Unit 99: Exploring Resistant Materials

Unit code: Y/502/5442

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to enable learners to develop their skills through practical exploration of resistant materials. They will also gain underpinning knowledge and understanding of resistant materials, their common properties and working characteristics and also individual qualities. This will inform learners, when they carry out future practical work.

Unit introduction

For any practitioner working three dimensionally within the field of art, craft and design, an understanding of materials, techniques and processes is essential. The ability to skilfully manipulate and explore materials and techniques to exploit their full potential, within both expected and unexpected contexts, is the backbone of any designer's work. This involves considering how materials can be prepared, worked, joined together and treated, to meet design intentions.

This unit has an emphasis on exploring and investigating, rather than on the production of finished pieces of work. It is expected that a number of the materials given to learners to work with may be new to them. This is an exciting opportunity to find out about new materials and their properties. The unit is richer for the inclusion of as many different materials as the centre can use.

It is essential that learners have time set aside for research, investigation and experimentation without the pressures of finished outcomes, therefore the emphasis of this unit is on exploratory work. They will learn how to conduct tests and samples to acquire technical and visual information and increasingly recognise the relevance of exploratory activities. An important aspect of this exploration is the continual analysis, evaluation and recording of information and referencing the knowledge and understanding gained to inform further work. Learners should develop their own methods of recording these investigations and keep a sketchbook or journal investigations, observations and conclusions. This can include photographs, drawings, written notes and references to others' works to evidence what they have learned. The sharing of results to extend learners' own knowledge will be a component of this unit.

Learners must have a full health and safety induction in the practice of working in a workshop environment and be shown the correct use of tools, equipment and protective clothing.

Learning outcomes

On completion of this unit a learner should:

1 Be able to investigate resistant materials and techniques safely

2 Be able to select and prepare resistant materials to meet specified requirements

3 Know about the properties and working characteristics of resistant materials.

Unit content

1 Be able to investigate resistant materials and techniques safely

Resistant materials: eg hardwoods, softwoods, composite materials, medium density fibreboard (MDF), plywood, metals (ferrous, non-ferrous, alloys), plastics, thermoformed materials, glass, plaster

Working methods: eg methodical, sequential, material manipulation, construction; techniques, eg sawing, cutting, carving, planing, turning, milling, sanding, joining, soldering, welding, appliqué, copper foiling, leading, gluing, assembling, fixing, fastening, bending, clamping, deforming, moulding, bending, forging (by hand, with machine); finishing techniques, eg painting, texturing, sanding, inlaying, embossing, enamelling, etching, thermal colouring, fusing, punching, sandblasting, varnishing; using specialist tools and machines, eg hammers, saws, cutters, band saw, drills, glue gun, files, scorers

Researching: eg contextual examples, use of materials, use of techniques, techniques, artists, designers, historical, contemporary

Health and safety: thinking and working safely within workshop studio environment, following procedures, having awareness of task based risks, following the COSHH guidance on materials, wearing protective clothing as necessary and looking after specialist tools

2 Be able to select and prepare resistant materials to meet specified requirements

Select resistant materials: eg evaluate notes on tests, consider results of explorations; consider fitness for purpose; evaluate design constraints

Prepare resistant materials: eg measuring and preparing cutting lists; list components, required tools, equipment, fastenings, fittings, glues, adhesives; adhere to health and safety standards

Shape, form and use finishing techniques: eg shaping, sawing, carving, planing, turning, milling, sanding, smoothing (by hand, with machine)

Construction techniques: eg cutting, joining, assembling, fixing, forming, deforming, manipulation by moulding, bending, forging, decorating, preserving, enhancing finished artefacts, applying treatments, surface finishes; health and safety

3 Know about the properties and characteristics of resistant materials

Properties: eg strength, durability, rigidity, flexibility, ductility, malleability, density, weight, surface treatments, construction possibilities, structural possibilities, ease of working, capacity to hold detail, suitability, health and safety

Record: findings, eg tests, working methods, outcomes, experiments, changes in materials; links, eg with research, with others' work; in appropriate form, eg notebook, sketchbook, journal, visual diary; potential; constraints; qualities (aesthetic, technical); formal elements

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 investigate resistant materials and techniques safely [IE, TW, SM]	**M1** conduct effective investigations about diverse resistant materials and techniques	**D1** document the potential of materials based on analysis of comprehensive investigations
P2 select and prepare resistant materials to meet specified requirements [TW]	**M2** select and effectively prepare resistant materials to coherently meet specified requirements	**D2** conduct independent and detailed investigations into diverse resistant materials and techniques.
P3 identify the properties and characteristics of resistant materials. [RL]	**M3** describe properties and characteristics of resistant materials.	

