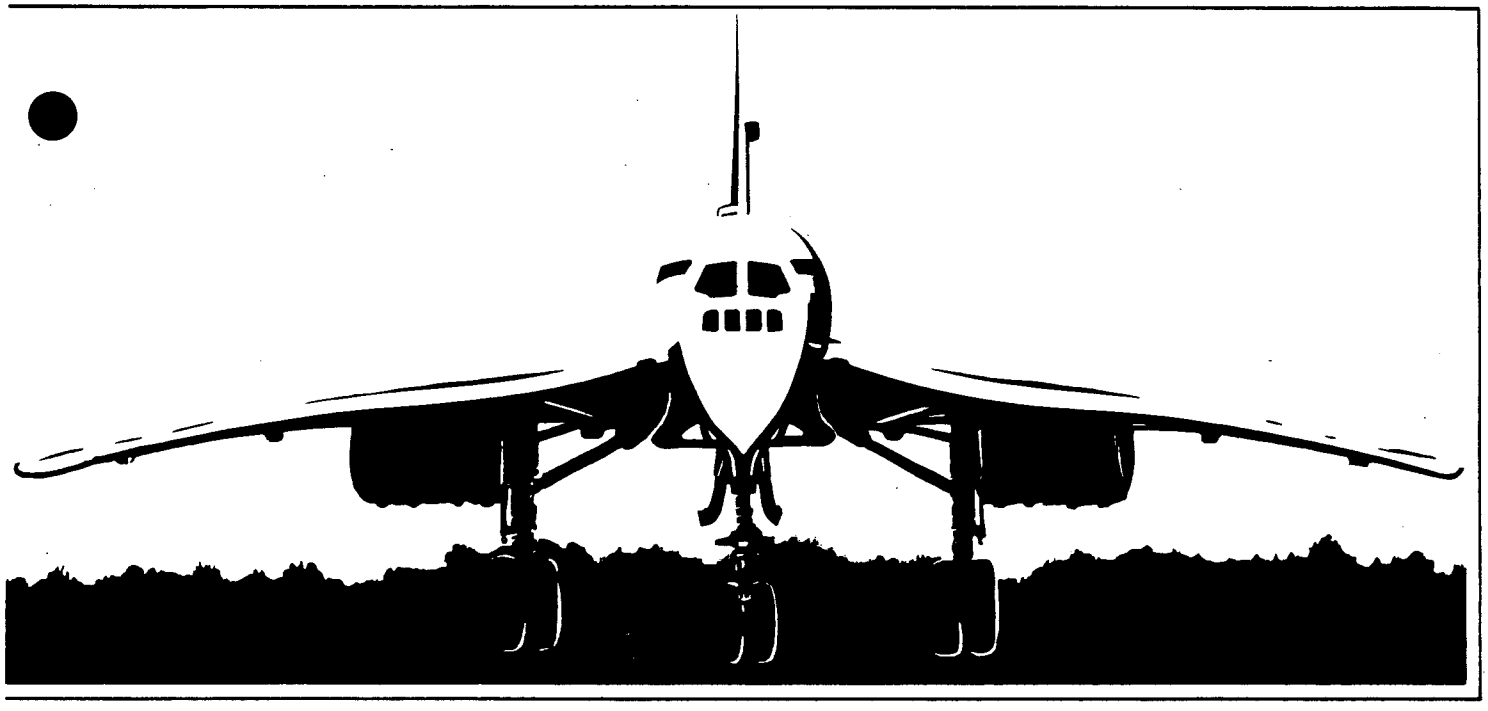
TECHNOLOGY EDUCATION
TRANSPORTATION SYSTEMS

GRADES 9-12
SYSTEMS BLOCK COURSE



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

July 1987

TECHNOLOGY EDUCATION

COURSE: **TRANSPORTATION SYSTEMS**

MODULE: Land Transportation Systems

TOPICS: Inputs
Resources
Process
Outputs
Monitor/Control

MODULE: Marine Transportation Systems

TOPICS: Inputs
Resources
Process
Outputs
Monitor/Control

MODULE: Aerospace Transportation Systems

TOPICS: Inputs
Resources
Process
Outputs
Monitor/Control

PREREQUISITES: None

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TOTAL TEACHING TIME: 18 weeks

DATE: July 1987

COURSE OVERVIEW

The development of transportation systems throughout the world has a tremendous impact on the intellectual and economic growth of societies. Transportation systems allow people to move not only themselves, but also durable and nondurable goods in increasingly fast and efficient ways.

