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IDENTIFIERS Special Needs Students

ABSTRACT

This teacher's guide is designed to help high school industrial arts teachers plan activities to develop their students' awareness of technology in our culture and the variety of related careers available to them. Discussed first are the objectives, scope, and sequence of industrial arts. Next, the special characteristics and needs of adolescents, women in industrial arts programs, disadvantaged or disabled students, and students from various ethnic and racial groups are examined. Discussed in the next two chapters is the need to incorporate basic skills and entrepreneurship education activities into industrial arts curricula. The fifth chapter consists of a series of program goals, course goals, and suggested activities for use in covering the following subject areas in an industrial arts curriculum: graphic communications, energy and power, materials and processes, academic skills, employment opportunities and career choice, safety, multicultural awareness, and entrepreneurship. Provided next are a series of course outlines devoted to the following topics: graphic communications, entrepreneurship, robotics, computer-aided design and computer-aided manufacturing, nondestructive testing, properties of materials, manufacturing processes, energy and power, voice synthesis, fiber optics, and optoelectronics. The final chapter discusses various resources available to industrial arts teachers, including advisory committees, student organizations, publishers, regional coordinators, journals, professional associations, and curriculum and resource centers.

(MN)

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# high school INDUSTRIAL ARTS a guide for teachers

1984

Verne A. Duncan  
State Superintendent of Public Instruction



Oregon Department of Education  
700 Pringle Parkway SE  
Salem, Oregon 97310-0290

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— WE BELIEVE —

- Education prepares people to function as productive and contributing members of society,
  - Society is highly technological,
  - Technology is the application of science and of technical advances in industry,
  - Industry uses technology to produce goods, services and information,
  - Industrial arts education is the study of industry and technology,
  - All students will benefit from participation in industrial arts programs.
-

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## FOREWORD

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Today's high school students will live in a society that demands an understanding of advanced technology. As we move toward the next century, technical literacy will become increasingly important to all citizens. No longer is technology the sole domain of engineers and scientists, but of all who seek more effective ways to live their lives.

The suggestions in this guide will help high school industrial arts teachers plan activities to develop their students' awareness of technology in our culture and the variety of related careers available to them. As students study the processes and tools of industry and technology, they begin to discover their own interests and talents, often laying the groundwork for future occupations.

This guide was created to help high school teachers in Oregon encourage their students to understand technology and the vital role it will play in their futures and in the future of our nation.

Verne A. Duncan  
State Superintendent of  
Public Instruction

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Charles G. Honey  
Drafting Instructor  
Crescent Valley High School  
Corvallis 97330-9735

Earl Marble  
Dept. Head, Wood Instructor  
North Marion High School  
Aurora 97002

Keith Thompson  
Industrial Education Teacher  
Neah-Kah-Nie Jr. Sr. High Dist. 56  
Rockaway 97136

Susan Ferrell Harlan  
Graduate Teaching Assistant  
Department of Industrial and  
General Engineering  
Oregon State University  
Corvallis 97331-2118

Larry J. Kenneke  
Department Chair  
Vocational-Technical Education  
Oregon State University  
Corvallis 97331-2118

Glen W. Winders  
Vocational Director  
Metals Instructor  
Stayton Union High School  
Stayton 97383-1133

Wayne E. Johnson  
Regional Coordinator  
Career/Vocational Education  
Linn-Benton ESD  
Albany 97321-3199

Paul Benninghoff  
Principal  
Cleveland High School  
Portland 97202

Henry J. Sredl  
Professor-in-Charge  
Industrial Education  
Oregon State University  
Corvallis 97331-2118

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John M. Fessant  
Specialist - Industrial Arts  
Oregon Department of Education

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## INTRODUCTION

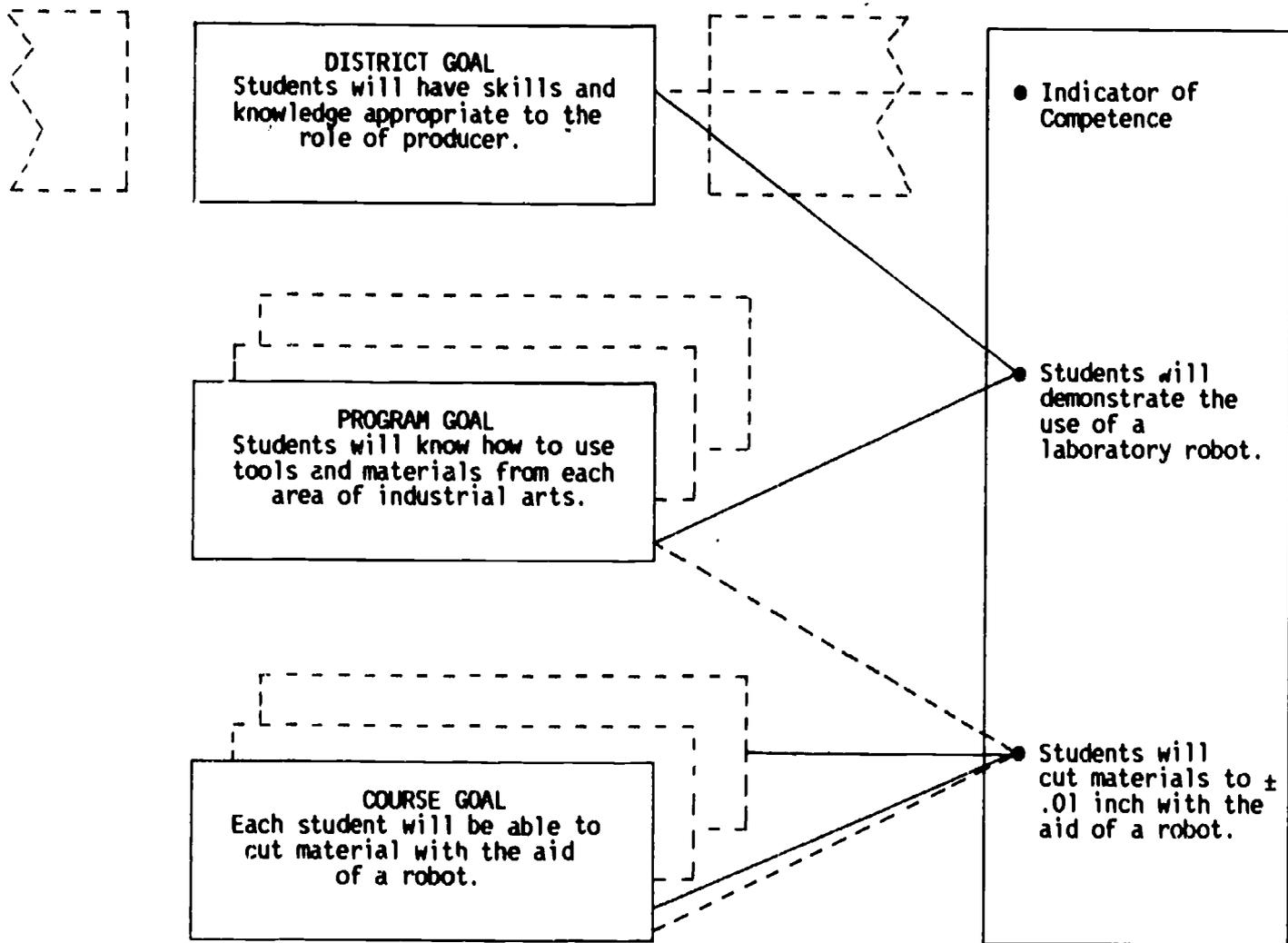
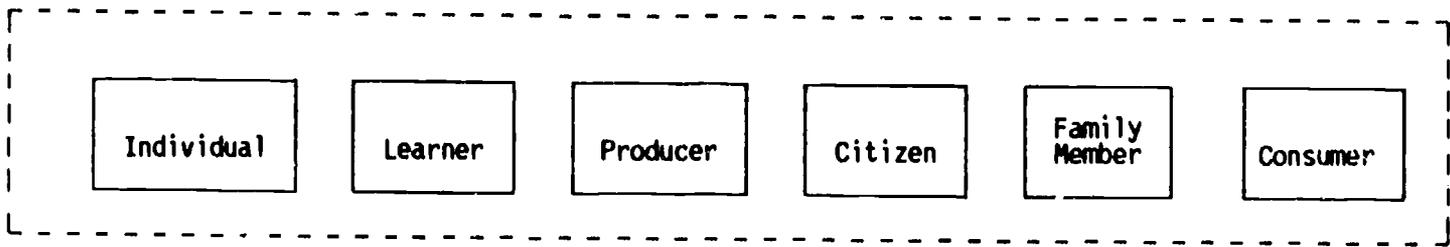
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This handbook suggests ways teachers may organize an industrial arts curriculum consistent with Oregon's goal-based planning for K-12 instruction.

- STATE GOALS answer the question: What does the Department of Education think a student should get out of public schooling in Oregon?
- DISTRICT GOALS answer the question: What do the local community and its schools think a student ought to get out of local schooling and how is that related to state goals?
- PROGRAM GOALS answer the question: What do the local curriculum planners and industrial arts teachers think a student ought to get out of industrial arts and how is that related to district goals?
- COURSE GOALS answer the question: What do the industrial arts teachers think a student ought to get out of industrial arts courses and how does that relate to program goals?
- COMPETENCY means being capable and fit. For students, it means having demonstrated they can likely apply outside school what they've already learned--in or out of school.

See the following page for a model of goal-based planning in industrial arts.

# GOAL-BASED PLANNING IN INDUSTRIAL ARTS



Goals are intended to help teachers, program specialists and administrators plan programs. Goals promote a framework for planning that can be shared by all those doing similar planning. Goals help in planning for individual students' goals and interests, to be done within the limits of available resources. It is important that industrial arts teachers be directly involved in developing district, program and course goals so that the industrial arts instruction is coordinated with other program areas. Goals for industrial arts should not be used to limit what is planned; rather, they should be a starting point.

