

# **Global Warming in the City Unit for the Greenhouse Effect**

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## **Overview:**

The population in the city of Philadelphia is increasing. A considerable amount of people living in the inner city live in subsidized housing. Many students attending public school live in subsidized housing. Public housing consumes a large amount of energy. The energy costs are at a reduced rate for people living in this environment. It is important that they realize that global warming is a large problem facing our planet. The children attending school will be the recipients of the damage caused by the present day adults. We have to address the problem of global warming collectively as a society. Education is the most effective way of bringing the problem to the forefront. Students need to be aware of the carbon footprint made by them and their families. This unit will have students examining how they can make a difference and help prevent global warming.

## **Rationale:**

The population in the city increased causing an increase in energy consumption. Global warming is a serious problem and if left unchecked will cause serious destruction to our planet. The cities are running out of places to dispose of our trash. The air is getting so polluted as a result of the increase in the vehicles using fossil fuels. The number of students having respiratory ailments has increased over the years for inner city school children. I believe that a student can cause his/her parents to change their attitude about how energy is consumed. It would make a big dent in the carbon footprint of a family if they would begin to recycle and conserve energy in their household.

## Humans and the Environment

Approximately 10,000 years ago five million people lived on the planet. The population exploded to six billion once dependable food supplies were developed, sanitation increased and individuals were able to get quality medical care. (Holt, Rinehart & Winston, 126). The Earth is one planet consisting of many different populations of organisms. We are interconnected to each other. A relationship exists between the organisms that inhabit the environment. Our environment is also affected by the actions of the organisms that depend on it. Learning about how we are interconnected will help us develop an appreciation for the environment and help ensure the survival of all organisms on this planet. (Holt, Rinehart & Winston, 125)

## How Humans Have Changed the Environment

Man has made a significant change in the environment. The population explosion is a direct result of an increase in agriculture. (Turk & Turk, 142) Early man lived in hunter-gatherer societies. Hunter-gatherer societies were nomads and they had small families. The biological carrying capacity for this type of society was relatively small for the area they occupied. (Turk & Turk, 139)

Permanent settlements first appeared in Europe and Asia. People began to use the land to grow food. The size of the family began to increase because children were valuable on the farm. Man began to adopt the agricultural way of life giving rise to the "Agricultural Revolution". (Turk & Turk, 141)

Societies began to become more diverse as the population began to increase. People had various types of jobs such as farmers, builders, bakers and merchants. The population explosion was a direct result of the Agricultural Revolution. (Turk & Turk, 142) The Roman Empire had several environmental problems. They suffered from air pollution because cooking and heating was done over uncontrolled fires and the lighting in the homes used smoky oil-burning lamps. Deforestation and a reduction in the available groundwater was due to the over farming of the land. (Turk & Turk, 145)

The impact of a population on the environment was illustrated in 1889 when the Oklahoma territory became open for the homesteaders. The non-Indian population grew from zero to 60,000 within a few weeks and by 1900 the population was approximately 390,000. During the year of 1924 a large cloud of dust blew over the East Coast emptying into the Atlantic Ocean. The cloud consisted of the topsoil that came from Oklahoma. (Turk & Turk, 146)

Man has continued to cut down trees to make room for agriculture. A large amount of greenhouse gas emissions come from deforestation and forest degradation in tropical countries. The world has lost about 13 million hectares of forest between the years of 1900 and 2005. The highest emission rates are directly associated with industrial agriculture. Industrial farming of soybean and cotton, cattle ranching in the Amazon River Basin, palm oil plantations in Southeast Asia, slash and burn agriculture in Africa

are the major contributors to an increase in the greenhouse gas emissions. (Brainard, Jones, Purvis, 87)

Everyone is aware how the climate change can affect the things that are grown in an environment. Climate is also affected by agriculture because it contributes 13.5 percent of all human-induced greenhouse gas emissions globally. In the United States agriculture represents 8.6 % of the nation's total greenhouse gas emissions, 80 percent of the nitrous oxide emissions and 31 percent of the methane emissions.

