DOCUMENT RESUME

ED 399 419 CE 072 536

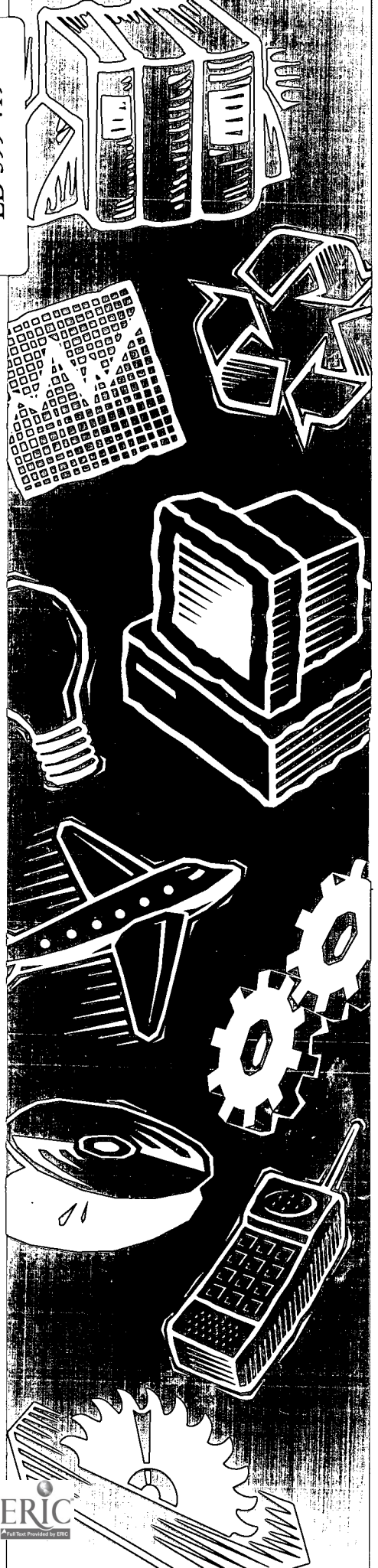
TITLE	Technology Education. A North Dakota Curricular Framework.
SPONS AGENCY	North Dakota State Board for Vocational-Technical Education, Bismarck.; North Dakota Univ., Grand Forks. Dept. of Business and Vocational Education.
PUB DATE	96
NOTE	42p.; Funded by the North Dakota Statewide Vocational-Technical Curriculum Project.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Behavioral Objectives; *Competence; Competency Based Education; *Curriculum Development; *Educational Assessment; *Educational Philosophy; Evaluation Methods; High Schools; State Curriculum Guides; Student Evaluation; *Technology Education
IDENTIFIERS	*North Dakota

ABSTRACT

This curricular framework is designed to assist administrators and teachers in planning, developing, and implementing technology education programs in North Dakota. It provides a philosophical foundation and a broad outline from which educators may construct comprehensive school technology education programs. The materials will aid local school systems in planning local curricula, developing a local philosophy, defining a local scope and sequence, evaluating the extent to which the goals and subgoals are contained in current curricular offerings, and identifying needed curricular content and instructional strategies. The document is organized into the following 10 sections: (1) philosophy (definition of the nature of technology education and description of its relationship to society, the learner, and the school curriculum); (2) definition of technology education; (3) definition of technology literacy; (4) definition of technology education; (5) vision for technology education; (6) technology education learner outcomes; (7) technology education goals and subgoals; (8) technology education expectancies (statements that specify the expected behaviors within each subgoal); (9) illustrative objectives; and (10) curriculum development and assessment (how to develop and use goals, subgoals, and expectancies in the preparation of technology education scopes, sequences, and instructional units). (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 399 419



Technology Education

A North Dakota Curricular Framework

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

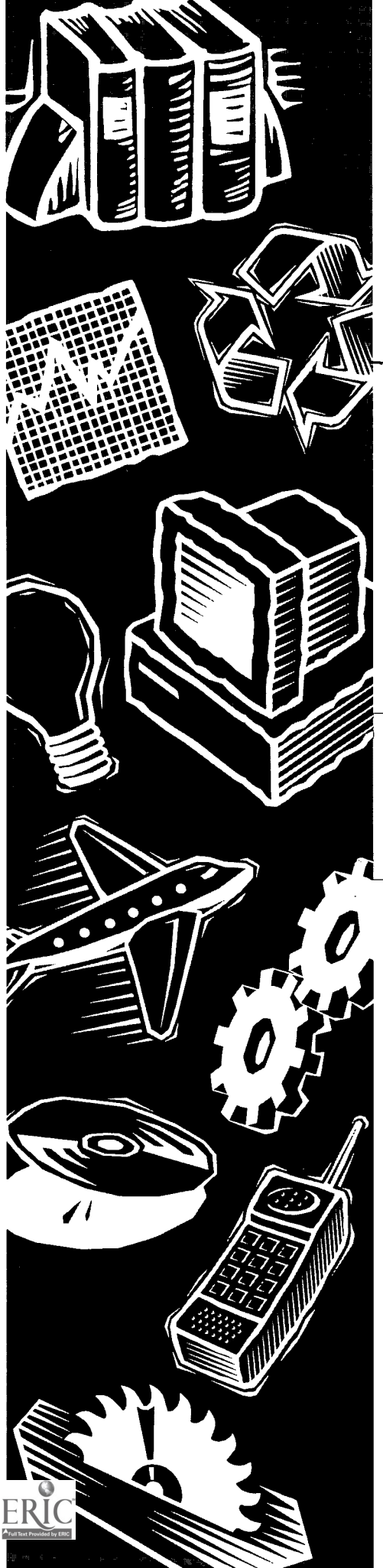
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Olson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

BEST COPY AVAILABLE



Technology Education

A North Dakota Curricular Framework

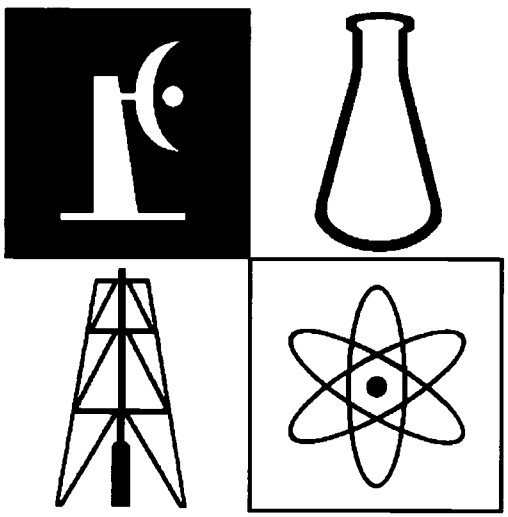
Major funding provided by the North Dakota Statewide Vocational-Technical Curriculum Project, a joint venture of the North Dakota State Board for Vocational and Technical Education, Mel Olson, Director; and the University of North Dakota Business and Vocational Education Department, Dr. James Navara, Chairperson.

contents

Explore

Invent

Make



The real challenge before Technology Education is to achieve the promise that lies within it as a vital component in the education of all citizens. This can be done by taking advantage of the principles and understandings related to learning and behavior, and capitalizing on its rich and relevant content as well as its processes.

Donald Maley, Prof. Emeritus
University of Maryland

Acknowledgments IV

Foreword V

Introduction: A Statement of Purpose 1

Philosophy 2

What Is Technology? 3
- What Is Technological Literacy?
- What Is Technology Education?

Vision for Technology Education 4

North Dakota Academic Graduation Outcomes 5

Technology Education Is An Integral Part of Education 6

Technology Education Goals 7

Technology Education's Contribution to Academic Education 16

Technology Education Program 19

Curriculum Design - Middle/Junior High 21

Course Outline - Middle/Junior High 22

Curriculum Design - High School 24

Course Outline - High School 25

Curriculum Design - Advanced 28

Course Outline - Advanced 29

Program Implementation 32

Organizing Technology 33

Technological Method Model 34

References 35

acknowledgments

The North Dakota Technology Education Profession is grateful to all who have contributed to the development of this publication. Special appreciation is accorded to the following:

Don Fischer
Technology Educator
Hazen Public School
Hazen, ND

Donald Mugan
Technology Teacher Educator
Valley City State University
Valley City, ND

Erv Van Veldhuizen
Technology Educator
A.L. Hagen Middle School
Dickinson, ND

Mark Wilson
Technology Educator
Simle Middle School
Bismarck Public Schools
Bismarck, ND

Rodney L. Wiseman
Technology Educator
Griggs County Central High School
Cooperstown, ND

Myron Bender (Project Director)
Technology Teacher Educator
Curriculum Project Director
University of North Dakota,
Grand Forks, ND

Bill Rosenberg
Supervisor, Technology Education
North Dakota State Board for Vocational & Technical Education
Bismarck, ND

Karla Glick
Publications Coordinator / Designer
Division of Biomedical Communications
University of North Dakota
Grand Forks, ND

foreword

Wayne G. Sanstead

Literacy today goes beyond the basic skills of reading, writing and arithmetic and includes computer and other technology-related skills in the context of the workplace. Literacy is defined as "...an individual's ability to read, write and speak in English, and compute and solve problems at levels of proficiency to function on the job and in society, to achieve one's goals and develop one's knowledge and potential." Technology education is a comprehensive experience based curriculum in which students learn about technology and are provided applications for solving problems. By using such experiences in a "hands on," cooperative environment, students will become wise decision makers and problem solvers.