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The growth of the human mind is still high adventure, in many ways the highest adventure on earth.

- Norman Cousins

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industrial arts  
**OVERVIEW**

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*This section provides background information on statewide goals for schooling and a definition, goals, content and scope and sequence for industrial arts.*

## **LIFE ROLES**

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Oregon schools provide all students with the opportunity to develop their ability to function as learners, producers, citizens, consumers and family members. These life roles are statewide goals for schooling; education is considered the combined result of experiences in school as well as in the family and the community.

## **DEFINITION OF INDUSTRIAL ARTS**

Industrial arts is that part of a general education which provides opportunities for students to develop an understanding of the many aspects of industry and technology: consumer, technical, occupational, managerial, social, historical and cultural. It helps students acquire knowledge and skills through creative and problem-solving concepts such as experimenting, planning, designing, constructing and evaluating. They also learn to use tools, machines, materials and processes. Such experiences provide students with the opportunity to apply reading, writing, computing, speaking and listening skills to practical situations. Industrial arts activities also give students a chance to apply scientific principles to practical situations.

## **GOALS FOR INDUSTRIAL ARTS**

Each student will:

- discover some of the ways industry and technology affect our culture.
  - discover and develop talents and interests related to industrial or technical areas.
  - develop the ability to properly use tools, machines and processes.
  - develop problem-solving skills using the tools, materials and processes of industry.
  - apply the content of other school subjects to that of industrial arts.
  - develop an understanding of a variety of careers related to industrial arts and their requirements.
  - acquire knowledge and develop skills to manage personal resources and enterprises.
  - learn to work in a safe manner.
-

## CONTENT

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This book covers the key areas of technology suggested for a high school industrial arts program, as well as specific processes within each area. They are:

### Graphic Communications

- Visualization
- Symbols
- Size and shape description
- Graphic reproduction
- Preservation and assembly
- Storage and retrievals

### Energy and Power

- Nomenclature
- Interrelationships of energy and power
- Energy sources
- Energy conversion
- Power transmission
- Transportation
- Fiber optics

### Materials--Processes

- Interrelationships
- Robotics
- Materials classification
- Materials analysis
- Forming processes
- Separating processes
- Combining processes
- Finishing processes
- Quality control

Safety, academic skills, self and career awareness, entrepreneurship and cultural diversity are also integral parts of the industrial arts curriculum.

# INDUSTRIAL ARTS SCOPE AND SEQUENCE

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## FOCUS

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ELEMENTARY SCHOOL

Learning  
Reinforcement  
and Awareness

---

MIDDLE SCHOOL

Exploration

---

HIGH SCHOOL

Pre-vocational

---

---

**CONTENT AREAS**

**INSTRUCTIONAL EMPHASIS**

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**Industrial arts activities  
integrated within the  
elementary curriculum**

**Provide students with  
introductory activities  
related to society and  
technology.**

- 
- **Graphic Communications**
  - **Energy and Power**
  - **Materials - Processes**

**Provide students with an  
opportunity to discover  
and develop individual  
talents, attitudes,  
interests and potential  
as related to society  
and technology.**

- 
- **Graphic Communications**
  - **Energy and Power**
  - **Materials - Processes**

**Provide students with a  
closer look at specific  
technologies. This level  
develops fundamental  
skills in the proper use  
of common tools,  
materials and processes.**

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Treat people as if they were what they ought to be and you help them to become what they are capable of being.

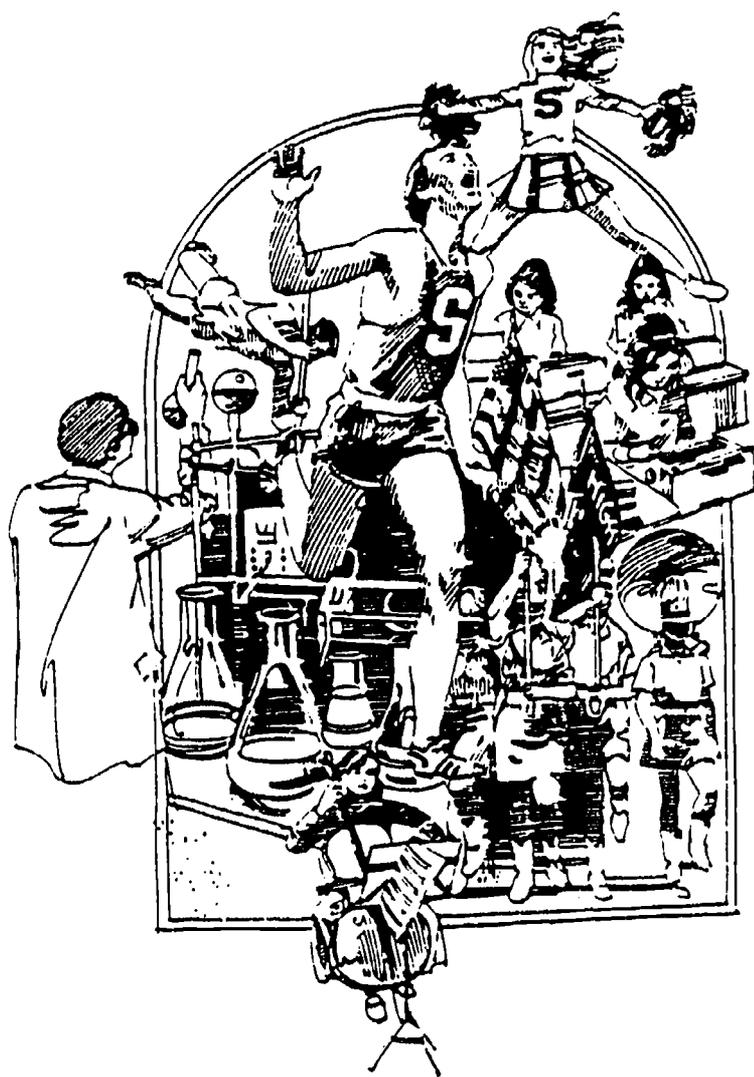
- Johann W. von Goethe

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high school  
**STUDENTS**

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*High schools care for the needs of students during early and late adolescence. Programs designed for them must reflect the developmental processes of these growth stages.*

## CHARACTERISTIC BEHAVIORS OF ADOLESCENTS

---

To encourage individual growth and development, an industrial arts program should be designed with the characteristic behaviors of adolescents in mind. The following chart illustrates some of the characteristics most commonly found in this age group.

BEHAVIORS	EARLY ADOLESCENCE (Ages 8-15)	LATE ADOLESCENCE (Ages 16 - Adult)
- Achieving an appropriate dependence-independence pattern.	- Establishing independence from adults.	- Establishing self as an independent individual in an adult manner.
- Achieving an appropriate giving-receiving of affection.	- Accepting self as a worthwhile person, really worthy of love.	- Building a strong mutual affectional bonding with a possible marriage partner.
- Relating to changing societal groups.	- Behaving according to a shifting peer code.	- Adopting an adult-patterned set of societal values by learning a new peer code.
- Developing a conscience.	- Strong identification with peers. - Learning one's role in heterosexual relationships.	- Learning to verbalize contradictions in moral codes, as well as discrepancies between principles and practice and resolving these in a responsible manner.
- Learning psychosociobiological sex role.	- Strong identification with peers. - Learning one's role in heterosexual relationships.	- Exploring possibilities for a future mate and acquiring "desirability." - Choosing an occupation. - Preparing to accept one's future as a responsible citizen.

---

BEHAVIORS	EARLY ADOLESCENCE (Ages 8-15)	LATE ADOLESCENCE (Ages 9 - Adult)
- Accepting and adjusting to a changing body.	- Reorganizing thoughts and feelings about self in the face of significant bodily changes. - Accepting the reality of one's appearance.	- Learning appropriate outlets for sexual drives.
- Managing a changing body and learning new motor patterns. - Learning to understand and control the physical world.	- Controlling and using a new body.	- Refining control and use.
- Developing an appropriate symbol system and conceptual abilities.	- Using language to express and clarify more complex concepts. - Moving from the concrete to the abstract and applying principles to the particular.	- Achieving the level of reasoning of which one is capable.
- Relating self to cosmos.		- Formulating a workable belief and value system.

*Adapted with permission from Association for Supervision and Curriculum Development. Fostering Mental Health in Our Schools - Yearbook (Washington, D.C.: National Education Association, 1950).*

## WOMEN AND INDUSTRIAL ARTS

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A number of strategies can be used to encourage young women to enroll in industrial arts classes.

- Do not use sexist language, inferences, expressions or jokes.
- Review course titles, course descriptions and recruitment materials to ensure they clearly state that classes are open to both sexes and will benefit both. Use language that is not specific to either sex.
- Review guidance materials used by counselors to be sure that neither girls nor boys are stereotyped.
- Eliminate policies, requirements and situations that would discourage or hinder females from enrolling in classes.
- Display photographs, posters, wall hangings, and projects in show cases that show both sexes involved in class work.
- Point out to students the sexism implicit in most of the existing teaching materials and books for industrial arts. Discuss how sex biases are encouraged by textbooks that only show boys operating machines or participating in industrial arts classes.
- Prepare a brochure or a one-page flyer describing why your subject might be attractive and beneficial to young women. Distribute them through the counselor's office, library and homerooms.
- Invite potential female students to a student organization meeting. Have club officers and members prepare a special meeting to explain advantages of classes and club activities.
- Involve present female students in industrial arts/technology classes as role models in recruitment activities.
- Send an informational letter to parents of potential female students pointing out the short- and long-range benefits of industrial arts education.
- Present information about benefits of industrial arts classes at open-house programs and PTA meetings.

Adapted from AIAA Affirmative Action publication, *Providing Technology Education for All Students*. 1983.

