. About half of the students in my science classes are placed in Honors Math 7 or Algebra 1 with the other half being placed in Math 7, creating a wide-range in levels and abilities in my science classes. Because of the various levels and backgrounds of my students, I must differentiate my teaching for all of my students' learning so that all my students can reach high-levels of learning. I also incorporate a wide-variety of strategies and activities in my classroom to engage all learners. My lessons are interactive and typically consist of the following components: introduction to content by teacher followed by an activity or inquiry lab for students to complete and create a concluding idea of the objectives.

Rationale:

This unit will focus on science content and objectives, as the application of science to the real world is my true passion. Based on the 7th grade Essential Standards for Science, an entire unit is dedicated to weather and the atmosphere. However, this unit will focus on

air quality to help students gain a greater global awareness of the impact of humans on the environment. Randolph Middle School is an International Baccalaureate middle school where I am highly encouraged to incorporate worldly views and find ways to develop my students to become compassionate and understanding lifelong learners who are determined to make a difference in their world. Therefore, as I have studied the standards in the unit on weather and the atmosphere, I have realized the incredible necessity to ensure that students understand how air quality and pollution affect our atmosphere and not only impact our health but also the environment in which we live. Students take far more ownership of their own learning and education when they can understand how what they are learning relates to them personally. If I can make this unit personally relate to them by applying air quality and air pollution and its effects on our school, our community, our city, and our state, then the students are more than likely to become engaged. When students are engaged, they are motivated to learn rigorous content that ultimately prepares them to become worldwide thinkers and life-long learners.

It is a well-known fact that humans are negatively impacting the environment around us, and students have some basic knowledge of this; however, they do not always know the whole story. Students also do not have the best awareness of the world around them. It is not surprising that young adolescents lack the knowledge and compassion to become passionate about the world around them. It is easy for anyone to become absorbed in just the tiny realm of their day-to-day lives. However, it is so critical that students are being exposed to the world around them and becoming more globally aware. Globalization is the reality of the world in which we live, and educators must be committed to guiding students to be prepared to contribute to this global society. Global education can be described as “learning that involves aspects of life that cross all boundaries” or the “study of how cultures interact, leading to the empowerment of students to act in matters of local, national, and international interest”.¹ Teachers must facilitate learning for students that prepares them “to collaborate with others, be open to differences, and think critically”, as is this the only way they will be successful in a world that is growing more interdependent and more interconnected. This goal can be achieved by incorporating a global perspective into the curriculum standards being taught. This unit particularly addresses increasing global awareness in the classroom by incorporating air quality studies of different countries, as well as focusing on what is going on in the city in which the students live.

Content Objectives:

With the shift to the Common Core Essential Standards in the state of North Carolina this past school year, there has fortunately already been a focus placed on a global view of academics.

Before I begin this unit, my students must have a basic understanding of the atmosphere and the weather that occurs in it. Therefore, before I begin this unit I will address the following standard:

7.E.1.5 Explain the influence of convection, global winds and the jet stream on weather and climatic conditions.

In order for students to understand the impact of humans on air quality and the atmosphere, they must first understand what is naturally occurring in our atmosphere and for what purpose. First off, students must be able to understand the difference between climate and weather so that they are able to understand how weather changes and climate change is affecting our world. The weather changing involves three main components to understand: air movement, formation of clouds, and precipitation. Without energy, none of these things would be possible; the energy that is causing these changes comes from the sun. Convection transfers heat from one place to another. Students must be able to understand that this change in heat ultimately results in a change in pressure. These changes in temperature and pressure lead to changes in the atmosphere resulting in winds, jet streams, the Coriolis Effect, and the Gulf Stream. Students must also be able to understand how these are impacted because they are occurring on a rotating planet.

In this unit plan, I will address the following Essential Standard for 7th grade Science:
7.E.1.6 Conclude that the good health of humans requires: monitoring the atmosphere, maintaining air quality and stewardship.

Once students have gained the background atmosphere and weather content from the previous essential standard, students are now able to study this standard to understand how air quality and the atmosphere influences our everyday lives. I will teach the students the Air Quality Index (AQI) so that they can understand the variants of air quality and how our advancements in technology have allowed us to study air quality. Air quality affects the quality of life for all living things on earth, which is why we, as scientists, must study the air quality and determine what needs to be done to protect our environment and climate. Our entire world and all the living things in it (not just humans) are being impacted by global ozone depletion, air pollution, increased particulate matter, acid rain, and global warming concerns. While students may have heard of some of these global concerns as they are major topics of conversation in our current media realm, they may have some misconceptions and may not fully understand how our air quality is being impacted. In order to understand the role that they play in our changing world of climate and air quality, they must understand stewardship and how our everyday actions impact the rest of the world.