The need for technical literacy is especially critical in today's environment. More than 3/4s of the approximately five million jobs added to the economy since 1993 require professional, management or technical skills. With increasing access to technologies, creating a literate, well trained and skilled workforce for an increasingly competitive world is a very high priority in North Dakota.

The publication, "Technology Education", which provides an integrated experience based instructional program, is a very valuable addition to other North Dakota curricular frameworks, which have been developed to assist local school districts create meaningful curriculum for all our students.

Sincerely,

Wayne G. Sanstead

Dr. Wayne G. Sanstead
State Superintendent
Department of Instruction, Bismarck, ND

foreword

Mel Olson

By the year 2000, 65-75% of all jobs will require specific skills that demand specialized technology training. The technology explosion we are currently experiencing is not only altering our work requirements, but it is also altering every facet of our lifestyle. It is important that we take a proactive stand regarding North Dakota and its people to assure that they are adequately prepared to meet the new demands that technology will make on their lives.

It is of paramount importance that the education and training programs offered the future workforce move forward from the industrial type training of the past to the technology education training programs of the future.

These TECHNOLOGY EDUCATION curricular frameworks will provide educators direction as they construct a school technology education program that will meet the needs of students in this high-tech world. I am impressed with the planning and foresight that went into designing this document and I encourage its users to carefully and enthusiastically engage in the recommended activities.

Mel Olson, State Director
State Board for Vocational and Technical Education
Bismarck, ND

introduction

A Statement of Purpose

Technology Education: The North Dakota Curricular Framework is designed to assist administrators and teachers in planning, developing, and implementing technology education programs. It provides a philosophical foundation and a broad outline from which educators may construct comprehensive school technology education programs. The materials presented will aid local school systems as they engage in the following activities:

- ✓ Planning local curricula.
- ✓ Developing a local philosophy.
- ✓ Defining a local scope and sequence.
- ✓ Evaluating the extent to which the goals and subgoals are contained in current curricular offerings.
- ✓ Identifying needed curricular content and instructional strategies.

Students must be prepared to understand technological innovation, the productivity of technology, the impact of the products of technology on the quality of life, and the need for critical evaluation of societal matters involving the consequences of technology.

National Science Board (1983)
Educating Americans for the
21st Century

This document is organized into the following sections:

1. The Philosophy - This section defines the nature of technology education and describes its relationship to society, the learner, and the school curriculum.
2. What is Technology?
3. What is Technological Literacy?
4. What is Technology Education?
5. Vision for Technology Education
6. Technology Education Learner Outcomes
7. Technology Education Goals and Subgoals - These broad statements of desired outcomes, which are derived from the philosophy, bring direction and clarity to the Learner Outcomes.
8. Technology Education Expectancies - These statements specify the expected behaviors within each subgoal.
9. Illustrative Objectives - These sample objectives show how goals and subgoals may be treated at different instructional levels.
10. Curriculum Development & Assessment - This section describes how to develop and use goals, subgoals, and expectancies in the preparation of technology education scopes, sequences, and instructional units.

philosophy

Technology education is a comprehensive, experience-based curriculum in which students learn about technology—its evolution, systems, techniques, utilization, and social and cultural significance. It develops "technological literacy" by dealing with the ways in which ingenuity, processes, materials, devices, science, and mathematics are applied for solving problems to meet our needs and desires.

A central role of education is to offer a curriculum that provides students with basic understandings and skills needed to function effectively in society. Our democratic society is characterized by rapidly advancing technological developments. It is absolutely necessary for all people to understand technology if they are to function as informed voters, productive workers, and wise consumers of technological products and services.

Technologies spring from the human abilities to reason, solve problems, create, construct, and use materials imaginatively. Since these abilities are an integral part of our technological society, they must be developed in all students, regardless of their educational and career goals.

Experience in applying technology and in solving problems builds both the competence and confidence for effective interaction with technology. An understanding of the applications and functioning of technology systems is important for decision making in the arenas of career, home, personal affairs, and government.

In today's high-tech society, all students should become technologically literate in order to become wise decision makers. Through experiences in a "hands-on", cooperative environment using a systematic, problem-solving approach, students should exhibit an understanding of the nature of technology, major technology systems, and the resources used in technology. Through the application of technical skills, knowledge, and processes, students should be able to solve problems in a systematic fashion. Coupled with sound work values, attitudes, and habits that include the recognition and pursuit of quality, these skills should enable students to become wise consumers, productive members of our community, and contributors to the forces of change that shape our world.

Technology: a system based on the application of knowledge, manifested in physical objects and organizational forms, for the attainment of specific goals.

R. Volti (1995)
"Society and Technological Change."

What Is Technology?

Technology is the application of knowledge, tools, and skills to solve practical problems and extend human capabilities.

American Association for the Advancement of Science (1989)
Technology—Report of the Project 2061, Phase I Technology Panel

What Is Technological Literacy?

Technology is a significant human phenomenon and pervasive force in the modern world. We must interact with it daily. Technology so impacts our decisions in the arenas of career, home, personal affairs, and government that "technological literacy" has been called a new basic in education.

> "Technological literacy" needs to be a part of general literacy and 'numeracy.' In a sense we are speaking of 'basics' in education, and we are identifying the knowledge and understanding of technology as basic. Technological literacy is quite different from scientific literacy and mathematical literacy. An understanding of scientific and mathematical concepts doesn't automatically result in an understanding of technology." (p.73)

National Science Board (1983)
Educating Americans for the 21st Century

Technological literacy is the ability to interact successfully with technology, to assess the impacts of technology on everyday life and make appropriate decisions, and to apply conceptual knowledge in order to solve problems. To individuals, these abilities are a great asset. To our state and nation, these abilities are essential if we are to remain competitive in the world market. We must provide our students with technological literacy for future success, the well-being of our communities, and our nation's preeminence.

> "Technological solutions to human problems are not unique. There are no right answers and choices must be made. It is vital that these choices be informed and value-based. A major question about this technical world is Who will develop and control the technologies so that they can best serve all citizens? In the broadest sense, the answer has to be—for a democratic society—a technically literate citizenry." (p.2)

American Association for the Advancement of Science (1989)
Technology: A Project 2061 Panel Report

What Is Technology Education?

Technology Education is an integrated, experience-based instructional program designed to prepare a population that is knowledgeable about technology—its evolution, systems, techniques, utilization, and social and cultural significance. It results in the application of mathematics and science concepts in technology systems. Students discover, create, solve problems, and construct by using a variety of tools, machines, materials, processes, and computer systems.

Vision For Technology Education

An integral part of the program of studies in North Dakota's schools, Technology Education is a new basic for all students. It is experience-based and involves the application of mathematics and science concepts in technology systems. There is extensive student involvement with problem solving laboratory activities that are rich with hands-on, multi-sensory experiences. Students work individually and in teams as they learn about technology—its evolution, systems, techniques, utilization, and social and cultural significance. Students learn how to utilize and interact with technology and to live adaptively in a rapidly changing, highly technological society.

Technology Education programs are among the first to demonstrate an integrated approach to learning. Interdisciplinary teams of teachers train and work together for cross-curriculum planning and integrated delivery of instruction. Technology Education is taught using a collaborative approach in which groups of students interact with teachers of mathematics, science, social studies, language arts, technology, and other disciplines. Cooperative learning, ingenuity challenges, modular activities, and computer-assisted instruction are some of the approaches used to provide students with hands-on learning experiences in which they can demonstrate established learning outcomes.

The Technology Education program challenges all students to acquaint themselves with their technological environment so they are better prepared to make informed decisions about their lives and eagerly participate in controlling their own destiny. Programs recognize, capitalize on, and build on the individual's inherent potential for reasoning and problem solving, for imagining and creating, for constructing and expressing by using implements and materials from which technologies spring.