## DISADVANTAGED AND/OR HANDICAPPED STUDENTS \_\_\_\_\_

The academically disadvantaged and/or handicapped (D & H) student requires a special instructional approach in industrial arts. Two checklists follow which help identify such students.

### A Checklist for Identifying Academically Disadvantaged Students

The student is NOT SUCCEEDING or is NOT EXPECTED TO SUCCEED in a regular industrial arts program.

AND the student speaks and comprehends English but CANNOT do one or more of the following:

- \_\_\_\_\_ Reads and comprehends course materials.
- \_\_\_\_\_ Writes sufficiently well to demonstrate the learning of industrial arts subject matter.
- \_\_\_\_\_ Performs computation activities at level required by the industrial arts program.

AND the deficiency is NOT caused by a handicapping condition.

### A Checklist for Identifying Economically Disadvantaged Students

The student is NOT SUCCEEDING or is NOT EXPECTED TO SUCCEED in a regular industrial arts program.

AND the student exhibits one or more of the following behaviors:\*

- \_\_\_\_\_ Is often tardy.
- \_\_\_\_\_ Is often absent.
- \_\_\_\_\_ Is offensively aggressive.
- \_\_\_\_\_ Lacks confidence.
- \_\_\_\_\_ Has difficulty relating to peers.
- \_\_\_\_\_ Has difficulty relating to supervisors.
- \_\_\_\_\_ Has difficulty following instructions.
- \_\_\_\_\_ is a disciplinary problem.
- \_\_\_\_\_ Is inattentive to assignments.
- \_\_\_\_\_ Has poor work habits.

OR the student exhibits other behaviors which could result in termination of employment.

---

AND one or more of the following conditions exists:

- \_\_\_\_\_ The student's family income is at or below the national poverty level.
- \_\_\_\_\_ The student or student's parent/guardian is unemployed.
- \_\_\_\_\_ The student or student's parent is recipient of public assistance.
- \_\_\_\_\_ The student is institutionalized or under state guardianship.

AND the student is NOT handicapped.

## **GUIDANCE**

Guidance and counseling services shall be available in the high school and shall provide assistance by:

- Orienting new students to the school and providing a bridge to later schooling or work.
- Focusing the attention of all school personnel on student needs.
- Drawing on school and community resources to assist with the physical, social and emotional problems of children.
- Interpreting to student and parents the student's cumulative record.
- Interpreting pupil data to teacher.
- Working with staff to develop appropriate guidance activities.

## **MULTI-CULTURAL AWARENESS**

All students should be encouraged to develop a respect for individuality and different cultures. Multi-cultural concepts and philosophy shall be infused throughout the educational program and not limited to "multi-cultural activities" or to the social studies program. Instructional programs should respond to the following goals:

- Awareness and appreciation of cultural/ethnic diversity and individuality.

---

*Prepared by the Vocational Education Special Needs Project, Department of Vocational and Technical Education, Oregon State University, Corvallis, OR 97331-2404.*

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- 
- Development and encouragement of respect for one's cultural background.
  - Recognition and reduction of ethnic stereotyping.

## **EQUALITY**

Industrial arts programs should be designed and operated to provide equal educational opportunities for all students, thereby complying with the following federal laws:

Title IX of the Education Amendments of 1972

- *No person in the United States shall, on the basis of sex, be excluded from participation in, be denied benefits of, or be subject to discrimination under any education program or activity that receives federal financial assistance.*

Title VI of the Civil Rights Act of 1964

- *No person shall be discriminated against because of his or her race, color, or national origin in any program or activity that receives federal financial assistance.*

Public Law 94-142, "Education for all Handicapped Children Act," mandates that free and appropriate public education be made available to all handicapped children and young adults in public schools until age 21.

- *Procedures to assure that, to the maximum extent appropriate, handicapped children will be educated with children who are not handicapped, and that special classes, separate schooling, or other removal of handicapped children from the regular educational environment occurs only when the nature or severity of the handicap is such that education in regular classes cannot be achieved satisfactorily.*

Contact the Oregon Department of Education regarding guidelines and standards that have been developed to comply with federal mandates. Phone: 378-2129.

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*The past must no longer be used as an anvil for beating out the present and the future.*

*- Paul-Emile Borduas*

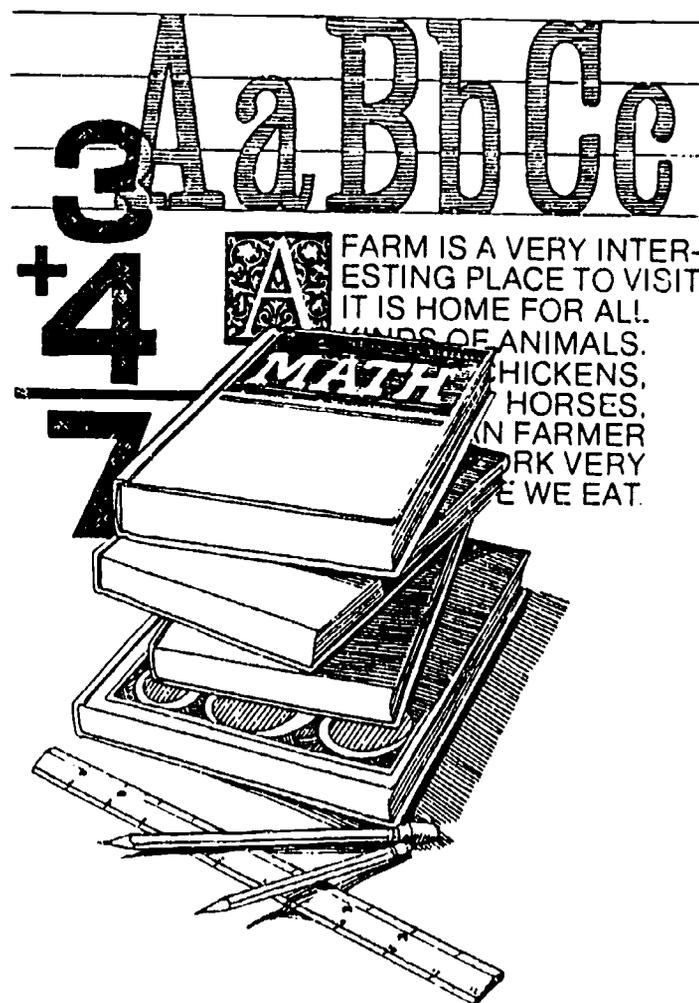
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academic

# BASIC SKILLS

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*Industrial arts combined with academic instruction lets the student know that basic skills are important in life and in achieving career goals.*

## **APPLYING ACADEMIC SKILLS IN INDUSTRIAL ARTS**

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A purpose of the high school program is to provide instruction in communications, mathematics and science. With implementation of Oregon Standard 581-22-402, there is a need for every teacher to reinforce basic academic skills in all subject matter areas. This is especially true for the industrial arts teacher. Because industrial arts activities illustrate practical applications of academic skills, they give students incentive for improving their reading, writing, speaking, spelling and computing skills. The combination of industrial arts concepts and basic skills instruction equips students for mastering industrial arts subject matter. Industrial arts, combined with academic instruction, teaches the student that basic skills are important in life, in achieving career goals and in leisure time activities.

### **MATHEMATICS IN INDUSTRIAL ARTS**

Industrial arts teachers, in consultation with mathematics specialists, can reinforce the concepts of measurement, fractions, percent, conversions, decimals and geometry. For example, industrial arts teachers can help students master measurement concepts while at the same time teaching industrial processing operations. As students prepare to cut stock to rough dimension, they learn skills associated with measurement, such as:

- the concept of measurement using a standard reference,
- the approximate nature of measure,
- estimation skills with a variety of scales,
- measurement in both the metric and English system.

### **SCIENCE IN INDUSTRIAL ARTS**

Industrial arts programs put scientific principles to work. When teachers demonstrate how things work they can show students how an application is often based on one or more scientific principles. For example, as students transmit power through mechanical devices they can at the same time be shown the application of Newton's Second Law - force and motion in gear trains. Further, the application of Charles' Law of Gases can be demonstrated as students work on heat engines. Buoyancy and flotation (Archimedes' Principle) can be illustrated as students repair a carburetor.

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The opportunities to show students practical applications of scientific principles are unlimited. Joint planning efforts between industrial arts and science teachers will ensure coverage of those principles which have direct application to graphic communications, energy, power and materials-processing technology.

### **COMMUNICATION IN INDUSTRIAL ARTS**

The motivation to use tools, materials and processes to produce and maintain goods provides students with a real and immediate reason for learning to communicate. Activities such as programming a robot, shaping parts to specification and assembling component parts give students a reason for learning to read, write and speak. Working together, industrial arts and language arts teachers can reinforce student communication skills. Spelling and reading skills can be honed through development of technical vocabulary lists. Referencing skills can be sharpened when students use automotive parts manuals to identify and locate replacement components. Speaking and listening skills can be improved as students engage in mass production activities. As students master communication skills, they will be equipped to master industrial arts concepts.

### **COMPUTER LITERACY IN INDUSTRIAL ARTS**

Students do not have to be programmers to understand how to use a computer any more than a person has to be a master chef to operate a microwave oven. Industrial arts programs can help students become computer literate. Classroom and laboratory activities can help students select an appropriate computer system for specific tasks. Further, these activities enable students to use the system to accomplish those tasks. As students analyze and process the materials of industry they will be able to:

- identify components that are common to all computers,
- correctly use computer terminology,
- operate a microcomputer and
- select an appropriate computer system for a specific task.

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*We must ask where we are and whither we are tending.*

*- Abraham Lincoln (1809 - 1865)*

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# ENTREPRENEURSHIP

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*Industrial arts provides students with insights into American enterprise. It helps students make decisions about whether or not to pursue self-employment.*

## **SMALL BUSINESS**

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Small business plays a vital role in our economy. There are approximately 14 million small businesses, a major portion of which are one-person or family-owned enterprises. Such small businesses generate most of the new jobs in the economy.

