Name: _____ Class: _____ Date: _____

The atmosphere: atmospheric pressure

PAGES 222 TO 225

CONCEPT REVIEW 29
Complete this concept review handout and keep it as a record of what you have learned.

Definitions

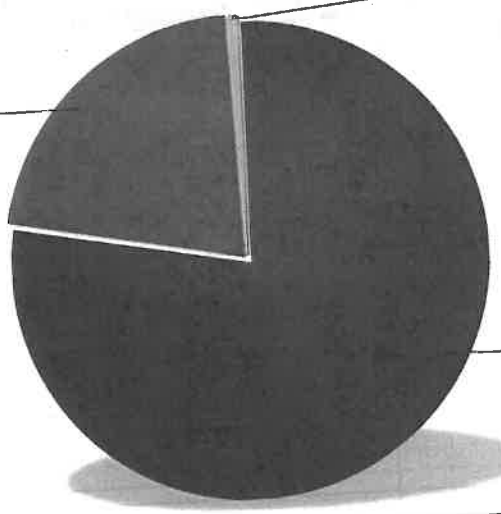
- The atmosphere is *the layer of air surrounding the Earth.*
- Air is *the mixture of gases, especially nitrogen and oxygen, that makes up the atmosphere.*
- Atmospheric pressure is *the pressure of the air in the atmosphere.*

Unit of measurement: *kilopascal* Symbol: *kPa*

Role of the atmosphere in maintaining life on Earth

- *It blocks out dangerous rays from the sun, such as ultraviolet rays.*
- *It retains heat, ensuring a relatively stable climate on Earth.*
- *The oxygen and carbon dioxide it contains make cellular respiration and photosynthesis possible.*

Composition of the atmosphere



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Layers of the atmosphere

Layer	Altitude	Distinctive features
Exosphere	*500 km and more*	• *Air is very rare.* • *Most satellites are found here.*
Thermosphere	80–500 km	• The hottest layer of the atmosphere, temperatures climb to 1800°C. • Shooting stars and polar auroras form here.
Mesosphere	*50–80 km*	• *The coldest layer, temperatures fall to –80 °C.* • *Air particles are very sparse.*
Stratosphere	*15–50 km*	• *The ozone layer, which absorbs UV rays, is here.* • *Temperatures rise with altitude.*
Troposphere	*0–15 km*	• *Most meteorological phenomena occur here.* • *Temperatures drop with altitude.*

Factors affecting atmospheric pressure

Factor	Variation in the factor	Effect
Number of air particles	*Increase*	• *Atmospheric pressure rises.*
	Decrease	• *Atmospheric pressure falls.*
Temperature of air particles	*Increase*	• *Particles move away from one another and the air tends to rise.* • *A low-pressure area forms.*
	Decrease	• Particles move closer together and the air tends to fall. • A high-pressure area (anticyclone) forms.

- Prevailing winds are major atmospheric currents that blow in a given direction over global patterns of movement.
- An air mass is a large expanse of the atmosphere with relatively uniform temperature and humidity.
- A cyclone is a tropical storm characterized by violent winds revolving around an area of low pressure.

Atmospheric circulation cells

Cell	Location	Movement of air
Hadley cell	Between the equator and the 30th parallel	• Air over the equator, rises into the atmosphere. • It gradually cools as it travels toward the 30th parallel. • It runs into winds from the Ferrel cell, descends and returns to the equator.
Ferrel cell	Between the 30th and 60th parallels	• Part of the air approaching the 30th parallel surges toward the poles. • Near the 60th parallel, this air collides with winds from the Polar cell. • The air rises and returns toward the 30th parallel.
Polar cell	Between the 60th parallel and a pole	• The temperature of the air drops to its minimum over the poles. • The air sinks to the Earth and then turns toward the 60th parallel, where it collides with the Ferrel cell. • The air is forced to rise and return to the poles.

