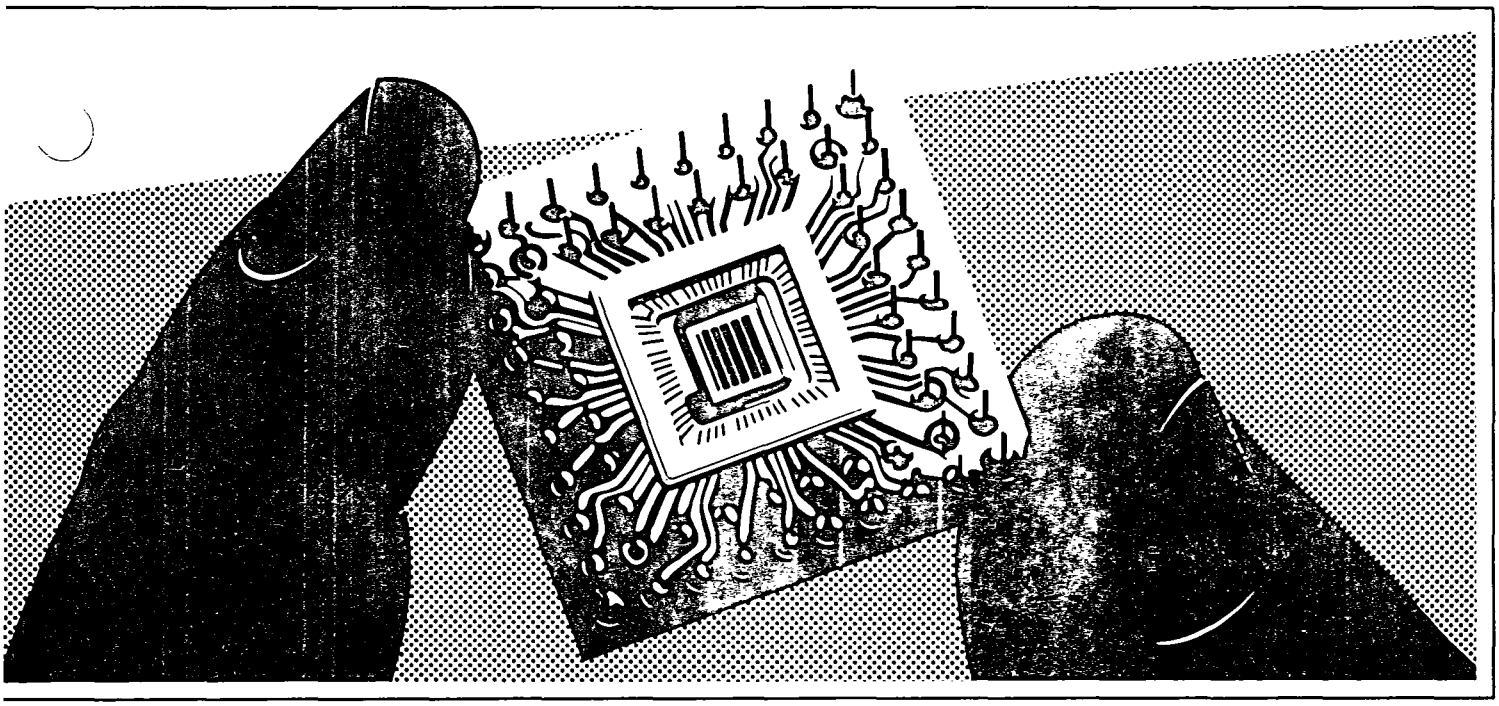
TECHNOLOGY EDUCATION

GRADES 9-12
FOUNDATION BLOCK COURSE



The University of the State of New York
The State Education Department
Division of Occupational Programs
Albany, New York 12234

June 1986

TECHNOLOGY EDUCATION
ELECTRICITY/ELECTRONICS

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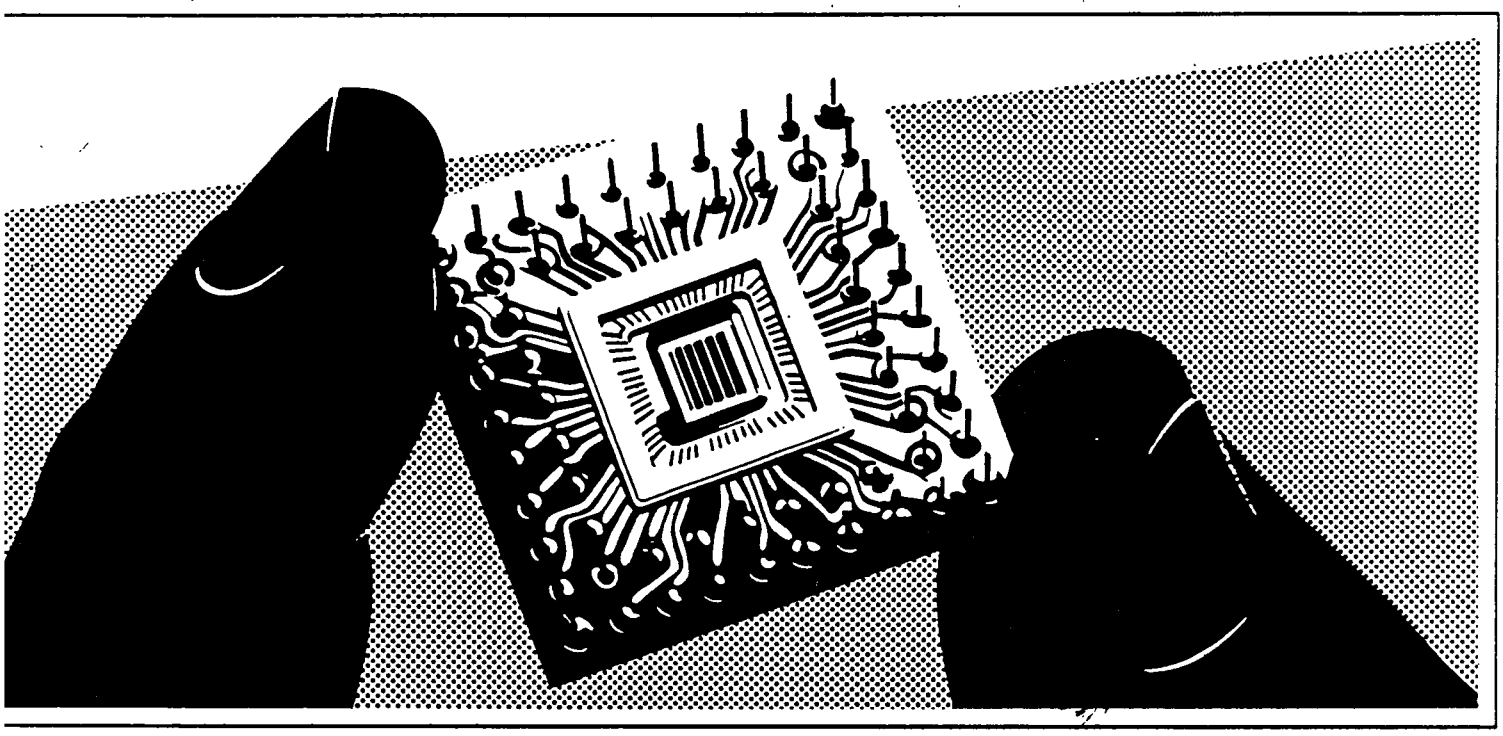
FOUNDATION BLOCK COURSE



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TECHNOLOGY EDUCATION

COURSE: **BASIC ELECTRICITY/ELECTRONICS**

MODULE: INTRODUCTION TO ELECTRICITY

Submodule: Low Voltage Applications

Submodule: Line Voltage Applications

MODULE: ELECTRONICS

PREREQUISITES: None

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TOTAL TEACHING TIME: 18 weeks

DATE: June 1986

COURSE: BASIC ELECTRICITY/ELECTRONICS

COURSE OVERVIEW

Course Description

This survey course of the Electricity/Electronics field has two modules: Introduction to Electricity and Electronics. Introduction to Electricity is composed of two submodules: Low Voltage Applications and Line Voltage Applications. The Electronics module includes content in Basic Passive and Active Devices, Circuits, and Systems as well as an Introduction to Integrated Circuits. Common threads throughout the entire course include career exploration, consumer awareness, youth leadership activities, safety, laboratory skills, and construction and fabrication skills. Through experimentation, construction, and problem-solving based instruction, students will be able to apply the basic elements common to all technological systems -- input, comparison, adjustment, process, control, output, and feedback -- and recognize the many ways these systems interact with other technologies. Focus of the course is on the comprehensive representation of electrical and electronic technologies in the home environment.

Instructional Methodology

Like other Electricity/Electronics Technology courses, this course is designed to be 25 percent instruction and 75 percent hands-on learning experiences. Of the latter, it is intended that half of this time be spent in laboratory activities with the other half of the time spent in electrical/electronic construction and fabrication. Where there is time pressure to complete everything, the time for application through products and laboratory activities should not be infringed upon; rather the depth of the conceptual instruction should be limited to the time available.

The content of both modules should be adjusted as necessary to reflect the revelance of the most recent electrical and electronic technologies. Emphasis is to be placed on the recognition of devices and systems in the home and/or the applications of electrical/electronic technologies to every aspect of American life. It is also expected that every instructor will maintain the scope and sequence of the course, but will adapt the level of instruction to the level of the students being served. The minimum performance level is left to the discretion of the instructor. Thus more able students may explore topics in greater depth in the allotted time and less able students will cover the same topics to a lesser depth.

Wherever possible, laboratory experimentation with circuits should be presented using systems block diagrams and modular breadboards to minimize student difficulty with assembly and disassembly. This approach will also allow students more time to explore the basic electrical concepts and applications. The course therefore requires a well-equipped laboratory environment to provide for safe student hands-on experiences with electrical/electronic components, devices, circuits, and instrumentation.

Instructional strategies preceded by * promote leadership skills in communication, decision making/problem solving, human relations, management, and human motivation.

COURSE OVERVIEW, continued

Course Credit

This course is part of the new State sequence in Technology Education. It is one of three half-unit courses which have been identified as foundation courses. They are Basic Electricity/Electronics, Energy, and Technical Drawing. Students completing a high school sequence in Technology Education must have successfully completed any two of these three foundation courses.

In addition to being taken to fulfill sequence requirements, this course may also be taken by any student as an elective. If the instructor uses this syllabus as a guide for instruction, students may be granted Regents credit for the course.

Special Populations Provision

Many students with handicapping conditions have, by definition, the intellectual capacity to master the curricular content requirements for a high school diploma. Such students must attain the same academic standards as their non-handicapped peers in order to meet these requirements. Students with handicapping conditions are provided instruction in a wide variety of settings from regular education classes to special education classes. Teachers of this course should become aware of the needs of those students with handicapping conditions who have been appropriately placed within their classes. Instructional techniques and materials must be modified as necessary so that the information can be attained by such students.

This course includes suggestions for modifying instructional strategies and materials to meet the needs of students with handicapping conditions. These suggestions are intended to provide teachers with a few examples and should be viewed as a base from which teachers in both regular and special education can develop additional strategies.

Youth Leadership Skills

Development of leadership skills is an integral part of occupational education in New York State. The New York State Education Department states that, "Each education agency should provide to every student the opportunity to participate in the education activities of the student organization(s) which most directly relate(s) to their chosen instructional program."