### **ENTREPRENEURIAL EDUCATION**

Entrepreneurial education can strengthen small business as the core of innovative technology and economic stability. It also presents business ownership as a career alternative to youth who perceive working for others as their sole option for the future.

Entrepreneurial education is a process to enable learners to identify, develop and apply their attitudes, abilities, skills and goals towards taking the risk of owning and managing a business. It can instill the values and attitudes of business ownership at all grade levels. Awareness of business can be generated in the elementary school. Explorations of business opportunities can occur at the middle school. The high school can prepare students for entrepreneurship through real and simulated business activities.

### **GOALS OF ENTREPRENEURIAL EDUCATION**

The goals of entrepreneurial education are to:

- develop knowledge, attitudes and skills of an entrepreneur.
- observe entrepreneurial settings and role models.
- apply and practice entrepreneurial skills.
- develop a basic understanding and appreciation of entrepreneurs as a vital part of the American society.

### **THE ROLE OF INDUSTRIAL ARTS IN ENTREPRENEURSHIP**

Industrial arts courses provide students with practical business experience and insights into entrepreneurship. They offer students the opportunity to organize and operate their own enterprise.

Student companies require interdisciplinary support within the school. They need management consulting assistance from volunteers representing local businesses and industries. Such activities build good relationships between the school and private sector. They are a means of establishing partnerships with the business community.

In organizing and running a company the student will:

- Establish goals and objectives
- Raise capital
- Organize a board of directors
- Secure workers
- Market a product or service
- Pay wages, costs, taxes
- Liquidate assets
- Make decisions
- Incorporate
- Elect officers
- Survey the market
- Manufacture a product
- Maintain records
- Write reports

High school teachers and business consultants provide the assistance students need to accomplish these tasks. For example, bankers and business teachers can help students determine capital requirements; i.e., using a cash flow projection to determine optimum initial capital. Economists working with economics teachers can help students with product pricing and production and sales goals. A chart depicting other ways business people and teachers can work together follows.

Suggested Adult Assistance

Task	Consultants	Teachers
Incorporate	Executive	Business
Secure Capital	Banker Stock Broker	Economics
Abide by Laws	Lawyer Judge	Social Science Language Arts
Manufacture Products	Production Supervisor Industrial Engineer	Industrial Arts Science
Work Safety	Safety Engineer	Industrial Arts Science
Secure Workers	Personnel Manager	Social Science Speech Counselor
Determine Fixed Costs	Market Researcher Manager	Business Economics
Sell Products/Services	Marketing Expert Salesperson	Distributive Education Speech
Keep Financial Records	Accountant Bookkeeper	Accounting Business
Liquidate Assets	Accountant Business Manager Auditor	Business Economics Accounting
Write Reports	Executive Manager	Language Arts

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*Let us not go over old ground, let us rather prepare for what is to come.*

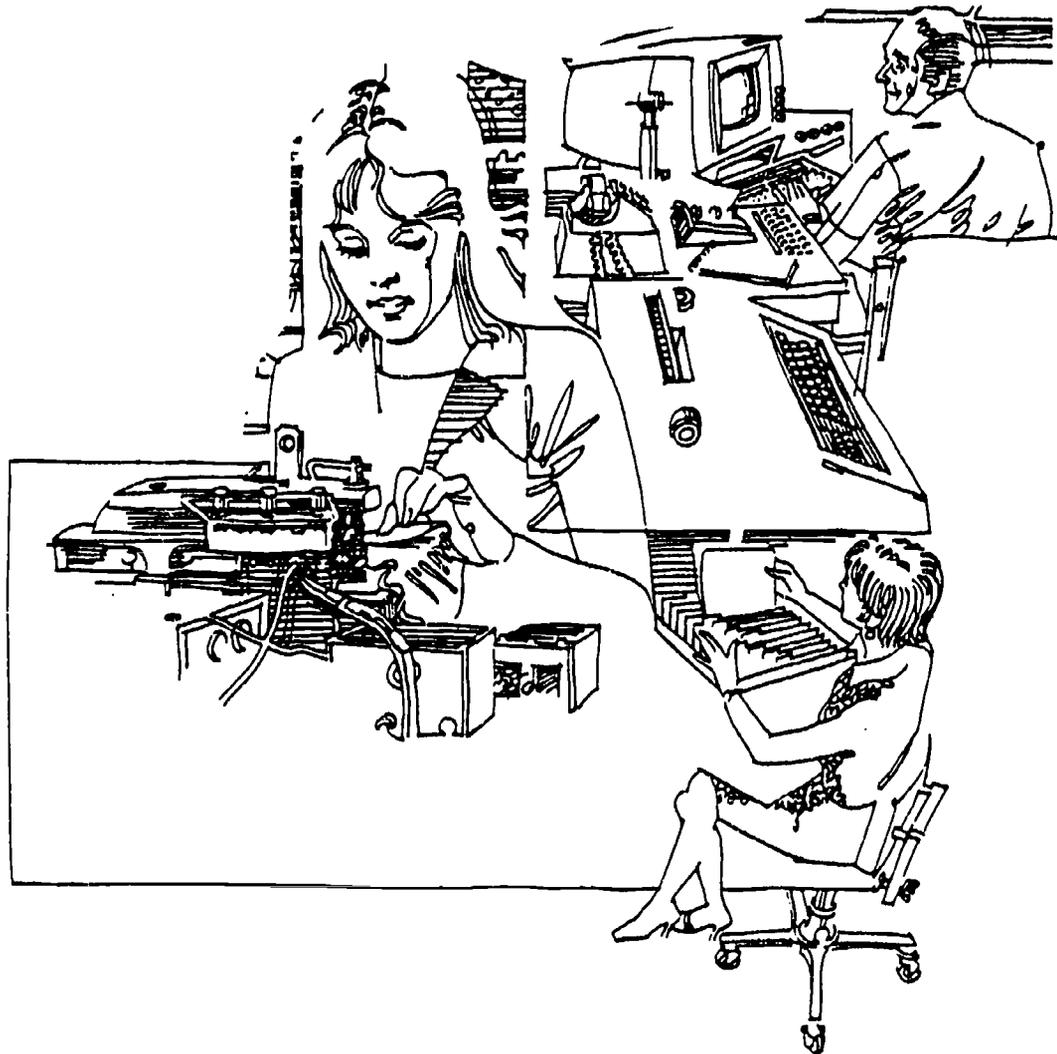
*- Marcus Tullius Cicero*

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high school  
**CURRICULUM**

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*The high school industrial arts program is pre-vocational and interdisciplinary in nature, emphasizing technological awareness through application of basic academic skills.*

## CONTENT

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The high school industrial arts program should provide students with experiences in the following areas of technology:

### PROGRAM GOAL #1.0 - GRAPHIC COMMUNICATIONS (Page 30).

- Visualization
- Symbols
- Size and shape description
- Graphic reproduction
- Preservation and assembly
- Storage and retrievals

### PROGRAM GOAL #2.0 - ENERGY AND POWER (Page 34).

- Nomenclature
- Interrelations of energy and power
- Energy sources
- Energy conversion
- Power transmission
- Transportation
- Fiber optics

### PROGRAM GOAL #3.0 - MATERIALS - PROCESSES (Page 39).

- Interrelationships
- Robotics
- Materials classification
- Materials analysis
- Forming processes
- Separating processes
- Combining processes
- Finishing processes
- Quality control

Safety, academic skills, self and career awareness, entrepreneurship and cultural diversity are integral parts of the content and are treated as significant topics when and where appropriate.

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## Graphic Communications

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### Program Goal

1. The student possesses the knowledge and skills of graphic communications technology.

### Course Goal

- 1.1 The student knows how to visualize ideas.

### Suggested Activities

- 1.1.1 Describe the visual communication process.
- 1.1.2 List basic steps in audience analysis.
- 1.1.3 Describe major advantages and limitations of four visual reproduction methods.
- 1.1.4 Given a communication problem, prepare a flow chart of operations and procedures to be used to solve the problem.
- 1.1.5 Use a classroom computer to schedule the process and procedures used to solve a communication problem.
- 1.1.6 Describe the impact of graphic communications technology on society.

### Course Goal

- 1.2 The student knows the impact symbology has upon technology and society.

### Suggested Activities

- 1.2.1 Use a classroom computer to apply symbols to the solution of a graphic problem.
- 1.2.2 Describe how ideas are translated into visual symbols.
- 1.2.3 Select an idea and design a symbol to represent it.
- 1.2.4 Design a trademark or logo.
- 1.2.5 Describe how symbols affect societal groups.

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**Course Goal**

1.3 The student knows how to prepare materials for graphic reproduction.

**Suggested Activities**

- 1.3.1 Analyze proof sheets of photos and crop to improve quality.
- 1.3.2 Develop designs and prepare paste-ups.
- 1.3.3 Apply proof marks to correct copy.
- 1.3.4 Mask copy for setting with full details.
- 1.3.5 Enter a message into a phototypesetting machine.
- 1.3.6 Enter a message into a word processor.
- 1.3.7 Set lead type.
- 1.3.8 Prepare a paper offset master.
- 1.3.9 Work with English composition classes to prepare term papers.
- 1.3.10 Prepare a drawing using tape drafting methods.

**Course Goal**

1.4 The student knows how to describe size and shape.

**Suggested Activities**

- 1.4.1 Apply principles of projections, spatial graphics, and graphic statistics to selected problems.
- 1.4.2 Describe the function of a standard symbol and illustrate its use.
- 1.4.3 Apply sketching and mechanical aids to render technical illustrations.
- 1.4.4 Sketch and identify isometric, oblique, orthographic projections and geometric constructions.
- 1.4.5 Dimension drawings using standard practices.
- 1.4.6 Use a computer to make a visual presentation.