Science Content Overview for Teachers:

Topic 1: What is air pollution?

Earth's atmosphere can be thought of as a layer or blanket of gases and tiny particles. Together, we call this air. The earth's atmosphere is composed of about 99% nitrogen and oxygen combined. More specifically, the atmosphere is composed of about 78 percent nitrogen and 21 percent oxygen, with the remaining one percent including all the other gases in the atmosphere like carbon monoxide, carbon dioxide, ozone, methane, and ammonia. Without the atmosphere, the earth would just be a lifeless rock, as all living things need the gases in the atmosphere to survive. Without air, we cannot breathe. However, many people in many cities suffer from the hazards of air pollution because the air is considered to be unhealthy to breathe. Breathing on average over 3,000 gallons of air each day, air can actually be harmful to humans and the environment in which we live if the air itself is polluted. In the simplest of terms, air pollution is harmful materials that are added to the air.

Topic 2: What causes air pollution?

Air pollution is contamination of the air both inside and outside by chemical, physical or biological sources that alters the natural atmosphere. Any substance that causes air pollution is called a pollutant. There are two main types of pollutants: primary pollutants and secondary pollutants. Primary pollutants are added directly to the atmosphere, while secondary pollutants do not directly cause pollution. Secondary pollutants become harmful when they interact with sunlight, air, or other primary pollutants. According to the Environmental Protection Agency, there are six common air pollutants: ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxides, and lead.

Ozone is a gas that exists in two parts of the atmosphere. This gas is produced naturally in the stratosphere of the atmosphere, which is known as the "good ozone". The "good ozone" is not considered to be a pollutant; however, it is being destroyed by man-made chemicals that were once found and sometimes still are found in coolants, foaming agents, fire extinguishers pesticides, and solvents. The ozone-depleting chemicals degrade slowly and thus have the chance to travel from the troposphere to the stratosphere. When these chemicals mix with the sun's UV rays, this is what ultimately destroys the "good ozone". While there is "good ozone" being destroyed by man-made, there is "bad ozone" that is a pollutant itself. In the troposphere of the atmosphere, or the layer of the atmosphere closest to the earth, this "bad ozone" is a pollutant damaging trees and other vegetation.²

Particulate matter is a "complex mixture of extremely small particles and liquid droplets".³ Particulate matter or PM can include several components, including acids, organic chemicals, metals, and soil or dust particles. Some of these particles in the air are

large enough to be seen, while others are microscopic. The size of this particle pollution is directly related to their health hazards, meaning the greater the size of the particle, the greater health problems they cause.³ Carbon monoxide is a colorless and odorless gas. Carbon monoxide is emitted during the combustion process. The majority of the emissions of carbon monoxide come from automobiles.⁴ Nitrogen oxides are “a group of highly reactive gases”. Nitrogen dioxide, specifically, forms from the emissions of mobile vehicles and off-road equipment.⁵ Sulfur dioxide is also in “a group of highly reactive gases”. The majority of sulfur dioxide emissions comes from the combustion of fossil fuels at power plants and other industrial facilities, and with a small part of emissions coming from extracting metal from ore and the burning of fuels containing sulfur by locomotives and ships.⁶ Lead is a natural-found metal that is an air pollutant. It can also be found in manufactured products, and most popularly known for being formally found in lead paints and fuels. Historically, lead emissions have come from the fuels in motor vehicles. Since the Environmental Protection Agency has regulated lead in vehicle gasoline, the majority of lead emissions come from ore and metals processing and aircraft with piston-engines that operate used leaded gasoline.⁷

Topic 3: How can you tell if air is clean or dirty?

The Environmental Protection Agency (EPA) is a federal government agency that operates to protect human health and the environment. They are responsible for setting and enforcing national pollution-control standards. One of these set of pollution standards and regulations that the EPA develops is the Air Quality Index or AQI. The AQI is an index used to report air quality by identifying how clean or polluted the air is and what health effects go along with particular quality of the air. The AQI is calculated using five major air pollutants: ground-level ozone, particulate matter, carbon monoxide, sulfur monoxide, and nitrogen dioxide. In order to calculate these levels on a daily basis monitors first record concentrations of each of these major pollutants at more than a thousand locations across the country. These measurements are then converted into separate AQI levels for each pollutant. The AQI is reported for a particular day based on the highest AQI level for any of the sources of pollution.

The AQI is divided into six categories using color coding as symbols to best understand how air quality affects health and can be organized as seen below.