(<http://www.epa.gov/climatechange/emissions/usinventoryreport.html>, 473)

When the population increases the amount of food required to sustain the population increases. Agricultural productivity is dependent upon the climate and the land resources that are available. The greenhouse gas emission rate will threaten the efficiency of how the United States will be able to produce food, feed, fuel, and livestock products. (Karl, Melillo, Peterson, 7)

### Forests and Carbon

Deforestation accounts for 17 to 25 percent of global greenhouse gas emissions. It is the second largest cause of emissions. It is larger than the amount given off by transportation and rank second behind energy use. (Brainard, Jones, Purvis, 87)

Since the Rio de Janeiro Earth Summit in 1992 1.5 million square kilometers of forest have been destroyed. The costs of the devastation had a large impact on the environment and the one billion people who depend on the forest for fuel, food and medicine. (Brainard, Jones, Purvis, 88)

In 2005 the global forest covered 3,952 million hectares of land this accounted for 30 percent of the total land area worldwide. Global forest store approximately 638 gigatons of carbon (GtC) in their ecosystem. Forty four percent (283 Gt) is stored in the forest biomass and forty six percent (355 Gt) is stored in the soil, 750 gigatons of carbon is stored in the atmosphere. (Brainard, Jones, Purvis, 90)

### Pollution

People can change and environment in many ways, many of the changes are harmful. Pollutants were entering the air from the smokestacks of many factories. Many of these pollutants entering the air caused problems to organisms living in these environments. The pollutants caused many health problems. They affected our quality of air, the food we ate and the water we drink. The pollutants were also causing property damage since many of them were corrosive. The federal government passed several legislative laws in effort to try and stop the affect of the pollutants. The Water Pollution Control Act of 1972 also known as The Clean Water Act and The Clean Air Act of 1977. (Turk & Turk, 15, 447).

The passing of these two forms of legislation only had a local affect. Some pollution problems can affect the entire planet. One example of this type of pollutant is carbon dioxide. Carbon dioxide is a trace gas that is almost transparent to sunlight. Carbon

dioxide absorbs the infrared radiation that is given off by the Earth's surface. When the lower atmosphere and the Earth's surface are warmer, we have a "greenhouse effect". (Kellogg, Schware, 2,3)

### Greenhouse Effect

The greenhouse effect occurs when the short wave solar radiation heats the surface and radiates back through the atmosphere as heat with a longer wavelength. In the wavelengths 5-30 micrometers (um) a significant amount of heat is absorbed by water vapor and carbon dioxide and the heat is radiated causing air to warm up. We need this because without it the surface temperature of the earth would be too cold for us to live on the planet. (<http://www.world-nuclear.org/info/inf59.html>, 1) The largest thermal radiation occurs within the 8-18 micrometers (um) band and this is where the water vapor is a weak absorber of radiation. An increase in the amount of carbon dioxide in this area allows a smaller amount of heat lost to space. The smaller amount of heat lost the higher the temperature at the surface level. (<http://www.world-nuclear.org/info/inf59.html>, 1)

Scientists have tried for years to try to figure out the causes of global warming. Natural cycles that have been known to influence the climate could not explain the reason for the climate change. Several organizations began to form in effort to address the problem. Several scientists under the direction of the United Nations formed a group called the International Panel on Climate Change (IPCC) attempted to address the problem and come up with a reasonable rationale for the usual change of events in the climate on our planet. (<http://environment.nationalgeographic.com/environment/global-warming/gw-causes>, 1) These prominent scientists in a report reached a consensus. The scientific findings led scientists to the conclusion that several gases were responsible for the change. The key factor in all of the cases was that humans were responsible for the emission of these gases into our environment. The one gas responsible for the largest change was carbon dioxide (CO<sub>2</sub>). Our oceans were looked upon as carbon sinks because it would hold more CO<sub>2</sub> than the atmosphere. Geothermal stratification of the oceans has caused a reduction in the number of phytoplankton. Phytoplankton store CO<sub>2</sub>. Tiny plants that make up the food chain are disappearing because the acid levels in the oceans are increasing. The cause for the increase in acidification is a direct result of an increase in atmospheric carbon. Carbon dioxide forms carbonic acid when it reacts with water. (<http://www.acoolerclimate.com/causes-of-global-warming.html>, 2)

