PROTOTYPE

NCDC
NATIONAL CURRICULUM DEVELOPMENT CENTRE

TECHNOLOGY AND DESIGN

TEACHER'S GUIDE

SENIOR ONE

LOWER SECONDARY CURRICULUM

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This material has been developed as a prototype for implementation of the revised Lower Secondary Curriculum and as a support for other textbook development interests.

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Contents

Preface

This Teacher's Guide has been designed to enable the teacher to interpret the revised curriculum and use the accompanying Learner's Textbook effectively. The Teacher's Guide provides guidance on what is required before, during and after the teaching and learning experiences.

To ease the work of the teacher, all the activities and instructions in the Learner's Textbook have been incorporated in this Guide but with additional information and possible responses to the activities. The guide has been designed bearing in mind the major aim of the revised curriculum which is to build in the learners the key competences that are required in the 21st century while promoting values and attitudes and effective learning and acquisition of skills, to prepare the learner for higher education and eventually the world of work.

This book has been written in line with the Revised Lower Secondary School Curriculum. The book has incorporated knowledge and skills partly required to produce a learner who has the competences that are required in the 21st century; promoting values and attitudes; effective learning and acquisition of skills in order to reduce unemployment among school graduates.

Associate Professor Betty Ezati

Chairperson, NCDC Governing Council

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Last but not least, NCDC would like to acknowledge all those behind the scenes who formed part of the team that worked hard to finalise the work on this Teacher's Guide.

NCDC takes responsibility for any shortcomings that might be identified in this publication and welcomes suggestions for effectively addressing the inadequacies. Such comments and suggestions may be communicated to NCDC through P. O. Box 7002 Kampala or email: admin@ncdc.go.ug.

Grace K. Baguma

Director, National Curriculum Development Centre

Introduction

Technology and Design Curriculum aims to develop creative activities where its graduates interact with their environment to bring about change in response to societal needs, wants and opportunities. This book is prepared for teachers of Senior One, based on the need to champion the concept of creative learning.

The learning experience is segmented and planned to unfold in three complimentary domains of Design Appreciation, Design & Drawing, and Technology in the making.

i) Design Appreciation is intended to give the learner knowledge on the basic principles of design and arouse his/her interest in design.

ii) Design & Drawing equips the learner with the basic procedures of communicating design ideas through drawing.

iii) Technology in the making enables the learner to put into action the generated and communicated ideas.

These learning domains are intended to inspire the learner to design in different areas of speciality.

The learning domains are meant to develop the cognitive and vocational skills of the learner to match the 21st century values of critical thinking and problem-solving, creativity, collaboration and communication.

Aims and Objectives

Technology and Design intends to enable the learner:

i) acquire basic knowledge on design.

ii) practise basic, creative techniques.

iii) appreciate his/her immediate environment as a source of materials for production of engineering articles.

iv) acquire skills of proper use of tools, equipment and materials.

v) comprehend works of the made world.

vi) be aware of different roles, functions, audiences and consumers of design products.

vii) relate the usefulness of design in other subject areas.

viii) identify, research and produce personal technology and design works and projects; develop interest for future vocation in technology and design for self and national development.

Technology and Design Textbook Themes

Theme One: Design Application

The learner will develop knowledge and skills by:

i) demonstrating ability to analyse the community needs regarding design of a particular resource/facility and the correct use of tools and materials.
ii) making appropriate design decisions.
iii) using exploration/experimentation, reflection and revision when producing a variety of models or mock-ups.

Theme Two: Design and Drawing

The learner will develop knowledge and skills by:

i) examining the basic items of engineering design equipment and also using them.
ii) using basic drawing equipment and properly lay out drawing paper.
iii) identifying common shapes and their features as used in design.
iv) constructing different shapes used in design and making models/mock-ups of shapes used in design.

Theme Three: Technology in the Making

The learner will develop knowledge, skills and good attitude by:

i) observing and applying health and safety rules associated with the use of materials, tools, and machines in design while making a product in a workplace, and show responsibility in terms of respect for the environment.
ii) demonstrating how to give first aid in relation to accidents on different parts of the body.
iii) analysing how the production of different designs can affect the environment
iv) applying environmentally responsible practices.

Chapter 1: Introduction to Design

Key Words

- design
- technology
- appreciation
- design function
- elements of design
- principles of design
- design features
- environmental awareness
- sustainable material use
- production
- after-use disposal
- societal and cultural influences

Learners will need:

1. notebook, pencil, pens
2. engineering articles
3. colours

After studying this chapter and practising its activities, the learner will be able to:

1. develop appreciation of function in the design world.
2. use basic elements and principles of design.
3. demonstrate awareness of environmental considerations related to sustainable material use, production methods and after-use disposal.

Introduction

In this chapter, the learner will be introduced to the basic concepts of technology and design. The concepts include design features, elements, principles and materials required.

By studying this chapter, the learner will be able to determine the usefulness of technology and design in the environment. This will give him/her the basis for why many structures in his or her environment are constructed in different shapes, designs and orientation.

Technology involves one or more of the following:

i) The use of tools or machines to help one do something useful.
ii) The materials used to make products.

iii) The knowledge and skills used to make products.
iv) The process used to make the products.

In this section you will guide the learner to further analyse the environmental, cultural and social influences on technology and design.

Technology involves the use of scientific knowledge to solve human needs. Explain to the learner, using relevant examples within the school environment, how science has been used to solve human needs.

Activity1: Familiarising with design terminologies and aspects (80 minutes)

1.1 Guide learners in groups to brainstorm the meaning of the following terms: design, technology, design technology, design aspects/features, design elements and design principles, sustainability, environmental conservation. (**10 Minutes)**

Invite group leaders to present their work/findings to the class. (**20 minutes)**

1.2 Task the learners to identify the objects that require design and technology in their immediate environment. **(10 minutes)**

1.3 Let learners choose one of the identified object and create a chart to relate/explain the design features/aspects with their functions in the environment. **(30 Minutes)**

Guide learners in groups to relate these features to design and technology. **(10 minutes)**

Possible Answers to Activity 1.1 -

Design: To create an idea, system or plan for solving an existing problem.

Technology: The application of scientific knowledge for practical use.

Design Technology: Science of creating practical ideas to solve society problems.

Design aspects/features: these are major visible features of a product which the designer would like to emphasise as particularly valuable or attractive.

Elements of design

Design elements are the basic units of any visual design which form its structure, such as colour, shape and space/size, texture/finishing.

Introduce the learner to the concept of elements of design, and use examples within the classroom environment to show how elements influence the design of these items.

Design Principles

Technology and design has guidelines that govern it. Design principles are widely applicable laws and considerations that are used to organise or arrange the structural elements of the design.

The principles of design are the rules a designer must follow to create an effective composition that cleanly delivers a message to her/his audience.

1.2 Objects that require design and technology

Possible solution to1.3: Object of choice: A cup

S/N	Feature	Function
1	Handle	Accommodates the fingers to hold the cup
2	Body	Contains the contents of the cup
3	Base	Supports the cup to rest on a surface
4	Mouth	Lets out contents of the cup

Activity 1.4: Familiarising with principles of design (80 minutes)

Guide the learners in groups to identify one of the objects in the previous activity and discuss the design principles as applied to the object. **(20 minutes)**

Instruct the learners in groups to identify two other objects in the immediate environment, and show how each of the principles has been used in their design. (**30 minutes)**

Let the groups present their findings through their leaders. **(30 minutes)**

Possible Answers to 1.4

Function: The purpose to which the design is made, or the problem to be solved by the design.

Architectural: An idea that focuses on components or elements of a structure.

Structural: Physical makeup of a design. The ability of a design arrangement to carry or support loads**.**

Economy: The design should be produced at a minimum cost.

Environment: The design should not destroy the environment in any way.

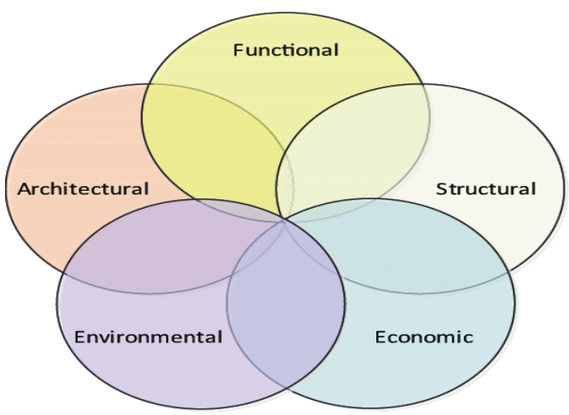


Figure 1.1: Design principles

Activity 1.5: Familiarising with the elements of design (80 minutes)

Guide learners in their groups to use one of the objects in the activity 1.4 and discuss the design elements as applied to the object. **(20 minutes)**

Instruct the learners in groups to identify two other objects and show how each of the elements has been used in their design. **(30 minutes)**

Instruct leaders of the different groups to present their findings/discussion. **(30 minutes)**

Possible Answers to 1.5

Lines-Defines the boundary of a design

Shapes Specifies the particular form of outline of a design

Colour: The property that gives an object a beautiful look.

The property of light as seen by human beings

Texture: (Rough or smooth texture); the feel, appearance, or consistency of a surface or a substance

Activities 1.6 to 1.11: Familiarising with the materials used in technology and design (80 minutes)

1.6: Guide the learners in pairs, to identify and describe the different materials used in technology & design and state their sources. **(5 minutes)**
1.7: Guide the learners in groups to state the reasons for the different choices of materials in technology and design. **(15 minutes)**
1.8: Guide the learners as a class to discuss societal influences on the use of different materials in technology and design. **(20 minutes)**
1.9; Guide the learners as a class to suggest practices that promote continuous availability of the different design materials. **(20 minutes)**
1.10: Guide learners in their groups to suggest the safe environmental practices of different design materials listed in 1.6 above. **(15 minutes)**
1.11: Discuss with the class and instruct them to write individual reports indicating the key points learnt in this chapter. **(5 minutes)**

Possible answers to Activity 1.6

a) **Wood:** A hard fibrous material from the main substance of the trunk, or branches of a plant.

b) Steel: It is an alloy of iron and carbon, and sometimes other chemical elements.

c) **Aluminium:** It is a silvery-white metal.

d) Plastic: This is a polymeric material that has the capability of being moulded or shaped, usually by the application of heat and pressure.

e) **Mud:** Mud is a liquid or semi-liquid mixture of water and any combination of different kinds of soil (loam, silt, and clay). It usually forms after rainfall or near water sources.

f) **Garden wastes:** This includes banana fibres etc.

Possible answers to Activity 1.7

Availability, cost, ease to work, warm to touch, strength, weight, texture, appearance, wearing properties etc.

Possible answers to Activity 1.8

Some cultures like the Karamojong prefer wood for their stools as compared to other materials.

The Baganda use backcloth on functions more than any other tribe.

Possible answers to Activity 1.9

i) Continues afforestation and reforestation
ii) Planting fast growing timber lot trees.
iii) Recycling waste into reusable forms of wood/plastic/steel.
iv) Adopting modern cost effective methods of wood/plastic/steel conservation.

Possible answers to Activity 1.10

- Planting fast growing timber lot trees
- Recycling waste into reusable forms of wood/plastic/steel
- Adopting modern cost effective methods of wood/plastic/steel conservation
- Promoting afforestation and reforestation
- Adopting clean energy cooking technologies
- Substituting wood with other materials where possible
- Combining or/and reinforcing wood with other materials to limit its use
- Adopting and promoting natural methods of wood preservation

Activity of integration (80 minutes)

Okello and Mugabi study in the same boarding school, and while in the hostel they have a problem of keeping safe their metallic boxes/suit cases. When they put them on the bed, then they are not in position to sleep comfortably. Similarly when they keep the boxes directly on the floor, the bottoms of the boxes attract moisture and rust. Their beds are 1.0 metres apart.

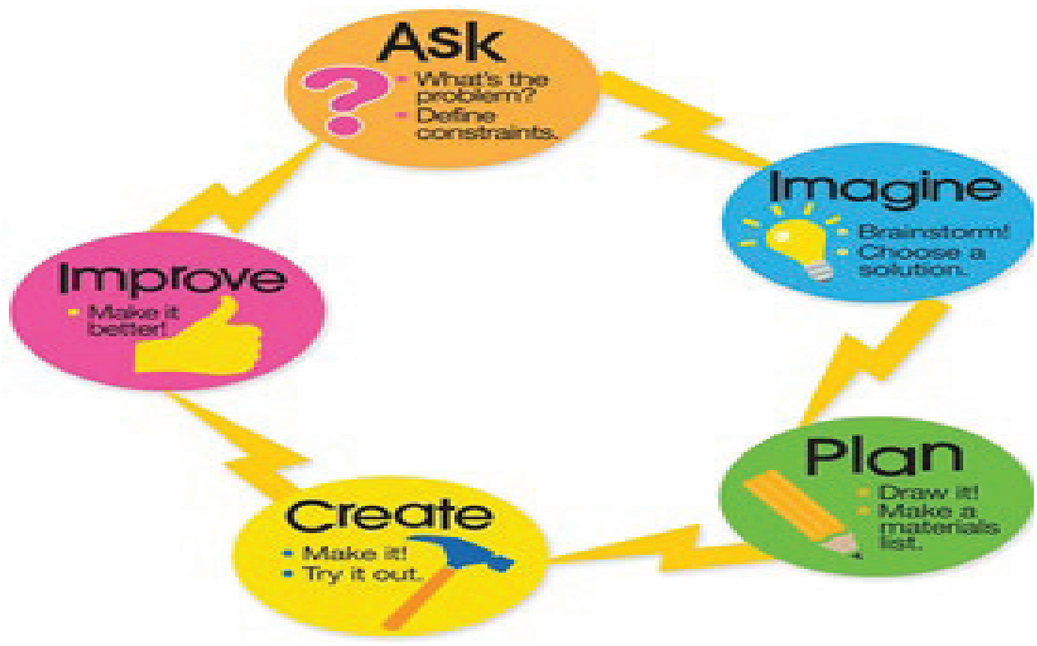
i) Identify all the possible materials to be used in the design solution, and state the reasons for your choice.
ii) Describe the principles to be followed in the design solution to the problem.

