Stage 5 Design and Technology

Year 9 unit 3: Fold it up

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<tr><td>Focus area of design: Engineering</td><td>Design project: Design an item that features a folding mechanism.</td><td>Length of time: 16 weeks</td></tr>
<tr><td colspan="2">Unit description
In this unit students will design and make a structure that folds up. They will identify a need for a folding structure, select the materials they need according to the characteristics, and match them with appropriate manufacturing processes. The optimum use of materials can be achieved through understanding their working characteristics, production processes, environmental and social issues, costs and aesthetics.

Students will apply their knowledge and understanding of the properties of materials when designing. The following content from the focus area of design: Engineering will inform their design activities. Students will:
• learn that the properties of materials will determine their selection
• select materials and match them with appropriate production processes
• experiment with the working properties of materials, e.g. heat treatment
• examine the diversity of one product and how they influence lifestyles
• consider how to minimise environmental damage, use materials wisely, and consider possibilities of reuse and recycling issues
• conduct tests using qualitative and quantitative methods
• research contemporary materials
• consider structural designs to withstand loads
• re-design products to distribute the forces of tension, compression and shear, evenly throughout the product.

• Students gain the knowledge, skills and understanding they need for this unit through product evaluation activities and practical tasks.</td><td>Project description
There are lots of situations in which you might use temporary structures – in the workshop, on the beach, by the river, in a tent or caravan, in the garden or even after an accident. Identify a need and design and produce a useful structure to fulfill that need. Your structure should fold up or be easily dismantled, so as to save space. Think carefully about suitable materials, considering whether your structure will be used indoors or outdoors. Refer to the Learning Activity Planning Grid to determine the types of activities that will be suitable for your students.
Outcomes:
A student:
5.3.1 analyses the work and responsibilities of designers and the factors affecting their work.
5.3.2 evaluates designed solutions that consider preferred futures, principles of appropriate technology and ethical and responsible design.
5.4.1 develops and evaluates innovative, enterprising and creative design ideas and solutions.
5.5.1 uses appropriate techniques when communicating design ideas and solutions to a wide range of audiences.
5.6.1 selects and applies management strategies when developing design solutions.
5.6.2 applies risk management practices and works safely in developing quality design solutions.
5.6.3 selects and uses and range of technologies competently in the development and management of quality design solutions.</td></tr>
<tr><td colspan="2">Resources:
Atkinson, S. and Mockford, C. (1991) Product Design, Oxford University Press, Oxford.
Bradley, C., Bradley, K., Dawson-Davis, L. and Harris, N. (1996) Design and Technology, Oxford University Press, Melbourne.
Fritz, A. (1994) Designworks: Design and Technology 7–10, McGraw Hill, Sydney.
Glover, N. (1992) Design and Technology: A student text for years 7 and 8, Social Science Press, NSW.
Hauffe, T. (1998) Design: A Concise History, Lawrence King Press, Italy.</td><td>Mackenzie, D. (1997) Green Design: Design for the environment, Lawrence King Press, Hong Kong.
McMahon, M. and Raphael, J. (2001) Instant Lessons in Design and Technology, Emerald City Books, Australia.
Nuffield Design and Technology (1998) Product Design, Longman, Essex.
Panousieris, Robin (1993) Technology in Action: A program for Junior Secondary Students, Heinemann, Melbourne.
www.practicalsubjects.com
http://amsd-www.larc.nasa.gov/amsd/materials.html</td></tr>
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Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
The concepts of design • Interdisciplinary nature of design which draws on disciplines such as mathematics, sciences, fine art and humanities.	• identify dependencies of design on other disciplines when designing solutions • analyse a case study that demonstrates the inter-disciplinary nature of design • outline, reflect and apply collaborative methods when developing a design solution	Teacher: ▪ outlines unit and design project. ▪ uses examples to describe *reverse-engineering.* Students: • brainstorm and list subjects or knowledge areas that will assist the development of this design project, *e.g. science will provide information about materials, their properties, uses, etc.* • complete a case study of a similar product and *reverse-engineer* it noting the choices made by the designer at the various stages and suggesting possible reasons that influenced their decisions. **Assignment 1:** Select an existing folding product and 'reverse-engineer' it.	• Brainstorming chart developed by groups. • Sources of knowledge identified (subjects). • Clear explanation of reverse-engineering of product. • Reasons why decisions were made.	Teacher observation of group discussions. Oral participation in the group. Written feedback using marking criteria. *(See appendix for a sample)*
Factors affecting a holistic approach to design and production • Design purpose and setting factors – function – form – aesthetics – end user aspirations and contexts – time factors: historical, contemporary and future considerations – quality – trends.	• describe factors affecting the design and production of design ideas and solutions within the engineering focus area • analyse and report on the factors that affect the decisions taken in the development of design ideas and solutions • apply a holistic approach by considering the factors affecting design and production in a design project	Teacher: • discusses *designing* to develop a deep understanding of the principles and elements of design. • leads discussion to develop an understanding of design specifications. Students: • discuss the notion of *designing* within this design project • identify relevant elements and principles of design when solving this design problem. • compile design specifications and criteria that reflect users' needs. • collect and combine ideas from a variety of sources. • develop a plan of action to solve this design brief.	Worksheets and tests to achieve the following: • Designing defined. • Elements of design listed and described. • Principles of design described, citing examples. • Develop a design specification criteria. • Develop a 'plan of action' for the design project at hand.	Teacher mark worksheets and provide written feedback.

