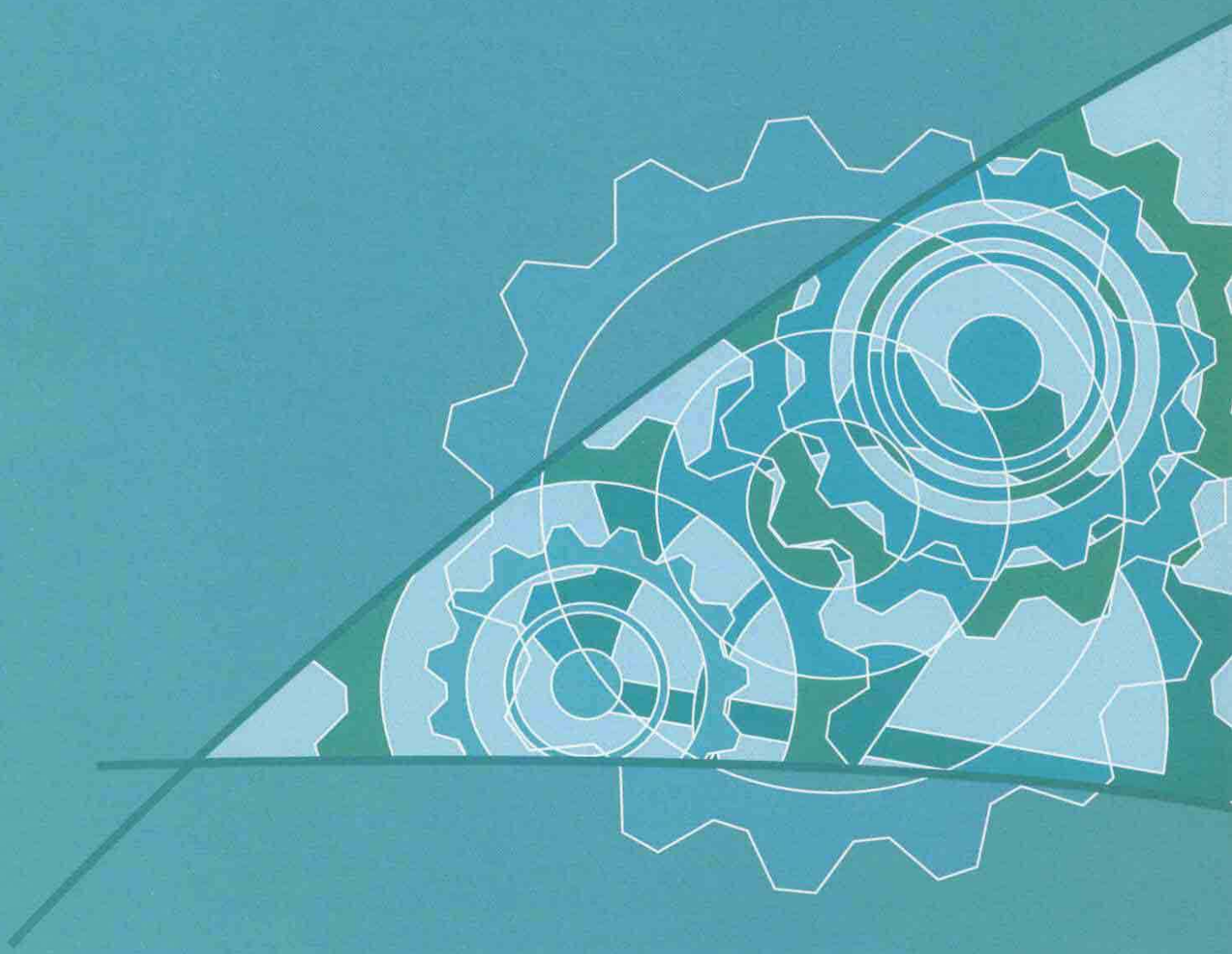
United Nations
Educational, Scientific and
Cultural Organization

Technology Education Guide



TECHNOLOGY EDUCATION GUIDE

Prepared by

The World Council of Associations for Technology Education
(WOCATE)

for UNESCO

Division of Secondary, Technical and Vocational Education
Section for Science and Technology Education

UNESCO, 2003

ADVISORY COMMITTEE

The authors are grateful to a dedicated set of colleagues who contributed their insights, experience and materials to the task at hand. The primary function of the Advisory Committee was to review, verify and validate the materials, and make recommendations to yield a state-of-the-art curriculum realistically applicable to a wide variety of local contexts. Sincere appreciation is extended to the members of the committee and to all others who helped.

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Foreword

This *Guide,* a technology education curriculum guide, is a resource produced specifically to help teachers and others interested in helping students/youth to develop their understanding and capability of one of the most powerful forces in the world – namely that of technology.

WOCATE and UNESCO seek to empower a unified effort to implement quality technological education within the context of the family and home, the local community and its agricultural, business, industry and other contexts. We also seek to show how technological education can reinforce basic academic skills while also enhancing general employability skills. We are convinced that effective technology education can occur just with what imaginative educators find and see in the environment housing their students.

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Acknowledgements

A special note of thanks and recognition is due to project support staff who have provided the effort essential to the project's success. Each person's contribution adds a unique value to the project. Special appreciation is also due to those listed below for their own particular contribution:

- Purdue University, the School of Industrial Technology, and Ms Kathy Heath for technical support of the project's production.
- To the Erfurt enterprise, TIAW for its significant support of the development of this *Guide*. Together with that of the WOCATE team, this effort enabled the production of this *Guide*.
- Mr Ronald Barker, Director for Technology Education, and the Georgia Department of Education, Atlanta, Georgia, United States, for kindly permitting the adaptation of portions of the *Georgia Guide for Technology Education* series.
- Finally, the WOCATE team wishes to acknowledge the wisdom and vision of Mr Orlando Hall Rose of UNESCO for his ongoing support of technology education and for his sensitivity in envisioning the utility of a guide for technology education. Without his marshalling of scarce resources, this *Guide* would never have been produced.

Contents

Introduction

This *Guide* was developed to help educators around the world implement technology education – and to do so in their present settings, or with minimal investment. The *Guide* describes the purposes and goals of technology education and it shares some ideas that can help start such a programme. To this end, it includes a course content outline, identifies enabling performance objectives and suggests instructional activities and evaluation procedures. Teachers should consider themselves welcome to revise, augment and/or extend the suggested learning activities contained in this *Guide*.

Use of the *Guide*

This *Guide* is intended to help educators (e.g. teachers, curriculum directors and supervisors, guidance personnel and curriculum developers) to develop, implement and maintain a quality technology education programme. Specific suggestions for use of the *Guide* by each of these groups are provided below.

Use by teachers

The compilers intend to help teachers plan instruction to help students in developing their understanding of technology. We do not intend to supplant good local curricular planning and documentation. Within the constraints of their local context, teachers can use this *Guide* to implement technology education through appropriate activities and assignments, and validate and record student achievement.

The *Guide*'s instructional modules are presented in a standard format using components widely deemed important to effective teaching/learning. Key cognitive, sensorimotor and affective objectives are identified, as are suggested learning activities and instructional strategies.

Use by curriculum directors and supervisors

Curriculum leaders can review teachers' instructional plans, activities and records. We encourage an assistive role in helping teachers select instructional materials to support and expand the modules contained in this *Guide*.

Philosophy, purpose, goals and strategies

Philosophy

Because of the pervasiveness of technology in all cultures, technology education should be made readily available in all schools from kindergarten to high school. Through such opportunities students will gain both academically and in their technological literacy. They will build a solid foundation for productive employment or for post-secondary education. The compilers believe it is the responsibility of every nation and every school to provide opportunities to develop the understandings, skills and attitudes so essential in today's dynamic technological environment.

Technology invariably involves the application of mathematics and science so the suggested learning activities in this *Guide* can provide a useful way of reinforcing these academic understandings. Technology employs knowledge, tools and skills to increase human potential, to solve practical problems, to modify our world. When properly understood, technology can be adapted • and humans are in control.

As an integral part of the school curriculum, technology education teaches students to understand, use and control technology. Teachers should help students study the development and use of technology and its effect on people, the environment and society. Students learn to adjust to change, to deal with forces that influence their future and to participate in controlling their future. Students further develop insights into the application of technological concepts, processes and systems.

Purpose

Technology education develops students' capabilities with the processes, and therefore the knowledge, attitudes and skills involved when humans engage in production, communication, or employ energy. Technology education should involve a reasonable balance of theoretical and practical information with hands-on activities that reinforce conceptual understanding. By capitalizing on student interest in addressing real-world situations • and getting involved with discovering, creating, problem-solving and constructing with a variety of tools, machines, materials and processes • students learn much about technology, themselves and their world.

A technology education programme provides a rich, attractive and motivating stimulus to a learning environment in which students can develop skills that will increase their abilities to solve practical problems, to make informed decisions and to interpret the impacts of technology on society.

The *Guide* is simply a strategy that, instead of focusing on the types of technology employed by the heavily industrialized societies of the world, employs the actual technology found in the everyday life experience of the students. Creative teachers can employ such experiences as the core of activities that teach the principles of technology, and that reinforce the foundation of other general education subjects such as mathematics, science and communications.

Goals

The prime goal of this *Guide* is to increase the technological literacy of students. Technological literacy, i.e. the understanding and capability of technology is necessary to live and work in a technological society. Every student lives in a world where decisions concerning technology have a significant impact on their careers, well-being and overall quality of life.

Students experiencing technology education activities will develop their ability to: (a) develop a better understanding of the role of technology in society; (b) nurture an appreciation for the importance between and among the technological systems; (c) solve technological problems through the application and use of tools, materials and processes; (d) investigate and study the technological world of the past, present and future; and (e) analyse technological systems and the impact of these systems on the environment and society.

Instructional strategies

During a technology education experience, students engage in hands-on activity in one or more areas of visual and other communication, electrical and other power utilization, and the processing of materials. Students employ processes such as systems analysis, systems synthesis, design, problem-solving, trouble-shooting, production, construction, etc. Both fundamental principles and career information are stressed throughout the *Guide* to assist them in making informed and meaningful decisions. Student activity will incorporate the application of mathematics, science and basic physics.

The primary strategies used in this *Guide* consist of brief instructor-led presentations integrated through a student (individual or group) project method. Instructors are encouraged to employ all other available strategies (e.g. field trips, community service, contracted work, etc.) that fit the situations and that do not take advantage of the students.

Important competencies[1]

that may be developed via
technology-based learning activities

A. Interpreting and assessing technology

A.01 Provide a definition of technology.
A.02 Explain how technology serves the needs and wants of societies.
A.03 Demonstrate how technology has changed over time by tracing the history of communication, production and/or energy utilization.
A.04 Explain how technology affects individuals in everyday life.
A.05 Explain how emerging technologies may impact careers.
A.06 State at least three reasons why it is important to become technologically literate.
A.07 Employ a technology assessment process to judge the desirability of a technology.
A.08 Provide examples of positive and negative, and intended and unintended consequences of technology.

B. Resources and constraints in technology

B.01 List and give examples of the resources (people, information, materials, tools and machines, energy, capital and time) employed by technological systems.
B.02 List and give examples of the technological systems.
B.03 Use a decision-making model to make rational technological decisions about resources and the use of technology.
B.04 Discuss why people must understand the uses and limitation of each resource in order to choose resources wisely.

1. *Note:* the exact competencies, number and level of performance will vary depending on the duration and scope of the learning activity and programmes. This *Guide* does not suggest that all competencies should be developed by any single experience.

C. Technological systems

C.01 Diagram and explain the systems model: inputs, processes, outputs, feedback and environment.
C.02 Apply the systems model to processing in communication, energy, manufacturing, construction and transportation technologies.
C.03 Explain how subsystems can be combined to operate a complex technological system.
C.04 Graphically describe open-loop and closed-loop systems.
C.05 Develop a technical vocabulary that will aid in the understanding of technology.

D. Technology, mechanization and automation

D.01 Describe social and environmental impacts that can occur in a technological system.
D.02 Analyse a local, national or a global technological issue related to mechanization/automation, determine options and discuss the consequences of potential decisions.
D.03 Anticipate the consequences of emerging technologies using futuring techniques (e.g. Delphi, trend analysis).

E. Visual communication

E.01 Define visual communication and describe its process.
E.02 Analyse example communication systems using a systems model and generate a graphic representation of it.
E.03 Plan and communicate a message using graphic means.
E.04 Describe locally employed graphic image generation and reproduction processes.
E.05 Solve practical problems in visual communication.

F. Electronic communication

F.01 Define an electronic communication system and describe its process.
F.02 Analyse example electronic communication systems using a systems model and generate a graphic representation of it.
F.03 Plan and communicate a message using electronic means.
F.04 Describe how messages are distributed electronically.
F.05 Evaluate the effectiveness and impact of an electronic message.

G. Material processing and production technology

G.01 Define and differentiate material processing, production, manufacturing and construction.
G.02 List and give examples of four ways of processing materials.
G.03 List and describe forming processes.
G.04 List and describe separating processes.
G.05 List and describe combining processes.
G.06 List and describe conditioning processes.
G.07 Employ forming, separating, combining and conditioning processes to produce a locally useful product.
G.08 Trace constructed or manufactured products from raw materials to finished products using a systems diagram.
G.09 Describe the characteristics and properties of families of materials (metals, plastics, woods, ceramics, lumber, concrete, steel, etc.) used in production.
G.10 Specify materials, determine cost, complete a bill of materials and carry out a plan of procedure for a production problem.

H. Energy, power and transportation

H.01 Define and differentiate energy, power, instrumentation, control and transportation.
H.02 Differentiate between kinetic and potential energy.
H.03 List the main sources of energy: chemical, solar, fossil fuels, nuclear, thermal and mechanical.
H.04 Describe energy conversion processes from a systems approach.
H.05 Describe how alternative forms of energy may be used in the future.
H.06 Explain how electrical motors operate.
H.07 Explain how transformers operate.
H.08 Explain how engines convert energy into mechanical force and motion.
H.09 Define the function of a transmission, and list five types (mechanical, hydraulic, pneumatic, electrical and magnetic).
H.10 Explain the methods for making transportation systems more efficient.

Overview of the *Guide*

It is recommended that the *Guide* be used as a full year-long course. However, it would be possible to teach a significant portion of the course in a half-year version. This chapter provides an overview of the sequence and suggested time allocations for both a full-year course and a one-semester course focusing on technology. This course should help students to understand better the resources, processes, applications and impacts of technology. Students will explore the systems commonly used in communication, manufacturing, construction, energy and power.

Implementation

Activities are specifically designed to be implemented with a minimum of equipment purchases, since the intent is to teach about technology using what is found in the students' local context. Creative planning by the teacher, visits to local enterprises where ideas abound, imaginative use of available text materials and contact with local, state, national and international agencies will yield a wealth of possibilities for teaching and learning about technology.

Teachers are responsible for the planning and delivering of units of instruction at the local level. They are encouraged to adapt the sample units of instruction contained in this *Guide*. Teachers are, however, encouraged to retain key elements of the format of each instructional unit including: objectives, enabling objectives, learning activities, testing and evaluation activities, instructional materials and estimated instructional hours.

It is suggested that, at the local level, units be divided and expanded into appropriate daily lesson plans to provide instruction and activities that encourage the development of the related competencies. Daily lesson plans should include specific enabling objectives selected for a given topic. The following structure is suggested for developing instructional units:

1. Title page (identifies the 'who, what, why, when and where' of the instructional unit).
2. Acknowledgements (identify those who helped in preparing the instructional unit).
3. Introduction (the purpose of the instructional unit).
4. Description of the instructional unit and identification of the target student population.
5. Relationships to other courses and instructional units (prerequisite, successor, collateral).
6. List of competencies/objectives to be developed by the instructional unit.
7. Safety and administrative procedures.
8. Instructional unit content outline.
9. Supporting instructional materials.
10. Assessment procedures.

Scope and sequence

The following represents one possible content outline for a technology education course. Depending on local interests and resources many other appropriate outlines could also be employed to develop a fundamental understanding and capability of technology.

Suggested instructional units	*Possible activities*
Unit 1. What is technology? Technological systems Technological resources and constraints	Careers in technology Work habits Historical technology study Problem-solving/design Brainstorming Technology assessment Technological futuring Systems analysis and synthesis
Unit 2. Communication and information technology Visual communication Electronic communication	Photography/pinhole camera Building a radio receiver Drafting/sketching Silk-screen printing Newspaper
Unit 3. Materials and processing technology Manufacturing Construction Foods, textiles and agriculture	Truss structures/bridges Adobe construction Testing water (chemical technology) Weaving Casting metal Dyeing textiles Making paper Food processing – jelly Preserving food Recycling Beating a metal bowl Pouring concrete
Unit 4. Energy and power technology Energy conversion Power transmission Applications of energy and power technology Transportation Production Communication Comfort	Model steamboat Model railroad Methane gas Stove technology Electrical circuits Water pump Paper aeroplane/gliders/kites Windmill Motor generator Electric motors Wind speed and weather indicator Water wheel Solar heating Parabolic oven Model aeroplane engines Mechanical power transmission Hydraulic circuits Bicycle maintenance

The learning activities listed within each unit guide sheet are divided into student and instructor activities. These listings are activities stated in broad, general terms and should be considered guidelines or suggestion to help instructors develop activities for their individual classroom environment.

UNIT 1. What is technology?

Competencies (see pages 10•12): A, B, C, D

Enabling objectives (Code: K = Knowledge, S = Skill, A = Attitude)

K-1 Apply criteria when deciding if something is an example of technology.
K-2 Identify tools, devices and methods in selected technological systems.
K-3 Understand timelines connected to human progress.
K-4 Describe specific jobs that have been created or made obsolete by emerging technologies.
K-5 Describe an educational programme appropriate to the requirements for a job such as technician, engineer or technology education teacher.
K-6 Define transferable skills.
K-7 Identify the transferable skills that might be necessary for continued employment.
S-8 Research and record data through use of charts, graphs and drawings.
S-9 Use materials, tools, instruments, equipment and procedures safely in an instructional setting.
S-10 Prepare evolutionary timelines, models or demonstrations.
S-11 Use materials, tools, instruments, equipment and procedures safely in a laboratory.
S-12 Demonstrate research skills.
A-13 Recognize the need for making wise decisions regarding technology.
A-14 Recognize that they must correctly use technology to benefit from its use.
A-15 Recognize how complex our world is and how technology can affect us positively and negatively.
A-16 Demonstrate a co-operative reaction to authority.
A-17 Display leadership in a student group.
A-18 Contribute to a group by being responsible.
A-l9 Display initiative in solving practical problems.
A-20 Demonstrate effort, both physically and mentally, in accomplishing a task in a safe manner.

Instructional and learning activities

Instructor	*Student*
A. Describe the historic development of technology. B. Show appropriate audiovisuals as available. C. Demonstrate how technological models are planned, researched and built. D. Demonstrate the safe use of tools and equipment. E. Supervise and evaluate student activities.	A. Read appropriate sections of instructor- or self-identified text materials. B. Listen, take notes and maintain a notebook which includes notes, information sheets and assignment sheets. C. Participate in class discussions. D. Investigate an early technological device, then build a three-dimensional model, write a report on the device and present the findings to the class. E. Develop a timeline of technological innovations. F. Study safety rules, and complete any necessary safety tests. G. Develop a technical timeline. H. Interview employers to describe desired work habits.

UNIT 2. Communication and information technology

Competence: E

Enabling objectives (Code: K = Knowledge, S = Skill, A = Attitude)

Topic 1: Communications • introduction

K-1 Identifies and describes some common resources used for effective communication.
K-2 Describes and utilizes techniques and processes used in communication.
K-3 Compares and contrasts the application of various types of communication in the industrial technologies of power and energy utilization and production.
K-5 Analyses the negative and positive impacts of communication on society and the environment.
K-6 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-7 Research and record data through use of charts, graphs and drawings.
A-8 Recognize the need for making wise decisions regarding technology.

Topic 2: Design and drafting

K-1 Identifies and describes the resources used for effective design and drafting.
K-2 Describes and utilizes design techniques and technical processes to convey a message with the use of drafting.
K-3 Compares and contrasts the applications of design and drafting in the industrial technologies of energy and power utilization, production and communication.
K-4 Analyses the negative and positive impacts of design on the environment and society.
K-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
K-6 Research and record data through use of charts, graphs and drawings.
S-7 Utilizes design techniques and technical processes to convey a message with the use of drafting.
A-8 Recognize the need for making wise decisions regarding technology.

Topic 3: Broadcasting unit (function, operation and use of graphics)

K-1 Identifies and describes the resources utilized for effective television and radio broadcasting communication.
K-2 Describes and utilizes graphic and electronic broadcasting techniques and technical processes to convey a message via television and/or radio media.
K-3 Compares and contrasts the applications for broadcasting media in the industrial technologies of energy and power utilization and production.
K-4 Analyses the negative and positive impacts of broadcasting communication on society and the environment.
K-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
K-6 Research and record data through use of charts, graphs and drawings.
S-7 Utilizes graphic and electronic broadcasting techniques and technical processes to convey a message via television and/or radio media.
A-8 Recognize the need for making wise decisions regarding technology.

Topic 4: Computers in communication (transmission, manipulation)

K-1 Identifies and describes the resources used for effective communication with a computer.
K-2 Describes and utilizes technical processes to communicate with computer and software.
K-3 Compares and contrasts the applications of computers in the industrial technologies of energy and power utilization and production.
K-4 Analyses the positive and negative impacts that computers have on society.
K-5 Research and record data through use of charts, graphs and drawings.
S-6 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
A-7 Recognize the need for making wise decisions regarding technology.

Topic 5: Photography

K-1 Identifies and describes the resources used for effective photographic communication.
K-2 Describes photographic techniques and technical processes to convey a message with the use of photography.
K-3 Compares and contrasts the application of photography in the industrial technologies of energy and power utilization, production and communication.
K-5 Analyses the negative and positive impacts of photographic communication on the environment and society.
S-6 Use periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-7 Utilizes photographic techniques and technical processes to convey a message with the use of photography.

Topic 6: Graphic arts (printing processes)

K-1 Identifies and describes the resources utilized for effective communication through graphic arts processes.
K-2 Describes technical processes used in graphic arts technology.
K-3 Compares and contrasts the industrial applications of graphic arts technology.
K-4 Analyses the positive and negative impacts of graphic arts on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-6 Utilizes technical processes used in graphic arts technology.

Topic 7: Telecommunications (telephones, satellites, fibre optics)

K-1 Identifies resources and recent developments in telecommunication.
K-2 Describes and utilizes techniques and technical processes used in telecommunication.
K-3 Compares and contrasts the application of telecommunication in the industrial technologies of energy and power utilization, production and communication.
K-4 Analyses the negative and positive impacts of telecommunication on the environment and society.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Instructional and learning activities

Instructor	*Student*
A. Identify locally available reading and other reference materials that pertain to communication technology B. Demonstrate the making of a pin-hole camera C. Demonstrate development of black-and-white film D. Critique and strengthen student generated articles E. Show basic sketching techniques F. Demonstrate same (alcohol-based) reproduction G. Take students on field trip to a local print shop H. Demonstrate silk-screen printing of a poster or T-shirt I. Show rigging of an antenna and demonstrate radio reception J. Deliver lesson on essential points required to document a radio station	A. Read appropriate sections of instructor- or self-identified text materials. B. Make and use a pin-hole camera C. Collect ideas, develop stories and write articles for a local newspaper D. Sketch a product to be made for the local setting E. Create a scaled and 3-dimensional drawing of a product to be made. F. Use a crystal or other radio receiver to receive and document many different stations. G. Systems analyse an electronic communication device, e.g. television set, radio receiver, short-wave radio, etc. H. Use locally available reproduction processes to make multiple copies of a poster or newspaper. I. Create a design for a silk-screened T-shirt.

UNIT 3. Materials and processing technology

Competence: G

Enabling objectives (Code: K = Knowledge, S = Skill, A = Attitude)

K-1 Apply criteria in deciding if something is an example of technology.
K-2 Research and record data through use of charts, graphs and drawings.
A-3 Recognize the need for making wise decisions regarding technology.

Topic 1: Manufacturing and construction · introduction to production

K-1 Identifies and describes the basic resources utilized for effective construction or production.
K-2 Describes basic production techniques and technical processes to produce or construct a product.
K-3 Compares and contrasts the applications of production with the industrial technologies of power and energy utilization and communication.
K-4 Analyses the positive and negative impacts of production on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on the impact of production.
S-6 Utilizes basic production techniques and technical processes to produce or construct a product.

Topic 2: Manufacturing and construction • materials and processes

K-1 Identifies and describes the resources utilized for effective material processing.
K-2 Describes different materials and processes to construct or manufacture products.
K-3 Compares and contrasts the application of materials and processes in the industrial technologies of power and energy, communication and production.
K-4 Analyses the positive and negative impacts of materials and processes on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-2 Utilizes different materials and processes to construct or manufacture products.

Topic 3: Manufacturing and construction • research and development

K-1 Identifies and describes the resources needed for effective research and development of construction or manufactured products and processes.
K-2 Describes research and development processes to research, select and develop products and processes.
K-3 Compares and contrasts application of research and development in the industrial technologies of power and energy utilization, production and communication.
K-4 Analyses positive and negative impacts of research and development on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve information about concepts being studied.
S-6 Utilizes research and development processes to research, select and develop products and processes.

Topic 4: Manufacturing and construction • production

K-1 Identifies, describes and utilizes resources necessary for effective manufacturing or construction of products.
K-2 Describes production and construction techniques, methods and processes to manufacture and/or construct a product.
K-3 Compares and contrasts the application of production and construction technology in the industrial technologies of power and energy utilization, production and communication.
K-4 Analyses positive and negative impacts of production on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information about concepts studied.
S-6 Utilizes production and construction techniques, methods and processes to manufacture and/or construct a product.