Evaluation Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Identification of materials to be used and reasons for the choice.	**Score 3** if the learner states the possible materials of the design solution - Timber - Metal - Bricks - Ropes	**Score 3** if the learner states the reasons for choice of any three of the materials.	**Score 3** if the learner states the correct reasons for choice of any three of the materials, relating to the design solution.	**Score 1** if the learner blends more than one materials for the design solution. OR if the learner states more than three materials and the reasons for their choice.
	Score 2 if the learner states at least two of the design materials.	**Score 2 i**f the learner states the reasons for choice of at least two of the design materials.	**Score 2** if the learner gives the correct reasons for choice of at least two of the materials and relating them to the design solution.	
	Score 1 if the learner states any one of the desisign materials.	**Score 1** if the learner states the reasons for choice of any one of the design materials.	**Score 1** if the learner gives the correct reasons for choice of any one of the materials relating to the design solution.	
Description of the principles to be followed in the design solution to the problem.	**Score 3** if the learner states any four principles to be followed in the design solution to the problem. - Functional - Environmental - Economic - Structural - Architectural	**Score 3** if the learner describes any four principles to be followed in the design solution to the problem.	**Score 3** if the learner describes correctly any four principles to be followed in the design solution to the problem.	**Score 1** if the learner presents the design priciples in a venn diagram to illustrate their relationship. OR if the learner states all the five principles to be followed
	Score 2 if the learner states at any two principles	**Score 2** if the learner describes any	**Score 2** if the learner describes correctly any two	

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
	to be followed in the design solution to the problem.	two principles to be followed in the design solution to the problem.	principles to be followed in the design solution to the problem.	in the design solution to the problem.
	Scores1 if the learner states any one principles to be followed in the design solution to the problem.	**Scores 2** if the learner describes any one principle to be followed in the design solution to the problem.	**Score1** if the learner describes correctly any one principle to be followed in the design solution to the problem.	

Chapter 2: The Design Process



Key Words

- design
- design process
- design need
- resource
- design brief
- design factor
- design idea
- design specifications
- sketch
- investigation
- model/mock-up
- suitability

Learners will need:

1. notebooks, pencil, pens
2. engineering articles
3. sample models
4. colours
5. drawing instruments
6. essential tools
7. materials from the environment

At the end of this chapter and after practising its activities, learners should be able to:

1 identify the community needs to design a particular resource/facility (e.g. bus shelter, library, water station, market, recycling centre).
2 make appropriate design decisions.
3 use exploration/experimentation, reflection and revision when producing a variety of models or mock-ups.

Introduction

The **design process** is a series of steps that designers follow to come up with a solution to a problem. Many times the solution involves planning a product (like a machine or computer code) that meets certain criteria and/or accomplishes a certain task.

This chapter introduces the learner to the basic design techniques required to generate ideas and actions necessary to satisfy identified community need(s).

The learner should be able to use the essential tools and materials to design and produce the article(s) required to solve community challenges.

Guide learner to understand the design process using simple examples in his/her community e.g. design of a simple chair from local materials, design of a storage facility for exercise books within the classroom using locally available materials, and design of a classroom rubbish bin from used boxes.

Activity 2: Practicing the design process (80 minutes)

2.1 (a)

Display the design process chart, and guide the learners in groups to discuss it**. (15 minutes)**

Task the learners to present their group discussions**. (30 minutes)**

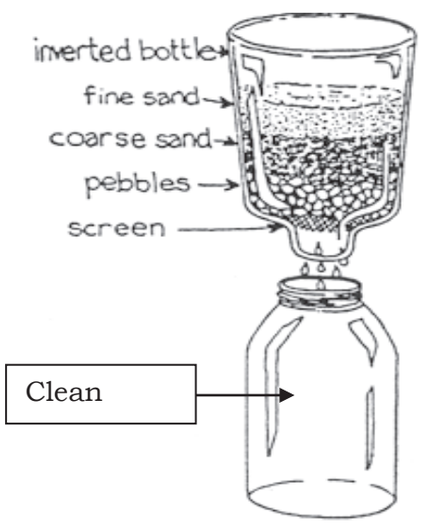
Guide learners as a class to discuss the term *societal need/challenge* and to identify the different needs of society. **(10 minutes)**

In groups, task the learners to discuss the societal needs/challenges identified above. **(10 minutes)**

Guidance to the teacher

Before displaying the design process chart, let learners identify the steps taken in design process to establish their prior knowledge on design. Then using the design process chart, guide the learners in groups to discuss the process chart.

Explanation of the Design Process	
Process	**Explanation**
Ask	Identify the society problem (need), such as l**ack of safe water for drinking**. Define the constraints of the problem. These are the possible causes of the problem: 1. Scarce water sources 2. No laid water pipes from the national supply lines. 3. No boreholes 4. Wells not constructed
Imagine	Brainstorm the following possible solutions: 1. Apply to the national water company to lay pipes from the supply lines to the affected area. 2. Request government authorities to construct boreholes in the affected area. 3. Request local authorities to construct wells in the affected area. 4. Encourage water harvesting. 5. Design systems of drawing water from underground. 6. Encourage local water purification systems. Choose the most feasible solution(s) depending on many factors, such as cost, availability of materials, ease of making and maintaining, size of community. 1. Design water harvesting schemes. 2. Dig shadoof. 3. Design simple water purification technology.

Explanation of the Design Process	
Process	**Explanation**
Plan	From the most feasible solutions, choose one; for example, water purification technology.  Draw the illustration of the technology/equipment Determine the list of materials required for the technology. 1. Purifying container (e.g. inverted bottle) 2. Water collection container (clean water bottle) 3. Sands (fine and coarse) 4. Pebbles 5. Loam and clay soil
Create	Use the materials identified and follow the drawing to make the design of the chosen feasible solution. Try out the solution to identify the weaknesses in performance.
Improve	In case of any weaknesses identified, suggest the possible modifications required for the weaknesses in performance. Choose the most feasible modification for the technology to work based on many factors: e.g. cost, availability of materials, ease of making and maintaining, size of equipment designed. Draw the illustration of the modification to the technology/equipment. Identify the materials required for the modifications. Use the materials identified and follow the drawing to make the design of the modification and attach to the initial (original) equipment. Launch the modified technology/equipment to solve the problem.

The above table is an explanation of how the design process should be used as a general guide to design.

Activity 2: Practicing the design process (80 minutes)

2.1(b): Guide learners in groups to identify the most pressing society need/challenge from those identified earlier. **(10 minutes)**

2.1 (c): Task learners in groups to;

- Identify and generate the possible solutions required to solve the pressing challenge**. (25 minutes**)
- Discuss each of the solutions identified based on practicability, cost, and availability of materials**. (15 minutes)**
- Select the most suitable solution from those identified. **(5 minutes)**
- Use free hand sketches to illustrate the most suitable solution. **(15 minutes)**

2.1(d): Guide learners to **d**iscuss the factors that affect the design of the suitable solution chosen putting into consideration the community needs. (**10 minutes**)

Activity 2.1 (e): Communicating the design solution (80 minutes)

- Guide learners to individually identify and generate the list of possible materials required to make the model and the final product of the suitable solution**. (30 minutes**)
- Guide groups to discuss the suitability of the identified materials in terms of their strength, durability, and weight, size, cost, availability. (**20 minutes)**
- Task them to write individual reports stating the components and materials required to make the most suitable solution (equipment) selected in 2.1(C). **(30 minutes**)

Activities 2.1(f-h): Modeling and evaluating the design solution (80 minutes)

2.1(f): Guide learners in groups to select the specific materials and tools to be used in the modelling**. (5 minutes)**

Guide the learners in groups to measure, mark, and cut the different components of the model**. (10 minutes)**

In groups, let the learners join the components of the model. **(20 minutes)**

In groups, guide the learners to finish the model. (**5 minutes)**

Let the groups present their complete models for discussion**. (10 minutes)**

Guide the learners to assess the model for practicability of the design solution. **(10 minutes)**

2.1(g): Let learners suggest ways of improving the model for better performance. **(10 minutes)**

2.1(h): Task the learners to use the model, to test ideas in the design brief; for example, **to obtain clean water from the model test**. **(10 minutes)**

Teacher's Notes

Use the learners' book for solutions to the above activities. Additional activities can be derived from a local problem familiar to the learners. The ones given above are a base for you to develop more activities from the community real life situations.

Activity of Integration (80 minutes)

Your uncle recently started rearing local chickens at home. There are 8 chickens. He wants to design a simple and small house to keep the chicken so that they do not have to stay in the main house with human beings.

1 State the problem.

2 Use a simple sketch to show a possible solution to the problem.

i) State the principles used and show where they are used.

ii) State the aspects used and where they are used.

3 Suggest possible materials that may be used for the design.

iii) Give two reasons for your suggestion for each of the materials.

iv) Suggest ways to ensure availability of materials for future use.

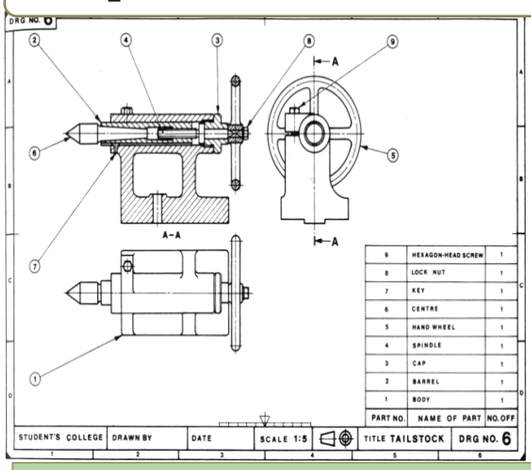
4 Suggest for which culture in Uganda uses the design in 2 above.

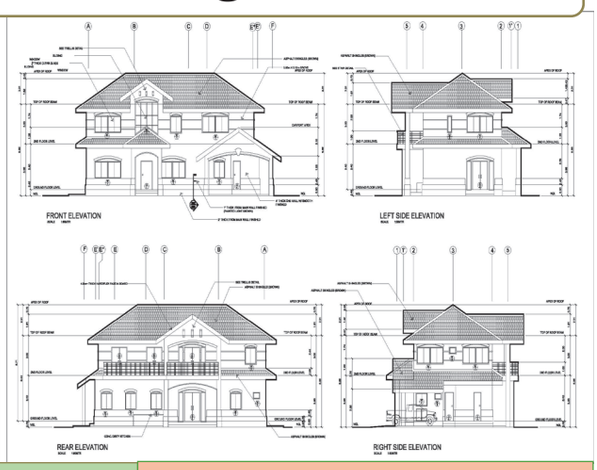
Evaluation Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Definition of the solution to the problem. Designing a simple house for 8 chickens.	**Score 3 if m**ajor features are integrated: - Function - Size for 8 chicken - Local materials choice - Design/shape	**Score 3 if** the right process is followed: - Statement of the problem - Sketching the design. - Choosing correct materials - Construction of the design	**Score 3 for** four correct aspects of information in the solutions - Specific number of chickens in proble statement - Masurements in the designs - Correct quantity of materials -Construction of the design in line with measurements on the drawings	**Score 1** if major features are integrated: - Function - Window and Ventilation - Blending of local materials - Design/shape: - Use of rare shapes like polygonal, tyriangular shape
	Score 2 if any three of the major features are integrated: - Function - Size for 8 chickens - Local materials choice - Design/shape	**Score 2 i**f any three steps of the process are followed: - Statement of the problem - Sketching the design. - Choosing correct materials - Construction of the design	**Score 2 for a**ny three correct aspects of the information in the solutions: - Specific number of chickens in proble statement - Masurements in the designs - Correct quantity of materials - Construction of the design in	

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
			line with measurements on the drawings	
	Score 1 if any two major features are integrated. - Function - Size for 8 chickens - Local materials choice - Design/shape	**Score 1 if a**ny two steps of the process are followed: - Statement of the problem - Sketching the design. - Choosing correct materials - Construction of the design	**Score 1 for** any two correct aspects of the information in the solutions: - Specific number of chickens in proble statement - Masurements in the designs - Correct quantity of materials - Construction of the design in line with measurements on the drawings	

Chapter 3: Introduction to Drawing





Key Words

- drawing
- engineering drawing
- engineering design
- drawing equipment
- drawing techniques
- lines
- primary angles
- secondary angles
- paper layout

You will need:

1. notebook, drawing pencils (HB, 2H), pens
2. drawing equipment
3. drawing set
4. engineering articles

After practicing activities in this chapter, the learners will be able to:

1. use basic drawing equipment and properly layout drawing paper.
2. use lines to construct primary and secondary angles.