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Learners should have access to as wide a range of materials, techniques and processes as are available in the centre, the relevant workshops equipped with appropriate tools and equipment and to library and internet facilities to research artists' works. Delivery should consist mainly of demonstrations and of monitoring learners' practical work. This unit is liked to *Extending Resistant Materials*, where the understanding gained in this exploratory unit can be applied to developing, realising and evaluating design outcomes. The companion unit is *Exploring Non-resistant Materials,* which focuses on a complementary range of materials, techniques and processes for the design crafts pathway.

Learning outcome 1 involves learners exploring techniques when working with resistant materials. In delivering this unit, tutors should break it down into the areas that learners are going to experience, such as metal, wood, plastics and glass. A full health and safety induction should be given in each area. This may include wearing of protective clothing or coverings such as goggles or particular footwear. Tutors should demonstrate how the materials can be prepared, manipulated and joined and ensure that learners have sufficient time to practise techniques and processes and give learners opportunities for personal investigations, experimentations and approaches. Work can follow established procedures, systematic, scientific and sequential investigations to the purely experimental for discovering unexpected outcomes, with regards to health and safety considerations. It is also important that learners are made aware of the range of available components such as fastenings, fittings, glues and adhesives. Learners need to develop procedures for trialling and sampling intended finishes, as natural accompaniments to designing and making. As these are time-consuming activities, learners should share findings and results and could work in small groups. Regular reviews and revisions should take place to consolidate and reinforce information.

Learning outcome 2 follows on from outcome 1 in that without direct experience of handling, manipulating and working with materials and reviewing their work to record investigations, learners would not meaningfully understand the properties and working characteristics of resistant materials. Delivery could take the form of explanatory demonstrations of degrees of strength, flexibility, ductility, malleability, as appropriate, to ensure learners understand how different materials have different properties and how they can therefore be selected for different purposes.

From the initial induction phase a more structured task should be given in the form of a brief. This should allow learners to investigate and select from the range of resistant materials in the *Unit content*. Delivery at this stage should take the form of close supervision, monitoring that materials are used appropriately and structured guidance. Learners need to be made aware of possibilities as well as technical and budgetary constraints. The importance of clearing up before the end of each session must be instilled. Tutors should also direct learners to research relevant works of practitioners and to link research with their own investigations.

Learning outcome 3 involves learners developing and retaining their knowledge of properties and working characteristics by keeping ongoing records in sketchbooks or journals. Learners should collate handouts and notes for personal reference as good working practice. Time should be set aside, such as at the end of each working session, so learners can record the materials and techniques they used, all stages of the explorations, not just the end result, while they are still fresh in their memories. They should also comment on the visual results, with particular reference to the formal elements. These records can take the form of a combination of written notes, drawings, diagrams, photographs, sample pieces or any other relevant method and include links with artists' works. Delivery may take the form of setting questions and one to one discussions. Tutors may give handouts of technical information, but learners should be encouraged to make their own personal recordings to aid memory of the practical work and to develop their independence. Tutors should monitor that the reference books are clearly organised, so learners may use the information in the future, rather than continually referring to tutors.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to unit and assignment programme.
Assignment 1: Introduction to Metals Introduction to workshop and health and safety considerations. Introduction to and demonstration about safe and appropriate use of hand tools and machine equipment. Learners: • From a line drawing, translate into flat linear wire reliefs, using wire of different thickness, rolling to flatten, twisting, joining etc. Awareness of task based risks. • Explore different surface treatments on small sample pieces, using tools, heat, chemicals, etching, and polishes. Awareness of task based risks. • From same drawing, cut and join flat shapes, by soldering, riveting and applying different surface treatments. Awareness of task based risks. • Into 3D: from drawing select a shape, cut out and beat into a 3D form. Awareness of task based risks. • Record all processes, materials, techniques used and health and safety considerations. • Collect examples of artists' works, noting visual and technical connections. • Present all samples and records of explorations for group critique.
Learner initiated study.
Assignment 2: Introduction to Heavy Duty Card Introduction to workshop and health and safety considerations. Introduction to and demonstration about safe and appropriate use of hand tools and machine equipment. Explore different methods of cutting and joining flat card to create freestanding forms by cutting, gluing, folding, interlocking, taping. Select a letter and construct as 3D hollow form exploring different ways of joining edges and curving planes. Awareness of task-based risks. Record all processes, materials, techniques used and health and safety considerations. Collect examples of artists' works, noting visual and technical connections. Present all samples and records of explorations for group critique.
Learner initiated study.

