Porosity

Common porous materials **D**

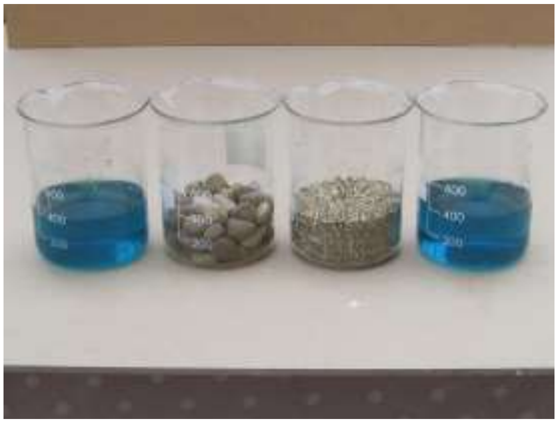
Show students a range of common porous materials such as sponge, breeze block, sponge cake and give them each pieces of aero chocolate to eat.

Porosity and permeability **D**

Pour water onto a sponge and a slab of vesicular basalt. Water flows through the sponge. Both are porous but only the sponge permeable.

Demonstration of porosity **D F**

This activity demonstrates that grain size does not affect porosity in well sorted sediments and it also demonstrates the meaning of yield and retention. Water is poured into beakers with equal volumes of well sorted pebbles and sand. Students calculate the volume of water that has gone into each sediment and are always surprised that it is the same. The water is then drained out of each and the students calculate the yield and the retention.



Porosity and grain size **D F**

Draw and shade in 20 or so circles which are touching to represent grains. Make enlarged and reduced copies of this. Students are shown one copy and asked to estimate the percentage porosity. They are then shown the other copies whose porosity is the same although the grain size is different.

Porosity and sorting **D F**

Use the same diagram as above but with smaller circles drawn between the larger ones.

Packing 1 *D*

Thirty six 5cm polystyrene spheres are glued together with araldite to show cubic packing. Another 36 are glued together to show hexagonal packing.

Packing 2 *P 5 minutes*

Steel balls, 6mm diameter, are put into a small clear plastic box (about 7cm by 5cm by 2cm). Students are asked to arrange them, without removing them, in cubic and then hexagonal packing. (Both are easy in two dimensions, cubic can be done in 3 dimensions but not hexagonal.)

Porosity of cubic packing *A I 10 min*

Students are asked to calculate the porosity of spheres with cubic packing. This is most easily done by imagining a sphere of radius r set in a cubic box whose sides are 2r. Alternatively imagine a similar cube with spheres whose centres are at each corner of the cube.

Packing 3 *A P 5 min*

To show how dependent porosity is on packing if the grains are not spheres.

Students are asked to draw cubes or coins packed so as to have minimum and maximum porosity.

Packing 4 *D*

Again to show how packing influences porosity. Students are shown a transparent box with sugar cubes stacked so that there are no gaps and another container with sugar cubes all jumbled up. Alternatively you can use a coffee jar filled with pennies laid flat, and another with the pennies jumbled. Take photos and then next time just use the photos.

Packing 5 *D*

Fill a jar with sand without shaking it. Level off the top using a ruler. Shaking it will rearrange the grains in a more compact form of packing.

Porosity of sediment *A P F 15 min for two samples*

Students determine the porosity of a variety of sediments to see how grain size, sorting, rounding and sphericity affect porosity.

Dry porosity *E P F 30 min*

Students determine the porosity of sediments and sedimentary rocks without wetting them by measuring the volume and weight and the density of he grains.

Porosity and Packing *A I 15 min*

Students draw 20 circles using a small coin arranged in cubic packing and the draw another 20 arranged in hexagonal packing. They note the number and size of the gaps between the circles in each group and work out which has the greater porosity.

Porosity of rectangular blocks of rocks **E P 10 mins in total**

Students measure and work out the volume of a rectangular piece of rock. They then weigh it. It is put in water for 24 hours and then weighed again. The difference in weight is the water it has soaked up. The weight of water in grams equals the volume of water in cc. and this, divided by the volume of the rock, is the porosity.

Porosity of clay ***A P 20 min***

Students are provided with a cradle which they fill with clay. The top is levelled and the sides cut flush with the wood. They measure the size of the clay. The clay is allowed to dry over a week and then weighed. The porosity can now be calculated. The weight of water lost in grams is the volume in cc and this, divided by the volume of the original clay, is the porosity.

Porosity of rock samples ***E P F 15 min per rock***

Students measure the porosity of irregularly shaped samples. First the volume must be found by weighing the sample in air and in water. The sample is soaked for 24 hours and weighed again in air. The change in weight in grams is the weight of the water absorbed in and this equals the volume of the pores in cc. A series of samples can be measured, for instance, sandstones of different ages or different types of limestone.

Intergranular and Intragranular porosity ***D***

The difference between the two terms can be illustrated by sugar lumps in a jar or a photo.

Porosity of vesicular basalt *A P* *[F](#) 30 min*

Take a slab of vesicular basalt and fill the vesicles with Polyfiller. Photocopy the slab enlarging if necessary. Students place a ruler on the photocopy and note if there is basalt or vesicle below each centimetre line on the ruler at the edge. They should move the ruler down when they have completed one row. They should make 100 readings and then calculate the percentage of vesicles.

Calculating the porosity of pumice *A P* *F* *30 min*

You will need a piece of obsidian and a piece of pumice both with a nylon line attached to them. Weigh the obsidian in air and in water and calculate its density. Find the volume per gram (reciprocal of density). Repeat for the pumice. The amount of expansion is $\frac{\text{volume of 1g of pumice}}{\text{volume of 1g of obsidian}}$

and the porosity of pumice is $\frac{\text{vol 1g pumice} - \text{vol 1g obsidian} \times 100}{\text{vol 1g pumice}}$

Rise an fall of the water table *E P* *F* *30 min*

This experiment is to show the relationship of the porosity of the ground, the rainfall, and the water table. Known volumes of water are added to a 2 litre measuring cylinder filled with gravel and the change in the height of the water is recorded.