'Let's get Practical'
– How Science Works

OCR
RECOGNISING ACHIEVEMENT

Bones

Apparatus and chemicals:

A supply of rigid plastic drinking straws [i.e. not those containing a concertina type bend]
Two bricks or other supports
A cradle to place over the straw when it is suspended by its ends on two bricks
A supply of 10g weights
Dry sand
Talcum powder
Rice
Table sugar
Table salt
Iron filings
Plaster
A supply of distilled water

Reference: Gateway Science Suite Biology Module B5a – Skeletons *'carry out an experiment to compare the strengths of solid and hollow structures'*

Bone is a composite structure made up of two main components: A mineral called hydroxy-apatite and a protein called collagen. Hydroxy-apatite is a hard brittle material, and collagen is a stringy rubbery polymer - it is the stuff which the end of your nose is made of.

Sharks and babies have bones made largely of collagen, which is flexible and tough (it can absorb a lot of energy in an impact) but they're not rigid enough to support large forces. This is where the hydroxy-apatite comes in, as this makes the bones stiff.

If a bone is soaked in vinegar, the hydroxy-apatite dissolves away, leaving the collagen. Now the bone is far too flexible to be useful. Similarly, if a bone is heated in a fire, most of the collagen protein is converted into charcoal. This leaves the hard hydroxy-apatite, with very little holding it together, so the bones are very weak and brittle.

Bones need to provide rigidity but also lightness, and a porous structure allows biologically important processes to take place within them. In this exercise students may compare the strengths of hollow and solid structures, or ones containing many cavities, to establish which factors affect the load bearing capacity of model bones.

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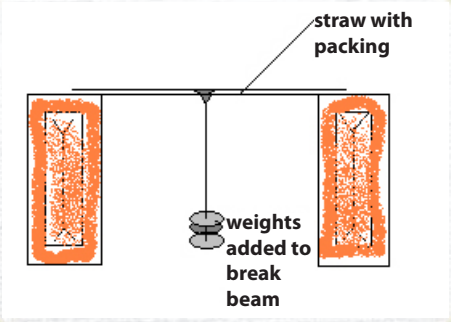
Procedure

1 Two bricks are placed on the bench to act as supports for a straw.

2 A straw is placed across the gap and weights attached to the cradle until the beam collapses. This load is noted.



Extensions and questions

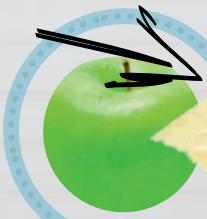
1 The straw may be filled with a variety of powders and the experiment repeated to investigate the load bearing capacities of different reinforcements. Single powders could be used or mixtures.

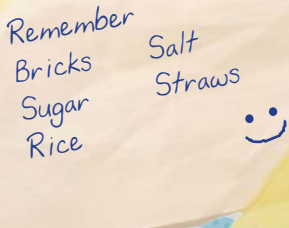
2 The effect of allowing water to percolate through before testing could be investigated. This may be particularly important with plaster which would set hard before testing.

3 The ends of the straws could be glued to the support or attached be some other means to investigate the effect that such attachment has on the final load-bearing capacity.

4 Would two straws together be more effective than simply multiplying the strength of one by 2? What would be the effect of taping two together? What if the two straws each had a different fill?

5 Devise a way to test the different straw bones' load bearing capacity in *compression* along their long axis.





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