Unit 1a

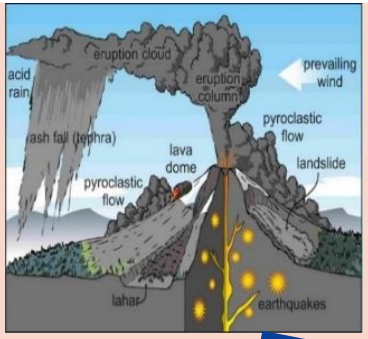
The Challenges of Natural Hazards

The structure of the Earth

The Crust	Varies in thickness (5-10km) beneath the ocean. Made up of several large plates.
The Mantle	Widest layer (2900km thick). The heat and pressure means the rock is in a liquid state that is in a state of convection.
The Inner and outer Core	Hottest section (5000 degrees). Mostly made of iron and nickel and is 4x denser than the crust. Inner section is solid whereas outer layer is liquid.

Volcanic Hazards

Ash cloud	Small pieces of pulverised rock and glass which are thrown into the atmosphere.
Gas	Sulphur dioxide, water vapour and carbon dioxide come out of the volcano.
Lahar	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.
Volcanic bomb	A thick (viscous) lava fragment that is ejected from the volcano.



Managing Volcanic Eruptions

Warning signs	Monitoring techniques
Small earthquakes are caused as magma rises up.	Seismometers are used to detect earthquakes.
Temperatures around the volcano rise as activity increases.	Thermal imaging and satellite cameras can be used to detect heat around a volcano.
When a volcano is close to erupting it starts to release gases.	Gas samples may be taken and chemical sensors used to measure sulphur levels.

Preparation	
Creating an exclusion zone around the volcano.	Being ready and able to evacuate residents.
Having an emergency supply of basic provisions, such as food	Trained emergency services and a good communication system.

Convection Currents

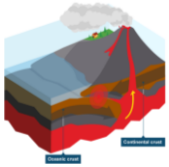
The crust is divided into tectonic plates which are moving due to convection currents in the mantle.

1. Radioactive decay of some of the elements in the core and mantle generate a lot of heat.
2. When lower parts of the mantle molten rock (Magma) heat up they become **less dense** and **slowly rise**.
3. As they move towards the top they cool down, become **more dense** and **slowly sink**.
4. These **circular movements** of semi-molten rock are **convection currents**
5. Convection currents create **drag** on the base of the tectonic plates and this causes them to move.

Types of Plate Margins

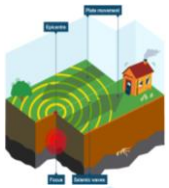
Destructive Plate Margin

When the denser plate subducts beneath the other, friction causes it to **melt and become molten magma**. The magma forces its ways up to the surface to form a volcano. This margin is also responsible for **devastating earthquakes**.



Constructive Plate Margin

Here two plates are **moving apart** causing new magma to reach the surface through the gap. Volcanoes formed along this crack cause a submarine mountain range such as those in the **Mid Atlantic Ridge**.



Conservative Plate Margin

A conservative plate boundary occurs where plates **slide past each other** in opposite directions, or in the same direction but at different speeds. This is responsible for earthquakes such as the ones happening along the San Andreas Fault, USA.

LIC -CS: Haiti Earthquake 2010

Causes

On a conservative plate margin, involving the Caribbean & North American plates. The magnitude 7.0 earthquake was only 15 miles from the capital Port au Prince. With a very shallow focus of 13km deep.

Effects

230,000 people died and 3 million affected. Many **emotionally affected**. **250,000 homes** collapsed or were damaged. **Millions homeless**. Rubble blocked roads and shut down ports.

Management

Individuals tried to recover people. Many countries **responded with appeals** or **rescue teams**. Heavily relied on **international aid**, e.g. **$330 million** from the EU. **98% of rubble** remained after **6 months**.

What is a Natural Hazard

A natural hazard is a natural process which could cause death, injury or disruption to humans, property and possessions.