Leadership skills have been incorporated into the New York State occupational education curricula to assist students to become better citizens with positive qualities and attitudes. Every individual should develop skills in communication, decision making/problem solving, human relations, management, and motivational techniques.

Leadership skills may be incorporated into the curricula as competencies (Performance Objectives) to be developed by every student, or included within the Suggested Instructional Strategies. Teachers providing instruction through occupational education curricula should familiarize themselves with the competencies. Assistance may be requested from the State advisor of the occupational student organization related to the program area.

COURSE OVERVIEW, continued

Students who elect to become active members of one of the student leadership organizations charted by the New York State Education Department have the advantage of a practical forum to demonstrate leadership skills in an action oriented format and have the potential for recognition of their achievements at the local, state, and national levels.

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS

I. Electrical Technologies

- A. Electrical versus Electronic
- B. Technological Systems Applications
  1. Power and energy
  2. Manufacturing
  3. Construction
  4. Communication (including fiber optics)
  5. Transportation
  6. Agriculture
  7. Aerospace/military
- C. Home Applications
  1. Generation and distribution (heat, light, etc.)
  2. Major appliances
  3. Communication/entertainment
  4. Automotive
  5. Personal computers
  6. Health and medical

II. Safety Education*

- A. Safety Practices
  1. Rules and regulations
  2. Tools, machines, and equipment
- B. Electrical Safety
  1. Home environment
  2. Laboratory environment

III. Electrical Construction and Fabrication*

- A. Tools and Hardware
  1. Electrical hand tools
  2. Wire selection and preparation
  3. Connectors - temporary/pressure
- B. Electrical Diagrams
  1. Bill of materials
  2. Graphic symbols
  3. Schematics
  4. Wiring/pictorials
  5. CAD
- C. Fabrication and/or Breadboarding
  1. Drilling
  2. Mounting
  3. Assembly
  4. Modular component/circuit assembly

*Not sequential. To be integrated in Content Outline where appropriate.

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE, continued

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS

D. Soldering - Desoldering
   1. Preparation and safety
   2. Tools and materials
   3. Technology

IV. Electrical Theory

A. Electrical Classification of Materials
   1. Conductors
   2. Insulators
   3. Semiconductors
   4. Electron theory
B. Electrical Current
   1. Movement of particles
   2. Direct and alternating
C. Electrical Circuit
   1. Source
   2. Load
   3. Conductors
   4. Control - switches

V. Low Voltage Systems

A. Simple Series Circuits
   1. Observing voltage and current
   2. Applications
B. Simple Parallel Circuits
   1. Observing voltage and current
   2. Applications
C. Basic Servicing Techniques
   1. Continuity/voltage tests
   2. Battery testing and charging
   3. Installing telephone jacks/plugs
D. Applications
   1. Battery-powered systems
      a. Automotive
      b. Entertainment equipment
      c. Toys and games
      d. Camping equipment
      e. Cameras, etc.
   2. Multivoltage/Step-Down Transformer
      a. Voltages
      b. Windings/color codes

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE, continued

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS

3. Home systems
   a. Bells, buzzers, chimes, etc.
   b. Telephones
   c. Alarms
   d. Low voltage lighting
   e. Toy train/racing sets, etc.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS

I. Common Sources of Electricity

   A. Cells and Batteries
   B. Generators
   C. Solar Cells

II. House Wiring Systems

   A. Generation and Distribution Systems
      1. Electrical service
      2. Kilowatt-hour meter
      3. Service center
      4. Circuits
      5. Fuses and circuit breakers
      6. Checking and resetting
   B. Electrical Lines and Wiring
      1. National Electrical Code
      2. Common wire sizes and color codes
      3. Wall, surface, and underground lines
      4. Extension cords
      5. Exterior wiring systems
   C. Basic Servicing
      1. Continuity/ground tests
      2. Replacing switches and receptacles
      3. Junction and outlet boxes

III. Appliance Systems

   A. Lighting Systems
      1. Incandescent devices
      2. Fluorescent devices
      3. Track and recessed lighting
      4. Common ratings and specifications

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE, continued

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS

B. Heating Systems
   1. Common elements/devices
   2. Controls: manual, electronic, programmable
   3. Common ratings and specifications
C. Electromagnetic Systems
   1. Magnetic effect
   2. Universal motors
   3. Motor-driven applications

IV. Consumer Education

A. Manufacturer Specifications and Ratings
   1. Operating instructions and parameters
   2. Efficiency ratings
B. Criteria for Evaluating and Purchasing Products
C. Consumer Protection and Services
   1. Warranty and guarantee
   2. Consumer publications
   3. National Board of Fire Underwriters and U.L. listings

MODULE: ELECTRONICS

I. Introduction to Electronics - Systems and Subsystems

A. Common Systems
   1. Communications
   2. Knowledge/information
   3. Production/manufacturing
   4. Transportation
   5. Energy
B. Component Subsystems
   1. Passive
   2. Active
   3. Integrated circuits

II. Introduction to Basic Passive Devices and Circuit Applications

A. Resistors
   1. Common types - fixed, variable, special
   2. Laboratory skills
      a. Symbols
      b. Units of measurement
      c. Color code charts
      d. Testing

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE, continued

MODULE: ELECTRONICS

3. Applications
   a. Limiting current
   b. Energy consumption
   c. Heat dissipation

B. Capacitors
   1. Common types - fixed, variable, special
   2. Symbols, units of measurement, and testing opens/shorts
   3. Applications - filters, tuners, timing, etc.

C. Inductors
   1. Common types - air core, iron core
   2. Symbols, units of measurement, and testing
   3. Applications - antennas, tuners, transformers, and relays

III. Introduction to Basic Active Devices and Circuit Applications

A. Diodes
   1. Common types - silicon, germanium, and LED's
   2. Symbols, specifications, lead identification, and testing
   3. Applications - rectification, blocking, LED indicators

B. Transistors - Bipolar
   1. Common types - NPN/PNP
   2. Symbols, specifications, lead identification, and testing
   3. Applications - switching, amplification

C. Silicon Controlled Rectifier (SCR)
   1. Common types
   2. Symbols, specifications, lead identification, and testing
   3. Applications - alarm systems, trigger systems, etc.

IV. Laboratory Experimentation and Circuit Fabrication*

A. Methods of Circuit Construction and Safety Practices
   1. Use of functional system block diagrams
      a. Guitar amplifier
      b. Light dimmer
      c. Strobe light
      d. Crystal detectors, etc.
   2. Use of laboratory equipment
   3. Use of tools and machinery
   4. Printed circuit fabrication
   5. Wire wrapping and soldering
   6. Testing and troubleshooting

B. General Safety Instruction
   1. Personal safety - physiological effects of current/voltage
   2. Emergency first aid for electrical shock
   3. Accident prevention

*Not sequential. To be integrated in Content Outline where appropriate.

COURSE: BASIC ELECTRICITY/ELECTRONICS

CONTENT OUTLINE, continued

MODULE: ELECTRONICS

V. Introduction to Integrated Circuits

A. Digital and Linear Types
   1. Definition of each, specific to operation
   2. Common types and uses
B. Laboratory Experimentation with Digital IC's
   1. Operating characteristics
   2. Pin locations, wiring considerations, and handling
   3. Using digital logic information - binary number system
C. Laboratory Experimentation with Linear IC's
   1. Operating characteristics
   2. Using linear devices
D. Impacts of Integrated Circuit Technology
   1. Human needs as an influence on technology
   2. Technology as an influence on human needs
   3. Future trends - global interdependence, cultural transitions, industrial to information based society
   4. Robotics

VI. Career Exploration*

A. Examination/Research of Diverse Electricity/Electronics Opportunities
B. Developing a Career Plan

VII. Consumer Awareness*

A. Developing Criteria for Evaluating Electronic Products/Services
   1. Human needs
   2. Quality, efficiency, and cost
   3. Frequency of repair
B. Impacts on Resources and Environment

*Not sequential. To be integrated in Content Outline where appropriate.

MODULE: INTRODUCTION TO ELECTRICITY

SUBMODULE: Low Voltage Applications

		Estimated Teaching Time
TOPICS:	Electrical Technologies	0.5 week
	Safety Education	0.5 week
	Electrical Construction and Fabrication	1.0 week
	Electrical Theory	1.5 weeks
	Low Voltage Systems	1.5 weeks

SUBMODULE: Line Voltage Applications

TOPICS:	Common Sources of Electricity	1.0 week
	House Wiring Systems	1.5 weeks
	Appliance Systems	1.0 week
	Consumer Education	0.5 week

TOTAL TEACHING TIME: 9 weeks

MODULE: INTRODUCTION TO ELECTRICITY

OVERVIEW OF MODULE

Goal

Upon the successful completion of both submodules, the student will have developed the basic knowledge, attitudes, and minimal skills that are required to work with simple electrical circuits and devices. Based on their laboratory activities and experiences in this module and the Electronics module, students will decide if they desire to continue study in this area of concentration.

Description

In this module, students will become familiar with the comprehensive electrical technologies as represented by the home environment. The content has been logically divided into two submodules: Low Voltage Applications and Line Voltage Applications. Each submodule requires approximately 4.5 weeks of instruction time. In the first submodule, students will investigate five topics as follows:

(1) Electrical Technologies includes awareness of the impacts and diversity of electrical/electronic technologies and systems in the home environment. (In this topic, the instructor should emphasize the linkage in content to other modules of instruction in Technology Education.)

(2) Safety Education develops basic competencies in the practices and procedures common to both the home and laboratory environment that must be followed when working with electrical devices and systems. (This topic is not sequential and should be included where appropriate in the Content Outline.)

(3) Electrical Construction and Fabrication explores the use of special tools and equipment, graphic materials, breadboard/fabrication techniques, and soldering/desoldering procedures. (This topic is also not sequential and should be included where appropriate in both submodules.)

(4) Electrical Theory introduces to the basic concepts of the electron theory, materials classification, current flow, and the structure of a simple electrical circuit.

(5) Low Voltage Systems explores simple series and parallel circuits and basic troubleshooting and develops student awareness of their wide application in low voltage systems commonly found in the home environment.

It should be emphasized here that the topics for this module cover a vast amount of material. The instructor is reminded, however, that this is an introductory survey course and topics in the Content Outline should be used as a guide for determining lesson titles. Items listed under each subtopic are added only for clarification or as examples of possible applications. Classroom instruction should incorporate a system analysis ("black-box") approach to electrical theory and circuits. Student competencies should be based on laboratory study and class discussions of "input-process-control-output" as it applies to low voltage and line voltage systems, rather than mathematical theories and laws. These higher level competencies, theories, and laws are to be developed in other elective Electronics Technology courses.

OVERVIEW OF MODULE, continued

The second submodule will build upon the basic competencies developed during the first 4-5 weeks of instruction, and apply those concepts to Line Voltage Applications as follows:

(1) Common Sources of Electricity explores chemical, mechanical (magnetic), and solar systems as common sources of electrical energy in the home. Linkages to content in the Energy Systems course is to be incorporated in this topic.

(2) Home Wiring Systems looks at the fundamentals of electrical generation and distribution systems and develops an understanding of common home wiring systems as well as basic servicing practices and procedures.

(3) Appliance Systems explores the areas of lighting, heating, and electromagnetic systems commonly employed in the home environment.

(4) Consumer Education includes basic competencies required for interpreting manufacturer specifications and evaluating consumer products, and familiarization with consumer protection services and publications.