Topic 5: Manufacturing and construction • marketing

K-1 Identifies and describes the resources utilized for effective marketing of manufacturing and construction products.
K-2 Describes and utilizes marketing techniques and processes to effectively market the construction project or manufactured goods.
K-3 Compares and contrasts the application of marketing in the industrial technologies of power and energy utilization, production and communication.
K-4 Analyses positive and negative impacts of marketing on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information about concepts being studied.

Topic 6: Manufacturing and construction • servicing of products

K-1 Identifies and describes the resources utilized for effective servicing.
K-2 Describes servicing techniques and technical processes to service manufactured or construction products.
K-3 Compares and contrasts the applications of servicing in the industrial technologies of power and energy utilization, production and communication.

K-4 Analyses the positive and negative impacts of servicing on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-6 Utilizes servicing techniques and technical processes to service manufactured or construction products.

Instructional and learning activities

Instructor	*Student*
A. Identify locally available reading assignments relevant to production technology. B. Demonstrate processes for assessing the characteristics of materials, e.g. strength, hardness, moisture content, size, density, etc. C. Demonstrating locally appropriate forms of separating, combining, forming and conditioning. D. Show how clay is prepared and used employing hand forming and throwing techniques. E. Demonstrate wood cutting, and shaping processes using hand tools F. Demonstrate material joining processes, e.g. gluing, mechanical fastening, joinery, etc. G. Take students on a field trip to a local construction site and highlight the processes employed. H. Disassemble a product to show students how it was made. I. Work with the students and environmental critics to analyse the impact of a technological advance. J. Design jigs and fixtures to enable students to effectively mass produce a locally needed item. K. Prepare a mould and demonstrate the mixing and pouring of concrete. L. Mix and form adobe.	A. Read appropriate sections of instructor- or self-identified text materials. B. Define material processing, production, manufacturing and construction. C. List and give examples of four ways of processing materials. D. List and describe forming processes. E. List and describe separating processes. F. List and describe combining processes. G. List and describe conditioning processes. H. Employ forming, separating, combining and conditioning processes to produce a locally useful product. I. Trace constructed or manufactured products from raw material to finished product using a systems diagram. J. Describe the characteristics and properties of families of materials (metals, plastics, woods, ceramics, lumber, concrete, steel, etc.) used in production. K. Specify materials, determine cost, complete a bill of materials and carry out a plan of procedure for a production problem.

UNIT 4. Energy and power technology

Competence: H

Enabling objectives (Code: K = Knowledge, S = Skill, A = Attitude)

K-1 Apply criteria in deciding if something is an example of technology.
S- 8 Research and record data through use of charts, graphs and drawings.
A-13 Recognize the need for making wise decisions regarding technology.

Topic 1: Energy and power • introduction to energy

K-1 Identifies and describes the major depletable, non-depletable and renewable energy resources currently in use or being researched in the United States.
K-2 Describes the concept of conservation of energy and how the process is applied to the conversion and storing of energy resources.
K-3 Discusses several applications of the effective use of energy in the United States and identifies the energy related industries and/or services in the local community.
K-4 Identifies several instances where the effective (or non-effective) use of energy resources has been made and discusses the impact of these on the present and the future.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Topic 2: Energy conversion (electronics orientation)

K-1 Identifies the major fuels which are used as resources in the energy conversion process.
K-2 Describes the operation of several of the major types of motors and engines which are used in the process to convert one energy form to another in order to produce usable work.
K-3 Identifies and describes several instances in today's world where energy conversion is applied to produce goods and services and transport them to places where they are needed.
K-4 Identifies and describes by-products of the energy conversion process which have a positive or negative impact on our lives or society as a whole.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Topic 3: Alternate energy unit (solar, wind, water, fossil fuels, nuclear)

K-1 Describes how and where alternate energy resources exist and what it takes to make energy sources feasible for the generation of electricity.
K-2 Describes each of the processes by which alternate energy sources are extracted, refined, transported and converted into other forms for home use and energy.
K-3 Describes and demonstrates applications of use and production of electricity in the home, school and industry.
K-4 Describes the impact that alternate energy sources have on present and future societies.
K-5 Use periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Topic 4: Energy conservation (consumer, career awareness)

K-1 Identifies energy resources which will be conserved in order to ensure adequate supplies in the future.
K-2 Identifies the various places where energy may be conserved and describes the process which might be utilized to extend valuable energy supplies.
K-3 Identifies several major energy users in the home and industry, and describes how the application of energy conservation techniques can make them more effective.
K-4 Describes how energy conservation techniques can impact the future of society and life as we know it at present.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Topic 5: Introduction to power

K-1 Identifies and describes the resources used to transport people and goods.
K-2 Describes technical processes related to power technology.
K-3 Compares and contrasts the application of power technology in the industrial technologies of energy utilization, manufacturing, construction and communication.

K-4 Analyses the positive and negative impacts of power technology on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.
S-6 Describes and utilizes technical processes related to power technology.

Topic 6: Power transportation (material)

K-1 Identifies and describes the resources used in power transportation systems.
K-2 Describes the respective guidance, propulsion and control processes related to various power transportation systems.
K-3 Compares and contrasts the application, uses and contributions of power transportation systems to the industrial technologies of communication, energy utilization, manufacturing and construction.
K-4 Analyses the positive and negative impacts of various power transportation systems on society and the environment.
S-5 Uses periodical indexes, computer databases (where available) to retrieve current information on concepts being studied.

Instructional and learning activities

Instructor	*Student*
A. Identify and assign locally available readings relevant to energy, power, instrumentation and control. B. Take students on a field trip to a power producing power plant. C. Show students how to perform an energy systems analysis of a major industry in the region. D. Demonstrate how to disassemble and assemble an engine. E. Deliver lesson on systems analysis. F. Show students how to work safely with electricity. G. Demonstrate the proper use of mechanics' tools. H. Deliver lesson demonstrating the conservation of energy. I. Explain basic simple machines and calculate mechanical advantage. J. Use a hydraulic brake system to demonstrate fluid power.	A. Read appropriate sections of instructor- or self-identified text materials. B. Identify and document examples of renewable energy available in your area. C. Sketch ideas for energy conservation in your locality. D. Prepare a systems analysis of a major energy use in your town. E. Build a solar or wind power collector. F. Disassemble and reassemble a gasoline engine and identify each part and its function. G. Compare the energy efficiency of various transportation mechanisms. H. Build a model electric motor and explain its operations. I. Wire series and parallel circuits for control and operation of standard electrical devices. J. Make a payload carrying glider.

Suggested instructional unit format

The following outlines a suggested format for teachers to use when preparing their own, locally adapted plans for teaching technology education. This structure incorporates many of the principles employed by effective teachers from around the world.

Instructor component of instructional unit

Technology activity module: No. / Title	Self-explanatory
Activity objective	A list of the key objectives to be addressed by the students
Module instructions	Guidelines to the instructor in each area listed:
Introduction	An overview of the instructional unit's activities.
Key content highlights	Highlighting of special, not routine, safety considerations required by this activity.
Materials required	A list of necessary and useful materials needed to teach this instructional unit. (*Note:* student materials are included in this list; they are repeated in the student component of the instructional unit.)
Supplies	Consumable and instructional materials needed for this Instructional unit
Equipment	Tools, machines and equipment needed to teach this instructional unit. (*Note:* the listed items are usually not the only ones with which this instructional unit can be taught; often inventive instructors can substitute other items to make do with what they have.)
Instructional resources	Books, hand-outs, and other resource materials needed by the instructor to teach the instructional unit
Management / Logistics	Generally some guidelines about the mechanics of organizing this instructional unit
Related instructional units	A listing of other instructional units that develop necessary/useful pre-requisite skills and understanding as well as those for which this instructional unit is a prerequisite.
Evaluation / Grading	Suggestions for the assessment and grading of student work done as a result of this instructional unit. Will include ideas for student self-evaluation and progress checks.
Suggested schedule / Time	Anticipated timelines. Note that given varying student and facility characteristics, these timelines are tentative at best, but they serve to communicate what the developers envisioned.
Key instructional suggestions	General hints and suggestions for the actual teaching associated with student work towards this instructional unit's objectives.
Safety	Specific recommendations for teaching and testing the safety competencies associated with this Instructional unit
Motivation	Ideas for increasing student interest in this Instructional unit
Prerequisite information	Suggestions for ensuring that students have the prerequisite understandings and skills for successful work in this instructional unit
Demonstration	Listing of key activities to be demonstrated to students
Attitudes	Suggestions for development of course and instructional unit-targeted attitudes.
Summary and review	Hints for reviewing and synthesizing the outcomes of this instructional unit.
Glossary	Key terms and definitions used in this Instructional unit.

Student component of instructional unit

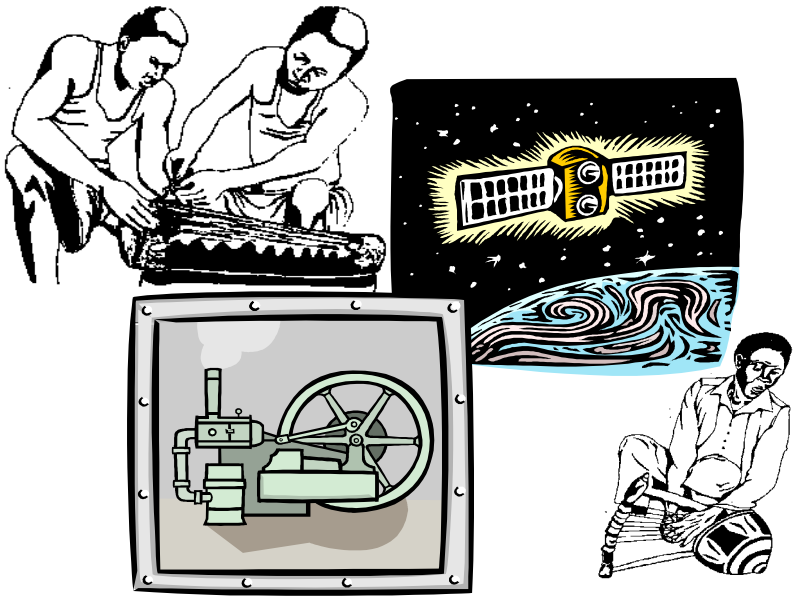
Technology activity module: No. / Title	Self-explanatory.
Module overview	Sets the stage for this instructional unit in student terms.
Objectives	Develops student interest in this instructional unit. Tells what and why and if useful, how.
Importance	Explains the link of this instructional unit to the indigenous technology it involves
Key information	Presents or directs the student to the information necessary to master this instructional unit
Class presentations and demonstrations	Outlines key information presented by the instructor and highlights key demonstrations to be given by the instructor.
Safety	Summarizes key safety considerations necessary for safe work in this instructional unit
Student activity	Overviews and explains important things students will do to develop their key knowledge and understanding. Typically this includes learning activities, homework, reading, etc.
Materials required	A listing of materials needed by the student (or each group) for completing the work called for by this instructional unit. If the Instructional unit includes multiple activities, separate lists are provided for each activity.
Supplies	Lists the consumable materials and other supplies needed to complete the work called for by this instructional unit
Tools and equipment	Lists the equipment/machines/tools needed to complete the work called for by this Instructional unit
Hand-outs / Instructional resources	Lists the hand-outs and other instructional resources needed to complete the work called for by this instructional unit
Activity sequence	This section gives students a detailed check-list of steps to follow in completing the work called for by this instructional unit. Typically, it follows the sequence shown below: (a) instructor start-up and specific instructions; (b) pre-assessment (if any); (c) plan of procedure; and (d) post-assessment.
	Includes detailed steps of procedure to accomplish each separate activity, instructions for when to call for instructor approval before moving on to the next step, when to use the self-checks, etc.
	Instructions for the final assessment
Summary	A structured plan to help students review what they have accomplished in this instructional unit

Unit 1

What is technology?

Module 1
Technological systems

Instructor guide



Activity objective

The purpose of this activity is to help students begin to understand the nature of technology and its systems.

Module instructions

Introduction

All technology involves systems. Systems take a variety of inputs and process them in some way, usually by an interaction of subsystems, and then they generate a set of outputs • some of which are desired and some of which are unwanted by-products. All of this occurs within a context or environment. At various points during the process • and at the end of the process • effective systems use feedback and assessment systems to generate information about how well the purpose for which the system was designed is being achieved.

Key content highlights

What is technology? Simply put, technology is the extension of our human capability, in order to satisfy our needs or wants.

Technology involves systems, sometimes very simple ones, and at other times very complex ones, and everything else in between.

Systems are human-developed organizations of subsystems and/or components that interact to achieve a goal. Systems use feedback to better achieve their goal(s).

Systems are hierarchical. They exist in the context of supra-systems which can also be considered to form the system environment.

Systems consist of subsystems and/or components that work together to achieve the system's goal.

Materials required

Supplies
Graph paper, pencils.

Equipment
None.

Instructional resources
Any technology textbook available, such as: J. Gradwell and M. Welch, *Technology: Shaping our World*, South Holland, Ill., Goodheart-Willcox, 1991; also examples of technological systems found in the school or neighbourhood.

Management / Logistics

Related Instructional units:
Technology Activity Module (TAM) 2: 'Technology Resources and Constraints'

Evaluation / Grading
Assess the thoroughness with which students identify all the essential aspects of the system (as given in the instructor's lesson) and their ability to identify examples of technology, both simple and complex • and in particular indigenous examples from the students' daily life.

Suggested schedule / Time
One class period for the instructor lesson followed by two periods of student practice and discussion in identifying and analysing technological systems. Allow students a day for a homework assignment in identifying technological systems from their home life.

Key instructional suggestions

Safety
When observing real systems, students should wear appropriate clothes, protection and maintain a safe distance.

Motivation
Help students understand the importance of technology and systems in terms of their enhanced ability to understand the world around them, and perhaps even for employment, comfort and recreation. This lesson will enhance the students' ability to learn unfamiliar technology and apply it to their lives.

Prerequisite information
None.

Demonstrations
Identify examples of technology in the students' experience.
Identify and analyse examples of systems in the students' experience.
Analyse a cooking stove and an automobile as examples of a system.

Attitudes
Importance of being thorough (not overlooking something).
Importance of being neat when sketching.

Summary and review
Technology extends human capability. Technology is used to serve human needs or wants. All technologies involve systems. Systems are developed to address a goal and consist of subsystems that work together. Feedback is used to control a system. Systems operate in environments.

Glossary

Component	A part of a larger system, often considered to be a part of a subsystem.
Environment	The context that houses a system. Also called the supra-system.
Feedback	Some information, signal or measure that tells a person, system or subsystem how well the goal is being achieved, or how well the process is working.
Goal	The reason for which the system or process was developed. The desired result.
Hierarchy	A relationship based on something. For example, size: a supra-system consists of one or more systems. Each of these systems consists of one or more subsystems. Each of these subsystems contain one or more components, etc.
Inputs	Resources available to the system or subsystem.
Outputs	Products or forces that are generated by systems or subsystems.
Resources	Any energy, material, information or person available to a system or subsystem.
Subsystem	A smaller system that acts as a component of a larger system.
Supra-system	The larger system or environment that houses a specific system.
System	Human developed organizations of subsystems and/or components that interact to achieve a goal.
Technology	Technology is the extension of our human capability in order to satisfy our needs or wants.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 1
Technological systems

Post-test

Instructions: *Work by yourself, and without using any notes, books or help, answer each question carefully*.

Sketch a diagram that shows at least five of the major systems of an automobile engine.

Using your own words, define the following terms as in your instructor's lesson:

Technology _____

System _____

Environment _____

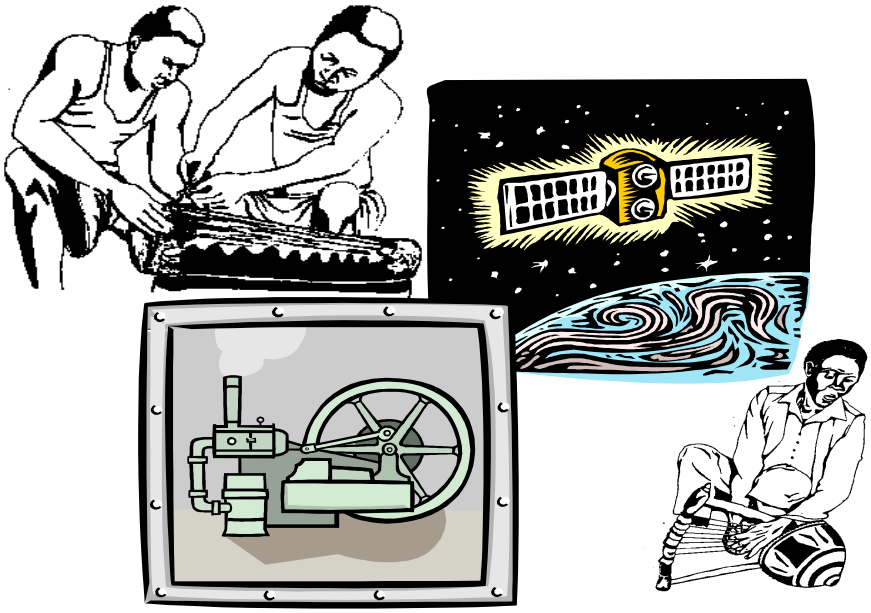
Subsystem _____

Goal _____

Feedback _____

Module 1
Technological systems

Student guide



Module overview

All technology involves systems. Systems take a variety of inputs and process them in some way, usually by an interaction of subsystems, and then they generate a set of outputs • some of which are desired and some of which are unwanted by-products. All of this occurs within a context or environment. At various points during the process • and at the end of the process • effective systems use feedback and assessment systems to generate information about how well the purpose for which the system was designed is being achieved.

Objectives

This activity will give you some practice in identifying and analysing systems that people use for technology. Typically, this involves processing of materials, communicating or converting energy and power.

Importance

Everything we do requires the use of technological systems. This happens when we play, study, work • or even at home. Think about things you want to do. Does that not require using systems? For example, systems to transport you from here to there such as a car. Or perhaps systems to entertain you, for example radio or television, or musical instruments. Or perhaps

even material processing systems such as agriculture, food preservation and preparation; or construction systems that produce homes and bridges; or even the systems that employ us in our factories.

Key information

Class presentations and demonstrations
Overview of technology.
Technology systems.
Technology systems analysis.

Safety
When your instructor assigns the systems analysis activity, be careful not to endanger yourself as you work to identify the system components. Always do an analysis of system inputs and outputs to learn what goes into a system and thereby get some sense of how much potential energy there exists that might possibly hurt you.

Student activity
Before beginning work on these activities it is recommended that you read: Gradwell and Welch's book entitled *Technology: Shaping our World*, op. cit., in particular the early chapters that outline what technology is, and how to conduct a systems analysis.

Materials required

Supplies
Graph paper, pencil.

Hand-outs / Instructional resources
J. Gradwell and M. Welch, *Technology: Shaping our World*, South Holland, Ill., Goodheart-Willcox, 1991.

Activity sequence

1. Participate in your instructor's start-up activities and presentation for this module. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
2. Do Activity 1: Generate a list of simple and more complicated examples of technology.
3. Do Activity 2: Generate a systems analysis of a technological system and sketch the system.
4. Review and summarize what you have learned.
5. Complete the post-assessment procedure.

Activity 1: Generate a list of simple and more complicated examples of technology

Generate a list of simple and more complicated examples of technology. Try to find at least one example from each of the following areas of human activity:

Human activity area	*Simple example*	*Complex example*
Food		
Clothing		
Work		
Play		
School		
Government		
Family		

Pick any two of these systems and identify the goal for which that system was developed.

Activity 2: Develop a systems analysis of a technological system

Working in groups of from two to four students, generate a systems analysis of any of the systems you identified in Activity 1, or any of the examples given below:

A construction system such as a road building or paving machine.
A manufacturing system such as a foundry or factory.
A communication system such as a radio or television or telephone.
A food processing system such as a stove.
A transportation system such as a bicycle.
An energy conversion system such as a windmill, a generator or an automobile engine.

This systems analysis is to include:

The name of the system

The purpose of the system

The inputs to the system

The system's outputs

The subsystems or components of the system _____

_____

The feedback used by the system _____

_____

The environment/context housing the system _____

_____

Then sketch a diagram that shows all of the items that you listed in the above section, and that also shows their relationships. Be sure to label each item.

For extra credit . . .

Activity 3: Develop a technology synthesis to design a system

Take any collection of system components and assemble them to make a new system.

1. Specify the goal for the technological system to be designed.
2. Sketch the overall configuration of the system to be designed.
3. Graphically show the relationships of the subsystems to one another.
4. Describe how the system you designed should work.
5. Evaluate whether the system you designed is likely to achieve the goal or design specifications stated in Step 1.

Technology Activity Module 1: Summary

Review and summary activities

Compare your system analysis to that of other students.
Ask them if they think you missed identifying any key components/subsystems of your system.
Is your system sketch clear to the other students?

Review questions • Check your comprehension!

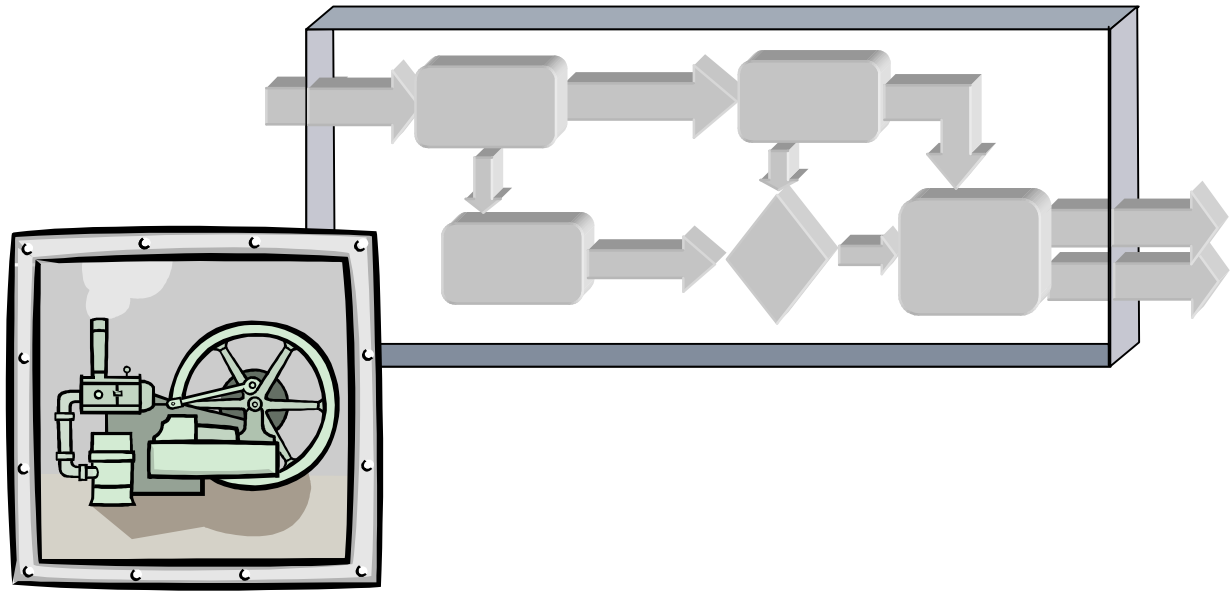
What occurs when humans want to solve a technological problem?
What affects the relationship between system components?
Why do we have technological systems?

Technology Activity Module 1: Post-assessment

1. Take the post-test that your instructor will give you.
2. Have the instructor evaluate your post-test and discuss any problems it identifies.
3. Correct your post-test.
4. If your results demonstrate mastery, go on to Technology Activity Module 2 or other activity assigned by your instructor. If you are less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 2
Technological resources and constraints

Instructor guide



Activity objective

The purpose of this activity is to help students begin to understand the fact that technological systems employ a variety of human, informational, material and energy resources to accomplish their purposes. Additionally, technological systems are constrained by various real and imagined forces and resource limitations. Finally, it is important for students to become aware that technological systems have intended and unintended outcomes, and that these usually have positive and negative dimensions.

Module instructions

Introduction

After establishing the nature of systems in Technology Activity Module 1 (TAM 1), the instructor now needs to help students evolve their thinking to focus on system inputs, outputs, resources and constraints. Things are just not as simple as TAM 1 presented.

Every system uses resources, some of which are apparent and others which may not be quite so obvious. Furthermore, all systems encounter constraints that ultimately affect their operations. Again, some of these constraints may be obvious, while others not at all so. The primary outcome of this module should be that students become able to carefully identify key system resources and constraints for technological systems.

Key content highlights

Technological systems all employ resources to accomplish their purpose. These resources can be people, information, material or energy. Often systems employ a combination of these. Subsystems also use such resources, often getting them from another subsystem.

The resources used by a system or subsystem are usually called inputs. The resources or products generated by a system or subsystem are usually called outputs. From this, it can be seen that the outputs of some systems or subsystems become the inputs of a subsequent system or subsystem.

All technological systems encounter constraints. Sometimes, for example, there is just not enough of a particular resource to be had, for example water during a drought or skilled people in times of rapid expansion. Energy, material and information could also be lacking.

Sometimes constraints are based on laws, or what might be deemed socially acceptable or unacceptable. For example, today, any form of discrimination favouring one race over another is considered unacceptable. Our societies impose constraints limiting pollution, energy use, work hours and many other things.

Systems may use resources that are material, energy or information in nature. Examples of these include, respectively, steel, electricity and knowledge. The resources used by a technological system may be obvious, such as gasoline fuel, an energy resource used by cars. Of course, systems may also use resources that are not at all obvious: for example, the car uses air as a material resource, but this is not readily apparent. If we were to consider the car and driver system moving down a road, another not immediately obvious resource is the knowledge of the driver as to what the road signs mean, and how to operate the particular vehicle he/she is driving.

Similarly, when thinking about technological systems, one must consider how the resources and systems operations are constrained or restricted. This occurs to all systems. Some of the constraints are physical (i.e. material or energy) and some are informational, i.e. social values, laws, attitudes, knowledge, etc. As with resources, some constraints are obvious and some are hidden or not obvious.

