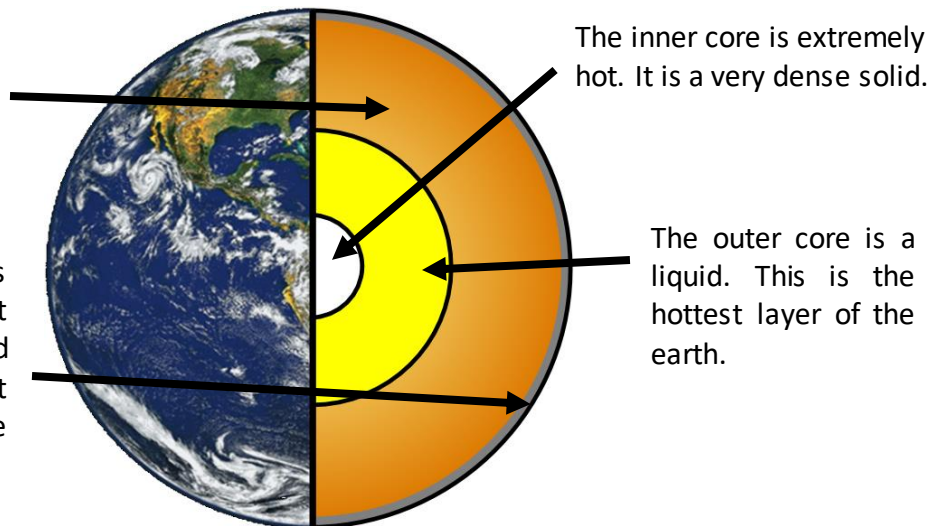# Geography Knowledge Organiser 8.1: Tectonics

## 1. The earth's structure and convection currents:

The Earth has four main layers : the **inner core**, the **outer core**, the **mantle** and the **crust**.

The mantle is semi-molten. The closer the mantle is to the core, the hotter and more liquid it is.

The crust is the rocky outer layer. It is thin compared to the other sections. It is uneven. If the Earth was scaled down to the size of an apple, the crust would be about the thickness of the apple skin.

The inner core is extremely hot. It is a very dense solid.

The outer core is a liquid. This is the hottest layer of the earth.

- The earth's crust is broken up into plates, called tectonic plates.
- There are two types of tectonic plate oceanic and continental.
- Oceanic plates carry **the oceans**. They are **newer** areas of crust. They are **thinner** but **more dense** than continental plates.
- Continental plates carry **the land**. They are **older** areas of crust. They are **thicker** but **less dense** than oceanic plates.
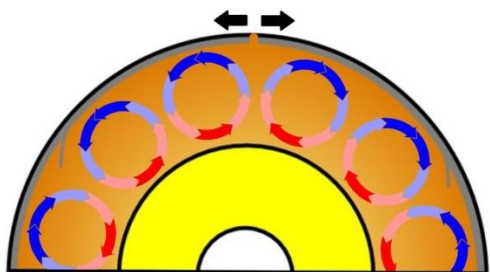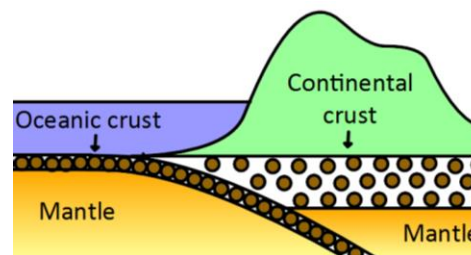
- Heat from the core causes **convection currents** in the mantle. These cause the mantle to move as it heats and cools.
  1. As the mantle falls, it gets closer to the hot core.
  2. As this part of the mantle is heated and becomes less dense, it rises.
  3. As the mantle rises and moves away from the core, it cools and then falls.
  4. This movement causes the crust above the mantle to move.
- Convection currents can move in different directions.