Each of the topics in both submodules includes class discussions, demonstrations, laboratory experimentation, and the on-going construction of a take-home project(s). The Performance Objectives within the topics are arranged to stress basic information, essential attitudes, and introductory skills. At the conclusion of this course, each student has the option to select subsequent modules in this area of concentration which have been developed to promote intermediate and advanced learning, leading to a degree of specialization in electronics.

Skills, Knowledge, and Behaviors to be Developed

Upon satisfactory completion of this module, the student will be able to:

1. Know the extent of electrical technologies and their dynamic effects on all other technological areas
2. Comprehend his/her interests, abilities, and aptitudes in working with tools, devices, and circuits representative of electrical technologies
3. Solve basic problems related to materials, processes, and products encountered in the electrical laboratory, using mathematical and/or scientific concepts
4. Manipulate basic hand tools, machines, and equipment commonly found in the electrical laboratory safely
5. Understand graphical representations of electrical components, devices, and circuits
6. Assemble and fabricate simple electrical circuits, using common methods of breadboarding or circuit board fabrication
7. Know about low voltage and line voltage devices and circuits in the home and be aware of their applications in other systems
8. Develop criteria for the evaluation of consumer products produced by the electrical industries
9. Understand the problems and potential solutions relative to resource management in the production and use of electrical energy
10. Apply career and occupational information from other modules of instruction to the electrical technologies

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS
TOPIC: Electrical Technologies

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction on electrical technologies and related technological systems, the student will demonstrate applications knowledge of the production and use of an electrical system in the home environment, to a level of completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Differentiate between electrical and electronic products and systems
   b. Identify a minimum of five other technological areas which rely on electrical systems and/or technology
   c. List a minimum of 10 tasks/operations performed by an individual in the home environment requiring an application of electrical technology
   d. Discriminate between power and energy and list five forms of energy
   e. Draw and/or label a system block diagram illustrating the energy transfer/conversion in a common electrical product

SUGGESTED INSTRUCTIONAL STRATEGIES

1. In a lecture/discussion, define "electrical" vs. "electronic" and "energy" vs. "power." Briefly outline the applications and impacts of electrical technologies on all other technological fields. Have students identify common tasks which could NOT be performed without electrical devices or systems in the home. Develop a list and have students copy in notebooks.

2. Use audiovisual materials such as pictures, slides, and filmstrips illustrative of electrical technology in manufacturing, construction, communications, transportation, agriculture, aereospace, and the military.

3. Use visuals of system block diagrams to depict conversion/transfer of energy in common electrical products or systems. Have students identify and apply these processes to other products or systems.

*4. Have student experiment with energy conversion systems.

*5. Have students develop teaching aids or materials such as transparencies, charts, or slides showing electrical technology or applications.

*6. Have students select one technological system and research and develop material relating to its reliance on electrical technology for existence and/or growth.

*7. Have students develop models or mock-ups illustrating energy transfer/conversion in a simple electrical system.

*8. Plan field visits for students to observe a particular application of electrical technology discussed in class.

9. Show commercial films, filmstrips, or videotapes on electrical technology.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS
TOPIC: Safety Education

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given an electrical laboratory situation, the student will work and behave in a safe and orderly manner and contribute to the maintenance and cleanliness of the facility, to a level of competency and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Identify common causes of accidents
   b. Identify accident prevention measures and apply to daily work
   c. List tool and machine safety rules
   d. Use safe practices in the use of tools, machines, and equipment
   e. Interpret and follow general safety rules and regulations on a daily basis
   f. Perform assigned maintenance and clean-up duties regularly

SUGGESTED INSTRUCTIONAL STRATEGIES

*1. Conduct a group discussion on causes and prevention of common accidents including the influences of mental states.

2. Prepare instruction sheets on safety rules and regulations, emergency procedures, clean-up assignments, special machine/equipment operating instructions, and first aid. Post copies in appropriate locations and have students file in notebooks.

3. Demonstrate the safe use and operation of tools, machines, and equipment.

4. Use audiovisual materials on eye safety, electrical safety, physiological effects of current/voltage, and lab safety.

*5. Have students devise safety posters and slogans for display.

6. Check individual use of tools, machines, and equipment through performance and written tests.

7. Include performance of safety and laboratory maintenance in regular student evaluation.

*8. Invite guest speakers to discuss safety practices and prevention techniques (opthamologist, OSHA representative, etc.).

*9. Have students use VOM to measure individual wet and dry body resistances between various points. During follow-up discussion, apply Ohm's Law to develop individual physiological chart of potentially hazardous voltage/current levels.

10. Discuss and demonstration first aid procedures for a shock victim.

*11. Use VCR equipment to record student behavior during work time. Discuss positive and negative actions and possible solutions for unsafe behavior.

*12. Use role-playing activities to illustrate proper work attitudes and/or clean-up responsibilities.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS
TOPIC: Electrical Construction and Fabrication

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given a laboratory situation and the necessary diagrams, materials, tools, and equipment, the student will demonstrate skill in assembling, fabricating, and/or constructing a simple electrical circuit/product, to a level of competency acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Follow safe operating practices and procedures in the electrical laboratory and demonstrate cooperative attitudes for working in pairs
   b. Operate basic tools, machines, and equipment according to demonstrated practices and procedures
   c. Read and interpret simple graphic diagrams and schematics for electrical circuits
   d. Interpret a bill of materials and specifications for common electrical components and devices
   e. Assemble/fabricate an electrical circuit from pictorical and schematic diagrams following written/verbal instructions, employing basic breadboarding or printed circuit techniques
   f. Use correct soldering practices and procedures during the construction of an electrical project
   g. Perform simple continuity tests to troubleshoot an electrical circuit

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Use transparencies, slides, and models to illustrate simple breadboarding operations for experiments and project(s) at various stages of completion. Discuss bill of materials, graphic diagrams, and schematics.

2. Demonstrate use of basic electrical tools and equipment. Include safety precautions involved. Use appropriate instruction sheets and pictorials. Have students file in notebooks for reference during experimentation and project construction.

*3. Demonstrate proper assembly and fabrication techniques as required for each experiment. Students should be assigned to work in teams of two.

*4. Display samples of completed student work.

5. Have students complete a project. Some suggested projects are:

   - Flashlight
   - Camp lantern
   - Continuity/voltage tester - sound, lamp, or meter output
   - Battery tester
   - 9-volt battery charger/eliminator
   - Alarm employing magnetic or reed switches

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

- Nerve/reaction tester
- Moisture/humidity detector
- Door bell/chime circuit
- Battery-powered game, toy, or puzzle
- Telephone extension cord
- Automotive ignition tester
- Ground-fault tester (line voltage)
- Multiple outlet extension, with switch(es)
- Night light
- Fluorescent lamp
- Magnetizer/demagnetizer
- Hot plate/hot dog cooker
- High intensity lamp
- Toy motor
- Motor-driven timer

6. Maintain a resource file for project ideas and/or extra credit activities within the scope of this module. Students may refer to this file when time is available or for leisure time ideas.

7. Review requirements and evaluation criteria for each laboratory experiment and project as required.

8. For written tests, include questions about the proper selection and use of tools, interpretation of graphic/schematic diagrams, and proper sequencing of assembly operations.

*9. As laboratory operations and procedures are discussed or demonstrated, have students develop and continue adding to a list of occupational titles involving those duties or responsibilities.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS
TOPIC: Electrical Theory

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and laboratory activities, the student will demonstrate understanding of the theory and operation of a basic electrical circuit, to a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Define a complete electrical circuit by using the terms "source," "load," "conductors," and "control device" correctly
   b. Differentiate between conductors and insulators and list examples of each
   c. Differentiate between alternating and direct current in terms of movement and direction of particles
   d. Compare the effect of resistance changes on voltage and current in verbal or written form
   e. Identify a simple series circuit and describe an application in the home
   f. Identify a simple parallel circuit and describe an application in the home
   g. List common electrical control devices found in the home and identify representative graphic symbols, diagrams, or samples

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Review basic terminology related to atomic and electron theories and outline electrical classification of materials based on those theories. Have students handle and identify representative samples of common conducting and insulating materials. Discuss applications to the manufacture and operation of common consumer products. Define circuit voltage, current, and resistance.

2. Assemble a simple low voltage light or bell circuit. Use light or sound effect to demonstrate simple Ohm's Law relationship, then insert voltmeter and ammeter to illustrate measurable effects. Have students identify major circuit parts and graphic representations.

*3. Have students assemble a circuit similar to one demonstrated, using modular circuit breadboarding techniques. Students should record observations about the effects of changes in circuit voltage or resistance, and define appropriate circuit terminology. The same type of laboratory apparatus should be used by students to assemble and observe simple series and parallel configurations. Theory of operation can be observed by recording the effects on miniature lamps or bells. Keep instrumentation to a minimum.

4. As home study assignments have students identify graphic symbols, complete wiring diagrams from schematic, and/or match terminology with definitions as used in presentations or experimentation.

*5. Have students construct teaching aids -- visuals or models -- to illustrate common conductors/insulators, basic circuit theory, series/parallel configurations or applications.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

*6. Use VCR equipment to facilitate visualization of circuit assembly or basic meter reading during demonstrations.

7. Provide students with computer assisted instruction to reinforce understanding of voltage, current, resistance, energy, and power.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LOW VOLTAGE APPLICATIONS
TOPIC: Low Voltage Systems

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and laboratory activities, the student will demonstrate knowledge and application of low voltage circuits and systems in the home, to a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Discriminate between transformer and battery operated circuits and systems
   b. Read and interpret graphic and schematic diagrams for simple low voltage circuits
   c. Assemble and test-operate a low voltage circuit from pictorial and schematic diagrams, representative of a home application
   d. Draw and label a block diagram illustrating the operating functions for a simple low voltage system
   e. Identify common low voltage systems and applications in the home environment
   f. Perform basic battery tests and services
   g. Replace/install a telephone jack or plug using diagrams and instructions

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Identify and explain the operation of common low voltage circuits and systems in the home environment. Use visual materials to illustrate system block diagrams and basic functions.

2. Conduct demonstrations and discussions on interpretation of winding color codes and voltages for multivoltage step-down transformer; assembly of low voltage circuit(s); testing/charging batteries and cells; telephone jack/plug installation.

*3. Have students assemble and test-operate a minimum of two low voltage circuits, one battery-powered, the other transformer operated. Documentation of observations should differentiate between alternating and direct current systems and include common applications.

4. Provide practice exercises with system diagrams, wiring, and identifying applications for home study.

*5. Have students collect pictures and/or articles about low voltage circuits, systems, or applications for discussion and display.

*6. Invite a representative of a telephone or alarm system company or an electrician to discuss concepts of installation and repair or point out new applications/technology.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS
TOPIC: Common Sources of Electricity

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction, the student will identify three sources of electrical energy and briefly discuss their operating theories, to a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Identify chemical, electromagnetic, and solar sources of electrical energy
   b. Differentiate between primary and secondary cells and batteries, and list common examples of each
   c. Discriminate between sources of alternating and direct current
   d. List natural resources required for the production of electrical energy and discuss recent technology to preserve them
   e. Draw and/or label a functional block diagram showing the basic energy conversion taking place in each source

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Outline energy conversion and basic theory of operation for dry cells, generators, and solar cells. List natural resources used for power generation and discuss problems related to resource management.

