

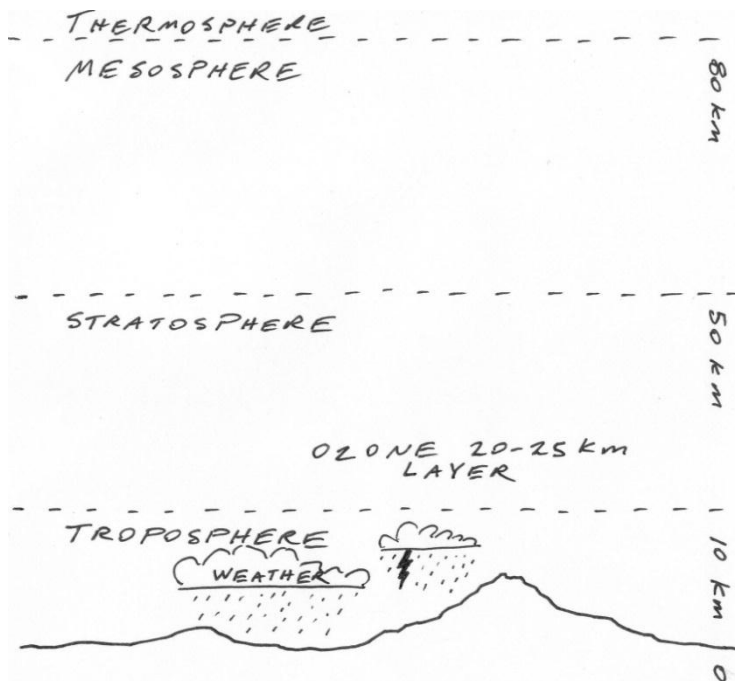
# APES in a BOX: The Review Sessions

## Air Quality and The Atmosphere

Our atmosphere is a layer of gases that surrounds the planet. These gases are held close to the planet by gravity. For the purpose of the AP exam, you should be concerned with the following layers of the atmosphere. (See Diagram on the following page)

**Troposphere:** The troposphere is the layer of the atmosphere that is closest to the surface of the earth. The troposphere contains the air that we breathe and live in. The troposphere is made up of approximately 78% nitrogen, 21% oxygen, and small amounts of CO<sub>2</sub>, methane, water vapor, and other trace gases.

**Stratosphere:** The stratosphere is the next layer of the Earth's atmosphere. The stratosphere is important for our purposes as it is the home of the ozone layer. Ozone (O<sub>3</sub>) is a gas that blocks a great deal of UV light as it enters the atmosphere.



## Common Air Pollutants in the United States

**Point Source Pollution** is a type of pollution that can be traced to a single source. Point source pollution is fairly easy to regulate as it is easy to identify the source. A smokestack on a factory would be an example of point source pollution.



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**Non-point Source Pollution** is caused by multiple sources acting together. This type of pollution is more difficult to control as the source is not as easily identified. Automobile exhaust is a good example of non-point source pollution with many cars each contributing a small amount of pollution.

Air pollution can come in the form of either **primary pollutants**, which are put directly into the atmosphere, or **secondary pollutants** which form from the interactions of primary pollutants with air and sunlight.

**Acid deposition** is simply the depositing of acid forming compounds on land, or water. Deposition can either be wet (acid rain), or dry (particulates). Acid deposition can disrupt terrestrial and aquatic ecosystems by altering the pH of the soil or water. Acid deposition is best dealt with by reducing the formation of acid forming compounds such as  $\text{SO}_2$ . In some cases, lakes that have been affected by acid deposition have been treated with large amounts of lime, or limestone, to buffer the acid.

**Carbon Monoxide** is a colorless, odorless gas that forms during the incomplete combustion of fossil fuels.

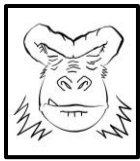
Sources: Cigarette smoke, incomplete combustion of fossil fuels, motor vehicle exhaust is the #1 source

Health and Environmental Effects: Affects  $\text{O}_2$  carrying capacity of red blood cells contributing to heart attacks, fetal development, pulmonary disease, brain cell damage

**Lead** is a solid toxic metal that is emitted into the air as particulate matter.

Sources: Paint, metal refineries, lead manufacturing, batteries, leaded gasoline

Health and Environmental Effects: Accumulates in the body causing brain damage, mental retardation, and digestive problems. Lead can negatively impact wildlife. Efforts have been made to remove lead from gasoline and paint but some countries persist in selling leaded gasoline.



