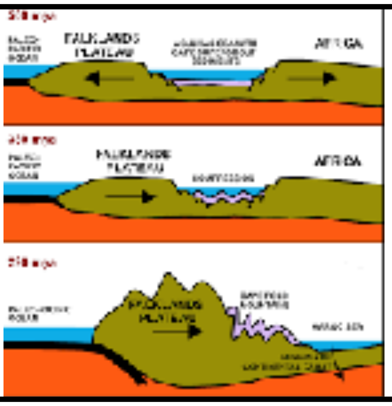
Environmental Management Key Terms:

Managing Natural Hazards

Supervolcano	A volcano that erupts at least 1000km3 of material.	Plate Techtonics	A theory developed in the 1960s that helps explain the formation of some of the important features on the Earth’s surface and how the continents move.
Natural Hazards 1	**A naturally occurring event that will have a negative impact on people.** • **Geographical** - earthquakes, volcanos • **Climatic** - drought, cyclones, floods Other classifications: - magnitude/size/intensity - speed of event - duration - frequency	Fold Mountains: 1	Mountains created where two or more tectonic plates are pushed together, compressing the rocks and folding them upwards.
Risk	The probability of a natural hazard occurring and the losses or damage that might result from the natural hazard.	Fold Mountains: 2 (https://commons.wikimedia.org/wiki/File:Formation_of_Cape_Fold_Mountains.jpg)	
Natural Disaster	When a natural hazard causes damage and the people affected are unable to cope. To be classed as a disaster by the UN’s International Strategy for Disaster Reduction (ISDR): - report of 10+ killed - report of 100+ affected - state of emergency delayed by a gov’t - request by gov’t for international assistance Impact on a community depends on: • length of time people are exposed to the hazard • vulnerability of the people affected • people’s ability to cope with the effects.	Crust: Oceanic	- **Younger** than continental crust - As it is constantly destroyed at subduction zones and made at constrictive plate boundaries (such as the Atlantic Ridge. - Mainly made of **basalt** rock - Average depth = 6km. **Thinner** than continental as weighed down by ocean above, so denser too. - At subduction zones it will **sink under the continental crust** **Sima:** another name for the oceanic crust. Rich in silicate and magnesium minerals.
Vulnerability	The characteristics and circumstances of people in a community that make them susceptible to the impacts of a natural hazard.	Crust: Continental	- **Older** than the oceanic crust - Mainly made of **granite** - It **doesn’t sink at subduction zones** so never gets destroyed or renewed. - **Thicker** than oceanic crust. Average depth of 35km, but over 100Km in mountain ranges. **Sial:** another name for the continental crust. Rich in silicate and aluminium minerals.

Crust: Continental Shelf	The part of the continental crust that is submerged under an area of relatively shallow sea water, forming the edge of the continental land mass.
	• Typically 100-200 m deep.
	• Full of life as sunlight can reach the bottom
	  • plants grow - food and home for marine animals
	  • Birds and other animals come for food
	• Economic asset - food, wildlife, tourism, jobs
		Granite	A course-grained intrusive igneous rock comprising the minerals quartz, feldspar and mica, it is formed at the destructive plate margins.

Earth Structure: 1 https://www.livescience.com/earth-inner-core-mushy)		Tectonic Plate	A piece of the lithosphere that moves slowly on the asthenosphere, seven major, eight minor and numerous micro plates have been identified.
Earth Structure: 2	**The Crust:** top lay, either continental or oceanic. 0-100km deep. **The Mantle:** 80% of the volume of the Earth. Made up of upper (brittle-ish) and lower mantle (viscous) with a transition layer between the two. Behaves like plastic, moving slowly with convection currents from the core. 1000-1200C **The Outer Core:** 4-5000C. Liquid iron and nickel **The Inner Core:** 5-6000C. Believed to be solid due to pressure. Iron and nickel.	Lithosphere	The outer and rigid layer of the Earth, comprising the crust and the upper parts of the mantle.
Asthenosphere	The layer of the Earth below the lithosphere, it is hotter and weaker than the lithosphere above and us capable of plastic flow (deformation of material that remains rigid).	Convection Currents	Transfer heat from place to place, denser colder fluid sinks into warmer areas, heat from the Earth's core causes convection currents in the mantle.
Basalt	A fine-grained extrusive igneous rock formed by the cooling of lava at constructive plate margins.	Plate Boundaries: 1	Where two or more plates meet, the three main types of plate boundary are **constructive** (divergent), **destructive** (convergent) and **conservative** (transform). Most earthquakes and volcanos occur close to or along a plate boundary (although volcanos can also be found at hotspots, and earthquakes can happen wherever the crust moves).