Key words:
current:
A liquid which moves in a particular direction

tectonic plates:
Huge plates that make up the earth's crust, and which move because of convection currents

convection currents:
Currents in the mantle which cause the tectonic plates to move, caused by extreme heat from the earth's core

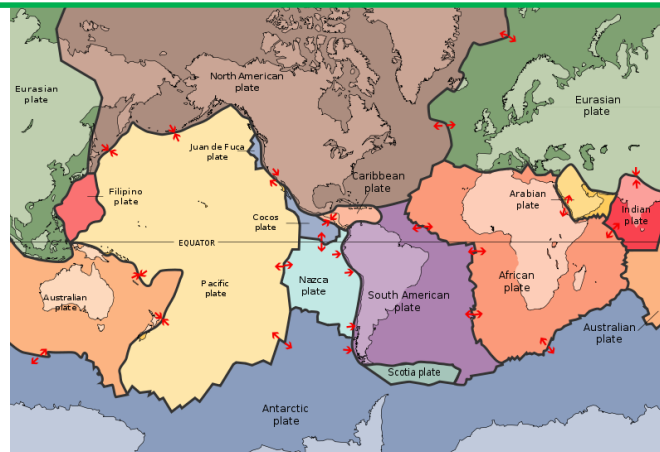**dense:**
When something is closely packed together

molten:
Something which is melted and has become a liquid

Geography Knowledge Organiser 8.1: Tectonics

2. Plate boundaries:

- The Earth's crust is broken into different plates, which sit on the Earth's mantle.
- These plates move because of **convection currents**.
- The plates move in different directions and meet at **plate boundaries**.
- As the plates move, parts of the crust are **destroyed** and in other areas new crust is **created**.
- There are four different types of plate boundary: **destructive**, **collisional** **constructive** and **conservative**. Which type they are depends on how the plates move at this boundary.
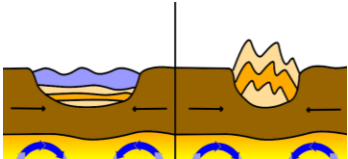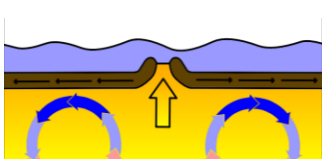- Different plates boundaries can cause different tectonic hazards.

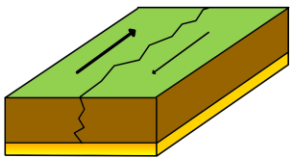| Boundary	Movement	Diagram	Landforms and hazards
Destructive	The plates move **towards each other** and the oceanic plate **subducts under** the continental plate.		Composite Volcanoes Earthquakes
Destructive (Collisional)	The plates move **towards each other**. They are both **continental** plates.		Fold Mountains
Constructive	The plates **move apart.**		Shield Volcanoes
Conservative	The plates move **alongside** each other.		Earthquakes

Key words:

plate boundary: Where two or more tectonic plates meet

tsunami: A series of ocean waves which are caused when earthquakes or other disturbances displace a large amount of water

hazard: A danger or risk

subduction: Where one plate is forced to move under another. This occurs at destructive plate boundaries
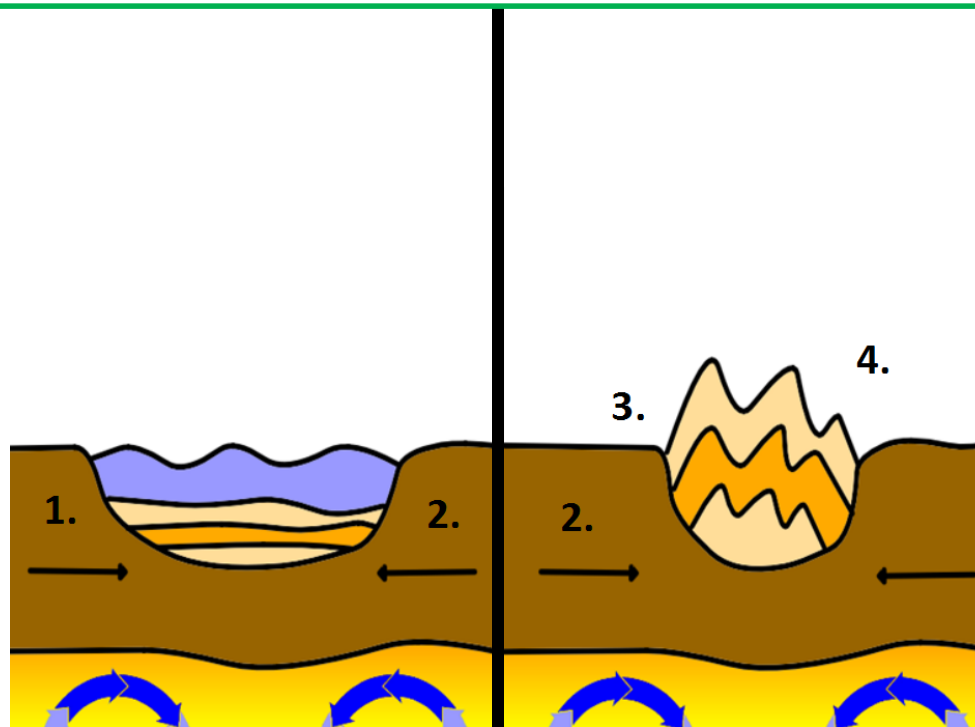
mountain range: A series of mountains which run along a line