2. Use a lemon and electrodes of aluminum and copper to illustrate simple chemical generation of voltage. List common types of cells/batteries, classifying as primary or secondary. Include visuals for simple construction/materials required. Also demonstrate generation of voltage by solar cell and discuss efficiency, cost, and recent technology.

3. Illustrate commercial generation of power using oil, coal, and nuclear resources. Have students develop or complete functional block diagrams showing basic energy transfer and conversion.

4. Provide students with matching exercises about sample devices, theory of operation, voltage generated, and/or symbolic representation.

*5. Have students assemble and/or observe operation of simple cells, generator or solar cell and document output resulting from a given input, efficiency, etc. Students can also test several cells or batteries, determine operational life, and perform charging/rejuvenating as required.

*6. Have students research material and prepare short written/oral reports regarding a particular power source, including problems of resource management related to the system.

*7. Obtain charts, posters, or other visuals from local power company about generating systems and/or conservation. Use for class discussion, role playing activities, or display.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

*8. Conduct a class debate about a particular problem associated with the conservation or management of resources and electrical power generation or use.

*9. Have students construct teaching aids: samples of chemical or solar devices mounted for demonstration or experimentation purposes, breadboards for investigating generator principles, or other visuals as required for presentations.

*10. Take a field trip to a local generation site or public information center to observe concepts discussed in class.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS
TOPIC: House Wiring Systems

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and laboratory activities for house wiring systems, the student will identify the major components of the system and replace common switches or receptacles, to a level of competency acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Diagram and label two methods of delivering electrical energy to the home
   b. Explain the function of the National Electrical Code in verbal or written form
   c. Read and interpret simple house wiring/schematic diagrams and a KWH meter
   d. Replace a simple two-way and/or three-way switch using accepted color code, practices, and procedures
   e. Replace a simple receptacle using accepted color code, practices, and procedures
   f. Use a ground-fault tester to check for proper installation of hot, common/neutral, and ground circuits
   g. Assemble and test a multiple receptacle extension cord using correct wire size, practices, and procedures for a particular function
   h. Differentiate between internal and external wiring systems in terms of wiring materials, lighting devices, outlets, grounding (G.F.I. devices), and weather-proofing

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Use charts, transparencies, slides, or other visuals to illustrate and discuss major elements of basic internal and external house wiring systems. Outline functions of each component and have students identify mounted samples. Include occupational information.

2. Demonstrate and discuss the following activities, including safe practices and procedures, tools used, and color coding/wire size:
   - Checking/resetting fuses and circuit breakers
   - Reading a KWH meter
   - Assembly and fabrication of an extension cord, or rewiring a lamp
   - Replacing a switch, receptacle, and/or porcelain fixture
   - Checking for ground faults
   - Installing external lighting and/or outlets for patio, pool, etc.

*3. Have students perform some of the activities listed in Strategy #2 in the laboratory.

*4. Have students construct a project from the list on page 15 or below.

   - Work/trouble light (12-volt or line voltage)
   - Soldering iron/copper
   - Light dimmer/speed control

*5. Have students construct teaching aids to illustrate various types of wire/cable, wiring systems, or installation techniques.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

*6. Invite an electrician to discuss National Electrical Code, local codes, duties, and responsibilities.

7. Show films, filmstrips, videotape, etc. demonstrating installation of residential wiring system during new home construction or basic service and maintenance.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS
TOPIC: Appliance Systems

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and common home electrical appliances, the student will list the application(s) of electric current represented, diagram the functions of each major component in the system, and identify occupations involving appliances, to a level of completeness and accuracy acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Distinguish between light, heat, and electromagnetic applications of electric current
   b. Draw/interpret basic functional diagrams of common lighting, heating, and motor-driven appliances in the home
   c. Define common specifications/parameters representative of electrical appliances
   d. Assemble and test-operate simple circuits from appropriate diagrams representing basic lighting, heating, and/or electromagnetic applications of electric current
   e. Perform simple continuity tests to troubleshoot basic system functions on an electrical appliance
   f. List occupations associated with the manufacture, installation, and/or service of electrical appliances

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Have students list and group common electrical appliances according to the application or combination of applications of current they represent. Use visuals to diagram and discuss system functions and operation. Define basic parameters, specifications, and efficiency ratings used to compare and select appliances.

2. Use simple breadboarding modules for students to assemble and/or observe construction and operation of basic lighting, heating, and universal motor circuits. Include familiarization with the function and operation of simple control devices for each application. Demonstrate basic continuity tests as required.

3. As homework, have students add electrical appliances to list begun in class and check name plates for additional specifications and ratings.

MODULE: INTRODUCTION TO ELECTRICITY
SUBMODULE: LINE VOLTAGE APPLICATIONS
TOPIC: Consumer Education

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and owner's manuals for electrical home appliances, the student will interpret the installation, operation, and specification information, to a level of competency and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Define and compare basic specifications, parameters, and efficiency ratings for common electrical appliances
   b. List criteria for evaluating and selecting a basic lighting, heating, or motor-driven appliance
   c. Read and interpret basic wiring and installation diagrams for common electrical appliances
   d. Interpret warranty/guarantee information applicable to the purchase and use of common appliances
   e. Identify common resources for information about the performance and operation of a particular appliance

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Select a particular appliance requiring some form of installation such as a ceiling fan, light fixture, air conditioner, etc. Develop with class a list of criteria for evaluation and selection for purchase. The list should include basic operating specifications, parameters, and efficiency ratings. If possible, obtain a representative sample of owner's manuals for the class to compare and discuss. Review terminology as required.

2. Have students develop or complete a list of evaluative criteria for a particular appliance.

3. Demonstrate how to follow installation instructions, having students interpret directions, diagrams, tools required, etc. Emphasize safety practices and procedures. A sample, model, or mock-up can be used when using actual appliance is not feasible. In some situations, use slides, pictures, or other visual materials showing a typical, step-by-step installation at home. Have students arrange steps in proper sequence, discover incorrect operations or procedures, and/or discuss misinterpretation of manual information. Explain circuit (amperage) requirements or other considerations as necessary.

4. Information/instruction sheets can be used as substitutes for owner's manuals or to define parameters, specifications, and efficiency ratings.

5. Have students use consumer publications to compare products and develop evaluative criteria. Explain warranty/guarantee information.

MODULE: ELECTRONICS

		Estimated Teaching Time
TOPICS:	Introduction to Electronics - Systems and Subsystems	1.0 week
	Introduction to Basic Passive and Active Devices and Circuit Applications	3.0 weeks
	Laboratory Experimentation and Circuit Fabrication	2.0 weeks
	Introduction to Integrated Circuits	2.0 weeks
	Career Exploration	0.5 week
	Consumer Awareness	0.5 week

PREREQUISITES: Electricity in the Home

TOTAL TEACHING TIME: 9 weeks

MODULE: ELECTRONICS

OVERVIEW OF MODULE

Goal

Upon the successful completion of this module, the student will have developed the basic knowledge, attitudes, and minimal skills that are needed to work with basic electronic circuits and devices. Based on their laboratory activities and experiences in this and the preceding module, students will decide if they desire to continue study in this area of concentration.

Description

In this module, students will be introduced to electronics technologies by Performance Objectives and Instructional Strategies that stress basic information and introductory level skills. The following topics will be covered in the nine weeks:

(1) Introduction to Electronics looks at common electronic systems in major technology areas and the subsystems required in terms of passive and active components and integrated circuits. (In this topic the instructor should emphasize linkage in content to other modules of instruction in Technology Education.)

(2) Introduction to Basic Passive and Active Devices and Circuit Applications includes competencies required for recognizing, using, and interpreting the fundamental applications of common resistors, capacitors, and inductors. Students will develop fundamental skills and concepts related to the use and primary circuit applications of signal diodes, bipolar transistors, and silicon controlled rectifiers.

(3) Laboratory Experimentation and Circuit Fabrication explores common electronic circuit fabrication techniques in terms of tools, materials, and equipment, as well as the safe practices and procedures required for their use. (This topic is not sequential and should be included where appropriate in the Content Outline.)

(4) Introduction to Integrated Circuits includes awareness of digital and analog system applications and the impacts of these systems on today's technological society. Essential laboratory skills required for handling and using these devices will also receive emphasis in this topic.

(5) Career Exploration examines the diverse occupational opportunities available in electronic technologies as they relate to the other topics above. (This topic is not sequential, but to be integrated as appropriate in other instruction.)

(6) Consumer Awareness focuses on the fundamental criteria for evaluating electronic products and services, and their impact on our resources and the environment. (This topic is also not sequential and should be integrated with instruction on devices, systems, and fabrication techniques.)

OVERVIEW OF MODULE, continued

It should be emphasized again that while these topics cover a large amount of material in electronics, this module is introductory in nature. When developing lesson plans, it is suggested that subtopics in the Content Outline, identified by letters, be used for lesson titles. Material notated by Arabic numerals is recommended for inclusion as the topical content of each lesson. The instructor should stress systems analysis when presenting this material, applying input-process-output to the function and application of components and circuits in all laboratory activities. Mathematical theory and specific understanding of semiconductor operation including "holes," "depletion zones," "potential barriers," and other higher level electronic concepts are to be covered in other elective Electronic Technology courses.

Each topics in this module includes class discussions, demonstrations, laboratory experimentation, and the on-going construction of a take-home project(s). The Performance Objectives and Instructional Strategies for each topic stress basic information, essential attitudes, and introductory skills. At the conclusion of this module, each student has the option to select subsequent modules in this area of concentration which have been developed to promote intermediate and advanced learning, leading to a degree of specialization in electronics.

Skills, Knowledge, and Behaviors to be Developed

Upon satisfactory completion of this module, the student will be able to:

1. Identify the passive and active components studied by matching the actual component to its schematic symbol and identifying its common unit of measurement/specifications
2. Identify the common applications for each device studied
3. Draw and describe in systems block diagram form the theory of operation for each circuit studied
4. Differentiate between digital and linear integrated circuits by definition, and give examples of common applications of both
5. Read schematic diagrams
6. Demonstrate safe and proper laboratory skills and techniques in the handling and use of semiconductors and integrated circuits, tools, equipment, machinery, and supplies
7. Demonstrate safe working practices and an awareness for the safety of others when working in the electronics laboratory
8. Apply relevant mathematical and scientific concepts when confronted with problems to solve while working with components and circuits
9. Relate the diverse career and occupational opportunities available in the field of electronics
10. Develop criteria for evaluating consumer products produced in the electronics industry
11. State the impact of advances made in electronics technology on one's personal and work lives and on the environment

MODULE: ELECTRONICS
TOPIC: Introduction to Electronics - Systems and Subsystems

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given appropriate instruction and a functional block diagram of a simple electronic system representative of a major industrial technology, the student will identify electronic systems and subsystem functions, to a level of completeness and accuracy satisfactory to the instructor.

   In order to do this, the student must be able to:

   a. Interpret basic block diagrams of technological systems in terms of input-process-output-monitor functions
   b. Identify passive, active, and integrated circuit electronic subsystem functions

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Briefly outline the major electronic systems and explain how all of these systems are dependent in some form on passive, active, and integrated circuit components. Introduce simple circuits incorporating these devices and illustrate how they are in themselves smaller systems of the broader systems discussed. Suggested circuits may include:

   - Simple telegraph
   - Relay light control
   - Photoelectric control
   - Burglar alarm
   - Power supplies
   - Intercom system

2. Use audiovisual materials such as pictures, filmstrips, or slides depicting electronics in industry, schools, offices, automobiles, armed forces, personal lives, entertainment, and aerospace. For example:

   a. Duplicate materials for systems block diagrams.
   b. Prepare breadboard/modular circuits.
   c. Enlarge schematic diagrams.
   d. Use VCR equipment to help students visualize small or difficult portions of circuits/equipment.
   e. Discuss consumer products which use electronic components.
   f. Mount actual samples of components, by family, on masonite-type material. Illustrate a variety of component packaging, types, and sizes with their respective schematic symbol.
   g. Whenever possible, use more than one type or size of the same component in a circuit, and encourage students to make substitutions.

