This work sheet about Plate Tectonics & Volcanoes has been adapted from materials put together by a team of Volcanologists at the University of East Anglia.

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PLATE TECTONICS AND PLATE BOUNDARIES

PLATES & VOLCANOES Part 1

The Earth's surface is made up of a number of tectonic plates. The map in Section 4 shows them as they would be looking from above, but the illustration below shows a cross-section of the plates looking sideways into the interior of the Earth.

These plates are generally made up of oceanic lithosphere or continental lithosphere, depending on the type of crust that makes up the uppermost part of the plate.

Oceanic crust

Oceanic crust is typically thinner but denser, whereas continental crust can have more than 3x greater depth, but is less dense. The plates move very slowly around the planet due to heat coming from the Earth's core – they move at about the same rate your fingernails grow.

Plate boundaries

Although plate motion is very slow, over millions of years this motion can build and destroy continents, mountain ranges and deep oceans.

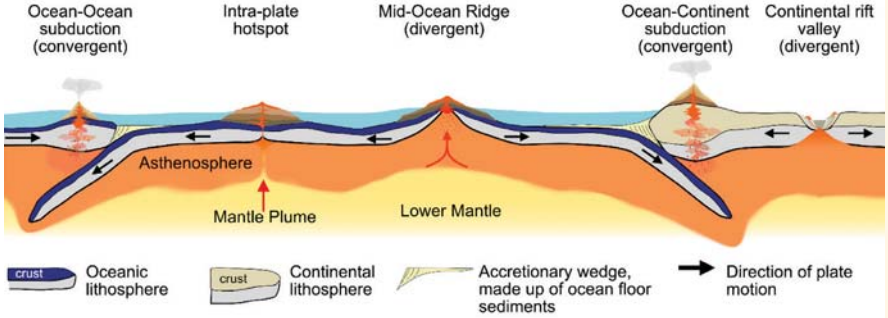
Now look at the diagram below. It shows you the different types of plate boundaries where volcanoes can form.

Where two plates meet, we call it a plate boundary. If the plates are moving apart it is called a divergent boundary – this could be a mid-ocean ridge, or a continental rift.

If the plates are moving towards each other it is a convergent boundary – a subduction zone.

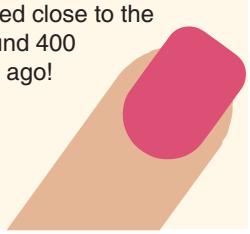
At both types of plate boundary, hot liquid magma is created and can erupt at the surface forming volcanoes, because it is less dense than the tectonic plate above it.

Diagram of a cross-section showing the different types of plate boundaries



Watch your fingernails really closely for one minute… can you see them growing?

Your fingernails grow very slowly… only about 2.5mm a month! So if you wanted to see them get longer you'd have to wait very patiently. The tectonic plates move at about the same rate. On average they move 3-5 cm per year. Some move faster and some move slower, but we still can't see it with our eyes. We use satellite measurements to track these very small movements of the plates. Although it is very slow, the movement of the plates can make big changes to the planet. For example, Scotland was positioned close to the equator around 400 million years ago!



Viscosity or Just how sticky are you ?

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PLATE BOUNDARIES, MAGMA PROPERTIES AND ERUPTIONS

PLATES & VOLCANOES Part 2

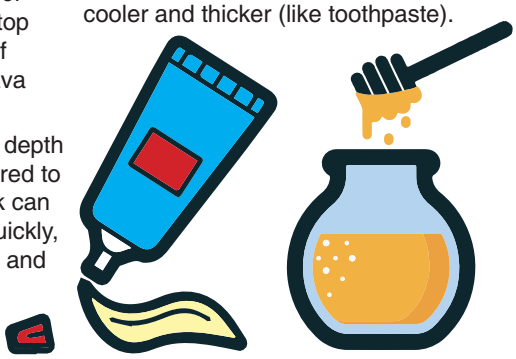
When tectonic plates have greater depth, magma can get stuck, crystallise a bit and change its composition. In turn, this changes how easy it is for magma to flow when it finally emerges. Depending on this, and how cooled it is, magma that erupts at the surface as lava can be runny (like honey) or thick (like toothpaste).