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3. Fold mountains:

1. In the past, **sedimentary rock** formed in oceans. These oceans have since dried up.
2. Continental plates move towards each other because of convection currents in the mantle.
3. As the plates collide, the **sedimentary rock** on the surface crumples and folds.
4. The sedimentary rock rises, forming **mountain ranges**.

4. The formation of composite volcanoes

1. Plates move towards each other because of convection currents in the mantle, the denser oceanic plate **subducts** under the continental plate. This is called the **subduction zone** and also forms a deep part of the ocean called an **ocean trench**.
2. The continental plate is less dense so it rises, forming mountains.
3. As the oceanic plate subducts it melts, forming a pool of **magma**.
4. When the pool of magma becomes full, it rises through cracks in the crust (caused by earthquakes).

Oceanic plate

Subduction zone

Ocean trench

Continental plate

Mantle

Key words:

sediment:
Eroded material in a river or ocean

compressed
When something pressed so that it becomes closely packed together

ocean trench:
A long narrow dip in the earth's crust which forms where one plate subducts below another

magma:
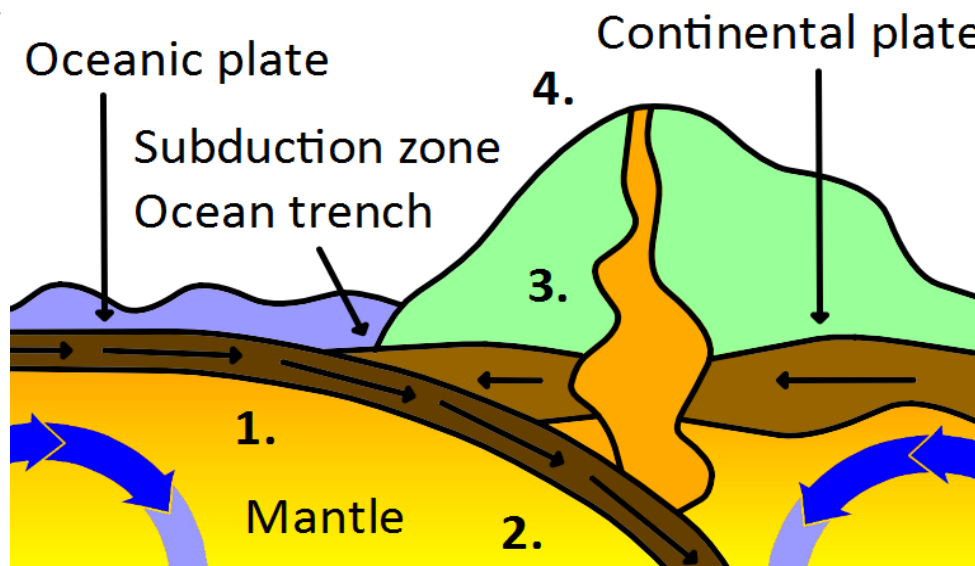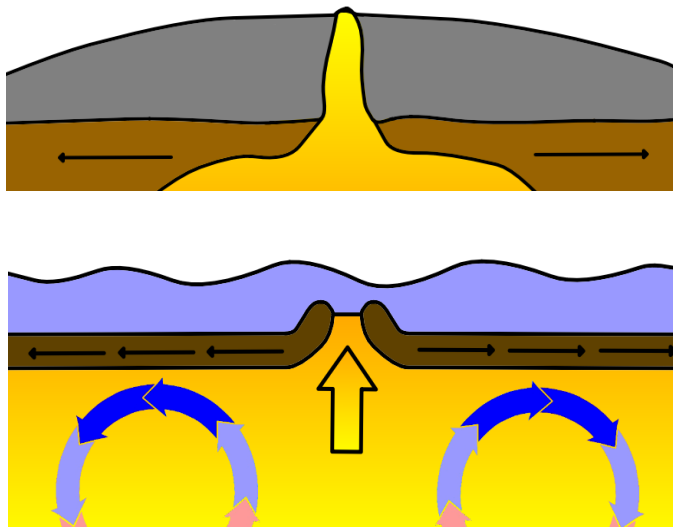Melted rock below the earth's crust

dense:
When something is closely packed together

subduction:
Where one plate is forced to move under another. This occurs at destructive plate boundaries