The resources for program implementation are adequate to assure the fulfilling of program potentials and meeting of student needs. Staff development experiences support teachers as they employ appropriate teaching-learning strategies. Instructional materials in a variety of forms facilitate student achievement of the valued outcomes. Laboratories are appropriately equipped to accommodate student learning through active, hands-on, multi-sensory interaction with significant technology systems. School and business/industry partnerships play a role in developing and making available these valuable resources. Thus, Technology Education is a fundamental curriculum for all students, regardless of learning level, career choices, or life aspirations.

Technology is concerned with applying knowledge to create an easier and a better lifestyle for humankind.

J.M. Ritz & W.S. Swail
"Technology Assessment: Integrating Technology, People, and the Environment"

North Dakota Academic Graduation Outcomes

Each student will have the ability to:

1. Apply concepts, generalizations, processes and strategies considered important to specific content areas.
2. Use complex reasoning processes.
3. Work in a cooperative / collaborative manner.
4. Regulate oneself in a variety of situations.
5. Communicate through a variety of products.
6. Gather information in a variety of ways.

Source: North Dakota Curriculum Frameworks, Volume I. Department of Public Instruction, Bismarck, N.D. (January, 1993).

Students must be prepared to understand technological innovation, the productivity of technology, the impacts of the products of technology on the quality of life, and the need for critical evaluation of societal matters involving the consequences of technology.

National Science Board (1983)
"Educating Americans for the 21st Century"

Technology Education is an Integral Part of Education

In response to the public's concern, North Dakota has produced a Technology Education content framework identifying content outcomes and student performance standards. The document contains: a list of North Dakota educators involved in the development of the framework; a mission statement for that particular subject area; the graduation outcomes for the state of North Dakota; a list of content outcomes; and a listing for content outcomes with the performance standards.

The content outcomes and performance standards are intended to serve as benchmarks (transition points) for state and local decision making and local curriculum development. They should not be considered to be statements of minimum competencies. The documents are designed with the belief that local curriculum developers will find direction and guidance as they plan for continued improvement in the various subject areas for all students. They also provide a framework for curriculum across the 6-12 continuum of learning.

The content outcomes and student performance standards section of the documents should be particularly useful to school districts as they develop local curriculum materials, determine instructional activities and tasks, and design assessment strategies for accountability purposes for their local communities. The content outcomes provide a broad framework for the total program, while the performance standards offer a more specific description of what students must know upon graduation. Districts can use these outcomes and standards to make decisions concerning: 1) what must be taught in each grade or course (curriculum); 2) the delivery of instruction; and 3) student learning (assessment).

It was the intention of the developers to produce a document that is a forward looking expression of the learning opportunities needed by students who will be citizens of the twenty-first century.

A need for restructuring the educational system is evidenced by a great deal of commentary about the current state of education at both the national and local levels. If we are to be responsive to the needs of our students now and in the future, we must increase our efforts to create an educational environment that will allow every student to develop to the highest achievement level. High standards and high achievement levels lead to world class standards and world class citizens.

technology education goals

The technology education goals listed below describe what students should be able to do, think and feel as the result of a technology education experience. The framework is composed of goals and subgoals from which activities and lessons are to be developed.

Application of Technology Systems
Students will demonstrate knowledge and skills regarding diverse technology systems, including their functioning and applications.

Nature, Impacts, and Evolution of Technology
Students will demonstrate knowledge of the nature of technology and the relationships and impacts among technological achievement, the environment, the advancement of science, the individual, and society. The context for this knowledge shall be historical, current, and futuristic.

Problem Solving Using Technology
Students will demonstrate the ability to solve problems with technology using a systems approach, higher-order thinking skills, individual and collaborative ingenuity, and a variety of resources including information, tools and materials.

Informed Decisions About Technological Issues
Students will make informed decisions about technological issues, including the development and use of technology and technology resources.

Use of Technology Resources
Students will demonstrate in an experiential setting the safe, effective, and creative use of technology resources— including tools, machines, and materials—in performing technological processes.

Application of Technology To Other Academic Areas
Students will apply science, mathematics, communications, social studies, arts and humanities to solve practical problems and extend human capabilities.

Career Information
Students will explore the multiple purposes of work and the range of career options, including entrepreneurship, and relate them to their individual interests, aptitudes and skills.

Multicultural and Gender Diversity
Students will recognize the multicultural and gender diversity included in past, present, and future uses of technology.

OAL 1

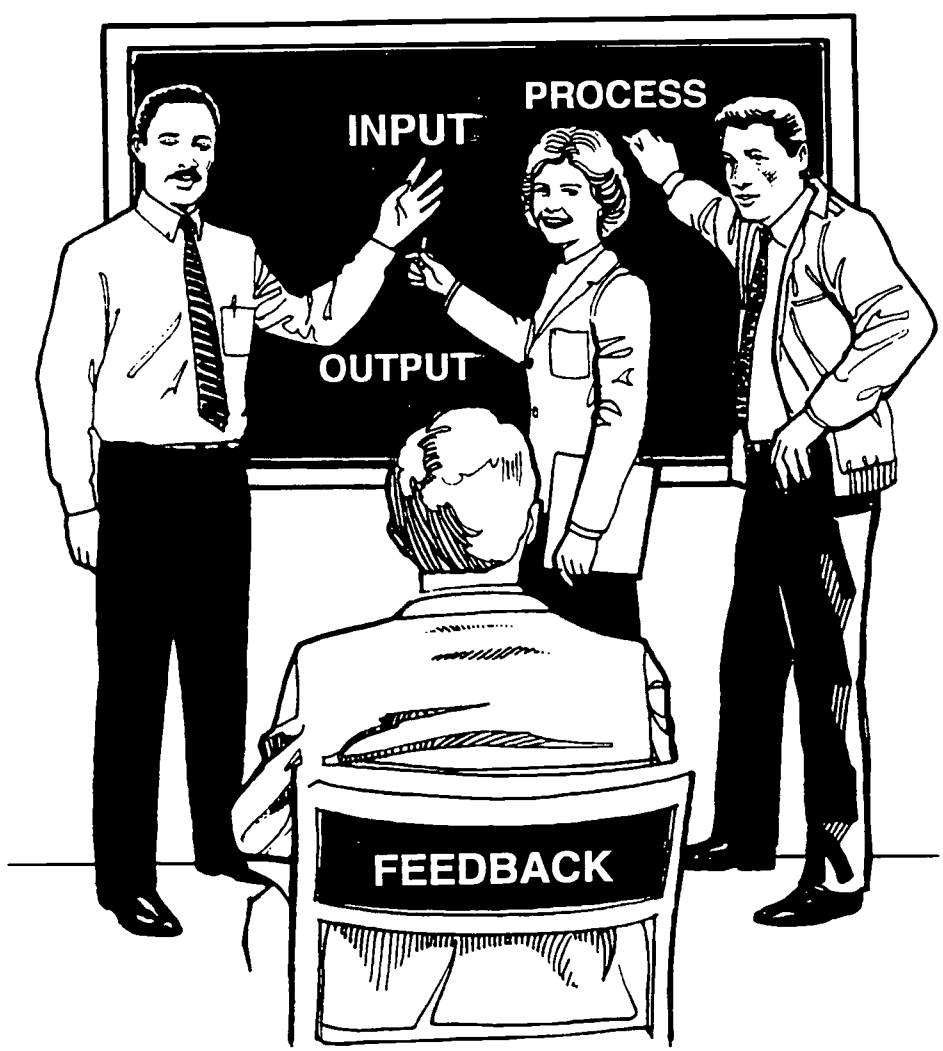
Applications of Technology Systems

Students will demonstrate knowledge and skills regarding diverse technology systems.

Subgoals

1.1 Students demonstrate knowledge and skills related to the applications of a variety of technology systems.

1.2 Students demonstrate knowledge and skills related to the functioning of a variety of technology systems.



Technology Education has been conceived as a part of general education with the intent to develop the knowledge and skills requisite for life and work in a technological society.