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- 1.4.7 Use a computer to help write specifications for working drawings.
  - 1.4.8 Reinforce knowledge of measurement, fractions and decimals through development of working drawings.
  - 1.4.9 Reinforce geometric concepts through completion of geometric constructions.
  - 1.4.10 Use a computer to describe an object by use of cartesian coordinates.

### **Course Goal**

- 1.5 The student knows how to reproduce materials in graphics form.

### **Suggested Activities**

- 1.5.1 List at least four factors that influence choice of a reproduction method.
- 1.5.2 Reproduce a message by the letterpress method.
- 1.5.3 Reproduce a message by the offset press.
- 1.5.4 Reproduce a message by the silk screen process.
- 1.5.5 Reproduce an image using the photo-offset method.
- 1.5.6 Reproduce a message using the spirit duplicator.
- 1.5.7 Use a classroom computer to analyze the advantages and disadvantages of major reproduction techniques.
- 1.5.8 Reproduce an image using the photographic method.
- 1.5.9 Reinforce basic mathematical concepts through the calculation of various reproduction methods costs.
- 1.5.10 Describe scientific principles applied to various graphic reproduction techniques.

### **Course Goal**

- 1.6 The student knows how to preserve and assemble graphic reproductions.
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### **Suggested Activities**

- 1.6.1 Laminate prints in plastic.
- 1.6.2 Spray prints with protective coatings.
- 1.6.3 Collate printed materials.
- 1.6.4 Fasten printed materials with a spiral binding.
- 1.6.5 Fasten printed materials with a saddle stitch.
- 1.6.6 Mount color reversal film in cardboard frames.
- 1.6.7 Place prints in appropriate jackets or frames.
- 1.6.8 Design secure and attractive product packages.
- 1.6.9 Calculate the costs of various binding techniques.

### **Course Goal**

- 1.7 The student knows how to store and retrieve information.

### **Suggested Activities**

- 1.7.1 Use a computer-assisted library search to identify major methods of abstracting information.
- 1.7.2 Abstract information in a manner appropriate for a selected storage and retrieval situation (microfiche or film, metal file, computer disk, etc.).
- 1.7.3 Record or image materials to acceptable reproduction levels.
- 1.7.4 Index and code materials in preparation for efficient storage.
- 1.7.5 Set up, operate and evaluate at least two types of viewing systems (cathode tube, fiche-film reader, etc.).
- 1.7.6 Set up a system for storage and retrieval of hard prints.
- 1.7.7 Describe the scientific principles involved in photoreduction methods.
- 1.7.8 Perform the calculations necessary to achieve a desired photoreduction of a selected graphic product.

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## Energy and Power

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### Program Goal

2. The student possesses knowledge and skills in the use of energy and power technology.

### Course Goal

- 2.1 The student knows the nomenclature of energy and power technology.

### Suggested Activities

- 2.1.1 Develop a definition of terms list using a classroom computer.
- 2.1.2 Develop vocabulary lists of energy and power terminology.
- 2.1.3 Reinforce spelling skills through vocabulary lists of energy and power technology.
- 2.1.4 Classify energy sources using a microcomputer.

### Course Goal

- 2.2 The student knows the interrelationships of natural resources and energy consumption patterns.

### Suggested Activities

- 2.2.1 Write a research paper on current and projected energy consumption patterns.
- 2.2.2 Describe the interrelationship of energy consumption and the environment.
- 2.2.3 Given appropriate data, calculate the cost savings of an energy efficient housing project.
- 2.2.4 Describe the scientific principles involved in household energy conservation measures (installation of storm windows, insulating an attic, etc.).
- 2.2.5 Conduct a debate on the use of nuclear power generation.

### Course Goal

- 2.3 The student knows the availability and potential of energy sources.
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### **Suggested Activities**

- 2.3.1 Discuss the economic considerations in the use of energy sources.
- 2.3.2 Research and report on the availability of selected energy sources.
- 2.3.3 Use a classroom computer to classify energy sources.
- 2.3.4 Gather data and use a microcomputer to forecast the supply and demand of a given energy source.
- 2.3.5 Write a paper on the environmental impact of the removal of a selected energy source.

### **Course Goal**

- 2.4 The student knows the theory and practice of energy conversion devices.

### **Suggested Activities**

- 2.4.1 Perform routine maintenance procedures on thermal or mechanical engines.
  - 2.4.2 Overhaul a two- or four-cycle engine.
  - 2.4.3 Perform experiments using a laboratory steam engine.
  - 2.4.4 Describe how a given thermal or mechanical conversion device applies scientific principles.
  - 2.4.5 Construct and operate active and passive solar conversion devices.
  - 2.4.6 Write a technical report on nuclear fission and fusion.
  - 2.4.7 Assemble and operate a laboratory electrical-mechanical conversion device.
  - 2.4.8 Describe how chemical principles are used in electrical batteries.
  - 2.4.9 Convert water flow into electricity through construction of laboratory devices.
  - 2.4.10 Convert wind into electricity through construction of wind generators.
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- 2.4.11 Describe how scientific principles apply to a rocket engine.
  - 2.4.12 Fire a model rocket. Observe and record the process.
  - 2.4.13 Convert chemicals into electricity through laboratory activities.

### **Course Goal**

- 2.5 The student knows the theory and practice of power transmission devices.

### **Suggested Activities**

- 2.5.1 Demonstrate the transmission of power through mechanical devices; i.e., pulleys, belts, clutches, gear trains, shafts, cams, screws, etc.
- 2.5.2 Calculate the mechanical advantage gained through use of selected mechanical devices.
- 2.5.3 Combine belts and pulleys to move parts or process materials on a mass production assembly line.
- 2.5.4 Illustrate hydraulic transmission concepts with fluid power laboratory apparatus.
- 2.5.5 Apply pneumatics principles to transfer power from one laboratory station to another.
- 2.5.6 Illustrate electrical power transmission concepts through laboratory experiments.
- 2.5.7 Demonstrate the transfer of light through experiments with fiber optics technology.
- 2.5.8 Write a technical report on transfer of light through laser technology.
- 2.5.9 Calculate electrical units using Ohm's and Watt's laws.
- 2.5.10 Combine electrical, mechanical and fluid devices to move parts from one place to another.
- 2.5.11 Troubleshoot electrical systems using diagnostic equipment.
- 2.5.12 Control transmission of power with the aid of a computer.

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- 2.5.13 Troubleshoot an electrical-mechanical system using appropriate diagnostic equipment.
  - 2.5.14 Repair an electrical transmission device.
  - 2.5.15 Combine electrical components to produce a fully functioning system.
  - 2.5.16 Design a simple electrical transmission device.

### **Course Goal**

- 2.6 The student knows the principles and practices of moving people and things from one location to another.

### **Suggested Activities**

- 2.6.1 Construct a laboratory conveyor belt system for moving parts from one lab station to another.
- 2.6.2 Program a classroom computer to control the movement of an assembly line conveyor system.
- 2.6.3 Describe the characteristics of various transportation methods used to move people and materials.
- 2.6.4 Transfer parts from one location to another using a simple "pick and place" manipulator.
- 2.6.5 Schedule movements of component parts to an assembly line using a microcomputer.
- 2.6.6 Interview a transportation traffic manager and describe scheduling operations.
- 2.6.7 Calculate cost differentials of taking a bus, car, train or plane from Portland, Oregon to New York City. Analyze the findings.
- 2.6.8 Write a report on the environmental impact of rail, water, auto and air transportation systems.
- 2.6.9 Research and report on the support systems needed to keep air traffic moving.
- 2.6.10 Move parts from one laboratory station to another using a playback robot.

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- 2.6.11 Program a classroom computer to schedule traffic flow in a given city bus system.

### **Course Goal**

- 2.7 The student knows the theory and practice of fiber optics.

### **Suggested Activities**

- 2.7.1 Fabricate actual fiber links.
- 2.7.2 Construct a modulated source driver circuit.
- 2.7.3 Construct and operate a fiber optic receiver circuit.
- 2.7.4 Research and report on industrial applications of fiber optics.
- 2.7.5 Describe the scientific principles at work when fiber optics are applied to a selected task.

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## Materials-Processes

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### Program Goal

3. The student possesses basic knowledge and skill in the use of materials and processes.

### Course Goal

- 3.1 The student knows the interrelationships of natural resources, energy and human resources to production and construction processes.

### Suggested Activities

- 3.1.1 Form a classroom corporation.
- 3.1.2 Secure financial support for a production or construction activity.
- 3.1.3 Secure human and material resources to complete a production or construction activity.
- 3.1.4 Keep production/construction records on a classroom computer.
- 3.1.5 Plan a production/construction activity on a classroom computer.
- 3.1.6 Secure appropriate energy for a classroom production/construction activity.
- 3.1.7 Combine manufactured and purchased parts into a completed product.
- 3.1.8 Keep an inventory of parts on a classroom computer.
- 3.1.9 Use a simple "pick and place" robot in the manufacture of a product.
- 3.1.10 Distribute finished products to consumers.
- 3.1.11 Dissolve the classroom corporation.

### Course Goal

- 3.2 The student knows the characteristics of robots and their applications to industry.

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## Suggested Activities

- 3.2.1 Define the term "industrial robot."
- 3.2.2 Describe six devices classified as industrial robots.
- 3.2.3 Transport objects using a laboratory manual manipulator.
- 3.2.4 Disassemble, reassemble and adjust a laboratory manual manipulator.
- 3.2.5 Prepare a flow chart or Warnier chart.
- 3.2.6 Operate a laboratory playback robot in order to input all information relevant to its operations (sequence, conditions and positions).
- 3.2.7 Prepare punched tapes, cards or digital switches for input to a numerical control (NC) robot.
- 3.2.8 Describe how an industrial robot makes practical use of at least four basic scientific principles.
- 3.2.9 Set up and operate a laboratory intelligent robot in at least two different work situations.
- 3.2.10 Prepare a report on the development of the humanoid "droid."
- 3.2.11 Set up and run an assembly line using a simple "pick and place" manipulator.
- 3.2.12 Compare/contrast the "X-Y-Z" axis movement and wrist/arm suppleness of at least four tabletop laboratory robots.
- 3.2.13 Describe at least six different applications of industrial robots.
- 3.2.14 Describe the relationship between computers and robots.
- 3.2.15 Prepare a report on the technological and human barriers to the use of robots in industry.
- 3.2.16 Describe the impact that use of industrial robots will have on society.
- 3.2.17 Describe how robots apply mathematics and scientific principles to their operation.

