

GLG205: Midterm 1, 2010, Answer Key

MULTIPLE CHOICE SECTION FORM A - Answers

- 1) The highly developed countries represent how much of the world's population?
 - a) **20%**
 - b) 30%
 - c) 50%
 - d) 70%
 - e) more than 80%

- 2) Which of the following is a nonrenewable resource?
 - a) **fossil fuels**
 - b) water
 - c) forests
 - d) soils
 - e) fishes

- 3) Which of the following is an important ecological service provided by protected wetlands?
 - a) fertile agricultural soils
 - b) improved rainwater run-off
 - c) erosion
 - d) **water purification**
 - e) transportation

- 4) What does an ecological footprint measure?
 - a) **natural resources used by each person in an area**
 - b) products bought and used by each person in an area
 - c) the amount of people that can live in a given area
 - d) the number of planet's worth of resources we have.
 - e) world population growth

- 5) Which of the following is most likely to happen if everybody in the world used resources at the rate that people in Canada and the United States do?
 - a) People would be healthier and happier worldwide.
 - b) **Our current resources would run out quickly.**
 - c) Violent conflicts would decrease because basic needs would be met.
 - d) Economies would prosper.
 - e) More people would experience health problems because people in more prosperous countries experience more stress.

- 6) Which breakthrough in the 20th century contributed to the recent exponential increase in human population?
- An increase in birth rate.
 - A movement of population from rural areas to urban areas.
 - The industrial revolution.
 - An increase in food production due to development and mining of fertilizers.**
 - Increasing literacy rates.
- 7) Which of the following best describes an ecosystem?
- populations + community.
 - all species, population, and community interactions for organisms in a given area.
 - the abiotic components of the environment.
 - all of the biological interactions, plus interactions with the abiotic environment, in a given area.**
 - interactions between physical processes and the abiotic environment.
- 8) The direction and strength of winds depend on differences in
- air pressure.**
 - the tilt of the earth.
 - relative humidity.
 - cloud cover.
 - distance from the equator.
- 9) Correctly order the following from wettest to driest regions.
- tall grass prairie, temperate desert, short grass prairie
 - short grass prairie, tall grass prairie, temperate desert
 - temperate desert, short grass prairie, tall grass prairie
 - tall grass prairie, short grass prairie, temperate desert**
- 10) What is the correct sequence of steps in the scientific method?
- State the problem
 - Analyze and interpret the data
 - Develop a hypothesis
 - Share the results with other scientists
 - Design and perform an experiment to test the hypothesis
- I - II - III - IV - V
 - III - I - V - II - IV
 - I - III - V - II - IV**
 - V - IV - III - II - I
 - V - II - I - III - IV

- 11) What type of chemical energy is stored in plant organic carbon?
- a) kinetic
 - b) nuclear
 - c) solar
 - d) potential**
 - e) radiant
- 12) Based on United Nations high estimate how large is the population expected to be in 2050?
- a) 5 billion
 - b) 6.7 billion
 - c) 8.1 billion
 - d) 7.7 billion
 - e) 10.6 billion**
- 13) Approximately what percentage of the atmosphere is CO₂?
- a) 0.001%
 - b) 0.04%**
 - c) 10%
 - d) 30%
 - e) 75%
- 14) Which of the following 3 parameters have the most effect on biome distributions?
- a) latitude, longitude, precipitation
 - b) precipitation, longitude, temperature
 - c) temperature, latitude, climate
 - d) latitude, precipitation, temperature**
 - e) altitude, longitude, rainfall
- 15) What is the first step in the nitrogen cycle, in which gaseous nitrogen is converted into a biologically available form (e.g. ammonia)?
- a) ossification
 - b) ammonification
 - c) assimilation
 - d) nitrification
 - e) nitrogen fixation**