5. Shield Volcanoes:

- Shield volcanoes are volcanoes which form at **constructive plate boundaries**, where the plates move apart.
  1. Plates move away from each other because of convection currents in the mantle.
  2. As the plates move apart, gaps form in the crust.
  3. Magma rises to fill the gap formed in the crust.
  4. Over time, the lava released by the volcano forms a shallow cone around the vent.
- Eruptions of shield volcanoes are usually more **regular** than composite volcanoes, but they are much more **gentle**.
- The lava from shield volcanoes is also much more **runny** than the lava from a composite volcano. As a result, shield volcanoes are **wider** and **flatter** than composite volcanoes.

6. The effects of a composite volcanic eruption:

- Volcanic eruptions usually affect a smaller area than earthquakes.
- They can cause damage through falling **debris**, **pyroclastic flow** and later issues, like **lahars** and **acid rain**.

Primary effect

Buildings can be destroyed by debris or collapse because of falling ash.

Crops can be damaged and water supplies can be contaminated by ash.

Roads and transport links and other infrastructure can be destroyed or disrupted.

People can be killed by debris or pyroclastic flow. Ash can also cause breathing problems.

Secondary effect

People can be left homeless or unemployed if businesses are destroyed.

There can be shortage of food and water.

It takes longer for aid and emergency services to reach the area.

People may suffer the loss of family members of loved ones.

Key words:

magma:
Melted rock below the earth's crust

debris:
Loose material, particularly pieces of rock

pyroclastic flow:
A mass of hot ash, gases and lava fragments which is ejected from a volcano at great speeds

lahar:
A dangerous mudslide which is caused by water mixing with ash and debris from a volcanic eruption

infrastructure:
The basic physical facilities in an area, such as electricity, running water, roads and buildings such as hospitals

Geography Knowledge Organiser 8.1: Tectonics

7. Predicting and monitoring volcanoes:

There are four main methods which scientists use to monitor and predict composite volcanic eruptions.

	Method	What it does	Why use it?
	Tiltmeter	A tiltmeter measures changes in the **shape** or **angle** of the land.	Volcanoes often bulge before they erupt, due to a build up of magma.
	Seismometer	A seismometer measures vibrations in the earth's crust.	Volcanic eruptions are often triggered by earthquakes. Small earthquakes often precede large ones.
	Monitoring gas	Sensors measure the amount of sulphur in gases released by the volcano.	Volcanoes release a lot of sulphur when they erupt.
	Monitoring temperature	Sensors measure the temperature around the volcano.	Hot magma builds up close to the surface of a volcano when it is close to an eruption.

Key words:

monitoring:
Using scientific equipment to record changes in an area such as a volcano

prediction:
Using data to say when or where something is likely to happen

Geography Knowledge Organiser 8.1: Tectonics

8. Planning for and protecting people from volcanic eruptions:

Reducing the risk from hazards such as volcanoes involves the 3 Ps – prediction (as seen on the previous page), planning and protection.

If people live near active or dormant volcanoes, it is important that they plan for and are protected from the effects of a volcanic eruption.

	Method	3Ps	What it does	Why use it?
	Volcano drills and evacuation plans	Planning	People living near volcanoes are given advice on what to do in the event of a volcanic eruption. People may practice evacuating.	People will be less likely to panic during a volcanic eruption and will know how to keep themselves and their property safe.
	Hazard maps	Planning	Local governments create hazard maps, showing the areas near a volcano which are likely to be damaged or affected.	People are unlikely to build or live in high risk areas, reducing the amount of property which is likely to be damaged.
	Emergency equipment	Planning	Homes and businesses can stock up on equipment, like respirators, before an eruption and keep in grab bags	People can reduce the risk of breathing problems by using respirators.
	Lava Channels	Protection	Redirects lava flows away from built up areas	Reduces damage to property and risk to life