Introduction

Different types of drawing are used in technology and design. Drawings are a way of communicating ideas.

This chapter introduces the learner to the basic drawing equipment and techniques for engineering design.

After studying this chapter, the learner will be able to use the essential equipment and materials to layout drawing paper, identify, draw, and use lines used in technology and design.

Activity 3: Familiarising with drawing equipment and basic concepts of drawing (80 minutes)

3.1 (a-e):

(**a**) Guide the learners in groups to brainstorm and list the different drawing instruments. **(10 minutes)**
Let the learners write down the specific application for each of the instruments**. (5 minutes)**

(b & c) Task learners to individually practise the techniques of applying the identified drawing instruments, for example, by laying out the drawing paper. Lay out of drawing paper should include the title block. **(20 minutes)**

(d) Guide learners to draw different lines used in engineering drawing and state the specific use of each**. (30 minutes)**

(e) Task the learners in groups to make a simple sketch of an object within the immediate environment to show how each of the lines in (d) above can be applied. **(15 minutes)**

Activities 3.1 (f & g): Understanding the concept of angles in drawing (40 minutes)

(f) Guide learners to brainstorm the different types of angles. **(5 minutes)**

(g) Guide learners to individually, construct the following angles: Primary angles, secondary angles, supplementary angles, complimentary angles, obtuse angles, right angles and acute angles. **(35 minutes)**

Possible Answers to 3.1 (f)

- Primary angles
- Secondary angles
- Supplementary angles
- Complimentary angles
- Obtuse angles
- Right angles
- Acute angles

Activity of Integration (40 minutes)

Your village has formed a football team and would like to construct a playground. Imagine you have been contacted to sketch the design of the playground.

1. List the instruments you will use.
2. Use a simple sketch to show the shape of the playground.
3. i) Suggest the angles that the playground is to be constructed from.
   ii) Give two reasons for your suggested angles.

Hint to the teacher

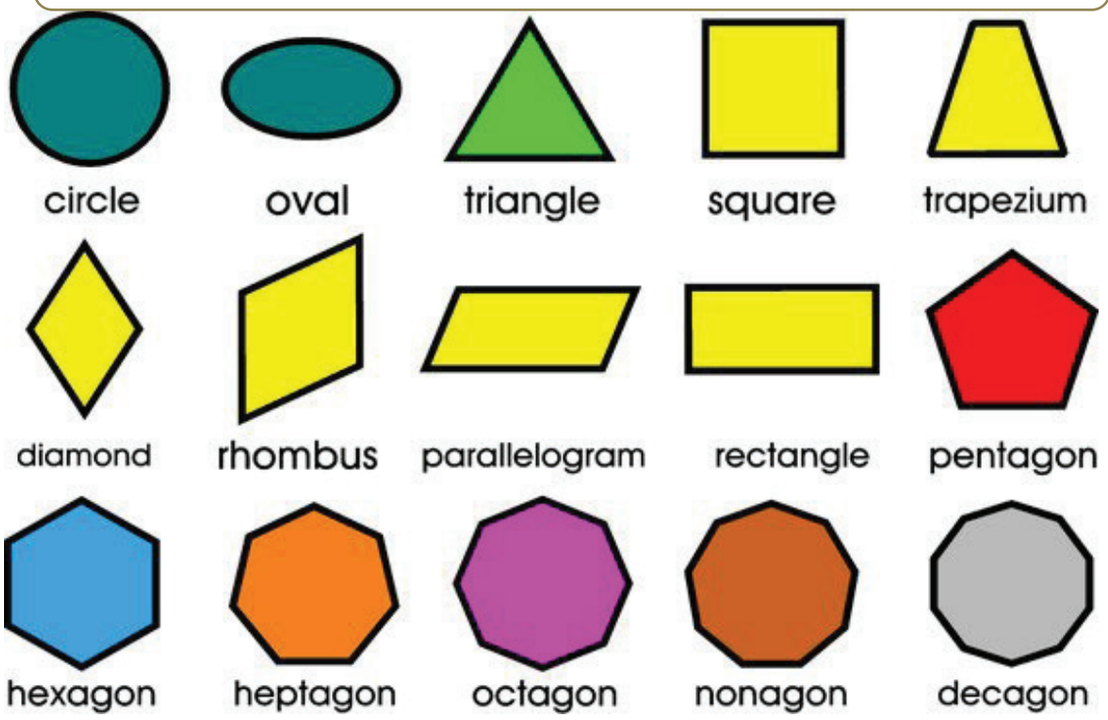
Learners are free to complete the sketching of this activity outside class as homework. This will give enough time to time-takers to complete the task and also attain the intended skills.

Assessment Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Definition of the solution to the problem. Designing a village football team playground.	**Score 3 if** the major features are integrated: - Perpendicular angles - Goalposts - Centre of the playground	**Score 3 if** chronology is followed: - Statement of the problem - Sketching the design - Choosing correct angles	**Score 3 for** the three aspects of information in the solution: - Using rightangles correctly - Placing the play ground features correctly - Correctly Sketching the design of the playground	**Score 1 if** any of the major features are integrated. - Dimensions of the play ground - External features of the playground
	Score 2 if two of the major features are	**Score 2 if** any two steps in the chronology are	**Score 2 for** any two aspects of information in the	

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
	integrated; - Perpendicular angles - Goalposts - Centre of the playground	followed; - Statement of the problem - Sketching the design - Choosing correct angles	solution. - Using rightangles correctly - Placing the playground features correctly - Correctly Sketching the design of the playground.	
	Score 1 if one of the major features is integrated: - Perpendicular angles - Goalposts - Centre of the playground	**Score 1 i**f one of the steps in the chronology is followed: - Statement of the problem - Sketching the design - Choosing correct angles -	**Score 1 for** any one aspect of information in the solution. - Using rightangles correctly - Placing the playground features correctly - Correctly sketching the design of the playground.	

Chapter 4: Basic Shapes



Key Words

- shapes
- features
- quadrilaterals
- polygons
- circles
- triangles
- models/mock-ups

Learners will need:

1. notebook, drawing pencils (HB, 2H), pens
2. drawing equipment
3. drawing set
4. engineering articles

After practising activities in this chapter, the learner will be able to:

1. appreciate common shapes and their features as used in design (k, u).
2. construct different shapes used in design.
3. make models/mock-ups of shapes used in design.

Introduction

Shapes are building blocks used in technology and design for construction of different articles. Every product of technology and design is formed from a specific shape(s). The designer chooses a shape based on functionality, cost of production, appearance, and end customer preference.

In this chapter, the learner is introduced to the basic geometrical shapes and their application in design. After studying this chapter, the learner will be able to use the shapes to design and make models.

Activity 4: Practising the application basic shapes (80 minutes)

4.1 (a-c):

(a) Guide learners in groups to identify and discuss the different geometrical shapes used in design. **(10 minutes)**

(b) Guide learners in groups to identify and discuss the different types of triangles. **(10 minutes)**

(c) Guide learners to individually construct triangles, given some of their features. **(60 minutes)**

- Given the three sides
- Given perimeter and ratio of sides
- Given perimeter and altitude
- Given perimeter ,base ,and base angle

Teacher's Notes

During the lesson you should use common objects within the environment to reflect on the activity.

Activities 4.1.(d & e): Construction of quadrilaterals (80 minutes)

(d) Guide the learners in groups to discuss the different types of quadrilaterals: rhombus, square, trapezoid, trapezium, parallelogram and rectangle. **(10 minutes)**

(e) Guide learners to individually construct quadrilaterals, given specifications. **(60 minutes)**

- Square, given the length of side
- Rectangle, given its sides
- Parallelogram, given sides and one angle
- Trapezium, given parallel sides perpendicular distance between the sides and one angle
- Rhombus given the length of side and diagonal

Teacher's Notes

During the lesson you should use common objects within the environment to reflect on the activity

Activity 4.1(f & g): Construction of polygons (80 minutes)

(f) Guide learners in groups to identify and discuss the different types of polygons. **(10 minutes)**

(g) Guide learners to individually construct polygons, given different specifications. **(70 minutes)**
- Polygon on a base
- Polygon in a circle
- Distance across flats or corners

Teacher's Notes

During the lesson you should use common objects within the environment to reflect on the activity.

Activity 4.1 (h): Manipulating circles (80 minutes)

i) Guide learners in groups to identify the different types of circles and discuss their features. **(5 minutes)**
ii) Task learners to individually draw circles and name parts. (**10minutes**)
iii) Guide the learners in groups to discuss and sketch the different types of circles. **(5 minutes)**
iv) Guide the learner to construct circles in different situations. **(60 minutes)**
- Circumscribing, inscribing, and escribing circles to triangles
- Circles in an equilateral triangle, touching each other, and one or two sides

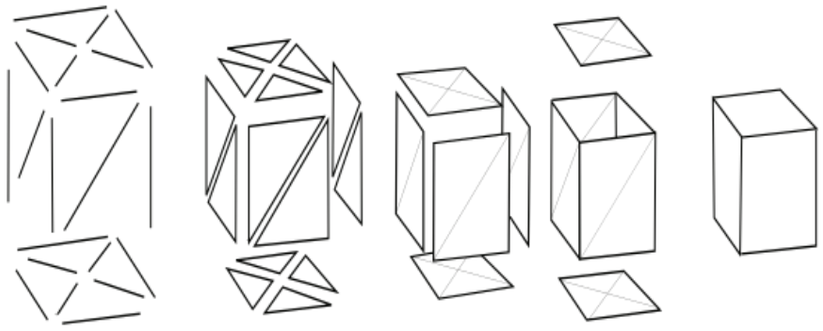
Activities 4.1 (i & j): Activity of Integration (80 minutes)

Your school is in partnership with another school where the students communicate with each other through letter writing. Design an envelope that will be used for enclosing and sending the letters to keep the partnership going.

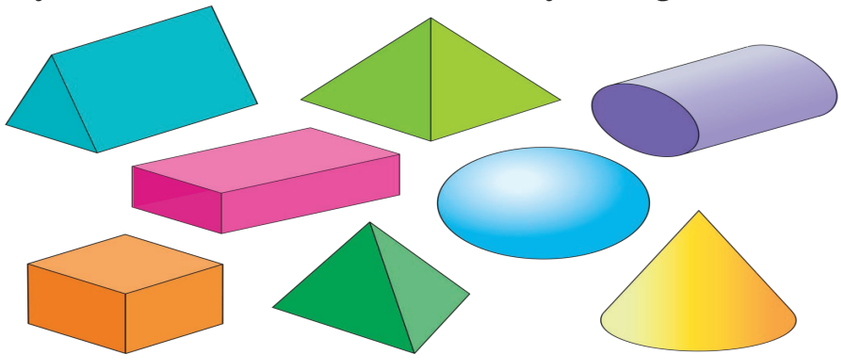
i) Guide the learners in groups to identify a packaging that can be used during delivery of communications. **(5 minutes)**
ii) Let the learners identify the shapes that make up the identified product. **(5 minutes)**
iii) Let the learners identify the materials for making the model and the final product. **(5 minutes)**
iv) Let the learners draw the designs of the identified models. **(5 minutes)**
v) Task the learners in groups to use the available materials and produce the designed models. **(60 minutes)**

Teacher's Notes

The learners' drawings may or may not be in an exploded view as represented below.



You are free to select any shape of the model from the ones below or innovate one that is within your reach and suitable for the activity of integration.