Plate Boundaries: 2
(https://slideplayer.com/slide/13123816/)

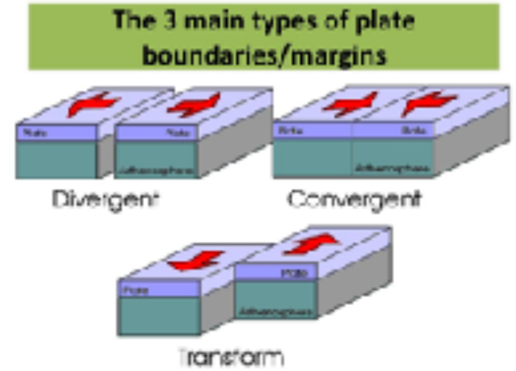


Plate Boundaries: 4
Continental/Continental
Constructive
(divergent)

Rift Valley
E.g. The East African Rift Valley
- **Convection currents**: plates pull apart
- **Valley**: A valley forms between the two faults.
- The area will be geologically active, with **volcanoes**, hot springs, geysers, and frequent **earthquakes**.

Plate Boundaries: 3
Oceanic/Oceanic
Constructive
(divergent)

Sea-floor spreading (ridge push)
E.g. the Mid-Atlantic Ridge
- **Convection currents**: pulls plates apart
- **Gap** (or weakness) forms
- **Convection currents**: Magma rises to the surface and through the gap (lava).
- **Ridges**: The lava solidifies when cooled by the sea water becoming basaltic ocean crust
- **Volcanos**: Can also form submarine volcanoes and volcanic islands (above sea level).

The sea floor is older the further away from the ridges it is.

Ocean Trench

A depression in the sea floor that runs parallel to a destructive plate boundary.

E.g. the Mariana Trench

These trenches form the deepest part of the ocean

Plate Boundaries: 5
Continental/Oceanic
Destructive
(convergent)

E.g, Nazco/South American plate boundary (Peru-Chile Trench, Andes Mountains)
- **Convection currents**: bring plates together
- **Subduction**: oceanic under continental **(slab pull)**
- **Trench:** Forming an ocean trench
- **Earthquakes**: Subduction creates pressure and triggers severe earthquakes in **Benioff zone**
- **Magma**: Oceanic crust melts in mantle
- **Volcanoes:** Magma rises and erupts through a weakness in the crust,
- **Fold mountains**: form on continental plate as sediment gets pushed up

Plate Boundaries: 6
Oceanic/Oceanic
Destructive
(convergent)

E.g. the subduction of the Pacific Plate south of Alaska, creating the Aleutian Islands
- **Convection currents**: bring plates together
- **Subduction**: The older, denser plate is subducted
- **Trench**: There is commonly an ocean trench along the boundary (at the subduction zone) as the crust bends downwards.
- **Magma**: Oceanic crust melts in mantle.
- **Volcanoes**: Magma rises up, forming chain of volcanic islands - an **island arc**.

Plate Boundaries: 8
Conservative
(transverse)

E.g. San Andreas Fault, California, USA (same direction, but different speeds)
- **Convection currents**: plates move past each other either in opposite directions, or the same direction at different speeds
- **Pressure builds**: plates lock together and the pressure builds
- **Earthquake**: Energy is suddenly released as the plates jolt past each other, shaking the ground, or moving it in sudden jerks.

Plate Boundaries: 7
Continental/Continental
Destructive
(convergent)

E.g. the Himalayas
- **Convection currents**: bring plates together
- Forming a **collision zone**
- **Fold mountains**: Form as sediments get squeezed together and pushed up
- **Earthquakes**: yes (but no volcanic activity as no magma from subduction)

Sea-floor Spreading

The process by which oceans are formed at constructive plate boundaries, new oceanic crust is formed as two plates move apart.

Ridge Push

A gravitational force that causes an oceanic plate to move away from the crest of a mid-ocean ridge and into a subduction zone, it works together with slab pull.

