Lesson Description

In this lesson we:

- Look at the Human influence on the environment in terms of:
  - Composition of the atmosphere and ozone layer (Depleting and replenishing the ozone layer)
  - Describing patterns of climate change and factors affecting climate change
  - Water availability in South Africa

Summary

Composition of the Atmosphere and the Ozone Layer

Ozone is a gas that occurs naturally in the atmosphere.
- An ozone molecule is made up of three oxygen atoms and has the chemical formula of O₃.
- Most of the ozone is found in a layer called the ozone layer in a part of the atmosphere called the stratosphere.

(Life Sciences for All, Grade 11, Macmillan 2012, p323)

(Life Sciences for All, Grade 11, Macmillan 2012, p337)
The ozone layer protects us from harmful UVB radiation from the sun. Too much UVB radiation can cause skin cancer, eye cataracts and damage to the immune system. Too much UVB can also cause a reduction in crop yields and the death of phytoplankton. Ozone molecules in the ozone layer absorb UVB radiation entering the atmosphere from space. This reduces the amount of UVB radiation that reaches the Earth’s surface.

**Depleting and Replenishing the Ozone Layer**

- **Ozone depletion** is the reduction of the amount of ozone in the stratosphere.
- A thin ozone layer absorbs less UVB radiation than a thick ozone layer.
- The ozone hole develops in spring over the Antarctic because of the special weather conditions that exist there and nowhere else on Earth.
- In most years the maximum area of the ozone hole is bigger than the Antarctic continent. Ozone has also thinned over the Arctic and other parts of the northern hemisphere.

(Life Sciences for All, Grade 11, Macmillan 2012, p338)

**Causes of Depletion**

- The two main types of ODSs produced include:
  - **Gases that contain chlorine (Cl)** such as chlorofluorocarbons (CFCs) also called freons. CFCs were used as cooling gases in fridges.
  - **Gases that contain bromine (Br)** such as: halons and methyl bromide. Halons were used in fire extinguishers and methyl bromide was used as a pesticide.
- Chlorine-containing gases and bromine-containing gases released into the troposphere move up into the stratosphere where UV radiation changes the chlorine-containing and the bromine-containing gases.
- These two substances break down ozone molecules to form oxygen ($O_2$) molecules.
Solutions to Ozone Depletion

- Due to the Montreal Protocol, global production of CFCs and halons ended in January 2010.
- Countries are allowed to use hydrochlorofluorocarbons (HCFCs) as a substitute for CFCs until 2030.
- If the international agreement is adhered to, the ozone layer is expected to recover by 2050.

Climate and Climate Changes

- The Earth’s climate is the long-term pattern of weather conditions for the whole planet over a time period of hundreds to thousands of years and longer.
- Climate change is any change in the long-established climate pattern that continues for a period of hundreds of years. Global climate change is climate change that affects the whole planet.
How the Earth’s Climate is Changing Now

- Over the past 100 years, the Earth’s average air temperature is increasing and it is increasing at a faster rate than expected from the Earth’s normal climate pattern.
- For the last 50 years, the air temperature has increased by 0.13 °C per decade.
- The current rapid increase in global temperatures is called **global warming**.
- This could cause many problems for people and the environment. For example, a rise in temperature could lead to more extreme weather such as droughts and floods.

Natural Causes of Climate Change

- Changes in Earth’s orbit around the sun
- Changes in the amount of energy released by the sun
- Changes in ocean currents.
- Changes in levels of greenhouse gas in the atmosphere

**Greenhouse Effect**

(Life Sciences for All, Grade 11, Macmillan 2012, p328)

Human Causes of Climate Change

- The two human activities that are the most likely causes of the current change in the Earth’s climate are greenhouse gas emissions and deforestation.
  - **Greenhouse gas emissions**:
  - **Deforestation**:

Effects of Climate Change

- More extreme weather.
- Rise in sea levels.
- Changes in ecosystems.
- Changes in agriculture.

Effects of Climate Change on South Africa

- The western and south-western parts of the country (including the winter rainfall region) may become hotter and drier. The rainfall season may be shorter and there may be more droughts.
- The maximum summer and autumn temperatures may increase. There will be fewer cold nights and fewer frosts.
- Many of the biomes will be replaced by desert.
- The eastern part of the country (the summer rainfall region) may become hotter and wetter.
- The rainfall may come later in the summer and the rainfall season may be shorter.
If the eastern part of the country gets hotter and wetter, pests (such as ticks) and disease-carrying insects (such as the mosquitoes that carry malaria) could spread into areas that were previously too cold or dry for them.

Water Availability in South Africa

Water Use in South Africa

- Urban and domestic.
- Irrigation and forestry.
- Mining and industry.
- Environment.

