Mix your own magma activity instructions:

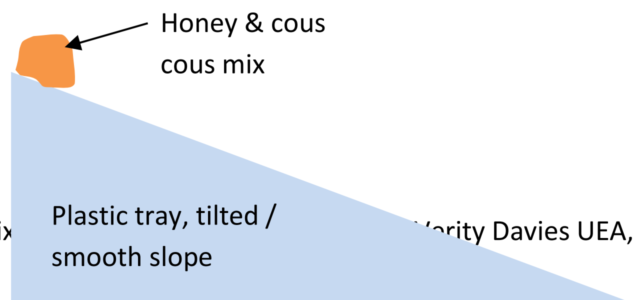
This experiment is designed to demonstrate a few key concepts in volcanology;

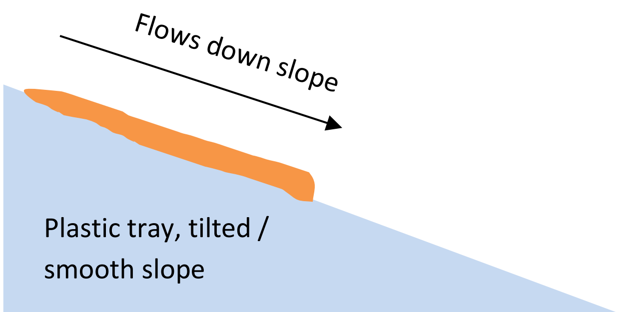
- Magmas have a variety of different chemical compositions
- A key element controlling the physical properties of a magma is Silica
- The more silica in the magma, the higher its viscosity
- The viscosity can impact the style of a volcanic eruption. Aka lava flowd vs explosive ash.
- Volatile phases such as water and CO_2 play an important role, especially when coupled with changes in viscosity.

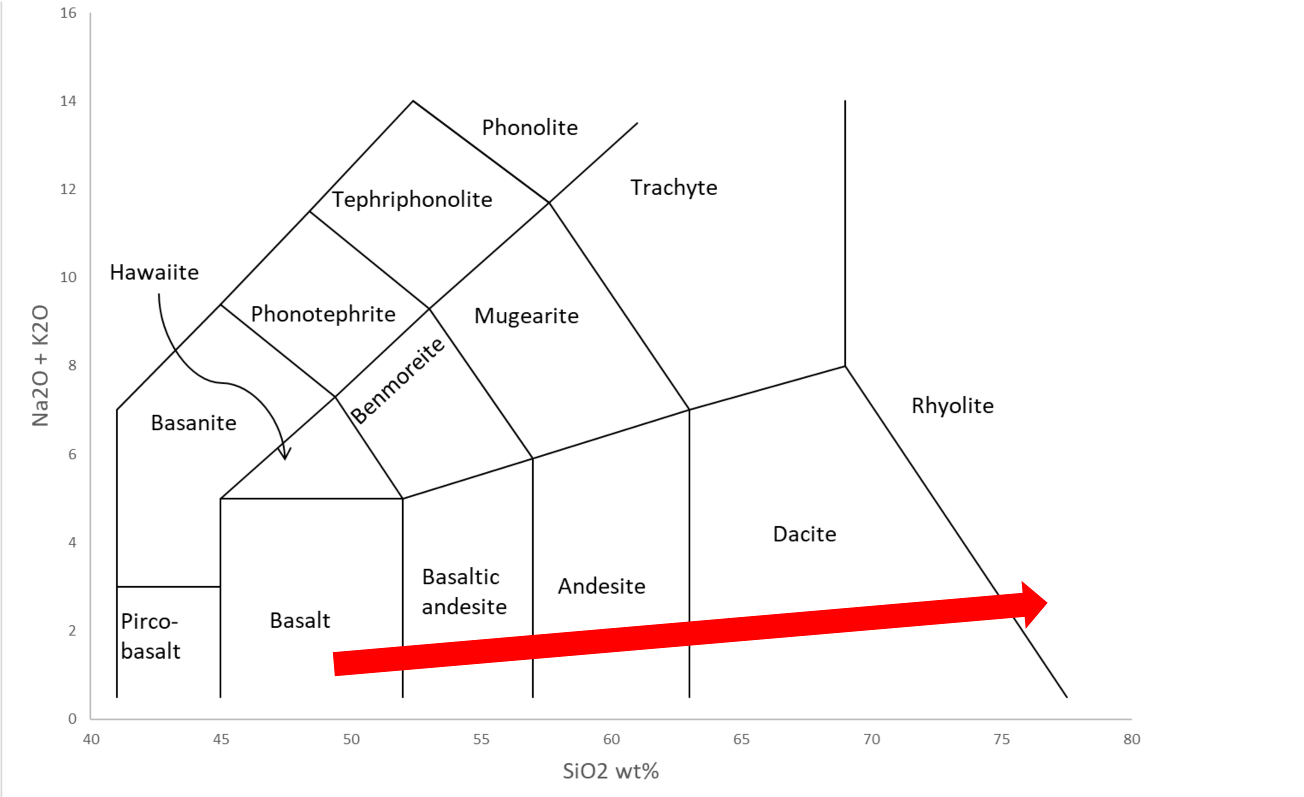
Equipment:

- Honey
- Cous cous
- Plastic bowls / cups to mix the honey and cous cous
- Spoons for mixing
- Plastic trays for running the magma down
- Blocks to stand the trays on at varying degrees of tilt (and tape to secure)
- Marker pens to note start and finish lines
- Timer / stop watch
- Calculators (for older children to calculate % silica)
- Cleaning materials
- Straws
- Balloon, and balloon pump
- Ruler to measure distance
- Videos of different styles of volcanic eruption:
    - https://www.youtube.com/watch?v=eoPz5O6_-d0 : pahoehoe lava from Hawaii. Low viscosity, high temperature flows relatively quickly. Basalt lava type. Representative of your lowest silica composition
    - https://www.youtube.com/watch?v=iyIV5fd1Aww&t=15s : Aa lava from Hawaii, slightly lower temperature, generates a blocky flow front and moves more slowly due to higher viscosity. Slightly more silica that pahoehoe.
    - https://www.youtube.com/watch?v=g28O5-X-2vU : Obsidian lava flow at Cordon Caulle volcano in Chile, 2013. So viscous that the magma movement is hardly visible. Similar to most viscous mixture you will make.
    - https://www.youtube.com/watch?v=NLhjNzQHphQ ; Explosive volcanic eruption at Anak Krakatoa in 2018, here there are high viscosities AND high gas contents – this links to the latter part of the experiment.

Experimental set up:







The diagram above is a plot of silica content vs the $Na_2O + K_2O$ content. We use these diagrams to name volcanic rocks when we have analysed their chemical composition. In the experiment you will be adding silica to the basaltic magma to increase the viscosity and make something more like a Rhyolite.

Activity instructions:

The honey is your "**basaltic magma**" composition with a baseline of 40-50% silica. The cous cous will be adding more and more silica to the magma, changing its properties. You will then compare the speed at which the lavas flow down the slope of the volcano.

Step 1: mixing the magma compositions

Weigh out 20-30g of honey into a cup/bowl. Add cous cous a spoon at a time to increase the mass.

For 30g of honey adding 3g of cous cous increases the silica content by 10% making something similar to an **Andesite**.

for smaller children, don't make them do the calculation, the observations that the honey gets thicker when you add cous cous is sufficient to link it to the viscosity. Try not to let them add too much at once or everyone's magmas will be rhyolite and will move very slowly!

Step 2: Lava race

Once you have two or three different magma compositions get the children to hold their cups/bowls at the same height above the tray at the top of the slope and count down for them to release the lava.

Pour/spoon the lava onto the tray and see which one gets to the finish line first.

While the lava is flowing get the children to observe the structures in the lava, the more viscous ones will form a higher flow front and you may see wrinkles in the top of the flow. You can compare this to the videos of the lavas.

