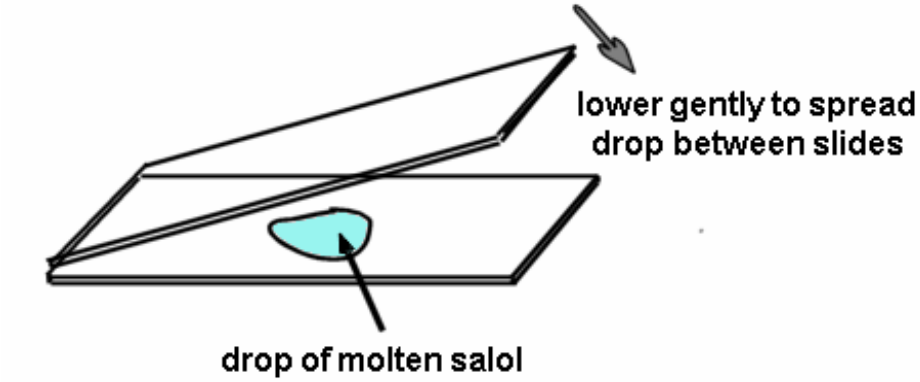
Grain size and cooling rate: an experiment with Salol.

Igneous rocks are formed when magma cools and crystallises.
The aim of this experiment is to investigate why *intrusive* igneous rocks like ***granite*** contain large crystals, whilst *extrusive* (volcanic) rocks like ***basalt*** are made up of tiny crystals. Have a look at a sample (or photograph) of each rock type and discuss your ideas before you start. This experiment will use molten **Salol** (phenyl salicylate) to model the behaviour of magma as it cools.

You will need:
Test tube containing molten Salol (from water bath), glass rod, test tube rack.
Two *cool* glass microscope slides (eg. from a fridge) and two *warm* slides. *Do not collect the slides until you are ready to use them.*
A hand lens or low-power microscope and a piece of coloured paper (Salol more easily seen on dark coloured paper)

Read the following carefully before you begin:
This experiment works well only if it is carried out quite quickly but carefully.
You will need to take a drop of molten Salol from the test tube and place it on one of the warm microscope slides using the glass rod. Then quickly, but carefully, place the other warm slide on top, to make a "sandwich" as shown below.
Repeat the process using the two cool slides.
It is important that you do this quite quickly so that the warm slides don't have time to cool down and the cool slides don't have time to warm up!



Place the two pairs of slides on the paper and look carefully using your lens to watch the crystals forming.

In which pair of slides do the crystals begin to form first – cold or warm?

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Why? ……

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In which pair of slides do the crystals grow largest, and why? ……

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If your experiment did not work well first time, think about what might have gone wrong and, if you have time, get a fresh set of slides and another tube of Salol – and try it once more.
Your teacher may be able to show you some photos and discuss your results.

Teacher/Technician Notes:

1. ***Background:***
   See pages on Crystallisation of magmas and also the Teacher background Notes in the Teachers' Zone pages. The photos included are from the JESEI website. It is a good idea for teachers to have these available for discussion with the students after they have made their own attempts (which may or may not be successful!)

2. ***Preparation of Salol samples and slides:***
   Salol samples are best prepared using a water bath set at a temperature which will just melt the Salol (around 45^{o}C). A class set of test tubes, each around ¼ full of Salol is needed, each with a glass rod inserted, so that the rod is also at the temperature of the Salol. Some spares are useful so that students can have a second attempt.
   Two sets of slides are needed for each student (again, spares will be useful). The cool slides should be kept in a cool place until the last moment, a cool cupboard or a fridge (not freezer) is fine. Similarly, the warm slides should be kept warm, on a radiator or in a *very* low oven is best.

3. ***Preparation for experiment:***
   Introductory discussion will stem from work on the origin, crystalline nature and varying grain sizes of igneous rocks. Its aim is to show how grain size relates to cooling rate from the molten state.
   Students will not find it easy to pick out he crystal boundaries to compare grain sizes, so it may be useful to show a photo first in order to make clear to students what they should look for.
   Students also need to be aware that this experiment is very temperature-sensitive; it needs to be performed quickly and carefully to achieve success, so it is vital that they understand exactly what to do before they start. Even so, it is likely that some students may be frustrated at their first (or even second) attempt.

4. ***Follow-up:***
   Like most experiments in Earth Science, this is actually a modelling exercise. As such, it is useful to question in what ways the Salol may or may not be a good model for molten magma. It is a single-component melt (as compared to magmas which contain several different mineral components), the "crystals" that form from Salol are actually bunches of radiating crystals formed from a single nucleus but, in most respects, the model works well.