AQI Values:	Levels of Health Concern:	Colors:
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for Sensitive Groups	Orange
151-200	Unhealthy	Red
201-300	Very Unhealthy	Purple
301-500	Hazardous	Maroon

As indicated in the chart above, the higher the AQI level, the greater the level of air pollution. The greater the level of air pollution, the greater the concern of hazard to humans' health. Typically, an AQI level below 100 is considered satisfactory, while AQI levels above 100 begin to cause concerns for sensitive individuals. As AQI levels increase, the hazards to health also increase. It is a requirement to report the AQI daily, and for AQI levels over 100, it is also reported who should be concerned about that day's AQI level.⁸

Topic 4: Where does this pollution come from?

Energy comes in many different forms and there are many different sources from which we get the energy that we use every day. There are two types of energy sources: renewable and nonrenewable. Renewable energy comes from sources that can be easily replenished or renewed. Examples of renewable energy sources include solar energy, wind, and hydropower. With nonrenewable energy sources, we are using up the resource faster than it can be replaced or recreated. Only about 9% of our energy consumption in the United States comes from renewable sources, while 36% of our energy comes from petroleum, 27% from natural gas, 18% from coal, and 8% from nuclear power.⁹

With about 81% of our energy consumption coming from coal, oil, natural gas, the United States is very dependent on fossil fuels for its energy. Fossil fuels were formed over millions and millions of years from the buried remains of plants and animals that lived millions of years ago. The remains of plants and animals that were alive millions of years ago decayed into organic material. The decayed or organic material was ultimately covered by sand and rock, trapping it underground. Because of pressure and heat, some of this organic material turned into coal, some into oil, and some into natural gas. Oil is the only nonrenewable energy source that is found naturally in liquid form. Oil is a smelly blackish yellowish liquid that is found in reservoirs underground; oil must be drilled for by first searching for the oil underground and then creating a well that will bring oil to the surface. While oil is found naturally as a liquid, natural gas is composed of mostly methane. In order to access natural gas, geologists must first study the rock formations to locate the types of rocks that contain gas and oil deposits. Along with methane, butane and propane are also brought to the surface from drilling underground as byproducts. Coal, composed of carbon and hydrocarbons, is sedimentary rock that can undergo combustion to produce heat. Coal specifically resulted from the decaying of plants during the time when earth was covered by swampy forests. After these decaying plants were covered by layers of water and dirt, the plant remains turned into coal due to heat and pressure.¹⁰

Topic 5: How are fossil fuels harming our environment?

Oil has become more and more popular as it has become more cost-effective to drill and produce. However, this also creates grave impacts on our environment during the

processes of finding, producing, moving, and actually using oil. When oil is burned as fuel, petroleum gives off a variety of emissions, including carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen oxides, volatile organic compounds, particulate matter, and lead. These emissions in return cause damage to the environment. Carbon dioxide is a greenhouse gas and affects climate change. Sulfur dioxide results in acid rain which harms plants and animals and can cause respiratory illnesses. Nitrogen oxides and volatile organic compounds add to the “bad ozone”, which results in irritation and damage to the lungs. Particulate matter, being the most visible, results in hazy conditions. Particulate matter also adds to the ozone and can contribute to cases of asthma and bronchitis and even lung cancer.¹¹

Coal can be mined from surface mines or underground mines. For surface mines, the miners disturb land at its surface in order to remove the soil and rock to reach the coal deposits. This not only changes the landscape in places like the Appalachian Mountains, but it also can pollute the water as water drains down the mountains and into the valleys. While not as common, underground mines do not have as great of an impact on the environment as surface mines. The major concern of underground mines is the release of methane, a strong greenhouse gas that must be vented out of the mine. Underground coal mining does result in some professional risks, as it can be an extremely dangerous job, and miners have the risk of getting black lung disease from exposure to the coal dust.¹²

Compared to the other fossil fuels of coal and oil, the burning of natural gas results in less emissions of all air pollutants and carbon dioxide. However, natural gas is made up of mostly methane, a very potent greenhouse gas. Natural gas leaks through gas wells, storage tanks, pipelines, and processing plants sometimes unintentionally release methane into the atmosphere. One of the most controversial aspects of natural gas, however, is the actual exploration and drilling of natural gas. When geologists explore and when natural gas is ultimately drilled for, this often disturbs vegetation and soils. The production of natural gas also results in contaminated water that needs to be handled, stored and treated so that it does not cause further pollution. With increases in technology, horizontal fracturing is limited the amount of ground on the surface being disturbed; however, fracking is a controversial process that raises many concerns. Fracking of shale rock formations opens up large areas of natural gas pockets. By pumping high-pressured liquids into the rock to fracture it and allow the gas to escape to areas of low pressure, this releases more reserves of natural gas underground. Some of the concerns of this process of fracking include the large amounts of water required to complete the process and in return the large amounts of wastewater resulting and the potential hazard of the chemicals in the fracturing fluid. Additionally, there is concern of the geologic impact on fracking on the ground below us.¹³

Topic 6: How is air pollution hurting humans?

