Sample Teaching Plan Unit G630: Materials for a purpose

Suggested teaching time	Plan is based on 12 weeks at 5 hours per week (4 hours contact time + 1 hour directed study).

The learning activities are suggestions only. Teachers may wish to develop alternative strategies. The plan should be read alongside the G630 Specification and, in particular, the Assessment Evidence Grid (attached for your reference).

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
	The first 4 weeks are broken into time slots ‘a’ and ‘b’. It is possible to cover all the ‘a’ content followed by all the ‘b’ activities, but interspersing them provides more variety in the student experience. It is anticipated that the ‘b’ activities will require 1½ - 2 hours each week.	‘a’ activities are designed to build up a body of theoretical knowledge supported by a variety of learning activities. ‘b’ activities consist largely of laboratory work.	
1a	3.11.1 Polymers.	Some teacher-led input of background theory may be appropriate interspersed with students activities such as: Construction of models showing molecular structures.	Molecular model kits.

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1b	3.11.2 Understand electrical conductivity and resistivity. Measure electrical conductivity.	Measure the resistance of a length of resistance wire or conducting putty using a multimeter. Measure the length of the wire/putty using a metre rule. Measure the diameter of the wire/putty using a micrometer. Calculate the resistivity and hence the conductivity. Understanding can be further developed by comparing the resistances of different lengths of wire/putty, different diameters (or wires in parallel) and different materials. If time permits resistance can also be measured by alternative methods such as the voltmeter ammeter method or a resistance bridge.	Digital multimeter. Length(s) of resistance wire **or** Conducting Putty (Philip Harris Product Code: B8C53157). Metre rule. Micrometer. Additional samples of resistance wire. Ammeter or second multimeter or resistance bridge.
2a	3.11.1 Metals.	Some teacher-led input of background theory may be appropriate interspersed with students activities such as: Construction of models showing crystal structures. Investigate how close packed layers of atoms in a metal can be arranged in sequences: • ABABAB for close packed hexagonal structures • ABCABC structures for FCC structures.	Molecular model kits. Polystyrene spheres glues together in sheets for models of metal crystals. Prepared diagrams illustrating dislocation movement.

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2b	3.11.2 Understand thermal properties: thermal conductivity, specific heat capacity and thermal expansivity. Measure specific heat capacity. **Assessment:** report on the results of experiment specific heat capacity. (NB Alternatively can report on the results of experiment measure electrical and thermal conductivities).	Measure specific heat capacity: The simplest method is to measure the specific heat capacity of a cylinder of metal, heated electrically. Measure the temperature of the block before and after heating. Measure the mass of the block. Measure the p.d. and current supplied to the block and the time heating.	Metal cylinder with holes drilled for thermometer and electrical heater. Electrical heater. Balance. Stopwatch or clock. Thermometer. Heat-proof mat. Lagging.
3a	3.11.1 Ceramics and glasses. Test the effectiveness of the following treatments: Work-hardening; Annealing; Tempering. **Assessment:** report on tests to show the effect of their work-hardening, annealing and tempering treatments.	Some teacher-led input of background theory may be appropriate interspersed with students activities. Repeated bending or paper clip. Noting that it becomes warm and stiffer before eventually snapping. Heat metal sample and cool slowly. Heat metal sample and quench in water. Test samples in tensometer if available. Alternatively clamp sample at one end horizontally and investigate bending when masses are suspended form the other end.	Paper clips. Tensometer if available. If sample is to be tested in a tensometer, then commercial samples should be used. Alternatively simple tests can be carried out using paper clips or similar pieces of metal.

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3b	3.11.2 Understand density, elastic modulus. Fracture strength, ductility and brittleness. Measure how the extension of a sample varies with tension. From a graph of the tensile force and extension, candidates need to: Calculate tensile stress and strain; obtain values of the Young modulus and tensile strength and comment on its ductility; Relate toughness to the area under the graph. **Assessment:** calculations of tensile stress and strain, the Young modulus and toughness from a graph of force against extension and details of sample dimensions.	**Either:** Use a tenosometer to produce a graph of force against extension against force applied **Or:** Measure the extension of a length of steel wire suspended from a wall bracket. Hang increasing masses from the wire and use Vernier scale to measure extension. To calculate stress from force applied also measure sample diameter and hence calculate cross sectional area. To calculate strain from extension measure length of sample. Plot graph of stress against strain. Measure gradient to find the Young modulus. Measure area under graph to find toughness. **N.B. Use appropriate shielding to prevent injury in case sample breaks.**	**Either:** Hounsfield tensometer. **Or:** Young Modulus apparatus e.g. (Philip Harris Product Codes: B8H25213 or B8H25225). Masses. Micrometer. Metre rule.
4a	3.11.1 Composite materials.	Some teacher-led input of background theory may be appropriate interspersed with students activities such as: Making sheet of glass fibre reinforced plastic and compare the properties with sheet of resin and glass fibre matt.	Glass fibre kit.

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5	**Assessment:** a presentation or poster and accompanying notes outlining the structures of polymers, metals, ceramics or glasses, and composite materials.	Preparation. Students should be encouraged to prepare for this activity during the preceding weeks.	A1 paper. Marker pens.
6	**Assessment:** a presentation or poster and accompanying notes outlining the structures of polymers, metals, ceramics or glasses, and composite materials.	Students present their work to the class. If students work in groups it is important that all should participate in the presentation and the contributions of each to the preparation should be clearly identified. Evidence should include teachers' comments on the presentation, which may be in the form of a completed checklist.	
7	3.11.3 Select materials for a stated purpose – Introduction. Candidates need to: • distinguish between objectives and constraints • identify the objectives and constraints for a given application. Take into account : • price • demand • environmental considerations • production costs • government regulations • quantity required • quality required.	Teacher input on how to make a selection followed by practice group activities to select materials for stated purposes <u>given data sheets</u>. Exercise on finding and selecting data using sources including but not exclusively the internet.	Selection of tasks and simplified data sheets for practice purposes. Internet access. Other sources relating to materials, properties, etc.

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8 - 12	3.11.4 For their case study, candidates need to: • research data on the properties of materials • draw up a shortlist • select the best material • suggest at least one alternative. **Assessment:** one case study describing, in detail, their selection of different preferred materials for a stated purpose. Candidate should use published data on material properties in their selection.	Candidates may be given a selection of appropriate applications or may choose their own. It is recommended that these should be approved by the teacher before work commences to ensure that the chosen application lends itself to more than one plausible solution and does not involve complexities beyond the time available. Candidates should be given interim deadlines for each of the four bullet points, plus draft and final report. In addition to ongoing guidance and support it is suggested that teachers review progress in detail as each deadline is reached.	Internet access. Other sources relating to materials, properties, etc.