When runny lava erupts at the surface we usually see glowing lava flows or fire-fountains.

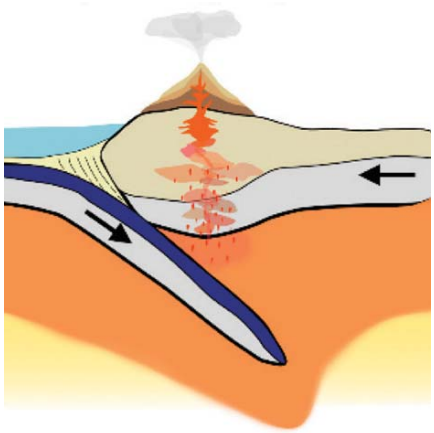
When thick lavas erupt they can create huge explosions of ash and rock, or they may just squeeze out of the top of the volcano making a big pile of hot rocks and lava. This type of lava doesn't flow very far.

As **oceanic lithosphere** has less depth and its crust is very dense compared to the rising magma, the molten rock can usually rise to the surface quite quickly, meaning it erupts while it is hotter and runnier (like honey).

Continental lithosphere has much greater depth and the crust is not as dense, so the rising magma can get trapped for longer, meaning by the time it reaches the surface it can be much cooler and thicker (like toothpaste).



Ocean-Continent subduction (convergent)



Experiment:

Find a jar of honey, syrup or a bottle of oil with the lid on, tip it and see how quickly the contents move. Now do the same for some ketchup or jam, or squeeze a little bit of toothpaste onto a plate and hold it at an angle. Does one move more quickly than the other, do some not move at all? Of the things you found, which one is thickest?

Write your observations in the table below:

Food item	How quickly does it move?

Answers: Oil and water will move much more quickly than honey, ketchup and syrup. But jam and toothpaste should move very slowly. This is because they are more viscous. If something is viscous it means it doesn't like to flow.

A good way to think about this is to consider the difference between walking through water compared to walking through air, and then imagine walking through a big pool of custard or thick toothpaste. It would be much more difficult because they are more viscous and they don't want to flow, so they resist your legs and arms as you move through them. (Just don't try filling your bath with custard at home!)

PLATES & VOLCANOES **Part 3**

Where do your volcanoes live?

Here you can take a look at where volcanoes occur on the Earth. There are many volcanoes, so we have just chosen 30 representative examples here of some well known one to make it a little more straight forward.

The locations of volcanoes

For this activity, you'll use the diagram below, which shows the locations of a selection of 30 volcanoes worldwide.