As briefly mentioned above in the effects of air pollution on humans, air pollutants can greatly threaten humans and their health. Humans breathe over 3,000 gallons of air each day. If this air is polluted, this will greatly impact an individual's personal health. Polluted air can cause daily concerns to one's health, such as eye, nose, and throat irritation. Ground level ozone and particle pollution can trigger respiratory issues. People at grave danger of respiratory issues due to air pollution are those individuals who suffer from asthma. In addition to asthma patients, air pollutions can also trigger health concerns in the elderly and those with heart and respiratory diseases. Other toxic chemicals that are released into the air from the variety of air pollutants can even cause cancer, birth defects, and long term damage to the lungs, nerves, and brain. Other pollutants also seek out harm as they travel from earth's surface and into the upper atmosphere, causing a thinning of the "good ozone", impacting global warming and climate change.¹⁴

Topic 7: What can we do to help?

In 1970, the United States government developed the Environmental Protection Agency (EPA) and passed the Clean Air Act. This act gave the federal government the authority to clean up air pollution. Individual states and local governments have to put in a lot of work to meet the requirements of the Clean Air Act. In 1990, amendments were added that address other areas of focus, such as acid rain, ozone depletion, and toxic air pollution. While the development of the EPA and the Clean Air Act have resulted in progress, air pollution continues to be a threat to our environment and health.¹⁴

The ethical idea of stewardship can be applied to many aspects of life and citizenship; however, environmental stewardship is critical to the preservation of our environment and the world in which we live. Stewardship includes responsibly using resources so that future generations have protected resources, as well. It is our responsibility as humans on the earth to live in a way that does not destroy our planet by developing and using sustainable practices.

Teaching Strategies:

Jigsaw

Jigsaw learning is a great way for students to become experts on a topic and then share that topic with the rest of the class. Students are divided into small groups and they are given resources to become experts on a particular topic. Each group develops a way to present and teach their topic to the rest of the class. Students then rotate to the different expert groups to gain the new knowledge and material. Students are provided with a graphic organizer where they will record their notes so that they too can become experts

on the new material. Just like each piece is critical in a jigsaw puzzle, each expert group's part is critical for the understanding of the entire class, making each student's work essential and meaningful, as well as allowing students to take ownership and responsibility for their own learning. Rather than trying to learn the material on their own or learning it from a teacher-provided lecture, students are responsible for learning it themselves in a collaborative fashion and then teaching it to their fellow classmates.

Technology

Technology is constantly developing and advancing around us, faster than we can even keep up. The students that we teach in our classroom everyday were practically born with an iPhone in their hands and headphones in their ears. Therefore, in order to keep students engaged in learning and daily activity in the classroom, technology must be incorporated in meaningful and effective ways. While a LCD projector is handy to have in the classroom to show PowerPoint presentations, technology in the classroom needs to be more engaging and interactive than that. I use my LCD projector every day for presentations and digital videos; however, in this particular unit I would like to incorporate more interactive forms of technology. My school has been fortunate enough to have received one set of Chromebooks and two sets of iPads to be used in classrooms.

Think-Pair-Share

It is critical that students are given time to process before they are expected to provide a solution or idea. It also benefits students to talk through their ideas before they are expected to express them. Providing "think time" and providing students with the opportunity to discuss with another student will ultimately result in more thoughtful and effective responses from students. To implement this, I will provide students with an open-ended question to ponder. They will use the "think time" to individually think, and then they will use the "pair time" to talk to their partner or group members. After students have actively discussed with their partners, we will come back together as a class to participate in a discussion. This particularly useful strategy helps students that need more "think time" or struggle with validating their answers individually and need a "sounding board".

Literacy

Literacy, the ability to read and write, is the responsibility of all teachers, not just language arts teachers. With low literacy levels being a national crisis, it is critical that students are being given every opportunity to improve their reading and comprehension skills. While there are content standards that students are required to learn and I am required to teach, I can use literacy as a means for how I will teach these standards to incorporate more reading and writing in a science classroom. Often times in a science classroom, this looks like students reading an article about a science topic and answering

questions based on it. Sometimes it also includes reading resources to compile research for a presentation.

