**MONDAY 4th MAY**

**TOPIC: CLIMATE**

**a. Definition**

Define the following terms.

i. Troposphere

ii. Stratosphere

iii. Mesosphere

iv. Thermosphere

Characteristics of the layers of the atmosphere.

Fill in the table below

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Troposphere</th>
<th>Stratosphere</th>
<th>Mesosphere</th>
<th>Thermosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains a layer of ozone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where weather takes place</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contains the ionosphere</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where airplanes travel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Located close to the earth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The air pressure is greatest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where meteors burn up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air temperature decreases with altitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air temperature increases with altitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The coldest layer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**TUESDAY 5\textsuperscript{th} MAY**

b. **Short answer question**
   
i. Explain why the layers of the earth are important.
   
ii. Describe the significance of the ionosphere.

c. **Definition**
   
   Define the following terms.
   
i. Insolation
   
ii. Absorption
   
iii. Scattering
   
v. Humidity
   
vi. Radiation
   
vii. Conduction
   
viii. Albedo
   
ix. Earth’s Heat Budget

**WEDNESDAY 6\textsuperscript{th} MAY**

j. **Resource interpretation**
   
   Use the resource below and your knowledge to answer the questions that follow.

![Global warming and the greenhouse effect](image)

i. Identify two ways heat is transferred from the earth to the atmosphere.
   
ii. Describe what happens when the atmosphere is heated.

k. **Short answer questions**
   
i. Explain why tropical areas do not overheat.
   
ii. State two factors influencing the temperature of a place.
   
iii. Differentiate between Temperature inversion and Temperature gradient.
THURSDAY 7th MAY

TOPIC: CLIMATE CHANGE

Objective: Investigate and discuss the concept of climate change, causes, impacts and mitigation measures.

What is climate change?

Climate change is influenced by the presence of greenhouse gases in the atmosphere, which can trigger changes in climate patterns across the globe. Climate change can also be defined as any changes in climate over time, whether due to natural variability or as a result of human activities. Changes can be found as follows:

- Temperatures are increasing or decreasing
- Weather patterns are changing
- Extreme weather events (such as floods and droughts) are becoming more common
- Sea levels are rising (due to warmer oceans and melting ice caps)
- Oceans are becoming more acidic (due to their absorption of atmospheric carbon dioxide)
- Precipitation patterns are changing globally (some areas becoming wetter, while others are becoming drier)

<table>
<thead>
<tr>
<th>Climate Variability</th>
<th>Climate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>The way climate fluctuates yearly above or below a long term average value and often used to denote deviations of climate statistics over a given period of time (e.g. a month, season or year)</td>
<td>Long term continuous change (increase or decrease) to average weather conditions or the range of weather</td>
</tr>
</tbody>
</table>

Carbon cycle

Carbon is one of the most abundant elements on Earth. Most of the carbon is stored:

- as carbon dioxide in the atmosphere
- as biomass in land plants and soils
- as fossil fuels in a variety of geologic reservoirs
- as a collection of ions in the ocean

Carbon cycle is one of the biogeochemical processes that regulate the earth’s climate. It circulates hundreds of billions of carbon annually among countless terrestrial, oceanic and atmospheric sources. The excessive presence of carbon dioxide in the atmosphere is the main contributor to the greenhouse effect.
**Activity**

**a. Definition**
Define the following terms.

i. Climate Change

ii. Climate variability

iii. Carbon Cycle

**FRIDAY 8th MAY**

**Greenhouse Effect**

Greenhouse gases are in the atmosphere, absorbing and holding heat, which causes the Earth’s temperature to rise. The increase in greenhouse gases in the Earth’s atmosphere is leading to the increase of the global temperature. The earth is getting warmer the greenhouse effect, whereby all the heat generated by solar energy hitting the earth surface is radiated back into space. Although the greenhouse effect is helpful in trapping some energy to keep the temperatures on our planet mild and suitable for living things, however, too much greenhouse gases can cause the atmosphere temperature to increase out of control.

<table>
<thead>
<tr>
<th>Greenhouse Gases</th>
<th>Sources of Greenhouse gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide (CO₂)</td>
<td>Tourism and Recreational Activities</td>
</tr>
<tr>
<td>Methane (CH)</td>
<td>Mining Activities</td>
</tr>
<tr>
<td>Water Vapour</td>
<td>Transportation</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Production Industry</td>
</tr>
<tr>
<td>Halocarbons</td>
<td>Agriculture</td>
</tr>
<tr>
<td></td>
<td>Transportation</td>
</tr>
<tr>
<td></td>
<td>Open burning</td>
</tr>
</tbody>
</table>
Causes of greenhouse effect

- Influenced directly by human activities
  - carbon dioxide (released through fossil fuel burning)
  - cement production
  - deforestation
  - methane (emitted by agriculture and livestock)
  - biomass burning
  - nitrous oxide (emissions increase due to use of agrochemicals)

- Influenced by non-human activities – even if humans stopped all activities that emit greenhouse effect gases, the impact of water vapour at current concentrations would continue to be experienced for generations. Non-human activities or natural phenomenon:

1. Variation in solar radiation
   Increasing evidence suggest that sunspot activities may significantly affects our climate. Times of high annual temperatures on earth appear to correspond to periods of maximum sunspot activity.