Human Impacts on our Water Supplies

- Construction of dams.
- Destruction of wetlands.
- Poor farming practices.
- Boreholes.
- Exotic plantations
- Wastage
- Urbanisation
- Pollution
Test Yourself

Question 1
What is global warming?
A an increase in Earth's average surface temperature
B a decrease in the amount of deforestation
C an increase in the concentration of ozone
D a decrease in Earth's average surface temperature

Question 2
What caused the depletion of ozone in the upper atmosphere?
A Production of greenhouse gases
B Pollution from motor cars
C Methane released from landfill sites
D Release of CFCs into the atmosphere

Question 3
What is the removal of trees without adequate replanting?
A a monoculture
B a carrying capacity
C bioremediation
D deforestation

Question 4
The following steps occur during eutrophication:
1. Aquatic algae grow rapidly
2. Bacteria use up oxygen
3. Excess nitrate and phosphate discharged into the river
4. Dead algae decomposed by bacteria
5. Fish die of suffocation
The correct order in which eutrophication occurs is …
A $3 \rightarrow 4 \rightarrow 1 \rightarrow 5 \rightarrow 2$
B $5 \rightarrow 3 \rightarrow 2 \rightarrow 4 \rightarrow 1$
C $5 \rightarrow 2 \rightarrow 3 \rightarrow 1 \rightarrow 4$
D $3 \rightarrow 1 \rightarrow 4 \rightarrow 2 \rightarrow 5$
Question 5

Deforestation would most immediately result in
A  the disappearance of native species
B  industrialization of an area
C  global warming
D  the depletion of the ozone shield

🏠 Improve your Skills

Question 1

Read the following statement and answer the questions that follow.

The Earth’s climate has changed many times over the course of its history due to natural processes. Over the past one hundred years, the average global air temperature has increased at a faster rate than it did in the past. In all likelihood this warming of the atmosphere is being caused by human activities.

a.) Name the natural processes that cause climate change.

b.) Describe the human activities that are likely to be causing the current global climate change.

c.) Explain the link between the greenhouse effect and global warming.

d.) What effects could the current global climate change have on ecosystems, farming and people in South Africa?

e.) Describe ways to reduce greenhouse gas emissions.

f.) Explain the importance of carbon sinks.

Question 2

a.) Why is South Africa classed as a ‘water stressed’ country?

b.) Do we get most of our water from surface or groundwater supplies?

c.) Describe alternative sources of water that we may have to use in the future.

Question 3

(Adapted from ECDOE Gr11 Paper 2 2014 Question 3.2)

Read the following paragraph and answer the questions that follow.

Modern-Day Plague

Deforestation is the permanent destruction of indigenous forests and woodlands. One of the reasons for deforestation is the conversion of forests and woodlands to agricultural land to feed growing numbers of people. Currently, 12 million hectares of forests are cleared annually. With the loss of a protective cover of vegetation by deforestation, more soil is lost. Annual soil loss in South Africa is estimated at 300–400 million tons. Our forests also act as a major carbon store because carbon dioxide (CO₂) is taken up from the atmosphere. Currently, up to 20 per cent of global carbon emissions come from deforestation and forest degradation – more than the total emissions from the global transportation sector. Deforestation will have an impact on the water cycle as well, because trees are responsible to draw ground water up through their roots and release it into the atmosphere (transpiration). Almost all of this deforestation occurs in the moist forest and open woodlands of the tropics. At this rate, all moist tropical forests could be lost by the year 2050.

[Adapted from: www. botany.uwc.ac.za]
3.1 Explain how the removal of plants by deforestation contributes to an increase in the concentration of greenhouse gasses.

3.2 Explain how deforestation increases soil erosion.

3.3 Explain how deforestation affects the water cycle.

**Question 4**

(Adapted from ECDOE Gr11 Paper 2 2014 Question 3.3)

Study the graph below, which indicates the amount of ozone depletion in the stratosphere between 1982 and 1996.

Amount of ozone depletion of the stratosphere between 1982 and 1996

4.1 Comment on the ozone depletion over the period 1982–1996.

4.2 How much of the ozone was lost from the atmosphere in 1990?

4.3 Besides chlorofluorocarbons (CFCs), name THREE other greenhouse gases.

4.4 CFCs can stay around for 100 years. What is the implication of this for the ozone layer?

4.5 Give THREE possible reasons for the decrease in ozone depletion after 1994.

**Question 5**

(Adapted from ECDOE Gr11 Paper 2 2014 Question 4)

Eutrophication and acid mine drainage are two of the most important water quality problems in South Africa. Write a mini-essay describing what they are, what causes them and their effects on the environment.

Content (17)

Synthesis (3)