Checks for Understanding and Assessment

While formal assessments are sometimes necessary and are required by the district, informal or formative assessments can be just as important in order for a teacher to gauge the students' success with the content. Checking for understanding in a variety of ways is an effective way to guide instruction. This helps a teacher determine if a topic or area needs to be re-taught or if enrichment needs to happen. It also assists with differentiation in the fact that it shows a teacher who is exceling and who needs an additional push. In this particular unit, I will use two specific forms of assessment or checks for understanding throughout lessons: whiteboard review and exit tickets. Whiteboard review is a means to check in with students and make sure they have fully grasped the content of a particular lesson. In my classroom, each student receives their own whiteboard, marker, and eraser, and they must write the answer to a question or problem on their whiteboard. When I tell them, they show their whiteboards. This can also be done in a group or partner fashion, if students are required to work with other students to formulate a response. During several of the lessons in this unit, I will also use exit tickets. This can be thought of as a miniature quiz on the lesson for the day, as it is their ticket out the door for the day. It covers the big idea of the lesson for that day and is typically easy for me to determine whether or not students fully understand the topic or not.

Science Notebooks: Guided Notes and Graphic Organizers

Every student is required to have a science notebook. We update our science notebooks in class together every day, and their science notebooks should look exactly like my model science notebook. Within their notebooks, students put everything we have done in class. On a regular basis, students take guided notes and use graphic organizers to organize the content material. Guided notes and graphic organizers are critical for helping students classify ideas and organize the content more effectively. I am training students to become organized learners through the use of these tools.

Cooperative Learning

Teaching students with a wide-range of abilities and backgrounds is common, particularly in science classrooms, making cooperative learning a strategic approach to organize students into groups to complete tasks and activities. During cooperative learning, students must work together in heterogeneous groups to complete tasks collectively. They are working towards a common goal together. Cooperative learning is also a critical time as a teacher to shift roles to just become a facilitator of learning and let the students accomplish goals and perform tasks using the help of each other. It is so important that students are working with a variety of different students, and that groups

are not homogenous. This is not to say that higher-level students should always be helping lower-level students; however, it is critical for all types of students to be accustomed to working together. In my classroom, I use the data I collect on my students' academic progress to determine their cooperative learning groups. By using data, I am able to ensure that my students are collaborating in heterogeneous groups and not just completing "group work".

Classroom Activities:

Day 1: Introduction to Air Pollution

On the first day of this unit, students will begin with a warm up that reviews the composition of the atmosphere and heat transfer. They will be expected to answer the following questions in their science notebook:

- Planes fly in the upper troposphere. Should the pilot have on the heat or air condition? Why?
- The sun heating the track is an example of _____.
- Walking on the hot track barefoot will make your feet hot because of _____.
- _____ occurs when warm air rises, cools, and sinks.
- 1% of the atmosphere is made up of _____ and _____.

After completion of the warm up, students will take guided notes (Appendix 2) from a PowerPoint presentation on air pollution, types of air pollution, and sources of pollution. Before students are introduced to the idea of the greenhouse effect, they will complete a Think-Pair-Share to answer the question "How does it feel to get into a car that has been closed all day in hot weather?". After students are given adequate time to think and then discuss with a partner, they will then share as a whole-class discussion. I will then explain that this is how the greenhouse effect works, as gases in the atmosphere absorb heat and this keeps the Earth warm. Through human activity, greenhouse gases and pollutants from fossil fuels are released into the air that destroy the ozone. Students already have an understanding of the layers of the atmosphere (troposphere, stratosphere, mesosphere, thermosphere, and exosphere), but to better understand the difference between "good" and "bad" ozone, students will read an article entitled "Good Up High, Bad Nearby" (Appendix 3). As students read, they will be asked to think about the following questions:

- What are humans doing to harm our good ozone layer?
- What are humans doing to increase the bad ozone layer?
- What are some natural causes of pollution that harms our ozone layer?

Day 2: Pollutants Jigsaw and Wanted Poster

Now that students have some background knowledge on air pollution, students will be divided up into collaborative learning groups to complete the Jigsaw strategy. There will be 6 groups- one for each of the six common pollutants. These pollutant groups will be responsible for becoming experts on their pollutant and completing a poster that answers the following questions about their pollutant:

- What is it? (solid, liquid or gas)
- Where does it come from?
- How does it affect the environment? Can its effects on the environment be reversed?
- What are two unique qualities about it? What makes it different from other pollutants?