As students work on this module, it will be helpful to have them remember what they did and learned in Module 1 and then convert their understanding of a technological system into a graphic model. If they do not understand some parts of their model, that is normal; they should just represent these unknowns with a ‘black box’.

To understand technological systems, students must understand the nature of systems, and then technology’s resources, inputs, outputs and constraints.

Materials required

Supplies
Graph paper, pencils.

Equipment
Drafting equipment or software, if available.
Instructional resources
Any technology textbook available, such as: J. Gradwell and M. Welch, *Technology: Shaping our World*, South Holland, Ill., Goodheart-Willcox, 1991; also examples of technological systems found in the school or neighbourhood.

Management / Logistics

Related instructional units:
Technology Activity Module 1 (TAM 1): 'Technological Systems'.

Evaluation / Grading
Assess the thoroughness with which students identify the key inputs, outputs and resources of their systems. Assess their ability to identify example constraints affecting their selected technological system. Finally, be certain to assess each student's ability to identify and evaluate the positive and negative consequences of technology. This latter assessment should be given most weight in the grade for this TAM.

Suggested schedule / Time
The instructor could effectively let the students begin working on their activities right away and only then follow it with a summary lesson. One class period for the initial activity followed by one for the instructor's presentation will launch this TAM well. Then, two periods of student practice and discussion in identifying and analysing technological system constraints, and another for student activity on the consequences of technology. This TAM should be concluded by a final instructor day for a lesson summarizing system resources, constraints and, above all, emphasizing technology assessment in terms of positive and negative consequences of technology deployment. Allow students a day for a homework assignment in identifying technological systems from their home life.

Key instructional suggestions

Safety
When observing real systems, students should wear appropriate clothes, protection and maintain a safe distance.

Motivation
Help students understand the importance of resources to technology systems and of outputs to understanding the functioning of subsystems. Reinforce, again, the link between technological understanding and the students' ability to understand the world around them, and perhaps even for employment, comfort and recreation. This lesson will also enhance student ability to learn unfamiliar technology and apply it to their lives. Resource and constraint related understandings are generally very important to technological problem-solving/trouble-shooting.

Prerequisite information
Technology Activity Module 1 (TAM 1): 'Technological Systems'.

Demonstrations
Identify examples of technology in the students' experience.
Identify examples of technology systems and subsystem inputs (resources) and outputs, using examples from the students' experience.
Identify and analyse examples of system constraints from the students' experience.
Analyse various local examples of technological systems and highlight possible positive and negative consequences.
Identify, analyse and discuss examples of resources used by these systems.
Identify, analyse and discuss examples of constraints affecting these systems.

Reanalyse the cooking stove and automobile examples of systems generated by Module 1, and this time augment the analysis with lists and descriptions of both resources and constraints of these systems.

Attitudes

Importance of being thorough (not overlooking something).
Emphasize the importance of criticizing (i.e. not just blindly accepting) technology.
Importance of being neat when sketching.
Importance of consulting others – in particular experts.
Importance of reflection, i.e. making sense out of something oneself.

Summary and review

Technology extends human capability. Technology is used to serve human needs or wants. All technologies involve systems. Systems are developed to address a goal and consist of subsystems that work together. Feedback is used to control a system. Systems operate in environments.

Technology systems and subsystems employ resources as inputs. The outputs of technology systems and subsystems often become the inputs of downstream systems or subsystems. All technological systems face constraints that may be physical, real and/or social and legal. Some constraints are even imaginary.

All systems employ resources that can take the form of materials, energy and information. Resources may be obvious or not readily apparent. Resources are used by the overall system, yet each subsystem that makes up the overall system also makes individual use of some or all the resources. All systems and subsystems face constraints that also may be informational, material or energy in basis.

All technology must be assessed in terms of both its positive and negative consequences. Technologists must be careful to look for unintended consequences and not just focus on intended ones. Overall judgements about the impact of technology depend on the weighting of numerous criteria. Different weightings produce different judgements.

Glossary

Black box	An unknown portion of a system that, while we know it exists, we do not know its components. We do, however, know (or at least could speculate) the inputs and outputs to the black box.
Constraint	A restriction, lack of resource, or other factor that prevents a system from being as efficient or effective or as extensively deployed as might be desired.
Energy	The ability to do work.
Information	Data or knowledge about something. This is another resource.
Intended consequences	Outcomes that are envisioned or planned for. Typically the target goals for which the technological system was designed.
Laws	Formal actions passed by the legislative authority of a nation, region or locality.
Legal	Pertaining to laws and regulations.
Material	Any substance such as air, water, metal, non-metal, agricultural item, natural resource and the like.
Regulations	Formal interpretations of a law by administrators. Usually regulations add detail to the laws, but must operate with the intent of the law. Some regulations are also established by international and/or national standards setting groups.
Resources	Any energy, material, information or person available to a system or subsystem.
Social	Having to do with groups of people: for example, how they interact, their laws and regulations, etc.
Society	A group of people acting together
Unintended consequences	Outcomes that are not envisioned or planned for. Typically these are the by-products of the main technology, or are social in nature.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 2
Technological resources and constraints

Post-test 1

Instructions: *Fill in the blanks of the form below by working independently and without using books or notes.*

Provide a definition and an example of each of the following for the electrical system that supplies your home.

Term/concept	*Definition*	*Example*
Constraint		
Society		
Energy		
Material		
Information		
Intended consequences		
Unintended consequences		

As a take-home test question, write a one-page paper describing the positive and negative, intended and unintended consequences of a technology used by one of your family in their work.

Post-test 2

Instructions: *Write in the answer to each question:*

1. Define what resources are in the context of technological systems.

2. Name a technological system, and then give some examples of obvious resources required by that system.

3. Identify at least one non-obvious resource for the system you named in Question 2.

4. Define what a constraint is in the context of a technological system.

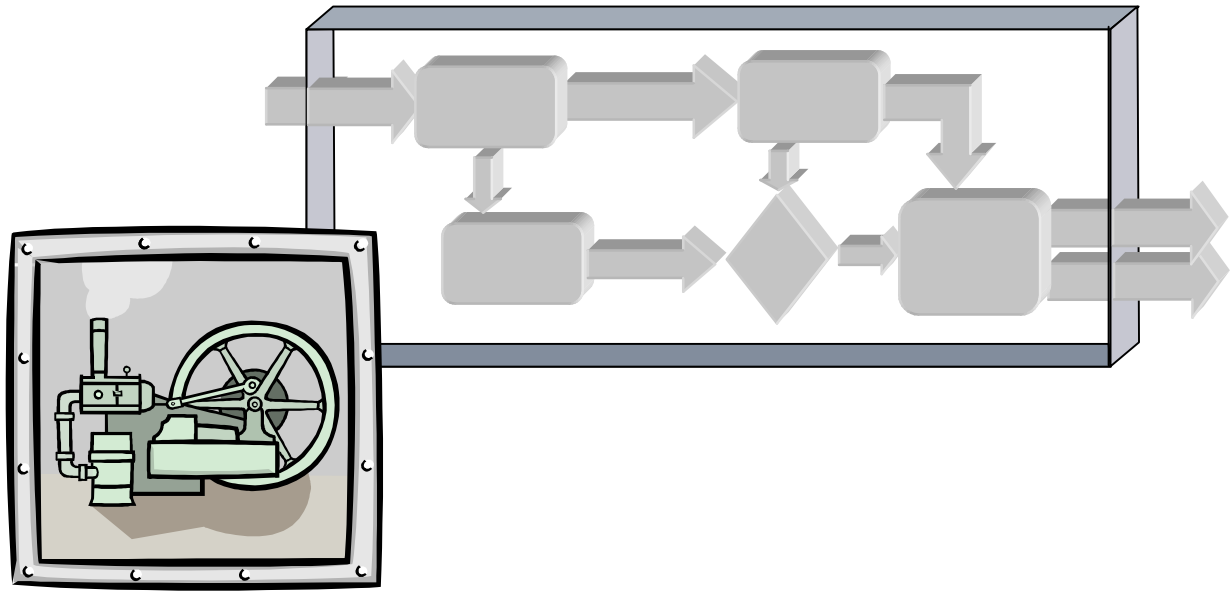
5. Give an example of a technological system's
   a. Material constraint:
   b. Energy constraint:
   c. Information constraint:
   d. Social constraint:

6. On a sheet of graph paper, draw a systems model of a technological system that involves at least three subsystems, and
   a. Identify on the drawing each resource needed by the overall system:
   b. Identify the constraints faced by that overall system:

7. For each subsystem on your drawing
   a. Show on the drawing each resource needed by each subsystem:
   b. Identify the constraints faced by each subsystem:

Module 2
Technological resources and constraints

Student guide



Module overview

Building on TAM 1's introduction of the system's nature of technology, this new module will extend your understanding of technology with three important ideas: (a) all technology systems and subsystems have inputs and outputs, and these are the resources and products of the system; (b) all technological systems face constraints of one kind or another; and (c) all technological systems have intended and unintended outcomes that are both positive and negative.

Every system uses resources, some of which are apparent, and others which may not be quite so obvious. Furthermore, all systems encounter constraints that ultimately affect their operations. Again, some of these constraints may be obvious while others not at all so. The primary outcome of this module should be that students become able to carefully identify key system resources and constraints for technological systems.

Systems may use resources that are material, energy or information in nature. Examples of these include, respectively, steel, electricity and knowledge. The resources used by a technological system may be obvious, such as gasoline fuel, an energy resource used by cars. Of course, systems may also use resources that are not at all obvious: for example the car uses air as a material resource, but this is not readily apparent. If we were to consider the car and driver system moving down a road, another not immediately obvious resource is the

knowledge of the driver as to what the road signs mean and how to operate the particular vehicle he/she is driving.

Similarly, when thinking about technological systems, one must consider how the resources and systems operations are constrained or restricted. This occurs to all systems. Some of the constraints are physical (i.e. material or energy) and some are informational, i.e. social values, laws, attitudes, knowledge, etc. As with resources, some constraints are obvious, and some are hidden or not obvious.

As students work on this module, it will be helpful to have them remember what they did and learned in Module 1 and then convert their understanding of a technological system into a graphic model. If they do not understand some parts of their model, that is normal; they should just represent these unknowns with a 'black box'.

Objectives

This module will teach you two very important concepts about technological systems. The first is about what resources are, and how to think about them. The second is what technological system constraints are, and how to use them in increasing your understanding of such systems.

This activity will introduce some very important ideas needed to fully understand technology. You will learn to identify the inputs and outputs of technological systems and subsystems. Then you will explore the concept of constraints and how they affect what you can do with technology. Finally, you will begin developing the most important of all technological skills, namely that of assessing technology.

Importance

Knowing about technology's systems is not enough to understand it; in no way is this sufficient. All systems have to use inputs, otherwise where would they get the energy needed to operate, and the material needed to make their products? Without information inputs, how would they know what to do? Even more important, almost all systems require people in some way.

All systems require some form of control, some way of keeping the system from going wrong. These things do not just happen. They must be engineered into a system. Furthermore, from your own experience, you will already have seen that technology's impacts can be both positive and negative. For example, the automobile, which has enabled so many people to transport themselves considerable distances, has had very positive consequences. However, we know that automobile accidents and pollution are also consequences of this technology. Neither were what we wanted or envisioned when we first developed the car.

But, why is it even important to know about technological system resources and constraints? Simply put, a knowledge of technological system resources is absolutely essential to designing, using and trouble-shooting such systems. For example, if you did not know that automobiles require gasoline as a resource, how would you know to fill the tank if the car stopped working?

Similarly, technological system constraints are important in order to understand how efficiently and effectively these systems are operating. What keeps a system from overworking and/or breaking? Why might a system or subsystem be less than optimal? Perhaps because of certain regulations such as pollution requirements or physical laws. For example, one cannot get more energy out of a system than what one puts into it – and usually one gets far less because of losses.

The context for this module is that of technological systems as established in TAM 1. All technology consists of systems and the more sophisticated the technology, the more systems are interlinked and interdependent. For these reasons, a solid understanding of resources and constraints is important.

This module will help you understand how to control technology and how to assess it.

Key information

Class presentations and demonstrations
Review of technology systems and systems analysis.
Identifying resources, the inputs and outputs of systems and subsystems.
Obvious and non-obvious resources required by technology systems and subsystems.
The nature of technological system constraints.
Obvious and non-obvious constraints faced by technology systems and subsystems.
Assessing the consequences of technological systems.

Safety
When your instructor assigns the systems analysis activity, be careful not to endanger yourself as you work to identify the system components.
Always do an analysis of system inputs and outputs to learn what goes into a system, and thereby get some sense of how much potential energy there exists to possibly hurt you.
When analysing systems, avoid putting your hands near moving parts.
Be certain that electrical systems are unplugged and discharged before working on them.
Wear appropriate protective equipment when near systems that can injure; for example, wear goggles around grinding and welding equipment, and wear a respirator around dusty or chemical equipment.

Student activity
Before beginning work on these activities it is recommended that you read: Gradwell and Welch's book entitled *Technology: Shaping our World*, op. cit., in particular the early chapters that outline what technology is, and how to conduct a systems analysis.

Materials required

Supplies
Graph paper, pencil.

Equipment
Drafting equipment or software if available.

Hand-outs / Instructional resources
J. Gradwell and M. Welch, *Technology: Shaping our World*, South Holland, Ill., Goodheart-Willcox, 1991; also examples of technological systems as in the school or neighbourhood

Activity sequence

Participate in your instructor's start-up activities and presentation for this module. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
1. Do Activity 1(a): 'Identifying Resources, the Inputs and Outputs of Systems and Subsystems', or
   Do Activity 1(b) 'Identifying Technological System Resources'.
2. Do Activity 2: 'Identifying Technological System Constraints'.
3. Do Activity 3: 'Assessing the Consequences of Technological Systems'.
4. Do Activity 4: 'Calculate Resource Efficiencies of Technological Systems'.
5. Review and summarize.
6. Complete post-assessment procedure.

Activity 1(a): Identifying resources, the inputs and outputs of systems and subsystems

1. Working in groups of two or three, develop a systems analysis of an automobile engine. Describe each subsystem and state the purpose of each subsystem. Generate a sketch that shows these subsystems and their relationship to the other subsystems.
2. Identify the inputs and outputs of each subsystem and list them in the following table.

Subsystem	*Inputs*	*Outputs*
Example: Lubrication subsystem	Rotational motion from the distributor's drive shaft Oil from the crankcase	Pressurized oil Heat Sound

3. Each group then presents its list of automobile engine subsystems analysis to the class and, together, all students generate one comprehensive list of all subsystems. The instructor will correct any misimpressions or errors.
4. For each subsystem then listed on the board, students compile a comprehensive list of all inputs and outputs of the subsystem. In doing this, students refer to their diagram showing subsystem relationships so that when one subsystem feeds into another subsystem, all resources are accounted for.
5. What happens to the outputs of one subsystem that does not serve as an input to the next subsystem? Where do these outputs go?

Activity 1(b): Identifying technological system resources: Plan of procedure

1. Identify a moderately complicated technological system in which you and three classmates are interested, and from which you can locate some information.
2. In groups of three or four, draw a large wall-chart technology systems analysis of this system, being sure to identify its major subsystems.
3. List on the systems analysis chart the overall system resource inputs and outputs. Be certain to include both obvious and non-obvious inputs/resources. The test of your accuracy in this would be that the system would operate with only the resources listed; if it cannot, you have missed something!
4. On this same wall-chart, identify and list the resources being used by each of the system's major subsystems. The check of your accuracy is that, taken together, all subsystem resources must have been listed as a resource for the overall system. If not, and if you are sure that a resource is required by a subsystem, revise the lists you generated in Step 3.
5. Try to come up with reasonable estimates of the amount of each resource (as listed in Steps 3 and 4) required for a given amount of output.
6. Present each chart to your class and invite your classmates and the instructors in your school to critique your work. The objective is to enlist as much help as possible (including industrial or business people willing to help), in detailing and validating your work.

Activity 2: Identifying technological system constraints

1. If possible, go on a field trip with your instructor to a local garage or automobile dealership and interview key personnel to get answers to the following questions; if a field trip is not possible, use books and magazines supplemented by interviews of family members to answer these questions:
   A. How does fuel efficiency (miles or kilometres per gallon or litre) affect engine use and popularity?
   B. Are there any government regulations that apply to automobile engines?
   C. How available are spare parts for various engines?
   D. Why are some engines more expensive than others?
   E. Can all engines be serviced locally? Why or why not?
   F. What makes one engine better than another?
   G. Why does not everyone use the best engine?
   H. What constraints or limitations on use do various engines have?
2. After getting these questions answered, come back to the school and discuss the answers you secured. Develop a comprehensive list of automobile engine constraints. Link each constraint to one of the engine's systems or subsystems.

Alternatively:

1. Form new groups of three or four classmates, and have each group pick one of the technology systems analysis charts that the class has prepared in Activity 1.
2. Create a wall-chart table that identifies the overall system's major constraints being certain to list some in each category: material, energy, information and social. Be certain to include both obvious and non-obvious constraints.
3. Repeat Step 2 for each subsystem in your overall technological system. List the overall system resource inputs and outputs on the systems analysis chart.

4. Present each chart to your class and invite your classmates and the instructors in your school to critique your work. The objective is to enlist as much help as possible (including industrial or business people willing to help), in detailing and validating your work.

Activity 3: Conducting a technology assessment

1. In small groups of three or four students, pick any one system and name it, and then list that system's outputs. Be sure to list all outputs, not just the desired or obvious ones. For example, does your system give off heat, noise or pollution?
2. Identify which of these outputs are intended and which are unintended.
3. Also note whether the use of the system has any social or other consequences or impacts. For example, the widespread use of cars might cause the unemployment of bus drivers.
4. Conduct a class discussion about each system and its outputs, and the consequences of these outputs. Have the class discussion:
   A. Confirm that all outputs have been listed.
   B. Confirm that all outputs are properly classified as intended or unintended.
   C. List the system's positive and negative effects on the environment/context housing it.
   D. Confirm that all social consequences have been identified.
   E. Consider whether, overall, the effect of employing the technology in question is positive or negative. End this consideration with a vote, by secret ballot, asking each student to indicate on a slip of paper his/her summary judgement as to whether the technology has had an overall positive or negative effect.
   F. Discuss why so many technologies are seen to have serious negative characteristics.

Activity 4: Calculate resource efficiencies of technological systems: Plan of procedure

1. Using your technological system wall chart, and working in the same groups as you did for Step 2, interact with your instructor, and with the school's mathematics and science teachers, to quantify the numbers you listed for each resource for both the overall system and each subsystem.
2. The check of your accuracy is that, taken together, all subsystem resources equal those of the resources listed for the overall system. If not, work with your instructors to better your estimates.
3. Now develop a sense of the technological system's output. What kind are they, and how large are they. Quantify your output amounts and validate them using consultant teachers and industrial people.
4. Develop a sense of the efficiencies of your system by inserting input (resource) and output amounts into the following expression:

$$\frac{\text{Output amounts and units}}{\text{Input amounts and units}} = \text{Efficiency}$$

For example, in the case of a car:

$$\frac{\text{120 kilometres driven}}{\text{6 litres of petrol required}} = \text{20 kilometres per litre}$$

5. Be certain to consider the nature of the units you place into this expression. When they are the same, you can calculate real efficiencies. For example, if you knew a lighting system required 30 watts of energy (electricity) but that it gave off only 20 watts (equivalent) of light, the system would be 66.7% efficient.

$$\frac{20}{30} = \frac{x}{100} \qquad x = 66.7\%$$

= 66.7

Now, calculate the efficiency of your technological system and show all steps and assumptions/estimates in your calculation.

6. Have your classmates and your instructor check your calculations.

Activity 5: Debate technological system constraints: Plan of procedure

1. Working as a whole class, pick one of the technological system analysis charts that most of the class is interested in.
2. Divide the class into two groups.
3. Have one group identify the positive constraints and consequences of the technological system as a whole.
4. Have the other group identify the negative constraints and consequences of the technological system as a whole.
5. Conduct a teacher-moderated debate of the positive group versus the negative group.
   A. The positive group should be arguing that the system is beneficial and therefore should be faced with fewer constraints.
   B. The negative group should be pointing out the negative consequences of the technological system and should therefore be arguing for greater numbers and severities of constraints.

Technology Activity Module 2: Summary

Review and summary activities

Meet with students from a social studies, history or science class, and discuss your three activities and your results. Are their opinions the same as your classes or not? Why is this the case?

If you encountered any words or terms that you did not understand, ask your instructor to explain their meaning.

Discuss how resources and constraints relate to one another.

Compile a list of all the items listed as a resource across all the technological systems analysed by your classmates.

Compile a list of all the items listed as a constraint across all the technological systems analysed by your classmates.

Review questions • Check your comprehension!

Why do we often overlook system inputs and outputs?
Is it common that one subsystem's outputs become the inputs of another subsystem?
Can a technological system face societal constraints?
Which constraints are more easily overcome, technical or societal ones?
Who performs technology assessments for a nation?
What are some unintended negative consequences of using technology?
What are some intended positive consequences of using technology?
What three categories of resources exist?
What four categories of constraints exist?
Why are constraints both good and bad?

Technology Activity Module 2: Post-assessment

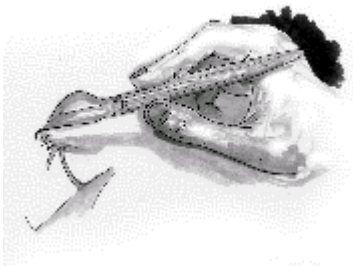
1. Complete the review questions in the previous section.
2. As a homework assignment, write a one-page paper on the positive and negative consequences of using a technology that your family uses at home. Be sure to discuss this paper with family members and include in it their ideas as well as yours. Come to school prepared to make a short oral presentation in front of the class to share the highlights of your paper.
3. Have the instructor evaluate your paper and discuss how to improve your writing.
4. If your instructor assigns a post-test for this TAM, be sure to take it.
5. If your results demonstrate mastery, go on to TAM 3, or do any other activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Unit 2

Communication and information technology

Module 3
Silk-screen printing

Instructor guide



Activity objective

The purpose of this activity is to help students learn about the basics of silk-screen printing as practised indigenously all over the world. Subsequently, they will apply the technique to the production of a T-shirt or poster.

Module instructions

Introduction

Communication technology has many aspects to it. People communicate orally, visually, by touch and, with increasing frequency and importance, via technology. Usually students think of electronic forms of communication, but graphic forms are also widely used. Provide examples of posters, print materials, T-shirts, and even tattoos to show the variety of graphic communication methods readily available. This TAM will focus on a simple method of graphic communication that can be widely applied to many different objects such as T-shirts, textile prints, caps, posters, cups and containers, among others.

Key content highlights

What is communication? Simply put, communication involves a person, called the sender, having an idea that he/she wants to get across to one or more other people.

The sender then encodes his/her idea into a message and then transmits this message using a medium to one or more receivers.

The receiver(s) then extract the meaning from the message by a process called decoding. The receivers then take the idea that they have decoded from the message and process it in their mind.

Often this process does not work as well as hoped for because of noise in the communication system. This noise can be many things; it does not just need to refer to sound. For example, if a printed poster is heavily faded by sun and rain, the fading is considered to be weather-related noise.

Finally, for effective communication to occur, the sender and receiver must engage in a follow-up activity that checks whether the received message is like the message that was sent. The instructor should make a point of having the students notice that often the sender's intention is significantly misinterpreted by receivers.

Materials required

Supplies

Silk-screen ink (even latex paint if no ink is available, home-made ink will also work, it is just a thick coloured paste that will eventually dry).
Fine screening, usually synthetic, but it could also be very fine metal; window screening could be used if needed (but it is quite coarse).
Masking or duct-tape (not cello-tape).
Wax.
Squeegee, a flexible but stiff rubber strip that is wide enough to hold easily. Often a narrow strip is fastened to a wooden handle to make things easier.
Wood strips, typically 2.5 cm × 5 cm, in lengths sufficient to make a rectangular frame approximately 45 cm × 75 cm.
Waterproof glue for wood.
T-shirts or paper to be silk-screened.

Equipment

An electric heating stove for melting wax (if a wax-based process is used).
Brushes and pens for applying wax (if used).
Hammer and nails, or screwdrivers and screws for fastening the frames together.
Paper towels or rags, scrap paper, e.g. newspaper, for cleaning.

Instructional resources

Any basic text on graphic communications or silk-screen printing. Often this can be found in a library.

Management / Logistics

Related instructional units

TAM 1: 'Technological Systems'

Evaluation / Grading

Instructors should focus on the communication process, and how well students can employ it and understand it – not on how artistic they are. The latter is clearly also a desirable characteristic in this TAM which focuses on graphic communication, but it is not the major point. Different students will have different degrees of artistic talent.

Key evaluative dimensions in this TAM include how well the student demonstrates that they understand the overall communication process, and then how well they employ it to get a message across to someone else. Because of the nature of this activity, neatness is also very important.

Suggested schedule / Time
The instructor may begin by describing the communication process to the class using an informal conversational method. During this period, he/she should try to elicit from the students a wide variety of communication methods. The next period should be a demonstration of silk-screening by whatever method is available to the instructor. This should be followed by a period where students develop their message/design to be screen-printed and another period for the students to make their screens. Finally, students should be given a period or two to actually screen-print their products. This technology module should then be concluded with a period during which students and others assess the effectiveness of the communication and the teacher summarizes the graphic communication process.

Key instructional suggestions

Safety
Typically this is a TAM with minimal concern for safety. If students use solvent-based inks or paints, make sure they work in a well-ventilated area with no open flames.

If wax is used then the instructor should alert students to the danger of spilling molten wax, and under no circumstances should an open flame be used to heat the wax.

Some screen preparations may involve the use of sharp knives to cut out stencils, and students should therefore be cautioned against unsafe use of knives. All knives should have blade protectors on them whenever they are not being used to cut.

When making the silk-screen frames, students will be using a handsaw and hammer and nails, or drill, screwdriver and screws. Normal safety precautions for simple hand tools should be taught to students, depending on the specific tools to be used in this setting.

Because of the materials used, the instructor should always have good hand soap and cleaners available so that students can remove any ink or solvent from their hands.