T. Erekson (1991)
"Technology Education: Preparing Students for Success in College"

GOAL 2

Nature, Impacts, and Evolution of Technology

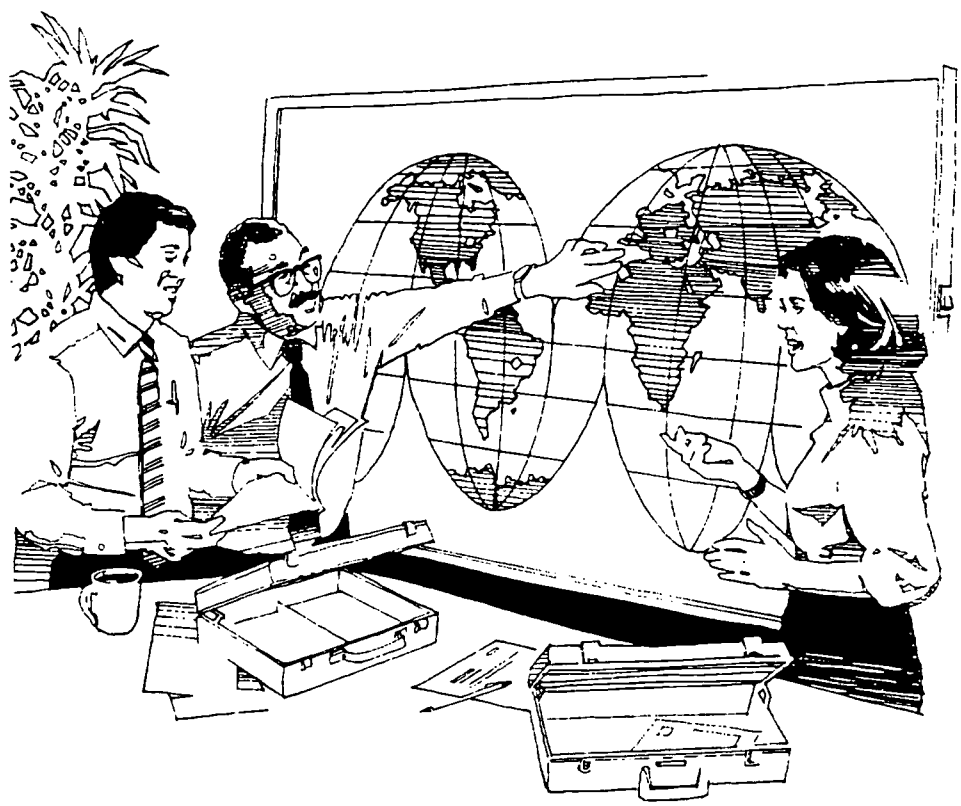
Students will demonstrate knowledge of the nature of technology, including its impacts and evolution.

Subgoals

2.1 Students demonstrate knowledge of the nature, evolution, and characteristics of technology.

2.2 Students demonstrate knowledge of the relationships among technological achievement, the environment, the advancement of science, the individual, and society.

2.3 Students demonstrate knowledge of the technical, social, financial, and environmental impacts of technology.



When education has environmental relevance for students, when students become convinced of the consequences of their actions, when they value what they are in danger of losing, then environmental literacy may be realized.

V. Rockcastle (1989)
"Environmental Literacy"

OAL 3

Problem Solving Using Technology

Students will demonstrate the ability to solve problems with technology.

Subgoals

3.1 Students utilize a systems approach in solving technological problems.

3.2 Students employ higher-order thinking skills for solving technological problems.

3.3 Students utilize collaborative and individual ingenuity for solving technological problems.

3.4 Students utilize a variety of resources and processes to solve technological problems.

3.5 Students demonstrate the ability to work as a team member in the solution of technological problems.

The capacity to create useful or beautiful products and to find ways of resolving perplexity is not limited to highly-gifted persons but is the birthright of every person of average talent.

E.R. Hilgard (1964)
"Creativity and Problem Solving"

17

GOAL 4

Informed Decisions About Technological Issues

Students will make ethical decisions about technological issues.

Subgoals

4.1 Students identify problems resulting from technological achievements.

4.2 Students utilize resources to develop a knowledge base for making informed decisions about technological issues.

4.3 Students assess the impact of technology on the individual, society, and the environment.

4.4 Students make judgments about technological issues.

Technology Education is the school discipline for the study of the application of knowledge, creativity, and resources to solve problems and extend human potential.

Technology Education
Advisory Council
"Technology - A National
Imperative"

GOAL 5

Use of Technology Resources

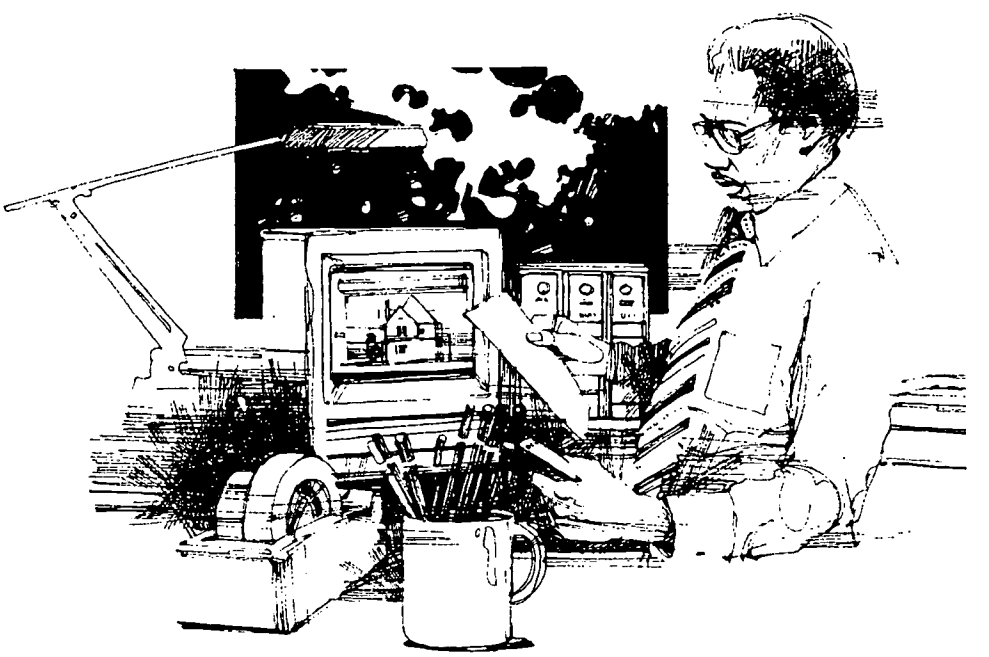
Students will demonstrate in an experiential setting the safe, effective, and creative use of technology resources including tools, machines, and materials.

Subgoals

5.1 Students create technology for human purposes through the skillful use of technology resources.

5.2 Students use technology resources in a safe and responsible manner.

5.3 Students demonstrate ingenuity and creativity in the use of technology resources.



Technology Education provides a commitment to a time-honored goal, this, to merge the realities of life in a technological society with the educational system.

Donald P. Lauda,
California State University
Long Beach

GOAL 6

Application of Technology to Other Academic Areas

Students will apply science, mathematics, communications, social studies, and arts and humanities to solve practical problems and extend human capabilities.

Subgoals

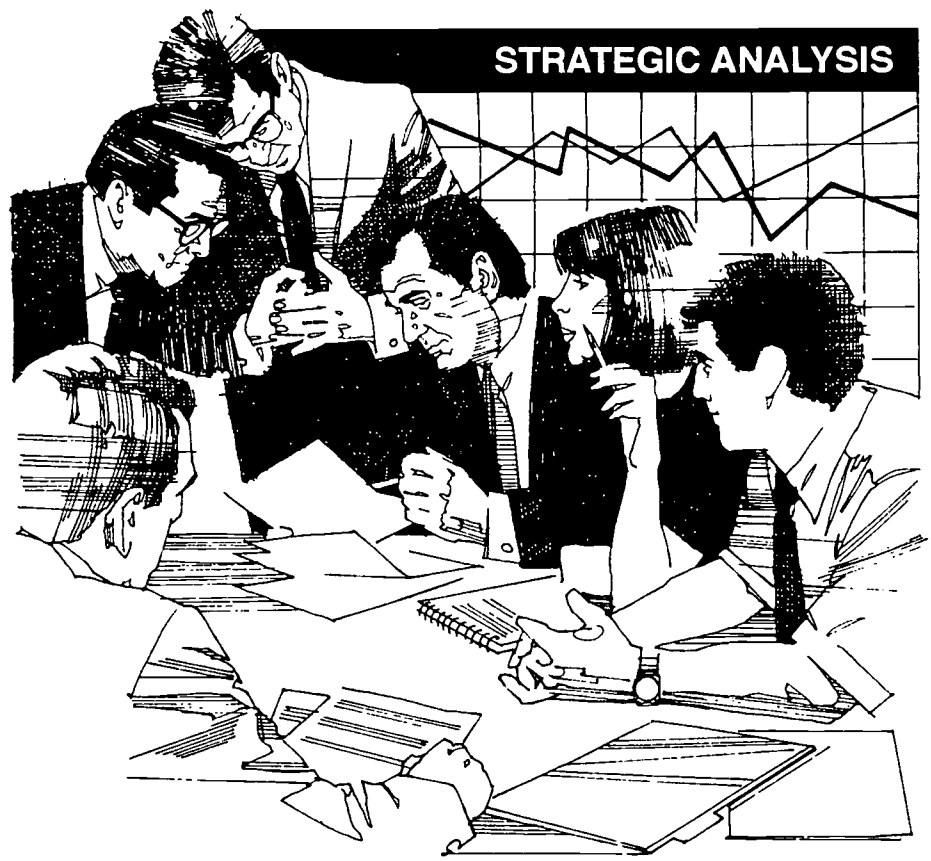
6.1 Students apply mathematical concepts, processes, and skills to solve technological problems.