Volcanoes 4:
Shield (basic) i

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

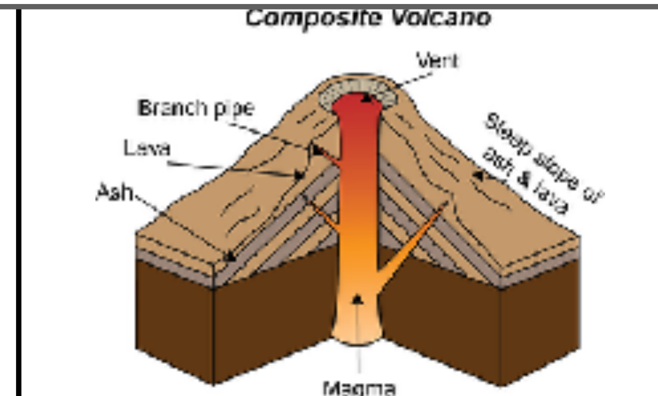
Shield/basaltic lava volcano/basic lava cone

Wide with shallowly-sloping sides, built up over time by flow after flow of relatively fluid basaltic lava coming from vents or fissures on the surface of the volcano. Found on constructive plate boundaries and hotspots, making up many of the largest volcanoes. E.g, Mauna Loa & Kilauea (Hawaii), and Etna (Sicily)

Basic lava: contain small amount of silica; highly fluid; low melting point; fast flowing; travels long distances, builds gently sloping cones, and are quiet and without much explosive activity.

Volcanoes 7:
Composite (strato) ii

(http://ds.iris.edu/aed2/c/alaska/popups/volcanoes/vol_1_vol6.html)



Volcanoes 6:
Composite (strato) i

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

Composite or strato volcano

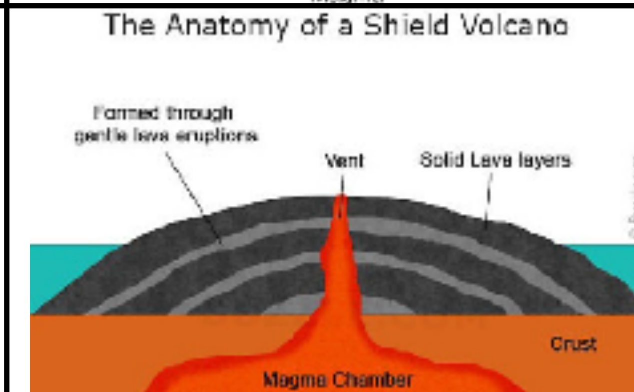
A tall, conical volcano built up through multiple eruptions, creating alternating layers of lava and ash, characterised by a steep profile and periodic, explosive eruptions. Found on destructive plate boundaries.

E.g. Mount St. Helens USA, Mount Vesuvius Italy, Mount Fuji Japan

Lava issued sideways from the main vent to form dykes which strengthened the cone. Sometimes active conelets known as parasitic or secondary cones are formed on the sides of the main of the main volcano.

Volcanoes 5:
Shield (basic) ii

(https://quizlet.com/gb/349454582/shield-volcanoes-diagram/)



Volcanoes 8:
Acidic/Lava Dome i

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

Dome volcano/acidic lava dome/silicic lava dome

These volcanoes are made just from lava. The domes are rounded, steep-sided mounds (cone shaped), built up by very viscous magma.

E.g. Unzen Volcano (Japan), Mount Hood (Oregon), Soufriere Hills Volcano (Montserrat)

Acidic lava: contain large amount of silica; are highly viscous/ sticky; have a high melting point; are slow flowing; seldom travel far; build steep sided cones; and have explosive volcanic activity

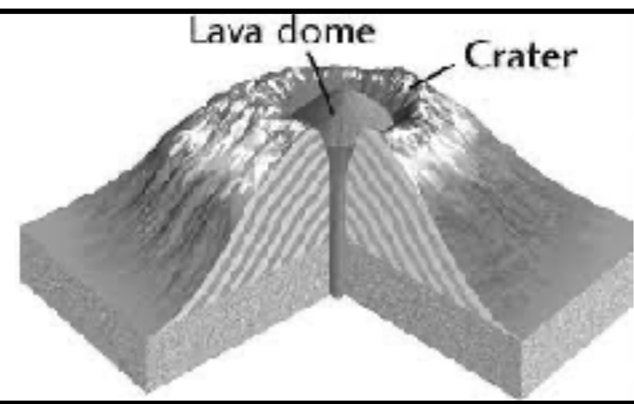
Volcanoes 10:
Pros

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

- Volcanic/ igneous rocks = **minerals**, e.g., nickel, copper and gold.
- Weathered lava produces good farming **soil**.
- Hot springs = source of **energy** for domestic use. Some spas/hot springs are used for health tourism,
- Geothermal electrical energy in Iceland is produced from hot springs and steam.
- Volcanic features are major **tourist** attractions
- Volcanic/ igneous rocks = **chemicals**, E.g. Mud rich in black iron sulphide is used in Dominica for soap manufacturing. (Dominica also exports pumice, which is a volcanic rock.)