Motivation
Students like to make posters and/or T-shirts with messages important to them. Perhaps the instructor can suggest a club T-shirt, a poster for an upcoming student event, or just solicit ideas from the students. Experience has shown this activity to have high motivational power.

Prerequisite information
The instructor's introductory lesson on communication, and basic hand-tool safety.

Demonstrations
This activity benefits from numerous demonstrations. Much of the important content is better demonstrated than talked about. The suggested sequence is:
Explain the communication process and secure examples from the students.
Demonstrate silk-screen printing of T-shirts or posters.
Demonstrate making of silk-screen frames and mounting of screen.
Demonstrate making a pattern/stencil or design to be silk-screened.
Demonstrate applying the design to the silk-screen.
Conduct a summary lesson on the communication process and focus on assessing how well the communication worked.

Attitudes
Neatness and cleanliness are essential to this activity.
Basic safety attitudes are also important.
Concern for the effectiveness and appropriateness of communication is also important.

Summary and review

Technology extends human capability. One of the important sets of technological systems involves communication. The communication process involves, in order, a sender and an idea, encoding it into a message, transmitting the message across a medium, a receiver decoding and interpreting the idea, and some feedback to ascertain the extent to which the original idea and the received message are the same. Noise at all stages, and in whatever form, works against effective communication.

Glossary

Decoding	The receiver's extracting of the information contained in the message.
Encoding	Moving the idea from the sender's mind into the message to be transmitted.
Feedback	The process of checking the extent to which the interpretation of the received message is consistent with the idea in the sender's mind.
Graphic communication	The process of exchanging meaning by using visual symbols and designs.
Idea	The concept or information that a sender wants to communicate to someone else.
Interpreting	The receiver's mental processing of the information he/she decoded from the received message.
Medium	The vehicle or means used to move a message from sender to receiver. For example, radio, television, print, etc.
Message	The encoded version of the sender's original idea. Messages are always packaged to suit the medium used to transmit them.
Noise	Any factor or process that interferes with effective communication.
Receiver	The person who gets a message. There may be intended or unintended receivers.
Receiving	The process used by the receiver to get the message from the medium.
Sender	The person who wants to send the message.
Silk-screen printing	A graphic communication process where ink is forced by pressure through some openings in a screen on to a material to be printed. The pattern of openings in the screen determines the pattern on the printed product.
Transmitting	The process of sending a message of the medium used to communicate.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 3
Silk-screen printing

Post-test

Instructions: *Work by your self to answer the following questions. Do not use any books, notes or reference materials*.

1. Number the steps below to indicate the proper sequence to follow in silk-screen printing a poster.

   ___ Confirm the idea to be communicated.
   ___ Assess how well the product communicated.
   ___ Make a screen frame and mount the screen.
   ___ Print the product.
   ___ Mount the design to the screen.
   ___ Make a design to be printed.

2. Generate a systems diagram showing all essential components of the communication process.

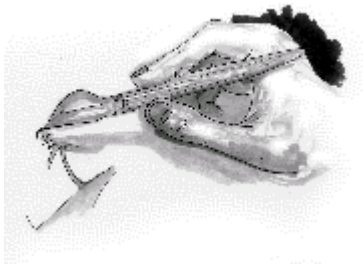
3. Give three examples of noise and describe how the communicator can work to minimize its negative effects

   A. _____
   B. _____
   C. _____

4. How can a sender ascertain the effectiveness of his/her communication?

Module 3
Silk-screen printing

Student guide



Module overview

You will recall that all technology involves systems. Three of the most important systems are communication, material and processing, and energy and power. This TAM focuses on communication technology systems and, in particular, on graphic communication. In this module you will make a silk-screened product such as a poster or T-shirt. You will also learn how to assess the effectiveness of communication and thereby how to increase your own ability to get a message across to others.

Objectives

This activity will develop your communication by introducing the communication process and then applying it to the making of a silk-screened poster or T-shirt. Another objective is to help you learn about how to judge the effectiveness of communication.

Importance

All interaction between people involves communication. The better we can communicate, the better we can get the things done that we want others to do; i.e. the better supervisors, teachers, managers, trainers and workers that we become. We are more persuasive if we can communicate better and, above all, we can solve problems better if we can communicate effectively.

Key information

Class presentations and demonstrations
The communication process.
Demonstration of silk-screen printing of T-shirt or posters.
Demonstration of making silk-screen frames and mounting screens.
Demonstration of making a pattern/stencil or design to be silk-screened.
Demonstration of applying a design to a silk-screen.
Assessing communication effectiveness and summary.

Safety
Use solvent-based inks or paints only in a well-ventilated area with no open flames.
If wax is used, be careful of the danger of spilling molten wax, and under no circumstances use an open flame to heat the wax.
Be careful when using knives. All knives should have blade protectors on them whenever they are not being used to cut.
When using hand tools to make silk-screen frames, follow normal safety precautions.
Frequently use good hand soap and cleaners to remove any ink or solvent from your hands.

Student activity
Before beginning work on these activities it is recommended that you read any reference book that you can find about silk-screen printing, and about effective communication.

Materials required

Supplies
Silk-screen ink (even latex paint if no ink is available, home-made ink will also work, it is just a thick coloured paste that will eventually dry).
Fine screening, usually synthetic, but it could also be very fine metal; window screening could be used if needed (but it is quite coarse).
Masking or duct-tape (not cello-tape).
Wax.
Squeegee, a flexible but stiff rubber strip that is wide enough to hold easily. Often a narrow strip is fastened to a wooden handle to make things easier.
Wood strips, typically 2.5 cm × 5 cm, in lengths sufficient to make a rectangular frame approximately 45 cm × 75 cm.
Waterproof glue for wood.
T-shirts or paper to be silk-screened.

Tools and equipment
An electric heating stove for melting wax (if a wax-based process is used).
Brushes and pens for applying wax (if used).
Hammer and nails, or screwdrivers and screws for fastening the frames together.
Paper towels or rags, scrap paper, e.g. newspaper, for cleaning.

Hand-outs / Instructional resources
TAM 1: ‘Technological Systems’

Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure
2. Do Activity 1: Make a design to be communicated.
3. Do Activity 2: Make a silk-screen frame and mount its screen.
4. Do Activity 3: Mount a design on to a silk-screen frame.
5. Do Activity 4: Print a silk-screen product.
6. Do Activity 5: Assess the effectiveness of your communication.
7. Review and summarize the lessons and demonstrations.
8. Complete post-assessment procedure.

Activity 1: Make a design to be communicated

1. Participate in the instructor-led discussion about communication and messages.
2. Think about an idea you wish to communicate, using a poster or T-shirt (depending on your teacher's instructions).
3. Sketch out a draft of the words and graphic designs you want to communicate. For this first project, produce a design that will work well using just one colour.
4. Form teams of six students and present your design to the student group. Ask them what message they received from seeing your draft *before* you tell them what you intended to communicate.
5. In your student groups, discuss what would make your design communicate more effectively.
6. Revise your design as you deem appropriate. Be certain that each final design has the instructor's approval for appropriateness and size. During this step, it is often effective to share talents within the student group. For example, if one student is a better artist than another, that student could improve the designs of other students.

Activity 2: Make a silk-screen frame and mount its screen

1. Secure the available frame-making supplies and tools from your instructor.
2. Measure the frame strips to the length specified by your instructor. Mark out the joint design you are told to use.
3. Cut the frame strips to length and cut the joints.
4. Trial fit the frame pieces together, make sure the joints fit, and make any adjustments needed. Be certain that the frame is square.
5. Sand the frame to remove any sharp corners and to smooth the surfaces.
6. Assemble the frames using the fasteners and method advised by your instructor. Clamp the pieces together and ensure that the frame is square.
7. After the frame's joints are dried, remove the clamps and apply a protective coat of clear varnish or other finish to make the frame easier to clean later.
8. Mount the silk or other screen supplied by your teacher. Use staples or other fastening method depending on the frame's design. Be certain that the screen is stretched tightly and that it lies without any wrinkles.
9. Have your instructor check your work and after he/she approves it, apply some tape over the staples or other fasteners you used to hold the screen to the frame.

Activity 3: Mount a design on to a silk-screen frame

1. There are many ways of mounting your designs to the screen. This depends on the materials you have. Your instructor will advise you specifically on what is available in your setting. For the purposes of this activity description, a very simple process using a paper stencil and water-soluble glue will be described.
2. In the previous activity, you should have cut out your paper stencil so that all the places where you want ink to be on the product are cut out. If you have centres of openings where you do not want ink, you will need to cut the openings but leave islands in them by cutting narrow (3 mm or larger) bridges to hold each island in place. Islands, depending on their shape and size, need to have at least three or four bridges holding them in place.
3. Place the design you have cut out on a clean, flat surface. Orient it so that it looks correct when looking at it from above, and then place the silk-screen frame with its stretched silk right on top of your design. Position the frame so that the design is centred in the frame.
4. Using a medium-sized brush, carefully apply thick water-soluble glue smoothly through the silk-screen, but only where your paper stencil is below the silk. Do not apply glue to the silk where your stencil's cut-outs are. What you are trying to accomplish is to glue the stencil to the silk-screen and particularly the stencils edges around each cut-out. Try to be very neat to ensure that all of the stencil's edges are adhered. If you should get some glue on an opening where you do not want it, because it is water-soluble you can remove it after you have glued the whole stencil, and it has dried.
5. After everything has dried, inspect the stencil carefully to make sure that all edges are glued tightly to the screen. If not, apply a little more glue to the loose places and let dry again.
6. Then, if there is an area around the outside of your stencil (between it and your frame) where you do not want ink to come through, mask it off using more paper and masking tape. When this is done, the only places in your silk that are not covered should be the places where you want ink to come through.
7. Have your instructor check and approve your work.

Activity 4: Print a silk-screen product

1. Prepare the products you want to screen print. If these are posters, then cut the poster paper to size. If they are T-shirts, cut out cardboard inserts that you can slip into the shirt to stretch it flat for screen printing.
2. Have your instructor show you how to clamp your silk-screen frame into the hinged base and top assembly. This simply positions the frame the same way every time you lower it on the work to be printed.
3. Whatever method of holding the frame you use, it is important to mark the base or work surface so that each product is properly positioned and that the frame is in the same relative spot every time it is lowered. A few poster-board strips, taped to the work surface, work well to position the product to be printed in the same place every time.
4. Have your instructor approve your set-up.
5. When everything is in order, squeeze a finger-sized ridge of ink across the width of the silk-screen on the top side (i.e. the side that does not come in contact with the product to be printed.

6. Now place a sample of the product to be printed on the work surface using the locators you mounted in Step 3.
7. Then, lower the frame on to the product to be printed (making certain that it is properly positioned on the work surface first) and have a friend hold the frame tightly on the product to be printed.
8. Now, take the rubber squeegee and holding it at an angle, pull the ink ridge all the way across the screen. While doing this, you want to have the rubber squeegee edge apply slight pressure to force the screen tightly against the work to be printed. Pulling the ink across the screen will force some of it through the openings you left in the design and on to the product, thereby printing it.
9. Place the squeegee in a tray and then hold the printed product down on the work surface. The friend who had been holding the frame down on the product should now carefully raise the screen thereby separating it from the newly printed product.
10. After the screen and frame are completely separated from the printed product, carefully remove the printed product from the work surface and place it in a drying rack. Depending on the ink you used, this can take up to a day to dry.
11. Now, repeat Steps 6 to 10 until you have printed the desired number of products. Add ink whenever needed.
12. Then, place some scrap newspapers flat on the work surface and lower the frame on to it. Now, using a plastic scraper, carefully remove any ink you can scrape off the top of the screen. Then using the appropriate solvent, wash the ink off the screen catching the excess on the newspaper. Repeat this step by replacing soaked newspaper with clean paper until the screen is free from ink. Have the instructor check your cleaning up.
13. If you have finished with the printing you may remove your design from the screen. Otherwise let the screen dry so that you can reuse it another time.

Activity 5: Assess the effectiveness of your communication

1. After your product has dried, show it to fellow students and ask them how well it was printed. Are the edges clear? Is it free from smudges? Can the design be understood?
2. Try to find someone from the audience for which you intended this product. Ask them the same questions. However, also ask them what message the product tells them. Do this *before* you tell them what you wanted to communicate.
3. Record any suggestions for improvement.
4. Summarize all feedback in a short, written paper, and hand this in along with a sample product for your instructor to evaluate.

Technology Activity Module 3: Summary

Review and summary activities

Compare your product to that of your classmates. What are its strengths and weaknesses?
What are the common points for improvement for the whole class's products?
Try to identify some local applications of screen printing in your community.
Describe how their procedures are similar and/or different from the ones you used in class.

Review questions • Check your comprehension!

What is screen printing?
List three different ways to mount a design on to a screen.
How could one do multi-colour work?
Why is it important to glue a design using a different adhesive than the ink solvent?
How could one produce a much larger number of products but still use screen printing?

Technology Activity Module 3: Post-assessment

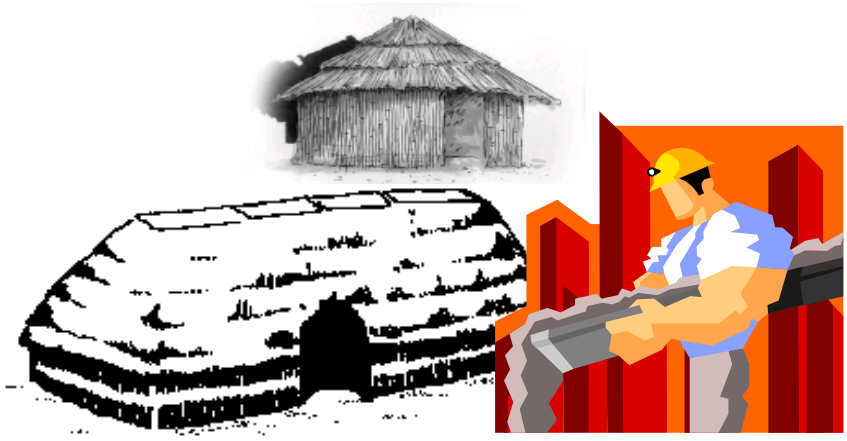
1. Complete a self-rating on the quality and effectiveness of the product you printed.
2. Have the instructor complete an evaluation of your product and discuss discrepancies between the two assessments
3. Complete the post-test for TAM 3.
4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Unit 3

Materials and processing technology

Module 4
Construction technology

Instructor guide



Activity objective

The purpose of this activity is to introduce the materials processing system of technology and, more specifically, the construction technology dimension of it. This module should teach basic construction techniques and how it is done in selected places around the world.

Module instructions

Introduction

Technology involves primarily three systems. These are materials process, communication, and energy and power. This module introduces the materials and processing system and then focuses student attention on that part of materials and processing that is typically done on-site. The term for this is ‘construction’. It involves the building of roads, dams, high-rise towers, bridges and houses.

Key content highlights

Perhaps the most common system of technology is materials and processing. It does not matter whether the materials are agricultural, food or engineering; when humans work with materials it is a form of materials and processing. Separating, combining and forming are the three primary ways of working with materials, and when these take place wherever the finished product is to be used, i.e. on-site, such materials processing is called construction.

Construction is typically conducted in five phases from start to finish. The first phase centres on planning the construction project in all its details. The second phase involves preparing the site for construction. Third, the builder establishes the foundation for whatever structure is being built. The fourth phase is the actual construction activity using whatever means of building is appropriate. The fifth and final phase involves finishing the site and the structure so that it can be used.

Materials required

Supplies
Twine, wooden stakes, local reeds, straw, lumber boards, mud.

Equipment
Machete, measuring tape, hammer, knife, brick mould, mixing pan, hoe, spade, pick-axe, saws.

Instructional resources
Any standard, locally published book on construction techniques, and TAM 1: 'Technological Systems'.

Management / Logistics

Related instructional units
TAM 1: 'Technological Systems' and TAM 2: 'Technological Resources and Constraints'.

Evaluation / Grading
This module is an excellent one to introduce the need for both cognitive and performance excellence when dealing with technology. The instructor should insist on having students demonstrate knowledge of various indigenous and contemporary construction practices, both in their environment and elsewhere. Additionally, the instructor should insist on effective demonstration of skill in one or more locally appropriate construction techniques. Naturally such skill expectations should be commensurate with the level and orientation of the pupils. Grading should be configured in such a manner that satisfactory performance on both cognitive and skill components is necessary to demonstrate mastery.

Suggested schedule / Time
One possible sequence for teaching this module is presented in the following:
Introduce materials and processing technology, and construction.
Highlight construction technology and its key phases.
Demonstrate adobe making.
Demonstrate reed construction.
Review and summarize construction technology.

Key instructional suggestions

Safety
Basic hand-tool safety applies. In addition, students could be carrying long building materials. Encourage them to do this in pairs so that there is no free end of material whipping about when they turn.

If power tools are used, the instructor should supervise closely and only allow students to use them after they receive systematic instruction in their use, and have demonstrated competence.

Motivation
Throughout history people have constructed shelters, roads, bridges, etc. It is fascinating to study their techniques and their ingenuity has been inspiring. More important, however, constructing is often necessary for one's own shelter and that of one's possessions and animals.

Prerequisite information
There are numerous items of information prerequisite to effective and safe learning in this module. The instructor has always the obligation to ensure that his or her pupils are aware of the safe use of the tools and equipment that they will use during the module's activity. Additionally, students need to be aware that when working in proximity of others also engaged in work, one group may affect the other's safety • hence they need to be constantly alert to what is going on around them.

Another essential set of information is that pertaining to the nature of the materials being worked with, and any potential hazards and/or safety precautions that they might engender. In renovation activities, for example, teachers must consider the possibility of asbestos products or lead-based paint. For example, if any of these are suspected, it would be advisable to avoid such work entirely.

Demonstrations
Introduce materials and processing technology and the part of construction.
Highlight construction technology and its key phases.
Demonstrate adobe making.
Demonstrate reed construction.
Review and summarize construction technology.

Attitudes
Highlight safety attitudes.
Stress the necessity of teamwork.

Summary and review
Construction is not only a necessary but also an intriguing activity. It involves the processing of materials on a site where they will be used.

Glossary

Adobe	A mixture of clay-based mud with straw that has been dried to form hard building blocks.
Construction	Building a product on the site where it will be used, for example, a home, a road or a bridge.
Foundation	The base on which a constructed object is built. It may be as simple as bare earth or as complicated as a cast concrete basement.
Layout	The process of marking the dimensions of the product to be built on the ground where the structure is to be erected. This process involves not only sizing the structure but also establishing its proper geometry and orientation.
Machete	A large wide- and long-bladed knife used to cut reeds.
Manufacturing	The processing of materials in a factory or somewhere other than where the finished product will be used.
Materials processing	Any separating, combining or forming of any kind of materials.
Site	The location where a structure will be built.
Triangulation	Measuring the diagonals of a rectangular shape. When the opposite diagonals are equal the rectangle is square.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 4
Construction Technology

Post-test

Instructions: *Take this worksheet home and answer each of the following questions carefully*.

1. On the way home, identify as many different construction sites as you can see.

2. Describe three different types of construction.

3. Talk to a person responsible for managing the construction at one of these sites and write down the stages through with the construction progresses before the finished product is turned over to the client.

4. What skills are important in construction?

Module 4
Construction technology

Student guide

Module overview

Technology involves primarily three systems. These are materials processing, communication, and energy and power. This module introduces the materials and processing system and then focuses student attention on that part of materials and processing that is typically done on-site. The term for this is construction. It involves building of roads, dams, high-rise towers, bridges and houses.

Building! It seems that all peoples do this around the world. We build shelters/homes for ourselves, our property and our animals. We build roads, bridges and much more. Building involves construction. This is different than production or manufacturing because it goes on at the site where the constructed building, etc., will be used. This contrasts to manufacturing or production which usually occurs in a workshop or factory, the product being transported and used elsewhere.

Objectives

In this module you will begin learning about one of humankind's most frequent use of technology – namely materials processing. In particular, you will learn about a form of materials processing called 'construction'.

In this module you will learn basic construction techniques and how they are done in selected places around the world. You will also learn the key stages involved in constructing something.

Importance

So many things are built wherever we live. Look around you. The school you are in, the road you took to get to school, your home, the shops along the way – all are constructed. Also things you may not immediately think of are constructed. For example, airports, power-lines, power-plants and the like. If you learn the basics of construction, you will develop very useful insights and understandings and skills that you can use for constructing things yourself, and perhaps even to help you get a job working in construction.

Key information

Class presentations
Introduce materials and processing technology and the part of construction.
Overview of construction phases.
Construction planning phase.
Site preparation phase.
Building foundations.
Construction procedures.
Site and structure finishing.
Review and summarize construction technology.

Demonstrations
Construction planning and its key phases.
Adobe making.
Reed construction.

Safety
Basic hand-tool safety applies, if you are unsure of how to use a tool, be sure to have your instructor show you before you begin using it.
Understand how and when to use personal protective equipment such as goggles, gloves and work shoes.
When carrying long building materials, do this in pairs so that there is no free end of material whipping about when you turn.

Student activity
Before beginning work on these activities it is recommended that you read the available textbook sections that pertain to construction.

Materials required

Supplies
Graph paper, pencil.

Tools and equipment
Drafting equipment or software if available.

Hand-outs / Instructional resources
J. Gradwell and M. Welch, *Technology: Shaping our World*, South Holland, Ill., Goodheart-Willcox, 1991; also examples of technological systems as in the school or neighbourhood.

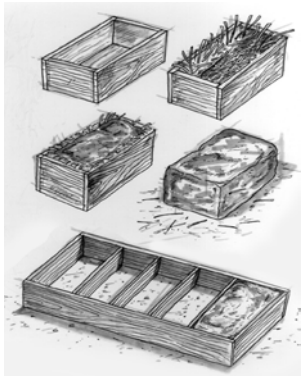
Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
2. Complete the pre-test given by your instructor.
3. Do Activity 1: Construction planning.
4. Do Activity 2: Construction site preparation and foundation building.
5. Do Activity 3: Construction building with adobe and reeds.
6. Do Activity 4: Finishing construction and sites.
7. Review and summarize.
8. Complete post-assessment procedure.

Activity 1: Build a diorama depicting the early construction of homes in your area

1. Research the history of your town and identify the first constructed structures in it.
2. Talk to old people and develop a description of how the old structures were built? What materials were used? How were the parts assembled? How was the foundation prepared? .
3. Make sketches of the important construction features, such as:

4. Working in a small group of students, re-create an early set of structures in your community by building a scale-model diorama, and illustrating the type of construction found.
5. Invite old people to your class and have them tell you how construction was done then.
6. In discussion with these old people, list the similarities and differences between old and modern construction methods.



Activity 2: Make adobe bricks

1. Make a wooden brick mould using lumber boards and typical measurements found in your region.
2. Calculate the number of bricks needed to construct a simple project such as a wall or small shed.
3. Using the mixing pan, make a very thick clay-based mud and mix some straw or other fibrous material into it for strength.
4. Fill the brick mould with the mud mixture, pack it in tightly and then push the damp brick out. If the brick loses shape after removing it from the mould, the mud is too wet. Add some more clay to stiffen up the mixture.
5. When the mix is right, make as many bricks as are needed for the structure you planned.
6. Place the bricks in bright sun to dry for a week before using them. Protect them from rainfall during this time.

Activity 3: Build a shed or structure

1. Together with your teacher, and as a whole class project, identify a school or local community need for a small structure.
2. Work with the school or community and plan the specifications for this structure. A small storage shed, for example, could be built from adobe bricks or a historical hut could be built for a park to commemorate the town's history.
3. Convert the input you have received into a detailed set of plans listing all the materials needed, the sizes, and accurate location.
4. Work to secure the appropriate approvals needed to build the structure according to your plans.
5. When all approvals are on hand, organize the class into various teams and then construct the structure using the following sequence:
   A. Planning the construction project in all its details.
   B. Preparing the site for construction.
   C. Establishing the foundation for the structure.
   D. Actual construction activity.
   E. Finishing the site and the structure so that it can be used.
6. Invite the appropriate authorities to approve the structure as it reaches various key stages.

Technology Activity Module 4: Summary

Review and summary activities

Compare your products to that of your classmates. What are its strengths and weaknesses?
What are the common features of all housing constructions?
How is local housing construction both similar and different to the construction used in other countries, or even regions of your nation?
What trends are occurring in construction?

Review questions • Check your comprehension!

What occurs when a person first wants to build a home?
List three different construction methods employed in your region.
How could construction technology as used locally be updated to incorporate more modern technology?
Why is new technology not being used in local construction?

Technology Activity Module 4: Post-assessment

Instructions:

1. Complete a self-check on the appropriateness and quality of the constructed product you created.
2. Have the instructor complete the evaluation and discuss discrepancies between the two assessments.
3. Complete the post-test for TAM 4.
4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 5
Paper-making

Instructor guide

Activity objective

The purpose of this activity is to help students apply materials processing techniques to the production of a basic material, in this case paper, that is essential to a major form of communications technology. Students will make a few tools used in paper- making, then collect raw materials suitable for making paper, and finally they will actually prepare some paper that will be usable for artistic projects, such as silk-screen printing, described in another module.

Module instructions

Introduction
Materials processing as a family of technological activity can involve many different materials. These include typical engineering materials such as concrete, steel and plastics. But materials processing also involves the making and working of biological materials such as foods, textiles and paper. Often these appeal to students who have not traditionally pursued, or thought of themselves as using, technological activity. Female students, for example, do not often think about the kinds of technological activity that they may have traditionally done. It is important, therefore, that the instructor gets this larger sense of technology across to all of the students in his/her charge.

Key content highlights

What is paper? It is a material that often serves to transmit information. It may be used to form containers and/or covers. Simply put, paper consists of fibres that are interlocked and held together by a combination of mechanical and chemical means. The latter often include adhesives or binders of some kind. Paper may be coated with another material to create special properties as desired by the maker. Paper may be made from almost any material that can be broken down into individual fibres. Most common are plant materials such as wood and grass. Recycled textiles or scraps are often used as well. Many times a combination of materials is used to create a paper with particular properties. Paper may be very fine and thin, such as those used for letters and offset printing, or they may be very substantial such as the cardboard used for boxes. For artistic uses and effects paper is often made to show some of the fibres that it consists of. The paper that students will make in this module will be of this type.