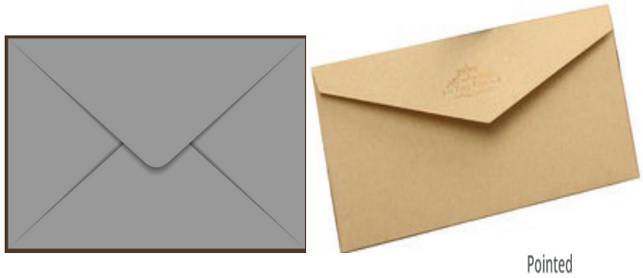


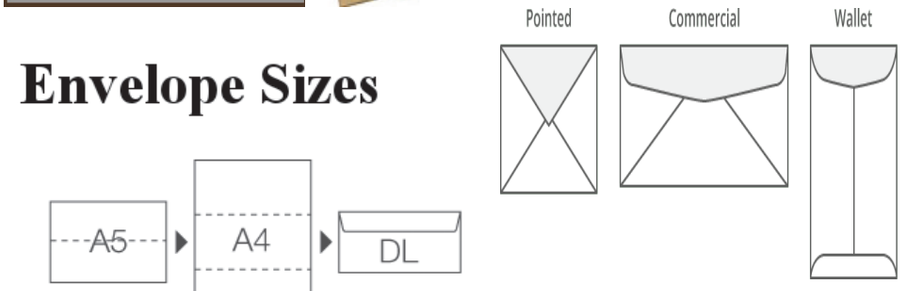
EVALUATION GRID

Activity	Criteria 1 Relevancy	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Definition of the design. Designing an envelope for enclosing and sending letter for communication between two schools.	**Score 3 i**f the learner integrates the major features. - Size (DL) - Local material choices: waste paper, banana fibres - Design/shape: a rhombus, a short-arm cross or a kite, rectangular, square.	**Score 3 i**f the learner follows the process of design. - Sketching the design. - Choosing correct materials - Constructio n of the design	**Score 3 i**f the learner fullfills the three levels of correctness of the design. - Correct overall size of material. - Correct measurement of different parts in the design - Correct fitting of the flaps	**Score 1** if the learner integrates additional features; - Blending of local materials - Finishing: decorating the envelop to attract
	Score 2 if the learner integrates two of the major features. - Size (DL) - Local material choices: waste paper, banana fibres - Design/shape: a rhombus, a short-arm cross or a kite, rectangular, square.	**Score 2 i**f the learner follows two steps of the processes of design. - Sketching the design. - Choosing correct materials - Constructio n of the design	**Score 2 i**f the learner fullfills two of the levels of correctness of the design. - Correct overall size of material. - Correct measurement of different parts in the design - Correct fitting of the flaps	
	Score 1 if the learner integrates one of the major features - Size (DL) - Local material choices: waste paper, banana	**Score 1** if the learner follows one step of the processes of design. - Sketching the design. - Choosing correct	**Score 1 i**f the learner fullfills one of the levels of correctness of the design. - Correct overall size of material. - Correct measurement of	

Activity	Criteria 1 Relevancy	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
	fibres - Design/shape: a rhombus, a short-arm cross or a kite, rectangular, square.	materials - Construction of the design	different parts in the design - Correct fitting of the flaps	

Teacher's Notes





STEPS OF MAKING AN ENVELOPE

1. Get a paper that is about twice as large as your desired **envelope** size.
2. Fold the paper over evenly.
3. Tape together the open left and right sides.
4. Fold down the top to make a flap.
5. Insert the letter or card.
6. Glue the flap to keep your message enclosed

Chapter 5: Tangents to Circles

Key Words

- tangent
- normal
- tangency/point of contact
- direct common tangent
- transverse/indirect common tangent

The learner will need:

1. notebook, pencil, pens
2. engineering articles
3. colours
4. drawing instruments

After studying this chapter and practising its activities, the learner will be able to:

1. identify tangents used in design.
2. construct different tangents.
3. make models/mock-ups to show how tangents are applied in design in day-to- day life.

Introduction

This chapter introduces the learner to the different types of tangents, their construction and application in design. By studying this chapter, the learner will be equipped with knowledge and skills to apply the principles of tangency in making models and different engineering designs.

Activity 5: Appreciating tangents (80 minutes)

5.1 Guide the learners in groups to define tangents and identify the types of tangents used in design. **(5 minutes)**

5.2 Guide learners to individually construct tangent to a circle from a point on the circumference of the circle. (10 minutes)

5.3 Guide learners to individually construct tangent to a circle from a point outside the circle. **(10 minutes)**

5.4 Tasks learners to individually construct a common:

i) external tangent to two equal circles.

ii) external tangent to two un equal circles.

(25 minutes)

5.5 Task learners to individually construct a common internal tangent to two:

i) equal circles

ii) un equal circles **(25 minutes)**

Teacher's Notes

During the lesson you should help the learners to identify objects within the environment to reflect on **Activity 5.1**.

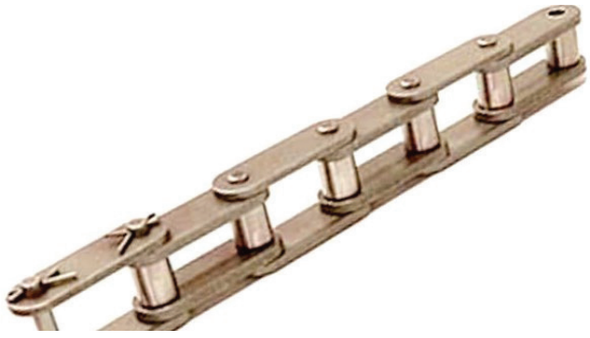
Activity 5.6: Appreciating the application oftangents

(160 minutes)

i) Guide the learners in groups to select products within the environment for modelling the principle of common external tangency (E.g. bicycle chain links and pulleys). **(10 minutes)**
ii) Let the learners identify the materials for making the model and the final product. **(10 minutes)**
iii) Let the learners draw the designs of the tangential parts of the identified models. **(30 minutes)**
iv) Task the learners in groups to use the available materials and produce the designed models. **(80 minutes)**
v) Let the learners make reports and describe the process of making the model produced. **(20 minutes)**

Teacher's Notes

The figure below is a bicycle chain. It represents application of common external tangents. This can be an activity of integration for the learners to model. You are as well free to make any other choice that is suitable and available in the school environment.



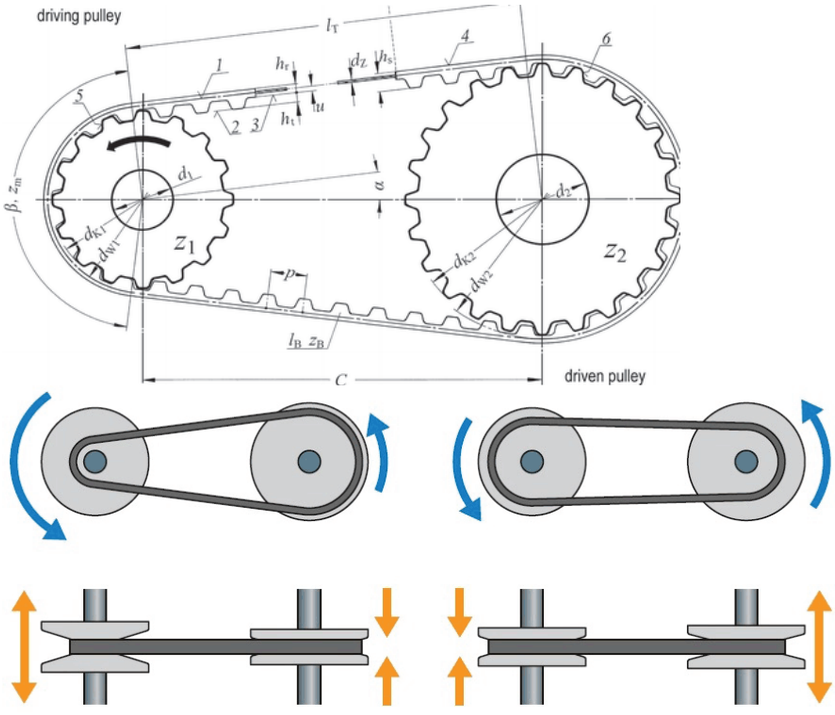
Activity 5.7: Activity of Integration (160 minutes)

i) Select a product within the environment (I.E Pulley system) and model the principle of a common internal tangency.
ii) Identify the materials for making the model and the final product.
iii) Draw the designs of the tangential parts of the identified model and the materials available in your environment to produce the designed model.
iv) Make reports and discuss the making process of the produced model.

Teacher's Notes

The figure below represents a **pulley system** that can help in the transporting materials up a building under construction. It represents application of common internal tangents. This can be an activity of integration for the learners to model. You are, as well free to make any other choice that is suitable and available in the school environment.

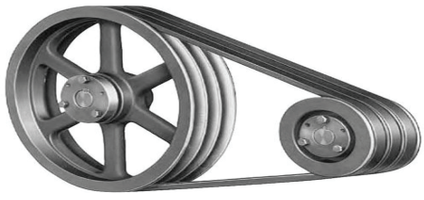
Learners can use paper boards or plastics to model the design selected.

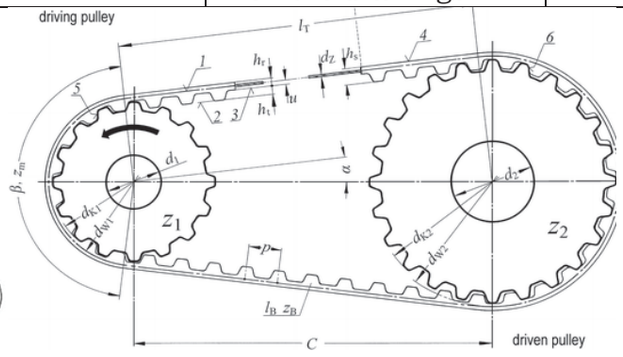


Assessment Grid

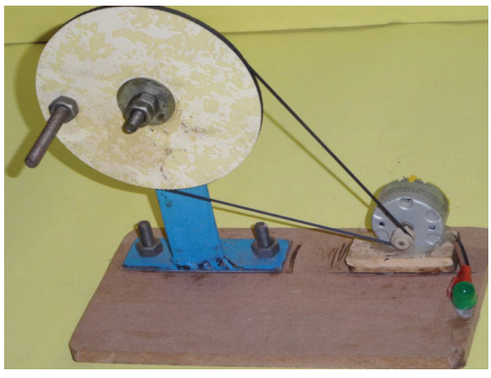
Activity	Relevance	Coherence	Accuracy	Excellence
Applying common internal and external tangents. Designing a pulley system for lifting materials.	**Score 3** if major features are integrated. - Driving pulley - Driven pulley - Belts - Shaft holes in the pulleys	**Score 3** if the learner performs any three of the following: - Sketching the pulley system. - Choosing correct materials - Construction of the pulley system. - Assembling and testing the pulley system	**Score 3** if the learner fullfills all the levels of correctness of the Design. - Measurements in the designs i.e. size of pulley and length of string - Accurate distance seperating the wheels - Accurate construction of different parts of the pulley system in line with measurements on the drawings	**Score 1** if the learner does any of the following: - Performs all of the four activities under coherence - Blend local materials i.e. uses plastics for pulleys and belts - Inserts drive shaft in the pulleys
	Score 2 if the learner integrates some of the major features. - Driving pulley - Driven pulley - Belts	**Score 2** if the learner performs any two of the following: - Sketching the pulley system. - Choosing correct materials - Construction of the pulley system. - Assembling and testing the pulley system	**Score 2** if the learner fullfills at least two levels of correctness of the Design. - Measurements in the designs i.e. size of pulley and length of string - Accurate distance seperating the wheels - Accurate construction of different parts of the pulley system in line with measurements on the drawings	
	Score1 if one of the major features is integrated - Driving	**Score 1** if the learner performs one of the following: - Sketching the	**Score 1** if the learner fullfills any one of the levels of correctness of the Design. - Measurements in the designs i.e. size	

Activity	Relevance	Coherence	Accuracy	Excellence
	pulley - Driven pulley	pulley system. - Choosing correct materials - Construction of the pulley system.	of pulley and length of string - Accurate distance seperating the wheels - Accurate construction of different parts of the pulley system in line with measurements on the drawings	





The figures below represent application of both common external and internal tangents of pulley systems. You can use it to demonstrate the principle of tangency and as well task the learners to develop its model following the steps in **Activities 5.2** and/or **5.3**.



Chapter 6: Health, Safety, Security and Environment

Key Words

- health
- safety
- security
- environment
- first aid
- accident
- annotation
- gadgets
- rules
- regulations
- protective wear
- recycling
- disposal

The learner will need:

1. notebook, pencil, pens
2. engineering articles
3. colours
4. drawing instruments

After studying this chapter and practising its activities, the learner will be able to:

1. demonstrate good practice of health and safety associated with the use of materials, tools, and machines in design.
2. demonstrate correct procedure of how to give first aid in relation to accidents affecting different parts of the body.
3. analyse how the production of design works can affect the environment and apply environmentally responsible practices.

Introduction

This chapter introduces the learner to the safety and health regulations to be observed during design. By studying this chapter, the learner will be equipped with knowledge and skills to protect himself or herself, materials, tools, equipment and environment during design and the making of engineering articles.

Activity (6.1-6.3): Understanding health, safety, security and environment (60 minutes)

6.1 Guide the learners in groups to brainstorm the meaning of the following terms: health, safety, security, environment, rules and regulations. **(10 minutes)**

6.2 Let the learners discuss in small groups: **(30 minutes)**

i) different personal and environmental health practices to be adhered to during design and making of engineering articles.

ii) safety rules and regulations for personnel and handling of materials, and tools equipment during design and making of engineering articles.

iii) security of personnel, materials, tools and equipment during design and making of engineering articles.

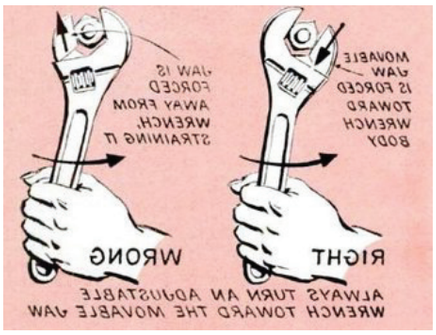
iv) impact of designing and making engineering articles on the environmental, such as waste disposal, pollution (noise, air, water), destruction of the ecosystem, climate change due to Green House Gases (GHGs).