Students will be given the following websites as sources to becoming experts on their pollutant:

- <http://www.ck12.org/earth-science/Types-of-Air-Pollution/>
- <http://www.epa.gov/airquality/urbanair/>
- <http://environment.nationalgeographic.com/environment/global-warming/pollution-overview/>
- <http://www.nrdc.org/air/>
- http://www.who.int/topics/air_pollution/en/index.html

After students have each become experts on one pollutant, their fellow classmates will be responsible for teaching them about all of the pollutants. Students will rotate to each of the expert groups so that they too can become experts on all of the pollutants that cause air pollution. As students rotate to each expert group, they will take notes on a graphic organizer about each of the types of pollutants (Appendix 4). Once students are familiar with each of the pollutants and how they are affecting air pollution, students will choose one pollutant and create a “Wanted” poster for that pollutant. On their “Wanted” poster, they must include the following about their pollutant:

- Name of your pollutant
- Why, in general, your pollutant is “wanted”
- Drawing(s) depicting your pollutant (the chemical structure, sources, etc.)
- Where your pollutant could be found
- Time your pollutant might be more common (e.g., the time of day or year)
- What your pollutant looks like (e.g. invisible, hazy, a brown cloud, black smoke, etc.)
- Sources of your pollutant (cars, factories, etc.)
- Problems your pollutant causes to humans and the environment

- Is there a reward (other than money) for your pollutant?

Students will be assessed on their “Wanted” posters using a rubric (Appendix 5). This will not only count as a project grade, but this will also be used as a form of formative assessment to ensure that students are fully comprehending the idea of pollutants and their role in air pollution and the environment.

Day 3: Introduction to Air Quality Index

Once students have an understanding of air pollution and its components, they need to be able to explain how we know if our air is clean or dirty, as we cannot always identify air quality with our sight. Students will take guided notes (Appendix 6) from a PowerPoint presentation about the Environmental Protection Agency and the Air Quality Index or AQI. They will then use these notes to create a mnemonic device to help them remember the levels and colors of the AQI. After developing the mnemonic device, students will participate in a Whiteboard Review to help them apply their understanding of the different levels of the Air Quality Index. They will be required to use their knowledge of the different levels to read air quality graphs to describe the current air quality in a particular area of the country. At the end of the lesson, students will be assessed on their understanding and knowledge of air quality with an exit ticket (Appendix 7). Students will be required to look at a map with color-coding to match AQI and answer the questions based on what they know.

Day 4: Local AQI Forecast

As a review from the previous day’s lesson, students will begin class by answering a warm up in their science notebook with the following questions on air quality and pollutants:

- What causes the greenhouse effect?
- Where is the good ozone located and what purpose does it do?
- Where is the bad ozone located?
- What is causing the bad ozone layer?
- Are pollutants only man-made?
- What agency would monitor the quality of our air?
- What color indicates good air quality?
- What color indicates hazardous air quality?

Students will have the opportunity during this lesson to use technology to research the air quality in particular areas. They will have access to the internet through either Chromebooks or iPads that can be reserved from the school media center. Students will access <http://www.airnow.gov/> to research information about the air quality of three different locations in the United States. Before allowing students to begin to develop their

forecast and analysis, I will show students how to access the website and find locations using Charlotte, North Carolina, as an example. Students will be required to select three cities or town in the United States; at least one of the three cities should be in an urban area and at least one of the three cities should be in a rural area. Students will complete a Local AQI Forecast sheet (Appendix 7) that requires students to analyze the current conditions in three locations in the United States. This will give them the opportunity to determine factors that may influence air quality and how different locations have different concerns in terms of air pollution.

Day 5-7: International Case Studies

While air pollution is not always visible, it is important for students to be able to visualize what the reality of air pollution means for the environment in which humans live. As an introduction to the international case studies, students will watch a YouTube video (<http://www.youtube.com/watch?v=UcWpkWBX04E>) that is a series of photos of devastating air pollution across the world. Students will have the opportunity during this lesson to use technology to research international cities to develop a case study on particular city. They will have access to the internet through either Chromebooks or iPads that can be reserved from the school media center. Students will select an international city and develop a case study on the air pollution and air quality in this particular location. Before students are given the opportunity to research for their case study, I will need to ensure that students are trained in research and finding quality resources. After helping students use websites to complete research on air quality in their selected international city, students will answer the following questions to complete their case study:

- What is the current Air Quality Index? What does this number and color tell you about the air quality in this location?
- Is air pollution a serious concern in this location? If yes, why? If no, how can you tell?
- What particular pollutants are causing air pollution in this location?
- How is air pollution affecting the environment in this location?
- How is air pollution affecting the health of the citizens in this location?
- What is being done to reduce air pollution or what has already been done to reduce air pollution?
- How does the culture or political structure of this location impact its air quality?