Materials required

Supplies
Fibre stock, e.g. scrap paper, cardboard, cloth or plant material such as soft fibrous wood, soft reeds, light-coloured tree bark.
Adhesive or binder such as starch, flour, sizing.
Very fine mesh such as silk screening, wire screening, or recycled nylon stockings; even loose woven cloth of hard finished thread could be used.
Wood strips to make a frame.
Drying surfaces that are porous.

Equipment
Rectangular frame for screen.
Heater.
Electric or hand-powered drill or beater.
Scissors and/or knives.
Large metal pot capable of being placed on a stove.
Stove or other cooking heat source.

Instructional resources
A basic book on paper-making. Typically these are found in arts and crafts stores.

Management / Logistics

Related instructional units
TAM 1: ‘Technological Systems’ and TAM 3: ‘Silk-screen Printing’.

Evaluation / Grading
Instructors should focus their teaching and assessment of learning in this module on using paper-making as an example of materials processing. Students’ performance in understanding and applying the various materials processing procedures is what should be evaluated. This is more important than the actual paper that is produced. Instructors should be careful not to raise student expectations to think that they will be able to produce commercial quality paper. The latter is very difficult without mass-production equipment.

Suggested schedule / Time
The instructor can begin by having students closely examine a variety of papers and paper products to attempt to identify the materials from which they are made. If a microscope or magnifying glass is available, have the students use it to examine the paper's structure and make-up.

Students will need time to collect a large amount of raw or recycled materials and then considerable more time should be allowed for students to process the raw materials into fibres and to allow these to become soft and separate. The actual paper-making can generally be accomplished in just one period, but drying usually takes a lot of time. If only a small number of paper screens are available, more time will need to be allocated because each sheet of paper will need to dry somewhat before it will hold together enough to be able to be removed from the screen. Typically, instructors should allow about a week for the paper-making activity.

Key instructional suggestions

Safety
This TAM involves minimal concern for safety.

Students should, of course, be careful with any cutting tools involved in shredding the raw materials for paper.

When cooking the fibre mix, students should be careful to avoid burns or spilling the hot liquid, as well as having moved anything around the heat source that might catch fire.

When beating and/or crushing the raw material into fibres, students must be careful not to get their fingers caught or hit by the beaters.

Motivation
Students will be able to create very artistic papers that can be used for many attractive projects such as greeting cards and posters. Some students have even started small paper-making businesses that supply the crafts trade, who then convert the paper into saleable products.

Prerequisite information
None other than the instructor's introductory lesson on basic safety, and on the overview of materials processing.

A book on art paper-making would be helpful because it contains useful paper recipes and hints gained from many years of experience. Typically, such books are available at the library or from art and/or craft stores.

Demonstrations
This activity is a very visual one, and students will benefit much more from this than from lectures. The suggested sequence is:

1. Demonstrate how to look at paper and its components.
2. Show how to cut and process raw material into fibres.
3. Demonstrate mixing and beating of fibre soup.
4. Demonstrating the building of various paper screen frames,
5. Demonstrate using the screens to make a sheet of wet paper and then removing it from the frame.
6. Show how to dry and flatten the paper.
7. Optionally, show how to size or otherwise treat the paper's surface.
8. Teach a summary lesson on natural materials processing.

Attitudes

Patience and attention to detail in ensuring that the raw materials are of even consistency is essential to good paper-making.

Normal safety attitudes and caution exercised with cutting and beating tools is important as is the care needed around hot equipment.

Summary and review

The materials and processing sector of technology involves many different types of materials that help humans create desirable products. Not all of these materials are hard, engineering materials like concrete or steel. Some are warm and soft like paper, cloth and food.

Organic or natural materials often consist of fibres. These can be held together and formed into thin mats or sheets that we call paper. The sheets we create can be considered as industrial stock from which many other things can be made.

Glossary

Adhesive	A form of glue. In paper-making these are often water-soluble such as starch or gluten.
Binder	An adhesive or glue that helps hold the paper fibres together to form a stronger sheet.
Fibre	The relatively long hairs or threads that make up many of the natural materials people use, for example, paper, cloth, wood and the like. Fibres can also be made of plastics and other engineering materials, but these are typically beyond the capabilities of schools.
Paper	Large flat sheets of fibrous plant or textile materials that are very thin. Generally the fibres are not woven or knitted together, but are rather interlocked by a combination of surface hooks on the fibres and adhesive binders coating the fibres.
Sizing	A coating that smoothes the surface of the finished paper.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 5
Paper-making

Post-test

Instructions: *Work by yourself and answer the following questions without using any books, notes or other people as resources*.

1. List and describe in their proper sequence the six steps needed to make paper:

   A _____

   B _____

   C _____

   D _____

   E _____

   F _____

2. Draw a sketch that shows the structure of a sheet of paper as it would look when highly magnified.

3. Describe what sizing does for paper.

4. List five materials that are often converted into paper.

   A _____

   B _____

   C _____

   D _____

   E _____

Module 5
Paper-making

Student guide

Module overview

Making things is an important part of technology. Materials processing is central to making things that humans want. We can make things of hard materials such as stone, steel and plastic, but we can also make things of soft and/or natural materials. Foods, wood products, textiles and papers are examples of natural products. In this activity, you will be using natural and recycled materials to make paper that you can later use to make gifts or artwork.

Objectives

This activity will develop your skills in materials processing, and it will show you how to make products that can be sold for profit. Another objective is to help you learn about the importance of consistency and attention to detail.

Importance

All materials processing involves thinking about the structure of the product to be made and then careful sequencing of a series of steps to actually make the desired product. This activity will teach you this exact process, and it does so in a manner that you will be able to apply to many other situations. In addition, it will show you how to make very saleable products with a minimum of equipment, even using only recycled, inexpensive or free materials.

Key information

Class presentations and demonstrations
Paper structure and component material.
Collecting and processing fibre stock.
Making paper frames.
Forming and drying paper sheets.
Treating paper sheets.
Materials processing of natural materials.

Safety
Be careful and work safely when using scissors and cutting tools.
Be careful when working around cooking/heating stoves to avoid burns and/or spilling of hot liquids. Also be certain that there are no flammable items anywhere in the vicinity.
When beating fibre stock, be careful not to get your fingers caught, or work with wet hands or feet using electrical tools.

Student activity
Before beginning work on these activities it is recommended that you read any basic crafts book on paper-making. Then, after your instructor gives you the overview of paper-making, collect a large amount of raw materials to be processed into fibre soup.

Materials required

Supplies
Raw fibre materials, such as old cloth, rough paper, fibrous reeds, grasses or very soft woods.
A fine mesh screen of wire, cloth or plastic.
Wood strips to make screen frames.
Nails and screws to fasten the frames together.
Flat porous surfaces on which to dry paper sheets.
Starch or other sizing materials (flour or clay or water-soluble adhesive).
Pots suitable for heating the fibre soup.
Plastic containers for holding the fibre soup while it digests.
Plastic tray, large and shallow.

Tools and equipment
An electric or hand drill with a home-made bent wire or paddle beater.
A stove or heater.

Hand-outs / Instructional resources
TAM 1 and TAM 3.

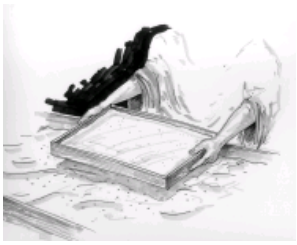
Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
2. Complete the pre-test given by your instructor.
3. Do Activity 1: Making the pulp mixture.
4. Do Activity 2: Forming paper sheets.
5. Review and summarize.
6. Complete post-assessment procedure.

Activity 1: Making paper pulp mixture

1. Collect raw materials for paper-making – begin with fibre sources such as old uncoated paper, old linen rags, fibrous grasses or young plant stems.
2. Cut the raw materials into short pieces, around 1 to 3 cm.
3. Soak the materials for several days.
4. Shred the materials using water and a rough surface against which to rub them.
5. If you have a beater, beat the pulp heavily.
6. Add bleach to whiten the mixture.
7. Mix in some sizing or other material to help the fibres adhere to one another.
8. Pour about 1–2 cm of pulp mixture into a tray and let it dry into a thick mat over a period of several days.
9. When the mat is strong enough to handle, remove it from the tray and prop it on stones in bright sunlight. Let it dry and bleach there for several more days. Turn opposite sides to the sun every day.

Activity 2: Making paper



1. Using the beater, mix the paper pulp mixture thoroughly after letting it sit for at least two days.
2. Pour the paper pulp mixture into a large plastic tray at least 10 cm deep.
3. Slide your paper screen under the paper pulp mixture in the tray by immersing the screen one edge first. You are trying to collect a thin, even layer of pulp on top of the screen.
4. Slowly lift the screen out of the plastic tray and let as much water as possible drip back into the paper pulp tray.
5. Set the screen aside to dry preferably in bright sun.
6. Repeat Steps 3•5 for as many screens as you have.
7. After the layer of paper fibre has dried enough to allow you to peel it off the screen, carefully remove and stick it to a smooth vertical or angled wall to finish drying.

Technology Activity Module 5: Summary

Review and summary activities

Compare the various paper sheets made by students in the class.
What makes them good or not so good?
What is the effect of using different materials to make the fibre soup?
Conduct a class discussion about how one might be able to make more, better quality, paper faster?

Review questions • Check your comprehension!

What occurs when raw paper materials are beaten and digested?
Why do the fibres that make up paper stick together?
How could the paper surface be made smoother?
What would be the effect of having longer fibres in paper?

Technology Activity Module 5: Post-assessment

Instructions:

1. Complete the self-check on the quality of the paper sheets that you produced.

2. Have the instructor complete the evaluation and discuss discrepancies between the two assessments.

3. Complete the post-test for Activity Module 5.

4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 6
Food preservation

Instructor guide

Activity objective

The purpose of this activity is to introduce the activities of food preparation and preservation as examples of materials and processing technology that are outside the more commonly considered arenas of manufacturing and construction. The goal in this is to help make male students more aware of the importance of such processes and to help women students make the connection between activities that they have traditionally been involved with, and technology. This recognition can then be used as a bridge to help encourage women to increase their involvement in technological activity of all kinds.

Module instructions

Introduction
Materials and processing technology includes a full range of processes with both natural and human-made materials. Foodstuffs constitute a major sector of materials processing. The individual person cooking or preparing his/her food represents one end, i.e. the crafts end of the production continuum, and the factory producing sugar or instant coffee represents the mass production end of the continuum. Instructors are encouraged to inject local examples of both individual and mass production of foodstuffs to help students see the continuum. It is also important to have the students recognize the differences between the production, i.e. growing or harvesting of foodstuffs and the processing of the foodstuffs, once we have them in hand. This TAM will focus on processing, not acquiring or growing foodstuffs.

Key content highlights

When considering the preparation and preservation of foodstuffs, the concepts of separating, combining and forming can naturally be applied. More common, however, is the use of other terms, such as, for example, cooking, drying, storing, fermenting, freezing, smoking and grinding. All of these come from the kitchen tradition more than they do from the manufacturing or production tradition. All, however, represent processes that are also employed in the commercial arena. This TAM will introduce students to four key materials processing processes commonly employed with foodstuffs around the world. Additionally, this TAM introduces an important data collection process, namely the first person interview of resource personnel.

Materials required

Supplies
Firewood.
Clean water.
Towels.
Soap.
Plastic food wrapping/bags.
Plastic or glass bottles with caps.
Fruit, meat, grains to be prepared and/or preserved.

Equipment
Stove.
Cooking pots.
Kitchen utensils, e.g. knives.
Mortar and pestle.
Grinding stones.
Smoking enclosure.
Cutting boards.
Meat thermometer.

Instructional resources
TAM 1 ‘Technological Systems’.
Family or local cookbook.
Grandparent or elders with memories of historical practices.

Management / Logistics

Related instructional units:
TAM 1 ‘Technological Systems’

Evaluation / Grading
Instructors should focus on communicating the parallels between industrial and business materials processing processes and those employed in the home for food preparation and preservation. Students should be assessed not only by how well they can perform the processes involved, but also by how well they demonstrate understanding (i.e. can explain)

what underlies the processes they are using. Additionally, students should be assessed on how well they research, typically by interview, the historical food preparation and preservation processes employed in their region, and then by how well they document these processes in Activity 1.

Suggested schedule / Time
The instructor should begin by assigning students Activity 1 and then allowing them a week or two to collect their information and write it up carefully. Subsequently, the balance of the demonstrations and student practice activities could be easily completed over a two-week period. The module should be concluded by an instructor-led review and summary lesson.

Key instructional suggestions

Safety
Because foodstuffs are involved in this module, cleanliness and effective sanitation practices are essential. Be certain to keep insects and pests away from the food. Finally, if there is the slightest doubt about the safety of any materials for consumption, discard the item in question.

As with other procedures involving cooking and stoves, remind students to be cautious working around hot stoves and to avoid flammable objects near the stove.

Students will be working with knives to prepare some food; demonstrations and checks for usage skills should form an integral part of the instruction.

Students must never place knives in their pockets.

Motivation
In some cultures it may be challenging to get male students interested in food preparation and preservation. Experience has taught the authors that if such activity is associated with the possibility of making money, then the activity works much better. This is probably equally true for female students.

Prerequisite information
It would be useful to describe how food spoils and to demonstrate the proper procedures to ensure cleanliness.

Demonstrations
Cooking processes.
Drying of meat and/or fruit or vegetables.
Fermenting.
Smoking.
Food cutting.
Grinding with stones or mortar and pestle.

Attitudes
The two most important attitudes that students must understand in this module are cleanliness and safety with respect to knife work.

Summary and review
Technology includes materials and processing as one of its primary arenas. Within this arena, the processing of foods is a critically important human endeavour. Many of the processes employed by the latter also have direct parallels in the industrial world.

Glossary

Contamination	The presence of dirt or germs in food or on work surfaces.
Cooking	Heating of foodstuffs to either convert them from a raw state to a more palatable one, or to reduce the amount of liquid in food.
Craft	Producing one or a small number of things, usually by hand or with limited machines. Typically there will be variation among the products and often they will have an artistic quality about them.
Drying	The removal of water (i.e. dehydration) from foodstuffs so that they do not spoil as quickly.
Fermenting	The conversion of sugar and yeasts in foodstuffs into an alcohol.
Germs	Microscopic organisms that grow in the presence of foodstuffs and that ultimately cause food to spoil, i.e. become unfit or unpleasant for human consumption.
Grinding	Breaking a material, a foodstuff in this module, into many smaller pieces.
Production	Producing a large number of items with minimal variation and a relatively standardized level of quality.
Smoking	The treating of foodstuffs, usually meats, by hanging them in a very smoky atmosphere, usually over a small indirect fire to dry the food and at the same time to infuse flavour from the smoke into the food as well.
Sterilizing	Treating, usually by high heat or chemical means, of materials such as cutting boards, knives, dishes, so that their surfaces are clean and free from germs or contamination.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 6
Food preservation

Post-test

Instructions: *Work by yourself to answer the following questions not using any books, notes or reference materials*.

1. Write a short one- to two-page rationale that presents the reasons why interviews are an excellent way of collecting information about historical and indigenous practices relevant to technology. In your rationale include a description of the problems that can arise from using interviews, and also describe how these problems can be avoided or minimized while still using interviews.

2. List the steps for preserving foods, using each of the following processes:

   A. Drying fruits.

   B. Smoking meats.

   C. Cooking vegetables.

3. Describe two historical and two modern ways of grinding foodstuffs:

   A. Historic 1.

   B. Historic 2.

   C. Modern 1.

   D. Modern 2.

4. Describe two similarities and two differences between personal and commercial food preservation processes.

Module 6
Food preservation

Student guide

Module overview

Think about the food you ate this week. Was it good? Some of it was not even fresh but nevertheless, it was still good. Food preservation made this possible. In this TAM you will learn some secrets and practices of food preservation and preparation that will always be useful to you throughout your life. In this module's activity section you will also learn how valuable our old people are. They remember many practices that could easily be forgotten and lost, unless students like yourself learn what they have already learned long ago.

Objectives

This activity will teach you an important data collection technique, and then it will have you apply what you have learned by preparing and preserving food that you and your classmates will eat later. In doing this, you will also address objectives related to cleanliness and knife safety.

Importance

All food production, whether private for one's family or commercial for business and industry, necessarily requires cleanliness, safety and preservation. Without this, people will become ill, or will have to spend inordinate amounts of their time on food preparation.

Additionally, this activity will teach you a critically important method for securing information. You will be using such methods throughout your life, so learning it here will build a skill that will pay off many times over.

Key information

Class presentations
Interviewing effectively.
Essentials for safe food preparation and preservation.

Demonstrations
Cutting and grinding food.
Drying and smoking food.
Cooking food.

Safety
Safety in food preparation begins with cleanliness. All surfaces must be cleaned and disinfected or sterilized regularly. This is particularly important for porous surfaces such as wood, soft plastics and marble. Naturally, you must also do your part and wash your hands with soap and water, and then dry them with clean towels.

When cooking or drying meats, be certain to raise their temperature to levels where all germs would be killed. Thermometers should be used to confirm this and the required temperatures are readily available in cooking references.

Safety when working with food also requires careful use of knives and other cutting utensils. Be careful to guide the knife in such a manner that your fingers are never under the blade. Also never walk or run with the blade pointing out.

Another important safety guideline is to be extremely cautious around hot stoves and pots. Always be careful to avoid spilling or knocking over hot pots and their contents. Never let the handles stick out over the edge of the stove where they could be accidentally hit. Always remove any flammable objects from the entire stove area, and remember that this includes flammable vapours.

Student activity
Before beginning work on these activities it is recommended that you read any teacher supplied references about the local food preparation and preservation practices. It would also be useful to scan any local cookbooks that might be available. Often these contain useful hints and instructions as well as great recipes.

Materials required

Supplies
Note pad and pencil or pen.
Fruit, vegetables or meat to be prepared/preserved.
Grains to be ground.
Wood to use for smoking.

Heat source such as gas or wood.
Soap, water and hand towels.

Tools and equipment
Cutting board and knives.
Mortar and pestle.
Smoker oven.
Cooking pots and storage containers.

Hand-outs / instructional resources
A local cookbook. Preservation guidelines from home economists or food agencies.
A guide to effective interviewing.

Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
2. Do Activity 1. Identifying historical and indigenous practices.
3. Do Activity 2. Food preparation and cooking.
4. Do Activity 3. Food preservation: smoking and drying.
5. Review and summarize the demonstrations and lessons.
6. Complete post-assessment procedures.

Activity 1. Identifying and documenting traditions: Plan of procedure

1. Make careful notes during instructor presentation on effective interviewing.
2. In a small group, discuss who in your school's vicinity, would be most knowledgeable about long established practices of food preparation and preservation. Also discuss how to best contact these people.
3. Develop an interview guide in your group. This guide should contain clear statements about the purpose of your interview and some key example questions.
4. In groups of two or three, go out after school and interview the people you identified. Be sure to try to compare the comments of at least two different people about each major point you are investigating.
5. As you interview at least two people for each major fact-finding topic assigned by your instructor, record the interviewee's responses carefully on a form that you have specifically prepared.
6. After you have completed all interviews, begin to summarize what you have found out from the people you spoke to. Be sure to get agreement of all interviewees that your summary contains the key points from each interview, and also highlights any major inconsistencies.
7. Write up your summary in a two-page narrative that communicates clearly the findings you have collected from your interviewees.

Activity 2. Food preparation and cooking: Plan of procedure

1. Make careful notes during your instructor's lesson and demonstration.
2. Take the meat and/or vegetables provided and clean them appropriately.
3. Cut the food provided into thin strips for cooking.
4. Grind the grains provided with the mortar and pestle or between the two flat grinding stones provided by your instructor.
5. Check that the food is of the correct size, and that it is still appropriately clean.
6. Cook the food as shown in the instructor's previous demonstration.

Activity 3. Food preservation: smoking and drying

1. Consult your cookbooks for recipes and foodstuffs that are well suited to smoking and drying.
2. Prepare the food provided by your instructor into the correct sizes to encourage effective drying and /or smoking.
3. Build an appropriate fire in the smoker and reduce the flame to the point where sufficient smoke fills the oven.
4. Hang the items to be smoked and/or dried in the oven and leave it in long enough to ensure a dry or thoroughly smoked product.
5. Remove items from the drying rack or from the smoker, and then store in a dry, airtight plastic container, but only after the items have thoroughly cooled.

Technology Activity Module 6: Summary

Review and summary activities

Conduct a student-led class discussion about the interview process. What worked well, and what was difficult. How did having a recording form affect what you recorded for information from the interviews?
Compare and contrast what different participants heard from the same interviewee. Why is this the case?
Conduct a class debate about whether old methods are as good as, or not as good as contemporary methods for food preparation and preservation.

Review questions. Check your comprehension!

What occurs when drying food?
What are the differences between drying and smoking foods?
How can interviews yield better quality data?
Where is grinding still used in food production?
How is grinding and drying used by industry in other fields than foods?

Technology Activity Module 6: Post-assessment

Instructions:
Complete the self-check on the quality of your finished dried and smoked products.
Have the instructor complete the evaluation and discuss discrepancies between the two assessments.
Complete the post-test for Technology Activity Module 6.
If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 7
Textile weaving and dyeing

Instructor guide

Activity objective

The purpose of this activity is to introduce the entire field of textiles into the materials processing technology context. The weaving, knitting, sewing and decorating of textiles represents a major field of technology. It is how humans clothe themselves, and often how they decorate their homes and businesses. Textiles extend into the fields of upholstery and carpets for houses, businesses and automobiles. Often people take textiles for granted, but with today's synthetics, they are really an engineered product.

In the indigenous context, instructors are encouraged to seek out examples of how local peoples clothe themselves, and how they create other products from textiles. Do they make their own thread and yarn? Are their textiles of plant or animal origin? How are the threads assembled? Are they woven or knitted? Look also for how they are decorated. Are the textiles dyed or painted? Is the decoration sewn on? How are the textile pieces assembled to make a product? How is sewing, the most common technique, done? What other textile assembly methods exist? What are the local trends for modernizing the production of textile products?

Module instructions

Introduction

This activity is designed to introduce the field of textiles and its related processes to students. Given the cultural imprinting that exists in many societies, it is likely that this will appeal more to female students than to male. However, the instructor should point out the many very successful males who work with textiles, such as fashion designers and decorators; also, upholsterers tend to be male.

The utilization of textiles involves many of the same sequences, such as needs assessment, design and conceptualization, production, finishing and maintenance, that all technological applications require. As such, students can develop general skills that will serve them well throughout life.

Key content highlights

The area of materials processing that involves textiles includes numerous processes, but perhaps the most common ones are weaving, sewing and decoration (such as dyeing).

Each of these processes can be readily learned, yet each also provides significant opportunity for craft and artistic expression that can become a lifetime calling, and that can certainly yield a lucrative living. Such products can become works of art that are highly sought after. Consider, for example, Persian carpets, Chinese silks and French tapestries.

Materials required

Supplies
Thread and yarns of varying sizes and colours.
Dye and appropriate solvent (usually water).
Wax and applicator brushes.
Cloth appropriate for decorating, e.g. canvas, simple cotton or even simple cotton T-shirts.
Plastic tubs large enough to hold the whole cloth to be dyed.
Absorbent cloth or paper towels.
Rubber gloves.

Equipment
Loom
Electric hotplate
Electric iron

Instructional resources
Any basic reference books on weaving, textiles and batik. These are typically found in the home economics or crafts sections of the library. Also, a basic book overviewing the design process will be useful.

Management / Logistics

Related instructional units
TAM 1. ‘Technological Systems’

Evaluation / Grading

Instructors should focus their assessment of student performance on how well they employ the typical technology design process to identify a need and then design a suitable product that addresses this need in a creative manner using textiles. Additional evaluation should focus on how well the student executes the textile making and decorating processes available in the particular setting.

Suggested schedule / time

This activity, unless it involves a lot of textile creation, can typically be conducted effectively in a two-week period. The instructor should always begin with an overview lesson which should contain many examples of student developed products, as well as commercial ones that have been successful. Subsequently, the instructor should devote at least one period to demonstrating the weaving process and two periods to demonstrating the intricacies of the batik process for decorating fabrics. This technology module should then allow at least one week for students to produce their own products. Because design is an essential element of this activity, the TAM should conclude with a group session wherein students assess each others' products and comment on their strengths and weaknesses.

Key instructional suggestions

Safety
Minimal safety concerns are presented by this student activity. Certainly students should be careful around the loom and any heating involved in dyeing and/or batik work. Perhaps the most important safety consideration is to avoid melting the wax used in the batik process on an open-flame stove. Always use an electrical hot plate for this and be certain to employ safeguards that would prevent the spilling of molten wax.

Motivation
This activity is inherently self-motivating to those students with a creative, artistic flair. Others, however, will need encouragement. Often, the opportunity to generate saleable products that could result in money for the maker helps with motivation. This is particularly true when there is a relatively high market volume for the product.

Prerequisite information
Students should be exposed to the basic design process prior to beginning this activity.

Demonstrations
This activity benefits from having numerous examples of textiles and decorated products available to stimulate student interest. Then, after an initial overview lesson by the instructor, wherein the many examples are shown, the following sequence of demonstrations should be all that is needed to get the students actively making textile products:
Weaving on small looms.
Dyeing textiles.
Decorating textiles using the batik process.

Attitudes
Paramount in this activity is a desire for an appealing product, i.e. one that is attractive. Given the extensive use of colorants in dyeing and batik work, this requires a concurrent emphasis

on cleanliness. Even a well-designed textile product will be deemed unattractive if it is smudged, or if stray colour spots are scattered throughout.