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Prevailing winds

Winds	Location	Direction in the Northern Hemisphere
Polar easterlies	*Between a pole and the 60th parallel*	*From northeast to southwest*
Westerlies	*Between the 60th and 30th parallels*	*From southeast to northeast*
Trade winds	*Between the 30th parallel and the equator*	*From northeast to southeast*

Jet streams

- Name: *Subtropical jet stream.*
  Speed: *Up to 400 km/h in winter.*
  Location: *Around the 30th parallel at an altitude of 11 000 to 14 000 m*
- Name: *Polar jet stream.*
  Speed: *Up to 300 km/h in winter.*
  Location: *Around the 60th parallel at an altitude of 9000 to 10 000 m*

Characteristics of fronts

Name	Formation	Movement of air	Meteorological conditions
Cold front	*When a mass of cold air meets a mass of warm air.*	The warm air rises rapidly above the cold air.	• Formation of puffy clouds (cumulus) • Probability of wind and heavy rain
Warm front	*When a mass of warm air meets a mass of cold air.*	*The warm air rises gently above the cold air.*	• *Formation of light clouds (nimbostratus)* • *Probability of cloudy weather and showers*

Anticyclones and depressions

Name	Formation	Movement of air	Meteorological conditions
Anticyclone	Surrounds a high-pressure centre.	• *Clockwise rotation in the Northern Hemisphere* • *Counterclockwise rotation in the Southern Hemisphere*	*Clear sky and stable weather:* • *Dry and sunny in summer* • *Cold in winter*
Depression	*Surrounds a low-pressure centre.*	• *Counterclockwise rotation in theNorthern Hemisphere* • *Clockwise rotation in the Southern Hemisphere*	• *Cloud formation* • *Precipitation*

- Climate change is *the abnormal modification of climatic conditions due to human activity.*
- The ozone layer is *a part of the atmosphere with a high concentration of ozone molecules, which absorb some of the ultraviolet rays from the sun.*
- Smog is *a thick mixture of fog, smoke and atmospheric pollutants.*
- Wind energy is *the energy that can be drawn from the wind.*

Factors leading to the intensification of the greenhouse effect

Greenhouse gas	Factors of natural origin	Factors linked to human activity
Carbon dioxide (CO_2)	• Forest fires • Volcanic eruptions • Cellular respiration	• *Combustion of fossil fuels* • *Clearing of land*
Methane (CH_4)	• Digestion in wild animals • Decomposing plants • Swamps	• *Digestion in farm animals* • *Decomposing household waste* • *Manure storage and management* • *Distribution of natural gas* • *Rice farming in paddy fields*
Nitrous oxide (N_2O)	• Bacteria in the soil and oceans	• *Applying nitrogen-rich fertilizer* • *Certain chemical processes*

Name: _____ Class: _____ Date: _____

Some atmospheric contaminants

Contaminant	Consequence
Sulphur dioxide (SO_2)	*Acid rain, smog*
Nitrogen oxides (NO_x)	*Acid rain, smog*
Metals (mercury, arsenic, lead)	*Toxic for human health*
Chlorofluorocarbons (CFCs)	*Destruction of ozone molecules*
Dust and airborne particles	Respiratory difficulties

Thinning of the ozone layer

Description of the ozone molecule (O_3)	Cause of the thinning of the ozone layer	Ways to combat the thinning of the ozone layer
Molecule composed of three oxygen atoms existing as a gas.	*Use of CFCs.*	*Montréal Protocol signed in 1987.*

Smog

Formation of tropospheric ozone: *Occurs when the Sun's rays hit nitrogen oxide molecules coming mainly from car exhaust or factories.*