Topic and suggested assignments/activities and/assessment
Assignment 3: Introduction to Wood Introduction to workshop and health and safety considerations. Introduction to and demonstration about safe and appropriate use of hand tools and machine equipment. Learners: • Explore different methods of cutting and joining wood by sawing, glueing, nailing, screwing. • Working from a reproduction Picasso Cubist painting, translate into a 3D construction using flat sheets and small offcuts to explore form and textures, positive shapes, negative spaces, edges, shadows and lines. Awareness of task-based risks. • Record all processes, materials, techniques used and health and safety considerations. • Collect examples of artists' works, noting visual and technical connections. • Present all samples and records of explorations for group critique.
Learner initiated study.
Assignment 4: Introduction to Plaster Introduction to workshop and health and safety considerations. Introduction to and demonstration about safe and appropriate ways of mixing plaster and cleaning equipment. Learners: • From direct observation and tonal visual studies, translate texture samples into drawn and pressed textures into soft clay slab. Construct surrounding walls and pour plaster. Leave to set, noting changes in heat and timescale, then peel away to evaluate results of set raise relief. Clean up appropriately. Awareness of task-based risks. • Mix and cast plaster into small card container, leave to set. Working from a small natural object, copy this accurately by carving, introducing textures. • Record all processes, materials, techniques used and health and safety considerations. • Collect examples of artists' works, noting visual and technical connections. • Present all samples and records of explorations for group critique.
Learner initiated study.
Assignment 5: Introduction to Glass Introduction to workshop and health and safety considerations. Introduction to and demonstration of glass cutting. Learners: • From black and white lino prints, translate into small appliqué mosaic panel, using clear glass plus one colour and black putty for the negative spaces. Awareness of task based risks. • From linear drawings, select one area and translate into copper foil hanging, cutting glass shapes accurately to a drawn line and joining with copper foil. • From tonal drawings and prints, explore painted tones and textures on glass as small test samples. • Record all processes, materials, techniques used and health and safety considerations • Collect examples of artists' works, noting visual and technical connections. • Present all samples and records of explorations for group critique.
Learner initiated study.
Review of unit and assessment.

Assessment

The unit enables learners to explore the possibilities and limitations of resistant materials. The focus of the unit is on exploration, rather than the production of finished artefacts and should be assessed to reflect this.

For P1, learners must show basic practical skills for conducting investigations, including being able to prepare, shape, form and use finishing techniques appropriately. Learners must use materials and techniques safely. They must follow procedures and sequences correctly. Explorations with materials may be limited and show a basic level of skills. Learners may require close supervision and frequent reminders of processes.

For P2, learners must select and prepare resistant materials to meet specified requirements. They should consider how materials and techniques can be used to produce particular outcomes and visual qualities, but this may be limited and some of the judgements reached may be tutor led and expressed using limited visual and critical analysis. There will be minimal evidence of links with practitioners' works and examples selected may not be consistently relevant. Learners' vocabulary will be basic.

For P3, learners must present records of their research and practical investigations. These must include technical information about properties and characteristics, their methods of working and how results were achieved. These records may lack consistency. Learners' observations about the qualities their investigations reveal, and their selections of examples, may be limited to the obvious. The appraisal of learners' tests may be limited. Language used in notes/annotations may be basic.

For M1, learners must work purposefully and in a consistent, organised way and they must prepare prepare materials, tools and equipment efficiently. They must show competent practical skills when manipulating and exploring materials and techniques. Learners must research different approaches, but they may be cautious about exploring beyond the familiar. They consult the tutor to clarify activities to ensure understanding and regularly take stock and review methods and results. Learners apply critical and visual analysis to their practical work.

For M2, learners must use their knowledge of the properties of resistant materials to prepare for and meet specified requirements. In the early stages, they should compare and make judgements about the potential of different techniques with one material, supported by relevant contextual links. As the unit progresses, learners should have increased experience of more materials and therefore should exploit their individual features and working characteristics, such as rigidity, flexibility, ductility, weight and density. They must explore specific materials, comparing the similarities and differences between works in different materials and how these were achieved, thus expanding information to evidence greater understanding at this level.