This curriculum guide explores transportation systems from three perspectives: land transportation, marine transportation, and aerospace transportation. Content has been provided to extend over a period of 18 weeks (180-minute week). This time block has been divided into two nine-week segments, the first devoted to land transportation systems, the second to marine and aerospace systems.

Land Transportation Systems. This module is organized around the systems concept, including: inputs, resources, process, outputs, and monitor/control components. Among the modes of transportation covered are: (1) fixed (rail), (2) random (auto, recreational), and (3) stationary (pipeline, conveyor, elevator).

Marine Transportation Systems. Like land transportation systems, this module is organized according to the following components: inputs, resources, process, outputs, and monitor/control. Inland marine content is devoted to canals, domestic lakes, and coastal waters. The maritime content treats transport in large inland lakes and oceans.

Aerospace Tansportation Systems. This module, like the two preceding, is organized around the systems concept. Content is divided into systems that operate in the atmospheric environment and those that operate in the space environment.

INSTRUCTIONAL METHOLOGY

Each phase of the course in Transportation Systems contains Performance Objectives representative of the knowledge and skills needed for student understanding of the three major systems involved. Instructors may select from the instructional strategies provided or develop others which will insure attainment of the objectives identified for each module.

The Suggested Instructional Strategies are cross-referenced to Performance Objectives and Supporting Competencies. The strategies are suggesive and not meant to be all-inclusive. Support materials and teaching/learning activities such as written reports, notebooks, oral reports, field trips, audiovisual aids, and tools are left to the discretion of the teacher.

It is important that students experience hands-on activities approximately three fourths of the time, with the remainder to be spent on related information, research, and demonstrations. The laboratory for the course should, therefore, contain specific, well-organized work stations, complete with the tools, equipment, computers, supplies, and related software needed to enable students to complete the learning activities and achieve the curriculum objectives.

This course should be considered a continuation of Introduction to Technology. Additional linkages are established with the other systems and foundations courses.

Throughout the course outline, strategies have been identified with an asterisk (*) that promote leadership skills in communication, decision making, problem solving, human relations, management, and human motiviation.

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.

Each 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 student leadership development activities. All occupational education students should be provided 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 good 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.

Students who elect to become active members of one of the student leadership organizations chartered 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 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 systems courses. They are: Communication Systems, Production Systems, and Transportation Systems. Students completing a high school sequence in Technology Education must have successfully completed any two of these three systems 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.