Other gases contribute to the greenhouse effect these gases include methane. Methane is released from landfills and agriculture and grazing animals. Fertilizers and refrigerants are the major contributors of nitrous oxide. (<http://environment.nationalgeographic.com/environment/global-warming/gw-causes>, 2) Methane is 100 times more powerful than CO<sub>2</sub> and it has the potential of having a greater impact on our climate in the future. (<http://www.acoolerclimate.com/causes-of-global-warming.html>, 2) Methane is a natural gas that occurs in the gut of most animals raised by farmers (cows, goats and sheep). Methane is also given off from landfills. It is a by-product when trash begins to decompose. Methane is also found in large chunks of ice

found in our oceans called clathrates. When the ice melts the methane is released. We are known as the blue planet. A large part of our planet is ocean. Ice core samples have been taken and the results have been shocking. Carbon dioxide has increased to the present day level of 380 parts per million (ppm). Ice core samples have revealed that carbon dioxide and methane are at their highest levels since 650,000 years ago. Carbon dioxide is at a level of 180-300 parts per million (ppm). (<http://www.world-nuclear.org/info/inf59.html>, 2)

The Green Revolution of the twentieth century caused an increase in the amount of nitrogen oxides entering into our environment. Farmers used various types of nitrogen fertilizers to produce a greater yield for the crops that they were growing. Nitrogen oxides have 300 times more heat trapping capacity per unit volume than carbon dioxide. According to findings from the United Nations Food and Agriculture Organization modern farming is contributing more to global warming than all of the transportation because methane and nitrogen oxide is released into the air. (<http://www.acoolerclimate.com/causes-of-global-warming.html>, 3)

### Energy consumption

The United States is the largest consumer of energy in the world, and we only make up five percent of the world's population. The energy that we use is used for providing heat and light in our homes. The majority of the energy comes from the burning of fossil fuels when we use our cars and run the factories. The burning of the fossil fuels is a significant factor in greenhouse gases. (<http://www.greenstudent.com/encyclopedia/energy>

### Carbon Footprint

Humans will consume large amounts of energy every day. A carbon footprint will measure the amount of carbon dioxide (CO<sub>2</sub>) we produce as we go about our daily lives. (<http://science.howstuffworks.com/carbon-footprint.htm>, 1) One way to reduce the greenhouse effect is to reduce your carbon footprint. We can accomplish this in many ways. We can buy hybrid cars and limit the amount of driving we do on the roads. We can use devices such as a bike or simply walk. Transportation accounts for approximately 33% of CO<sub>2</sub> emissions. We can also purchase energy efficient appliances for our homes. Home energy consumption accounts for approximately 21% of CO<sub>2</sub> emissions. (<http://science.howstuffworks.com/carbon-footprint.htm>, 2) Some things that we can do in the home include limit the amount of H<sub>2</sub>O you use when you take a shower, and purchase a toilet that uses a smaller amount of water when you flush it. Replacing the light bulbs with a new energy efficient bulb and lowering the thermostat will help lower your carbon footprint. If everyone began to conserve and take the advice given above along with increased government regulation CO<sub>2</sub> emissions would drastically decrease.

Big cities contribute a large amount of carbon dioxide emissions. Large populations produce large amounts of carbon dioxide emissions into the air. Federal government regulation is required in order to bring down the CO<sub>2</sub>

(<http://science.howstuffworks.com/carbon-footprint2htm>, 1) A carbon footprint is one component of an ecological footprint. The ecological footprint is used to make a comparison between the consumption of the population and land to the planet's ability to regenerate. We are over the Earth capacity of about 23 percent. We are consuming more than the Earth can regenerate. It would take about one year and two months to regenerate what we consume. (<http://science.howstuffworks.com/carbon-footprint1.htm>, 2)

### Reduce, Re-Use, Repair and Recycle

When you reduce the amount of packaging for a product you are saving energy and resources. When a product has a large amount of packaging materials it has a larger weight. The amount of gas required to deliver these items is increased. It is beneficial to buy products locally because it does not require a large amount of energy to transport these items from one destination to another. Excessive packaging materials end up in landfills. (<http://www.carbonfootprint.com/recycling.html>, 1) Landfills are filling up with these materials and several large cities have to ship their trash to other locations. The process of shipping trash to other locations is rather expensive and the citizens have to bear the cost.

Re-use an item whenever possible. The cost will go down and you will have more money in your pocket. Individuals are re-using things out of sheer necessity because of the economy.

Recycling uses less energy and reduces the amount of pollution. More energy is involved when you make something from scratch. Recycling garbage and making compost has an added effect for the environment. Compost is good for the environment because it will act as a fertilizer and lower the cost of trash collection. (<http://www.carbonfootprint.com/recycling.html>, 2) Giving unwanted items to a charity is another way to recycle and it can serve as a tax write off.

