**Investigating the properties of a plastic bag**

**Introduction**

In this experiment students will be investigating the properties of the material used to make a carrier bag.

They are expected to be familiar with the concept of the application of a force leading to the extension of an elastic material in tension and the further concepts of stress and strain.

They will be plotting a graph to show the effect of increasing load.

They should be familiar with the appropriate terminology to describe their observations.

**Aim and skills covered**

* To determine the relationship between force and extension or stress and strain
* To use these observations to describe the materials behaviour.

**Intended class time**

* 45 to 60 minutes

**Links to Specification**

**Physics A**

* 3.4.1(a) tensile and compressive deformation; extension and compression
* 3.4.1(b) Hooke's law
* 3.4.1(d)(ii) techniques and procedures used to investigate force–extension characteristics for arrangements which may include springs, rubber bands, polythene strips
* 3.4.2(c) stress, strain and ultimate tensile strength
* 3.4.2(e) stress-strain graphs for typical ductile, brittle and polymeric materials
* 3.4.2(f) elastic and plastic deformations of materials

**Physics B**

* 3.2a(i) simple mechanical behaviour: elastic and plastic deformation and fracture
* 3.2a(iii) behaviour/structure of classes of materials - polymer behaviour in terms of chain entanglement/unravelling
* 3.2b(i) Make appropriate use of the terms: stress, strain, Young modulus, tension, compression, fracture stress and yield stress, stiff, elastic, plastic, ductile, hard, brittle, tough, strong, dislocation
* 3.2d(i) plotting force-extension characteristics for arrangements of springs, rubber bands, polythene strips, etc.

**Practical Skills**

* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follows written procedures
* 1.2.1(d) makes and records observations
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification
* 1.2.2(a) using appropriate analogue apparatus to record length and distance and to interpolate between scale marks
* 1.2.2(b) Use of appropriate digital instruments to measure mass
* 1.2.2(c) Use methods to improve accuracy of measurements

**CPAC**

* (1) Follows written procedures
* (3) Safely uses a range of practical equipment and materials
* (4) Makes and records observations

**Mathematical skills**

* M0.1 Recognise and make use of appropriate units in calculations
* M0.2 Recognise and use expressions in standard form
* M0.3 Use ratios, fractions and percentages
* M1.1 Use an appropriate number of significant figures
* M3.1 Translate information between graphical, numerical and algebraic forms
* M3.2 Plot two variables from experimental or other data
* M3.4 Determine the slope of a linear graph

**Equipment**

* samples of plastic bag cut both in line with the normal load direction and at ninety degrees to that
* 100g masses on holder
* calipers or vernier measurement system
* metre rule
* stand
* boss and clamp
* material clamps

**Health and Safety**

Care should be taken such that when the material finally breaks the masses land safely without damaging equipment or endangering people.

[Make sure the masses are less than 10cm above the desk, and that there is a soft protective material for them to land on after the material breaks.]

Before carrying out any experiment or demonstration based on this guidance, it is the responsibility of teachers to ensure that they have undertaken a risk assessment in accordance with their employer’s requirements, making use of up-to-date information and taking account of their own particular circumstances. Any local rules or restrictions issued by the employer must always be followed.

**Notes**

* These practical activities are not controlled assessments, should not be carried out in exam conditions and can be adapted by the centre. Students can collaborate during the activities which should take place as part of the normal teaching sequence. They are intended to be formative with students acquiring and practising skills throughout the course.
* To achieve a pass in the Practical Endorsement each student is required to demonstrate competence in all the skills, apparatus and techniques listed in section 1.2 of the specification and assessed against the Ofqual Common Practical Assessment Criteria (CPAC) at the end of the course.
* The skills, apparatus and techniques can be demonstrated during any practical work undertaken during the A Level course whether an OCR practical activity or not.
* The centre should try the experiment in advance to determine the appropriate width of plastic strip which demonstrates the initial elongation, the increase in stiffness and ultimate breaking point when using 10 x 100g masses.
* Note that any imperfection in cutting the strip can cause it to break prematurely.
* Old cassette tape gives an alternative material for an investigation in one plane only.

**Recording**

* Learners should not need to re-draft their work but rather keep all their notes as a continuing record of Practical Activity.
* As evidence for the Practical Endorsement learners should have evidence of the data collected from their individual readings in a clear and logical format.

In addition, to support the assessment of practical work in the written examinations:

* They should plot a graphs as required
* They should make appropriate observations
* Explaining their observations reinforces the use of scientific terms.