Key words:

protection:
Making the damage from an event as small as possible

planning:
Ensuring people are ready if a hazard happens and decisions have been made that minimise risk

active:
Volcanoes which erupt frequently

dormant:
A word to describe volcanoes which have not recently erupted

evacuation:
Leaving a dangerous area to go somewhere safer

respirator:
Equipment which cleans air before it is breathed in

debris:
Loose material, particularly pieces of rock

Geography Knowledge Organiser 8.1: Tectonics

9. Mount Merapi, Indonesia, case study:
- In 2010 Mount Merapi, the most active composite volcano in Indonesia, erupted.
- Tiltmeters first showed an eruption was likely as the dome bulged.
- The eruption started in late October and continued for over 30 days.
- Over 11,000 people, mostly poor farmers, lived on the slopes of the volcano prior to the eruption.

Effects

Primary:
- Volcanic bombs and heat clouds of up to 800°C for 10 km.
- Pyroclastic flows 3 km down the mountain sides.
- Volcanic ash fell up to 30 km away, covering villages.

Secondary:
- Transport disruption, including air travel.
- 350,000 people displaced.
- 353 killed and increased risk of disease for survivors.

Responses

- Short term evacuation of thousands of people.
- International aid from NGOs such as Red Cross.
- Long term relocation of over 2,500 people away from the volcano.

10. Living near a volcano:
- Roughly 10% of the world's population live in an area with **volcanic soil**, despite the fact that this soil only covers about 1% of the world's land.
- Many people have **no choice** but to live near volcanoes:
    - In some countries, like Japan, it is almost impossible for people to avoid living near an active or dormant volcano.
    - Many cities near volcanoes have existed for hundreds of years, and so have too much **history**, **wealth** and **infrastructure** to simply abandon.
- There are also advantages to living near a volcano:

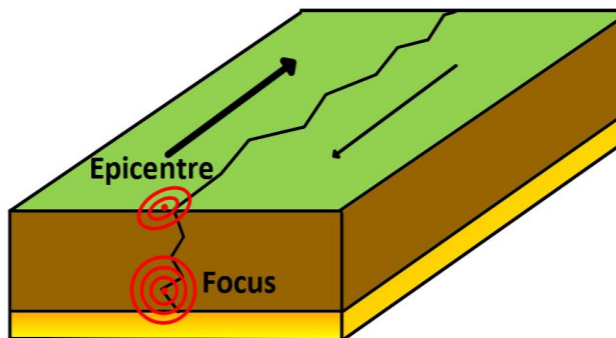|		
	Fertile soil	Over time, volcanic ash can make soil much more fertile and easy to farm.
	Tourism	People can generate income from tourists who visit volcanoes. (E.g. bus tours and hotels)
	Geo-thermal energy	Hot water or steam near volcanoes can be used to heat homes or to generate power.

Key words:

plate boundary:
Where two or more tectonic plates meet

infrastructure:
The basic physical facilities in an area, such as electricity, running water, roads and buildings such as hospitals

fertile:
Land which can produce a lot of crops

income:
The amount of money which people receive from something

cone:
The layer of ash and rock which forms around the vent of a volcano

Geography Knowledge Organiser 8.1: Tectonics

11. Earthquakes:

- Earthquakes are the **shaking** of the earth, which caused by the **release of pressure** when two tectonic plates had become stuck.
- The plates can become stuck for two main reasons:
  1. The plates have rough edges, causing them to get caught.
  2. The plates move at different speeds (particularly when they're both moving in the same direction).
- If an earthquake happens near an ocean, it can cause a **tsunami** when a large amount of water becomes **displaced**.
- Every earthquake has an **epicentre** and a **focus**.
- The **focus** is where the earthquake actually happens, **within the crust**.
- The **epicentre** is directly above the focus, **on the crust's surface**.
- The closer a settlement is to the epicentre and the focus, the more intense the vibrations will be.