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**Course Goal**

3.3 The student knows the materials classification system.

**Suggested Activities**

- 3.3.1 Name two major industrial material classifications.
- 3.3.2 List the material subgroups of each major material classification.
- 3.3.3 Describe four types of materials hardness tests.
- 3.3.4 List four materials inspection methods.
- 3.3.5 Classify and inventory industrial materials with a microprocessor.
- 3.3.6 Describe how industrial materials classification relates to what is studied in science classes.

**Course Goal**

3.4 The student knows how to analyze materials.

**Suggested Activities**

- 3.4.1 List the six properties of materials.
- 3.4.2 Classify materials properties into seven categories.
- 3.4.3 Determine the shear strength of given materials.
- 3.4.4 Find out the compression strength of ductile and brittle materials.
- 3.4.5 Determine tensile strength and ductility of laboratory materials.
- 3.4.6 Test the load capacity of hardwood and softwood columns.
- 3.4.7 Test the strength of glues and adhesives.
- 3.4.8 Conduct a strength comparison of two common wood joints.
- 3.4.9 Analyze materials with a microprocessor.

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3.4.10 Describe the relationship of laboratory materials testing activities to units of study in physics and chemistry classes.

3.4.11 Describe the primary mathematical concepts that are applied to materials testing.

### **Course Goal**

3.5 The student knows industrial forming processes.

### **Suggested Activities**

3.5.1 Plan an entire industrial production activity using a classroom computer.

3.5.2 Mix and pour concrete.

3.5.3 Cast an object using fiberglass casting resin.

3.5.4 Make a slip casting.

3.5.5 Cast an object in plaster.

3.5.6 Cast an object using aluminum.

3.5.7 Make a lost wax casting.

3.5.8 Extrude plastic objects.

3.5.9 Injection mold plastic objects.

3.5.10 Use compression to mold thermo-setting plastics.

3.5.11 Use blow molding on plastics.

3.5.12 Mold metal using centrifugal casting.

3.5.13 Laminate wood over plastic materials.

3.5.14 Heat treat metal.

3.5.15 Control a forming process with a microprocessor.

3.5.16 Explain how a given forming process applies scientific and/or mathematical principles/concepts.

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## Course Goal

3.6 The student knows industrial separating processes.

### Suggested Activities

- 3.6.1 Separate material using a laboratory intelligent robot.
- 3.6.2 Perform shearing operations using squaring shears, punch, press, tin snips, nibblers, etc.
- 3.6.3 Perform drilling operations using a drill press, hand drill, and brace and bit.
- 3.6.4 Form cylindrical shapes using a metal cutting and/or wood lathe.
- 3.6.5 Perform milling and sawing operations using milling machines, table saws, jointers, band saws or scroll saws.
- 3.6.6 Shape materials using a shaper.
- 3.6.7 Remove materials using grinding and abrasive machines.
- 3.6.8 Separate materials using oxyacetylene, shielded metal, air arc, hot wire cutting, or plasma arc.
- 3.6.9 Cut metals through etching, electronic discharge machinery (EDM) or electro-mechanical machining (ECM).
- 3.6.10 Use a numerical control device in a separating process.
- 3.6.11 On a classroom computer, keep a record of separating process activities.
- 3.6.12 Explain how a given industrial separating process applies mathematical and scientific principles.

## Course Goal

3.7 The student knows industrial processes used for combining materials.

### Suggested Activities

- 3.7.1 Combine materials using a simple "pick and place" manipulator.
  - 3.7.2 Combine materials using any or all of the following bonding processes; fusion, flow, pressure, cold or hot adhesives.
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- 3.7.3 Permanently fasten materials using rivets.
  - 3.7.4 Fasten materials semi-permanently using screws, bolts, nails or staples.
  - 3.7.5 Temporarily fasten materials using wing nuts, clips or cotter pins.
  - 3.7.6 Fasten materials with mechanical force with seaming, joints or shrink and press fitting.
  - 3.7.7 Maintain a parts inventory on a classroom microcomputer.
  - 3.7.8 Describe the application of major scientific principles when materials are combined using industrial processes.

### **Course Goal**

- 3.8 The student knows industrial finishing processes.

### **Suggested Activities**

- 3.8.1 Use a "playback" robot to finish materials.
  - 3.8.2 Finish materials by embossing them.
  - 3.8.3 Finish materials by extrusion injection.
  - 3.8.4 Knurl a metal object on the metal lathe.
  - 3.8.5 Use a router to finish a product.
  - 3.8.6 Sand the surface of a product using a pedestal grinder.
  - 3.8.7 Obtain the desired surface through application of a finish material by spraying, brushing, dipping, electroplating or anodizing.
  - 3.8.8 Transport materials using a manual manipulator.
  - 3.8.9 Use a microcomputer to control a finishing process.
  - 3.8.10 Use a computer-controlled "pick and place" robot in a finishing process.
  - 3.8.11 Explain how a given industrial finish adheres to materials. Give the scientific principle(s) underlying the process.
  - 3.8.12 Report on new and emerging industrial finishing processes.
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**Course Goal**

3.9 The student knows the importance of quality control.

**Suggested Activities**

- 3.9.1 Check accuracy according to specifications.
- 3.9.2 Check accuracy to  $\pm .05$  using a micrometer.
- 3.9.3 Check accuracy to  $1/32$  using a scale.
- 3.9.4 Check quality of joint fit (no spacing).
- 3.9.5 Check quality of finish (smooth, no ripples).

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## Academic Skills

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### Program Goal

4. The student possesses communication, scientific and mathematical skills required for appropriate use of technology.

### Course Goal

- 4.1 The student knows how to read, write, speak and listen to make appropriate use of technology.

### Suggested Activities

- 4.1.1 Prepare technical vocabulary lists.
- 4.1.2 Write specifications for working drawings.
- 4.1.3 Proofread and mark copy.
- 4.1.4 Interpret a set of blueprints.
- 4.1.5 Verbally instruct another student to assemble a product.
- 4.1.6 Write component-part assembly instructions.
- 4.1.7 Complete a job application form.

### Course Goal

- 4.2 The student knows how scientific principles apply to industry.

### Suggested Activities

- 4.2.1 Explain the application of Archimedes' Principle to the operation of a gasoline tank float.
- 4.2.2 Describe how the principles of heat and thermodynamics effect the operation of a thermocouple.
- 4.2.3 Explain how the principles of wave motion and sound effect the design of stereo systems.
- 4.2.4 Observe force and motion in a mechanical power transfer system and describe physics principles that have direct application to its operation.
- 4.2.5 Write a report on the principles underlying operation of the polaroid camera.

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## Course Goal

- 4.3 The student knows how to use mathematical concepts to solve technological problems.

## Suggested Activities

- 4.3.1 Calculate the proper value of a resistor that must be installed into an amplifier circuit.
- 4.3.2 Measure and cut stock to proper dimension.
- 4.3.3 Select a proper sized number drill from a fraction-sized set.
- 4.3.4 Calculate the proper gear ratio for a five-speed transmission given special job requirements.
- 4.3.5 Rotate an object through N revolutions with the aid of a classroom computer.

**Program Goal**

5. The student is aware of career opportunities in industry that would best suit his or her interests and aptitude.

**Course Goal**

- 5.1 The student knows his or her own interests, aptitude and attitudes.

**Suggested Activities**

- 5.1.1 Use tools and materials that are representative of those used by persons working in industry.
- 5.1.2 Use CIS to do a job search.
- 5.1.3 Complete an interest inventory or aptitude test.
- 5.1.4 Analyze individual test results.

**Course Goal**

- 5.2 The student knows educational and occupational requirements of industry-related jobs.

**Suggested Activities**

- 5.2.1 Interview a worker.
- 5.2.2 Observe a worker on the job.
- 5.2.3 Visit a high school, community college, or other vocational training program.
- 5.2.4 Participate in a cooperative work experience program.

**Course Goal**

- 5.3 The student knows advantages and disadvantages of various industry-related occupations.

**Suggested Activities**

- 5.3.1 Interview a worker and determine opportunities for advancement in that job.
- 5.3.2 Use the help wanted section of the newspaper to determine the demand for workers in selected fields. Report the findings.
- 5.3.3 Video tape an interview with a worker.

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## Safety

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### **Program Goal**

6. The student knows the importance of working in a safe manner.

### **Course Goal**

6.1 The student knows and practices safety policies and procedures.

### **Suggested Activities**

- 6.1.1 Form a student safety and health committee.
- 6.1.2 Develop a safety program.
- 6.1.3 Appoint a student safety foreman.
- 6.1.4 Enforce the safety program.
- 6.1.5 Conduct weekly shop safety inspections.

### **Course Goal**

6.2 The student knows how to use tools safely.

### **Suggested Activities**

- 6.2.1 Sharpen hand tools.
- 6.2.2 Perform routine machine tool maintenance.

### **Course Goal**

6.3 The student knows when and where to use protective clothing and devices.

### **Suggested Activities**

- 6.3.1 Reinforce compliance with rules through a safety awards program.

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## Multi-Cultural Awareness

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### Program Goal

7. The student is aware of and has respect for individuality and different cultures.

### Course Goal

- 7.1 The student knows the contributions that individuals and groups from different cultures have made to the advancement of technology.