Volcanoes 9:
Acidic/Lava Dome ii

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)



Volcanoes 11:
Cons

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

- **Death - volcanic eruption: ash, lava flows, lahars, pyrocastic flows, volcanic earthquakes,**
  - **After: make shift informal settlements (disease, poor living conditions), lack of emergency relief (medicine, food, water)**
- **Destroyed settlements,** woodland & agriculture, **habitats, ecosystems, and wildlife.**
- Infrastructure: schools, places of work, hospitals, communication channels, loss of crops/farm animals, damaged gas pipes, sewage pipes
- Can cause earthquakes

Volcanoes 2:
Volcanic Activity

(http://notesychs.weebly.com/uploads/1/8/5/4/18542518/volcanic_handout_grade_9_(2).pdf)

Intrusive: when magma cools underground to form igneous rocks

Extrusive: when magma flows out onto the Earth's surface as lava.

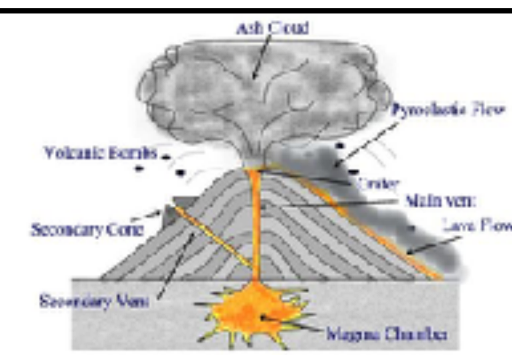
Active: A volcano that has erupted within the last 500 years and still shows signs of activity.

Dormant: Not erupted within the last 500 years but still shows signs of activity such as hot springs. E.g, Mt. Kilimanjaro.

Extinct: Not erupted within the last 500 years and shows no signs of activity. E.g, Mt. Kenya.

Island Arc

A chain of volcanoes, generally with an arc shape, that run parallel to an oceanic trench at a destructive (oceanic-oceanic) plate boundary.

Collision Zone	A destructive plate boundary between two continental plates, resulting in fold mountains.	Tsunami	A large wave created by ocean floor displacement or landslides.
Focus	The location under the Earth's surface where an earthquake originates.	Earthquakes 1	Where the ground jerks or shakes as a result of the build up and sudden release of tension, usually along a fault line. Shock/seismic waves travel out from the **focus**. **Physical Consequences:** - faults/cracks may appear in the ground's surface - the ground may suffer from liquefaction - aftershocks - tsunamis, if focus is under the sea or in a coastal area.
Epicentre	The point on the Earth's surface directly above the focus of an earthquake. Damage is greater the nearer to the epicentre you get.	Earthquakes 3: Factors Determine Impact	Factors that influence the no. of deaths and injuries: - magnitude of quake - location of the epicentre (urban/rural, formal/informal settlement, LEDC/MEDC, population density) - time/season (impact worse at night or in winter) - relief of the area (mountains=landslides, coasts=tsunamis) - severity of aftershocks - on already damaged buildings - building strength.
Richter Scale	A measure of the magnitude of an earthquake, taken with a seismograph and with a scale of one to ten, ten being the most powerful. It is a logarithmic scale which means that if an earthquake measures two on the scale, it is ten times more powerful than an earthquake that measures one.	Volcanoes 1	A hole or crack (fissure)through which magma erupts to the surface. Gases and pyroclastic material can also erupt out.
Liquefaction	The process where loose sediments with a high water content behave like a liquid when shaken by an earthquake.	Volcanoes 3: Features (https://golearngeo.wordpress.com/2010/02/24/volcano-features/)	 Main Features of a Volcano

Pyroclastic Material

Very hot gases, ash and volcanic bombs. Pyroclastic flows can reach speeds over 100Km/h, at temperatures of 200-700 degreesC.