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**Nitrogen Dioxide** is a reddish-brown gas that gives smog its brown color. In the atmosphere it can be converted to nitric acid. Nitric acid can then fall as acid rain.

Sources: Fossil-fuel burning in cars and power/ industrial plants

Health and Environmental Effects: Lung irritation, NO<sub>2</sub> can increase susceptibility to respiratory problems, and irritate asthma. NO<sub>2</sub> can reduce visibility and contribute to acid deposition. As a component of acid rain it can degrade soil quality, harm aquatic life, and damage buildings.

**Sulfur Dioxide (SO<sub>2</sub>)** is a colorless gas that is generated by the combustion of sulfur containing fuels like coal and oil.

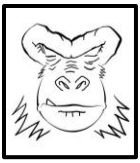
Sources: The incomplete combustion of fossil fuels. Many people are exposed to unsafe levels through improper ventilation of heating and cooking exhaust.

Health and Environmental Effects: SO<sub>2</sub> can irritate asthma and contribute to acid deposition.

**Suspended Particulate Matter:** SPMs are particles, or droplets, that are light enough to stay suspended in the air for extended periods of time.

Sources: SPMs can be created by burning, plowing, construction, or anything that puts particulates into the air.

Health and Environmental Effects: SPMs can cause respiratory tract irritation. Some SPMs such as lead, dioxin, or PCBs can cause much more serious health problems. SPMs can reduce visibility and cloud water. SPMs in water can interfere with the function of fish gills and impact photosynthesis by clouding the water.

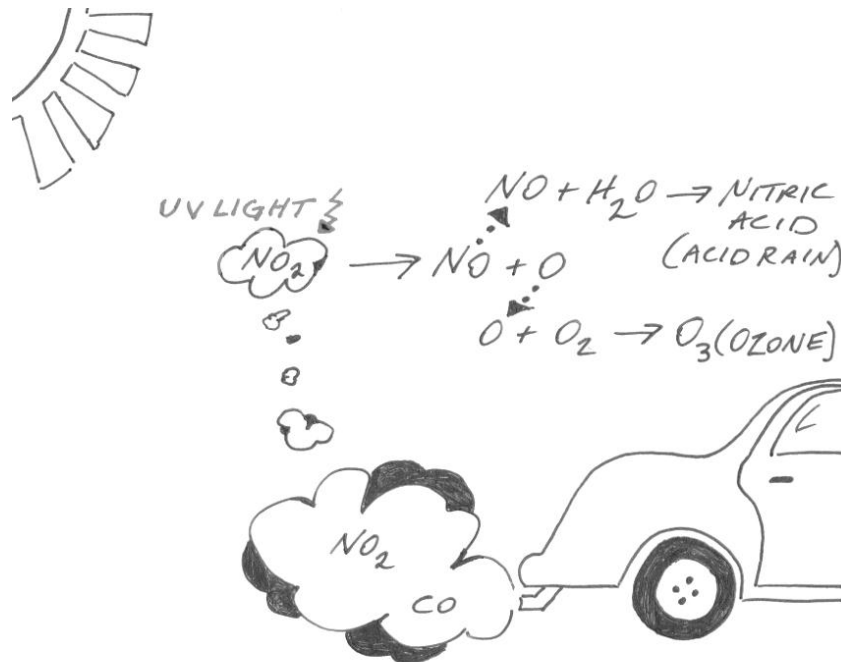


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**Ozone (O<sub>3</sub>):** Ozone is a highly reactive gas. Ozone days, ozone action days, ozone alert days, or whatever your weatherman calls them, are days when weather conditions are just right for an accumulation of ground-level ozone. Since ozone is formed as a component of photochemical smog, sunny days with little wind are prime days for ozone accumulation.

Sources: Ozone forms in the troposphere as a secondary pollutant (photochemical smog).

Health and Environmental Effects: Ozone is a lung irritant.



