

THE STRENGTH OF ROCKS 1

Purpose

The purpose of Activity I is to measure the relative strengths of rocks by dropping a marble onto them whereas the purpose of Activity II is to investigate which of the following factors determine the strength of rock: crystallinity, grain size, porosity, mineral hardness

Background

When the marble hits the rock both the rock and the marble deform slightly. You will find that the marble will bounce higher on some rocks than on others. The height of bounce is directly related to the elasticity (Young's Modulus) of the rock. There is a positive correlation between Young's Modulus and the strength of the rock. The Schmidt hammer used by professionals to determine the strength of rocks works on the same principle.

Instructions

Activity I

- 1. Take one of the rocks, note its name and briefly describe it.*
- 2. Place the base of the metre rule on the edge of the slab of rock.*
- 3. Trial run: Drop the marble from a height of one metre onto the slab, while your partner notes the approximate height to which it bounces.*
- 4. Now your partner gets into position looking directly at that height.*
- 5. Drop the marble from one metre, while your partner observes exactly how high the marble bounces. Do this three times.*
- 6. Repeat instructions 1 to 4 for all the other rocks you have chosen.*
- 7. Work out the average bounce for each rock and then list the rocks in order of decreasing strength.*
- 8. Draw graphs to illustrate your data.*

9. Draw any conclusions you can and suggest why some rocks are stronger than others.

Activity II

1 Choose suitable pairs or groups of rocks to check the effects of each of these variables.

2 Record the following data about each rock

Name of rock

Crystalline or fragmental

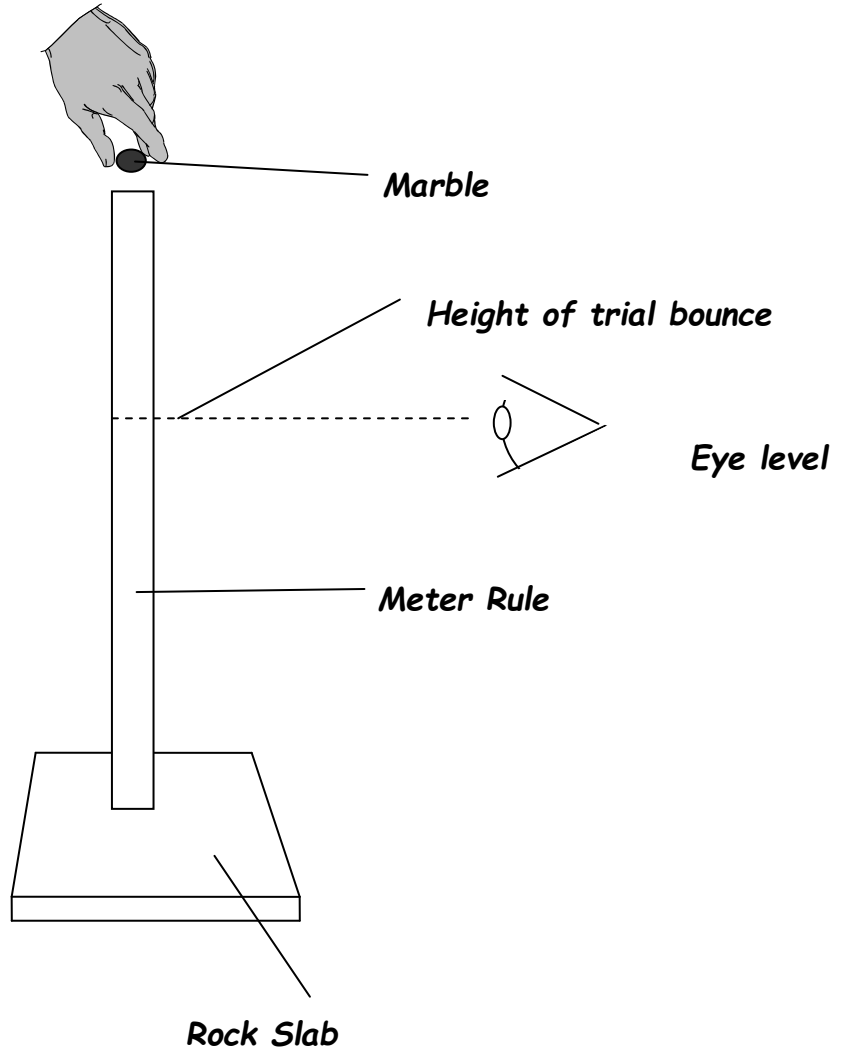
Grain size

Minerals and their hardness

Porosity

3 Find the height of bounce of each rock type. Follow the instructions given in Activity I but take 5 measurements and record both the average and range.

4 Draw your conclusions.



Teacher's Section

Requirements

One metre rule, glass marble about 1.5cm diameter.

Clamp or wall to hold up the rule or it can be held up by a student.

Activity I

About 12 slabs of rock with flat surfaces. The slabs should be at least 10cm by 10cm and all should be 2cm thick. There should be a variety of igneous, metamorphic and sedimentary rocks,

Activity II

Slabs of the following rocks, preferably all 2cm thick

To test grain size: granite and microgranite or gabbro, dolerite and basalt

To test the effects of mineral hardness: marble and metaquartzite

To test the effects of porosity: marble, limestone, and chalk or metaquartzite and sandstone, basalt and vesicular basalt (the porosities should be given).

Reference books for hardness of minerals and composition of rocks

Notes

Activity I works well at the beginning of a Geology course.

Activity II is good for revision of rocks and minerals.

Students often suggest density as a suitable factor to investigate however it is difficult to evaluate because it cannot be separated from either porosity or hardness of minerals.

If rectangular slabs are used it is easy to calculate the porosity by the dry porosity method, see Dry Porosity activity II.

Checks

That students are putting the ruler on top of the rock. Also that they are adjusting the height of their eyes to avoid parallax problems.

In Activity II it is important to check that students have chosen suitable rocks to investigate the effects of each of the variables.

Results

Activity I

Igneous rocks are the strongest with bounces of about 85cm, then metamorphic and lastly sedimentary. Conglomerate is very variable

because it depends on which clast the marble hits. Vesicular lava is very low.

Activity II

Grain size makes no difference. There is a positive correlation between mineral hardness and rock strength and a negative correlation between porosity and rock strength. Crystalline rocks are stronger than fragmental rocks.

Time

Activity I One hour for 12 samples. Activity II I hour.

Cost

Slabs of many rock types can be obtained free from stonemasons. But you may need to get slabs of metaquartzite and migrogranite cut. They will cost about £5 per cut.