### Oil Refinery

A large amount of energy is required to make gasoline. Gasoline is the major cause of greenhouse gases. Crude oil consists of several components. The components have different boiling points, weights, and sizes. Fractional distillation is required for these components to be broken down. (<http://science.howstuffworks.com/oil-refining4.htm>, 1) Crude oil is heated at very high temperatures (1112 degrees Fahrenheit. Some of the oil is turned into a vapor and collected. The vapor condenses and several by-products are collected. (<http://science.howstuffworks.com/oil-refining4.htm>, 1) Fractional Distillation is the process of separating crude oil into the many by products. In the fractional distillation column the gases separate according to their weight and boiling point.

The lightest fractions are located at the top of the column they have a lower boiling point. Examples of the substances found at the top of the column are liquid petroleum gas and petrol. Kerosene is found in the middle of the column and the very heavy fractions are found at the bottom of the column.

(<http://www.moorlandschool.co.uk/earth/oirefinery.htm>, 1) Many additives have been blended into the petrol in order to meet certain performance requirements. More than 200 hydrocarbon additives have been placed into our gasoline before it even reaches the consumer. The petroleum industry places a grade on the fuel it sells to the consumer. The gasoline sold in places such as Alaska is not going to be the same as the gasoline sold in Florida. The climate for these two locations will determine the grade of fuel used in the area. (<http://www.moorlandschool.co.uk/earth/oilrefinery.htm>, 2)

### Wind Power

Wind Power is a renewable form of energy. The wind is constantly blowing and you do not have to be in a specific location in order to feel the wind. It has no boundaries and it is available on the land or out in sea. Wind power has been used for centuries to propel ships across the oceans and to pump water and grind grain. (Turk & Turk, 230) Wind is a resource that can supply all of the world's energy needs. Prior to 1980 fossil fuels were cheaper. The costs of fossil fuels have drastically risen over time and the world is looking for other alternative forms of producing energy.

Windmills were not as attractive as they are today. They have a better architectural style today when we compare them to the previous years. If wind turbines were mass-produced the cost would go down significantly. In 1974 windmill electricity was 20 cents per kWh, in 1982 the cost dropped to 7.5 cents per kWh. (Turk & Turk, 232) Turbines that have longer blades produce large amounts of power. If you take a trip to the Jersey Shore you can observe a wind farm. The wind farm is rather modernistic and resembles a form of art.

### Biodiesel Fuels in the City

Biodiesel fuels would appear to be an alternative source in an urban environment. Biodiesel fuels are friendly to an urban environment. Biodiesel fuels are biodegradable and they are non-toxic. These fuels are easy to store and they burn clean. The pollution levels would drop significantly if this type of fuel was used. It would take the intervention of the federal government in order for biodiesel to become a major player in the energy production arena.

### Power and Energy

Biodiesel fuels, fossil fuels and the wind are some of the many sources used to generate energy. The sun and the wind are renewable sources of energy. They are very clean, however fossil fuels are non-renewable forms of energy. The energy produced by all of these forms of energy is used to perform some type of work over a given period of time. The rate at which the work is done is called power. The unit for power is watt, it is important that you pay close attention to the amount of wattage an appliance will consume. Horsepower is another unit of power and it is equal to approximately 746 watts.

(Serway, Faughn 179,180) It requires the burning of fossil fuels to operate your car. Cars engines are measured according to the amount of horsepower they will generate.

### **Objectives:**

The students will learn the following:

- How to compare and contrast the human activities that alter and environment using case studies
- How to identify renewable and nonrenewable resources from one another using a field trip to an oil refinery and a wind power plant
- How to increase awareness about global warming by plotting data from an Almanac and observing satellite photos
- How to identify the role we play in global warming by starting a recycling program in school

### **Strategies:**

Field trips to and oil refinery and a wind power plant are incorporated in this unit. Students will use their laptop computer to observe videos of foreign oil sources from various websites (<http://www.howstuffworks.com/oil-refining.htm/printable>, 5) They will also observe the refining process on the laptop computer and test their knowledge of oil and oil production prior to the trip by taking the “Oil Shale Quiz Link” given on the website (<http://www.howstuffworks.com/oil-refining.htm/printable>, 3) Students will also look at several wind power videos using their laptop computers. The students have 11 wind power videos to observe on the website