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS

SUGGESTED INSTRUCTIONAL TIME: 9 weeks

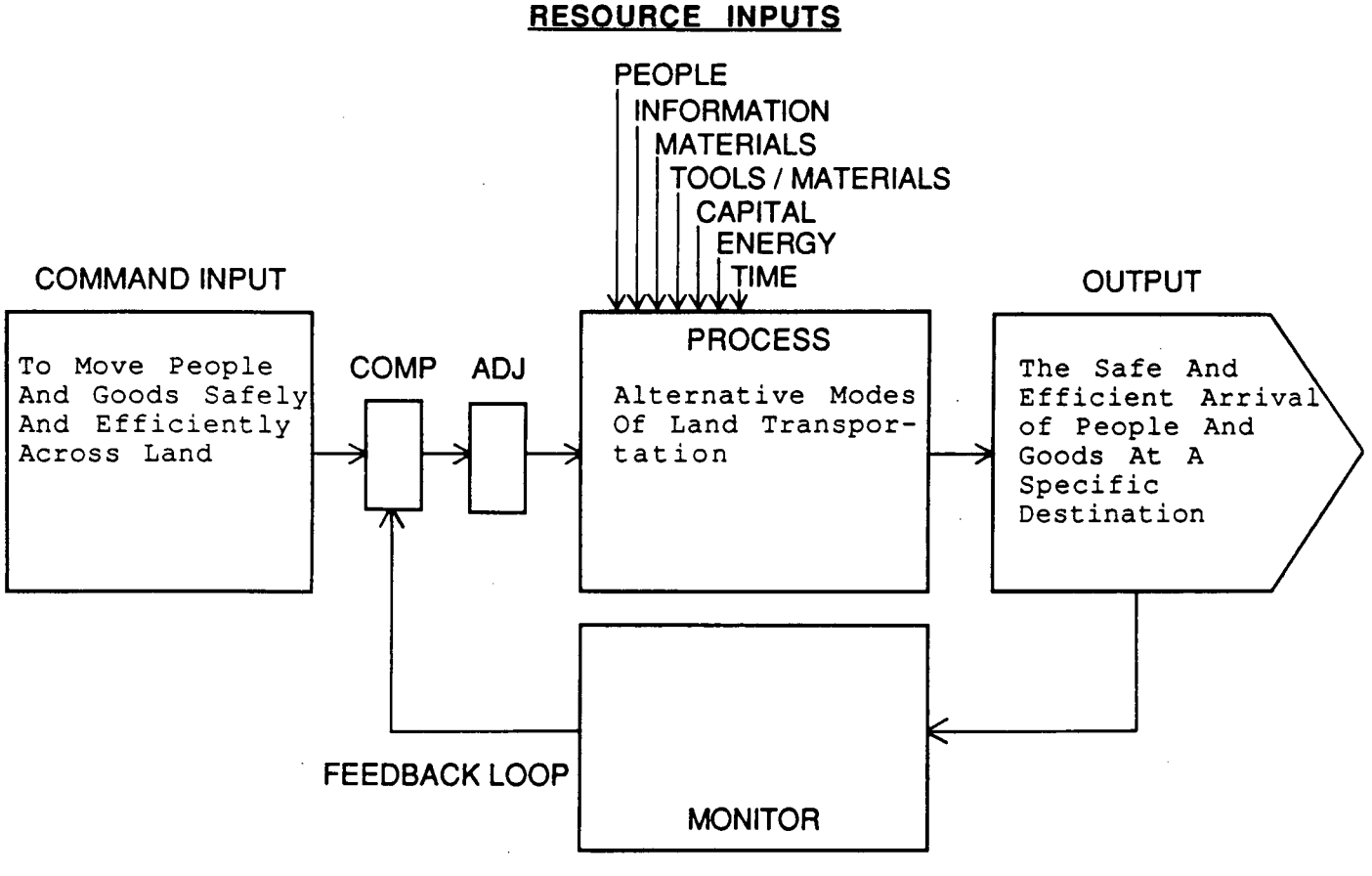
OVERVIEW OF MODULE

Goals

Land Transportation Systems, the first of three modules included in the Transportation Systems Course, is designed to achieve the following student outcomes:

1. Develop insights and understanding of land transportation and its place in our culture
2. Provide experience with a wide variety of materials, products, tools, and procedures common to the field of land transportation
3. Develop an understanding of the many careers in the land transportation field and their requirements

SYSTEMS DIAGRAM



OVERVIEW OF MODULE, continued

Description

Nearly 95 percent of the movement of goods and people still occurs today on land. In the United States, this tremendous movement has been made possible as a result of our pioneering effort in transportation technology.

The United States led the world in the building of railroads. Thousand of miles of modern highways, built through the expenditure of billions of dollars, also make it possible to travel coast to coast in a few days. Intracoastal highways have stimulated truck transportation and brought vast quanitites of goods and services to the most remote communities.

Experimentation and research in land transportation continue in an effort to handle the volume of land transportation more efficiently and reduce problems of environmental pollution and congestion.