Tropical Cyclones 4: Characteristics

- up to 800km diameter
- up to 20km high
- Usually last about a week
- Northern hemisphere - anti-clockwise
- Southern hemisphere - clockwise
- In the eye - clear skies, little wind or rain, warm
- In the eye wall - heavy rain and wind
- Sunny intervals in between rain bands

Loses energy:

- over land
- over cold ocean currents

Lahars

Mudflows of volcanic material, caused when ash mixes with heavy rain or water from melting snow.

Tropical Cyclones 5: Features

(https://en.wikipedia.org/wiki/Eye_(cyclone))

Tropical Cyclones 1

A large area of very low pressure with wind speed over 119km/hr

Tropical cyclones - Indian Ocean and Australia
Hurricanes - Atlantic and eastern Pacific Ocean
Typhoons - western Pacific Ocean
But collectively called 'tropical cyclones'.

Categorised using the Saffir-Simpson hurricane wind scale - wind speed rated 1-5.
(1 = 119-153km/hr, 5 = >252km/hr)

Tropical Cyclones 6: Hazards

- High wind - damage to trees and buildings. Falling debris is a danger to human life
- Heavy rainfall - river flooding and landslides
- Storm surges - flooding in low-lying areas, intense pressure = sea levels rising, wind can push waves 5m inland.

Tropical Cyclones 2: Necessary Conditions

Necessary conditions for a tropical cyclone

- Ocean water at least 60m deep
- Between latitudes 5 and 20, north and south, warm but far enough from equator for Coriolis.
- High sea temperatures of at least 27°C.
- Converging winds near ocean surface forcing air to rise and form storm clouds.
- Low wind shear - winds don't vary much with altitude - storm clouds can rise high vertically

Northern hemisphere: between May and November
Southern hemisphere: between November and May

Flooding 1: Causes

When the discharge of a river exceeds the capacity of the river's channel. It overflows the bank and covers the adjacent floodplain.

Cause
Natural: heavy rainfall (exceed infiltration capacity, saturated soil - raise water table, overland flow on permafrost, impermeable rocks and soil, steep relief); snow melt; tsunamis and storm surges.
Man-made: deforestation; urbanisation; agriculture (overgrazing, ploughing down slope, heavy machinery compacting soil; climate change.

Tropical Cyclones 3: Formation

- Warm seas heat air, **warm air rises.**
- Cooler air is pulled in to replace it, making **low altitude winds.**
- This air is also warmed by the sea, **rises** and **condenses** to form huge columns of clouds.
- Condensation releases the latent heat energy in the vapour, providing more power to the cyclone - creating a **self-sustaining heat cycle,** with even more air being pulled in and rising even faster.
- **Coriolis effect** causes air currents to rotate.
- Cool air sinks forming the **eye of the storm.**

Storm Hydrograph

A graph showing how quickly a river responds to a rainfall event.

Useful for planning against future flooding and times of drought.

Discharge	The volume of water passing a measuring point or gauging station in a given time, measured in cubic meters per second (cumbers).	Percolation	The vertical movement of water from the soil into the underlying rock.
Lag Time	The time difference between peak rainfall and peak discharge.	Interception	The process by which vegetation prevents rainfall from reaching the surface directly, the intercepted rainfall is temporarily held as interception storage and then either falls directly to the ground or is evaporated back into the atmosphere.
Infiltration Capacity	The maximum rate that water enters the soil.	Drought 1: Causes	When there is a lock of rain or less rain than normal over a long period of time. **Causes:** - Changes in atmospheric circulation patterns altering storm tracks and wind patterns - Sinking air in high pressure but no cloud forming - El Niño - Climate change **Human influences:** Agricultural practices (irrigation, over cultivation, overgrazing), deforestation, dams.
Antecedent Soil Moisture	The amount of moisture present in the soil before a rainfall event.	Inter Tropical Convergence Zone (ITCZ)	A low pressure belt that lies around the equator, where the north-east and south-east trade winds meet. It receives high precipitation because of intense heating from the sun.
Impermeable	Does not allow water to pass through.	El Niño Southern Oscillation (ENSO)	The change in the prevailing winds that leads to a change in the pattern of currents in the oceans of the south Pacific.