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
• human, technical and environmental factors – human capital (skills, knowledge and techniques) – ergonomics – safety, values and ethics – industrial and workplace legislation – appropriateness of technology choices and design decisions – social and environmental sustainability – resource choices and availability (tools, materials, time, finance)		Teacher: • Organise a range of activities that give students an opportunity to: – learn about the diversity of products. – consider possible recycling and disposal of materials used. – explore the use of modern materials. Students: • compare different examples of one product that are intended to meet similar needs. • identify how designing for the user and for manufacture can conflict with other design criteria. • explore the use of modern materials, *e.g. compare the characteristics and uses of composite materials such as glass-reinforced polyester with other material.* • suggest appropriate treatments for materials to acquire required properties.	Worksheets on the following: • Study of at least three different products that have the same functions. • Modern materials and typical uses. • Treatment of materials to alter or improve the properties of materials • Test on this topic.	Teacher to check students work and provide oral feedback.

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
Innovation • types of innovation • examples of innovation	• define and describe innovation • assess the impact of past, current and emerging technologies and innovation on society and environments • demonstrate design ideas and solutions that are innovative and enterprising.	Teacher: • leads discussion, using examples, to develop a clear understanding of innovation. Students: • describe innovation using examples. • identify a product that has been in the market for a long while and trace its lifecycle over the years noting changes it went through, including the impact of competition, advent of new materials and production techniques and its impact on society, e.g. telephone, TV, etc. **Assignment 2:** Identify a product that has influenced the lives of people over a considerable period of time. Trace its development from its origin to its current status. Discuss its impact on society and how society has influenced its development process over the years.	Worksheets on the following: • Definition of innovation. • Identify three innovative products.	Mark worksheets and provide oral overall feedback. Assessment criteria for this assignment to include a section for feedback on performance.
Research and exploration • access information and data	• use electronic communication tools to research information • identify and summarise information from a range of sources for the design project	Teacher: • discusses and identifies research needs and possible sources of information related to design project. Students: ▪ collect, collate and analyse data from a range of sources relating to their design project. ▪ present analysed data in a simple form.	• Evidence of research. • Collation and analysis of research data collected. • Evidence of data in the development of the design project.	Discussion with individual students on their research needs and progress.

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
Communication and presentation techniques • visual • graphical • written • oral • digital	• outline a range of communication techniques appropriate to various audiences • apply appropriate communication techniques when documenting and presenting design ideas and solutions • use ICT applications such as multimedia communication devices, computer-generated graphics, word processing and desktop publishing for presentation of techniques • construct and use models or computer generated simulations to communicate design ideas and solutions • use appropriate ICT applications when designing and producing solutions	Teacher: • discusses and sets learning activities to help students understand the various presentation techniques. Students: • experiment with a number of techniques used by designers to present their design ideas, including: – 2D – 3D – pictures/photographs – modelling skills – mechanisms – computer software – multimedia. • apply appropriate presentation techniques in the development of their design solution. • use ICT applications to improve the quality of their presentations. • use appropriate modelling techniques to experiment, analyse and demonstrate the design ideas.	Worksheets used to guide student experimentation with a range of presentation techniques.	Oral feedback during class and when prompted by students facing difficulties.
Evaluating • criteria for success • evaluation techniques	• document and evaluate decisions made throughout the design process using specified criteria for success • self-assess and peer-assess design solutions • justify and document decisions made during the development of designed solutions • reflect on their learning in the design project	Teacher: • discusses and identifies key factors for effective evaluation. Students: • discuss evaluation techniques used by designers • evaluate their product against the original design criteria and assess how well the users' needs have been met • write an account of their (on-going) evaluation justifying decisions made when solving this design problem • provide a reflective diary of learning experiences, indicating changes for the future	Use appropriate worksheets to achieve the following: • Evaluation defined. • A range of evaluation techniques explored and used. • Evidence of reflective thinking throughout the development of the design project.	Oral feedback after marking students' worksheets.