1 How many of the volcanoes are near plate boundaries? How would you express that as a percentage?

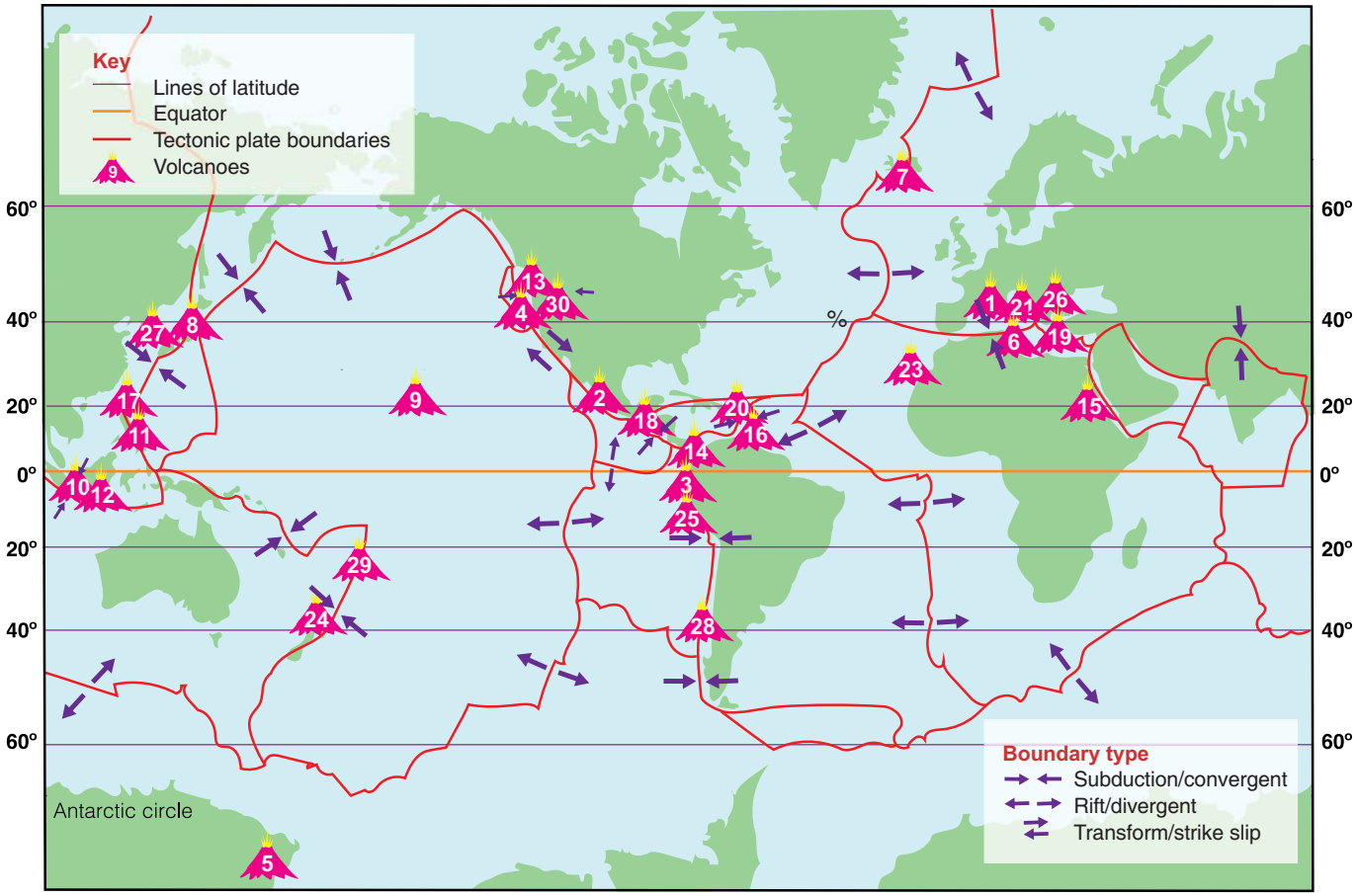
%

2 What percentage of the volcanoes are found near subduction zones?

%

3 Globally, around 80% of historical eruptions have occurred near subduction zones. Is the proportion of volcanoes that are at subduction zones a good representation of this global proportion? Why?

Diagram of volcano locations worldwide and the major tectonic plate boundaries



Answers:

1) The total number of volcanoes here is 30. Erebus, Kilauea and Teide are the volcanoes not obviously near a margin. This is 3 from 30.

The fraction is 3/30 = (simplify) = 1/10 = 0.1

Expressing this as a % means multiplying by 100 = 0.1 x 100 = 10%

If you included Nyiragongo, this would be 4/30 = 2/15 which, multiplied by 100 = 13.33%

2) There are 25 volcanoes near subduction zones (areas where plates are moving towards one another).

25/30 = 5/6 = 0.833 (rounded to three decimal places)

0.833 x 100 = 83.3%

3) With just 30 volcanoes here, 83.3% is not a bad representation of the correct proportion. 24 volcanoes would have been exactly 80% but since its only 'around' 80% our proportion is pretty good!