Summary and review

Technology includes both a practical and an aesthetic side. Design is often used to bring these two together. Needs assessment is an essential process to yield a foundation of knowledge that is built upon during the design process, and which ultimately yields the product's specifications. Craft and artistic work generates the actual product which, in the case of textiles, tends to be a combination of a functional item that also involves a significant communication component. For example, the message on a decorated T-shirt.

Glossary

Batik	A process of textile decoration that involves creating a pattern using resists and then dyeing the uncovered portions of the textiles. Often this process is repeated to create complex, multi-colour designs.
Design	The process used to convert needs assessment, capability and resource information into a creative solution, i.e. product.
Dye	A plant-based or synthetic liquid that colours textile materials immersed in it.
Dyeing	The process of immersing textiles into a liquid colorant in order to change the colour of the textile material.
Needs assessment	A process used to identify problems and to clarify desirable characteristics of potential solutions.
Resist	A material that adheres to the textile to which it is applied and that repels dye so that the textile it covers will not be coloured by the dye in which the textile is soaked.
Textile	A piece of cloth, that typically consists of woven threads.
Thread	A thin, long flexible fibre that is typically created by twisting animal or plant fibres together. Contemporary threads are also often made of synthetics, i.e. plastics.
Weaving	The process of interlocking alternating threads across the length and width of a piece of textile material. The simplest forms of weaving involve alternating over and under threads, but many other sequences may be used to create special patterns.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 7:
Textile weaving and dyeing

Post-test

Instructions: *Answer the following questions by working independently and without the use of any books or notes.*

1. Indicate the major purpose(s) of the needs assessment process.

2. Critique the following statement: *Design is the process of making a product pretty*.

3. List three examples of woven textiles:

   A. _____

   B. _____

   C. _____

4. How is the wax-based resist removed from batik decorated materials?

5. Which of the following is not a typically used way of applying the wax resist in batik work?

   A. Brush

   B. Spray gun

   C. Applicator pen

   D. Wood applicator

Module 7
Textile weaving and dyeing

Student guide

Module overview

This module will teach you about needs assessment, design, weaving textiles and decorating them using the batik process. As such, you will be engaged in both materials processing and in communication processes

Objectives

This activity will develop your ability to weave small items. Additionally, you will learn how to dye and how to decorate textiles using a world famous batik process.

Importance

Look around. The chances are that at least several of your classmates are wearing decorated clothes. If not in school today, how about out on the streets or when at play? Do you not find some of the decorations attractive? Do some of them convey messages such as the name of a sports team or a picture of something attractive? In this activity module you will learn, not only how to make a piece of textile material, but also how to decorate it attractively. Well done, you will even be able to make a saleable product that could be used to earn some money.

Key information

Class presentations and demonstrations
Conducting and interpreting needs assessments.
The design process.
Weaving as a form of materials processing.
Dyeing textiles.
Batik decorating.

Safety
Avoid getting fingers caught in the many moving parts of mechanical looms.
Wear rubber gloves when immersing your hands in textile dyes.
Be careful not to spill molten wax when doing batik work.
Be certain to use only an electric hot plate to melt wax. Never use an open-flame stove.

Student activity
Before beginning work on these activities it is recommended that you read a basic book describing the design process. Then review one on the batik process so that you can develop an appreciation for the many opportunities this process allows.

Materials required

Supplies
Thread and yarns of varying sizes and colours.
Dye and appropriate solvent (usually water).
Wax and applicator brushes.
Cloth appropriate for decorating, e.g. canvas, simple cotton or even simple cotton T-shirts.
Plastic tubs large enough to hold the whole cloth to be dyed.
Absorbent cloth or paper towels.
Rubber gloves.

Tools and equipment
Loom
Hot plate (electric)

Hand-outs / Instructional resources
TAM 1: 'Technological Systems'

Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions and, by review, the steps of procedure.
2. Complete the pre-test given by your instructor (if assigned).
3. Do Activity 1: Conduct needs assessment and design process.
4. Do Activity 2: Weaving textiles.
5. Do Activity 3: Dyeing textiles.
6. Do Activity 4: Decorate textiles with batik.
7. Review and summarize.
8. Complete post-assessment procedure.

Activity 1. Conduct needs assessment and design process

1. Form several small teams from the members of your class. Try to mix the skills and talents in each group so that there is a blend of artistic and technological characteristics in each team.
2. Have all the class agree on a specific type of textile product, for example a school T-shirt, that would benefit from decoration and that could be marketable.
3. Have each team conduct a needs assessment of potential customers to identify desired characteristics of the product to be made.
4. After the needs assessment data have been collected, conduct a team meeting to design the product to be made in accordance with the customers' perception of needs and interests.
5. Work with your instructor to finalize the design for the product to be made, and estimate how many can be sold.

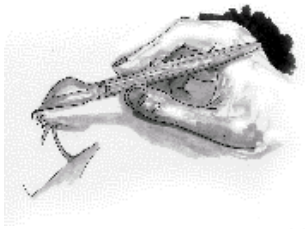
Activity 2. Weaving textiles

1. Watch your instructor's demonstration of how to weave on the small loom in your class.
2. Thread the loom with the yarns needed to make the product that the loom is set up for.
3. Manipulate the shuttle and the loom controls to create the pattern that you want in the product.
4. As you weave, be sure to apply tamping pressure to the fabric you are weaving so that it is sufficiently tight.
5. When finished, have your instructor check your work, then remove the product from the loom and allow the next student to start his/her work.

Activity 3. Dyeing textiles

1. Watch your instructor's demonstration of the dyeing process.
2. Prepare the amount of textile you wish to colour with dye.
3. Mix the dye to the colour of your preference and pour it into a dish large enough to hold all the fabric you wish to dye.
4. Immerse the fabric into the dye and let it soak for the specified length of time.
5. Carefully wring out the dye when ready and hang up the fabric to dry in a place where drips will not stain the floor and where the wet fabric will remain clean.
6. Pour the excess dye into a sealable container that prevents air from getting to it.

Activity 4. Decorating textiles using the batik process



1. Watch your instructor's demonstration of the batik process.
2. Select an appropriate product or cloth to be decorated.
3. Develop a paper pattern, full size, of the design you wish to create on the cloth. Indicate which colours go where, and then get your instructor's feedback and approval.
4. Melt wax in a pot on an electric hot plate, and then apply it to the cloth where, according to your pattern, the first resist should be. Remember, everything will be dyed where there is *no* resist.
5. Double-check your work to ensure that there is a solid coating of wax wherever you want to protect the fabric.
6. Now soak your fabric carefully in a tray of the first dye to be used.
7. After drying, remove the wax resist by ironing the dyed cloth between wax absorbing layers of paper towels or cloth. Use an electric iron to melt the wax out of the cloth.
8. Repeat the above steps until your cloth is completely coloured the way your pattern is laid out.
9. Have your instructor assess your work.

Technology Activity Module 7. Summary

Review and summary activities

Participate in your instructor's summary lesson.
Compare and discuss the attributes of the various products produced by your class members.
Discuss which products best address the customer needs.
Identify what you would do differently if you were to produce another product.
Create a flow chart to communicate the design process that your class would recommend to the next class.

Review questions. Check your comprehension!

What does needs assessment do?
How does the design process differ or not from the engineering process?
How can weaving be varied to yield different products?
What are the advantages and disadvantages of dyeing materials as compared to painting them?
What are the strengths of the batik process?

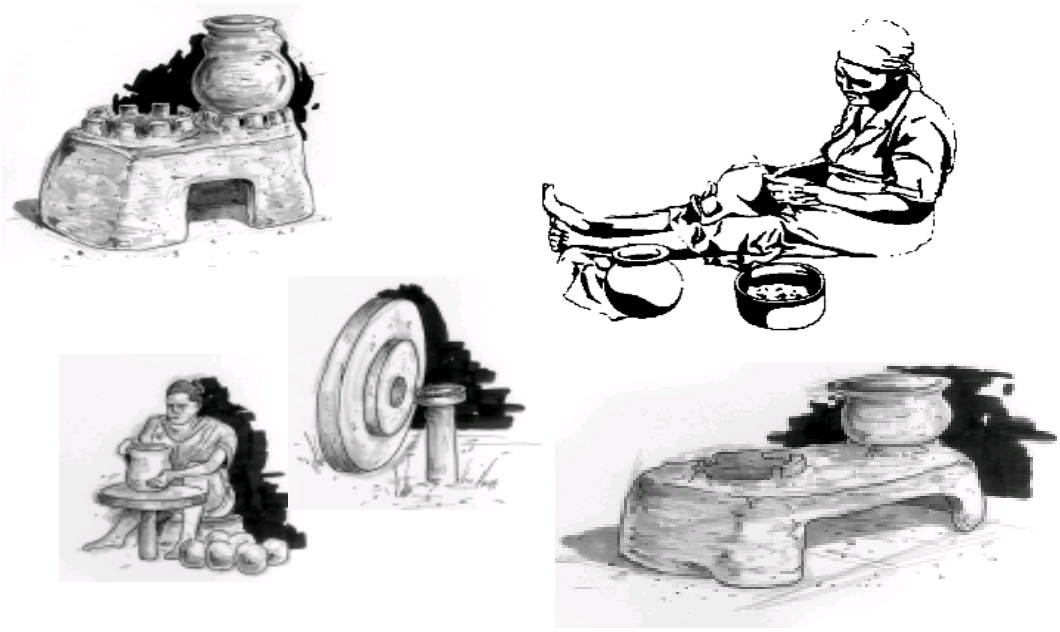
Technology Activity Module 7. Post-assessment

Instructions

1. Complete the self-check on the products you made and submit them to your instructor.
2. Have the instructor complete the evaluation and discuss discrepancies between the two assessments.
3. Complete the post-test for TAM 7.
4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 8
Manufacturing pottery

Instructor guide



Activity objective

The purpose of this activity is to introduce students to the forming and thermal conditioning aspects of materials processing. Historically, almost all people have engaged in one form of pottery or another. The process lends itself well to school settings and, even without machines, desirable products can be made relatively easily. Furthermore, because of the workability of clay, forming processes can be employed and used to show students procedures that would require extraordinary investments if working with metals or plastics.

Module instructions

Introduction

Manufacturing pottery can involve many processes such as casting, pressing, jiggering and jollying. This activity module, however, will focus on the traditional process of throwing pottery on a wheel. The lessons will address finishing and firing, but only in passing. Glazing is an aspect that is an art in itself and therefore it will only be addressed in a cursory form.

Key content highlights

The manufacture of pottery involves shaping clay in one way or another. Subsequently it is dried, and only when completely dry it is fired in a kiln wherein the temperature rises high enough for the clay particles to melt and fuse together somewhat. Usually it is the silicates in the clay that do this. After initial firing, the pottery pieces are often glazed, i.e. coated with a glass powder that when refired to a temperature below that of the original firing, melts and forms a complete coating over the clay to render it completely watertight and at the same time to decorate it.

The process for shaping clay on a potter's wheel is called 'throwing' and it requires considerable practice. The instructor should be prepared to have students experience considerable frustration when learning to throw clay, but the basic skill comes soon, and from then on the process is most rewarding. Fortunately, there are alternative processes (such as slab forming and pinch forming) that students who seem unable to learn throwing within the available time can still employ to generate a desirable product.

Materials required

Supplies
Clay and clay slip (thick liquid clay).
Plaster of Paris or other absorbent surface.
Glaze.
Brushes.

Equipment
Potter's wheel.
Kiln.

Instructional resources
Any basic book on pottery to describe and illustrate the key steps. Craft oriented books are preferable to ones with an art orientation.

Management / Logistics

Related instructional units
TAM 1. 'Technological Systems'

Evaluation / Grading
Instructors should focus on the students' mastery of the overall process of creating and finishing usable products using the throwing process. Overall skill is one dimension reflected in the product but an equally important one is the overall design. Poorly proportioned objects not only do not please the eye, but they are often less functional as well.

Suggested schedule / time
The instructor needs to begin this module with a systematic overview presentation of the entire sequence of steps involved in making and finishing a clay product. This lesson will be significantly enhanced if the instructor can show students examples of products at each stage. Following such a start, the instructor needs to show students how to prepare clay by wedging it, and then he/she needs to demonstrate how to throw the pot on the wheel.

These demonstrations need to be followed with others on finishing, drying, firing and glazing the clay products. Shorter demonstrations on alternative clay forming techniques such as slab forming, pinch forming, jiggering and slip casting could well be interspersed with the primary demonstrations. This will provide the students who find throwing difficult to learn with an alternative method that will still yield a good product.

When finished, the instructor should summarize the process and highlight its similarity to other materials processing, with metals, plastics and glass.

Key instructional suggestions

Safety
Pottery work fortunately involves a minimum of safety challenges. Perhaps the most important is to be careful when firing the clay products because the temperatures are so extremely high and because the product takes so long to cool off. Another precaution that should be noted is that some glazes give off dangerous fumes when firing so the kiln area needs to be well ventilated.

Motivation
Once students see throwing demonstrated, most of them want to try it themselves. It looks so easy and fun. They quickly become frustrated, however, when things are found to be more difficult than what they seem at first sight. Instructors should be prepared to offer much encouragement and to stimulate perseverance. For those who persist, the payoff will come soon and be significant.

Prerequisite information
Little prerequisite knowledge is needed other than that which is demonstrated by the instructor in his/her first overview lesson. A glance through a basic crafts-oriented pottery book would be useful.

Demonstrations
This module benefits from numerous demonstrations because the work involves so many chained operations. Much of the important content is better shown than talked about. The suggested demonstration sequence is:
Overview of the entire process.
Demonstrating of clay preparation and wedging.
Demonstrating the throwing process on the potter's wheel.
Finishing, drying and firing.
Decorating.
Alternative forming processes (slip casting, slab forming, jiggering).

Attitudes
Perhaps the most important attitude component to success in manufacturing pottery, at least when using the wheel-throwing method, is that of perseverance. Success will not come immediately, but once learned it will stay with students for life.

Summary and review
The materials processing sector of technology is obviously an important one. It includes engineering materials, foods and textiles, etc. This activity module introduces students to the processing of clay materials that lend themselves to forming process which are generally difficult to demonstrate with other materials. The module also introduces ceramic materials

such as the glazes employed to seal pottery. Finally, the making of pottery requires the use of very high temperatures, i.e. thermal conditioning.

Glossary

Clay	A silica rich earth that is very formable when moist and that can be fired to yield a very strong durable product.
Fettle	To trim clay products usually when they are in a leather-hard stage.
Fire	To heat a clay product to a high enough temperature so that the clay particles just begin to fuse together.
Glaze	A liquid carrying glass powder that melts to create an impervious coating over a clay product.
Jiggering	Shaping of round objects like plates on a potter's wheel using a mould.
Kiln	A very high temperature oven, typically fuelled by either electricity or gas.
Pinch forming	The forming of a lump of clay into a usable object using nothing but the fingers.
Potter's wheel	A horizontally spinning round table usually mounted on a bearing to minimize friction. Often they are equipped with a flywheel that is foot powered, or powered by an electric motor.
Slab forming	To create a clay product out of rolled out sheets of clay joined at the corners with mechanical pinching and slip to help adhesion.
Slip	Thick liquid clay.
Thermal conditioning	Crafting new material properties by means of temperature.
Throw	To create a clay product on a rotating potter's wheel.
Wedge	To knead clay on a plaster bat in order to make it of even consistency throughout, and to remove all air pockets.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 8: Manufacturing pottery

Post-test

Instructions: *Answer the following questions working by yourself and without any notes or reference materials*.

1. Clay is:
   A. An organic material.
   B. A ceramic material.
   C. A metallic polymer.
   D. A composite material.

2. Pottery products are typically not made using:
   A. Throwing.
   B. Slip casting.
   C. Pinch forming.
   D. Welding.

3. Describe the steps to be followed in making a pottery object on the potter's wheel:

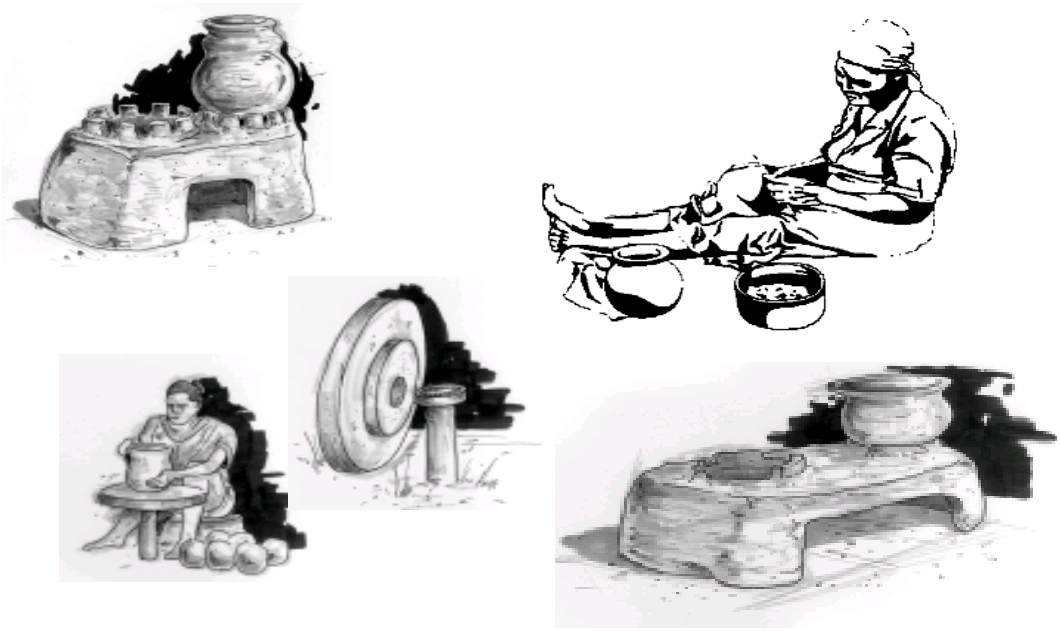
4. What would happen if a damp object is placed in a kiln?

5. What is glaze and what is its function on a clay object?

6. What would or would not happen if the temperature in a kiln does not get high enough when firing a product the first time?

Module 8
Manufacturing pottery

Student guide



Module overview

By now you will have made many things in your classes at school. You have used woods metal, paper and perhaps even plastic. Now, however, you will learn one of humankind's oldest and yet most enduring ways of shaping materials and forming extremely durable and useful objects. You will employ both manual shaping and machine processes. Additionally, you will use thermal conditioning as well as decorative processes. You will be challenged, and at the same time you will find great satisfaction in your successes.

Objectives

This activity will develop your ability to shape objects from clay and then condition them so that they become strong, durable, attractive and useful to people. You will learn the importance of both skill and perseverance in this activity. And, if you wish, you will develop a capability that you can use to create valuable artistic products throughout your life.

Importance

The shaping of clay has been an important means of making pottery throughout history. Even today we are still discovering useful clay objects that date back thousands of years.

Key information

Class presentations
Overview of the entire clay product manufacturing process.
Clay and glaze materials.

Demonstrations
Wedging and preparing clay and slip.
Throwing a simple clay pot on the potter's wheel.
Finishing and fettling clay products.
Decorating and glazing clay products.
Loading kilns and firing.
Slip casting, pinch forming and slab forming clay products.

Safety
Watch out for the high temperatures around kilns when firing, and allow a very long time for the products to cool after firing.
Avoid breathing in clay dust.
Fire the clay and glaze products only in well-ventilated areas.

Student activity
Before beginning work on these activities it is recommended that you read a basic book on making clay products. If at all available, a video tape of the process would be very useful, but the instructor's demonstrations could provide similar information.

Materials required

Supplies
Clay and clay slip (thick liquid clay).
Plaster of Paris or other absorbent surface.
Glaze.
Brushes.

Tools and equipment
Potter's wheel.
Kiln.

Hand-outs / Instructional resources
TAM 1. 'Technological Systems'

Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material and by reviewing the steps of procedure.
2. Complete the pre-test given by your instructor if assigned.
3. Do Activity 1. Wedging clay and preparing slip.
4. Do Activity 2. Throwing on the potter's wheel.
5. Do Activity 3. Fettling and finishing clay objects.

6. Do Activity 4. Firing the kiln.
7. Do Activity 5. Glazing clay objects.
8. Review and summarize.
9. Complete post-assessment procedure.

Activity 1. Wedging clay and preparing slip: plan of procedure

1. Take the chunk of clay that is given to you by your instructor and start kneading it on the plaster bat. The goal is to make it evenly soft and pliable – but do not get it too wet.
2. Periodically cut through the clay with a wire and check to ensure that there are no air pockets in the clay.
3. Keep kneading until the entire lump is of even consistency and texture.
4. Let the clay sit for approximately fifteen minutes. During this time, start preparing the slip.
5. Take a handful of clay and start mixing it with a small amount of water in a bowl.
6. Keep squeezing the clay through your fingers in the water until you create an evenly thick paste or liquid clay about the consistency of heavy cream.
7. Place this slip in a plastic bottle and cap it to keep out air and contaminants.

Activity 2. Throwing on the potter's wheel: plan of procedure

1. Take the lump of clay you prepared in Activity 1 and literally throw it on to the centre of the potter's wheel. Usually such wheels have concentric rings on it to help with centring.
2. Sit down on a strong stool in front of the wheel, tuck your elbows firmly to your side and then with the clay rotating with the spinning potter's wheel, press down on to the top centre of the clay to press the clay firmly on to the wheel.
3. Then, with your thumbs still pressing on the centre of the spinning clay, use the rest of your hand and gradually and smoothly apply sideways pressure on the clay lump to round it off and to better centre it on the wheel.
4. Keep wetting your hands to keep the clay rotating smoothly on your hands.
5. Once the clay is centred, keep even sideways pressure on the rotating lump of clay while at the same time gradually pressing your thumb into the top centre to create an opening.
6. Gradually enlarge this opening, and by working the rotating clay between your fingers, gradually shape the object to the desired form.
7. When the shape and wall thickness are correct, use a wire to cut the pot free from the potter's wheel and set the clay pot you have just created aside to dry slowly.

Activity 3. Fettling and finishing clay objects: plan of procedure

1. Once the clay pot has become leather-hard, it will be in a condition where it has considerable strength, but it is still moist enough to be worked easily.
2. Now use a knife and other trimming tools to smooth off edges and carefully reshape the object where needed.
3. You can scratch any design of your choosing into the surface of the clay object using any tool that seems appropriate.
4. After finishing, set the clay object aside to dry completely.

Activity 4. Firing the kiln: plan of procedure

1. When the clay objects to be fired are all completely dry, arrange the objects in the kiln so that they will be heated evenly.
2. Close the kiln and turn on the heat. If you have a temperature control, regulate as specified by your instructor.
3. Fire the kiln for the specified time and temperature after which it is to be shut down and let to cool. Typically this takes several days.
4. Unload the kiln and examine each object.

Activity 5. Glazing clay objects: plan of procedure

1. Mix the desired glaze so that it is of even consistency.
2. Using appropriately sized brushes, apply the glaze to the object wherever a coating is desired.
3. Remember glazes can be mixed.
4. Multiple layers of glaze often create interesting effects.
5. Allow the glazed object to re-dry completely.
6. Re-fire the glazed object in the kiln for the temperature and time needed by the particular glaze you have applied.

Technology Activity Module 8. Summary

Review and summary activities

Compare the various products produced by students in your class. How are they similar and different?

Watch other students throw. Are their techniques for centring and raising the shape the same, or does each have a different style?

Which style seems most effective and why?

How do the various glazing techniques compare?

Review questions – check your comprehension!

What occurs when wedging the clay?
Why is it important to have the clay completely dry before firing it?
How can the clay be centred on the wheel more easily?
What does one do with a broken or misshapen pot before one is finished with the throwing process?
What determines how hot and how long to fire a kiln?
Can glazes be mixed and why?

Technology Activity Module 8. Post-assessment

Instructions

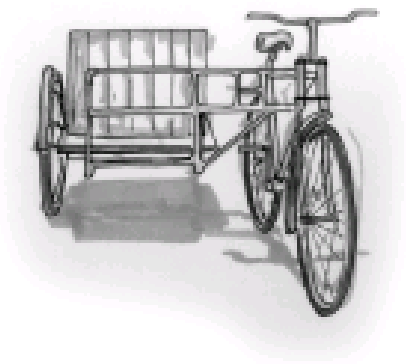
1. Complete the self-check on this activity if assigned by the instructor.
2. Have the instructor complete the evaluation and discuss discrepancies between the two assessments.
3. Complete the post-test for TAM 8.
4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

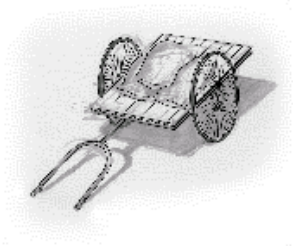
Unit 4

Energy and power technology

Module 9
Bicycle technology

Instructor guide





Activity objective

The purpose of this activity is to have the student consider energy and power principles while designing and building a bicycle component-based transportation vehicle that meets the local needs.

Module instructions

Introduction

This activity is aimed at helping students to design a cost effective and workable solution to a local transportation need. The type of problem envisioned is an open-ended ambiguous one, and there will invariably be more than one that could work. Because of the nature of this problem scenario, it lends itself well to a competition where student teams compete to generate the winning solution. As such, this activity can emulate quite well competitive practices found in the business world.

Key content highlights

The processing outlined for student learning in this module guides them through the typical four-step process used in much of technological activity: (a) needs assessment; (b) design; (c) construction; and (d) testing. Problem-solving of various types will be required as will be the establishment and weighing of various criteria to assess potential solutions and procedures.

Materials required

Supplies
Bicycle components.
Welding rods and electrodes.
Welding gas.
Graph paper.

Equipment
Oxy-acetylene welding kit.
MIG welding kit.
Welding safety equipment (goggles, gloves, aprons, etc.).
Grinders.
Drill presses.
Metal-working hand tools.
Wrench and socket set.
Measuring tools.
Clamps.

Instructional resources
Basic metal-working handbook.
Bicycle component handbook.

