Activity 4.6 Extraction of 'fibres' from stinging nettles

Purpose

- To extract 'commercially useful fibres' from a plant stem and investigate their properties.
- To develop certain experimental skills, namely planning an experiment that will produce appropriate results to test a hypothesis or idea, using apparatus and a procedure that is suitable to produce valid results.

Using plant fibres

In this activity you extract the fibres from nettles and then test their strength.

'Fibres' have been extracted from plant stems for centuries and used in the commercial manufacture of a wide range of textiles and paper. The term 'fibres' does not just refer to the sclerenchyma but is used to describe a range of 'fibre-like' structures. These plant fibres have been used for different purposes, as indicated in Table 1. Their use is dependent on their properties.

Table 1 Fibres and their uses.

Fibre	Useful part of the plant	Applications
Flax	Stem of flax plant	Linen for clothing
Cotton	Hairs on the seeds on plant belonging to the mallow family	Cotton for clothing
Hemp	Fibres from the stem/leaves of the hemp plant	Used for ropes, backing for carpets
Coir	Fibre from the husks of the fruit of the coconut	Floor coverings, ropes
Jute	Fibre from the stem of the jute plant	Hessian, sacking and carpets
Manila	Hard fibres from the leaves of a type of banana	Marine cables and other ropes, nets and matting
Pulp	Softwood trunks	Paper, cardboard

Fibres can be removed from plant stems by retting. This can be field retting – plant stems are cut or pulled up and left in the field to rot; microbial action breaks down the stalks. Alternatively water retting may be used – stems are immersed in water. The latter produces more uniform, higher quality fibres but is more expensive and produces nitrogen-rich waste water that must be treated before discharge. During soaking, bacteria and fungi break down the soft tissues of the stems leaving the cellulose intact. It is then relatively easy to remove the cellulose-rich fibres. The procedure on the next page uses this technique to extract the fibres from nettle stems.

Activity 4.6 Extraction of 'fibres' from stinging nettle

Student

Extracting fibres from mature nettle stems

Safety

Wear eye protection and gloves when handling the unretted nettles to avoid being stung.

Wash your hands after handling the soaked fibres.

You need

- Stems of mature stinging nettles or other plant stems
- Bucket or bowl
- Rubber gloves
- Paper towels

Procedure

1 Remove the leaves and any flowers from stems of mature stinging nettles. Place the stems in a bowl/bucket of water so that they are completely submerged. This may have already been done for you. The stems are soaked for at least a week.

2 Remove the stems from the water. Wash the stems to remove the softened tissue and then dry the remaining fibres. The outside cuticle and epidermal layer will rub away and the central pith will be left when you peel away the fibres. These 'fibres' are made up of the vascular tissue; they contain both the xylem vessels and the sclerenchyma fibres.

How strong are the extracted fibres? Are they as strong as the intact stem? Devise an experiment to test the strength of the nettle fibres

Strength can be defined as the maximum stress a material can withstand without failing (breaking). Tensile strength is the maximum stress caused by a pulling force that a material can withstand without failing. Compression strength is the maximum stress caused by a pushing force that a material can withstand without crushing.

You could investigate whether the strength of the stem is entirely due to the fibres or whether the epidermis and packing tissue make a major contribution. You could extract and compare some different fibres.

You could design an experiment to find out if the nettle fibres under tension are stronger or weaker than concrete. Concrete has a tensile strength of 2×10^6 N m^{-2}.

Your plan should include a detailed description of the procedure used to test the fibres. It should use apparatus that will provide valid results. The method should produce precise repeatable measurements that reduce any systematic or random errors.

Can you think of any other important properties you could test for?

Plant stems must not only be strong, but often they must able to bend in the wind and return to their original shape without any permanent distortion. They must not be too stiff. How stiff are the extracted fibres and plant stems? Is it the fibres that make the stem stiff? Does stiffness vary between different plant fibres and stems?