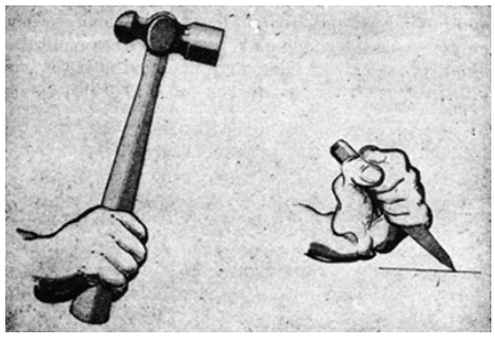
v) different environmental considerations to be observed during design and making of engineering articles.

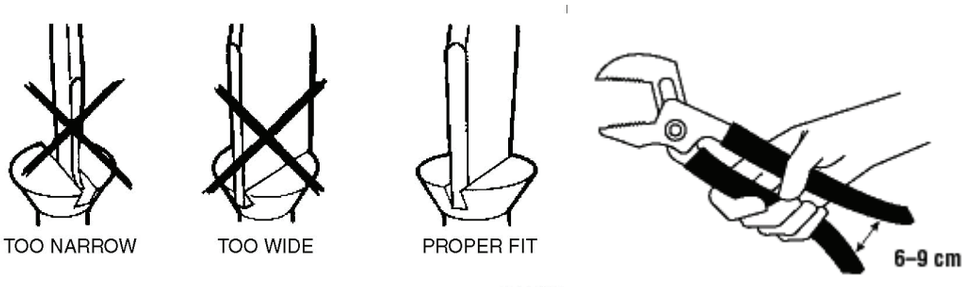
6.3 Guide the learners in groups to demonstrate the correct use of tools and machines in the process of design. **(20 minutes)**

Teacher's Notes

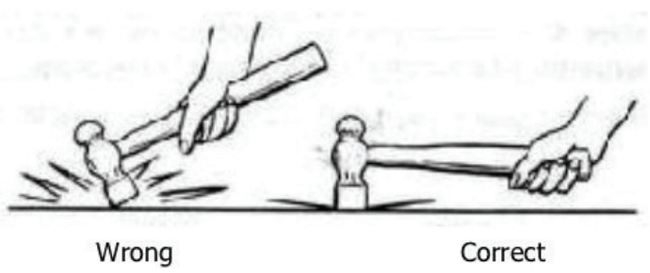
Possible responses to 6.1.3

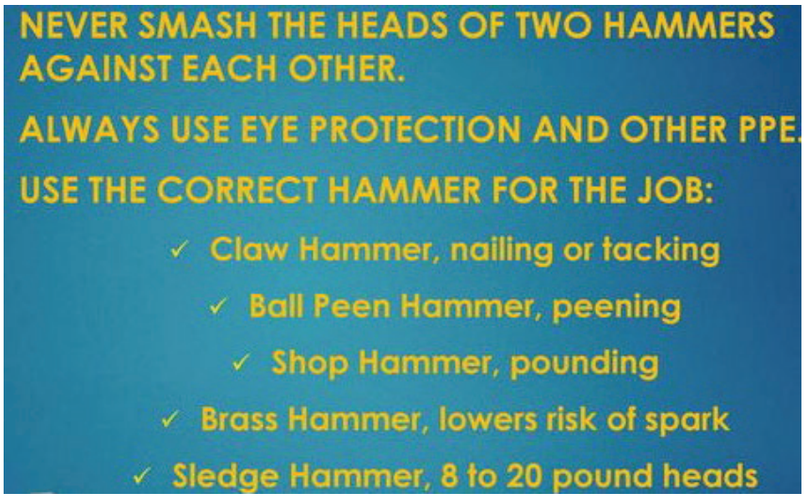






When using a hammer, always grasp it at the **end of the handle** to provide **balance** and **striking force.**





- Do not use a hammer if the handle is damaged or loose.
- Never weld, heat, or regrind a hammer head.
- Remove from service any hammer exhibiting signs of excessive wear such as cracks, chips, or a mushroomed head.
- Sledgehammers with hardened heads are prohibited (refer to prohibited items register).
- Do not strike the surface at an angle. The hammer face should contact the striking surface squarely. Glancing blows made with a hammer often lead to injury.

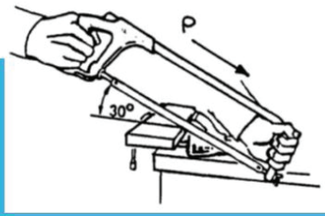
Screwdrivers

- Do not hold the work piece against your body while using the screw driver.
- Do not use a screwdriver as a punch, chisel, pry bar or nail puller.
- Do not use a screw driver to make a starting hole for screws
- Never use a screwdriver as a pry bar, chisel, punch, stirrer, or scraper.
- Always use a screwdriver tip that properly fits the slot of the screw.
- Throw away screwdrivers with broken or worn handles.

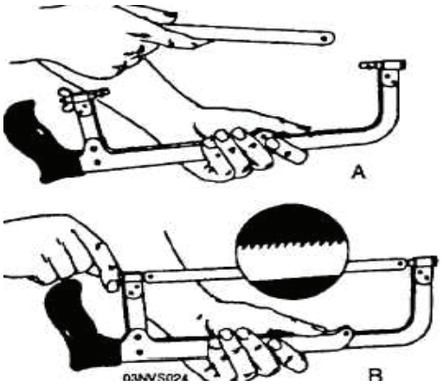
- Use magnetic or screw-holding screwdrivers to start fasteners in tight areas.
- Never use pliers on a screwdriver for extra leverage. Only use a spanner on screwdrivers specifically designed to accept them.
- For electrical work specialised insulated screwdrivers shall be used.

Cutting saws

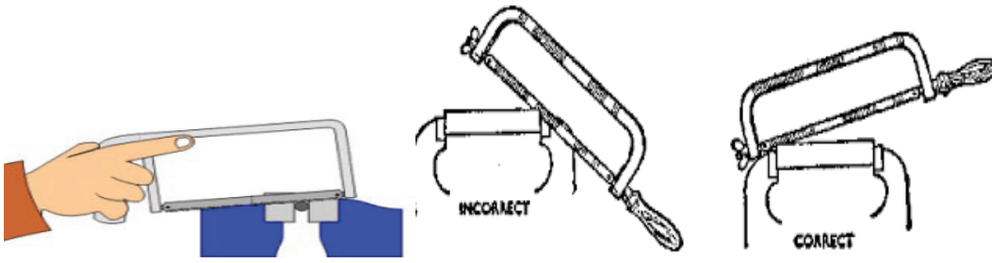
1. Hold the hacksaw properly at an **angle of 30°**
2. When cutting, **move your body** rather than just your arms.
3. Apply **pressure only during the forward stroke** (cutting stroke).
4. Use the **entire length** of the blade in each cutting stroke.
5. The usual cutting speed is from **40 to 50 strokes per minute**



6. Choose the correct blade for the material being cut.
7. Secure the blade with the teeth pointing forward.



8. Keep the blade rigid and the frame properly aligned.
9. Cut using strong, steady strokes directed away from you.



Activities 6.4 - 6.8: Applying health, safety, security and environmental regulations (80 minutes)

6.4. Guide learners in pairs to sketch a human figure, annotating it to show areas that need protection while working. **(20minutes)**

6.5. Guide learners in pairs to name the basic gadgets and tools required in design to make articles and the safety regulations associated with each; for example, hammer, screw driver, cutting saws, machete, knife. **(15 minutes)**

Task them to state the details of their proper use.

6.6. Task learners to demonstrate the proper use of protective wear when using the gadgets/tools. **(10 minutes)**

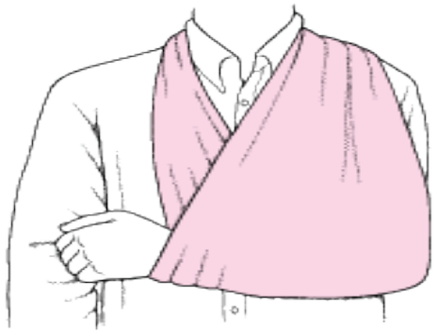
6.7. In groups, guide learners, to participate in role-plays to demonstrate how first aid is applied in different cases of accident occurrence. **(25 minutes)**

i) Fractured hand
ii) Fractured limbs

6.8. In small groups, guide the learners to discuss and demonstrate the proper use and disposal of used materials in environmentally responsible ways. **(10 minutes)**

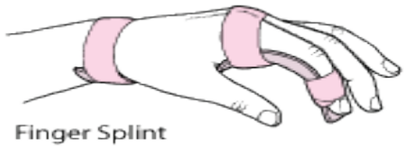
Teacher's Notes on 6.7

Demonstration of how first aid is applied when an accident occurs**.**



Sling

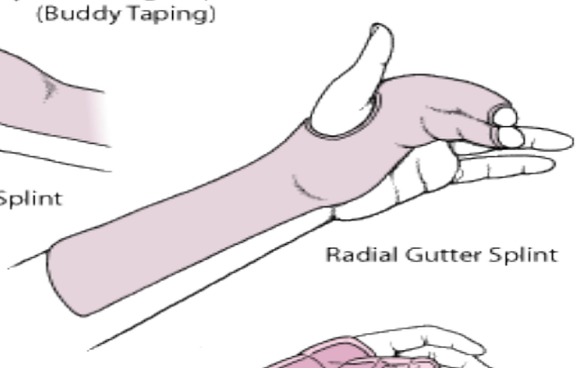
Sling and Swathe



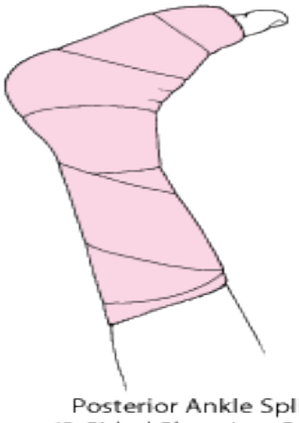
Finger Splint

Dynamic Finger Splint
(Buddy Taping)

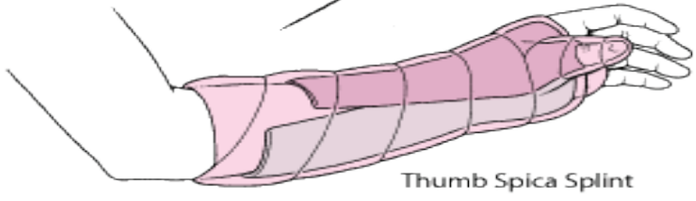
Ulnar Gutter Splint



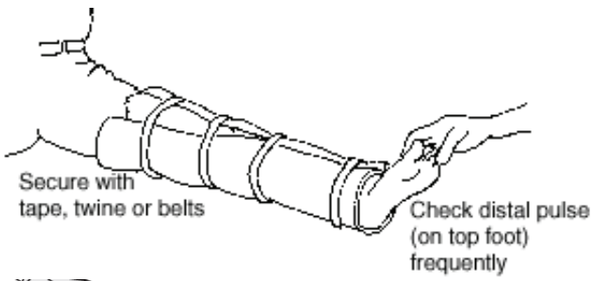
Radial Gutter Splint

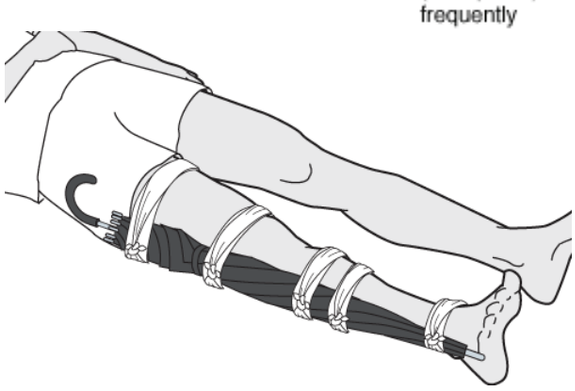


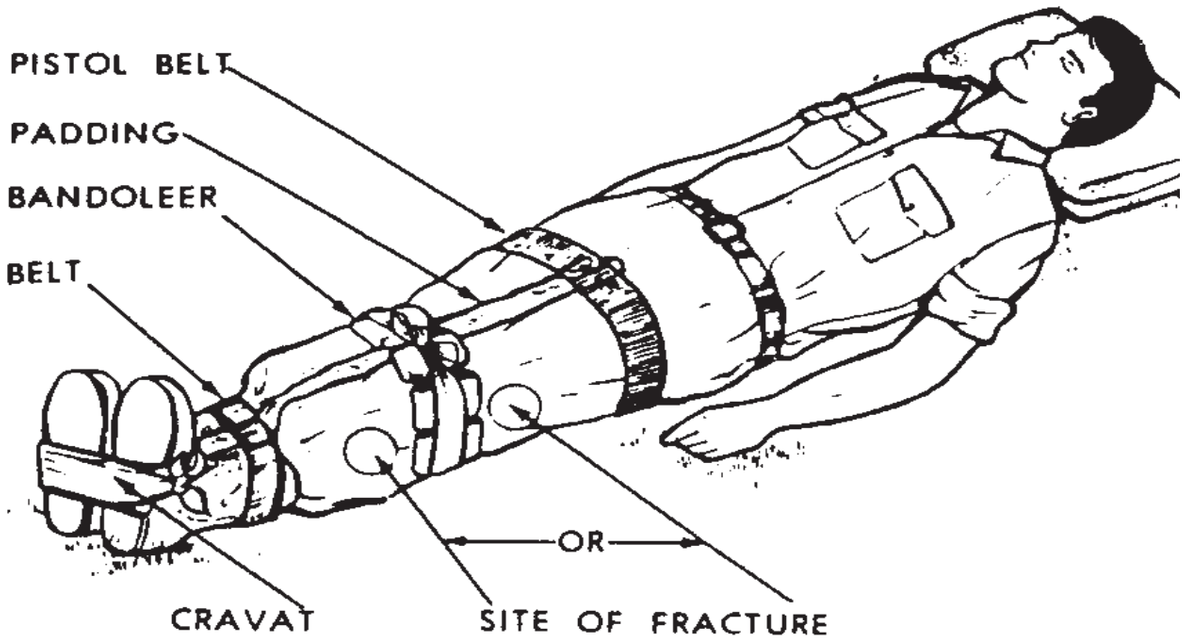
Posterior Ankle Splint
(3-Sided Short Leg Splint)