Day 8-11: Culminating Project

Students will work in cooperative learning groups to complete a final culminating project that incorporates pollution, energy sources, and air quality. Student groups of four will select one alternative energy source. They will need to develop a use for this alternative

energy that helps improve their everyday lives while helping improve the air quality at the same time. For example, students could make an environmentally-friendly way to charge their cell phone or power their family car. Students will develop the design and complete the following requirements:

- Define and describe your alternate energy source.
- How does this energy source affect the environment?
- Describe your design, including a drawing or picture.
- How does this affect your everyday life? How does this reduce air pollution?
- How easy would this be to promote or sell to customers? Is it reasonable?

Once students have developed their designs, they will be required to present them to their classmates.

Appendix 1

With the shift to the Common Core Essential Standards in the state of North Carolina this past school year, there has fortunately already been a focus placed on a global view of academics.

Before I begin this unit, my students must have a basic understanding of the atmosphere and the weather that occurs in it. Therefore, before I begin this unit I will address the following standard:

7.E.1.5 Explain the influence of convection, global winds and the jet stream on weather and climatic conditions.

In order for students to understand the impact of humans on air quality and the atmosphere, they must first understand what is naturally occurring in our atmosphere and for what purpose. First off, students must be able to understand the difference between climate and weather so that they are able to understand how weather changes and climate change is affecting our world. The weather changing involves three main components to understand: air movement, formation of clouds, and precipitation. Without energy, none of these things would be possible; the energy that is causing these changes comes from the sun. Convection transfers heat from one place to another. Students must be able to understand that this change in heat ultimately results in a change in pressure. These changes in temperature and pressure lead to changes in the atmosphere resulting in winds, jet streams, the Coriolis Effect, and the Gulf Stream. Students must also be able to understand how these are impacted because they are occurring on a rotating planet.

In this unit plan, I will address the following Essential Standard for 7th grade Science:
7.E.1.6 Conclude that the good health of humans requires: monitoring the atmosphere, maintaining air quality and stewardship.

Once students have gained the background atmosphere and weather content from the previous essential standard, students are now able to study this standard to understand how air quality and the atmosphere influences our everyday lives. I will teach the students the Air Quality Index (AQI) so that they can understand the variants of air quality and how our advancements in technology have allowed us to study air quality. Air quality affects the quality of life for all living things on earth, which is why we, as scientists, must study the air quality and determine what needs to be done to protect our environment and climate. Our entire world and all the living things in it (not just humans) are being impacted by global ozone depletion, air pollution, increased particulate matter, acid rain, and global warming concerns. While students may have heard of some of these global concerns as they are major topics of conversation in our current media realm, they may have some misconceptions and may not fully understand how our air quality is being impacted. In order to understand the role that they play in our changing world of climate and air quality, they must understand stewardship and how our everyday actions impact the rest of the world.

Appendix 2

AIR POLLUTION NOTES:

Air Pollution: _____ materials are added to the air.

EFFECTS of AIR POLLUTION:

- _____ of the eyes, lungs, nose and throat
- Can cause _____
- Building damage
- Destroys plants
- Creates _____

SOURCES of AIR POLLUTION:

- Burning _____ - oil, gas, coal
- Power plants
- _____ from cars
- Forest fires
- _____

TYPES of AIR POLLUTION:

-
-
-
-
-

Particulate Matter:

- _____ particles or droplets that are mixed into the air, such as _____, _____ or _____.

What is OZONE?

- O₃
- A _____ molecule found in the _____
- Ozone absorbs _____ of UV rays from the sun

TWO TYPES of OZONE:

GOOD OZONE:

- In the _____

- _____ us from the sun's harmful rays

BAD OZONE:

- In the _____
- _____ the air and makes smog

GREENHOUSE EFFECT:

- The _____ that does _____ allow _____ from the _____ to escape _____.
- Gases in the atmosphere absorb and give off _____ that keep the Earth warm. This is called the _____.
- Humans release _____ and _____ into the air that destroy the _____.

Appendix 3

"Good Up High Bad Nearby - What is ozone?." AIRNow. N.p., n.d. Web. 6 Nov. 2013. <<http://www.airnow.gov/index.cfm?action=goodup.page1>>.

Appendix 4

The 6 Common Pollutants

Pollutant:	Source:	Effects on Environment:	Effects on Humans:	Additional Notes/Comments:
Ozone				
Particulate Matter				
Carbon Monoxide				
Nitrogen Oxides				
Sulfur Dioxide				
Lead				

Appendix 5



Wanted for Polluting Our Air Poster

A wanted poster is a public notice typically used to educate people about criminals that are wanted by the authorities. A wanted poster usually describes the person (or thing) that is wanted, why it is wanted, and what to look for when searching for the wanted person or thing.

