5.1 What is a hazard?

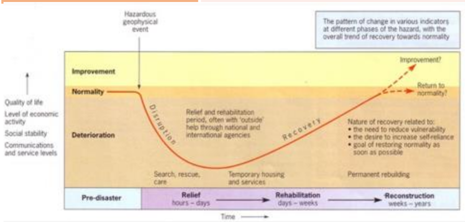
A hazard is the threat of substantial loss of life, substantial impact upon life or damage to property that can be caused by an event.

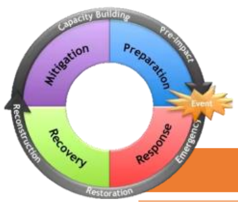
Atmospheric	Driven by processes at work in the atmosphere e.g. tropical storms and drought
Geophysical	Driven by Earth's own internal energy sources e.g. plate tectonics
Hydrological	Driven by water bodies, mainly oceans. E.g. floods, storm surges and tsunamis

5.1.2 The Park Model

The Park Model describes three phases following a hazardous event.

Relief	Immediate local and possible global responses. Aid, expertise and search and rescue
Rehabilitation	Longer phase, lasting weeks or months. Infrastructure and services are restored although maybe temporarily.
Reconstruction	Restoring to the same or better quality of life as before the event. Likely to include mitigation for future hazards.





5.1.3 The Hazard Management Cycle

Manages both pre- and post-event situations

Preparedness	Education and raising public awareness of hazards can reduce the impacts. Knowing what to do in the immediate aftermath can speed up the recovery process.
Response	Speed of response will depend on the effectiveness of the emergency planning. Immediate responses focus on saving lives and medical assistance.
Recovery	Restoring the affected area to something similar to normality.
Mitigation	Actions aimed at reducing the severity of an event and lessening the impacts. This can include improving building design to withstand hurricanes or earthquakes, flood defences or preparing barriers that will halt the advance of wildfires.

Perception of Hazards

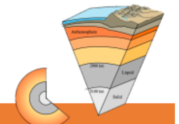
How we perceive a hazard is determined by the effect it may have on our lives. Perception increases if people have direct experiences of hazards and the long term impacts on lives.

Human Responses

Fatalism	Acceptance that hazards are natural events that we can do little to control and losses have to be accepted.
Prediction	With the increase in technology we can now predict hazardous events more and more. Information can be shared around the world and warnings communicated promptly. This will reduce the risk and impacts of hazards,
Adaptation	Once we have accepted that natural events are inevitable we can adapt our behaviour accordingly to try and keep losses to a minimum. This is both a realistic and cost effective option for governments.

Unit 1, Section C, Topic 5

Hazards

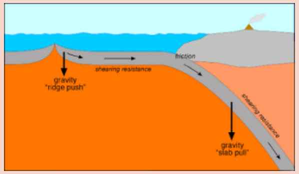


5.2 The Structure of the Earth

The crust	The crust varies in thickness from between 5 to 10km beneath the oceans to nearly 70km under countries. ***Oceanic crust*** – an occasionally broken layer of basaltic rocks known as sima (silica and magnesium) ***Continental crust*** – mainly granite rocks known as sial (silican and aluminium)
The lithosphere	Together the crust and upper mantle are known as the lithosphere. This is where tectonic plates are formed.
The mantle	The widest section, 2,900km thick. Mainly silicate rocks in a thick liquid state due to the heat – density increases with depth. Rocks in the upper mantle are solid and sit on top of the asthenosphere, a layer of softer rock. The asthenosphere can move slowly carrying the lithosphere on top.
The core	The centre and hottest part of the Earth – temperatures of around 5000°C. Mostly iron and nickel. ***Outer core*** – semi liquid and mainly iron ***Inner core*** – solid and iron – nickel alloy. Natural radioactivity in the core is the main source of heat energy, generating convection currents in the mantle above.

5.3 Tectonic Plate and Plate Movement

Gravitational sliding	The lithosphere cools and thickens with distance from the ridge. As a result it slopes away from the ridge.
Ridge push	Gravity acting on the weight of the lithosphere near the ridge 'pushes' the older part of the plate in front (***ridge push***)
Slab pull	Following subduction the lithosphere sinks into the mantle and 'pulls' the rest of the plate with it **(*slab pull*)**
Convection currents	Hot spots around the core create convection currents which rise towards the surface spreading in the asthenosphere, then cooling and sinking again.
Sea flood spreading	As plates slowly move away from each other, lava erupts and cools to form new rocks. The rate of spreading is estimated at 5cm a year.



5.4 Plate boundaries

Constructive: When two plates separate, moving away from each other. This is where some of the youngest rocks on Earth are found as new crust is formed.

Oceanic Areas Mid-ocean ridges (e.g. the Mid-Atlantic Ridge)	• Forms chains of submarine mountains • Regular faults cut along the ridge • Mid-ocean ridges can rise up to 4000m above the ocean floor • Volcanic eruptions along the ridges build submarine volcanoes that may grow to rise above sea level creating volcanic islands.
Continental Areas Rift Valleys (e.g. East Africa's Great Rift Valley)	• Lithosphere stretches and fractures into parallel faults • The land between the faults collapses into deep, wide valleys.