There are two systems for moving goods on land -- vehicular and stationary. Cars and trucks are included in the vehicular classification. Pipelines and conveyors are examples of stationary systems. Systems designed to move people are either fixed-route systems, such as subways, elevators, and escalators, or random-route systems, including automobiles, motorcycles, mopeds, and human-powered land vehicles. Fixed routes, while efficient in land use, often lack the degree of responsiveness necessary to meet modern human needs.

In this module, students will have an opportunity to explore these primary land transportation systems and to assess the impacts of land transportation on the environment, use of energy resources and career opportunities.

Skills, Knowledge, and Behaviors to be Developed

The student will be able to:

1. Identify and evaluate the components of a land transportation system
2. Identify basic skills necessary for careers in land transportation
3. Understand technical advances in land transportaiton
4. Identify and use information resources
5. Design and contruct a land vehicle
6. Analyze, use, and maintain various subsystems of a land vehicle
7. Model land transportation modes
8. Understand and apply safety procedures, laws, and regulations
9. Understand the impacts of a land transportation systems
10. Understand human and machine monitor/control devices
11. Select and use appropriate tools, techniques, and devices associated with land transportation

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS

CONTENT OUTLINE

I. System Command Input

- A. Desired Result
  1. Specifications for movement of goods and people
  2. Safety considerations
  3. Vehicl design specifications
  4. Economic qualifications
- B. Expected Impacts
  1. Environmental
  2. Economic
  3. Societal
  4. Personal

II. Resources

- A. People
  1. Job classifications
  2. Career opportunities
- B. Information
  1. Historical technical advances
  2. Information systems
     a. Maps
     b. Operating and servicing manuals
  3. Safety
- C. Materials
  1. Vehicle construction materials
  2. Characteristics and design considerations
- D. Tools/Machines
  1. Identification
  2. Function/selection
  3. Utilization and safe operating techniques
  4. Maintenance
- E. Capital
  1. Source
  2. Effect on development
- F. Energy
  1. Types and sources
  2. Conversion and applications
- G. Time
  1. Requirements/quantity
  2. Management and outcomes

CONTENT OUTLINE, continued

III. Process

- A. Modes
  1. Fixed (rail)
  2. Random (auto, recreational)
  3. Stationary (pipeline, conveyor, elevator)
- B. Vehicle Subsystems
  1. Propulsion (engine types)
  2. Structure (frame, body)
  3. Suspension (wheels, tracks, air cushion)
  4. Guidance and control

IV. Output

- A. Service Provided/Goods Delivered
- B. Impacts
  1. Environmental
  2. Economic
  3. Societal
  4. Personal

V. Monitor and Control

- A. Types and Methods
- B. Purposes

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Inputs

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will identify the technical advances that have been made in the way people move themselves and their goods over land, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Explain the need for the safe transportation of people and their goods
   b. Analyze the physical weakness of humans and the benefits derived through the use of machines
   c. Identify the development of various vehicles on a timeline
   d. Describe the physical make-up of the various vehicles used for land transportation

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Request free materials that deal with the developments of transportation.
   b. As a class, develop a timeline related to land transportation using a roll of paper. Place, in order of time, each development from walking to the "bullet train."
   c. Have students research, design, and make models of transportation modes using papier-mache, modeling clay, wood, cardboard, metal, plaster, or plastics.
   d. Use a series of pictures depicting various forms of tranportation and have students record the name of the mode or vehicle and the date it was developed.
   e. List materials available at each stage of development of land transportation.
   *f. Have students write letters to the following associations/agencies for information on the history of land transportation:
      - o Society of Automotive Engineers
      - o Major auto manufacturers
      - o American Trucking Institute
      - o American Railroad Association
      - o United Auto Workers
      - o National Highway and Traffic Safety Board

   *g. Invite senior citizens to speak on the "Development of Transportation in My Lifetime."

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Resources

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will explain careers available in fields directly or indirectly related to land transportation and identify the training required, with a degree of accuracy and completeness acceptable to the isntructor.