12. The Effects of an Earthquake:

- Earthquakes usually affect a larger area than volcanoes.
- They can cause damage through falling **debris** and **vibration of the earth** and later issues, like **lack of clean water.**

Primary effect	Secondary effect
Buildings can be destroyed because of the shaking of the ground.	People can be left homeless or unemployed if businesses are destroyed.
Water pipes and sewage pipes can be damaged.	There can be a shortage of clean water and poor disposal of waste leading to diseases like cholera.
Roads and transport links and other infrastructure can be destroyed or disrupted.	It takes longer for aid and emergency services to reach the area.
People can be killed by debris.	People may suffer the loss of family members of loved ones.
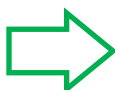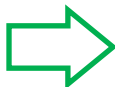
Key words:

plate boundary:
Where two or more tectonic plates meet

displacement:
When something is forced to move somewhere else

settlement:
Anywhere where people live

tsunami:
A large wave which is caused by water being displaced

focus:
The point where the earthquake actually happens, **within the crust**

epicentre:
The point directly above the focus of an earthquake, **on the crust's surface**

debris:
Loose material, particularly pieces of rock

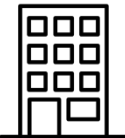# Geography Knowledge Organiser 8.1: Tectonics

13. Predicting earthquakes:

It is extremely difficult to predict earthquakes. However, there are methods which scientists can use.

	Method	What it does	Why use it?
	Seismometer	A seismometer measures vibrations in the earth's crust.	Large earthquakes are usually preceded by a series of small ones.
	Monitoring radon gas	Sensors monitor the amount of radon gas near plate boundaries.	Radon gas is released when plates move.
	Lasers	Lasers monitor movement in plate boundaries.	Changes to the normal pattern of movement may suggest that a large earthquake is about to happen.

14. Planning for and protecting people from earthquakes:

If people live near active or dormant volcanoes, it is important that they prepare for and are protected from the effects of a volcanic eruption.

	Method	What it does	Why use it?
	Earthquake drills	People in offices and schools will practice what to do when there is an earthquake.	People will be less likely to panic in an earthquake and will know how to be safe.
	Earthquake resistant buildings	Buildings are built to either sway with the earthquake or have deep foundations to absorb the earthquake's vibrations.	Buildings are less likely to collapse, lowering the risk of death and lowering the cost of damage.
	Emergency kits	Offices and homes have kits with medical supplies, torches and rations.	People are more likely to survive if they get trapped in buildings while they wait for help.

Key words:

tectonic hazard:
A risk created by the movement of tectonic plates, such as damage caused by an earthquake

to drill:
To practise a method or procedure before an event

to precede:
When something happens before something else

Geography Knowledge Organiser 8.1: Tectonics

15. Earthquakes in areas of differing levels of development

There are a number of factors which can affect how badly an area is affected by an earthquake. These include **how severe the vibrations were**, how well the country used **PPP**, whether the country has a **history of earthquakes** and how **developed** the country is.

	Key figures:	Effects	Response
Japan (2016)	Strength: 7.0 on the Richter Scale. Japan's development (HDI Ranking): 19/188 (0.909)	Primary: - 50 people died. - 3000 people injured. - 1000 buildings damaged. - Some damage to transport infrastructure including the bullet train and road bridges. Secondary: - Kumamoto city without water. - A number of fires broke out due to damage to infrastructure.	- 44,000 people evacuated. - Repairs to infrastructure completed by government. - Insurance companies paid out £2.4billion for repairs to property.
Indonesia (2018)	Strength: 7.5 on the Richter Scale. Indonesia's development (HDI Ranking): 111/188 (0.707)	Primary: - 4,340 people died. - 70,000 buildings destroyed. - Many schools, hospitals and public buildings including Palu airport were damaged or destroyed. - 10,000 hectares of farmland flooded and crops destroyed. - Communications infrastructure destroyed. Secondary: - Many thousands made homeless. - Tsunami damaged ports and coastal regions. - Hundreds of air travellers stranded. - Looting occurred in Palu city.	- Resources, medical teams and military support sent from unaffected regions in Indonesia. - Satellite phones used for communication. - International aid provided by other SE Asian countries and HICs including Australia, the USA and from Europe.

Key words:

the Richter Scale:
A scale which is used to measure the strength of earthquakes. It uses the strength of vibrations

to loot:
To steal goods, particularly during a war or riot

infrastructure:
The basic physical facilities in an area, such as electricity, running water, roads and buildings such as hospitals

aid:
Money or resources which is given to a country by another country or an organisation

the HDI:
The human development index, which measures development according to the quality of a country's healthcare, wealth and education and then gives that country a score between 0 and 1