### Suggested Activities

- 7.1.1 Explain how various cultural and ethnic groups and individuals have contributed to industry and technology.
- 7.1.2 Describe the industrial and scientific accomplishments of various ethnic groups.
- 7.1.3 Report on how various cultural and ethnic groups have used their natural resources.
- 7.1.4 Describe techniques from various cultural and ethnic groups that demonstrate production and construction methods.
- 7.1.5 Describe techniques from various cultural and ethnic groups that illustrate communication methods.
- 7.1.6 Describe contributions that various cultural and ethnic groups have brought to this culture.
- 7.1.7 Identify ways cultural/ethnic stereotyping in industry influenced the training and employment of individuals.
- 7.1.8 Identify societal changes that have expanded training and employment opportunities for cultural/ethnic groups in business and industry.

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\*Adapted from Portland Public Schools Multi-cultural/Ethnic Curriculum Guidelines.

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## Entrepreneurship

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### Program Goal

8. The student possesses an understanding and appreciation of entrepreneurship as a part of the American society.

### Course Goal

- 8.1 The student knows the attitudes, interests and abilities possessed by successful entrepreneurs.

### Suggested Activities

- 8.1.1 Observe a class presentation given by an entrepreneur.
- 8.1.2 Research and write a report on American entrepreneurs.
- 8.1.3 Observe an entrepreneur at work.
- 8.1.4 Interview a successful entrepreneur.

### Course Goal

- 8.2 The student knows how to apply and practice entrepreneurial skills.

### Suggested Activities

- 8.2.1 Participate in a cooperative work experience.
- 8.2.2 Organize and conduct a student business.
- 8.2.3 Make simulated sales presentations.
- 8.2.4 Manage a simulated enterprise with the aid of a classroom computer.
- 8.2.5 Raise capital for the industrial arts student leadership organization.

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*Real generosity toward the future consists in giving all to what is present.*

*- Albert Camus*

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course

# OUTLINES

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*This section contains sample outlines from various sources. They are presented as examples for use in developing your own courses.*

## SUGGESTED OUTLINES

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The following outlines are offered as guides to the development of high school industrial arts programs. They are by no means all-inclusive and should be used only as aids to program development. Each outline is referenced to course goal numbers identified in an earlier section. The exact number of goals addressed will vary. This number will depend on many variables:

- Time available for instruction
- Grade level
- Facilities
- Equipment
- Teacher background
- Available support resources

Selection of course goals and instructional content is a local decision that is made in view of the overall purpose of industrial arts. Every effort has been made to address the reinforcement of academic skills through the content of industrial arts. Similarly, outlines have been referenced, where judged appropriate, to goals addressing safety, self, careers, multi-cultural and ethnic awareness and entrepreneurship.

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## Graphic Communications

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### I. Drafting

- A. Terminology
- B. Equipment
- C. Techniques

### II. CAD

- A. Nomenclature
- B. Engineering graphics
- C. Hardware and functions
- D. Interactive computer graphics
- E. CAD interface

### III. Graphic communication

- A. Visualization
- B. Symbology
- C. Materials preparation
- D. Graphic reproduction
- E. Binding, finishing and packaging
- F. Storage and retrieval

### IV. Technology and Enterprise

- A. Communication systems
- B. Communication models
- C. Communication enterprises
- D. Being an entrepreneur

See the following course goals:

1.1-1.7	5.1-5.3
3.1	6.1-6.3
3.8	7.1
4.1-4.3	8.1

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## Entrepreneurship

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### I. Getting ready to become an entrepreneur

- A. Nature of small business
- B. Are you an entrepreneur?
- C. How to succeed and how to fail

### II. Becoming an entrepreneur

- A. Developing the business plan
- B. Where to locate the business
- C. Legal issues and small business
- D. Government regulations and small business
- E. Choosing the type of ownership
- F. How to finance the business
- G. Resources for managerial assistance

### III. Becoming an entrepreneur

- A. Managing the business
- B. Financial management
- C. Keeping the business records
- D. Marketing management
- E. Successful selling
- F. Managing human resources
- G. Community relations
- H. Business protection

See the following course goals:

1.7	5.1-5.3
2.2	6.1
2.3	7.1
3.1	8.1
4.1	8.2
4.3	

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## Robotics

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### I. Fundamentals of robotics

- A. Moving parts
- B. End effectors
- C. Control systems
- D. Drives
- E. Limited sequence
- F. Point-to-point playback
- G. Continuous path control playback

### II. Robot subsystems

- A. Electronic
- B. Hydraulic
- C. Pneumatic
- D. Servomechanical
- E. Electromechanical
- F. Sensors
- G. Microprocessors
- H. Computers

### III. Robot programming

- A. Computer control system elements
- B. Robot computer languages
- C. Teaching modes
- D. Playback modes
- E. Data
- F. Artificial intelligence

See the following course goals:

1.7	5.1
2.3-2.5	5.2
3.2	6.1-6.3
4.1-4.3	7.1

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## CAD/CAM

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### I. Engineering graphics

- A. Orthographic projection
- B. Dimensioning
- C. Auxiliary and pictorial views
- D. Detail and assembly drawings

### II. CAD/CAM hardware and functions

- A. Graphics terminals
- B. Point and position devices
- C. Keyboards
- D. Plotters
- E. Computer networks
- F. Geometric modeling
- G. Analysis
- H. Kinematics
- I. Drafting
- J. Numerical control
- K. Process planning

### III. Interactive computer graphics

- A. 3-D design/construction
- B. Descriptive geometry
- C. Planes/surfaces
- D. Perspective views
- E. Stress analysis
- F. 3-D mechanical designs
- G. Wiring diagrams, schematics and circuit boards

### IV. CAD/CAM interface

- A. Manufacturing by computer
- B. Machine-tool controls
- C. Robots
- D. Artificial intelligence

See the following course goals:

1.1-1.7	6.2
4.1-4.3	7.1
5.2	8.1
6.1	

---

## Nondestructive Testing

---

### I. Basics of testing

- A. Common faults
- B. Techniques
- C. Visual and leak detection
- D. Codes and standards

### II. Nondestructive tests

- A. Radiographics
- B. Eddy current
- C. Magnetic particle
- D. Liquid penetrant

### III. Special tests

- A. Sonics
- B. Infrared
- C. Acoustic emission
- D. Microwave
- E. Optical holography
- F. Acoustical holography

See the following course goals:

3.3-3.7	5.3
3.9	6.1-6.3
4.1-4.3	7.1
5.1	8.1

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## Properties of Materials

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### I. Classification

- A. Physical
- B. Chemical
- C. Mechanical
- D. Thermal
- E. Electrical
- F. Magnetic
- G. Acoustical
- H. Optical

### II. Properties

- A. Density
- B. Porosity
- C. Hygroscopicity
- D. Corrosiveness
- E. Composition
- F. Tension
- G. Compression
- H. Flexure
- I. Shear
- J. Impact
- K. Fatigue
- L. Elasticity
- M. Resilience
- N. Ductility
- O. Hardness
- P. Lubricity
- Q. Brittleness
- R. Conductivity
- S. Heat capacity
- T. Permeability

See the following course goals:

- |     |         |
|-----|---------|
| 3.1 | 4.1-4.3 |
| 3.3 | 5.1     |
| 3.4 | 6.1-6.3 |

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## Manufacturing Processes

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### I. Pre-processing materials

- A. Selecting
- B. Preparing
- C. Receiving
- D. Unpackaging
- E. Handling
- F. Storing

### II. Processing materials

- A. Preparing
- B. Separating
- C. Combining
- D. Forming

### III. Post-processing materials

- A. Installing
- B. Maintaining
- C. Repairing
- D. Altering
- E. Dismantling

See the following course goals:

1.7  
3.1-3.9  
4.1-4.3  
4.5

5.3  
6.1-6.3  
7.1

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## Energy and Power

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### I. Sources

- A. Oils
- B. Nuclear
- C. Geothermal
- D. Wind
- E. Hydro/Water
- F. Solar
- G. Wood
- H. Coal
- I. Synthetic
- J. Gases
- K. Waste (Burned)

### II. Conversion devices

- A. Thermal/mechanical
- B. Radiant
- C. Nuclear
- D. Chemical
- E. Electro-mechanical

### III. Transmission devices

- A. Mechanical
- B. Hydraulic
- C. Pneumatic
- D. Electrical
- E. Light

See the following course goals:

1.7	5.1-5.3
2.1-2.7	6.1-6.3
4.1-4.3	7.1

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## Voice Synthesis

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- I. The human voice
  - A. Phonetics
  - B. Waveforms
- II. Digitized speech
  - A. Linear encoding
  - B. Alternative encoding
- III. Linear predictive coding
  - A. Parameter encoding
  - B. Chip connections
  - C. Programming
- IV. Phoneme speech synthesizer
  - A. Elements
  - B. Interconnections
- V. Programming for PSS
  - A. Phoneme phrase
  - B. Speech synthesis

See the following course goals:

1.7	4.1-4.3
2.3-2.5	5.3
3.2	6.1-6.3
3.9	7.1

---

## Fiber Optics

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### I. Optical energy

- A. Electromagnetic spectrum
- B. Optical spectrum
- C. Physics of light
- D. Optical components
- E. Radiation measurement
- F. Radiometry
- G. Photometry

### II. Optical fibers

- A. Optical fiber principles and development
- B. Light propagation
- C. Optical fiber construction and types

### III. Light sources

- A. Light-emitting diodes
- B. Fiber optic LEOS
- C. LED design
- D. Types of LEOS

### IV. Fiber optic receivers

- A. Photoelectric effect
- B. Performance
- C. Photodetectors
- D. Receiver circuits

### V. Fiber optic systems

- A. System types
- B. Performance factors
- C. Passive interconnections

See the following course goals:

1.7	4.1-4.3
2.1-2.5	5.1
2.7	6.1-6.3
3.1	7.1
3.4	

---

## Optoelectronics

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### I. Optical principles

- A. The optical spectrum
- B. Measurement

### II. Sources

- A. Light generation
- B. Incandescent lamps
- C. Illuminescent sources
- D. Light-emitting diodes
- E. Lasers

### III. Displays

- A. Character displays
- B. Graphic displays

### IV. Light reactive devices

- A. Photo cells
- B. Photodiodes
- C. Phototransistors
- D. Photo FETs
- E. Light activated SCR
- F. Phototubes
- G. Integrated optics

### V. Fiber optics

- A. Basic optics
- B. Characteristics

See the following course goals:

1.7	3.4
2.1	4.1-4.3
2.3-2.5	5.3
2.7	6.1-6.3
3.3	7.1

---

The art of progress is to preserve order amid change and to preserve change amid order.