Management / Logistics

Related instructional units
TAM 1. 'Technological Systems'

Evaluation / Grading
This activity can involve two different sets of evaluative criteria and even a combination thereof. One treats the primary function of this unit as a design and problem-solving exercise. The other views this activity as a construction project. Instructors are free to even employ a combination of these two criteria sets, as long as they communicate the weighting of each set to the students.

Suggested schedule / Time
The nature of this activity is that it could range from a month to an entire year. It depends on how much time is available, and how much the instructor wishes to emphasize this content. As a minimum, students should be allocated a two-week needs assessment and design block. Construction will normally require a minimum of three weeks, and testing another two.

Key instructional suggestions

Safety
Typical metal-working safety precautions will need to be applied.

Motivation
The nature of this unit is that it lends itself very well to a competitive exercise just as experienced by real world companies when they compete for contracts. The instructor could form student teams to compete for the award of a contract to serve the local needs.

Prerequisite information
To be effective in addressing this unit's objectives it is expected that students will already have mastered basic metal-working skills as well as needs assessment ones, such as interviewing. They will need to be able to sketch, and also to be able to create a viable testing programme for their prototype vehicles.

Demonstrations
Welding with MIG.
Welding with oxy-acetylene.

Attitudes
The important attitudes central to this activity are those that pertain to safe work in a metal-working environment. Additionally, in order to meet the objectives of this unit, students will need to commit themselves to solving the problems of a client / customer group that is probably quite unlike them.

Summary and review
This activity requires students to grapple with unstructured and ambiguous problem situations as they navigate through the four stages: (a) needs assessment; (b) design; (c) manufacturing; and (d) testing.

Glossary

Design	The process of developing prototype solutions to a problem or need.
MIG	Metal inert gas welding involves a consumable wire feed electrode.
Open-ended problem	A situation where there is more than one plausible solution.
Prototype	A working model of a solution that can serve as a test bed to judge whether all design needs/criteria have been adequately addressed.
Testing	The assessment of a prototype solution's functioning.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 9:
Bicycle technology

Post-test

Instructions: *Working in your student teams, generate one group answer to each of the following questions. You may not use any references or notes but you are encouraged to talk among your team members.*

1. How can you be sure that you have conducted an effective needs assessment?

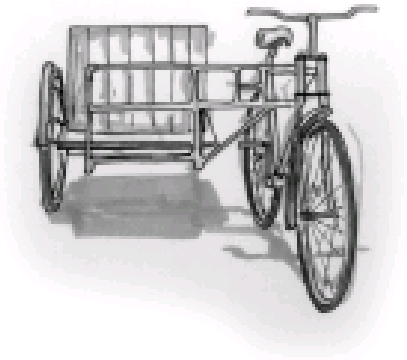
2. How does a team properly handle a design situation where it needs some skills or knowledge that its members do not possess?

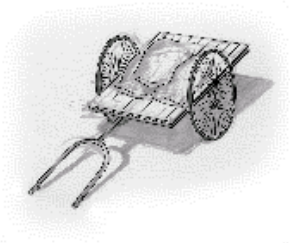
3. How would a design team approach an open-ended problem differently than a very defined one?

4. What are the essential criteria for an effective assessment of a prototype device/solution

Module 9
Bicycle technology

Student guide





Module overview

This is a most challenging activity module. You will be designing a bicycle component-based transportation vehicle that will effectively meet local needs, and that also will be cost effective and easily manufactured. After this has been accomplished you will systematically test your prototype

Objectives

The purpose of this module is to help you learn how to handle unstructured technological problem-solving by stepping systematically through the needs assessment, design, manufacturing and testing phases of activity.

Importance

This is a most realistic situation. Often companies are in competition for a contract that will be awarded, based on the evaluation of a prototype solution. Your instructor has configured this activity to generate just such a situation.

Key information

Class presentations
Needs assessment procedures.
Design processes.
Considerations in metal-work project planning.
Designing effective prototype testing processes.

Demonstrations
MIG welding.
Oxy-acetylene welding.
Bicycle component assembly.

Safety
Students need to remember and apply all basic metal-working safety procedures. You will need to wear proper protective clothing in the workshop, and that includes eye protection at all times.

Student activity
Before beginning work on these activities it is recommended that you read a basic book describing bicycle components and their repair and adjustment.

Materials required

Supplies
Welding supplies.
Basic metal-working supplies.
Graph paper.

Tools and equipment
Metal-working and welding equipment.
Mechanic's tools for assembling parts.

Hand-outs / Instructional resources
TAM 1. 'Technological Systems'

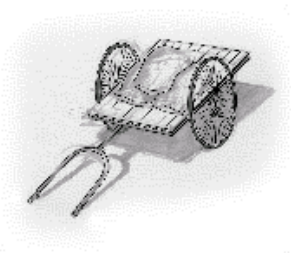
Activity sequence

1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material and by reviewing the steps of procedure.
2. Establish teams from the class members and begin role-playing competitive companies.
3. Do Activity 1. Conduct the needs assessment within your local community pursuant to the design brief supplied by your instructor.
4. Do Activity 2. Design several potential solutions and select the most appropriate one, given the results of your needs assessment.
5. Do Activity 3. Manufacture the prototype solution.
6. Do Activity 4. Test the prototype solution systematically.
7. Review and summarize.
8. Complete post-assessment procedure.

Activity 1. Conduct transportation needs assessment: plan of procedure

1. Identify the client groups highlighted in your instructor's design brief.
2. Plan on how to best sample and collect information from them.
3. Develop a data collection instrument or protocol.
4. Use the instrument or protocol to collect the required needs assessment data.
5. Validate that the process is working effectively.
6. Analyse and summarize the needs assessment results and write them in proper report format.

Activity 2. Design the prototype solution(s): plan of procedure



1. Review the summary of the needs assessment data.
2. Develop criteria to be used to assess the potential solutions that will be developed.
3. Develop several plausible alternative solutions. It is very important that you develop more than one potential solution at this stage.
4. Apply the criteria you developed in Step 2 of this activity and select the potential solution that your team deems best.
5. Develop a narrative rationale on why you chose the particular solution that you did, and write it up so that others can review it.

Activity 3. Manufacture the prototype solution: plan of procedure

1. Review the selected prototype's design specifications.
2. Build the prototype from the available components and employing conventional metal-working processes. Always employ all appropriate safety precautions while building the prototype.

Activity 4. Test the prototype solution: plan of procedure

1. Review the design specifications for the prototype that you built.
2. Develop a systematic testing programme where the eventual consumer tests it in its actual settings.
3. Allow the potential users to test the prototype and observe this usage. Be sure to record all appropriate evaluative data.
4. Analyse the results and either redesign the prototype to improve its performance or to ease its manufacture.
5. Develop an assessment report and write it up for your instructor.

Technology Activity Module 9. Summary

Review and summary activities

Review the summary reports that your team created during each phase of this project.
Interpret the findings and ascertain whether you were gradually arriving at an effective solution, or whether your team ended up more divergent than when you started?
Invite an industrialist into your class and have him/her comment on the effectiveness of your procedures.

Review questions – check your comprehension!

What are the most important aspects of a good needs assessment?
What should occur before using the needs assessment instrument or procedure to collect data?
Why are design selection criteria important, and why should they be evaluated before potential solutions are developed?
Debate the point of whether it is necessary to actually be able to employ and understand metal-working processes in order to be a good designer?
What are the essential prerequisites to an effective prototype testing programme?

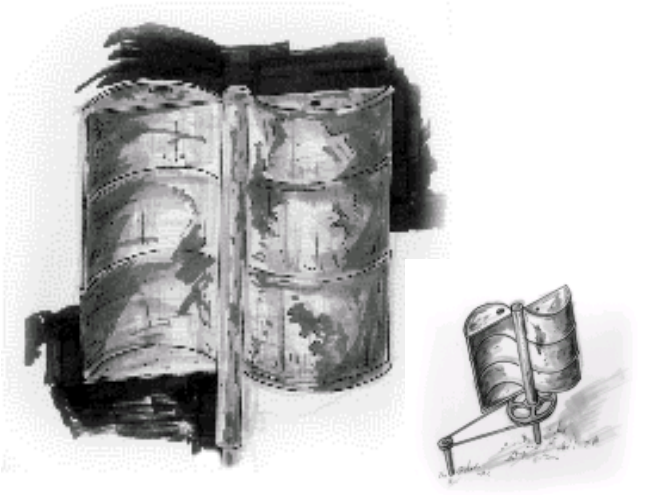
Technology Activity Module 9. Post-assessment

Instructions:

Complete the narrative reports required at the end of each of the four activity phases.
Have the instructor complete his / her evaluation and discuss discrepancies between the two assessments.
Complete the post-test for instructional unit 9.
If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 10
Wind power generation

Instructor guide



Activity objective

The purpose of this activity is to have students consider design requirements for wind power devices, to assess indigenous approaches and materials used to develop power, and then to build prototype versions of these to meet local needs.

Module instructions

Introduction
This activity is designed to have students apply power technology principles to the design of wind power systems to pump water and to generate electricity. The intent is to have practical and affordable devices built that could actually be deployed where needed in poor or remote areas.

Key content highlights

The student activity expected in this module mirrors that of TAM 9 in that the sequence is (a) needs assessment; (b) design for two applications; (c) construct; and then (d) test. This time, however, the application arena is the effective generation of mechanical power to pump water or to generate electricity, in contrast to TAM 9's focus on transportation. Naturally, safe workshop procedures will also be required in this activity.

Materials required

Supplies
Graph paper.
Design software (if available).
Basic metal supplies and welding supplies.
An assortment of mechanical components such as pulleys, bearings, shafts, etc.

Equipment
Water pump.
Electrical generator or alternator.
Batteries for electrical power storage.
Welding and metal-working machines.
Appropriate hand tools.

Instructional resources
Basic references for mechanical and electrical power technology.

Management / Logistics

Related instructional units
TAM 1: 'Technological Systems' and TAM 9: 'Bicycle Technology'

Evaluation / Grading
For the evaluation of the student, instructors should focus on the overall effectiveness of the solution as demonstrated by the prototype's effectiveness in meeting the design specifications. As such, satisfactory performance will require an effective synthesis of design, and actual manufacturing skill. Because this project will likely involve a team of students working together, the instructor will also need to monitor that each student is carrying an appropriate part of the load.

Suggested schedule / Time
This activity requires as much time as is available. In any case, as a minimum, instructors should schedule at least six weeks for this activity. It is also important that the instructor provides a clear programme at the start of the module, and that he/she conduct a systematic review and summary at the end. The latter should not be shorter than two days.

Key instructional suggestions

Safety
Normal metal-working and electrical safety rules apply in this module.

Motivation
Students will find the challenge given in the design brief to be inherently motivating. This will be particularly true if forming teams where each member is free to contribute and work in the areas of greatest interest to them.

Prerequisite information
By the time students tackle this unit they will have considerable experience with the design process, as well as with the various materials processing technologies that are essential to success.

Demonstrations
Overview of power transmission devices.
Wiring of electrical generators/alternators.

Attitudes
This unit requires no different attitudes than what was already emphasized in TAM 9. Naturally, safe working habits will be important, as will be the exercise of an appropriate amount of care around electricity.

Summary and review
This activity focuses on the design and construction of wind powered systems that will either pump water or generate electricity. Students are expected to proceed through a systematic problem-solving and manufacturing phase.

Glossary

Crankshaft	A device that converts rotary motion to reciprocating motion, or vice versa.
Propeller	An aeroplane-like rotating fan.
Reciprocating	Motion that moves back and forth in a straight line.
Savonius	A type of windmill that uses offset half cylinders to catch the wind.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 10:
Wind power generation

Post-test

Instructions: *Answer the following questions by working within your team. You are free to use any references to which you have access.*

1. What are the most critical steps in establishing the design specifications for wind power systems?

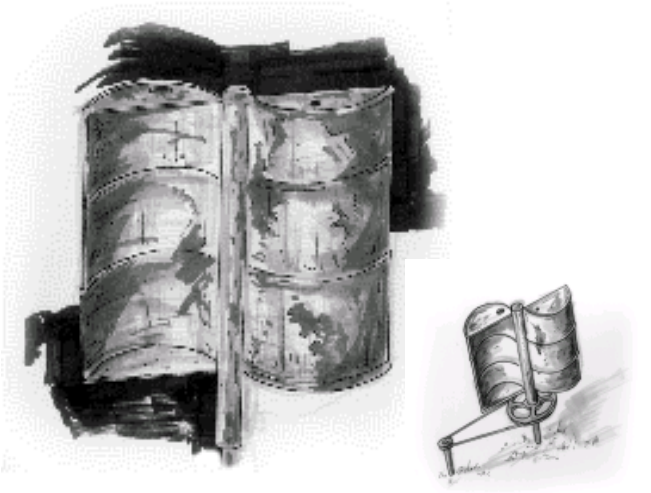
2. How can wind power be stored for use even if there is no wind?

3. What are typical friction losses and how can they be minimized in wind power systems?

4. Are wind power systems better suited for electrical power generation or for pumping water? What are the relative efficiencies of each?

Module 10
Wind power generation

Student guide



Module overview

You will recall the teamwork you did in working on the bicycle transportation design requested in TAM 9. Well, this module invites you to engage in a similar activity but this time it is one that will require more design, engineering and thought. You are asked to build two commercially viable prototype wind power systems, one to pump water and the other to generate electricity.

Objectives

This activity requires that you employ the needs assessment, design, manufacturing and testing cycle again – only this time with a greater amount of in-depth calculations. You will need to assess the amount of energy potentially available from wind in your region, then you will look at a conversion mechanism, and finally you will design and test a set of solutions. Because this is an activity that requires more than what any one person can accomplish, you will need to learn to work in teams effectively.

Importance

Wind energy is a renewable resource and one that does not generate pollutants when using it. As such, if effective solutions to the design challenge can be found, the result will be a greatly increased quality of life for those in remote areas, and it should yield considerable recognition and potentially even financial reward to the designers.

Key information

Class presentations and demonstrations
Engineering electrical power and storage systems.
Converting mechanical power.
Effective teamwork.

Safety
Normal metal-working and shop work safety rules must be followed.
Eye protection is essential.
Safety straps must be used when climbing on high windmill towers.

Student activity
Before beginning work on these activities it is important to form effective teams that consist of a range of skills. Uni-dimensional teams will not be effective in addressing complicated problems such as those assigned in this activity.

Materials required

Supplies
Metal standard stock.
Electrical wiring.
Bearings and mechanical system components.

Tools and equipment
Soldering equipment.
Electrical meters.
Mechanical tool sets.

Hand-outs / Instructional resources
Basic reference books for electrical power generation systems.
TAM 1. 'Technological Systems'
TAM 9. 'Bicycle Technology'

Activity sequence

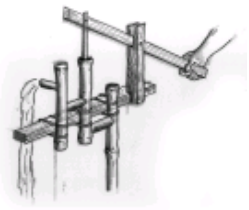
1. Participate in your instructor's start-up activities and presentation for this instructional unit. Follow all instructions, e.g. reading the assigned material, and by reviewing the steps of procedure.
2. Review the design brief assigned to your team by your instructor.
3. Do Activity 1. Perform needs assessment.
4. Do Activity 2. Design alternative solutions.
5. Do Activity 3. Manufacture prototypes.
6. Do Activity 4. Test prototypes.
7. Review and summarize.
8. Complete post-assessment procedure.

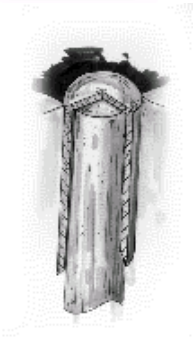
Activity 1. Conduct needs assessment: plan of procedure

1. Review literature on wind power systems for electrical generation and water pumping.
2. Establish the potential customers for such systems, and identify how to sample them.
3. Develop data collection instruments and/or protocols to secure the needs of the clients.
4. Conduct the needs assessment and validate the data collection process.
5. Summarize the needs assessment findings.
6. Write up the results of the needs assessment in a formal report form.

Activity 2. Design prototype applications: plan of procedure

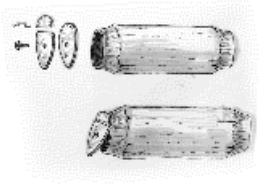
1. Develop alternative selection criteria for electrical and water pumping systems.
2. Design and detail several wind power systems for electrical power generation.
3. Design and detail several wind power systems for pumping water.
4. Use the criteria you established to select the best prototype.





Activity 3. Construct prototype applications: plan of procedure

1. Detail each part to be made, e.g. the pivot bearing and the valve mechanism shown on the right, before beginning construction.
2. Employ standard metal-working skills and produce each part required to make the two selected alternatives.
3. Install the two prototypes.



Activity 4. Test prototype applications: plan of procedure

1. Implement electrical generation and water pumping systems.
2. Test the performance of these wind power systems over a period of months.
3. Analyse and summarize the test data, and develop a formal narrative summary report.

Technology Activity Module 10. Summary

Review and summary activities

Invite a team of industrial experts to come to your school.
Have students present the summary reports of each phase as well as an overall one.
Compare student generated solutions to those of industry.
Reflectively, identify the most important skill you learned through this activity.

Review questions – check your comprehension!

How are the demands of water pumping systems different from those generating electricity?
How can energy be stored for effective use later?
Why is there so little action in terms of commercially produced alternative electrical and pumping systems?
Compare and contrast the relative advantages of small and large teams?

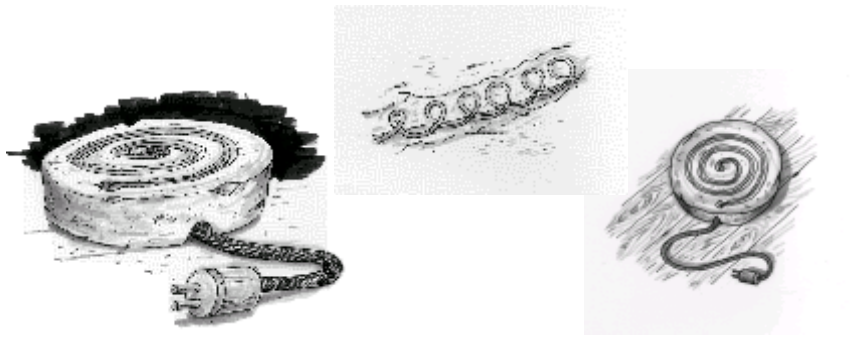
Technology Activity Module 10. Post-assessment

Instructions:

1. Compare a self-check on each formal report submitted.
2. Have the instructor complete the evaluation and discuss discrepancies between the two assessments.
3. Complete the post-test for TAM 10.
4. If your results demonstrate mastery, go on to the next instructional unit or activity assigned by your instructor. If less than completely successful, see your instructor and plan what to do to raise your level of mastery.

Module 11
Electrical wiring

Instructor guide



Activity objective

The purpose of this activity is to introduce the key concepts of electricity and electrical wiring to students. Additionally, instructors should ensure that students are aware of the rudiments of electrical safety.

Module instructions

Introduction

This activity is designed to make students learn to respect the dangers of working with electricity, as well as the means of how to do simple wiring and applications. Students will construct simple appliances and circuits, and they will learn to trouble-shoot open- and short-circuited wiring.

Key content highlights

Safe working with electricity outlined in this module is based on developing a healthy respect for the dangers of electricity, and on a basic knowledge of circuitry principles as typically taught in science. Students will learn basic electrical components, the characteristics of open, closed and short circuits • the vehicle for this will be their construction of an electrical hot plate.

Materials required

Supplies
Clay.
Nichrome or other resistance wire, preferably coiled.
Line plug.
Line cord (electrical two conductor).
Electrical on/off switch.
Basic hand tools.
Source of electricity.

Equipment
Electrical voltage meter or power indicator.
Ohmmeter (or resistance measuring device).

Instructional resources
TAM 1. 'Technological Systems'

Management / Logistics

Related instructional units
TAM 8. 'Manufacturing Pottery'

Evaluation / Grading
The focus of assessment for this instructional unit should be on the quality of the design process employed to generate the prototypes. Note, while the actual execution (i.e. building of the prototype) is less important than the quality of the design, it still has some importance. The suggested ratio is 40% on the prototype and 60% on the design. Testing of the prototype should contribute at least 10% to each of these weights.

Suggested schedule / Time
This activity involves the application of a theoretical base that should require two lessons to impart. Subsequently, students should be given at least one day of practice to apply the theory, i.e. ohms law, followed by another two days' practice to measure electrical resistance. Finally, students should be permitted one or two weeks' practical workshop time to build their heating plate.

Key instructional suggestions

Safety
Conduct demonstrations to impress on students the need for electrical safety.
Always work with line voltage disconnected.
Review and correctly use all electrical instrumentation.

Motivation
To interest students in this activity, point out that it will result in a useful product that they can take home and use on a daily basis. Also highlight that the electrical skills learned in this activity will be applicable to all other arenas where electricity is being used.

Prerequisite information
Basic mathematical capability (e.g. solving simple equations) is a prerequisite to this unit. Instructors should point out that knowledge of science and mathematics is most supportive of effective performance with technology.

Demonstrations
Measuring resistance.
Measuring voltage.
Measuring current.
Wiring electrical plugs and making electrical connections.

Attitudes
Safety is the primary attitude that needs to be reinforced in this activity. Instructors should emphasize the dangers of electrical work and the need for significant precautions when working with electricity.

Summary and review
This activity will deal with basic electrical theory, measurements and then the construction of a useful project. Rudimentary circuitry and basic electrical tasks (e.g. making wire connections) will be taught. Students will be able to apply this theory in many other situations.

Glossary

Circuit	A path through which electrons (i.e. current) may flow.
Closed circuit	A continuous path for electron flow.
Current	The flow of electrons in a circuit;, usually current is measured in amperes.
Open circuit	A path for electron flow that is interrupted somewhere.
Parallel circuit	An electrical circuit where some of the current flowing through it may follow one path, while the balance of the current flows through one or more alternative paths.
Resistance	A restriction to the flow of electrons in a circuit, usually resistance is measured in ohms.
Series circuit	A path for electrical flow that requires all current to go through each component.
Short circuit	An electrical circuit that has a second path bypassing a portion of the circuit's load.
Voltage	The electromotive force being applied to a circuit, usually voltage is measured in volts.
VOM	A volt-ohmmeter; this is an electrical instrument that can be used to measure voltage, current and resistance.

Date: _____ **Class:** _____ **Name:** _____

Technology Activity Module 11:
Electrical wiring

Post-test

Instructions: *Working individually, and without any references, answer the following questions:*

1. Electrical current flows in:
   A. An organic material.
   B. An insulating material.
   C. A conducting material.
   D. Non-metallic materials.

2. A circuit is a break, in a current path, which prevents electrical flow:
   A. True, explain why
   B. False, explain why

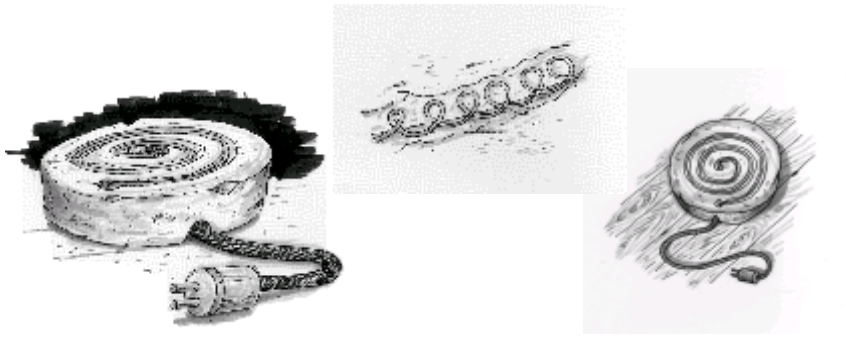
3. Explain what voltage is and how one measures it:

4. Electrical current is measured by placing:
   A. A voltmeter in parallel across the power supply.
   B. An ohmmeter in line with the circuit.
   C. Any meter in series with the circuit.
   D. An ammeter in series with the load of a circuit.

5. Calculate (and show results) the total resistance of a wire that is rated at 10 ohms per centimetre when you have a total wire length of 35 centimetres.

Module 11
Electrical wiring

Student guide



Module overview

Electricity is a wonderful tool when you understand its use and safety. In this activity you will develop skills in working with electrical components and then you will actually make a working hotplate that will give long service.

Objectives

The purpose of this activity is to develop essential knowledge about electricity and some directly related skills that you can use every day in working with electricity. Safe practices for working with electricity will also be taught, so that you can avoid injuring yourself or others while working with electricity.

Importance

Just think of how much we use electricity. Frequently, we need to be able to make or repair something electrical. At other times we want to do something else that requires a knowledge of electricty. Employers want people who know how to be safe around electricity. For these reasons, and more, it is important to know how to work safely with electricity.

Activity 1. Calculate ohm's law values: plan of procedure

1. Ohm's Law is an expression that describes, basically, how electricity operates within a circuit. The law is expressed as:

   $E = I \times R$ where E = Voltage I = Current R = Resistance

   and is measured in volts, amperes, ohms

2. If the above is correct, solve the equation for:

   $I =$

3. Also solve the equation to show that:

   $R =$

4. Given the situation where 12 volts are applied to a circuit with a simple 5 ohm resistance, calculate the amount of current following (show your result).

5. What is the resistance in a circuit that when 220 volts are applied to it, shows a current flow of 5 amperes (show your result).

6. Calculate the voltage that is being applied to a circuit in order to generate a 6 ampere current flow through a resister of 36 ohms.

Activity 2. Measure current, volts and resistance: plan of procedure

Your instructor will set up several experimental electrical circuits. Sketch each circuit and then measure and calculate the voltage, current and ohms found in each.

1. Measure the current _____, voltage _____ and resistance _____ of Circuit 1 provided by your instructor, and be sure to write in both the amount and name of the units measured. Sketch the circuit.

2. Calculate the current ____, voltage _____ and resistance _____ of Circuit 1 provided by your instructor and be sure to write in both the amount and name of the units measured. Sketch the circuit.