- 16) Why have some plants evolved mutualistic relationships with nitrogen-fixing bacteria?
- The bacteria transform nitrogen into useful forms for the plants; the plants provide water and a place for the bacteria to live.**
 - The bacteria protect the plant from harmful effects of nitrogen compounds such as ammonia; the plants provide carbohydrates for the bacteria.
 - The bacteria utilize nitrogen to produce energy for the plants; the plants provide the source of the nitrogen for the bacteria.
 - The bacteria provide natural immunities to the plants; the plants shelter the bacteria from predators.
 - There is not a mutualistic relationship between nitrogen-fixing bacteria and plants.
- 17) Which of the following is an adaptation of flowers resulting from the coevolution of plants and pollinators?
- mycorrhizae
 - nectar**
 - epiphytes
 - nitrogen fixing bacteria
 - zooxanthellae
- 18) What are the two most important sources of primary air pollutants?
- Volcanoes and forest fires.
 - Agriculture and forest fires.
 - Transportation and industrial fuel combustion.**
 - Electrical power plants and agriculture.
 - Chemical industry and the paper industry.
- 19) Which of the following organisms would be predicted to have the lowest biotic potential?
- bacteria
 - humans
 - cockroaches
 - mice
 - whales**
- 20) Why is tall grass prairie one of North America's rarest biomes?
- Historically it only occurred in a very tiny region of North America.
 - Because over 90% of this biome has been converted to agriculture.**
 - Global warming has resulted in the conversion of most tall grass prairie to short grass prairie.
 - Pollution has degraded most of our tall grass prairie region.
 - Overgrazing and intensive agriculture has resulted in desertification of this biome.

- 21) How is carbon transferred from organic matter to the atmosphere?
- photosynthesis
 - cellular respiration
 - erosion
 - burning fossil fuels
 - Both B and D**
- 22) Which of the following statements regarding photochemical smog is true?
- It was first described in Chattanooga, Tennessee.
 - It is formed by reactions involving NO_x, SO_x, and CO_x and sunlight.
 - It is caused mainly by particulates released during the burning of coal.
 - It is formed by reactions involving NO_x, hydrocarbons, and sunlight.**
 - It is formed by reactions between CFCs and ice crystals in the upper atmosphere.
- 23) Why did lead pollution decrease significantly after the creation of the Clean Air Act?
- Lead is now removed from coal before it is used as fuel.
 - Electrostatic precipitators mandated by the Clean Air Act have greatly decreased the amount of lead being emitted from smokestacks.
 - Catalytic converters in cars greatly reduce the amount of lead emitted.
 - Leaded gasoline was outlawed.**
 - Lead paint was outlawed.
- 24) When you complained to a friend from India about India's high population he responded by suggesting you consider the billboards in Times Square and consider that the United States is also overpopulated. What do you think he or she meant?
- Each individual in a population consumes too large a share of resources, jeopardizing sustainability.**
 - The urbanized industrial lifestyles of people in the United States is not good.
 - There are simply too many people in the United States to live sustainably.
 - The demand on resources in the United States limits population size.
 - There is too much immigration into the United States.
- 25) Which of the following best illustrates the process of evolution?
- A lizard changes color from green to brown to match the rock it is sitting on.
 - A bear goes into hibernation to avoid the environmental stress of winter.
 - A plant loses its leaves in a drought.
 - A population of mosquitoes develops resistance to a pesticide.**
 - A population of foxes increases as more prey becomes available.

- 26) Which of the following is needed for secondary succession to occur?
- a) bare rock or gravel
 - b) mature vegetation
 - c) **soil**
 - d) lichens.
 - e) abandoned vegetation
- 27) Which of the following parameters are needed to estimate humans' impact on the environment?
- a) population
 - b) consumption
 - c) affluence
 - d) population and consumption are both necessary
 - e) **all of these are necessary**
- 28) What term or phrase do population ecologists use to describe the maximum number of individuals of a given species that a particular environment can support for an indefinite period, assuming there are no changes in the environment?
- a) environmental resistance
 - b) biotic potential
 - c) **carrying capacity**
 - d) sustainability
 - e) demography
- 29) An analysis of air pollutants in an urban area resulted in the detection of NO₂, SO₂, CO, and particulates. How are all these chemicals related?
- a) **All of them are classified as primary pollutants.**
 - b) All of them are classified as secondary pollutants.
 - c) All of them contribute to acid precipitation.
 - d) All are components of photochemical smog.
 - e) All of them are related mainly to the burning of methane.
- 30) The nitrogen cycle is one of the most important and complex of the biogeochemical cycles. Why is nitrogen important?
- a) It's a greenhouse gas.
 - b) **It's an essential part of biological molecules such as proteins and nucleic acids (DNA).**
 - c) It's the most toxic element to living organisms.
 - d) Nitrogen dilutes the oxygen in the atmosphere causing respiratory problems.
 - e) It's a crucial part of the process of photosynthesis.