<http://videos.howstuffworks.com/science/wind-power-videos-playlist.htm>

Upon returning from the field trips and observing the videos students will complete a Frayer Model graphic organizer to check for understanding. Class discussions will follow and the students are required to keep a journal. Students will also collect pictures showing examples of renewable resources being used in our city and other cities. They will write an essay explaining how their pictures illustrate a renewable resource. Students will take a trip to a local recycling plant. A contest will be held for the best commercial stressing the importance of recycling. The winner will receive a monetary reward and a certificate. The name of the winner will appear in the local newspaper. Teachers in the school along with someone from the administrative staff will serve as the judges for the contest.

### **Classroom Activities:**

Lesson one



Objective: To identify ways in which humans can alter an environment using actual case studies.

Activity:

Pictures showing deforestation in South America, Fish Kills, and landfills will be given to the students. Students will work in pairs. They will analyze the picture and complete a graphic organizer. Each group will present his picture to the class. They will explain how man has altered the environment. Each group will be given five minutes to present their picture to the class. They will explain how man has altered the environment by listing three environmental issues. Students will present their picture to the entire class and then they will mount it on a posterboard. Each group will write and essaying explaining what they observed.

Lesson two

Objective: Students will compare conservation to restoration using an actual case study.

Activity:

Students will be given an article discussing the case of sewage in Boston's harbor. Students will engage in a debate about causes of sewage in the Boston Harbor. They will use the Internet to look at videos about the sewage problem in Boston. Students will examine the problem in our city and compare it to the situation in Boston harbor. They will write an essay explaining how conservation and restoration solve environmental issues. They will also address the question why it is important for societies to consider environmental impact when planning for the future?

Lesson three

Objective: To identify the role of recycling in our environment

Activity:

Students will take a field trip to a local recycling plant. They will identify the role the recycling plant on the community it serves. Students will keep a journal highlighting the various things that they observed at the facility. Students will develop a commercial that will stress the importance of recycling. The group of teachers and one administrator will judge the contest. The winner of this event will receive a monetary reward and a certificate. The student will appear in the local newspaper. The commercial will be aired in the school on the PA system.

Lesson four

Objective: Students will learn the characteristics of a now renewable resource

Activity:

Students will take a trip to an oil refinery. They will keep a journal highlighting their experience. A discussion will occur upon returning to the school. Students will be given

the Frayer Model graphic organizer. They will complete the graphic organizer and they will compare their model another student in the classroom. Students will then write and essay explaining why oil is a not considered a non-renewable resource. If you are unable to visit an oil refinery a virtual tour of an oil refinery is available on the following website, <http://science.howstuffworks.com/oil-refining4.htm>.

#### Lesson five

Objective: Students will learn the characteristics of a renewable resource

#### Activity:

Students will take a field trip to a wind farm. They will keep a journal highlighting their experience. A discussion will occur upon returning to the school. Students will know be able to make an accurate comparison about renewable energy sources and non-renewable energy sources. Students will be given a Frayer Model graphic organizer upon returning to the building. They will complete the graphic organizer. The students will compare their graphic organizer with another student in the class. Students will write and essay explaining why wind is a renewable resource. If you are not able to take your class to a wind farm you can take a virtual tour of several wind farms on the following website, <http://videos.howstuffworks.com/science/wind-power-videos-playlist.htm>

#### Lesson six

Objective: The students will learn about global warming and the importance of recycling. Deforestation is a major contributor to global greenhouse emission gases. In this activity students will learn how to recycle paper.

#### Activity:

Tear two sheets of used paper into small pieces. Place them into a blender along with one liter of water. Allow the blender to pulse until the mixture appears soupy. Cover a pan with wire mesh and pour the mixture over the screen until it is evenly spread. Lift the screen. Lift the screen out of the water and place it inside of a section of newspaper. Turn it over so that the screen is on top of the mixture. Cover the newspaper with a flat board and press the board to squeeze out the water. Open the newspaper and let your paper dry overnight. Students can come up with alternative ways they can make their paper stronger.

#### Lesson seven

Objective: To calculate the amount of power and acceleration of a toy car. The activity will give students the opportunity to relate the concepts of energy, time and power.