Thumb Spica Splint


Secure with
tape, twine or belts
Check distal pulse
(on top foot)
frequently




PISTOL BELT
PADDING
BANDOLEER
BELT
OR
CRAVAT
SITE OF FRACTURE

Teacher's Notes on 6.8

Table showing the proper and safe use of materials in the environment

Material	Safety risks	Safe use/Safety regulations
Clay materials	Can cause lung problems if inhaled	• Use protective respiratory equipment. • Do not sweep a dusty area, but use water to moisten before sweeping.
Paint materials and other chemicals	• Can lead to respiratory problems • Can cause cancer of the skin and internal organs • Can affect the eyes	• Use protective respiratory equipment. • Do not stay longer in areas where paint and chemicals are used or stored. • Avoid fire near paint and other chemicals. • Do not use paint and other chemicals in an open environment or where people, animals, vegetation and other living organisms are exposed.
Metallic materials	• Can cause simple or heavy cuts • Can cause fractures if fallen on body	• Always use proper protective equipment such as gloves, safety shoes and head safety helmet. • Always protect Metallic materials from environmental rusting and corrosion
Wooden Materials	• Can lead to injuries such as puncture wounds and sprained ankles, broken toes or worse	• Always lift the appropriate weight • Use proper protective equipment such as gloves, safety shoes, head safety helmet

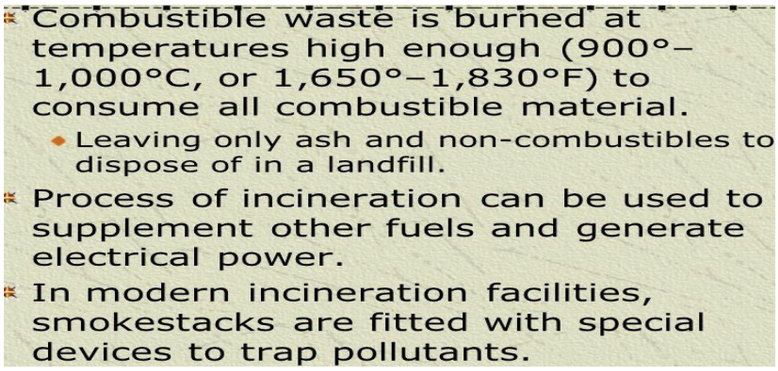
Disposal of Used Materials in Environmentally Responsible Ways

Waste Disposal Practices

The different waste management methods include source reduction and reuse, animal feeding, recycling, composting, fermentation, landfills, incineration and land application.

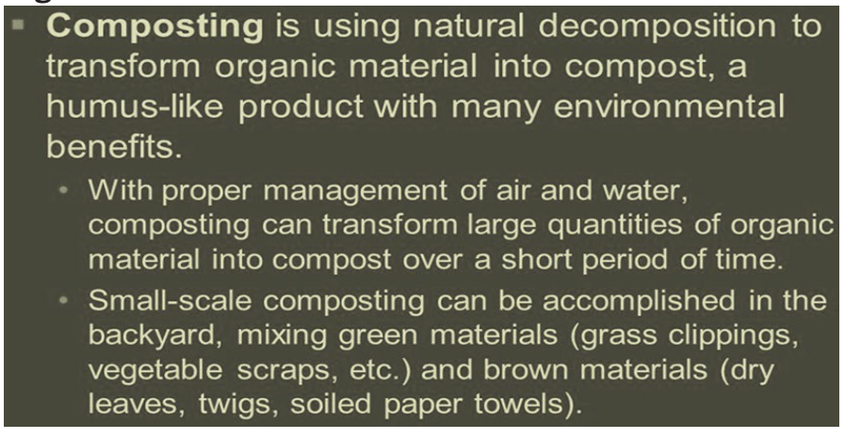
- **Incineration/Combustion**

Incineration or combustion is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products.



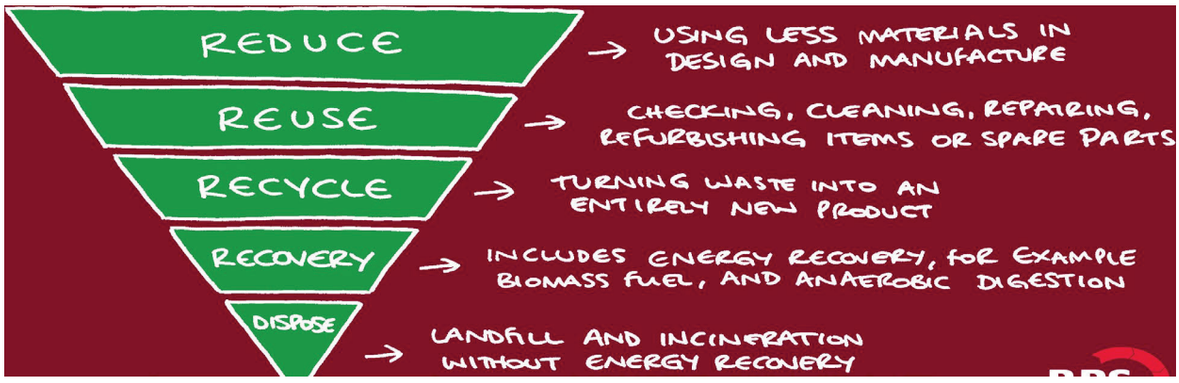
- Incineration is the process of ***control and complete combustion***, for burning solid wastes. It leads to **energy recovery** and **destruction of toxic wastes.**
- In these plants the recyclable material is segregated and the rest of the material is burnt.
- **Example**: waste from hospitals
- In some newer incinerators designed to operate at temperatures high enough to produce a molten material, it may be possible to reduce the volume to about 5% or even less
- One of the most attractive features of the incineration process is that it can be used to **reduce the original volume** of combustible solid waste by 80–90%.

- **Composting**



This process recycles various organic materials; otherwise, regarded as waste products and produces a soil conditioner (**the compost**). Compost is rich in nutrients.

- **Recovery and Recycling**



Resource recovery is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel.

Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of reduce, reuse and recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use.

- **Landfill**

Landfill is the most popular method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land.

Activity 6.4: Activity of Integration (20 minutes)

You are participating in the school weekly general cleaning session and one of your colleagues gets injured when a chair accidentally falls on his leg. Prepare and demonstrate a first aid plan to help your friend.

Evaluation Grid

Activity	Relevance	Coherence	Accuracy	Excellence
Definition of the solution to the problem. Preparation of a first aid plan for the injured colleague.	**Score 3 if** major features are integrated: - Get the patient out of accident scene. - Identify local materials that will be used; ruler, cloth/string. - Tie piece of cloth above injured limb to stop bleeding	**Score 3** if all the chronology or process is followed. - Bar the patient from moving. - Let the injured leg of the patient lie horizontal on a flat surface - Seek attention of medical personnel	**Score 3** if there are three levels of correctness of information in the solutions: - Prepare the activity in a clean environment - Clean the affected part with water - dispose off used materials correctly	**Score 1 if** major features are integrated: - Blending of local materials
	Score 2 if two of the major features are integrated - Get the patient out of accident scene. - Identify local materials that will be used: stick, cloth/string	**Score 2** if two steps of the chronology or process above are followed.	**Score 2** if there are two levels of correctness of information in the solutions.	
	Score 1 if only one major feature is integrated. - Get the patient out of accident scene.	**Score 1** if one of the steps of the chronology or process is followed.	**Score 1** if there is one level of correctness of information in the solutions.	

Chapter 7: Tools

Key Words

- tools
- marking-out tools
- measuring tools
- marking-out
- gauging

The learner will need:

1. notebook, pencil, pens
2. different tools

After studying this chapter and practising its activities, the learner will be able to:

1. demonstrate proper use and maintenance of tools used for marking out.
2. demonstrate accuracy while using measuring tools.

Introduction

Tools are gadgets used in faster and accurate execution of tasks, and they maybe hand or power driven.

This chapter introduces the learner to the different tools used in design. By studying this chapter, the learner will be equipped with knowledge and skills to accurately use and maintain the common measuring and marking-out tools in design.

Activity 7: Understanding measuring and marking out tools (80 minutes)

7.1. In groups, guide the learners to discuss the meaning of measuring and marking-out. **(10 minutes)**
In groups, task the learners to identify measuring and marking-out tools for wood, metals and plastics. **(10 minutes)**

7.2. In groups, task the learners to practise measuring of different objects in the environment (e.g. desks, blackboard, classroom, windows, and doors), using different measuring tools. **(60 minutes)**

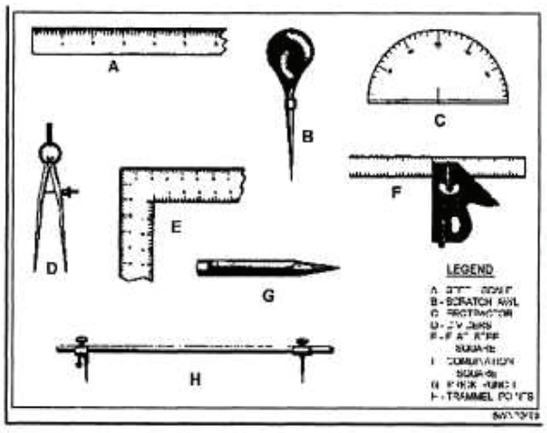
Teacher's Notes

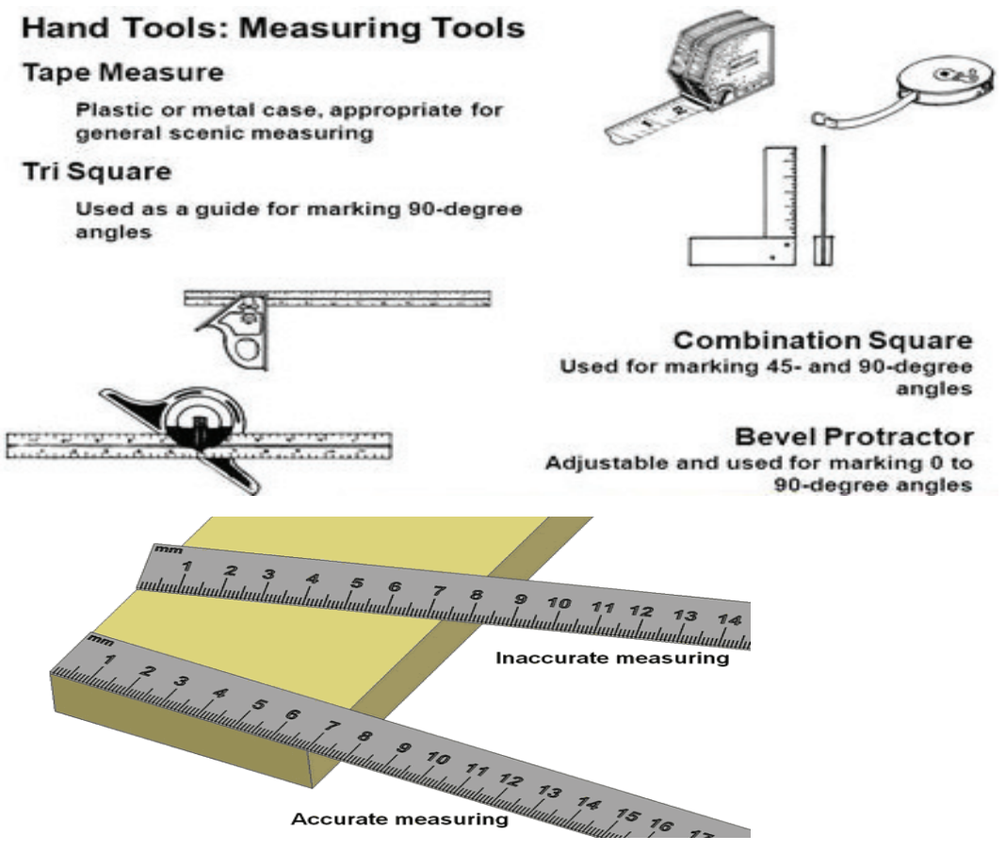
Measuring is the process of determining the size and weight of an object. The sizes may include length, width, and height /depth/ thickness. Measurement helps to avoid inaccurate and substandard design and production of articles.