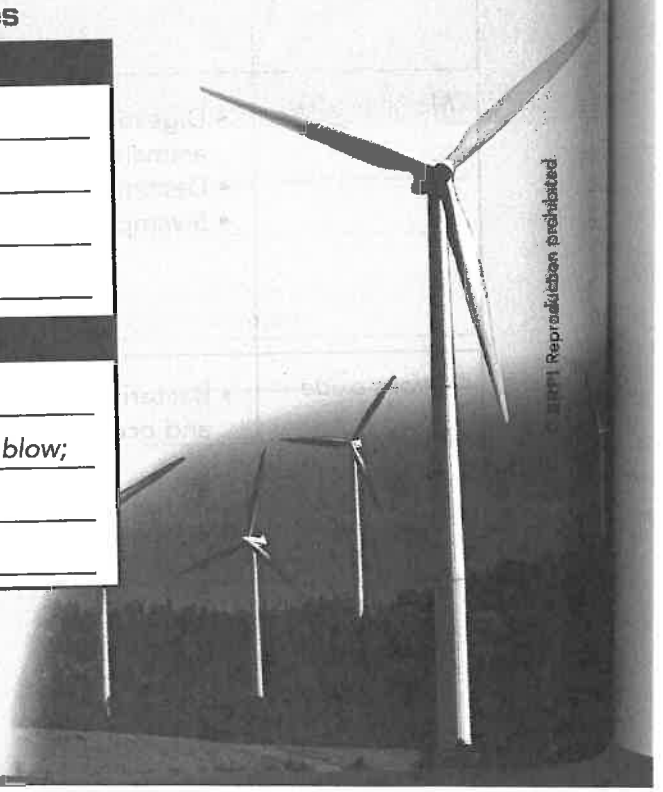
Formation of smog: *Occurs when tropospheric ozone combines with other atmospheric pollutants, such as nitrogen dioxide or sulphur dioxide.*

Consequences of smog: *Forms a thick fog; leads to respiratory problems.*

Advantages and disadvantages of wind turbines

Advantages
• *Renewable resource*
• *No production of greenhouse gases*

Disadvantages
• *Visual pollution*
• *Impossibility of predicting when and where the wind will blow; wind energy cannot be stored.*



Characteristics of the Sun

- Composition: *75% hydrogen and 25% helium.*
- Temperature at the centre: *15 millions degrees Celsius.*
- Form of energy emitted: *Nuclear energy.*

Types of solar ray making their way to the Earth's surface

- *Infrared rays*
- *Visible light*
- *Ultraviolet rays*

Technologies that put solar energy to use

Technology	Use	Characteristics
Passive heating systems	Heating of homes	• Positioning of windows toward the sun • *Use of materials that absorb solar energy, such as concrete.*
Photovoltaic cells	*Supplying home appliances with electricity*	• *With the action of light, electrons contained in material are set in motion.*
Solar collectors	*Heating of buildings, and water in homes or swimming pools*	• *Capture, by glass panels, of the heat of the Sun's rays.*

Advantages and disadvantages of solar energy

Advantages	Disadvantages
• *Renewable source of energy.* • *Does not emit greenhouse gases.* • *Supplies electricity to isolated areas.*	• *Costly system.* • *Amount of energy produced varies with the Sun's position and cloudy conditions.*

- Tidal energy is *the energy obtained from the ebb and flow of tides.*

Characteristics of the Moon

- Average diameter: *3476 km*
- Theory on its origins: *The Moon is thought to have been formed following the reuniting of fragments produced by the collision of a large meteorite and the Earth.*
- Duration of the Moon's rotation on its axis: *27.3 days.*
- Duration of the Moon's revolution around the Earth: *27.3 days.*

Tidal range

Definition	Factors influencing tidal range
Difference in water levels at low and high tide	• *Shape and slope of the coastline* • *Depth of the water* • *Distance of the Moon or Sun from the Earth*

Advantages and disadvantages of tidal power plants

Advantages	Disadvantages
• *Renewable source of energy.* • *Reliable source of energy.* • *Does not emit greenhouse gases.*	• *Complex plants.* • *Costly plants.* • *Suitable sites are rare (tidal range must be at least 5 m).*

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