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

   a. Distinguish among the major land transportation systems
   b. Explain the requirements for one or more jobs associated with a particular system

2. Following instruction, the student will describe information systems currently available to the land traveler, with a degree of accuracy and understanding acceptable to the instructor.

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

   a. Explain the use of a road map and its various information symbols
   b. Explain the use of a compass and how to correct for area declination
   c. Describe the use of radio communication in land travel
   d. Describe significant clues available in land travel for dead reckoning
   e. Follow and perform manufacturers' recommended operating and servicing procedures

3. Following instruction, the student will generate a drawing, model, or a full-scale land vehicle (past, present, future), with a degree of detail acceptable to the instructor.

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

   a. Research and identify materials of construction and designs that are likely to affect land vehicle construction
   b. Identify and safely utilize the major tools, machines, and operations needed to construct a vehicle

4. Following instruction, the student will describe how capital, energy, and time have affected the development of a land transportation system, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Research the capital, energy, and time requirements for a land transportation system
   b. Relate these resources to the development of the system

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Resources

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students research wage scales of truck drivers, train engineers, auto mechanics, car salespersons, civil engineers, and gas station attendants.
   *b. Have students ask parents about any connections their jobs may have to any type of land transportation. Through class discussion, compile a list of these connections.
   c. Research school programs offering advanced training in a specific career related to land transportation.
   d. Have the class review local newspapers and compile a list of job ads associated with land transportation.
   e. Have each student select a career associated with land transportation and determine the following:
      (1) Entry requirements
      (2) Wages, advancement opportunities
      (3) Working conditions
      (4) Future of the career choice
   f. Distribute and have students complete a career-exploration series of tasks that includes career planning, gathering job information, self-assessment, job matching, job exploration, and tentative decision making.

2. (P. O. #2)

   a. Using road maps, have students plot a trip from school to a city at least 500 miles away, selecting either a fast route or a scenic route, listing the major route numbers, directions, and any possible tolls.
   b. Have students replicate the various highway signs found in the State.
   c. Make a time zone chart for the United States and have students determine what time it is in major cities across the country. Do the same with a world time zone chart.
   d. Have students select landmarks that can be used to orient an individual to his/her surroundings.
   e. Have students make a compass using a needle, cork, and a dish of water.
   f. On the school grounds, lay out a random course without direction identification. Have students construct a map by transposing the on-site course to a workable paper drawing with a North orientation and appropriate symbols.
   g. Discuss local topography and the rising and setting of the sun, showing students that a compass is not always necessary to determine direction of travel.
   h. Have students orient a map and compass with the proper declination for the given area.
   i. Using a schedule from a land transportation system, have students plan a trip to a predetermined destination with a specific time frame.

3. (P. O. #3)

   a. Generate drawings and/or models of students' ideas of land vehicles. Have a competition with the models.
   b. Discuss principles of air flow and wind resistance.
   c. As a class project, build a wind tunnel.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

d. Have students conceptualize the shape of a vehicle that will carry a family of four on a two-week vacation in 100 years and of what materials the vehicle might be made.
e. Using popular trend magazines, have students read, discuss, and write reports on transportation trends projected for the future.
f. Discuss and compare common materials and fasteners utilized in the construction of land vehicles.

4. (P. O. #4)

a. Provide the class an opportunity to use a computer simulation of a highway or rail transportation system.
*b. Invite the school district transportation director to address the class on the effects of capital, energy costs, and related items on bus transportation.
c. Compare delivery time and cost of an item shipped via U. S. Postal Service, United Parcel Service, and an air express company.