- 31) In order for the growth rate to be zero (i.e., a constant population) what must happen to the birth rate?
- a) it must equal zero
 - b) it must decline
 - c) it needs to be less than emigration
 - d) it must equal the death rate**
 - e) it must exceed the dispersal rate
- 32) What layer of our planet is made of rock and soil?
- a) hydrosphere
 - b) ecosphere
 - c) biosphere
 - d) lithosphere**
 - e) atmosphere
- 33) What is necessary for populations to reach their biotic potential?
- a) they must be bacteria
 - b) unlimited time
 - c) unlimited resources**
 - d) high carrying capacity
 - e) all of these are necessary
- 34) Which of the following is an example of environmental resistance?
- a) unlimited resources
 - b) predation**
 - c) ideal conditions
 - d) high growth rate
 - e) unlimited time
- 35) What is probably the single most important factor affecting high total fertility rates in human populations?
- a) limited access to family planning services
 - b) the low status of women in many societies**
 - c) the economic status of large families
 - d) tradition
 - e) religious values

- 36) What component of the atmosphere is the second largest?
- a) Nitrogen
 - b) **Oxygen**
 - c) Carbon dioxide
 - d) Water vapor
 - e) Argon
- 37) Why don't global oxygen concentrations change?
- a) **Oxygen levels remain balanced by photosynthesis and cellular respiration.**
 - b) Photosynthesis replaces oxygen loss to air pollutants like NO_x, SO_x, and ozone.
 - c) Oxygen levels have been increasing since the Industrial Revolution.
 - d) Excess oxygen is broken down by ozone in the upper atmosphere.
- 38) Which of the following processes plays an important role in the phosphorus cycle?
- a) **erosion**
 - b) fixation
 - c) combustion
 - d) cellular respiration
 - e) ammonification
- 39) How are nitrogen oxides, sulfur oxides, and carbon oxides related?
- a) All of them are secondary air pollutants that contribute to global warming.
 - b) All of them are primary air pollutants that contribute to acid deposition.
 - c) **All of them are air pollutants that are formed by combustion of fossil fuels.**
 - d) All of them are air pollutants that result in respiratory diseases in humans.
 - e) All of them are air pollutants with no known natural sources.
- 40) Why is air pollution increasing in China?
- a) Increased burning of wood and dung for fuel as populations increase.
 - b) Pollutants are coming into China because of the global distillation effect.
 - c) Global warming is increasing the impact of temperature inversions and dust domes.
 - d) **Increased burning of coal for heat and industrial power.**
 - e) Increased reliance on leaded gasoline.

SHORT ANSWER SECTION (7 questions)

1. (6 pts) Carrying capacity estimates for the planet Earth range from 4-16 billion. Describe at least 4 factors that are considered when these estimates are made and explain why such a range in estimates exists.

Carrying capacity is the largest population that can be sustained indefinitely assuming no change in the environment. Estimates for the carrying capacity of the Earth for humans vary because many factors are considered when determining a population that can be maintained sustainably on Earth (sustainably means that future generations will have the same standard of living and resources available as current conditions).

- Standard of living – the higher standard of living that would be expected for the whole population, the lower carrying capacity will be
- Resource consumption – the amount of renewable and nonrenewable resources that humans use will affect estimates of how many humans can live sustainably on Earth
- Technological advances – Models that get large carrying capacities for the Earth generally assume that there will be technological advances that reduce our resource consumption per human or reduce our waste generation or control disease/hunger etc...
- Waste generation – High levels of waste generation will lead to greater levels of pollution and thus non-sustainable practices for future generations. Thus lower or controlled waste generation is necessary to have higher carrying capacities.
- Pollution – high levels of pollution are non-sustainable practices for future generations. Thus high levels of pollution will result in lower carrying capacities
- Disease – As the planet gets more crowded, one might expect higher disease rates. Thus assumed low disease rates are generally associated with lower carrying capacities.

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2. (10 pts – **revised to 7 points**) Draw a schematic of the carbon cycle and label the major reservoirs and fluxes (both natural and human). Name the 5 major reservoirs of carbon on the planet in order from largest to smallest.