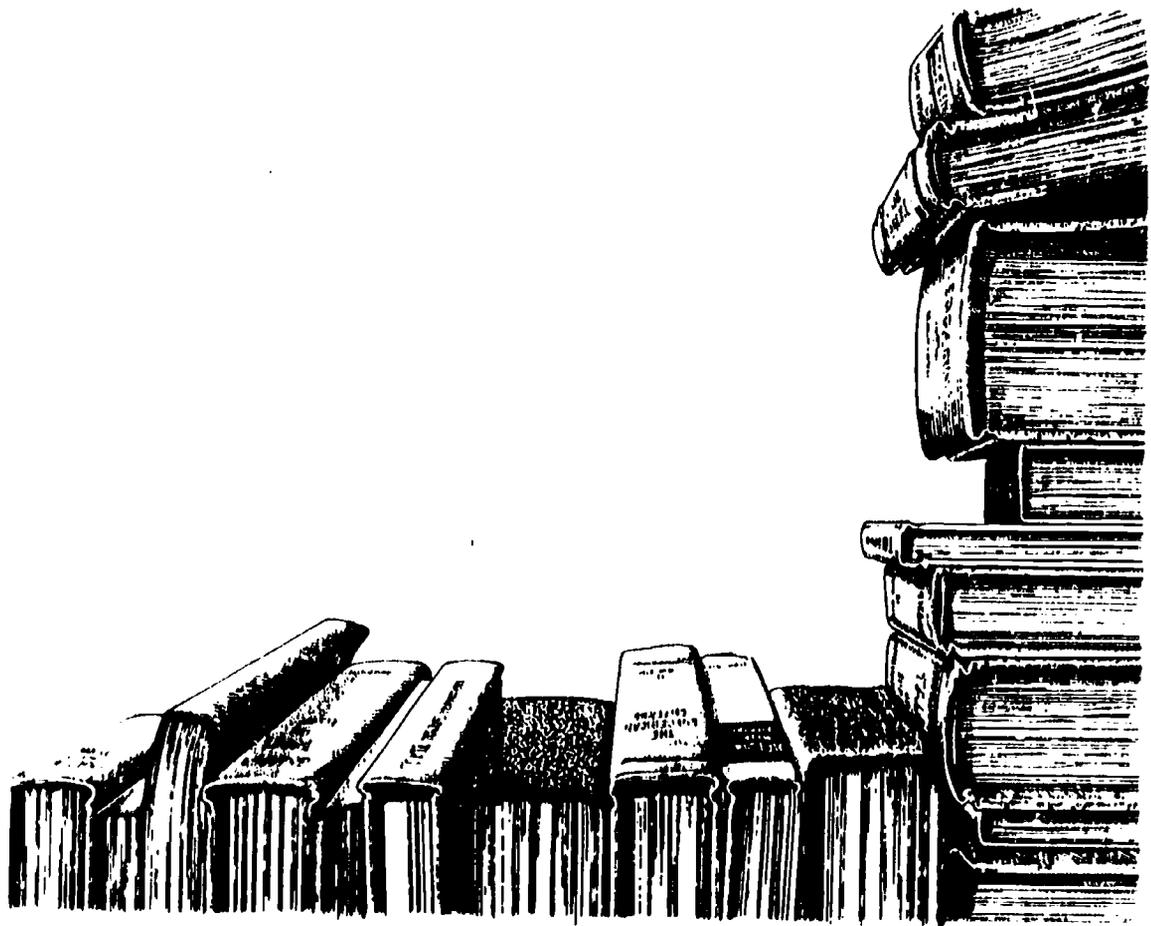
- Alfred North Whitehead

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# RESOURCES

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*Many resources are available to develop and present industrial arts experiences to high school students. A few resources appear on the following pages.*

## ADVISORY COMMITTEES

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An advisory committee can stimulate citizen participation in the activities of the industrial arts program. Its purpose is to act as a liaison between the school and the community by providing advice and assistance to the teacher. The industrial arts advisory committee can help:

- Establish working relationships between industrial arts teachers and representatives of the community.
- Provide a means of communicating between school and community.
- Promote industrial arts programs in community organizations, i.e., Rotary, Lions, Chamber.
- Help determine goals, objectives, curriculum needs and evaluations of programs.
- Develop short- and long-range plans.
- Secure cooperative work experience stations.
- Secure guest speakers for industrial arts classes.
- Locate industry observation sites.
- Secure special event funds.
- Upgrade technological content.
- Update laboratory materials and equipment.

Successful industrial arts programs are an integral part of the community in which they exist. Further, they reflect the technological aspects of that community. If this reflection is to be accurate, close cooperation between the program and business and industry is essential. One of the best means of providing for this cooperation is the industrial arts advisory committee.

## STUDENT ORGANIZATION

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The American Industrial Arts Association AIASA (pronounced ī-ā-sa) is designed to develop the leadership and personal abilities of students as they relate to the industrial-technical world. It is a national organization for elementary, middle and senior high school students who are presently enrolled in, or have completed industrial arts courses.

### Goals of AIASA

- Promote industrial arts in school, community, state and nation.
- Increase knowledge and broadens understanding.
- Provide leadership training.
- Inspire students to respect the dignity of labor and to appreciate craftsmanship.
- Assist students in making informed and meaningful career choices.

### Benefits to Students

- Learn from leadership training.
- Develop civic pride and responsibility.
- Grow, develop and mature according to one's own interests and abilities.
- Meet and work with leaders from industry and the community.
- Learn from participation in conferences and competition.

### Benefits to the School

- Promotes, expands and improves the industrial arts program.
- Creates additional means of developing student interest.
- Promotes the school through community projects.
- Provides opportunities for students to adapt learning experiences from other disciplines.

### Organizing a Chapter

For help in organizing a local AIASA chapter, call your state industrial arts specialist.

## PUBLISHERS

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Allyn and Bacon, Inc.  
470 Atlantic Avenue  
Boston, MA 02210

Americal Technical Publishers, Inc.  
12235 S. Laramie Avenue  
Alsip, IL 60658

Bennett Publishing Company  
809 W. Detweiller Drive  
Peoria, IL 61615

Bobbs-Merrill  
Educational Publishing  
4300 West 62nd Street  
Indianapolis, IN 46206

Chessell-Robacom Corporation  
111 Pheasant Run  
Newtown, PA 18940

Chilton Book Company  
Radnor, PA 19089

Cook Education Systems  
12855 W. Silver Spring Drive  
Butler, WI 53007

Davis Publications, Inc.  
Technology Education Program  
Printers Building  
Worcester, MA 01608

Delmar Publishers, Inc.  
2 Computer Drive, West  
Albany, NY 12212

Edu-Tech Publications  
Commercial Service Co.  
PO Box 2499  
Anderson, IN 46018

Goodheart-Wilcox Co., Inc.  
123 West Taft Drive  
South Holland, IL 60473

Heathkit Zenith  
Educational Systems Divisions  
PO Box 167  
St. Joseph, MI 49085

Individualized Learning Systems  
Portland State University  
Division of Continuing Education  
PO Box 1491  
Portland, OR 97207

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1221 Avenue of the Americas  
New York, NY 10020

McKnight Publishing Company  
PO Box 2854  
Bloomington, IL 61701

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150 White Plains Road  
Tarrytown, NY 10591

Singer Career Systems  
80 Commerce Drive  
Rochester, NY 14623

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Golden, CO 80401

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5101 Madison Road  
Cincinnati, OH 45227

Terek Corporation (CAD)  
14151 North 76th Street  
Scottsdale, AR 85260

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Marylhurst, OR 97036  
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Roseburg, OR 97420  
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Klamath Falls, OR 97601  
Phone: 883-5000  
Counties Served: Klamath, Lake

## **JOURNALS**

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School Shop  
Prakken Publications  
416 Longshore Drive  
PO Box 8623  
Ann Arbor, MI 48107

Industrial Education  
Harcourt Brace Javanovich Publications  
Subscription Department  
1 East First Street  
Duluth, MN 55802

VOCED  
Journal of American Vocational Association  
2020 N. 14th Street  
Arlington, VA 22201

The Technology Teacher  
Journal of the American Industrial Arts Association  
1914 Association Drive  
Reston, VA 22091

## **PROFESSIONAL ASSOCIATIONS**

American Industrial Arts Association  
1914 Association Drive  
Reston, VA 22091

American Vocational Association  
2020 N. 14th Street  
Arlington, VA 22201

Oregon Education Association  
1 Plaza SW, 6900 SW Haines Road  
Tigard, OR 97223

Oregon Industrial Arts Association  
Box 411  
Salem, OR 97308

Oregon Vocational Association  
Box 411  
Salem, OR 97308

## **CURRICULUM AND RESOURCE CENTERS**

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Northwest Vocational Curriculum Management Center  
Commission for Vocational Education  
Building 17  
Airdustrial Park, NS-LS-10  
Olympia, WA 98504

Northwest Regional Educational Laboratory  
300 Southwest Sixth Avenue  
Portland, OR 97204

Resource Center  
Oregon Department of Education  
700 Pringle Parkway  
Salem, OR 97310-0290

The National Center for Research in  
Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, OH 43210

Vocational Instructional Services  
F.E. Box 182  
Texas A & M University  
College Station, TX 77843

## High School Industrial Arts

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