Conservative: Where two plates slide past each other

- Friction between the two plates leads to stresses building up when sticking occurs
- These stresses are eventually released as earthquakes

Magma Plumes: Hot spots around the core heat the lower mantle creating localised currents where magma rises vertically

- As the hotspot remains stationary the movement of the plates results in the formation of a chain of active volcanoes – e.g. Hawaii

5.6 Volcanic Hazards

Ash cloud	Small pieces of pulverised rock and glass which are thrown into the atmosphere.
Gas / acid rain	Sulphur dioxide, carbon monoxide and carbon dioxide come out of the volcano. Can contribute to acid rain
Lahar / mudflows	A volcanic mudflow which usually runs down a valley side on the volcano.
Pyroclastic flow	A fast moving current of super-heated gas and ash (1000°C). They travel at 450mph.
Nuées ardentes	Glowing clouds of hot gas, steam, dust, volcanic ash and pyroclasts travelling at a high velocity

5.7 Responses to Volcanic Eruptions

Adaptation	Preparedness
Avoid living in areas at risk	Study the eruption history of a volcano
Ensure evacuation routes are available and clear	Measure gas emissions, land swelling and groundwater levels
Mitigation	
Creating an exclusion zone around the volcano.	Build barriers to slow down lava flows
Having an emergency supply of basic provisions, such as food	Trained emergency services and a good communication system.

The distribution of hazards is uneven, some areas of the world are more at risk than others.
- Earthquakes along plate margins
- Volcanoes along plate boundaries as well as hot spots e.g. Hawaii

5.9 Seismic Hazards

Earthquake	As tectonic plates move over, under and against each other the stress generated by frictional drag causes earthquakes
Tsunami	Usually generated by seismic activity such as ocean floor earthquakes or volcanic eruptions
Landslide	a collapse of a mass of earth or rock from a mountain or cliff, often induced by earthquakes
Liquefaction	The jelly-like state of silts and clays resulting from intense ground shaking.

5.12 Responses to Seismic Hazards

Adaptation	Preparedness
Avoid areas where liquefaction is likely	Monitoring of fault lines and local magnetic fields
Avoid building in high risk areas, e.g. low lying coasts in tsunami prone areas	Study of groundwater levels, the release of gas and animal behaviour
Mitigation	
Infrastructure designed to withstand ground shaking	Meters that cut off gas supplies at a tremor threshold
Public education such as drills in schools and workplaces	Keep emergency services well organised with correct gear in place

5.14.1 Distribution of Tropical Storms.

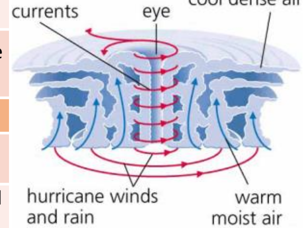
They are known by many names, including hurricanes, cyclones and typhoons. They occur in a band that lies roughly between the tropics of Cancer and Capricorn. Some storms can form just outside of the tropics, but generally the distribution of these storms is controlled by the places where sea temperatures rise above 27°C.

5.14.2 Formation of Tropical Storms

1	The sun's rays heats large areas of ocean in the summer. This causes warm, moist air to rise.
2	Once the temperature is 27°C, the rising warm moist air leads to a low pressure. This eventually turns into a thunderstorm where air is sucked in from the trade winds.
3	With trade winds blowing in the opposite direction and the rotation of earth involved (Coriolis effect), the thunderstorm will eventually start to spin.
4	When the storm begins to spin faster than 74mph, a tropical storm is officially born.
5	With the tropical storm growing in power, more cool air sinks in the centre of the storm, creating calm, clear condition called the eye of the storm.
6	When the tropical storm hit land, it loses its energy source and it begins to lose strength. Eventually it will 'blow itself out'.

5.15 Responses to Storm Hazards

Adaptation	Preparedness
Construction of sea walls and flood barriers	Hurricane drills
Strengthening of buildings to withstand storms, buildings on stilts to protect from floods	The NOAA uses computer modelling to predict changes in wind speeds, humidity etc
Ensure areas of high risk have limited development	Tracking and predicting the origin of storms.
Mitigation	
Reducing the storms energy while it is still over the ocean	'Seeding' the storm using silver iodide outside the eye wall to produce rain.



5. 16.2 Impacts of fires

- Loss of timber, livestock and crops
- Loss of wildlife
- Release of toxic gas
- Damage to soil structure and nutrient content

Plate Boundaries Continued

Destructive: When two plates collide, moving towards each other.

Oceanic vs Continental	• The oceanic plate is denser so subducts forming a deep ocean trench. • Continental land mas is lifted, compressed and buckled to form form mountains • Friction builds up and can be released as earthquakes • The descending oceanic plate melts and rises as magma which may eventually reach the surface to form a volcanic eruption
Oceanic vs Oceanic	• One plate subducts leading to a deep ocean trench • The subducted plate melts, causing magma to rise and submarine volcanoes grow
Continental vs Continental	• Continental plates are lower density than the asthenosphere so there is no subduction • The colliding plates uplift to form fold mountains

5.16 Fires in Nature

10% of fires in nature, commonly known as bushfires, brush fires or wildfires occur naturally as a result of lightening strikes. Most are human induced and spread out of control. Fires are associated with semi-arid climates where there is enough rainfall for vegetation to grow however a dry season for ignition conditions.

5.16.3 Responses to Fire Hazards

Adaptation	Preparedness
Land use planning and fire resistant housing	Technology to warn at risk areas
Fire breaks and wide roads to allow access for firefighting equipment	Training communities to coordinate responses
Mitigation	
Reducing or eliminating fuel supplies from the potential path of fire	Extinguishing fires as they occur.

Case Studies and Recent Events

Event/Case Study	Example
5.8 A recent volcanic event	Eyjallajökull - 2010
5.11 A recent seismic event	Haiti Earthquake - 2010
5.18 Two recent storms in contrasting areas of the world	Hurricane Katrina - 2010 Typhoon Haiyan - 2013
5.17 A recent wildfire event	Australia Bushfires - 2019/2020
A multi-hazardous environment	The Philippines
5.13 A local scale of a specific place in a hazardous setting	Tokhu, Japan