

'Let's get Practical'
– How Science Works

The Strength of Hair



Apparatus and chemicals:

Hair samples, noted with colour (original colour if dyed), age and racial type of donor, any recent hair care treatments

A supply of thin card to cut supports for individual hairs, scissors, pencils and rulers

Adhesive tape

Clamp stand and boss and clamp

A supply of small weights to suspend as described, giving an indication of the comparative strength of hairs

Commercial hair care products of the students' choice

Hair dryer

Reference: Twenty First Century Science. Chemistry Module C2.1 – *How do we measure the properties of materials and why are the results useful?*

One of the defining characteristics of mammals is the presence of body hair.

Human hair is made of a protein called keratin; a polyamide molecule with many disulfide bridges between the chains which gives the hair its strength and stiffness.

The colour is due to eumelanin [fair hair if in low concentrations or brown and black if higher] or pheomelanin [a yellow red colour giving rise to redheads and freckles]. Grey hair lacks either colouring pigment. In keeping with other man-made fibres the strength of hair will depend to a large extent on the nature of the intermolecular bonds, the more there are the stiffer the hair will be, and the higher its tensile strength.

In this investigation students must come up with a convenient and safe way of handling single strands of hair, and devise a simple method of comparing tensile strength.

Learning outcomes – this activity can be used to prepare candidates for aspects of the controlled assessments. The task can either be presented as an open investigation (suitable for GCSE Chemistry) or as an example of a standard procedure, using the method shown below (suitable for GCSE Additional Applied Science). We recommend giving students a clear focus for the task, such as optimising their experimental design for repeatability or quantifying errors.

Could also be used with
Additional Applied Science
Topic B1.2 – Mechanical
behaviour of materials

Procedure:

- 1 A card is cut as shown in figure 1 with holes reinforced with strips of tape. A single hair is fixed as shown, with ends curled round to ensure that it breaks instead of simply being pulled out from under the tape.
- 2 Once assembled the cord and hair is suspended from a pencil held horizontally in a clamp. The card is then cut as shown in figure 1. It is then loaded to breaking point. At that point both weights and the lower piece of residual card is weighed and recorded.

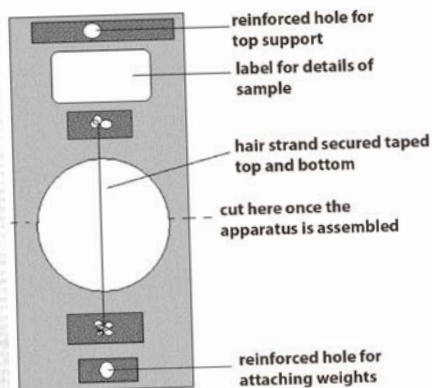


fig.1



I Love science

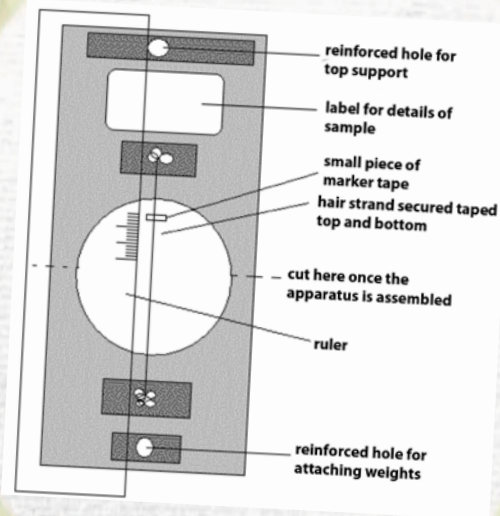


fig.2

Extensions and questions

- 1 Since hair grows from the scalp, the tips will be the oldest part of the strand. Differences in sampling along the hair [i.e. its age] could be investigated if the hair were long enough. How quickly, on average, does hair grow?
- 2 Is it possible to investigate the extension of hair prior to breaking? A ruler could be used as given in figure 2.
- 3 The investigation could be extended to compare hair from pets and domestic animals.
- 4 There are many variables that could be investigated: colour; length that is tested, heat pre-treatment, wetted or dry, or subject to treatments by various commercial hair care products such as conditioners, perming lotions and bleaches.
- 5 Students will also learn the need to complete replicate measurements in order to establish a range of values of a measurement as well as improve the validity of the conclusion to a question.