#### Activity:

Students will have a race car derby. They will compete with one another and make it like a championship event. Students will enjoy the activity more if they have the opportunity to personalize their cars. The course will measure a distance of about 10 meters. Each student will calculate the mass of their car using the scales provided in the classroom and record it. Identify the start line and the finish line for the course. Students will work in groups of three. One student will act as a time keeper, another student will be at the finish line and the other student will be at the beginning pushing the car down the track. Students will make trial runs using the energy generated by pushing the toy car down the track. Students will collect data and place it on a data sheet. The following information should appear: mass of the car, acceleration, force. Using the data collected the students can determine the amount of power required for the car to travel down the course.

### **Bibliography**

Brainard, Jones, Purvis, Climate Change and Global Poverty, Brookings Institution Press, 2009. Pages 87, 88, 90.

Holt Biology, Johnson & Raven, Holt, Rinehart & Winston, 2004, Pages 394, 395.

Holt Physics, Serway, Faughn, Holt, Rinehart & Winston, 2006, Pages 179, 180.

Karl, Melillo, Peterson, Global Climate Change Impacts in the United States, Cambridge University Press, 2009. Pages 7.

Kellogg, Schwart, Climate Change and Society, Westview Press, 1981. Pages 2, 3.

Turk & Turk, Environmental Science, 3<sup>rd</sup> Ed., Saunders College Publishing 1984. Pages 15, 139, 141, 142, 145, 146, 447.

<http://www.acoolerclimate.com/causes-of-global-warming.html>, Page 2, 3

<http://environment.nationalgeographic.com/environment/global-warming/gw-causes.html>, Page 1, 2

<http://www.epa.gov/climate/emissions/usinventoryreport.html>, Page 473

<http://www.greenstudent.com/encyclopedia/energy>, Page 2

<http://www.world-nuclear.org/info/inf59.html>, Pages 1, 2

### **Annotated Bibliography for Teachers**

Fox, Warwick. "Ethics and the Built Environment." London, : Routledge Press, 2000.

This book main objective is to analyze the ethics surrounding global warming. If a teacher wants to generate debates in the classroom this book is your point of reference.

Johansen, Bruce. "The Global Warming Desk Reference." Westport, CT: Greenwood Press, 2002. This book would serve as an excellent reference book for teachers.

Maslin, Mark. "Global Warming." Stillwater, MN.: Voyageur Press, 2006. This book Is a good resource book for the classroom.

Weart, Spencer. "The Discovery of Global Warming." Cambridge, MA.: Harvard University Press, 2003. This book introduces you the concept of Global Warming from the inception of the concept

### **Annotated Bibliography for Students**

Holt, Rinehart & Winston, Modern Biology Text, Austin, Texas, 2002. The book offers many different types of graphs and good pictures.

Holt, Environmental Science, Holt, Rinehart & Winston, Austin, Texas, 2000. The book provides Case studies and this allows the students to thin critically about several different possibilities. Every chapter has Portfolio activities and interdisciplinary activities.

### **Teacher Resources**

National Oceanic and Atmospheric Administration. Website on Climate issues. <<http://www.ncdc.noaa.gov/oa/climate/globalwarming.html>>.

Pearce, Fred With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change, Boston: Beacon Press, 2007.

Speth, James Gustave, Red Sky at Morning; America and the Crisis of the Global Environment, New Haven: Yale University Press, 2004.

### **Student Resources**

Bonneville Environmental Foundation. Website on student activities. <http://www.b-e-f.org/carbon/>>.

National Geographic. Website on global warming issues. <<http://environment.nationalgeographic.com/environment/global-warming/gw-causes>>.

Natural Resources Defense Council (NRDC). Website on global warming basics. <<http://www.nrdc.org/globalWarming>>.

**Appendices:**

The Core Curriculum of the School District of Philadelphia is aligned to the Pennsylvania Academic Standards for Ecosystems and their interactions. The following topics are included in these standards: The Carbon Cycle and it's role in an Ecosystem; The Consequences of Interrupting Natural Cycles; Carrying Capacity in an Ecosystem; The Availability of resources an it's affect on an Ecosystem. Global warming and the causes of global warming are connected to these standards.

4.6 A. Explain the biotic and abiotic components of an ecosystem and their interaction.

4.6.B. Explain how cycles affect the balance in an ecosystem