6.2 Students apply scientific concepts, processes, and skills to the solution of technological problems.

6.3 Students utilize communication skills in the solution of technological problems.

6.4 Students apply social studies concepts, processes, and skills to explore the impacts of technology.

6.5 Students utilize arts and humanities concepts in the solution of technological problems.



Technology topics need to be integrated into the present curriculum. This includes science and mathematics classes, technology education, social studies, and the language arts, and art and music.

National Science Board (1983) Educating Americans for the 21st Century

GOAL 7

Career Awareness and Exploration

Students will apply knowledge of and perform tasks representative of technology-based careers including engineers, technologists, technicians, and craftspersons.

Subgoals

7.1 Students identify personal interests and abilities related to technology-based careers.

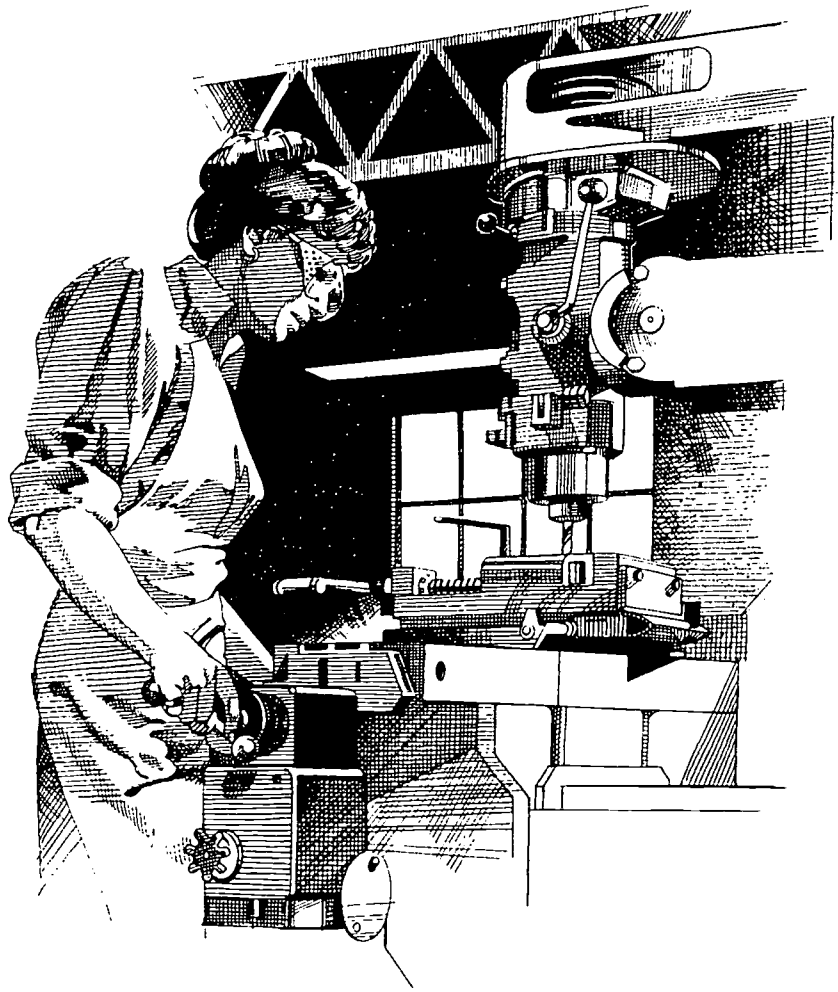
7.2 Students investigate educational opportunities and requirements related to technology-based careers.

7.3 Students investigate career opportunities, trends, and requirements related to technology based careers.

7.4 Students identify and demonstrate factors for employability and advancement related to technology based careers.

7.5 Students assess how changes in society, technology, government and the economy affect individuals and their careers and require them to do life long learning.

7.6 Students identify and demonstrate concepts of entrepreneurship and relate them to their individual aptitudes.



We live in a technology world, rapidly growing complex and more sophisticated. Each of us needs to know more about technology in order to participate in its development, use and control.

J.R. Johnson
"The Urgent Need for
Broad-Based
Technology Education"

GOAL 8

Multicultural and Gender Diversity

Students will recognize the multicultural and gender diversity inherent in the evolution of technology.

Subgoals

8.1 Students recognize the importance of the historical contributions of men and women of different cultures to the advancement of technology.

8.2 Students understand the current and future implications of multicultural contributions to the advancement of technology.

We recommend that all students study technology -- the history of man's use of tools, how science and technology have joined, and the ethical and social issues technology has raised.

The Carnegie Foundation for the Advancement of Teaching, High School: A report on Secondary Education.

technology education's contribution to academic education

North Dakota Technology Education Student Goals

Technology education can make the most meaningful contributions to the fulfillment of the North Dakota academic graduation outcomes.

COMMUNICATIONS
Students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communications.
Students listen to and understand complex oral messages and identify their purpose, structure, and use.
Students respond orally and in writing to information and ideas gained by reading narrative and informational texts and use the information and ideas to make decisions and solve problems.
Students compose and make oral presentations for each academic area of study that is designed to persuade, inform or describe.
Students read and use a variety of methods to make sense of various kinds of complex texts.
Students use effective research and information management skills, including locating primary and secondary sources of information with traditional and emerging library technologies.
Students analyze and make critical judgements about all forms of communication, separating fact from opinion; recognizing propaganda, stereotypes and statements of bias; recognizing inconsistencies; and judging the validity of evidence.
Students write for a variety of purposes, including to narrate, inform and persuade.

MATHEMATICS
Students compute, measure and estimate to solve theoretical and practical problems using appropriate tools, including modern technology such as calculators and computers.
Students apply the concepts of patterns, functions and relations to solve theoretical and practical problems.
Students use numbers, number systems and equivalent forms (including numbers, words, objects and graphics) to represent theoretic and practical situations.
Students formulate and solve problems and communicate the mathematical processes used and the reasons for using them.
Students evaluate, infer and draw appropriate conclusions from charts, tables and graphs, showing the relationships between data and real-world situations.
Students make decisions and predictions based upon the collection, organization, analysis and interpretation of statistical data and the application of probability.

SCIENCE AND TECHNOLOGY
Students use and master materials, tools, and processes of major technologies which are applied in economic and civic life.
Students explain the relationship between science, technology and society.
Students construct and evaluate scientific and technological systems using models to explain or predict results.
Students evaluate advantages, disadvantages, and ethical implications associated with the impact of science and technology on current and future life.
Students develop and apply skills of observation, data collection, analysis, pattern recognition, prediction and scientific reasoning in designing and conducting experiments and solving technological problems.
Students evaluate the impact on current and future life of the development and use of varied energy forms, natural and synthetic materials, and production and processing of food and other agricultural products.
Students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real-world situations.
Students demonstrate knowledge of basic concepts and principles of physical, chemical, biological and earth sciences.

ENVIRONMENT AND ECOLOGY
Students evaluate the implications of finite natural resources and the need for conservation and stewardship of the environment.
Students think critically and generate potential solutions of environmental issues.
Students analyze the effects of social systems, behaviors and technologies on ecological systems and environmental quality.
Students understand and describe the components of ecological systems and their functions.

CITIZENSHIP
Students demonstrate their skills of communicating, negotiating and cooperating with others.
Students demonstrate that they can work effectively with others.