For M3, observations about the properties of materials and techniques must be thought through and the potential for future application identified. Reviewing and recording will be a regular and purposeful activity. Learners need to consistently show direct links between their investigations and the works of others. Annotations must include thoughts about aesthetic considerations. The information should be clearly organised with reflection given to the layout and design of the reference book.

For D1, investigations must be thorough. Learners should take risks or explore personal directions make discoveries, but within understood parameters. Learners must analyse their practical investigations and professionals' works to identify possible applications in their own work. They must recognise the potential in unexpected results. Recording must be thorough, with expanded information detailing the reasons for particular qualities of materials.

For D2, learners must show a strong knowledge of the qualities of materials and the relevance of the techniques and how they are applied to achieve particular results, by referring to their own investigations and others' works. They need to analyse works by practitioners to inform their understanding and to learn how professionals manipulate materials, techniques and processes to achieve their outcomes.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3 M1, M2, M3 D1, D2	**Assignment 1**: Introduction to Metals	A designer explores new area of metals through various techniques.	Continuous tutor monitoring and observation of practical work. Regular tutor/learner reviews of explorations. Presentation at group critique. Tutor written feedback
P1, P2, P3 M1, M2, M3 D1, D2	**Assignment 2**: Introduction to Heavy Duty Card	A designer explores new area of metals through various techniques.	Continuous tutor monitoring and observation of practical work. Regular tutor/learner reviews of explorations. Presentation at group critique. Tutor written feedback.
P1, P2, P3 M1, M2, M3 D1, D2	**Assignment 3**: Introduction to Wood	A designer explores new area of wood through various techniques.	Continuous tutor monitoring and observation of practical work. Regular tutor/learner reviews of explorations. Presentation at group critique. Tutor written feedback.
P1, P2, P3 M1, M2, M3 D1, D2	**Assignment 4**: Introduction to Plaster	A designer explores new area of plaster through various techniques.	Continuous tutor monitoring and observation of practical work. Regular tutor/learner reviews of explorations. Presentation at group critique. Tutor written feedback.
P1, P2, P3 M1, M2, M3 D1, D2	**Assignment 5**: Introduction to Glass	A designer explores new area of glass through various techniques.	Continuous tutor monitoring and observation of practical work. Regular tutor/learner reviews of explorations. Presentation at group critique. Tutor written feedback.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Art and Design sector suite. This unit has particular links with the following unit titles in the BTEC Art and Design suite:

Level 1	Level 2	Level 3
Creative Use of Materials, Techniques and Processes	3D Visual Communication	Extending Resistant Materials
Introduction to 3D Crafts	Working with 3D Design Crafts Briefs	Exploring Non-Resistant Materials

Essential resources

Workshop facilities equipped to the appropriate standards for this level of specialist work are essential. Conditions and equipment should equate to those of professional practitioners. Specialist workshops and working areas are important and should ideally be separated for each discipline to avoid contamination of materials, and to provide learners with the necessary understanding of the working methods. For example, the methodology in working in the jewellery workshop should be very different to working in the fabrication and welding workshop. Learners also need a 'clean' area for working in, and clearly defined areas for hazardous activities such as welding or working with acids. For all of the areas of working, the relevant health and safety practice should be in place, such as extraction in workshops for wood, plastics and metal and plaster. There should be appropriate storage for work in progress and finished work. In addition, learners should have access to library and internet facilities to be able to research the works of practitioners.

Employer engagement and vocational contexts

Centres should develop links with local practitioners who work with resistant materials, such as sculptors, jewellers, furniture designer-makers, wrought iron workers and glass artists. Organised visits to such workshops and other working environments would provide understanding of how practitioners use and organize materials, tools and equipment.

Links with employers are essential to the delivery of the programme for work experience and future employment.

Vocational learning support resources:

- Learning and Skills Network – www.vocationallearning.org.uk

Business and finance advice:

- local and regional Business Link – www.businesslink.gov.uk

Assignments should be vocationally relevant; centres should consider the delivery of 'live projects', for example, to support the vocational content of the unit and programme.

Creative and Cultural Skills (www.ccskills.org.uk), the Sector Skills Council for Arts, Crafts and Design, has launched the web portal Creative Choices (www.creative-choices.co.uk). This portal has a range of information about careers in the arts, crafts and design sector, including job descriptions.