MODULE: ELECTRONICS
TOPIC: Introduction to Basic Passive and Active Devices and Circuit Applications

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and learning experiences in the study of discrete components, the student will demonstrate knowledge of passive and active electronic devices, to a level of understanding acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Match the physical component to its schematic symbol
   b. Identify the common units of measurement/specifications for each discrete component discussed and describe how it may be tested
   c. Use a color code chart to interpret resistor size and tolerance
   d. Identify physical samples of common types of each component family studied
   e. Discriminate between fixed and variable component operation
   f. Cite common circuit applications for each component studied
   g. Draw accurate systems block diagrams of simple circuits incorporating each component and explain system operation
   h. Transfer this knowledge to a systems block diagram depicting a broader application of the component/circuit

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Suggested demonstrations:

   a. Demonstrate new components in circuits that require as few parts as possible. Isolate components and explain their function and relationship to the total circuit operation.
   b. Use microscope to demonstrate internal semiconductor component structure.
   c. Have students draw a systems model of the circuit operation.
   d. Trace circuit operation using test equipment.
   e. Change component sizes and values to illustrate what effect, if any, there is on the circuit operation and to what degree parts may be substituted.

*2. Laboratory experimentation suggestions:

   a. Provide students with quick connect/disconnect-type circuits.
   b. Design new specifications for the experimental circuit operation and have students determine what component changes need to be made to alter the system for those specifications.
   c. Have students maintain a log/record of their activities and summarize in a systems block diagram.

*3. Give examples of the applications of the circuits studied and have students research the broader applications of the same systems.

MODULE: ELECTRONICS
TOPIC: Laboratory Experimentation and Circuit Fabrication

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given a laboratory situation and the necessary diagrams, materials, tools, and equipment, the student will demonstrate proper laboratory and circuit fabrication techniques, to a level of competency and accuracy acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Follow safe operating practices and procedures in the electronics laboratory and demonstrate cooperative working attitudes
   b. Operate basic tools, machines, and equipment according to demonstrated practices and procedures
   c. Read and interpret simple graphic diagrams and schematics for electronic circuits
   d. Perform simple tests and troubleshooting operations on an electronic circuit, e.g., continuity, shorts, signal injection and tracing, and passive component testing
   e. Assemble/fabricate an electronic circuit from pictorial and/or schematic diagrams, employing basic breadboarding or printed circuit techniques
   f. Construct a take-home project that meets the criteria outlined by the instructor

2. Given an electronics laboratory situation, the student will demonstrate understanding and awareness of safety practices and procedures, to the expectations of the instructor.

   In order to do this, the student must be able to:

   a. Identify common causes of accidents and list the preventative measures that should be followed to avoid injury to oneself and others in the electronics laboratory
   b. Describe the physiological effects of electric current on the human body by listing the potentially hazardous levels of voltage and current and their effects
   c. Observe and follow personal safety practices and procedures
   d. Demonstrate safe handling of tools, materials, and equipment
   e. Demonstrate positive work habits through neat and accurate fabrication of all laboratory work assigned

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Demonstrate use of all tools and equipment, including safety precautions involved. Have students retain pertinent information in their notebooks.

2. Demonstrate all laboratory techniques. Post reminders of procedures on equipment and at work areas.

3. Demonstrate the operation of all components and circuits using a systems block diagram either on poster board, chalkboard, felt or magnetic board and have students analyze the schematic diagrams.

4. Have samples of finished projects available that exemplify the quality of work you desire your students to achieve.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

5. Use slides and pictures of previous projects to illustrate construction procedures, unusual or exceptional project work.

6. Prepare a resource file of additional project ideas that are within the range of concepts and skills contained in this module. Make this file available for students to refer to for extra credit work or leisure time activities. If possible, distribute copies of project ideas for students to keep in their notebooks.

7. Explain criteria for the evaluation of lab experiments and projects. Have students retain printed copies in their notebooks.

8. As laboratory operations and procedures are discussed or demonstrated, have students develop and continue listing occupational titles involving those duties or responsibilities.

*9. As a class, develop criteria for evaluation of common electronic products for use as a consumer. The criteria should be based on methods of manufacture and circuit fabrication employing discrete vs. integrated circuit technology. Instruct students to use the developed list of criteria to research a particular product in consumer publications and/or retail store, comparing different manufacturers.

*10. Provide computer assisted instruction.

11. Review general safety procedures and rules that must be observed at all times.

    a. Require a section of the student's notebook be devoted to safety. Issue copies of general rules and regulations.
    b. Require students to recopy safety rules, date, and sign copies. Retain these copies in your files.
    c. Post copies of general rules and special operating instructions for equipment and machinery in clearly visible locations.

12. Require eye protection to be worn at all times.

13. During every demonstration requiring power, test equipment, or tools and machinery, discuss accident prevention measures and outline proper operating procedures. Have students copy these procedures in safety section of notebook.

14. To demonstrate the physiological effects of current/voltage, the following activities are suggested:

    a. Use VOM to measure dry and wet skin contact resistances between various points. Note differences in readings.
    b. Apply Ohm's Law to develop personal physiological chart. Have students compare charts and discuss affecting factors.

15. Use commercially prepared films on safety.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

*16. To promote positive safety awareness, the following methods are suggested:

a. Display posters or charts illustrating proper safety practices.
b. Use VCR equipment to tape students at work. Discuss positive actions and methods to improve negative behavior or attitudes.
c. Use role-playing activities that exemplify proper procedures to reinforce positive attitudes and help students develop an awareness of others in the room.

17. Discuss first aid procedures for accidental shock and physical injuries that may occur in the lab. Invite the school nurse to participate in the discussion.

MODULE: ELECTRONICS
TOPIC: Introduction to Integrated Circuits

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and learning experiences in the study of integrated circuits, the student will demonstrate knowledge of digital and linear circuit technology, to a level acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Differentiate between integrated circuits and discrete components
   b. Locate pin 1 and the remaining pins on the IC in the correct order
   c. Identify the writtren information as it appears on the face of the IC package: generic number, manufacturer's logo, date of batch
   d. Distinguish by definition between digital and linear ICs
   e. Demonstrate safe handling of integrated circuits and proper circuit construction procedures
   f. Cite five examples each of common applications for digital and linear integrated circuits
   g. Explain the function of the integrated circuits used in this module following the systems approach
   h. Draw and explain two applications of digital and linear integrated circuits using a systems model for each application

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Lecture/discussion on the topic of integrated circuits and the scales of integration. Include reference to discrete devices and concepts of analog vs. digital operation.

2. Have students compare a digital counter wired with discrete components to one using an IC.

   a. Note complexity of wiring using discrete devices.
   b. Using an EPROM or similar IC with a window, have students examine the circuit under a magnifier lamp.
   c. Compare a discrete amplifier circuit to one with an IC.
   d. Use logic equipment to trace circuit operation.

3. Use pictures, slides, or films to illustrate IC manufacturing.

4. Have students compare consumer products such as radios, stereos, and TVs manufactured with linear and digital IC components; note miniaturization of products.

5. Breadboard circuits and demonstrate using a systems block diagram approach.

6. Use VCR equipment to aid visualization of circuits/components.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

7. Do at least one demonstration and experiment each for digital and linear IC's.

   a. Suggested circuits:
      - Digital counter
      - Sound generator
      - Voice synthesizer
   b. Use demonstrations and experiments to:
      - Explore binary number system, truth and function tables, operating voltages.
      - Illustrate the use of test equipment such as logic probes, analyzers, VOM's, oscilloscopes, and frequency counters.
      - Demonstrate proper handling of components
      - Illustrate the operation of the circuit using a systems model.
      - Illustrate principles of analog and digital operation.

*8. Conduct class discussion and have students research the impacts of integrated circuit technology.

   a. Use audiovisuals depicting electronic technology advances and impacts on society and the environment.
   b. Have students develop a list of products, tools, machines, and devices exemplifying electronic technology. Have them explore alternative methods for entertainment, communication, and other daily routines if these items/devices were removed.

MODULE: ELECTRONICS
TOPIC: Career Exploration

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and laboratory activities, the student will select careers or occupations of interest in the electricity and electronics fields and prepare a personal career plan, to a degree of accuracy and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. List three occupations in the electronics industry and three in electricity and write a brief job description for each
   b. List personal interests, aptitudes, and work habits and compare this list to the criteria for personnel in the careers selected
   c. List the entry requirements for a selected career goal
   d. Structure occupations according to the classifications (manufacturing, service)

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Through lecture/discussion, highlight the wide scope of occupations and careers in the fields of electricity/electronics.

2. Student research assignments:

   a. Give students five occupational titles and instruct them to write a job description for each using one or all of the following resources:
      - Library - journals, occupational handbooks
      - Interviews - personnel departments in local business or industry
      - Films/filmstrips - on careers and occupations
   b. Give students five occupations to research employment advertisements and locate a minimum of one ad per title

3. Construct a paste-up of classified ads as a class activity. Note differences in salaries, requirements, or working conditions. Structure ads according to criteria discussed in class: educational/skill requirements, salary, future outlook, etc.

4. Invite guidance personnel to assist in career plan development specific to each student's personal interests, abilities, and needs.

*5. Have students role-play interviews and/or job simulations to help them develop awareness of interests, abilities, and aptitudes.

MODULE: ELECTRONICS
TOPIC: Consumer Awareness

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Given instruction and a consumer electronic product, the student will analyze the construction features and estimate its durability and worth, to a level of competency and completeness acceptable to the instructor.

   In order to do this, the student must be able to:

   a. Evaluate product function and cost efficiency in terms of basic human needs and wants
   b. Recognize components, devices, and assembly techniques that determine product cost and durability
   c. Interpret consumer publications describing product design, operation, and frequency of repair information
   d. Annotate possible impacts of product use and/or manufacture on resources and the environment

SUGGESTED INSTRUCTIONAL STRATEGIES

1. Develop a list of considerations for the selection and purchase of an electronic product. Have students identify the criteria for each consideration which may be used to make a purchase decision.

*2. Divide students into groups to develop a decision-making checklist to aid in the selection and purchase of an electronic product. Students may then use the checklist individually or in their groups to investigate and report on a particular consumer product to the class.

*3. Make a bulletin board display of consumer publications, articles, or other illustrations about products, incorporating components, circuits, and systems covered in this module.

*4. Have students use library materials and consumer publications to determine product quality, efficiency, frequency of repair, and/or possible resource and environmental impacts.

*5. Plan a field trip to a nearby electronic product manufacturing plant or research facility to observe assembly techniques and/or equipment design procedures.

COURSE: BASIC ELECTRICITY/ELECTRONICS

SUGGESTIONS FOR STUDENTS WITH SPECIAL NEEDS

Students who are educationally handicapped and appropriately mainstreamed should be exposed to all of the concepts involved in this course. The success of these students may depend, however, on how the information is presented. Different teaching approaches are often the key. Below are some suggestions for assisting handicapped students to benefit from the instruction provided through the modules and to demonstrate their knowledge and skills in relation to the performance objectives and supporting competencies contained in the module.