CAREER EDUCATION AND WORK
Students understand and demonstrate the importance of relating their academic and vocational skills -- for example, interviewing, creative thinking, decision-making, problem-solving, understanding, and giving written and oral instructions -- to their ability to seek, obtain, maintain and change jobs.
Students explore the multiple purposes to work and the range of career options, including entrepreneurship, and relate them to their individual interests, aptitudes, and skills.
Students assess how changes in society, technology, government and the economy affect individuals and their careers and require them to continue learning.
Students completing a senior high technology education program exhibit the skills required for entry level in a particular occupation for which they have prepared.

technology education program

Technology education is an integral part of the education of each student. It is a comprehensive activity-based program that is concerned with understanding the evolution, application and significance of technology; its organization, personnel, systems, processes, resources and products; and the associated social/cultural/environmental impacts.

The content of technology education is derived by identifying the elements of creating and applying technology throughout the world. This interdisciplinary knowledge-based curriculum concentrates on the concepts and principles of technology and the consequences technology has for society and culture.

The technology education program at the middle/junior high education level is exploratory, comprehensive, interdisciplinary and integrated among the grade levels. This program provides practical applications for resources and processes of major technological systems. Attention is given to the input, process, output, feedback and modification of each system. Technology teachers need to ensure that students learn this technology content and experience the technological method. Students who experience technology education activities at the middle/junior high education level mature as they:

- Appreciate the breadth and impacts of contemporary technology;
- Use selected tools, machines, materials and processes;
- Identify relevant occupations, careers and educational programs in technological fields;
- Experience the organizational structure of technological endeavors through collaborative efforts;
- Research, plan, design, produce and evaluate technological products and services;
- Understand and apply the technological method of inquiry and problem solving;
- Apply and reinforce math, science and communication skills in practical situations and in life skills development;
- Perform computer applications in technological areas; and
- Explore solutions to environmental and ecological problems utilizing technology.

This publication guides the teacher in implementing a comprehensive and valid technology education program. It is supported with nationally developed resources that have been developed by the Center for Implementing Technology Education (CITE), the West Virginia Vocational Curriculum Laboratory, and the Mid-America Vocational Curriculum Consortium (MAVCC). Materials from these and other commercial sources can be identified and adapted to the North Dakota technology education curriculum.

All technology educators are encouraged to continually review and improve their activity-oriented programs. Teachers who have been using a socio-economic analysis of American industry approach to identify their curricular content should find a relatively easy transition to this analysis of universal technologies approach. On the other hand, those teachers who have previously identified their content through a trade analysis approach will have greater challenges to implementing technology education. However, the use of this implementor's guide should assist all individuals who are committed to initiating and implementing new and improved programs.

Technology Education Program Model

Middle/Jr. High Courses
9-18 Weeks
EXPLORING TECHNOLOGY
APPLYING TECHNOLOGY

High School Courses
18-36 Weeks
COMMUNICATION TECHNOLOGY
PRODUCTION TECHNOLOGY
ENERGY & TRANSPORTATION TECHNOLOGY
PRINCIPLES OF TECHNOLOGY
ENGINEERING TECHNOLOGY

middle / junior high school curriculum design

Example of a Local Technology Education Scope and Sequence

The scope and sequence of technology education provides a picture of the entire curriculum from the school system level. It provides a broad overview of the content of the curriculum and illustrates the sequence of the material from the middle school through high school. This document will address:

- middle school technology education
- high school technology education
- advanced high school technology education

Middle/Junior High School Technology Education

Technology education at the middle/junior high school level is characterized by the term "exploration." At this level, students should be involved in broad, introductory experiences in communication, construction, manufacturing, transportation, and bio-related technologies. It is recommended that all students study technology at this level regardless of educational and career goals. This is because technology influences every consumer, worker, and citizen in our society. Every person should be able to understand and use technology.

Middle School/Junior High School Technology Education students will:

1. define technology.
2. explore technology systems.
3. utilize a problem-solving strategy to solve technology-related problems.
4. develop a positive self-image by meeting success in hands-on experiences.
5. develop skills in the safe use and operation of basic tools, machines, materials, and processes of technology.
6. identify his/her talents, abilities, and interests in technological fields.
7. develop cognitive (mental), psychomotor (physical), and affective (ethical) problem-solving skills by researching and developing, designing, producing, operating, and analyzing technology systems.
8. identify various technology-related careers, the opportunities in these fields, and their educational requirements.
9. experience the organization and management structure of industry.
10. appreciate the nature of technology and its impact on the individual, society, and the environment.

course outline

MIDDLE / JUNIOR HIGH SCHOOL

Course Title:
EXPLORING TECHNOLOGY

Course Description:
Exploring Technology is an activity-based course that introduces students to technology by examining the basic systems of communication, production, and energy/transportation. Students will study the evolution of technology, invention and innovation, impacts of technology, the systems approach and various problem-solving methods.

Course Objectives:
During this course, the student will be able to:

1. Develop knowledge in technology and its basic systems of bio-related, communication, production, energy and transportation.
2. Understand the systems approach and how it is applied to the study of technology.
3. Understand the relationship between technology, mathematics and science.
4. Make decisions and solve problems as an individual and in group situations.
5. Demonstrate safe, proper and efficient use of various tools, machines and equipment.
6. Appreciate the evolution of technology; analyze its impact on people, society and the environment; and research possible future developments.
7. Explore communication, production, transportation and bio-related technologies by performing basic processes.

Content Outline:
A. Definitions of Technology

B. Classroom/Lab Safety

C. Systems of Technology

D. Systems Approach

E. Impacts and Trade-offs

F. Evolution of Technology

G. Invention and Innovation

H. Problem-Solving Methods

I. Communication Technology

J. Production Technology

K. Energy and Transportation Technology

course outline

MIDDLE / JUNIOR HIGH SCHOOL

Course Title:
APPLYING TECHNOLOGY

Course Description:
Applying Technology is an activity-based course that focuses on the application of the tools, materials and processes of communication, manufacturing, construction and transportation. Students will study the ways materials, energy and information are processed to transmit information, build structures, make products and move passengers and freight.

Course Objectives:
During this course, the student will be able to:

1. Know how each system of technology processes information, energy and materials and manages people.
2. Apply mathematics and scientific principles to the solution of technological problems.
3. Apply a wide variety of materials.
4. Communicate information using a variety of graphic and electronic communication media.
5. Design and develop products and structures using a variety of forming, separating and combining processes.
6. Produce structures using rigid and nonrigid structural elements to withstand specified loads and forces.
7. Understand the importance of energy to each system of technology.
8. Transport freight and/or passengers on land, water and in the air, and analyze the six technical subsystems of transportation.

Content Outline:
A. Systems Approach

B. Classroom/Lab Safety

C. Materials

D. Energy

E. Communication - Graphic

F. Communication - Electronic

G. Production Processes

H. Transportation

high school curriculum design

High School Technology Education Program

The mission of Technology Education at the high school level is to develop technological literacy in each student so that he or she can become an effective and contributing member of society. This is accomplished through instruction and experiences pertaining to technology and its evolution, applications, significance, and career opportunities.

Technology Education's content should focus on the technology systems that are an integral part of our society. These systems include, but are not limited to, manufacturing, construction, transportation, communication, and bio-related technologies. Activities will promote problem solving, critical thinking, and the cognitive, psychomotor, and affective development necessary for interaction with modern technology. These laboratory activities will also provide opportunities for the application of science, mathematics, language arts, and social studies knowledge and skills. Students will recognize the multicultural and gender diversity included in the development of technology.

High School Technology Education students will:

1. demonstrate knowledge and skills regarding diverse technology systems, including their functioning and applications.
2. demonstrate knowledge of the nature of technology and the relationships and impacts among technological achievement, the environment, the advancement of science, the individual, and society. The context for this knowledge shall be historical, current, and futuristic.
3. demonstrate the ability to solve problems with technology using a systems approach, higher-order thinking skills, individual and collaborative ingenuity, and a variety of resources including information, tools, and materials.
4. make ethical decisions about technology-related issues, including the development and use of technology and technological resources.
5. demonstrate in an experiential setting the safe, effective, and creative use of technological resources— including tools, machines, and materials—in performing technological processes.
6. apply science, mathematics, language arts, social studies, and technological concepts to solve practical problems and extend human capabilities.
7. apply knowledge of and perform tasks representative of technology-based careers, including engineers, technologists, technicians, and craftspersons.
8. recognize the multicultural and gender diversity inherent in the evolution of technology.

course outline

HIGH SCHOOL

Course Title:
COMMUNICATION TECHNOLOGY

Course Description:
Communication Technology is an activity based course that explores the application of tools, materials, and energy in developing, processing, using and assessing communication systems. Student will produce graphic and electronic media as they explore techniques used to apply technology in communicating information and ideas.