Marking-out is a means of transferring shapes and lines onto a material to provide a guide for cutting, bending, shaping and various other processes.

Accurate marking-out and measuring are important in ensuring that materials fit together properly.

Measuring Tools and Marking-Out Tools





Activity 7.3: Practising the proper use of marking-out (80 minutes)

In groups, guide the learners to discuss the marking-out process. **(20 minutes)**

In pairs, task the learners to identify a design object in the environment and practise marking-out of the different parts of the object. (e.g. desks, blackboard, classroom, windows, doors, hinges, latches, locks), using different measuring tools. **(40 minutes)**

Let the learners cut out the component boundaries of the marked object. **(20 minutes)**

Teacher's Notes

Marking-out process using datum approach:

- Line datum
- Edge datum
- Face datum

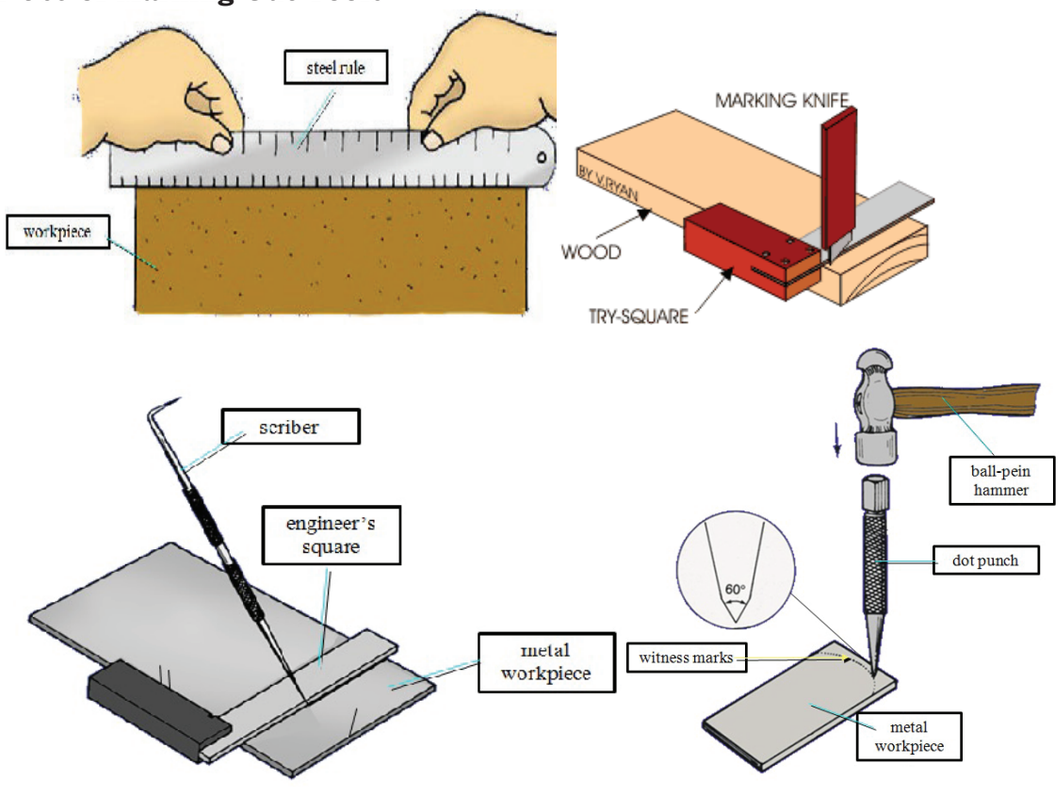
Activities 7.4 & 7.5: Practising maintenance of measuring and marking-out tools (80 minutes)

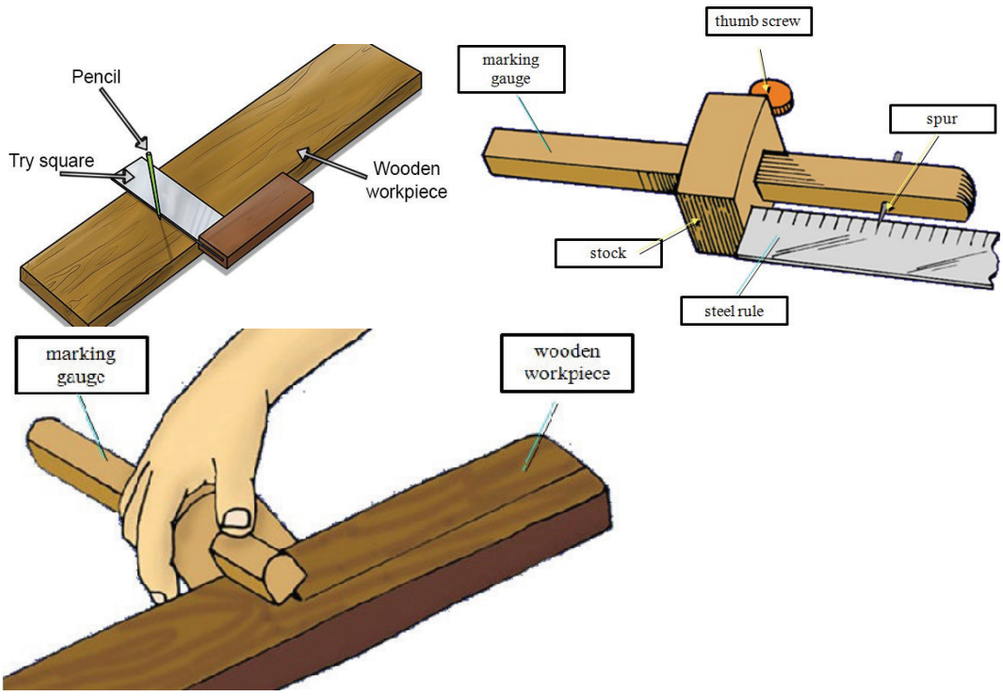
7.4. In groups, guide the learners to discuss the meaning and importance of maintenance and care of tools. **(10 minutes)**
In pairs, task the learners to discuss and demonstrate the proper and accurate use, maintenance and care of the measuring and marking-out tools. **(45 minutes)**

7.5. Guide learners to write individual reports on the proper and accurate use and maintenance of the measuring and marking-out tools **(25 minutes)**

Teacher's Notes

Proper Use of Marking-Out Tools





Activity of Integration (80 minutes)

Mrs Isoke is your neighbour. She has a family business that deals in making party cakes. You have been tasked to design the packaging which will be used in the delivery of the cakes.

Design and make a suitable product, making proper use of measuring, marking and testing tools.

7.4.1 Task the learners to individually collect materials and make a packaging box using appropriate measuring, marking-out, cutting and joining processes. **(60 minutes)**

7.4.2 Let the learners individually write a report to describe the steps taken in making the packaging box and the tools/materials used. They can state the uses of the object produced. **(20 minutes)**

Evaluation Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Definition of the design. Designing packaging for delivery of party cakes.	**Score 3** if major features are integrated. - Size. - Local material choices: wastepaper, banana fibres - Design/shape:	**Score 3** if chronology or process of design is followed. - Sketching the design - Choosing correct materials - Construction of the design	**Score 3** if the level of correctness of the design is followed. - Correct overall size of material - Correct measurement of different parts in the design - Correct fitting of the flaps	**Score 1** if major features are integrated. - Blending of local materials - Finishing: decorating the packaging to attract
	Score 2 if any two major features are integrated. - Size - Choice of local materials: wastepaper, banana fibre - Poor design/shape	**Score 2** if two steps of the chronology or process of design are followed. - Sketching the design - Choosing inappropriat e materials - Construction of the design	**Score 2 i**f two of the levels of correctness of the design are followed. - Correct overall size of material - Correct measurements in the designs - Incorrect fitting of flaps	
	Score 1 If any one major features is integrated. - Incorrect size - Local materials choice: wastepaper, banana fibre	**Score1** If at least one step of the chronology or process of design is followed. - Choosing correct or inappropriat e materials - Construction of imperfect design	**Score 1** If one of the levels of correctness is the design are followed. - -Incorrect measurements in the design. - - Incorrect fitting of flaps	

Chapter 8: Materials

Key Words
- materials
- engineering materials
- properties: toughness, brittleness, strength, hardness
- working properties

Learners will need:
- notebook, pencil, pens
- engineering articles
- materials

After studying this chapter and practising the activities, the learner should be able to:

1. analyse the nature and properties of common materials used in design (k, u).
2. use and manipulate the common engineering materials in design work.

Introduction

This chapter introduces the learner to the different engineering materials and their application in the design process.

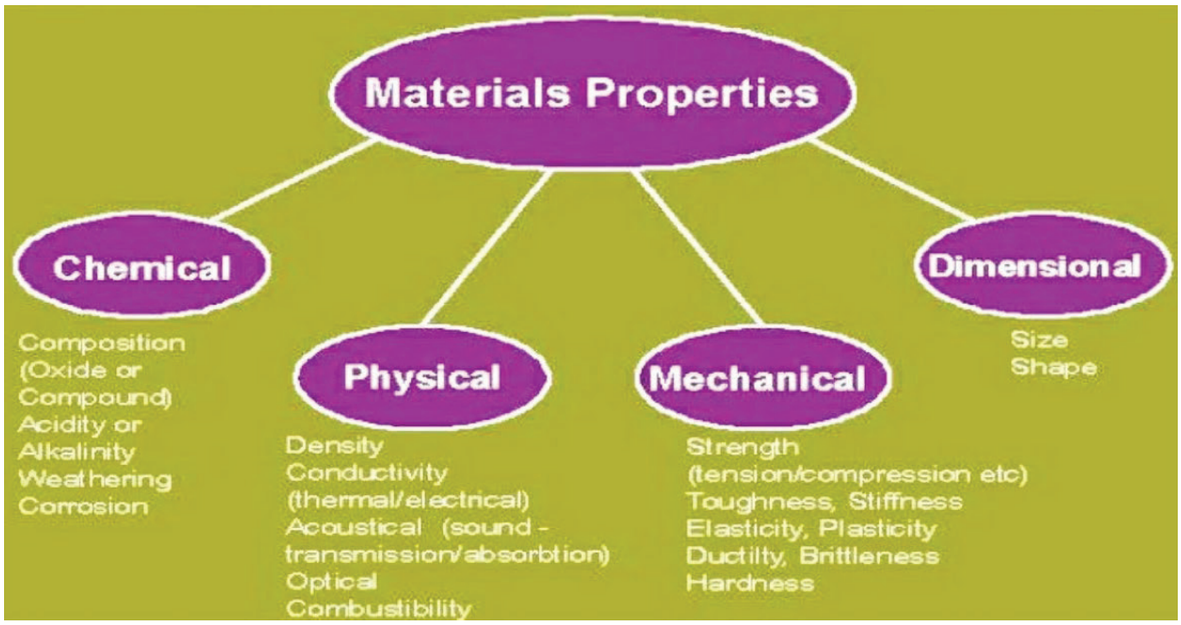
Therefore, the study of this chapter will equip the learner with the necessary knowledge and skills to analyse the nature and properties of common materials and their applications, and manipulation in the design process.

Activity 8: Manipulating the design materials (80 minutes)

8.1 In groups, guide the learners to define the term 'materials' and to identify the different design materials in the school environment. (**20 minutes**)

In groups, task the learners to categorize and discuss the properties of design materials. (**60 minutes**)

Teacher's Notes



Activity 8.2: Familiarising with the design materials (80 minutes)

In groups, guide the learners to discuss the applications of different design materials. (**20 minutes**)

Task the learners to individually arrange design materials in a chart and state reasons for the particular applications of each material. (**60 minutes**)

Teacher's Notes

Use the sample table below to complete **Activities 8.2.1** and **8.2.2.**

Material	Application Areas	Reasons for its application in the specific condition
Wood	• Making of furniture • Construction industry	• It's light in weight. • It's workable in design. • It's readily available and thus cheap to acquire. • It's long-lasting in structure and resists corrosion and wear. • It contains a good surface appearance.
Metals	• used in construction of buildings • applied in electronics. • they are used to make wires and parts for equipment and gadgets that function on electrical current	• metals are good conductors of heat and electricity i.e. copper, aluminium • **Metals** are lustrous (shinny), giving a good surface finish • Metals can be rolled into any shape without breaking, • Some metals are light like aluminium • Metals have a hard surface that easily resists scratching
Clay	Used for: • making pottery. • making of construction products, such as bricks, wall and floor tiles. • making house ware.	• It has a plastic behaviour when wet, • catalytic abilities, • It can easily swell when wet • Has low permeability (allows water to flow through at a slow rate) • Has good heat insulation ability • Can be moulded into any shape • Has a permanent non fading outlook.
Plastics	• It is used in numerous packaging applications including containers, bottles, drums, trays, boxes, cups and vending	• Plastics is versatile (multipurpose) i.e can be made in any shape. • It is hygienic material to use. • It is also light in weight, it has high durability.