1. Develop a vocabulary list for distribution. Permit use of "open book" and dictionaries for researching definitions.

2. To ascertain and ensure retention, use informal oral quizzing on a daily basis, if appropriate. Apply this strategy to check knowledge of content material and vocabulary terms.

3. Decorate classroom with flip charts, posters, and enlarged key words.

4. Provide students with an outline of key concepts included in each of the major topics covered in the module. This can serve as a study guide for the student during the course.

5. Allow students to tape record key informational lectures to use in conjunction with written notes for studying course material.

6. For some students, worksheets and other written material may need to be simplified and organized so as to present concepts in a more gradual manner.

7. Written directions and instruction for class work may be helpful for some students in addition to those provided verbally.

8. Some students can benefit from maintaining a notebook for the module which is organized sequentially and contains key information necessary to achieve the module competencies.

COURSE: BASIC ELECTRICITY/ELECTRONICS

RESOURCES

Source	Kits	Media	Texts	Training
Access Electronics 220 Washington Ave. N. Minneapolis, MN 55401	Kits			Training
American Tech Publishers 12235 S. Laramie Ave. Alsip, IL 60658			Texts	
Bennett & McKnight Publishing Co. 809 W. Detweiller Drive Peoria, IL 61614		Media	Texts	
Bergwall Productions, Inc. 106 Charles Lindberg Blvd. Uniondale, NY 11553		Media		
Bobbs-Merrill Ed. Publishing H. W. Sams Educational Material 4300 W. 62nd Street Indianapolis, IN 42628		Media	Texts	
Brodhead Garrett Co. 4560 E. 71 Street Cleveland, OH 44105	Kits	Media		Training
Career Aids, Inc. 8950 Lurline Avenue Chatsworth, CA 91311		Media	Texts	
CES Industries 130 Central Avenue Farmingdale, NY 11735			Texts	Training
Chilton Book Company Chilton Way Radnor, PA 19089			Texts	
Computer Aided Instructional Systems Box 177 Holly, MI 48442			Texts	Training
DCA Educational Products 424 Valley Road Warrington, PA 18976		Media		
Delmar Publishers 2 Computer Drive West Albany, NY 12205			Texts	

MODULE: ELECTRONICS

RESOURCES, continued

Source	Kits	Media	Texts	Training
Dynalogic, Inc. 11 School Street W. Chelmsford, MA 01863				Training
Edu-Tech Publications Commercial Service Company Box 2499 Anderson, IN 46011		Media	Texts	Training
Education Associates P.O. Box Y Frankfort, KY 40602				Training
EKI, Electronic Kits Inc. 791 Red Rock Road St. George, UT 84770	Kits			
Energy Concepts, Inc. 3254 Kilbourn Avenue Chicago, IL 60641		Media	Texts	Training
ETCO Electronics North Country Shopping Center Plattsburgh, NY 12901	Kits		Texts	Training
Feedback Inc. 620 Springfield Ave. Berkley Heights, NJ 07922	Kits			Training
Goodheart-Wilcox Co., Inc. 123 W. Taft Drive South South Holland, IL 60473			Texts	
Graves-Humphreys 1948 Franklin Road Roanoke, VA 24035	Kits	Media	Texts	Training
Graymark International 1751 McGraw Avenue Irvine, CA 92714	Kits	Media		
Rampden Engineering Co. P.O. Box 563 East Longmeadow, MA 01028				Training
Bayden Publishing 10 Mulholland Drive Hasbrouck Heights, NJ 07674			Texts	

MODULE: ELECTRONICS

RESOURCES, continued

Source	Kits	Media	Texts	Training
Hearlihy & Co. 708-714 W. Columbia Street Springfield, OH 45501		Media		
Heathkit/Zenith Educational System Benton Harbor, MI 49022	Kits	Media	Texts	Training
Hobar Publications 1234 Tiller Lane St. Paul, MN 55112	Kits	Media	Texts	
IASCO Industrial Arts Supply Co. 5724 W. 36 Street Minneapolis, MN 55416	Kits			
Industrial Media, Inc. 6660 28th Street SE Grand Rapids, MI 48506		Media		
Kelvin Electronics, Inc. 1900 New Highway Farmingdale, NY 11735	Kits	Media	Texts	Training
Kempf Training Systems 194 Edgemond Lane Barrington, IL 60010			Texts	
Komech Corp. 8 Morris Avenue P.O. Box 118 Schenectady, NY 12301			Texts	
Lab-Volt Systems Division Buck Engineering Co., Inc. P.O. Box 686 Farmingdale, NJ 07727		Media	Texts	Training
Lindsay Publications P.O. Box 12 Bradley, IL 60915-0012			Texts	
Marcraft Corp. 6515 W. Clearwater Avenue Keenewick, WA 99336	Kits			Training

MODULE: ELECTRONICS

RESOURCES, continued

Source	Kits	Media	Texts	Training
McGraw Hill, Gregg Div. 1221 Ave. of the Americas New York, NY 10020			Texts	
McKilligan Industrial Supply 435 Main Street Johnson City, NY 13790	Kits	Media	Texts	Training
Multitech Electronics 195 West El Camino Real Sunnyvale, CA 94087				Training
Omnitron Electronics 770 Amsterdam Avenue New York, NY 10025		Media	Texts	Training
NIDA Corp. 388 Kirby Avenue Palm Bay, FL 32905				Training
Paxton/Patterson 5719 W. 65 Street Chicago, IL 60638	Kits	Media	Texts	Training
Photocom Productions Box 3135 Pismo Beach, CA 93449		Media		
PITSCO, Inc. Box 1328 Pittsburg, KS 66762	Kits	Media		Training
Prentice-Hall Media 150 White Plains Road Tarrytown, NY 10591		Media	Texts	
Reston Publishing 11480 Sunset Hills Road Reston, VA 22090			Texts	
SATCO Div. Satterlee Co. 924 South 19th Avenue Minneapolis, MN 55404	Kits	Media		
Singer Career Systems 80 Commerce Drive Rochester, NY 14623		Media		Training

MODULE: ELECTRONICS

RESOURCES, continued

Source	Kits	Media	Texts	Training
South-Western Publishing 5101 Madison Road Cincinnati, OH 45227		Media	Texts	
Tab Books Inc. P.O. Box 40 Blue Ridge Summit, PA 17214			Texts	
Teaching Aids, Inc. P.O. Box 1798 Costa Mesa, CA 92626		Media	Texts	
Technovate 910 Southwest 12th Avenue Minneapolis, MN 55404	Kits		Texts	Training
Theta Industrial Products P.O. Box 258 Mound, MN 55364	Kits			
Triplett Corp. One Triplett Drive Bluffton, OH 45808		Media		
Van Nostrand Reinhold Co. Inc. 135 W. 50 Street New York, NY 10020			Texts	
Vega Enterprises, Inc. R.R. #3, Box 193 Decatur, IL 62526				Training
Whirlpool Corp. 1900 Whirlpool Drive LaPorte, IN 46350			Texts	Training

TECHNOLOGY LEARNING ACTIVITIES (TLAs)

One of the more unique aspects of the Technology Education Program has been the creation of Technology Learning Activities, or TLAs. TLAs will provide teachers with laboratory activities which can be used to enable students to meet the performance objectives and to communicate the major concepts identified in each of the curriculum modules. In addition to being used by teachers as actual laboratory activities, TLAs will serve as models for Technology teachers who are encouraged to develop their own.

This Technology Learning Activity has been prepared as a model for teachers to follow in developing additional laboratory activities.

Major concepts and performance objectives identified within the syllabus are accomplished through activity outlined on the page entitled "Procedure for this Activity."

Key elements of the Technology Learning Activities are the problem-solving approach incorporated within the activity, and the link between Technology and other disciplines established by the ten identified constants.

BASIC ELECTRICITY/ELECTRONICS
H.S. TECHNOLOGY LEARNING ACTIVITY

==========

TLA TITLE: UNDERSTANDING AND USING ELECTRONIC COMPONENTS

==========

MODULE: ELECTRONICS

==========

TOPIC: ALL TOPICS TIME IN DAYS: 45

==========

SKILLS, KNOWLEDGE, AND BEHAVIORS

The ability to:

1. Identify passive and active components by matching the actual component to its schematic symbol and identifying its common unit of measurement/specification
2. Identify the common applications for each device studied
3. Draw and describe, in systems block diagram form, the theory of operation for each circuit studied
4. Differentiate between digital and linear integrated circuits by definition and give examples of common applications of both circuits
5. Read schematic diagrams to a level that is acceptable to the instructor

(continued on next page)

OVERVIEW OF TLA

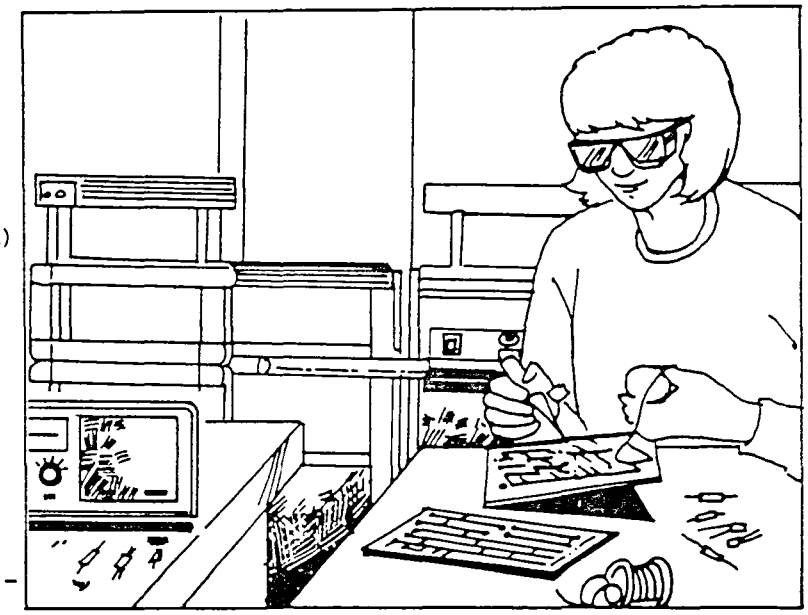
In this activity, the student will investigate modern electronics timing circuits that employ integrated digital circuit components. Through breadboarding, fabrication of a product, class discussion, and demonstrations, the student will identify basic electricity/electronics components, digital signals and applications to home, industrial timing, and data handling systems. In addition, upon successful completion of this TLA, the student will develop the basic knowledge, attitudes, and minimal skills needed to work with basic electronic circuits and devices. Based on their laboratory activities and experiences in this TLA and other TLA's, students will decide if they desire to continue study in this area of concentration.

