Climate Change & Global Warming

By Hana Taha

1. Definitions of Weather and Climate

Term	Definition
Weather	The state of the atmosphere at a specific place and time — includes precipitation, temperature, humidity, wind, and pressure
Climate	The long-term, prevailing general weather conditions in a particular area over a long period of time

🔑 **Key Difference: Weather = short-term (today's conditions). Climate = long-term (patterns over decades).**

2. Key Definitions

Term	Definition	Example
Climate Change	A change in climate measured over several decades or longer. May be due to natural or human causes.	Volcanic eruption (natural); factory fumes, car exhausts (human)
Adaptation	A response or action taken to cope with actual or anticipated impacts of climate change.	Cooling of public transportation
Mitigation	An effort to stop or slow climate change.	Buying an electric car
Resilience	The combination of mitigation + adaptation strategies that allow us to minimize or avoid bad effects of climate change.	Both strategies together

🧠 **Mnemonic: C-A-M-R → Climate change, Adaptation, Mitigation, Resilience**

Climate change can be prevented by buying Mercedes CAR.
M:- Mitigation / C:- Climate change / A:- Adoption / R:- Resilience.

3. The Water Cycle

The water cycle is a continuous, closed loop with NO starting point, driven by the energy of the SUN.

Term	Definition
Evaporation	Water transforms from liquid to gas (water vapor) as it moves from land or water bodies into the atmosphere. Water vapor is invisible (cannot be seen).
Transpiration	The release of water vapor from plants into the air.
Condensation	Water vapor transforms back into liquid water droplets in the air — forms clouds and fog.
Precipitation	Condensed water vapor that falls to Earth's surface. Forms: rain, snow, hail, fog drip, and sleet.
Freshwater Storage	Sources of freshwater: wetlands, lakes, ponds, large rivers, ice, and snow.
Snowmelt Runoff	Snow melts into streams.
Groundwater Storage	Water present beneath Earth's surface in soil pore spaces and fractures in rock formations.

Facts About the Water Cycle

- Very old groundwater is called fossil water
- The sun is the energy source that drives the entire water cycle
- The water cycle has no starting point — it is continuous

4. The Greenhouse Effect

Step-by-Step Mechanism

1	Short-wave solar (radiant) energy enters the atmosphere from the sun
2	Some waves reflect off clouds and greenhouse gases (GHGs) → return to space
3	Other solar energy waves pass through and reach Earth's surface
4	When they hit the Earth, they slow down and form longer heat (thermal) energy waves

5	**These longer heat energy waves struggle to escape back into space through the GHGs → trapped heat warms the planet**

Enhanced Greenhouse Effect (Human Influence)

- As human activity and natural sources add MORE GHGs to the atmosphere → heat waves find it even harder to escape
- GHGs act like the glass or plastic covering of a greenhouse — trapping heat inside

🔑 **Natural Greenhouse Effect = some heat escapes. Human-enhanced effect = LESS heat escapes → planet warms more.**

5. Greenhouse Gases (GHGs)

GHG #1 — Carbon Dioxide (CO2)

Sources:

- **a.** Burning of organic matter (wood, coal, gasoline) in the presence of oxygen
- **b.** Deforestation — destroying forests ⟶ forests → ↓CO_2 ⟶ so Deforestation ⟶ ↑CO_2
- **c.** Respiration of living things
  ↳ gives CO_2

GHG #2 — Methane (CH4)

Three main sources:

- **a.** Fossil fuel production, distribution, and use — 26%
- **b.** Natural release from plant decomposition, wetlands, and oceans — 22%
- **c.** Livestock farming — 21%

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GHG #3 — Nitrous Oxide (N2O)

Two main sources:

- **a.** Natural release by soil bacteria and oceans
- **b.** Agricultural sources: livestock waste and fertilizing crops

GHG #4 — Water Vapor (H2O)

- Produced naturally by evaporation, sublimation, and transpiration

6. Global GHG Emissions by Gas

Gas	% of Emissions	Notes
CO2 — Fossil Fuels & Industrial Processes	65%	Largest contributor
CO2 — Forestry & Other Land Use	11%	CO2 total = 76%
Methane (CH4)	16%	
Nitrous Oxide (N2O)	6%	300x more potent than CO2!
F-gases	2%	Smallest share

🔑 CO2 total = 65% + 11% = 76% of all global GHG emissions

7. Global GHG Emissions by Economic Sector

Rank	Sector	%	Priority
#1	Electricity & Heat Production	25%	HIGHEST
#2	Agriculture, Forestry & Other Land Use	24%	
#3	Industry	21%	
#4	Transportation	14%	4th source
#5	Other Energy	10%	
#6	Buildings	6%	

🌍 Electricity production = #1 source of GHGs (25%) | Transportation = 4th source (14%)

8. Key Facts About the Greenhouse Effect

The right amount of GHGs keeps us from freezing to death and protects us from dangerous UV radiation (skin cancer).