Material	Application Areas	Reasons for its application in the specific condition
	packaging, baby products and protection packaging • Also used in construction industry for water plumbings. • Used as insulators. • Used in electricity and electronic components.	• It has a good heat and electricity insulation ability. • It has a shiny lustre. • It can melt at very low temperatures compared to other materials.

Activity 8.3: Manipulating the design materials (80 minutes)

Guide learners in groups to practise using design materials and explore the physical properties of each. (**80 minutes**)

Teacher's Notes

i) To manipulate is to manage, utilize or work a material skilfully. Let learners manipulate the materials in the environment, to explore their properties.

ii) Let them decide on a specific design to make from the materials (I.e. a stool, chair, mat, shoe, shirt, ball, among others)

iii) Let them state the material properties required for making of the design.

iv) Guide them to determine the criteria for selection of the materials (i.e specific features/use of the material)

v) Let learners Identify the candidate (qualifying/intended) materials according to the criteria determined.

vi) Let them evaluate the candidate materials to reveal features that will guide in selecting the most appropriate.

vii) Task them to select materials based on the prior evaluation.

viii) Let them manipulate the materials to reveal their properties.

Activity 8.4: Activity of Integration (80 minutes)

Tour your classroom block and identify any five articles. Identify the materials they are made of.

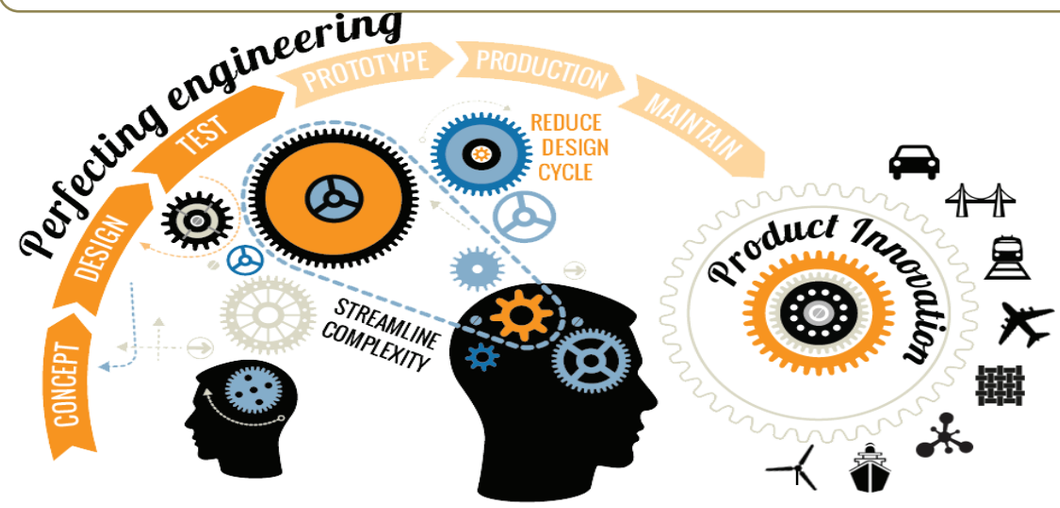
Write a report explaining the reasons that led to the selection of the specific materials for each of the articles identified.

Evaluation Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Identification of articles Distinguishing materials used in constructing different articles	**Score 3** if the learner: - identifies design articles. - identifies materials used to construct the articles. - states the reasons for selection of materials for construction of the articles.	**Score 3** if the learner: - identifies the visual properties. - states source of materials.	**Score 3** if the learner: - states the correct names of design article. - states the correct material composition. - states the correct reasons for the selection of the different materials.	**Score 1** if major features are integrated. If the learner is able to recognise blending of materials in the construction of design articles.
	Score 2 if the learner: - identifies design articles. - identifies materials used to construct the articles. - does not state the reasons for selection of	**Score 2** if the learner: - identifies the visual properties, or - states source of materials only.	**Score 2** if the learner: - states the correct names of design article. - states the correct material composition. - states the incorrect reasons for the selection of the different	

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
	materials for construction of the articles.		materials.	
	Score 1 if the learner: - only integrates one major feature. - identifies design articles. - identifies materials used to construct the articles.	**Score 1** if the learner: - does not identify the visual properties. and/or - does not state source of materials.	**Score 1** if the learner: - states the correct names of design article. - states the incorrect material composition. - states the incorrect reasons for the selection of the different materials.	

Chapter 9: Making Process



Key Words

- design
- appropriate
- cut out
- cutting tool
- bend/fold
- join
- assemble

The learner will need:

1. notebook, pencil, pens
2. sample engineering articles
3. models
4. design tools and equipment

After studying this chapter and practising its activities, the learner will be able to:

1. demonstrate the correct use of tools and simple machines. (k, u, s)
2. use and follow the procedure for making a product from a specific design.

Introduction

This chapter introduces the learner to the process of implementing design ideas and transforming them into real-life articles.

This chapter will equip the learner with the necessary skills to manipulate materials and tools and implement the design process to make different products.

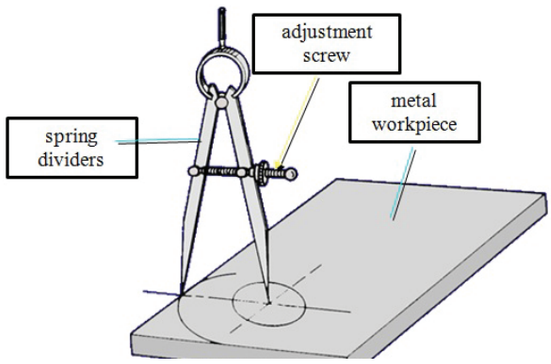
Activity 9.1: Marking-out objects of various shapes on the design materials (80 minutes)

In pairs, guide learners to practise measuring and marking-out of objects of various shapes and sizes.

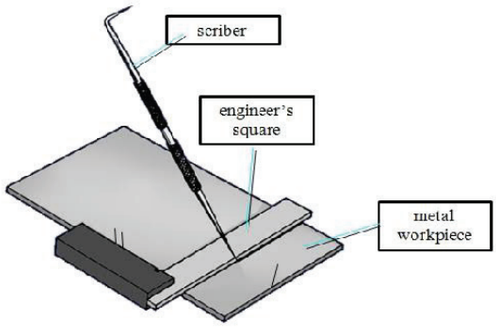
i) Circular/oval (**25 minutes**)
ii) Rectangular/Square/ triangular (**25minutes**)
iii) Irregular (**30 minutes**)

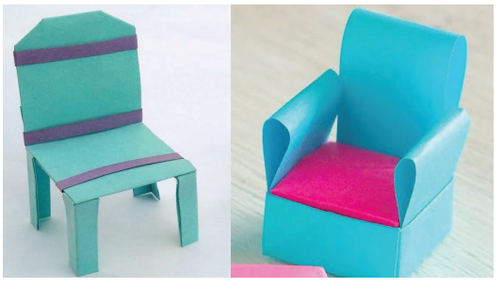
Teacher's Notes

Marking-out circular/oval shapes

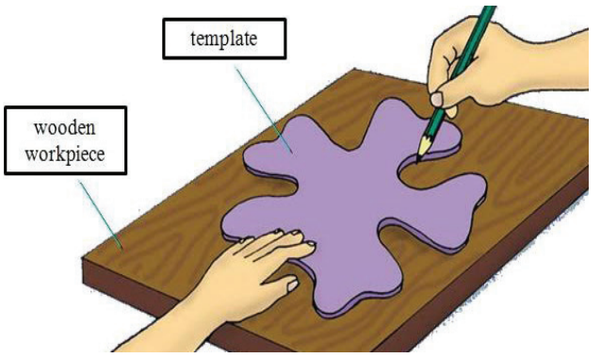


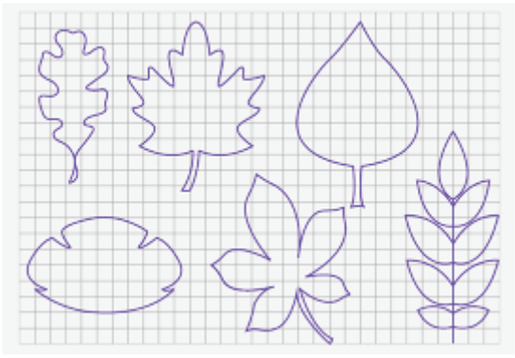
Marking-out rectangular, square/triangular shapes





Marking-out irregular shapes





Activity 9.2 (i): Shaping the design materials (80 minutes)

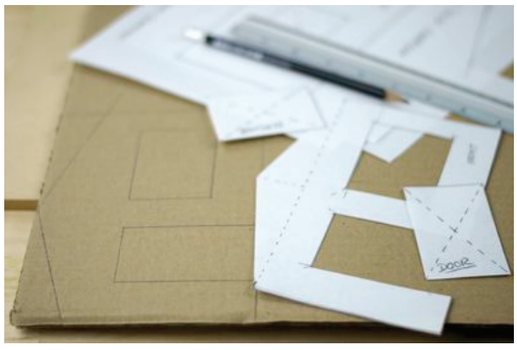
In pairs, guide learners to identify the different tools for cutting out the shapes marked out in activity **9.1** above. **(30 minutes)**

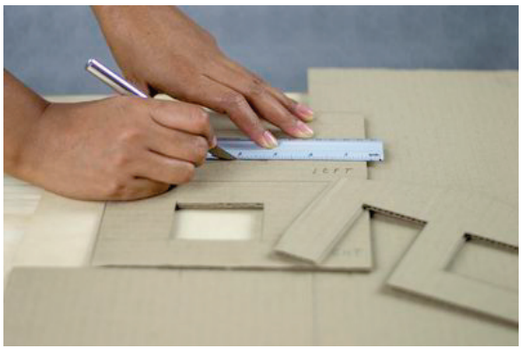
Task them to cut out the marked shapes using suitable cutting tools. **(50 minutes)**

Hints to the teacher: The learners should practise cutting different shapes.

Teacher's Notes

Cutting out the marked shapes





Activity 9.2 ii) – iv) and 9.3: Forming shapes in the design materials (80 minutes)

ii. In pairs, guide the learners to bend or fold one of the cut shapes using suitable tools. **(20 minutes)**

iii. Task learners to join and assemble the product using the appropriate method. **(20 minutes)`**

iv. Let learners perform other necessary (finishing) tasks to complete the product making process. **(10 minutes)**

9.3. Assign learners to write individual reports on the above activity to: **(30 minutes)**

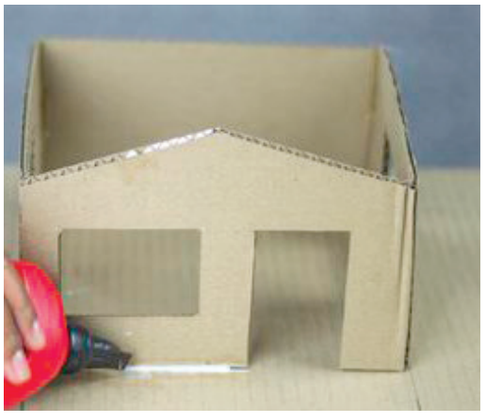
i) describe the making process followed to put the design into and physical product.
ii) explain the safety precautions followed in the making process.
iii) make features of the product.

Hint to the teacher

The learners should practise cutting and bending or folding shapes of their choice. Each pair or group should bend a different shape to cover all possible shapes.
You can assign a home work to make sure all learners practice making a variety of shapes.

Teacher's Notes

Bend or fold to make the required shapes using the most suitable tools. You can improvise where necessary but let the learners know the right tools for each task.



Activity of Integration (80 minutes)

During the recent sports day, the guest of honour pledged to reconstruct the Senior One classroom block. You have been selected to make a model of the classroom block that will be taken to his office so that he can begin to plan for the project.

As a student of technology and design, make the model of the classroom block following the steps of the making process.

Assessment Grid

Activity	Criteria 1 Relevance	Criteria 2 Coherence	Criteria 3 Accuracy	Criteria 4 Excellence
Definition of the task Making the model of classroom block	**Score 3** if the learner makes use of: - size (scale) - the local materials: wastepaper, banana fibres - different designs/shapes : square, rectangle, oval.	**Score 3** if the learner: - sketches the design. - chooses the correct materials. - construction of the design	**Score 3** if the learner makes: - correct overall size of material. - correct measurement of different parts in the model. - correct fitting of the different parts.	**Score 1** if the learner: - blends local materials. - finishes decorating the model to attract.
	Score 2 if the learner: - makes use of some of the major features. - sizes (scales). - makes use of the local materials: wastepaper, banana fibre. - makes poor design/shape	**Score 2** if the learner: - makes use of sketching design. - chooses inappropriate materials. - constructs the design.	**Score 2** if the learner makes: - correct overall size of material. - correct measurements in the designs. - incorrect fitting of different parts.	
	Score 1 if the learner: - integrates any two major features. - makes incorrect size. - makes use of the local materials: wastepaper, banana fibre.	**Score 1** if the learner: - chooses incorrect or inappropriate materials. - constructs imperfect design.	**Score 1** if the learner makes: - correct overall size of material. - incorrect measurements in the design. - incorrect fitting of different parts.	

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