Step 3: Gasses and lava

Make up the same mixtures you used for the lava race experiment in some cups/bowls. Take a straw and get them to blow into the mixtures to see how easily bubbles form in the different viscosities. You should see that it is harder to make bubbles in the ones with lots of cous cous – instead you get sudden puffs of air ripping through the mix in a more brittle fashion. Compare these with a cup of honey without any cous cous (the basalt) to see how much easier it is for gasses to escape from a low viscosity fluid.

You can also try this with water to show a really low viscosity fluid.

Step 4: How does gas make an explosion?

This part of the experiment uses the balloon and balloon pump.

You have seen how it is more difficult for gasses to form bubbles and escape high viscosity fluids. Now we demonstrate why this can cause an explosive eruption.

The balloon in this experiment represents a bubble growing in a magma. The rubber of the balloon is the molten rock of the magma and is fairly high viscosity (aka harder to blow a bubble in than water).

Start pumping up the balloon. This initial stage represents the point at which the water or CO_2 in the magma turns into a gas. This happens as the magma gets closer to the surface, the water and CO_2 become less soluble as the pressure from the overlying rock decreases.

As the magma gets closer to the surface, the bubbles expand more and more (like the balloon) the expanding gasses increase the pressure pushing out on the bubble walls until eventually….the magma is not strong enough to allow the bubble to grow any bigger and it POPS!

When the balloon bursts it makes a big bang. Get the children to imagine what it would be like if the balloon was made of molten rock, how much more pressure there would have to be to blast the rock apart. Imagine millions of these rock balloons bursting all at once inside the volcano. Then you can show them the video from Anak Krakatoa as a real world example.

Then summarise what they have learnt:

- Changing the silica content of the magma makes it more or less viscous
- Highly viscous magmas flow slower as lavas
- When there is lots of gas in a low viscosity magma it is easy for the gas to escape, eruptions are less explosive
- When the magma is very viscous the gas can't escape as easily and can cause an explosive eruption.

** this activity can be run as a worksheet activity for a class, or as a more free flowing workshop where children experiment with the different viscosities, you can also change the steepness of the slop and explore how changing this variable impacts the flow of the lava**

*** to adapt it for secondary school children include concepts such as brittle and ductile strength of rocks, how silica forms bonds in the magma which increases the viscosity, and the concept of decompression related gas expansion***

Below is an example of a worksheet you can use with this activity.

MIX YOUR OWN MAGMA!

Different magmas have different amounts of SILICA, this is an element that helps to make magma THICK.

THICK means EXPLOSIVE LAVA!

RUNNY means FAST LAVA!

We are going to experiment first with how fast our lava is…..

Experiment 1		**Slope Height:**		**Distance =**	
Sample name	Weight Honey (magma)	Weight cous cous (Silica)	% Silica	Time taken (s)	Speed (distance/time)

Experiment 2		**Slope Height:**		**Distance =**	
Sample name	Weight Honey (magma)	Weight cous cous (Silica)	% Silica	Time taken (s)	Speed (distance/time)

Experiment 3		**Slope Height:**		**Distance =**	
Sample name	Weight Honey (magma)	Weight cous cous (Silica)	% Silica	Time taken (s)	Speed (distance/time)

Now let's see how EXPLOSIVE our magmas are:

We are going to use a straw to see how hard it is for gasses to escape our magma, the harder it is the more **EXPLOSIVE** the eruption will be!

Rate how hard it was to blow into the mixture from 1-5

- 1 = barely blowing at all
- 5 = blowing so hard you might pop!

Rate how much of a POP you got:

- Little pop,
- Middle pop
- BIG POP

Magma Type	**Difficulty**	**Pop Factor**

This experiment isn't VERY scientific, but the basic idea is the same.

For the gasses in the magma to escape a sticky lava more pressure has to build up before they escape which means instead of a louder pop in your honey you get a BIGGER BANG in your volcano!