On your *Wanted for Polluting Our Air* poster, you should include the following:

- ☛ Name of your pollutant
- ☛ Why, in general, your pollutant is "wanted"
- ☛ Drawing(s) depicting your pollutant (the chemical structure, sources, etc.)
- ☛ Where your pollutant could be found
- ☛ Time your pollutant might be more common (e.g., the time of day or year)
- ☛ What your pollutant looks like (e.g. invisible, hazy, a brown cloud, black smoke, etc.)
- ☛ Sources of your pollutant (cars, factories, etc.)
- ☛ Problems your pollutant causes to humans and the environment
- ☛ Is there a reward (other than money) for your pollutant?

How will I be graded?

Category	Exceeds Expectations	Meets Expectations	Needs Work	Area of Concern
Student Study Guide	All 6 questions answered. Information is accurate, written using complete sentences, and provides great detail.	All 6 questions answered. Information is accurate, but lacks detail and/or is not written using complete sentences.	4 or more of the questions are answered. The information is not accurate. There is very little detail and lack of complete sentences.	Fewer than 4 questions are answered. The information is not accurate. There is very little detail and lack of complete sentences.
Poster Information	All 8 criteria have been displayed on the poster. The information is accurate, provides great detail, and is written in your own words.	All 8 criteria have been displayed on the poster. The information is accurate and written in your own words, but it lacks detail.	5 or more of the criteria have been displayed on the poster. The information is not accurate and has little detail. Some of the information is written in your own words.	Fewer than 5 of the criteria have been displayed on your poster. The information is not accurate, lacks detail, and may not be written in your own words.
Appearance	Information is displayed neatly using the entire area provided. Color has been added and there are no visible mistakes.	Information is displayed neatly using most of the space provided. Color has been added but there may be some visible mistakes.	Information is displayed using some of the area provided. There are signs of several mistakes and color is limited.	Information is displayed poorly. There are signs of many mistakes and color is lacking.
Presentation	All information was presented in a loud, clear voice. Presenter knew the information and did not look at the poster. Presentation was less than 3 minutes.	All information was presented in a loud, clear voice. The presenter knew the information but had to look at the poster. Presentation was more than 3 minutes.	Most information was presented. The presenter knew some of the information, but relied on reading from the poster. Presentation was more than 3 minutes.	Some information was presented. The presenter read most of the information from the poster. The presentation was more than 3 minutes.

Appendix 6

Air Quality Notes

DO NOW: Compare and contrast the two images on the board

What gases are in our air? _____, _____, _____, _____.

- _____ are added to the air from either man-made or natural activities _____ types of gases can be added
- With increased pollutants, our air quality _____
- BUT: Air quality _____ the quality of life for all organisms on earth

How do we know our air quality is decreasing?!

- The _____ (EPA) monitors this through an _____ (AQI)

- The air quality index _____ the amount of _____ that are present in the air.

The two main ones are:

- o _____ matter _____ smog
- o _____ matter

AQI:

1. What is the color showing good air quality?
2. How do levels below good air quality affect human health?

Moto for the AQI levels (Green. Yellow. Orange. Red. Purple. Maroon)

Appendix 7

Air Quality Exit Ticket:

1. What do you notice about the map above?
2. What do red shaded regions mean about the air quality in those areas?
3. The Northeast region of the U.S. has many big cities, such as New York, Philadelphia and Boston. Why do you think the Northeast region of the US has the least healthy air?
4. If my little brother has asthma, name one state you would recommend we live and explain why you chose that state:
5. Knowing about the different levels of air quality, what effects on the human population do you think poor air quality has?
6. What activities do humans do to contribute to bad air quality?

Appendix 8

Local AQI Forecast

Location #1: _____

- ❖ Date: _____
- ❖ Time: _____
- ❖ Color: _____
- ❖ Health Message:
- ❖ Analysis Questions:
 1. What do you think might be causing this location to have this AQI reading?
 2. Should the citizens of this location be concerned about air pollution?

Location #2: _____

- ❖ Date: _____
- ❖ Time: _____
- ❖ Color: _____
- ❖ Health Message:
- ❖ Analysis Questions:
 1. What do you think might be causing this location to have this AQI reading?
 2. Should the citizens of this location be concerned about air pollution?

Location #3: _____

- ❖ Date: _____
- ❖ Time: _____
- ❖ Color: _____
- ❖ Health Message:
- ❖ Analysis Questions:
 1. What do you think might be causing this location to have this AQI reading?
 2. Should the citizens of this location be concerned about air pollution?

Conclusion Questions:

1. Compare and contrast the air quality indexes of the three locations that you selected. What do they locations have in common? What sets these locations apart from each other?
2. If the air quality of a location is good today, does that mean it will be good tomorrow? Explain.
3. How does location affect air quality? In other words, does the air quality depend on the type of environment (example: rural vs. urban)?

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