==========

EQUIPMENT AND SUPPLIES

Equipment - Tools

Proto breadboard #PB10
Digital logic probe #LB-1
Spray Etcher model BTE 202
Silk Screen frame 12" x 12"
Drill press
Multi-meters
Low watt soldering irons (25-45 watt)
Dremel motor tool
Portable hand drill
Motor speed control
Nut driver set
Diagonal cutters
Long nose cutters
Heat sinks
Wire strippers
Screw driver sets



Equipment and Supplies (continued)

Supplies

Copper clad circuit boards
Ferric chloride etching solution
Dry transfer, etch resist, photo silkscreen supplies (depends on process used)
Solder 60/40 rosin core 1/32" dia.
24 gauge stranded hookup wire red & black
Drill bit set 1/16 to 1/2"
#55 Drill bit (drill PC board component holes)
Electrical tape

Electronic Parts

		1985 Prices / 100
IC #1 #7405 hex inverter (open collector)	Quantity 1	$0.36 each
IC #2 #7473 Dual J-K (master slave) flip flop	Quantity 1	$0.56 each
D 1 IN4001 or equal 50v 1a	Quantity 1	$0.33 each
D 2, D 3 LED MV10B or equal	Quantity 2	$0.18 each
C 1 electrolytic tubular capacitor 10 mfd. (radial leads)	Quantity 1	$0.16 each
R 1 resistor 1000 ohms 1/4 watt	Quantity 1	$0.05 each
R 2, R 3 resistor 220 ohms 1/4 watt	Quantity 2	$0.05 each
S 1 SPST slide switch	Quantity 1	$0.26 each
S 2 push button switch (normally open)	Quantity 1	$0.29 each
14 pin dip IC socket (pc soldering pines)	Quantity 2	$0.32 each
AA Penlite cells 1.5 volts	Quantity 4	$0.14 each
4 Penlite battery holder	Quantity 1	$0.49 each
9 volt battery connector (I or T type)	Quantity 1	$0.17 each
Plastic case (optional) Kelvin #133-58	Quantity 1	$0.97 each

Skills, Knowledge, and Behaviors (continued)

6. Demonstrate safe, accurate, and proper laboratory skills and techniques in the handling and use of:
   a. semiconductors and integrated circuits
   b. tools, equipment, machinery, and supplies
7. Demonstrate safe working practices and an awareness for the safety of others when working in the electronics laboratory
8. Apply relevant mathematical and scientific concepts when confronted with problems to solve while working with components and circuits
9. Describe diverse career and occupational opportunities available in the field of electronics
10. Develop criteria for evaluating consumer products produced in the electronics industry
11. Acknowledge the impact of advances made in electronics technology on our personal and career lives and on our environment

See the Electronics module for Performance Objectives related to the following topics:

TOPIC	ABBREVIATION
Introduction to Electronics	IN
Introduction to Basic Passive and Active Devices and Circuit Applications	PA
Laboratory Experimentation and Circuit Fabrication	LAB
Introduction to Integrated Circuits	IC
Career Exploration	CE
Consumer Awareness	CA

PROCEDURE FOR THIS ACTIVITY

Time Days	POs	Teacher Activity	POs	Student Activity
3	IN1	Show electronic systems built by previous classes. Include systems of communication, information, production, transportation, and energy. Begin to identify components that are used in electronic circuits.	IN1	Record examples of systems in notebook. Record component information by placing data in notebooks by family. Leave room for other data to be recorded.
3	IN1	Continue identifying basic units, color code, schematic symbols, and applications of components.	IN1	Record data in notebook.
3	PA1	Provide measuring devices to check components. Explain safe operation. Provide simple circuits for investigation.	PA1	Name components to be checked. Verify values and operate test equipment safely. Enter simple circuits in notebook.
2	LAB 2	Begin safety lesson by discharging a large capacitor or car coil. Explain effects of electric current on the human body. Demonstrate safe use of the above equipment, common causes of accidents, and proper work habits.	LAB 2	Record safety notes in a separate section of notebook. Check skin resistance with VOM.
2	LAB 1	Display catalogues and kits available	LAB 1	Choose device to construct. Use the device to accomplish the remaining goals (performance objectives and supporting competencies) of the course. Identify components, interpret schematics, and fill out systems chart (how device works).
3	LAB 1,2	Show all options for circuit board construction. Issue directions. Explain safe operating practices. Provide demonstrations and related lessons on fabrication where needed.	LAB 1,2	Begin construction using equipment and materials for chosen process. Demonstrate safe practices in the lab.
3	IC1	Explain the function of integrated circuits using the systems approach. Give examples of digital and linear ICs. Locate pin 1. Explain IC data on package. Demonstrate the handline of ICs.	IC1	Finish assembly of devices. Use IC data recorded in notebook to handle, identify, and install ICs.
3		Provide test equipment and demonstrations. Use systems diagrams.	LAB 2	Perform simple tests and trouble-shooting operations on devices.

Total Days

PROCEDURE FOR THIS ACTIVITY

Time Days	POs	Teacher Activity	POs	Student Activity
3		Conduct oral reports.		Explain orally how his/her device functions using systems diagrams, test instruments, flowcharts, and schematics.
2		Facilitate learning.	IC1	Cite examples of IC applications. Explain function using systems approach.
3	CA1	Discussion on assembly techniques, cost, design, warranty, and repair of electronic devices.	CA1	Record data in notebook. Evaluate product function and cost in terms of wants and needs. Research impact of product use on resources and environment.
3	CE1	Provide reference books for careers. Relate job titles to experiences and topics covered in the course.	CE1	List occupations, job descriptions, personal interests, aptitudes, and entry requirements in notebook.
2		Review module competencies.		Take test on module competencies.

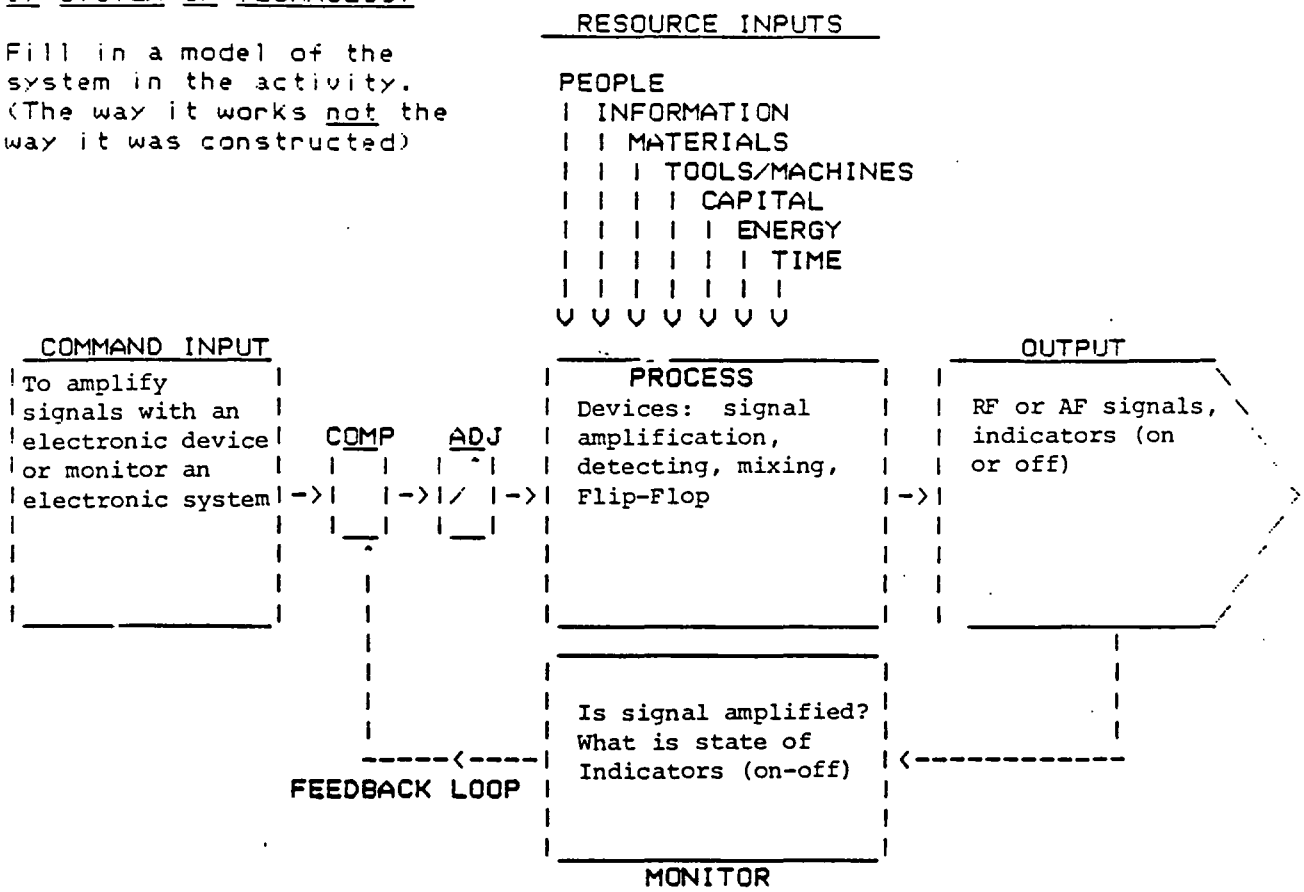
Total Days				

CONSTANTS FOR INFUSION INTO THE TLA

==========

1) SYSTEM OF TECHNOLOGY

Fill in a model of the system in the activity. (The way it works not the way it was constructed)



IDENTIFY THE ROLE OF THE FOLLOWING RESOURCES IN THE SYSTEM ABOVE:
PEOPLE, INFORMATION, MATERIALS, TOOLS & MACHINES, CAPITAL, ENERGY, TIME.

CONSTANTS FOR INFUSION INTO THE TLA

==========

2) MATH Units of measurement; periods; frequency; binary number systems; and truth tables.

3) SCIENCE Energy conversion (chemical to electricity, electricity to light); electron flow; semiconductor materials.

4) HUMAN & SOCIAL IMPACTS Applications of micro- miniature hearing aids, computers, watches; voice recognition and voice synthesizer; robotics; special electronics devices for the handicapped which aid in mobility and communications.

CONSTANTS FOR INFUSION INTO THE TLA

==========

5) COMMUNICATION SKILLS Digital display; digital timers; compact disc; TVs; VCRs; system monitoring sensing controls; word processing; electronic bulletin boards.

6) SAFETY AND HEALTH Psychological effects of electronic devices; physiological problems of possible misuse; safety problems involving chemical fluxes and etchants; hot metals; solvents; vapors, disposal of cleaning solvents and vapors; care with electronic hand tools and equipment.

7) PSYCHOMOTOR SKILLS Eye- hand coordination; use of test applications; measuremen of time; soldering and desoldering; use of tools.

8) CAREER RELATED Manufacturing; construction; economics; energy; computer applications; industrial production; technicians; sales; and marketing.

9) CREATIVE PROBLEM SOLVING -Opportunities for creative problem solving will be provided by this TLA including: identification and definition of a problem, goal and criteria setting, generation of alternative solutions and recognition of limitations, optimization, testing, and evaluation.

==========BACKGROUND REFERENCES AND RESOURCES==========

Free Materials: Address requests on school letterhead.

Consumer Electronics Education Program
Suite 2700
500 Fifth Avenue
New York, NY 10110

Request: Age of Electronics - Curriculum Guide

Con Edison
Consumer Affairs Room 1625-S
4 Irving Place
New York, NY 10003

Request: Energy Conservation Kit. Package covers grades 4-9. Many good display materials as well as reference.

Write to semiconductor manufacturers to ask for damaged chip wafers to use as visual teaching aids under microscope.