Course Objectives:
During this course, the student will be able to:

1. Demonstrate the ability to work safely with communication technologies.
2. Demonstrate interpersonal skills as they relate to communications.
3. Identify and apply methods of information acquisition and utilization.
4. Apply basic skills in communications, mathematics, and science appropriate to communication technology.
5. Demonstrate and apply design/problem solving processes.
6. Express an understanding of communication systems and their complex interrelationships.
7. Identify, organize, plan and allocate communication resources.
8. Discuss individual interests and aptitudes as they relate to a meaningful career choice.

Content Outline:

A. Introduction to Communication
B. Safety and Ethics
C. History of Communication
D. The Communication Process
E. Design and Technical Graphics
F. Printed Graphics
G. Electronic Communications
H. Communication Impacts
I. Careers in Communication

course outline

HIGH SCHOOL

Course Title:
PRODUCTION TECHNOLOGY

Course Description:
The *Production Technology* course provides students with a general introduction to the material processing and management components of a production activity. The major emphasis will be placed on the production and management processes used to convert resources into structures, goods, and services. Students will become aware of the social and environmental impacts of technology.

Course Objectives:
The learner:

1. Demonstrates knowledge of and apply skills related to diverse technology systems.

2. Demonstrates knowledge of the impact of technological advancements on the individual, society, and the environment.

3. Demonstrates the ability to solve problems with technology using a systems approach, higher order thinking skills, individual and collaborative ingenuity, and a variety of resources including information, tools, and materials.

4. Makes informed decisions about technology-related issues.

5. Demonstrates in an experiential setting the safe, effective, and creative use of technological resources including tools, machines, and materials - in performing technological processes.

6. Applies science, mathematics, language arts, social studies, and technological concepts to solve practical problems and extend human capabilities.

7. Applies knowledge of technology-based careers in terms of: personal interests and abilities: educational opportunities and requirements; career opportunities, trends, and requirements: and other factors for employability and advancement.

8. Recognizes the multi cultural and gender diversity included in past, present, and future uses of technology.

Content Outline:

A. Introduction to Technology Systems

B. Technology and Production

C. History of Production

D. Resources for Production

E. Production Processes

F. Problem Solving in Production

G. Production Impacts

course outline

HIGH SCHOOL

Course Title:
ENERGY AND TRANSPORTATION TECHNOLOGY

Course Description:
Energy/Transportation Technology is an activity based course which introduces students to generation, conversion, control, transmission and storage of energy. Machines and tools are used to increase strength and mechanical advantage and the movement of people and materials. Energy and Transportation is equally applied to Production and Communication as well as transportation. The activities introduce major scientistic and mathematical concepts to support Energy/Transportation.

Course Objectives:
1. Evaluate energy and transportation systems and their impact on people, the environment, culture and the economy.

2. Plan, schedule, manage, and evaluate energy and transportation activities or projects using identified problem solving techniques.

3. Identify and investigate various types of energy and transportation technology systems.

4. Identify and describe new career and emerging technology in energy and transportation field.

5. Strengthen cooperative attitudes, manipulative skills and demonstrate technical literacy, unique to this system.

6. Integrate and apply technological systems, thereby enriching and reinforcing the disciplines of math and science.

Course Outline:
A. Introductory Concepts

B. Energy Sources

C. Energy Conversion and Transmission

D. Energy Storage

E. Energy Control

F. Energy Utilization Systems

G. Transportation Systems

H. Environmental Impact

I. Trends in Energy and Transportation

advanced curriculum design

HIGH SCHOOL

Advanced Technology Education

Advanced technology education courses provide opportunities for the in-depth study of technology. The scope of these courses is more narrow than the basic high school course, allowing students to develop more advanced skills and deeper understandings of selected technological systems or processes. The learner outcomes for technology education remain the basis for these courses with one exception. Learner outcome number one states that students will demonstrate knowledge and skills regarding "diverse" technology systems. Advanced technology education students will demonstrate knowledge and skills regarding "selected" technology systems and processes.

There are a variety of approaches to organizing advanced technology sequences. One is to select a specific human enterprise or institution that utilizes technology such as communications, transportation, manufacturing, commerce, or finance, and then provide instruction and activities resulting in a significant knowledge and skills base related to the technologies that support the enterprise.

General education should describe technology in a holistic way, showing it as part and parcel of our history, our everyday existence, and our future.

Project 2061 Report by the
AAAS "Technology"

Another approach is to base the advanced technology education course on a technological process such as research and experimentation, technological assessment, or pre-engineering design.

A third method might be to examine the core technologies systems used in all technology systems. The core technologies include mechanical, structural, thermal, electrical, electronic, optical, fluid, bio, and materials technologies. In each approach, students must demonstrate the ability to create technology through the skillful use of tools and equipment and analyze the impact of the technology.

As a continuation of the study of technology, advanced technology education courses will provide opportunities for acquiring deeper understanding of technological concepts and increasingly complex technical skills. The focus of study must be technology—the application of knowledge, tools, and skills to solve practical problems and extend human capabilities. The goal must be the development of technological literacy, which is the ability to interact successfully with technology, to assess the impacts of technology on everyday life and make appropriate decisions, and to apply conceptual knowledge in order to solve problems.

HIGH SCHOOL

Course Title:
PRINCIPLES OF TECHNOLOGY

Course Description:
Principles of Technology is a multimedia hands-on course about technical applications of important scientific principles. It examines the similarities of these applied science principles in mechanical, fluid, electrical and thermal systems. It incorporates the related mathematical concepts and in order to interpret results.

Course Objectives:
1. Examine unifying technical concepts inherent in basic energy systems.

2. Master technological principles that are universal and can be transfer as equipment and technical means change.

3. Reinforced scientific and mathematical concepts in practical problem solving applications to compliment basic academic skills.

4. Strengthen technical reading and writing skills.

5. Develop hands on laboratory skill.

6. Establish a foundation of experiences for understanding technologically oriented courses.

Course Outline:
A. Force

B. Work

C. Rate

D. Resistance

E. Energy

F. Power

G. Force Transformers

course outline

HIGH SCHOOL

Course Title:
ENGINEERING TECHNOLOGY

Course Description:
Engineering Technology provides an orientation and exposure to the careers and challenges of engineering. As an experienced-based course, students are actively involved with the practices of various engineering fields, high-technology systems, devices and materials, engineering graphics, and mathematics/science principles through a laboratory-based set of case studies involving problem solving and design experiences.

The major engineering concepts to be included are modeling, systems, optimization, technology-society interaction, design, and ethics. Content is provided in applied engineering graphics, communicating technical information, engineering design principles, material science, research and development processes, manufacturing techniques and systems, and opportunities and challenges of other emerging branches of engineering.

Students manipulate tools, materials, and machines to solve real-world engineering problems using prototypes and models, testing apparatuses, CAD/CAM systems, robotics, computer modeling, and simulations.

Course Objectives:
The learner will:

1. Describe engineering achievements and their impact on society.
2. Apply science and mathematics principles and skills to modeling, systems, and organization.
3. Analyze the properties of materials to engineer solutions to problems.
4. Describe the characteristics and educational requirements of various engineering fields and related careers.
5. Communicate technical information.
6. Apply the systems approach to problems of engineering and their solution.

Content Outline:

A. Modeling

B. Systems

C. Optimization

D. Technology-Society Interaction

E. Design and Ethics

F. Engineering Graphics

G. Communicating Technical Information

H. Engineering Design

I. Materials Science

J. Research and Development Processes

K. Manufacturing Techniques

L. Career Exploration
- Industrial Technology
- Engineering Technology
- Engineering (Industrial, Civil, Mechanical, Electrical, Chemical, Agricultural and Architechtural).

program implementation

The goals of technology education at the middle/junior high level are to assist learners in (a) understanding technology and its social/cultural/environmental impacts, and (b) making related informed and meaningful education and occupational choices. Accomplishing these goals requires middle education level students to apply academic skills and develop problem-solving knowledge with technology.

The following two planned courses (minimum of 9 weeks each) are recommended:

EXPLORING TECHNOLOGY
APPLYING TECHNOLOGY

Course Organization and Methodology

Proponents of technology education advocate teaching technology activities from the perspective of understanding the entire system. This approach provides the learner with the opportunity to identify specific components of a system and to relate these components to the total function of a system. The universal systems model has been adapted to the content areas of communication, production and energy and transportation technologies.