Tropical Cyclones 7: Impacts	- Flooding from storm surges and heavy rainfall - Disruption of electricity, transport and water supply - Water-borne diseases - Economic loss as production is halted - Damage to crops, food shortages and loss of export earnings - Loss of wildlife habitats	Natural Hazards 3: Management Strategies	**Prediction** (before)**, prevention** (during (preparation)) **and protection** (after event)
Drought 2: Impacts	- **Societal**: travel for new water sources; introduction of water conservation methods; conflict over water, food, land; forced migration - **Environmental:** Loss of plants and wildlife; Plant diseases and insect infestations; soil erosion and desertification; increased risk of wild fires; poor air quality - **Economic:** land prices down; unemployment up (production in decline); food prices up; loss of crops and farm animals - **Health**: malnutrition; famine; dehydration - elderly and young most vulnerable	Earthquakes 4: Management Strategies	**Prediction:** seismometers, mapping of epicentres and frequency, measuring local magnetic fields and ground water levels, hazard zone map, unusual animal behaviour **Preparation and protection:** earthquake-proof buildings, smart meters to cut off gas supply, land-use planning hospitals etc. built in low-risk areas). **Earthquake-proof buildings:** Rubber shock absorbers at base, foundations in bedrock, cross-bracing steel beams, no bricks or concrete blocks, computer-controlled weights, fire-resistant materials, flexible gas, water, electric piping
Flooding 2: Impacts	- Dispossession and migration - Contamination of water supplies = disease - Food shortages - loss of crops and farm animals - Deposition of silt from flood waters - Rivers change course BUT - Recharge of ground water stores	Volcanoes 12: Management Strategies	**Prediction:** seismometers, satellites (heat seeking cameras), tiltmeters/global positioning systems (monitor changes in volcano shape), emissions of steam and gas. **Preparation and protection:** volcano hazard map based on past eruptions; plans for lava diversion channels, lava barriers, spraying lava with water, halting lava advance (concrete slabs into flow); building reinforcements (e.g. sloping roofs - protects against ashfall).
Earthquakes 2: Impacts	- Ground shaking - destroys buildings, roads, bridges, rail tracks etc. - Landslides covering buildings and roads - Tsunamis hit coast lines - Fires from ruptured gas pipes - Starvation as aid cannot reach victims - Temporary accommodation - no sanitation, clean water = disease - Water contaminated by broken sewage pipes	Tropical Cyclones 8: Management Strategies	**Prediction:** tracking using satellites **Preparation and protection:** cyclone shelters; embankments built along coast; preserving mangrove swamps to absorb energy of storm surges.
Natural Hazards 2: Impacts	Social, Economic, Environmental, and can become political (civil war etc.) Short-term and Long-term General: fatalities, injuries, loss of livelihoods, destruction of property, destruction of infrastructure. Greatest on LEDC - lack of finance to rebuild, no insurance, lack of tech and expertise - and so more reliant on emergency aid.	Flooding 3: Management Strategies	**Prediction:** monitoring rainfall and changes in river discharge; knowledge of the drainage basin and type of storm to determine severity of flooding. **Preparation and protection:** hard engineering projects e.g. levees, flood barriers, flood control channels, dams etc.; soft engineering projects, e.g. afforestation, controlled flooding of meadow land and stage basins; straighten/widen/deepen river channel (dredging/clearing vegetation); land-use planning (higher land for settlements); sandbags and pumps; adapt homes, e.g. high power sockets.

Drought 3: Management Strategies	**Prediction:** monitoring precipitation and temperature. **Preparation and protection:** increase water supplies (dams, reservoirs, percolation ponds, wells, pumps and aquifers, transfer by pipeline, desalinisation); water conservation (storage tanks, spray irrigation, drought-tolerant crops, reducing deforestation, water recycling); agricultural improvements (plant shelter belts, bunds (infiltration), fending (prevent overgrazing)); government stockpiling water, food and medicine.		
Natural Hazards 4: Why Stay?	• It's home - family, friends • Perceive risks as low if always lived there • Confidence in prediction, preparation and protection methods • Employment opportunities - fishing, mining, agriculture, tourism • No money to move • Volcanoes - fertile soil, scenery, geothermal energy, minerals • Flooding - rivers (water, irrigation, communications, flat lands to build on)		
Human Needs	• Employment • Clean water • Food • Shelter • Energy Supply • Clothing • Medical care • Sanitation/sewage/disposal • Education • Clean air		
Informal Settlements: Problems	• No proper water supply/sewage system • No reliable electricity • Over crowding • Risk of disease • Risk of building collapses and fires • Lack of security • High crime • Risk of eviction		