SOFTWARE

Bergwall
P. O. Box 238
Garden City, NY 11530-0238

#8010E Basic Electricity + Electronics
(direct current) Set of 6 disks
(6 primary diskette + 6 backup diskettes,
with courseware guide.) Apple II plus, 48k,
IIe, IIc. set $399.00 individual $89.00

Career Aids Inc.
20417 Nordhoff Street, Dept. M-3
Chatsworth, CA 91311

#AU 3148-01 Electronic Design (Apple) $49.95
#HRAG 305a Electronic Principles + Related Review (Apple) $29.50
#HPIE 750a Ohm's Law, Series + Parallel Circuits (Apple) $29.50
#TB 7105 Circuit Layout Planner (TRS-80) $29.95

Useful Filmstrips

Career Aids Inc.
20417 Nordhoff Street, Dept. M-3
Chatsworth, CA 91311

Society and the Chip 2 filmstrips and cassettes $84.00

Vocational Media Associates
Prentice Hall Media
P. O. Box 1050
Mount Kisco, NY 10549-9989

Introduction to Electricity 2 film strips + cassettes, w/guide $97.00

Fundamentals of Alternating Current 2 filmstrips + cassettes, w/guide $97.00

Bergwall NY collect (516) 222-1111
P. O. Box 238
Garden City, NY 11530-0238

#807 Transistors-Operating Principles filmstrip-cassette or VHS cassettes 14-20 min. with study guide $79.00

#865 Soldering for Electronic Repair set of 3 filmstrips + cassettes or VHS cassettes 14-20 min. with study guide. set $179.00

#801 Basic Electricity + Electronics (direct current) set of 6 filmstrips + cassettes or VHS cassettes with study guide. set $329.00

#802 Basic Electricity + Electronics (alternating current) set of 10 filmstrips + cassettes or VHS cassettes with study guide. set $529.00

Suppliers of Electronic Parts

Fordham
260 Motor Parkway
Hauppauge, NY 11788

JDR Instruments
1224 South Bascom Avenue
San Jose, CA 95128

Heath Company
Dept. 020-406
Benton Harbor, MI 49022

Micro Mart
508 Central Ave.
Westfield, NJ 07090

All Electronics Corp.
P. O. Box 20406
Los Angeles, CA 90006

Jameco Electronics
1355 Shoreway Road
Belmont, CA 94002

JDR Microdevices
1244 S. Bascom Avenue
San Jose, CA 95128

Mark V Electronics
248 E. Main Street
Alhambra, CA 91801

Radio Shack
see your local store
for catalog.

R.N.J. Electronics
P. O. Box 528
Albany Avenue
Lindenhurst, NY 11757

Long's Electronics
2700 Crestwood Blvd.
Birmingham, AL 35210

Mouser Electronics
P. O. Box 699
Mansfield, TX 76063

NTE Electronics, Inc.
44 Farrand Street
Bloomfield, NJ 07003

William B. Allen Supply Co.
300 Block North Rampart
New Orleans, LA 70112

Dick Smith Electronics
P. O. Box 8021
Redwood City, CA 94063

Saratoga Electronics
12380 Saratoga-Sunnyvale Road
Saratoga, CA 95070

Digitron Electronics
110 Hillside Avenue
Springfield, NJ 07081

Electronic Parts Outlet
2515 N. Scottsdale Road
Scottsdale, AZ 85257

Digi-Key Corporation
P. O. Box 677
Thief River Falls, MN 56701

Ramsey Electronics, Corp.
2575 Baird Road
Penfield, NY 14626

Spectrum Electronics
5932 Market Street
Philadelphia, PA 19139

Kelvin Electronics
P. O. Box #8
1900 New Highway
Farmingdale, NY 11735

Omnitron Electronics
770 Amsterdam Avenue
New York, NY 10025

Edlie Electronics
2700 Hempstead Turnpike
Levittown, NY 11756

PROJECT SUPPLIERS

Heath Kit Company
Benton Harbor, MI 44902

IASCO
5724 West 36th Street
Minneapolis, MN 55416-2544

Graymark
Box 5020
Santa Ana, CA 92740

Paxton Patterson
1144 Clifton Avenue
P. O. Box 3040
Clifton, NJ 07012

EQUIPMENT SUPPLIERS

Brodhead Garrett Co.
4560 East 71st Street
Cleveland, OH 44105

CES Industries
130 Central Avenue
Farmingdale, NY 11735

RJT Educational Training Systems
561 Jerome Court
Franklin Square, NY 11010

Kelvin Electronics
P. O. Box 8
1900 New Highway
Farmingdale, NY 11735

Chaney Electronics
P. O. Box 4116
Scottsdale, AZ 85261

Marcraft International Corp.
6515 W. Clearwater Ave.
Kennewick, WA 99336

EKI - Electronic Kits International
23210 Del Lago Drive
Laguna Hills, CA 92653

Shortess-Rawson and Associates
50 Lafayette Place
Kenilworth, NJ 07033

Vowell Associates, Inc.
1 Lockwood
Pittsford, NY 14534

TEXT AND REFERENCE BOOKS

Bethume, James D. Basic Electronic and Electrical Drafting. Englewood Cliffs, NJ: Prentice Hall, 1980.

Buban, P. and Schmidt, M. Understanding Electricity and Electronics. New York: McGraw Hill, 1981.

Davies, Hellen and Wharton, Mike. Inside the Chip. Tulsa: EDC Publishing Company, 1985.

Gerrish, H. and Dugger, W. Exploring Electricity and Electronics: Basic Fundamentals. Bloomington, IL: Goodheart-Wilcox Publishing Company, 1981.

Groneman, Chris H. and Feirer, John L. Getting Started in Electricity and Electronics. New York: McGraw Hill, 1979.

Hughes, Frederick W. Illustrated Guidebook to Electronics Devices and Circuits. Englewood Cliffs, NJ: Prentice Hall, 1983.

Tokheim, L. Electronic and Microcomputer Circuits. New York: McGraw Hill, 1985.

PERIODICALS AND PUBLISHERS

Electronic Education

Electronic Communications
1311 Executive Center Drive
Tallahassee, FL 32301

Electronic Servicing and Technology

Intertec Publishing Corp.
9221 Quivira Road
Box 12901
Overland Park, KS 66212-9981

Electronics for Kids of All Ages

Charleson Publishing Company
124 East 40th Street
New York, NY 10016

Hands-On Electricity

Gernsback Publications, Inc.
200 Park Avenue
New York, NY 10003

EVALUATION

The teacher should develop a two-component evaluation system to determine if the student understands: (a) performance objectives and (b) skills, attitudes, knowledge, and safety related to specific lab activity.

a. EVALUATION OF PERFORMANCE OBJECTIVES (examples)

Student will:

1. Identify component and link to corresponding schematic symbol and common unit of measurement/specs.
2. Chart several examples of common application for the device studied.
3. Complete a system block diagram illustrating the theory of operation.
4. Distinguish between digital and linear integrated circuits and give examples.
5. Interpret schematic drawing related to device studied.
6. Exhibit safe working practices that demonstrate proper handling of semiconductors, integrated circuits, hand tools, and equipment during an activity in the electronics lab.
7. Compare career and occupation opportunities available in the field of electronics.
8. Develop a product rating by comparing several similar electronic parts.

b. EVALUATION OF LAB ACTIVITY (examples)

1. Written unit test with object and subjective testing.
2. Practical testing of pin voltages on both ICs.
3. Establish a truth table using a logic probe.
4. Test for proper functioning circuit.

APPENDIX:

VOCABULARY

ANALOG - Information that is continuous over a range. Analog means the same as linear.

BATTERY - A combination of two or more cells connected together.

BINARY - Number system having base of 2, using only the symbols 0 and 1.

BREADBOARD - A circuit arrangement in which electrical components are fastened together temporarily for testing or experimental work.

CAPACITANCE - The property of a capacitor that enables it to store an electric charge. The unit of measurement for capacitance is the farad.

CAPACITOR - A device capable of storing electric energy. It is constructed of two conductor materials separated by an insulator.

CATHODE - The negative terminal of a cell or battery; the part of an electronic device from which electrons are emitted.

CELL - A device that produces voltage by means of chemical action. A voltaic cell is made of two different kinds of conductor materials placed within a paste or a fluid (electrolyte) that also conducts electricity.

CIRCUIT - A system of conductors and devices through which electrons can move. A complete circuit contains (1) conductors, (2) a switch, (3) a load, (4) an electircal source.

CIRCUIT, OPEN - An incomplete or broken circuit.

CIRCUIT, PARALLEL - A circuit in which loads are connected across two wires or conductors of the power line.

CIRCUIT, PRINTED - A method of circuit wiring in which the conductors are copper strips on a sheet of insulator material.

CIRCUIT, SERIES - A circuit in which the loads are connected into one wire or conductor of the power in a "one after the other" fashion.

CIRCUIT, SHORT - A circuit containing a defect that causes electrons to follow a path of smallest resistance.

CONDUCTOR - A solid, liquid, or gas through which electrons pass easily.

CONTINUITY TEST - The test made to determine whether a circuit or a part of a circuit provides a complete electrical path.

CURRENT - The movement of electrons through a conductor material.

CURRENT, DIRECT - The movement of electrons through a conductor in one direction only.

DIGITAL - Data in discrete bits or pieces.

ELECTRONICS - The study of electrons and how they move through space and through special conducting materials. The term electronics is usually applied to the study of how electrons flow in electron tubes and semiconductors.

FARAD - The unit of measure for capacitance. A capacitor is said to have a capacitance of one farad when a voltage applied to it, changing at the rate of one volt per second, produces a current of one ampere in the capacitor circuit. Because the farad is such a very large unit, the term microfarad, or one-millionth of a farad, is most commonly used.

FLIP-FLOP - An electrical circuit made using several transistors, which can be one of two states 0 and 1. Flip-flops are used in memory chips to form memory cells and on a microprocessor to form registers.

FREQUENCY - The number of cycles of an alternating current completed in a certain period of time - usually one second.

HEAT SINK - Mass of metal used to carry heat away from component.

INTEGRATED CIRCUIT - A concentration of transistors, diodes, resistors, and capacitors on a microminiature chip.

INTEGRATED CIRCUIT SOCKET - A socket which integrated chips are plugged into.

KILO - A prefix meaning thousand.

LIGHT EMITTING DIODE (LED) - A PN junction that emits light when biased in the forward direction.

METER - A measuring instrument.

NEGATIVE - The electrical property of an object that contains more than the normal number of electrons.

OHM - The unit of electrical resistance. A circuit has a resistance of one ohm when one volt produces a current of one ampere.

OHMMETER - An instrument used to measure resistance.

OHM'S LAW - A basic electrical law that states the relationship between current, DC voltage, and resistance in a DC circuit.

OSHA - The abbreviation for the Occupational Safety and Health Administration, an agency of the U.S. Department of Labor. This agency issues safety and health standards related to working conditions.

POLARITY - An electrical condition that determines the direction of current. In a circuit, electrons move from a point of negative polarity to a point of positive polarity.

RECTIFIER - A device that changes alternating current into direct current.

RESISTOR - A device used to insert electrical resistance into a circuit.

SEMICONDUCTOR - A group of solid materials that are good conductors of current under one condition and poor conductors under another condition.

SERIES - PARALLEL CIRCUIT - A circuit containing one or more combinations of series and parallel circuits.

SWITCH - A device used to complete or to open a circuit.

TRANSISTOR - A semiconductor device used to amplify electrical signals.

VOLTAGE - The electromotive force that causes electrons to move through a circuit.

VOLTMETER - An instrument used to measure voltage.

WIRE STRIPPER - A tool used to remove the insulation from wire.

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