2. Volcanic Eruptions
   When volcanoes erupt, they eject tons of sulfur dioxide and ash into the air. Both of these substances reflect solar energy back into space, leading to global cooling. This cooling normally peaks 1 to 3 years after the eruption occurs. Volcanoes also expel water vapor and carbon dioxide. These greenhouse gases actually cause warming long after the ash and sulfur dioxide have settled. Volcanic eruptions helped build up the earth’s atmosphere and the current global average temperature to current levels. The strongest effects come from high-sulfur eruptions from tropical volcanoes like Krakatoa rather than sideways ash eruptions from more polar volcanoes like Mount St. Helens

3. Plate tectonics
   Plate movement has led to redistribution of land masses at different latitudes. Land is push upwards creating more mountains, resulting in high altitude getting colder climate, glacier overland and higher albedo. It also affects the ocean currents and alters the global atmospheric circulation.

4. Changes in oceanic circulation
   Climate change affected the oceanic circulation by exchanging of heat between the ocean and the atmosphere.

5. Composition of the Atmosphere
   Gases in the atmosphere can be increased and altered following volcanic eruptions. At present there is increasing concern at the build-up of CO2 and other greenhouse gases in the atmosphere which absorbs and retains the heat making world to be warmer place.
**Activity**

i. Define greenhouse effect

ii. Discuss two causes of greenhouse effect

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**MONAY 11th MAY**

**Social Impacts of Climate Change**

- **Human Health**

  ![Human Health diagram]

  - Displacement of people and migration

  - Climate change will affect all four dimensions of food security: food availability; food accessibility; food utilisation, and food systems stability.

  - Water resources – water utilisation by humans through various activities like agriculture, industrial, domestic, recreational and fisheries.

  - Shortages of Food and Water

    As the world population is growing, there is a higher demand for these vital resources. However, agricultural output in many regions of the world is depleting because of drought, desertification, heat waves, wildfires, and changes in precipitation. In addition, fresh water supplies are decreasing due to the melting of glaciers, the shrinking of lakes, and water contamination.

**Activity**

i. Discuss two benefits of climate change on agriculture.

ii. Discuss two drawbacks of climate change on agriculture.

iii. Examine two ways to reduce global warming.
TUESDAY 12th MAY

Economic Impacts of Climate Change

- Increase in government expenditure
  Government have to spend more money on climate change due to its increasing effects.

1. Rehabilitation
   Re-building nation after frequent natural disasters will have greater impact on gross domestic product.

2. Relocation
   People and industries facing problem with coastal inundation needs to be relocated which may be very costly and done at government expense.

- Impacts on agriculture and marine industry - Coastal inundation will affect the low-lying agricultural production. Increase in temperature due to oscillation in ocean current will cause high salinity and migration of fish from an area.

- Tourism - Tourism industry will benefit thorough winter tourism as some areas will have colder temperature.

- Energy sector – due to climate change, energy production, transmission and distribution will be affected. Extreme climate conditions contribute to increased electricity and energy demand that affect the efficiencies and capacities of energy generation and energy security.

Impacts of climate change on the physical environment

- Ocean acidification – the ocean acts as a carbon sink, it absorbs carbon dioxide and removes carbon dioxide from the atmosphere. When carbon dioxide dissolves in seawater, carbon dioxide forms a weak acid, carbonic acid that leads to decreased pH levels of the seawater. At high concentrations of atmospheric carbon dioxide, high amount of carbon dioxide absorption occurs, thus creating high acidity in the ocean, resulting in negative impacts on marine life. As acidity increases, phytoplankton is reduced, resulting in less aquatic plants being able to uptake the greenhouse gases. Coral bleaching and coral erosion occurs because the less alkaline seawater would decrease the amount of carbon ions available for many marine organisms to form the calcium carbonate of their hard parts.

- Warmer Oceans
  When water heats up, it expands. Thus, the most readily apparent consequence of higher sea temperatures is a rapid rise in sea level. Sea level rise causes inundation of coastal habitats for humans as well as plants and animals, shoreline erosion, and more powerful storm surges that can devastate low-lying areas.