It is important at the middle/junior high education level that the selected strategies provide practical application of academic skills and the technological method. Emphasis should be on applying technology to teach and reinforce appropriate student learning outcomes. Identifying the major concepts to be learned will help focus attention on these academic skills. Learning the technological method is critical to developing technologically literate people who have the know-how to approach, apply and assess technology.

Assessment

A variety of assessment strategies should be applied in evaluating the knowledge and performance of each student in the technology education planned courses. Examples include sketches, drawings, prototypes, products, written reports, oral presentations, performance demonstrations and examinations. Documentation of assessment such as samples of student work, written testimony of teachers, test results and learning objective profiles should be presented in student-developed portfolios.

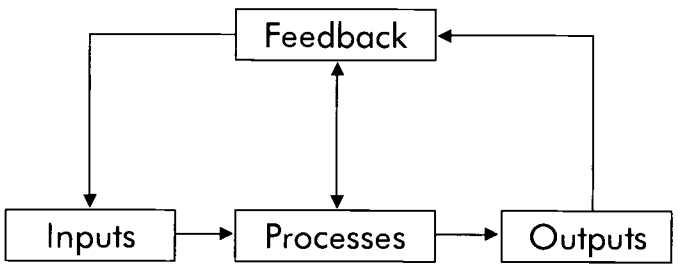
The mathematics and science now offered to our young people could be greatly enriched if we were to incorporate a technological content.

"A Nation at Risk"
National Commission on Excellence.

The Universal Systems Model

A system suggests a combination of elements or parts that work together to accomplish a desired goal. Technology education uses the Universal Systems Model as an organizational tool to help both teachers and students understand the concept of systems.

UNIVERSAL SYSTEMS MODEL



INPUTS: Provides all the needed resources to accomplish the goals of the system.

PROCESSES: The means of bringing about the system goals using the inputs.

OUTPUTS: The ends or goals (products, services or desired results) to which all the inputs and processes are applied.

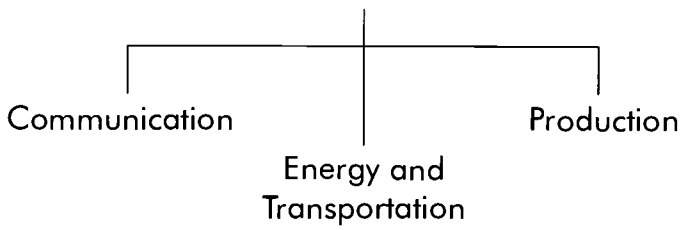
FEEDBACK: Adds an element of control to systems. Evaluation can be conducted at any position in the system, and corrections can be made to the inputs or processes to achieve acceptable outputs from the system.

Technological Systems

Throughout history, people have produced goods and structures, communicated ideas, and transported goods and people. Because of this, technology education has been divided into the systems of communications, construction, manufacturing, and transportation. Each system represents a uniquely human endeavor that is defined by the nature of its activity. These systems are related to each other but are unique in the types of questions and problems pursued and in their structure, concepts and goals.

The four systems are the most commonly used in technology education:

TECHNOLOGICAL SYSTEMS



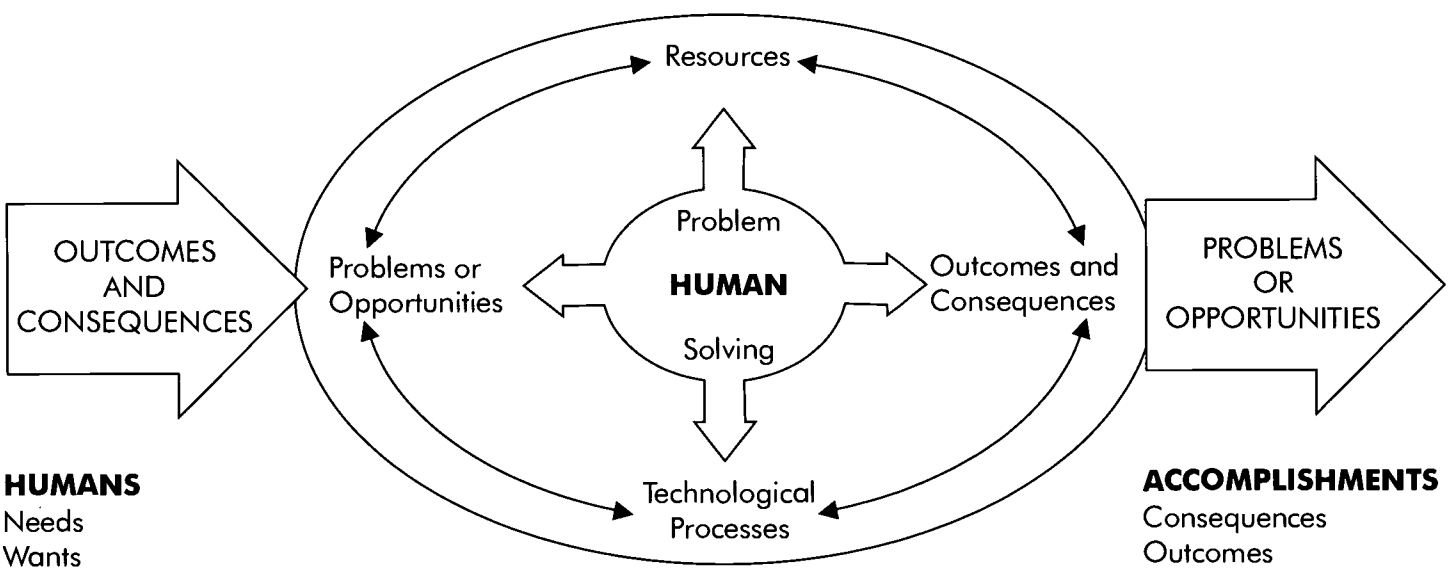
COMMUNICATION: The ways that humans create, store and transmit information.

TRANSPORTATION: The ways that humans use technology to physically move materials, goods and people.

PRODUCTION: Processes and techniques used by humans to produce goods and structures.

technological method model

The learning of the technological method is a unique and vital contribution of technology education. This process is applicable and transferable to the various technology content areas. Just as courses in science employ the scientific method, courses in technology must apply the technological method of creating technology and problem solving. Instructional strategies that will help students to understand and apply the technological method include (a) the design brief for recognizing technological problems, (b) problem solving by following logical procedures, (c) the design portfolio for communicating ideas and solutions and (d) technology assessment for analyzing impacts.



HUMANS
Needs
Wants

ACCOMPLISHMENTS
Consequences
Outcomes

CHALLENGES
Problems
Opportunities

PROBLEM SOLVING
Defining the Problem
Developing Alternate Solutions
Selecting a Solution
Implementing and Evaluating the Solution
Redesigning the Solution
Interpreting the Solution

RESOURCES
People
Tools/Machines
Information
Materials
Energy
Capital
Time

TECHNOLOGICAL PROCESSES
Communication Technology Processes
Production Technology Processes
Energy and Transportation Technology Processes

Source: Savage, E. & Sterry, L. (1990). A conceptual framework for technology education. Reston, VA: International Technology Education Association.

references

Department of Public Instruction. (January, 1993). North Dakota Curriculum Frameworks. Volume 1. Bismarck, ND.

Dugger, W.E., Bame, E.A. & Pinder, C.A. (1985). Standards for technology education programs. Reston, VA.: International Technology Education Association.

International Technology Education Association. (1994). Maryland Technology Education Graduation Outcomes -- Questions and Answers for Teachers.

Maryland State Department of Education. (no date). Technology Education -- A Maryland Curricular Framework.

Marzano, R.J., Pickering, D. & McTighe, J. (1993). Assessing Student Outcomes -- Performance Assessment Using the Dimensions of Learning Model. Alexandria, VA: Association for Supervision and Curriculum Development.

Pennsylvania Department of Education. (March 1994). Technology Education in Pennsylvania -- Middle Level Performance-Based Implementation Guide. Harrisburg, PA.

Savage, E. & Sterry, L. (1990). A conceptual framework for technology education. Reston, VA: International Technology Education Association.

Wright, T. & Sterry, L. (no date). Industry and technology education - A guide for curriculum designers, implementors, and teachers. Lansing, IL: Technical Foundation of America.

Technology is a body of knowledge and actions used by people to apply resources in designing, producing, and using products, structures and systems to extend the human potential for controlling and modifying the natural and humans, their societies and the life giving and life-sustaining environment.

P.W. DeVore
1992 CTTE Yearbook

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement (OERI)
Educational Resources Information Center (ERIC)

ERIC®

NOTICE

REPRODUCTION BASIS

☑ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").

ERIC