Geological Hazard	Meteorological Hazard
These are hazards caused by land and tectonic processes.	**These are hazards caused by weather and climate.**

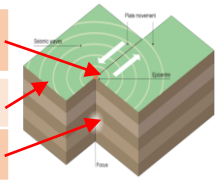
Causes of Earthquakes

Earthquakes are caused when two plates become **locked** causing **friction** to build up. From this **stress**, the **pressure** will eventually be released, triggering the plates to move into a new position. This movement causes energy in the form of **seismic waves**, to travel from the **focus** towards the **epicentre**. As a result, the crust vibrates triggering an earthquake.

The point directly above the focus, where the seismic waves reach first, is called the **EPICENTRE**.

SEISMIC WAVES (energy waves) travel out from the focus.

The point at which pressure is released is called the **FOCUS**.



Earthquake Management

PREDICTING

Methods include:

- Satellite surveying (tracks changes in the earth's surface)
- Laser reflector (surveys movement across fault lines)
- Radon gas sensor (radon gas is released when plates move so this finds that)
- Seismometer
- Water table level (water levels fluctuate before an earthquake).
- Scientists also use seismic records to predict when the next event will occur.

PROTECTION

You can't stop earthquakes, so earthquake-prone regions follow these three methods to reduce potential damage:

- Building earthquake-resistant buildings
- Raising public awareness
- Improving earthquake prediction

HIC – Japan (Tohoku) earthquake and tsunami 2011

Causes : The North-American and Pacific plates moving towards each other on a destructive (subduction) plate boundary. The magnitude 9 earthquake was in the top 5 biggest ever recorded in the world. The epicentre was under the ocean and created a 40m high tsunami wave.

Primary effects: 15,853 deaths; 90% of deaths were from drowning and most of the dead were aged over 60. The Earth shifted on its axis; £181 million of damage

Secondary effects: 40m high tsunami reached up to 10km inland; nuclear accident at Fukushima

Immediate responses: sirens warned people about the tsunami; army sent to help; quick and efficient; exclusion zone set up around the nuclear power plant.

Long term responses: A new, higher tsunami wall is being build; nuclear power plants decommissioned;

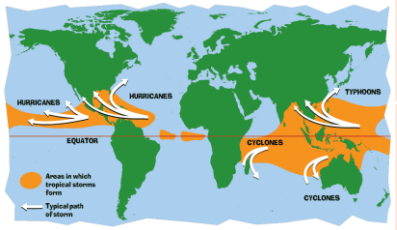
Global pattern of air circulation

Atmospheric circulation is the large-scale movement of air by which heat is distributed on the surface of the Earth.

Hadley cell	Largest cell which extends from the **Equator** to between **30° to 40° north & south**.
Ferrel cell	Middle cell where air flows **poleward** between **60° & 70°** latitude.
Polar cell	**Smallest & weakness** cell that occurs from the poles to the Ferrel cell.

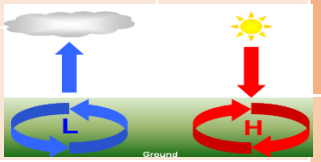
Distribution of Tropical Storms.

They are known by many names, including hurricanes (North America), cyclones (India) and typhoons (Japan and East Asia). They all occur in a band that lies roughly 5-15° either side of the Equator.



High and Low Pressure

Low Pressure	High Pressure
Caused by hot air rising. Causes stormy, cloudy weather.	Caused by cold air sinking. Causes clear and calm weather.



Formation of Tropical Storms

1	The Sun's rays heats large areas of ocean in the summer and autumn. This causes **warm, moist air** to rise over the particular spots
2	Once the **temperature is 27°**, the rising warm moist air leads to a **low pressure**. This eventually turns into a thunderstorm. This causes air to be 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 (such as a hurricane) 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 hits land, it **loses its energy source** (the warm ocean) and it begins to lose strength. Eventually it will 'blow itself out'.

Changing pattern of Tropical Storms

Scientist believe that global warming is having an impact on the frequency and strength of tropical storms. This may be due to an increase in ocean temperatures.

Management of Tropical Storms

HURRICANE EVACUATION ROUTE

Protection
Preparing for a tropical storm may involve construction projects that will improve protection.