Greenhouse gases come from both natural AND man-made sources.

N2O is 300 times more efficient at trapping heat than an equal weight of CO2! (Very important exam fact)

9. Global Sea Surface Temperature

Key Stat	Value
Ocean coverage of Earth's surface	~70%
Excess heat absorbed by oceans	~90%

Effects of Rising Sea Surface Temperature

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Effect	Explanation
Rising Sea Levels (result of water warming.)	Water expands as it warms + warmer water speeds up melting of sea ice
Threatened Marine Ecosystems	Coral reef bleaching; low oxygen levels for fish in parts of the ocean
Disruptive Weather Patterns	More water vapor over oceans → heavier rains/snows in some areas, drought in others
Threatened Human Livelihoods	Coastal flooding, loss of fishing, displacement of communities

10. Ways to Mitigate Human GHG Emissions → And Mitigate Climate Change

- Reduce energy consumption (conserve energy)
  - → Electricity production is the #1 source of GHGs
  - → Transportation is the 4th source of GHGs
- Reduce emissions from existing industrial and agricultural processes → by using fertilizers
- Switch to renewable energy sources that do not produce GHGs (e.g., solar panels)

11. Ways to Adapt to Climate Change in Agriculture

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- Increase shade and improve ventilation in barns for livestock
- Breed crops that are drought-tolerant or thrive in variable temperatures
- Breed disease-resistant crop and livestock species
- Change crops grown in an area to ones suited for new climate conditions
- Harvest and plant seeds from forest trees doing well in changing climate → زراعة الأشجار التي تنجح في تعديل المناخ.
- Use only the water and fertilizers needed by the crop (precision agriculture)
- Use cultural practices like mulching to conserve water and improve soil temperatures

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Economic Concerns with a Changing Climate

- **Damage to infrastructure** from extreme weather events (floods, hurricanes, wildfires) costs billions in repairs
- **Loss of agricultural productivity** due to droughts, floods, and unpredictable seasons → food prices rise
- **Rising energy costs** — more cooling needed in summers, disrupted energy supply
- **Loss of coastal property and land** due to rising sea levels → displacement of entire communities
- **Decline in tourism** — melting glaciers, bleached coral reefs, and extreme heat reduce visitors
- **Higher insurance costs** as natural disasters become more frequent and severe
- **Job losses** in sectors dependent on stable climate (fishing, farming, skiing)

Health Concerns with a Changing Climate

- **Heat-related illnesses and death** — heatwaves become more frequent and deadly
- **Spread of vector-borne diseases** — warmer temperatures expand the range of mosquitoes carrying malaria, dengue fever, and Zika virus
- **Respiratory diseases** — worsening air quality and increased wildfire smoke → asthma and lung problems
- **Food and water insecurity** — droughts and floods reduce clean water and food availability → malnutrition
- **Waterborne diseases** — flooding contaminates drinking water sources → cholera, typhoid
- **Mental health impacts** — displacement, loss of homes, and climate anxiety
- **Longer allergy seasons** — warmer temperatures extend pollen seasons

Read those carefully…

Environmental Concerns with a Changing Climate

- **Loss of biodiversity** — many species cannot adapt fast enough and face extinction
- **Melting of ice caps and glaciers** → rising sea levels threatening coastal ecosystems
- **Ocean acidification** — oceans absorb CO_2, becoming more acidic → harms marine life
- **Desertification** — fertile land turns to desert due to prolonged drought
- **Deforestation worsens** as fires increase and forests struggle to survive
- **Disrupted ecosystems** — animals migrate or go extinct, breaking food chains
- **Coral reef bleaching** and collapse of marine habitats because of rising temperature & Acidification.

EXAM SUMMARY TABLE

Numbers You Must Memorize

Topic	Key Number / Fact
CO2 from fossil fuels & industry	65%
CO2 from land use & forestry	11%
CO2 total share	76% (65+11)
Methane (CH4)	16%
Nitrous Oxide (N2O)	6%
F-gases	2%
Electricity & Heat (sector #1)	25%
Agriculture, Forestry & Land (sector #2)	24%
Industry (sector #3)	21%
Transportation (sector #4)	14%
Buildings (sector #6)	6%
N2O vs CO2 heat-trapping efficiency	N2O is 300x more efficient than CO2!
Ocean coverage of Earth's surface	~70%
Excess heat absorbed by oceans	~90%
Methane: Fossil fuels source	26%
Methane: Natural decomposition source	22%
Methane: Livestock farming source	21%

Good luck on your exam!

Just Memorise highlighted :- My POV ☺