Major reservoir to identify (in order from largest to smallest):

- 1) Sedimentary carbon
- 2) Marine dissolved carbon
- 3) Soils and surface sediments
- 4) Atmosphere
- 5) Living biomass

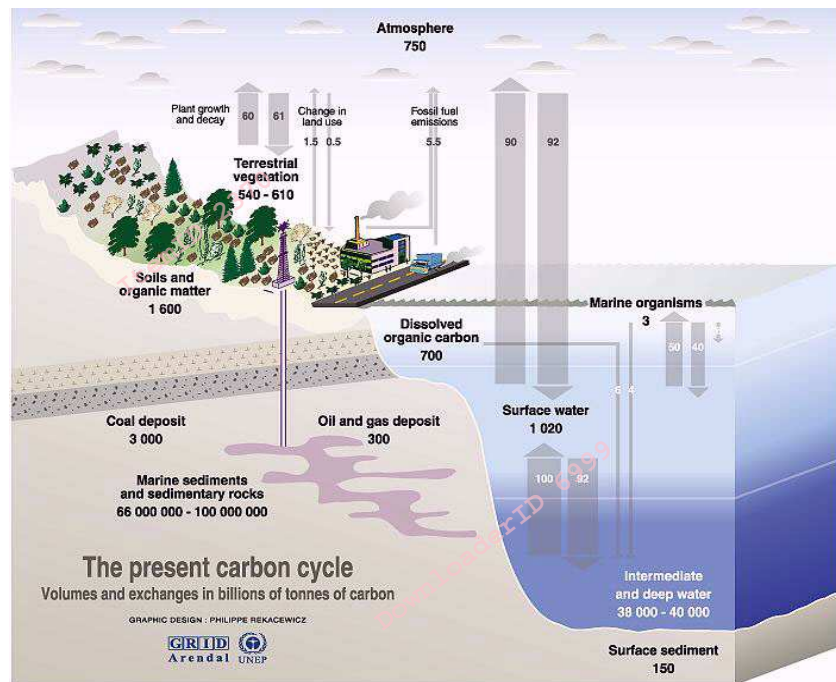
Major fluxes to identify:

Natural:

- 1) Photosynthesis
- 2) Respiration
- 3) Flux to and from the ocean (solubility)
- 4) Burial in sediments (long term sink for carbon) and also in soils

Human

- 5) Fossil fuel burning
- 6) Land use changes



Sources: Center for climatic research, Institute for environmental studies, university of Wisconsin at Madison; Okanagan university college in Canada, Department of geography; World Watch, November-December 1996; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

3. (6 pts) What major biomes exist in Canada (name 3) and describe at least 2 of the major abiotic characteristics and 2 of the major biological characteristics of each of biome.

1) Tundra

Tundra Abiotic:

- Large temperature range from -30°C to 20°C
- Limited/low precipitation
- Short growing season
- Nutrient poor soils
- Permafrost
- Landscape of broad, shallow lakes, ponds and bogs

Tundra Biological

- Relatively few species
- Mosses, lichens, grasses, sedges
- Lemmings, arctic foxes, weasels, owls
- Summer caribou and reindeer
- Mosquitoes, blackflies, deerflies

2) Boreal Forest

Boreal Abiotic:

- extreme temperature range from -25°C to 20°C
- cold, extreme winters
- little precipitation
- acidic, mineral- poor soils
- Some permafrost
- Huge amount of freshwater storage (lakes, wetlands)

Boreal Biological

- Coniferous trees
- Caribou, wolves, bears, moose
- Rodents, rabbits, mink, lynx
- Abundant birds in summer

3) Temperate Deciduous Forest

Temperate Forest Abiotic:

- Mild winters, but pretty large T range from 4°C to 30°C
- fair amount of precipitation
- acidic, mineral- poor soils
- rich topsoil, clay beneath