**Temperature Inversions** can cause air pollution to concentrate and cause increased health impacts. Inversions occur when a warm air mass moves into an area and traps the existing cold air mass below. The stagnant air at ground level concentrates any air pollutants that have been generated in the area.

### Prevention of Air Pollution

Air pollution is a particularly interesting problem since air has no boundaries. A pollution source in one place or country can be a pollution problem in another. The problem is further complicated as there are both point and non-point sources of pollution. Air pollution is one of the environmental success stories in the United States. While we still have a long way to go, there have been major improvements in air quality over the last 50 years. Cleaner technology developed for industry and



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transportation along with air quality legislation and consumer demand has improved air quality. Point sources of pollution have been dealt with through legislation such as the Clean Air Act, and non-point sources, such as automobile exhaust, are generally managed through local requirements for automobile inspections.

## **The Fine Print**

Clean Air Acts 1970, 1977, and 1990

**The Clean Air Acts** give the Environmental Protection Agency (EPA) the power to regulate emissions of air pollutants.

Cap and trade or emissions trading programs allow companies a certain amount of pollution. If they do not use it, they can trade or sell their allotment to other companies.

## **Indoor Air Pollution**

**Indoor Air Pollution** is a significant health issue. Air quality inside homes and workplaces is often worse than the air outside. As we have developed our building techniques to make homes better insulated, we have inadvertently made them better at trapping indoor air pollution where we spend most of our time! Indoor air pollution can include gases from lawn chemicals, paints, household chemicals, tobacco smoke, and carbon monoxide. Allergens such as dust, pollen, and smoke particles also contribute to decreased indoor air quality.

**Radon** is a radioactive gas that can enter homes from the surrounding bedrock. Radon has been implicated in lung cancer cases of people who live in homes with high concentrations of radon.



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## **Air Quality Review Questions**

### **Multiple Choice**

1. Which of the following air pollutants is a colorless, odorless gas that forms during the incomplete combustion of fossil fuels?

- A) Carbon Monoxide
- B) Sulfur dioxide
- C) Lead
- D) Ozone
- E) Nitrogen dioxide

2. Which of the following is a human health impact of overexposure to lead?

- A) Cardiac arrest
- B) Brittle bone syndrome
- C) Nervous system damage
- D) Asthma
- E) Affects the oxygen carrying capacity of red blood cells



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3. Which of the following air pollutants can contribute to acid rain?

I.  $\text{NO}_2$

II.  $\text{SO}_2$

III. Carbon monoxide

IV. Ozone

A) I only

B) II only

C) I and II only

D) I, II, and III

E) I, II, III, and IV

4. Which of the following air pollutants forms in the troposphere as a secondary air pollutant?

A) Ozone

B) Lead particulates

C) Carbon monoxide

D) Nitrogen

E) Chloroflourocarbons

5. Which of the following laws gives the EPA the authority to regulate air pollution in the United States?

A) The Clean Air Act

B) Cap and Trade

C) The Montreal Protocol

D) The Pollution Prevention Act

E) CERCLA



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6. Which of the following is a radioactive gas that has been implicated in cases of lung cancer?

- A) Ozone
- B) Uranium
- C) Hydrogen
- D) Radon
- E) Freon

### **Free Response**

1. Often times the source of a pollutant may determine how difficult it is to regulate or mitigate the production and impact of that pollutant. Point source pollution and non-point source pollution are two categories of pollutants.

- A. Describe point source pollution, and give one example.
  
- B. Describe non-point source pollution, and give one example.
  
- C. Define secondary pollutant.





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## Multiple Choice Scoring Guidelines

1. A	3. C	5. A
2. C	4. A	6. D

## Free Response Scoring Guidelines

**1.A. (2pts total)** One point each for a definition of point source pollution being a single identifiable source of pollution, and for an example such as a factory smokestack.

**1.B. (2pts total)** One point each for a definition of non-point source pollution being a diffused source of pollution coming from many places, and for an example such as fertilizer runoff from an agricultural area.

**1.C. (1pt total)** One point for correctly defining secondary pollutants as forms of pollution that form as a product of in interaction between a primary pollutant, and the environment.