3. Compare and explain the differences (if any) found between your measured results and the calculated ones.

4. Repeat Steps 1•3 for each circuit provided by your instructor.

Appendices

Appendix A: Glossary of curriculum and technology terms

Curricular terms

Affective – a set of six-tiered interest and/or attitudinal capabilities ranging from receiving to characterization.

Cognitive – a set of six tiered mental capabilities ranging from recall to evaluation.

Competency • a description of the ability one possesses when able to perform a given occupational task or solve a specific problem effectively.

Competency-based instruction • a systematic programme of instruction designed around tasks/competencies and the related knowledge, skills and attitudes.

Course • a planned sequence of learning experiences designed to develop or reinforce a strongly related set of competencies within the learner.

Enabling objective • one of a set of related objectives that support the student's attainment of terminal objectives.

Evaluative techniques • the procedures and devices used for obtaining evaluative data indicating an objective has been achieved.

Learning strategies • the planning methods that may be utilized in a teaching/learning situation to facilitate attainment of an objective.

Programme • a combination of courses available for a given discipline within a curriculum.

Resources • available instructional materials which include items such as textbooks, computer software, audiovisuals, activity booklets, agencies and business and industry personnel and publications.

Sensorimotor – a set of muscle- or sense-based capabilities involving each human sense and/or fine and large muscle movement.

Task • a well-defined unit of work having an identifiable beginning and end consisting of two or more steps.

Terminal objective – a statement describing a student's expected performance after instruction. Terminal objectives contain conditions, actions and standards and are supported by a set of enabling objectives.

Unit of instruction - a major division of a course involving a logical sequence of instruction, learning activities and performance evaluation. Units of instruction normally involve several consecutive class periods.

Technology terms

Actual result – the realized output of a system. The actual result is usually monitored and compared to the desired result.

Adaptability -the result of a broad-based education providing career mobility.

Adjustment – a change in the process to cause the actual result (output) to conform to the desired result (input).

Aesthetics – sensitivity to art and beauty.

Agriculturally based society – a society whose economic system is based upon the production of plants and animals.

Appropriate resource – a resource which is suitable for a particular application.

Appropriate technology – a technology that is suitable for a given human need or want within designated constraints.

Assessment – evaluation of a situation or problem after careful study.

Attainment of goal – an acceptable match of the results of a process or system with the desired goal.

Automatic control – pre-programming a process to function without human intervention.

Automation – the use of electronic control systems to make a system operate without direct human intervention.

Automation – a method or technique involving self-regulation and self-control through feedback which permits a process to operate by the use of built-in supplementary controls within the system.

Brainstorming – a group idea/generation technique based on the premise that quantity of ideas will produce quality of ideas. The activity is performed in a non-critical atmosphere and a limited time frame. Participants are encouraged to generate ideas in rapid succession and to allow the input of other members to spark ideas within themselves. Evaluation of ideas is deferred until after the generation phase.

Capital – a resource in the form of a commodity or currency (money) having value which can be used in exchange for other resources.

Capital constraints – limitation imposed by a limited amount of commodity or currency for purchase of resources for the process.

Career – the occupation or work a person is engaged in.

Career awareness – student knowledge of various career clusters, work requirements and job readiness skills.

Career cluster – jobs which are related to a particular occupational category.

Career exploration – investigating the necessary preparation for jobs, opportunities for jobs and potential for reward and fulfilment in various careers one might attempt to enter.

Closed-loop system – a system that works on the basis of feedback which is used to control the system automatically or manually. Examples would be the utilization of a thermostat to monitor and adjust the home heating system or homeostasis in living organisms.

Command input – a statement of the desired result of the system.

Communication - the conveying of information and/or ideas from one place, thing or person to another.

Comparison device – a subsystem or component which receives information from the main system's output sensors and compares this with the command input. This device provides the proper adjustment signal(s) to modify the system's process component.

Components – the pieces, elements or subsystems that make up a system.

Compromise – an adjustment of conflicting demands or requirements in which something is given up on each side.

Computer – an electronic tool used for information processing, communication and control.

Computer control – using a computer to guide or direct devices and processes.

Computer hardware – equipment used in a computer system, including the keyboard, disk drives, tape storage, central processing unit, monitor, printer and modem.

Computer software – computer programmes (user or commercially developed) which instruct the computer to execute a specific task or tasks.

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1. This glossary is adapted with permission from the Georgia Department of Education. Depending upon the ability levels of the students, the teacher may have to rephrase some definition for students.

Confluence of systems – the joining together of two or more systems to form a new system. The original system becomes a subsystem of the new system.
Consensus – general agreement.
Conservation – minimizing the use of energy or materials.
Constraints – limitations imposed by scientific principles or limited resources or resulting from people's values and attitudes.
Construction – building something on the site where it will be used, e.g. a bridge, road or building.
Control – influencing the operation of a system.
Design – the configuring of the function or form of a product, system or solution to attain the desired ends/effects or performance.
Electronic communication – the use of electrical or electro-magnetic (e.g. radio waves) energy to convey a message or information from one place to another.
Energy – the ability to do work.
Environment – the context or surrounding system of something. In generalized use this term refers to the air, water, and immediate world that a society or people find themselves in.
Environment (system) – the context or surrounding system of something. When used in a systems context, environment is always the supra-system housing the system being studied.
Feedback – information about a system's or subsystems performance that is routed back towards the system's controllers with the goal of enhancing the system's performance.
Fluid power – transferring energy from one place to another by means of a liquid or gas.
Futuring – techniques used for predicting likely happenings or effects to come. Includes such approaches as the Delphi process, charting and trend projection, focus groups, etc.
Graphic communication – the use of images to convey a message or information from one place to another.
Indigenous – that which is found locally.
Inputs – energy, resources, ideas, capital or other items provided to a system to enable its operation.
Instrumentation – indicators that show the condition of a system variable, e.g. tachometer, thermometer, speedometer, odometer, voltmeter, etc.
Manufacturing – producing something in a factory for subsequent use elsewhere.
Material – any substance used to make something, e.g. wood, metals, plastics, fuels, ceramics, etc.
Mechanical Advantage – the ratio of output to input force of a system or machine.
Mechanization – the use of non-electronic (e.g. cams, interlocks, counters, etc.) controls to supplant direct human control of any small number (but not of a whole system) of steps in a process.
Outputs – the results of a system's or component's operation.
Pneumatics – the transfer of energy using a gas.
Power – the rate of doing work.
Production – the processing of materials to yield a desired item.
Recycling – the re-use of materials for a second purpose after they have served their originally intended purpose.
Resources – any input made available to a system, typically energy, information, capital, hardware.
Society – a group of people living according to a joint set of rules and relationships.
Subsystems – one or more smaller systems that make up a larger one.
Supra-systems – the larger system or environment housing the system being studied.
Systems analysis – a process used to identify the component parts, elements, inputs, and functioning of a system.
Systems synthesis – a process used to assemble and integrate a set of inputs, components to generate a system able to meet a desired goal.
Systems theory – the rules, ideas and principles that pertain to systems analysis and synthesis and related procedures.
Technological capability – skill with a technological process.
Technological literacy – the understanding and capability of technology.
Transportation – moving of energy, information, material, or things from one place to another.
Visual communication – conveying of information or ideas graphically from one place to another.

Appendix B: Assessment forms

The following forms can be used by the instructor to evaluate the technology-relevant knowledge, performance and work habits and attitudes important to student growth. It is suggested that students be evaluated at regular periods and be informed on how to make improvements. Provided are samples of knowledge, attitude and performance instruments. Teachers are encouraged to adapt these instruments to better fit the specific objectives of their course.

1. Work and attitude assessment form.
2. Technology literacy assessment instrument.
3. Performance tracking checklist.

1. Work and attitude evaluation form

Student's name: _____ Date: _____

Work habits	Ignores directions	Follows some directions, works indifferently	Follows directions and works satisfactorily	Steady conscientious worker	Very accurate resourceful and efficient
Safety habits	Sloppy and hazardous to self and others	Fair, needs improvement	Generally works safely	Meets required safety standards	Neat conscientious and careful
Work area neatness	Very sloppy, inconsiderate	Forgetful and unconscientious	Adequate	Thorough	Pride in overall appearance
Work area attendance	Often not in work area	Makes excuses to leave	Generally in work area	Seldom leaves work area	Always where assigned
Self-esteem	Does not display self-confidence	Insecure, self-conscious	Balanced attitude	Positive self-evaluation	Self-confident and secure
Integrity	Not trustworthy	Erratic	Sincere	Reliable and dependable	Exceptionally trustworthy
Responsibility	Sometimes unreliable	Usually reliable	Reliable	Very conscientious	Reliable
Motivation	Apathetic	Seldom motivated	Generally motivated	Interested in excellence	Highly involved and motivated
Initiative	Requires constant pressure	Needs occasional prodding	Does assigned work	Occasionally seeks extra work	Seeks and recognizes work to be done
Effort	None	Applies minimal effort	Shows satisfactory effort	Shows unusual determination	Is determined, persevering and diligent
Peer relations	Uncooperative	Sometimes hard to work with	Generally cooperative	Works very well with others	Outgoing, warm and co-operative
Leadership	Does not lead	Follows well	Shows leadership when requested	Displays leadership	Voluntarily consistent leader
Reaction to authority	Hostile	Indifferent	Accepting	Generally co-operative	Exceptionally co-operative
Personal appearance	Sloppy	Needs improvement	Acceptable	Neat and attractive	Exceeds requirements

Adapted from *How to Prevent Performance Problems*, Maryland Vocational Education Department.

2. Technology literacy assessment instrument

This instrument is designed to assess basic understanding and knowledge of technology. It represents only one small sample of this, therefore it should not be used as an exclusive measure of what students know about technology. Teachers are encouraged to augment this instrument with additional items of their own construction and with open-ended items that yield additional insight into student performance.

Date: _____ Name / ID: _____

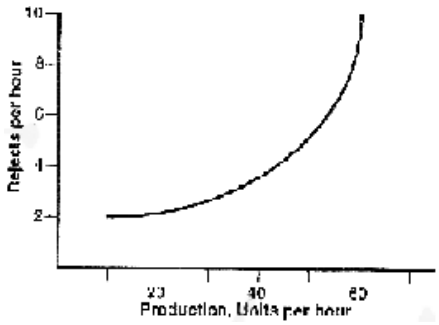
1. *Flying chips are generally not a problem in industry because all machines are equipped with safety shields.*
   A. The statement is true
   B. The statement is false
   C. The statement is true but safety glasses need to be worn anyway
   D. The statement is false but safety glasses need to be worn anyway

2. *The American space exploration programme was only possible because of the development of:*
   A. New ceramic materials
   B. Computers
   C. New navigational devices
   D. All of the above

3. *Which of the following problems would best be classified as a technological problem?*
   A. When one should buy a car
   B. What car one should buy
   C. How one insulates a home
   D. Why people have red hair

4. *Which source would most likely contain up-to-date information on a technical problem and solution?*
   A. Monthly trade magazine
   B. An online data base
   C. Government research report
   D. Technical book

5. *This graph illustrates:*
   A. Fewer rejects at higher production rates
   B. A straight link between production rates and rejects
   C. Low production rates at times of high rejects
   D. Rapidly increasing numbers of rejects at high production rates



6. *Which answer best describes the parts of a computer:*
   A. Input unit (e.g. keyboard); output unit (e.g. printer); storage unit (e.g. disk drive); indicator unit (e.g. video display); memory unit; central processing unit
   B. Intelligence unit; output unit (e.g. printer); analog unit; indicator unit (e.g. video display); digital unit; memory unit
   C. Membrane unit; central processing unit; input unit (e.g. keyboard); indicator unit (e.g. video display); digital unit
   D. All of the above

7. *Consider a typical factory's automated spray paint station that uses a robot to paint parts passing on a conveyor. Which of the answers contains the best list of subsystems of such a work station?*
   A. Controlling computer, transfer robot, auto-conveyor, cell perimeter
   B. Instrumentation unit, auto-conveyor, warehouse unit, read-out and input unit
   C. Auto-conveyor, controlling computer, spray robot, read-out and input unit
   D. Vision system, auto-conveyor, light system, transfer robot

8. *Which one of the following careers would be heavily affected by the increased use of robotics?*
   A. Assembly line welder
   B. Painter of tractor parts
   C. Assembler of hydraulic valves
   D. All of the above

9. *Most technological innovations have:*
   A. Positive and negative social impacts
   B. Negative economic and positive social impacts
   C. Both positive and negative economic and social impacts
   D. Neither economic or social impacts

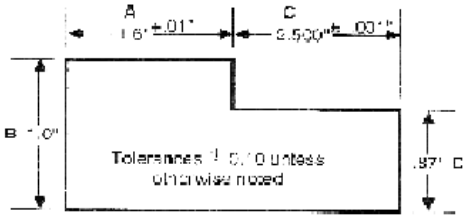
10. *Energy cannot be:*
   A. Created
   B. Stored
   C. Used
   D. Unused

11. *Why has solar energy not achieved the widespread acceptance that some had predicted twenty years ago?*
   A. An oil company conspiracy
   B. Acid rain has decreased the intensity of the sunlight reaching earth
   C. It is still too expensive to produce
   D. Lack of government research funds

12. *Most American automobile production is an example of:*
   A. Intermittent production
   B. Continuous flow production
   C. Mass production
   D. Craft production

13. *Construction technology is typically:*
   A. Used in factories rather than on-site
   B. Old fashioned and obsolete
   C. Contemporary and modern
   D. Used on-site rather than in factories

14. *Refer to the working drawing given opposite and select the answer that gives the right <u>maximum</u> and <u>minimum</u> of distance C.*



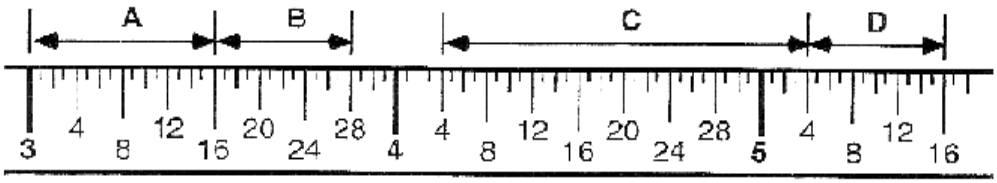
A. 2.590//2.490
B. 2.600//2.400
C. 2.501//2.499
D. 2.510//2.500

15. *If you wanted to buy a VCR but were uncertain about which one of two major brands to buy, what is the best way to decide?*
A. Read the specification sheets for each
B. Read an independent consumer testing magazine
C. Ask people who have used both
D. Try each one for several days

16. *Information can be transmitted over:*
A. Fibre optic cables and wires
B. Touch and mechanical means
C. Sound and symbols
D. All of the above

17. *Assembly line production is used because:*
A. It costs less than other methods
B. It makes many products per hour
C. Workers can be quickly trained for it
D. All of the above

The ruler shown below is to be used for questions 18, 19 and 20.



18. *The distance A = _____ / 8*
A. 16
B. 1
C. 4
D. 8

19. *The total of distance A + B + C + D = _____ / 8*
A. 28
B. 16
C. 32
D. 18

20. *The total A + B + C + D (from 19 above) reduces to:*
A. 1 7/8
B. 2 1/4
C. 2 3/8
D. 18/8

21. *The machining method that typically produces the best surface finish is:*
    A. Lapping
    B. Grinding
    C. Turning
    D. Reaming

22. *Which of the following usually results from the introduction of computers into the manufacturing process?*
    A. More skilled than unskilled jobs are created
    B. More unskilled than skilled jobs are created
    C. Fewer people work harder
    D. Everyone works less and gets paid more

23. *The process of tempering metal:*
    A. Softens the metal and removes internal stresses
    B. Increases the metal's resistance to scratching and abrasion
    C. Toughens the metal
    D. Is not described

24. *Using the conversion table shown opposite, convert the following fraction to a decimal 21/64 = _____*
    A. .3281
    B. .2164
    C. .8281
    D. Not given

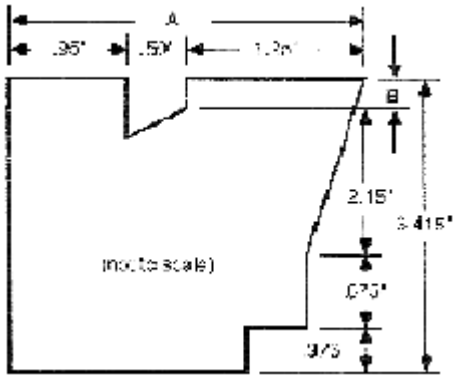
Decimal equivalents				
3/32	.0938		19/32	.5938
17/64	.2656		49/64	.7656
9/32	.2812		25/32	.7812
19/64	.2969		51/64	.7969
5/16	.3125		13/16	.8125
21/64	.3281		53/64	.8281
11/32	.3438		27/32	.8438

25. *The typical automobile engine contains:*
    A. Cooling, mechanical and physical systems
    B. Fuel, ignition and lubrication systems
    C. Lubrication, cooling and arbitrary systems
    D. Ignition, physical and lubrication systems

Use the diagram to secure the needed values for questions 26 and 27.

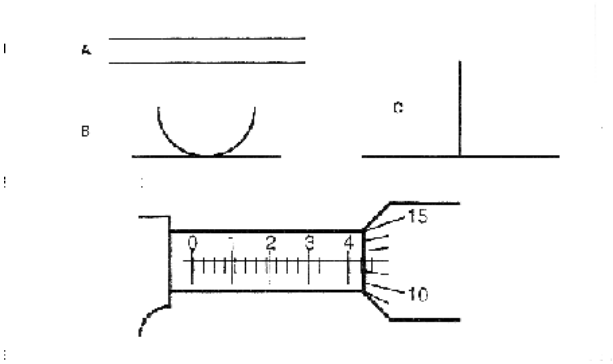
26. *The value of dimension A*
    A. 1.85
    B. 2.45
    C. 2.70
    D. 1.95

27. *The value of dimension B*
    A. 2.350
    B. 0.215
    C. 0.455
    D. 0.100



28. *The normal physical states materials can take are:*
    A. Solid, liquid, gas, plasma
    B. Ambient, diffraction, charge
    C. Alpha, gamma, beta
    D. Atomic, radioactive, stable

29. *Which answer best describes the geometry of the lines shown in Figure B?*
    A. Perpendicular
    B. Transverse
    C. Parallel
    D. Tangent



30. *The micrometer reading shown is:*
    A. 1.41
    B. 41.12
    C. 0.41
    D. 0.437

31. *Which step in the problem-solving process would best be done right after one defines the problem?*
    A. Choosing the best solution
    B. Brainstorming and generating several possible solutions
    C. Testing the ideas
    D. Establishing ways to evaluate competing solutions

32. *CAD/CAM means:*
    A. Communication assisted digital / computer-aided memory
    B. Computer-aided design and manufacturing
    C. Computer-aided design and marketing
    D. Computer-assisted design and memory

33. *To properly judge the effects of a technological innovation, one should:*
    A. Measure the dollar effects resulting from it
    B. Estimate the impacts of it on our society
    C. Identify its impact on the people using it
    D. All of the above

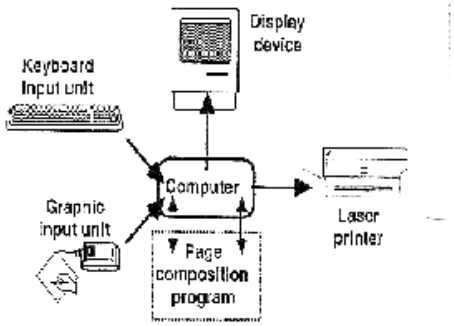
34. *Technology can be applied to many purposes. Which answer contains the broadest set of such applications?*
    A. Business, industry, commerce, distribution
    B. Medical, military, agriculture, industry
    C. Factory, transportation, control, recreation
    D. Social, psychological, economic, government

35 *What is a hologram?*
    A. A laser produced three-dimensional image
    B. A telegram printed by a computer
    C. One thousand grams on the metric scale
    D. A message received from a satellite

36. *Getting additional training beyond high school, instead of working, typically:*
    A. Makes one more specialized
    B. Widens one's options for a job
    C. Puts one behind others in seniority
    D. All of the above

37. *Which of the following is not typically used for information storage?*
    A. Floppy disk, magnetic memory chip
    B. Blueprint, photographic film
    C. Book, magazine
    D. Television screen, capacitor

38. *Select the best name for the system shown in the diagram:*

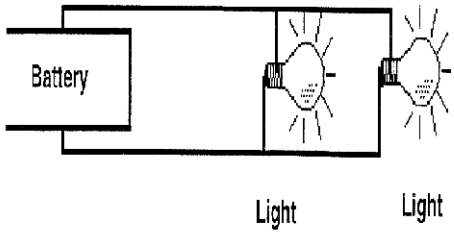


A. Typesetting system
B. Electronic publishing system
C. Remote communication system
D. Computer-based display system

39. *The earliest development leading to modern factory automation was the:*
A. Jacquard loom
B. Solid state memory chip
C. Electric motor
D. Steam engine

40. *For communication systems to be effective:*
A. Little or no noise should exist
B. The receiver and sender must share a common language
C. Messages must be accurately sent and received
D. All of the above

41. *The circuit shown in the diagram is a:*



A. Series circuit
B. Parallel circuit
C. Alternating circuit
D. Open circuit

42. *Which of the following is not an example of a communication system?*
A. A conveyor
B. A newspaper
C. A television show
D. A book

43. *Communications may go on between:*
A. Human and human
B. Human and machine
C. Machine and machine
D. All of the above

44. *The words pneumatic, hydraulic, mechanical and electrical, each describe:*
A. A type of power transmission system
B. An energy source
C. A type of motor
D. A form of power loss

45. *The key concepts of electrical power are:*
A. Motors, wires, ohms
B. Resistance, pressure, flow
C. Continuity, flexibility, circuitry
D. Volts, tension, electromotive force

46. *Sensors and transducers are typical components of:*
A. Instrumentation and control systems
B. Production systems
C. Manufacturing systems

D. Computer systems

47. *Ultrasonic testing is an example of:*
A. Destructive testing
B. Measurement testing
C. Non-destructive testing
D. All of the above

48. *Which three main fields make up industrial technology?*
A. Metals, organics, natural materials
B. Construction, manufacturing, transportation
C. Energy and power, materials and processing, communication
D. Economics, materials, people

49. *Materials and processing technology includes:*
A. Manufacturing
B. Construction
C. Materials science
D. All of the above

50. *Knowing one's personal limits is important to understanding technology. For example even high-level technologists would not attempt to:*
A. Use a computer
B. Communicate detailed technical information
C. Repair an integrated circuit
D. Make things from wood, metal or plastic

3. Performance tracking checklist

Materials and processing	*Activity demonstrating competence*	*Tangible product*	*Instructor assessment*
Separating			
Combining			
Forming			
Manufacturing			
Construction			
Other . . .			
Communication and information			
Visualization			
Design			
Transmitting			
Other . . .			
Energy and power			
Energy conversion			
Power transmission			
Instrumentation			
Control			
Other . . .			

Appendix C:
Ideas for technology education learning activities

This list is designed to share some activity ideas to trigger instructors involved in delivering technology education.

Technology fundamentals (interpreting, resources, systems) and automation

Interviewing people working with/in technology
Mapping the future
Developing a technology timeline for a local technology, e.g. irrigation
Problem-solving a community problem
Brainstorming possible causes for a local problem
Performing a systems analysis of a local technology, e.g. a well
Identifying technological controls employed in local businesses
Describing the intended and unintended effects of implementing a technological solution, e.g. a car
Taking a technology from somewhere else and adapting it to local needs
Identifying the outputs of a technological system, e.g. a stove
Analysing machines to identify the presence of the basic machine elements (e.g. levers)
Conducting an environmental impact study
Designing a solution for a communication, production or energy need
Comparison of yesterday, today and tomorrow
Developing a worker job rating form and testing it out

Communications

Making and using a pin-hole camera
Demonstrating electronic communication using a crystal radio
Printing a class newspaper
Sending visual coded messages
Preparing graphs and charts
Silk-screen printing, e.g. a T-shirt
Sketching
Drafting plan for a building in town
Making a three-dimensional drawing of a product made in the vicinity
Creating pictorial drawings

Materials processing and production

Making paper
Recycling some locally available scrap into a useful product
Food processing or preserving
Making fruit jelly
Create a model of a primitive tool and comparing it to a modern one
Mass producing/manufacturing a product for sale
Building a form and pouring concrete
Shape a metal bowl
Build a model structure
Experiment with an agricultural test plot of various fertilizers
Constructing a storage shed
Measuring techniques, e.g. very small or very large
Building a bridge or truss structure
Harvesting and preserving a food crop
Making and using a hydroponic greenhouse

Energy, power and transportation

Conduct a historic study describing how an energy and power technology evolved
Building a steamboat
Working model trains
Planning and designing a canal
Designing a lock
Disassembly/assembly and operation of the glow plug engine
Experiments with lift (hydraulic cylinders)
Building and flying a hand-launched glider
Solar convection heater
Saving water while growing food (drip irrigation)
Wind powered electric generator
Model cars
Wind speed indicator
Building a solar heating system
Making an electric motor
Disassemble and reassemble a mechanical transmission
Analyse how a fluid-power transmission system works, e.g. an automobile brake system
Build and fly a kite or glider
Bicycle care and maintenance
Construct a windmill
Make an electrical cell from a lemon
Make a solar battery
Building waterwheels
Building a parabolic solar oven
Building a windmill with a savonius rotor
Using solar energy to cook food
Miniature photovoltaic collector
Solar battery charger
Savonius rotor wind turbine
Experimenting with a water-powered generator
Measure the heat characteristics of burning various woods or other fuels.

Appendix D: Resource agencies

Rudolph Ryser
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Documentation Center

WOCATE
World Council of Associations for technology Education
Schlösserstrasse 9
99084 Erfurt
Germany
Tel: (49) 361-562-1082

NativeTEch
Waab Aki Crafting
Tel: (1) 860-456-8118

UNESCO
Hall Rose Orlando
Chief, ED/STE, Section for Science and Technology Education
UNESCO
7, Place de Fontenoy
75352 Paris 07-SP, France