Temperate Forest Biological

- Dense canopy of trees
- Hardwood trees
- Deer, bears, many birds

4) Temperate Rain Forest

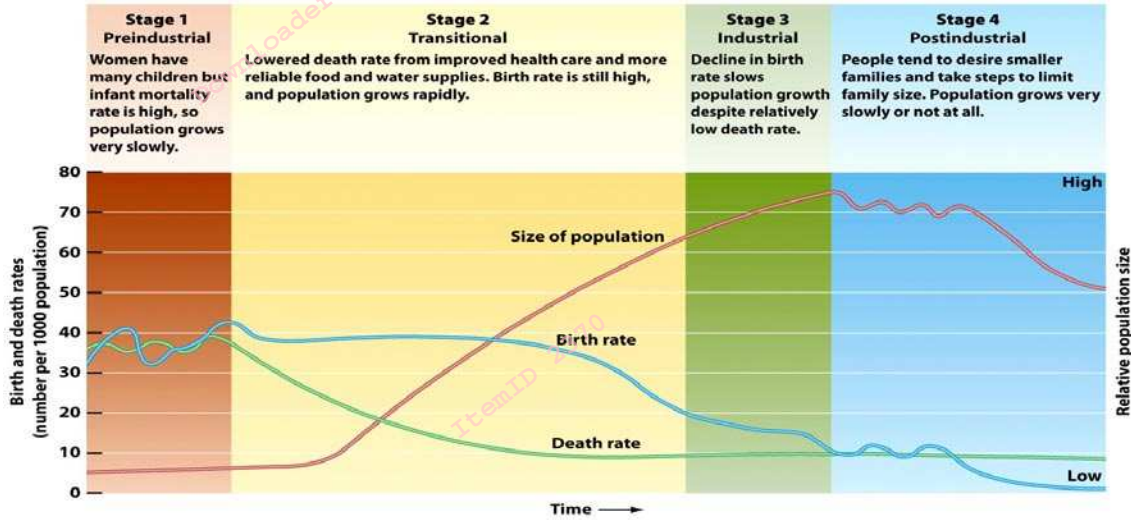
Temperate RF Abiotic:

- Mild winters, cool summers (0°C to 20°C)
- lots of precipitation
- nutrient-poor soils

Temperate RF Biological

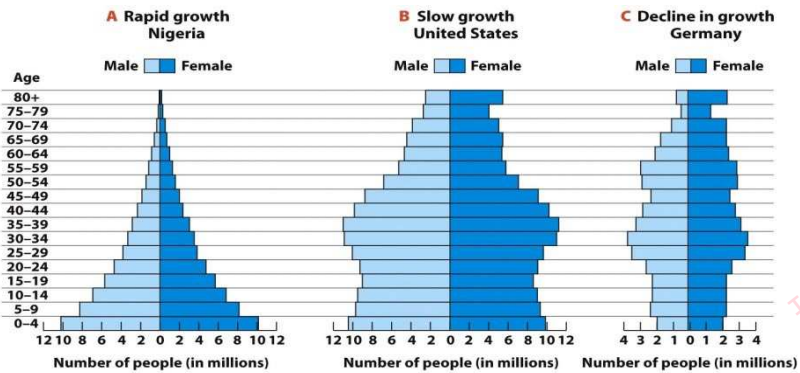
- Evergreen trees
- Epiphytes: plants growing on trees such as mosses, ferns, lichen
- Squirrels, elk, birds, amphibians, reptile

4. (8 pts) Demographers have identified four stages through which a population progresses as its society becomes industrialized. Graph relative birth rates, death rates and size of population as a function of time and each stage (identify and briefly describe each stage). For stage 1 and 4 also draw a representative age distribution diagram and explain how the age distribution pattern relates to the population growth you put on your graph.



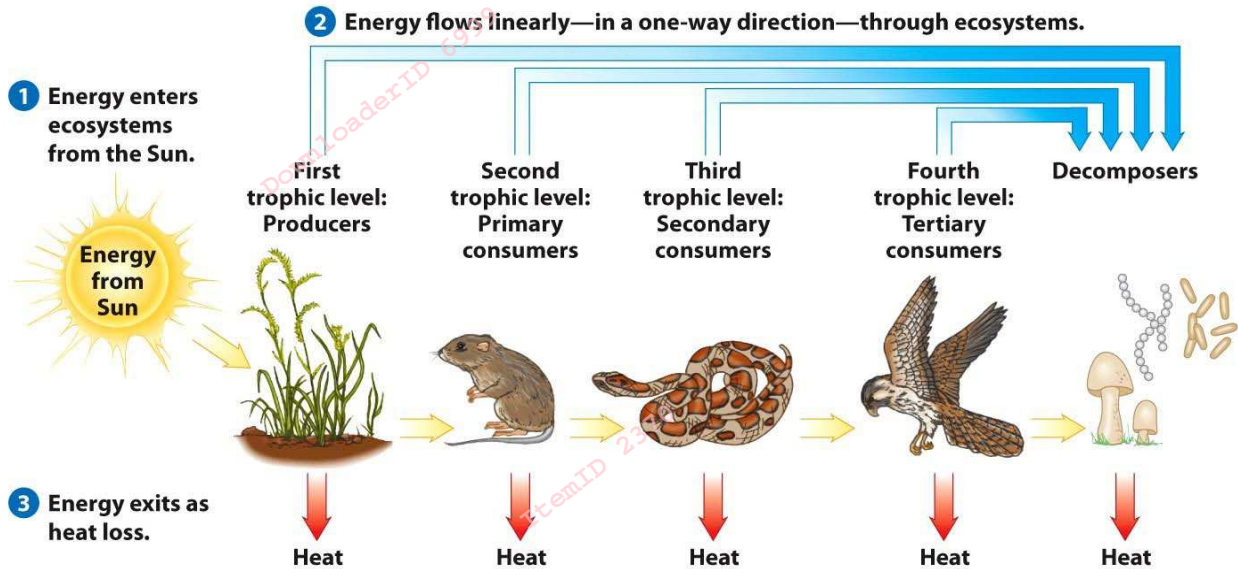
What you are looking for:

- Stage 1: high birth rates, high death rates, low population
- Stage 2: high birth rates, lowering death rates, rising population
- Stage 3: lowering birth rates, low death rates, slower rising population
- Stage 4: low birth rates, low death rates, steady or declining population



Stage 1 corresponds to age graph A: As long as death rates stay high and the young do not make it to reproductive state, then population will not grow. However if death rates drop, there is a significant amount of population in the pre-reproductive stage that will give this population a lot of future reproductive people. Thus potentially rapid growth. Stage 4 corresponds to age graph C: Less people in the pre-reproductive age group. Thus this population will be stable and/or decline (depending on how they drew the rest of the population).

5. (8 pts) How does this diagram illustrate the first and second laws of thermodynamics? How does energy move through a food web? Why are there fewer organisms at the higher trophic levels than the lower trophic levels?



Part 1: The first law of thermodynamics states that energy can neither be created nor destroyed but it can change forms. This diagram illustrates the solar energy being converted into chemical energy by the green plants. It also shows that some of it is converted into heat energy and lost to the system. The conversion of the chemical energy to heat energy is another example of the first law. The fact that the heat energy is lost to the ecosystem is an example of the second law which states that when energy is transferred from one form or level to another, some of it is lost to the system. Here it is being lost as heat energy.

Part 2: Energy generally flows in one direction through ecosystems (illustrated above) from one trophic level to the next trophic level.

Part 3: Energy is lost from the system as energy is transferred from one trophic level to another. This leads to there being less energy available at higher trophic levels and thus less organisms.

6. (6 pts) Give an example of how human activities are changing each one of the following biogeochemical cycles: carbon, nitrogen, phosphorous, sulfur. Be specific about not only what the human activity is, but how it impacts the cycle. Then give an example of how one of these human impacts can affect ecosystems.

(they only need to give 1 example each)

Carbon:

- Combustion of coal, oil, natural gas and wood – these all increase carbon in the atmosphere
- Land use changes – e.g. deforestation, agriculture, reforestation – although these can go either direction, it is currently thought they are adding more carbon to the atmosphere than removing

Nitrogen

- Fertilizer use – this leads to an increase of biologically available nitrogen
- NO_x emissions from industrial and fossil fuel combustion – increases NO_x concentrations in atmosphere which leads to increase in air pollution

Phosphorous

- Fertilizer use (from phosphate mining) – this leads to an increase of biologically available phosphorous

Sulfur

- Coal combustion or industrial produced SO₂ – increases SO₂ which leads to increases in air pollution and acid rain

Examples of how one of these changes influences ecosystems (there are many – so here are few):

- P or N – eutrophication of aquatic systems from fertilizer runoff
- C – any example of how climate change is affecting an ecosystem would do
- S – acid rain has many affects on ecosystems including stripping nutrients from soils, damage to plants and trees...

7. (6 pts) How would you answer a person who asks you the following question? “Why should I worry about the ozone layer? Today's air quality report says there is plenty of ozone in my city.”

The ozone in the ozone layer is different than the ozone found in cities.

Good Ozone:

The ozone in the ozone layer occurs in the stratosphere as a result of oxygen reacting with ultraviolet radiation to form ozone. This ozone forms an important protective layer that limits the amount of cancer-causing UV radiation from reaching the Earth. CFCs and other anthropogenic molecules react with this ozone to break it down, thinning the protective ozone layer.

Bad Ozone:

Ozone that occurs close to the Earth's surface in the troposphere is a secondary pollutant formed by the reaction of volatile hydrocarbons and nitrogen oxides in the presence of sunlight (it is one of the primary components of photochemical smog). This ozone never reaches the upper atmosphere to replenish the lost ozone of the stratosphere because of the short lifetime of ozone and slow mixing time between the troposphere and stratosphere. Ozone in the troposphere reduces visibility in cities and causes severe health problems.

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