Indicative reading for learners

Textbooks

Abbott M – *Green Woodwork: Working with Wood the Natural Way* (Guild of Master Craftsman Publications, 1998) ISBN 978-0946819188

Beveridge P, Domenech I and Pacaul E – *Warm Glass: A Complete Guide to Kiln-Forming Techniques: Fusing, Slumping, Casting* (Lark Books, 2008) ISBN 978-1579906559

Bosworth J – *Ceramics with Mixed Media* (A&C Black, 2006) ISBN 978-0713667714

Bray C – *A Dictionary of Glass: Materials and Techniques* (A&C Black, 2001) ISBN 978-0713657920

Brown C – *The Bible of Sculpting Techniques* (A&C Black, 2007) ISBN 978-0713687590

Connell J – *The Potter's Guide to Ceramic Surfaces* (Apple Press, 2002) ISBN 978-1840923605

Hughes R and Rowe M – *The Colouring, Bronzing and Patination of Metals* (Thames & Hudson, 1991) ISBN 978-0823007622

Jackson A and Day D – *Collins Complete Woodworker's Manual* (Collins, 2005) ISBN 978-0007164424

Kaiser P – *Introduction to Glass Fusing: Project-by-Project Guided Lessons* (Wardell Publications, 2003) ISBN 978-0919985384

Leften C – *Plastic (Materials)* (RotoVision, 2001) ISBN 978-2880465483

Mayer R and Sheehan S – *The Artist's Handbook of Materials and Techniques* (Faber and Faber, 1991) ISBN 978-05711143313

McCreight T – *Jewellery: Fundamentals of Metalsmithing* (A&C Black, 2003) ISBN 19780713649000

McCreight T – *Working with Precious Metal Clay* (A&C Black, 2000) ISBN 978-0713658286

McGrath – *The Jeweller's Directory of Decorative Finishes* (A&C Black, 2005) ISBN 978-0713670936

Noakes K – *The Fiberglass Manual: A Practical Guide to the Use of Reinforced Plastics* (The Crowood Press, 2003) ISBN 978-1861265753

Petersen I – *Silver Wire Jewellery: Projects to Coil, Braid and Knit* (Lark Books, 2005) ISBN 978-1579906450

Plowman J – *The Manual of Sculpting Techniques* (A&C Black, 2003) ISBN 9780713665802

Rae A – *Taunton's Complete Illustrated Guide to Working with Wood* (Taunton Press, 2005) ISBN 978-1561586837

Semanchuk Dean I – *Faux Surfaces in Polymer Clay* (Lark Books, 2006) ISBN 978-1579907518

Journals

Blueprint	Wilmington Media
Crafts	Crafts Council
Creative Review	Centaur Communications Ltd
Design Week	Centaur Communications Ltd
New Design	DWB Associates

Websites

www.craftscouncil.org.uk	Crafts Council
www.design-council.org.uk	Design Council

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	trying out alternative or unusual ways of working with materials and techniques selecting practitioners' works which make links with their own work exploring materials and techniques from contextual research recognising potential in unexpected results investigating materials and techniques
Reflective learners	reviewing prior to recording the properties of materials and techniques discussing results of investigations to inform their own understanding of materials and techniques evaluating results of practical investigations
Team workers	following health and safety procedures with awareness of risk to self and others helping others practically when working with tools and equipment sharing findings about physical and visual properties of materials and techniques with others
Self-managers	being organised and carrying out investigations about materials and techniques systematically
Effective participators	experimenting and exploring, undertaking tasks and recording observations.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	using self-set task to explore materials further
Creative thinkers	looking for new applications of techniques and materials
Reflective learners	recording observations and using findings to develop learning
Team workers	sharing results, collaborating with peers during investigation work
Self-managers	working to targets and deadlines, setting personal investigative brief
Effective participators	experimenting and exploring, undertaking tasks and recording observations.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Manage information storage to enable efficient retrieval	using USB, CD, hard drive to store information
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching the work of artists, craftspeople or designers using CD ROMs, DVDs and the internet
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using the internet and online journals to investigate techniques and working practice
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	using spreadsheets and tables to record findings and analyse results
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	planning and making models to scale the construction of models
Select and apply a range of skills to find solutions	measuring materials scaling up or down drawings for models or final pieces mixing chemicals
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	presenting their own work and the work of artists, craftspeople and designers to a tutor or group discussing their own, their peers' and others' views on their work and the work of artists, craftspeople and designers listening and responding to what others say
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching artists' work
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	transcribing their research annotating information.