Aid
Aid involves assisting after the storm, commonly in LIDs.

Development
The scale of the impacts depends on the whether the country has the resources cope with the storm.

Planning
Involves getting people and the emergency services ready to deal with the impacts.

Prediction
Constant monitoring can help to give advanced warning of a tropical storm

Education
Teaching people about what to do in a tropical storm.

Case Study: Typhoon Haiyan, 2013

Typhoon Haiyan was a tropical cyclone that affected the Philippines in South East Asia in November 2013. It was one of the strongest tropical cyclones ever recorded with winds of 313 km/h. In some areas, 281.9 mm of rainfall was recorded, much of which fell in under 12 hours. Waves of up to 7 m in height battered the coast

Primary effects: 90% of Taclaban city was destroyed. 1.1 million houses damaged. $12 billion of damage done. 6190 deaths. 1.1 million tonnes of crops destroyed. 5m storm surge caused flooding.
Secondary effects: Over one-third of farmers and fishermen lost their income because crops and boats were destroyed. Water and soil polluted with saltwater, chemicals and oil. Cholera outbreak. Looting and other crime.

Immediate responses: PAGASA broadcast warnings two days before Typhoon Haiyan hit. This led to the evacuation of approximately 750,000 residents. However, people ignored it because they had survived previous storms. A 'State of National Calamity' was declare. The Philippines asked for international help after one day. People evacuated to a sports stadium in Tacloban but died when it flooded.
Long term responses: Philippines launched the 'Build Back Better' campaign in 2014. It aims to upgrade damaged buildings and protect them from future damage. No build zone along coast in Eastern Visayas but some people have ignored this. New storm surge warning system. Mangroves replanted.

Case Study: Flooding of the Somerset Levels 2013-14

Causes: Heavy rainfall. Low-lying, flat land. Rivers had not been dredged for 20 years so were full of sediment. A succession of depressions from the Atlantic.

Effects: 600 houses flooded. 16 farms evacuated. The village of Muchelney was cut off. 14,500 ha farm land under water for 3-4 weeks. Estimated £10m of food damage. Habitat damage. Water pollution. Road to Yeovil shut.

Immediate responses: Flooding forecast using satellite imagery. Warnings issued. Army sent to help evacuate people to safety. Roads shut.
Long-term responses: 8km of the Rivers Tone and Parrett were dredged. Road levels raised. River banks raised.

What is Climate Change?

Climate change is a large-scale, long-term shift in the planet's weather patterns or average temperatures. Earth has had tropical climates and ice ages many times in its 4.5 billion years.

Recent Evidence for climate change.

Global temperature	Average global temperatures have increased by more than **0.6°C since 1950**.
Ice sheets & glaciers	Many of the world's glaciers and ice sheets are melting. E.g. the Arctic sea ice has declined by **10% in 30 years**.
Sea Level Change	Average global **sea level has risen by 10-20cms** in the past 100 years. This is due to the additional water from ice and thermal expansion.

Enhanced Greenhouse Effect

Recently there has been an increase in **humans burning fossil fuels** for energy. These fuels (gas, coal and oil) emit **greenhouse gases**. This is making the Earth's atmosphere thicker, therefore trapping more solar radiation and causing **less to be reflected**. As a result, the Earth is becoming warmer.

Evidence of natural change

Orbital Changes	Some argue that climate change is linked to how the Earth orbits the Sun, and the way it wobbles and tilts as it does it.
Sun Spots	Dark spots on the Sun are called Sun spots. They increase the **amount of energy Earth receives** from the Sun.
Volcanic Eruptions	Volcanoes release large amounts of **dust containing gases**. These can **block sunlight** and results in cooler temperatures.

Managing Climate Change

Carbon Capture
This involves new technology designed to reduce climate change.

Planting Trees
Planting trees increase the amount of carbon is absorbed from atmosphere.

International Agreements
Countries aim to cut emissions by signing international deals and by setting targets.

Renewable Energy
Replacing fossil fuels based energy with clean/natural sources of energy.