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
Realisation of design ideas using technologies including: • tools and equipment • materials • techniques	• identify a range of tools and equipment, materials and techniques and calculate requirements for each design project • select and use tools and equipment when designing and producing each project • select and use a variety of appropriate techniques when designing and producing each design project • select and use appropriate materials when designing and producing each design project	Teacher: • discusses modern materials, production techniques, tools and equipment. Students: • prioritise and reconcile decisions on materials, time and production. • match and select materials, considering their fitness for purpose and environmental impact. • specify and justify the exact types and grades of materials, and give details of processing methods in the specification. • specify and justify the exact types and grades of materials, and give details of processing methods in the specification. • use materials sympathetically.	Use a range of techniques, worksheets, class discussions, industry visits, videos, etc, to achieve the following: • Understanding of materials for load-bearing products and their selection. • Understanding the costs, availability and classification of materials. • Selection of materials for the project. • Recommendation of appropriate industrial or non-industrial processing methods. • Skills in working materials.	Oral feedback on discussion of ideas. Worksheets on videos, industry visit, etc. to be marked and written feedback provided. Demonstration of correct techniques of working materials.
Management • project management strategies when implementing and evaluating a process of design	• prepare and implement time and action plans in design projects • estimate financial costs in design projects • manage materials, tools and techniques when developing the design project • evaluate the role of project management when developing the design project	Teacher: • discusses and explains typical project management techniques. Students: • identify and list a sequence of activities in the production of their design solution. • prepare a timeline plan. • allocate resources to their production sequence. ▪	Using worksheets: • Management defined. • Understanding of management styles and underlying principles. • Key factors identified in choosing a management technique for this project. • Sequence of activities for project production. • Timeline plan. • Resources identified and allocated.	Oral and written feedback

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
▪ occupation health and safety legislation and risk management practices ▪ anti-discrimination legislation, equal employment opportunity principles • safe work practices and safe environments	• apply risk management practices in each design activity • demonstrate safe work practices when producing design projects	Teacher: • discusses and identifies OH&S legislation and risk management techniques. Students: • describe risk management. • apply risk management procedures to their design project. • indicate safe work practices in their management plan.	• Risk management described. • Sample risk management activities. • Incorporate risk management in this project.	
Ethical and responsible design	• research an example of ethical and responsible design within the engineering focus area • discuss issues relating to ethical and responsible design	Teacher: • discusses ethical and responsible design. Students: ▪ describe their understanding of ethics in design and responsible design. ▪ identify areas of design where designers are most likely to be faced with moral dilemmas of ethics and responsibility. ▪ identify the driving forces behind the ethical and responsible design debate. ▪ reflect on the ethical issues relating to their design project.	Develop and use appropriate worksheets: • Ethics in designing described in detail using relevant examples. • Understanding of responsible design.	Oral feedback on completed worksheets

Students learn about:	Students learn to:	Integrated learning experiences, instructions and assessments:	Evidence of learning:	Feedback:
Creativity and problem-solving techniques used by designers • needs and opportunity analysis (SWOT: strengths, weaknesses, opportunities and threats) • constraints analysis • collaboration • research and exploration	▪ identify creativity and problem-solving techniques used by designers in their work	Teacher: • discusses and outlines the activities of designers as a problem-solving activity. Students: • define and demonstrate their understanding of problem-solving. • list and show an understanding of the techniques used by designers when solving problems. • demonstrate their understanding of the needs and opportunities analysis using the SWOT analysis.	Use a range of techniques, worksheets, quizzes, tests, etc, to achieve the following: • Understanding of problem-solving evident in the project work. • Use of techniques for solving problems. • Identification of a need/opportunity for this project. • Use of SWOT analysis in the development of their design.	Written and oral feedback on written tasks. Written feedback on tests.
Enterprising activity	• define and describe enterprising activity • initiate and manage action to successful completion in response to needs and opportunities when developing design projects	Teacher: • discusses and develops an understanding of enterprising activities. Students: • define an enterprising activity using examples. • solve the design project as an enterprising activity.	• Identify typical enterprising activities • Lists the key components of an enterprising activity	

At the end of this unit, it is expected that:

Most students will:	**Some students will not have made so much progress and will:**	**Some students will have progressed further and will:**
• Understand the physical and chemical properties and the working characteristics of a range of common and modern materials; • Classify materials and components according to their properties and working characteristics, using a range of sources of information; • Take account of the characteristics and properties of materials when deciding when and how to use them; • Reconcile those decisions, taking account of aesthetics, time and cost; • Combine, process and finish materials and components to create more useful properties and particular aesthetic effects; • Select tools and equipment to shape and form materials safely and accurately and to finish them appropriately; • Understand whether resources have been used appropriately, and the impact of resources beyond the purpose for which they were designed *(including global and environmental impact and whether they are sustainable)*	▪ Consider aesthetic characteristics as they design, exploring the use of materials and describing their attributes; ▪ Understand how working characteristics of materials affect the way they are used; ▪ Combine and mix materials to create useful properties; ▪ Measure, mark out, cut shape and form a range of materials safely and with some accuracy; ▪ Carry out appropriate tests before putting any improvements into practice; ▪ Recognize that the quality of a product depends on how well it is made and how well it meets its intended purpose, *e.g. how well a product meets social, economic and environmental considerations.*	▪ Use a range of industrial applications when working with common materials and processes, where appropriate; ▪ Cut, shape and form materials to specified tolerances; ▪ Combine processes or materials to create more useful properties, and know how the ability to change materials is exploited in industry; ▪ Take account of a wider range of issues, *e.g. product maintenance, safety, the degree of accuracy required in production;* ▪ Devise tests to check the quality of their work at critical points; ▪ Know how to ensure that their products are of a suitable quality for intended users, *e.g. how well a product meets moral, cultural and environmental consideration*; ▪ Suggest modifications that would improve their product's performance, if required.