  - Sea level rise – due to global warming, polar ice melting is said to be the main cause of sea level rise. Besides ice melting, thermal expansion of the oceans also contributes to the rise of sea level. When temperature increases, water expands as it warms; thereby the warmer water takes up more volume, which would result the increase in seawater level.
The physical effects of sea level rise are as follows:
- displacement of coastal lowlands and wetlands
- increased coastal erosion
- increased flooding (frequency and depth) – inundation by salt water
- salinization of surface and groundwater due to salt water intrusion
- groundwater rise

The socioeconomic impacts of sea level rise are as follows:
- loss of property and land
- loss of property value due to increased risk
- loss of agricultural capacities
- impacts on agriculture and aquaculture through decline in soil and water quality
- increased flood risk/loss of life
- damage or loss of coastal protection works and other infrastructure
- loss of renewable and subsistence resources
- loss of tourism, recreation, and coastal habitats

- Damage to coral reefs
  - These reef-building corals are highly vulnerable to rising sea temperatures and ocean acidification.
  - Slowed growth and loss of hard corals will reduce essential habitat for many other reef creatures.
  - Reef structures themselves will also begin to crumble if reef growth does not keep pace with erosion by animals and storm

- Sea surface temperature rise – this affects all marine life, contribute to coral bleaching

- Natural disaster and extreme event – more extreme weather and climate related hazards will increase the frequency and intensity of natural disasters

- Changing growing season
With a warming climate, the growing season for some plants may be extended. The last frost would come earlier in the spring and first frost would come later in the fall. However, this advantage can be erased if there is limited water to nourish forests and crops during hot weather. Warmer winters allow forest and crop pests to reproduce longer and suffer less winter die offs, so pest populations can boom. This is already happening in Canada and even Ecosystem changes from shifting seasons can:
  - break historic linkages between predator and prey migrations
  - shift timing of bloom times and necessary pollinators
  - cause population booms or crashes that affect the rest of the system
  - allow invasive plants, animals and insects to move into new territory
  - stress native species with unusual weather and water conditions
THURSDAY 14th MAY

- **Multiple emergency response needs**
  Extreme weather across the state can
  - overtax the emergency response systems and funding for flood response,
  - result in major storms and power outages,
  - create landslides affecting buildings or transportation routes, and
  - causes drought-related fires.

- **Desertification**
  Mass desertification is occurring at an increasing rate and is one of the least known effects of climate change.
  - Millions of square kilometres of once agricultural land have become barren. Any lakes or rivers in its path have disappeared.
  - There are over a 100 countries, primarily in Africa, Asia and Latin America that are currently affected by desertification.

- **Melting Glaciers and Polar Ice Caps**
  Both the melting polar ice caps and melting glaciers pose serious threats to human civilization. The polar ice caps as well as glaciers around the world play an important role in regulating temperature by not only absorbing heat, but also by reflecting the sun's light. Moreover, glaciers play an integral role in forming the world's perennial rivers which are responsible for agriculture that much of the world population is dependent on. Hence, if these glaciers melt, millions of people will have to struggle for water, and wars over natural resources may occur in the far future. Additionally, when ice in Antarctica or glaciers in Greenland melt, they will contribute to rising sea levels.

**Climate change mitigation**

**International efforts to address climate change**

The United Nations plays a vital role in global efforts to address climate change. The United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol are key international or political agreements on climate change through which global negotiations are made.

**United Nations Framework Convention on Climate Change (UNFCCC)**

- The IPCC’s (Intergovernmental Panel on Climate Change) first assessment report in 1990 spurred governments to create the UNFCCC
- The UNFCCC entered into force on 21 March 1994. Today, it has near universal membership. The 197 countries that have ratified the Convention are called Parties to the Convention.
- The ultimate objective of the UNFCCC is to stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system
FRIDAY 15th MAY

Kyoto Protocol (KP)
• The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on climate Change, which commits its Parties by setting internationally binding emission reduction targets.
• Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of “common but differentiated responsibilities.”
• Legally binding agreement under which industrialised countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990

Paris Agreement
On 5 October 2016, the threshold for entry into force of the Paris Agreement was achieved. The Paris Agreement entered into force on 4 November 2016. The first session of the conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA 1) took place in Marrakech, Morocco from 15-18 November 2016. The Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.

COP23
The 2017 UN Climate Conference took place in Bonn, Germany, from 6-18 November. Leaders of national governments, cities, states, business, investors, NGOs and civil society gathered to speed up climate action to meet the goals of the Paris Climate Change Agreement. The COP is organized by the UN Framework Convention on Climate Change (UNFCCC).

Define the following terms.
i. Kyoto Protocol
ii. COP 23
iii. Paris Agreement
iv. Discuss two climate change mitigation measures.