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Process

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe and/or model various modes of land transportation, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Explain/describe the differences between three modes of land tranpsortation:
      (1) Fixed route - mass transit, railroad, trams, monorail, etc.
      (2) Random route - bicycle, auto, recreational vehicle, etc.
      (3) Stationary conveyance - pipeline, conveyor belts, elevators, etc.
   b. Model one of the modes of land transportation

2. Following instruction, the student will describe the subsystems of a land vehicle that have been devised to move people and goods, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify vehicle subsystems
   b. Describe the functions of each subsystem
   c. Perform repair and maintenance on one subsystem

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students construct models of fixed, random route, or stationary conveyance transportation vehicles.
   b. Examine local examples of fixed route, random route, and stationary conveyance transportation, utilizing cameras, video, field trips, etc.
   c. Using Department of Commerce figures, discuss the number of people who commute to work each day. Compare rural and urban statistics. Calculate the number of cars needed to carry two people each and the passenger count of mass transit buses, subways, and trains.
   d. Calculate the difference in fuel consumption of individual travel versus mass transit.
   e. Discuss which mass transit system carries the most people and then have students prepare a short report on one system, such as trolley, bus, subway, train, escalator, or elevator.
   *f. Have students obtain information from their parents on their work/travel expenses. Make a comparison of the costs of fuels to move people.
   g. Show films on mass transit. The Boards of Cooperative Educational Services (BOCES) supply films through their media centers. Free film catalogs are also published which contain the listing of mass transit films.
   h. Relate environmental concerns and declining fuel reserves with a need to develop mass transit system that can be operated profitably.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

2. (P. O. #2)

a. Have students disassemble and assemble a small engine to study the engine's lubrication, cooling, fuel, and ignition systems.
b. Have students construct model vehicle frames and bodies from available materials. Perform various testing procedures on models (wind tunnels, weight strength comparison, destructive testing)
c. Have students repair a flat tire on a bicycle
d. Have students check tire pressure on a car
e. Have students construct an external combustion steam engine for comparison with the internal combustion engine.
f. Using a Saybolt Viscosimeter, have students determine various Saybolt universal seconds of selected fuels and lubricants at various temperatures.
g. Students can investigate various alternatives to common petroleum fuels used today by researching such forms of land transportation as Maglift monorails.
h. Have students investigate the impact on the internal combustion engine of the use of a small engine that runs on propane, gasoline, alcohol, or diesel fuels.
i. Review samples of different fuels used in land vehicles and have students identify and correlate each with a vehicle using it.
j. Using a flat plane and different models representing sleds, skiis, and wheeled vehicles, have students calculate the force needed to move each along the plane, using the formula $F = MN$ (F = force; M = coefficient of friction; N = normal pressure). (Houseman & Slack, Physics, pp. 77-82)
k. Conduct a "Metrics 500" contest among the students.
l. Have students conduct H.P. experiments using various land propulsion systems such as the combustion engine and steam engine.
m. Have students assemble a steam engine kit and test and calculate the brake horsepower developed. Add lubricants such as oil, wax, grease, and water between the test plane and vehicle to observe the decrease of friction.
n. Have students use an engine dynometer to demonstrate the coupling of a power producer to a power user.
o. Have students research why and how a particular recreational vehicle was developed.

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Outputs

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe relationships between people and safe, efficient land transportation systems, with a degree of understanding and completeness acceptable to the instructor.

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

   a. Comprehend the cost factor involved in the movement of goods by various forms of land transportation
   b. Identify the shortcomings of transportation systems in other parts of the world and their effect upon the economy of the countries involved
   c. Relate various land transportation systems to the need for a functioning labor force

2. Following instruction, the student will describe the ecological and environmental impacts our systems of land transportation have had on the Earth, including the consumption of world resources, with a degree of understanding and completeness acceptable to the instructor.

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

   a. Explain the effects of various fuels and resulting emissions on our ecological systems
   b. Project impact data on the world's known reserves of fuels, construction materials, manufacturing needs, and land utilization

3. Following instruction, the student will describe legislation, publications, and services available to consumers when purchasing a product or service related to land transportation, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Be aware of the function and services provided by the New York State Consumer Protection Board and the Attorney General's Office
   b. Identify and interpret information available in current periodicals for comparing a product or a service
   c. Identify recent State legislation pertaining to land vehicles designed to protect the consumer

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Outputs

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students design a research project to compare costs of moving 1000 kg of 25 mm square steel bars, 1000 mm long, a distance of 166 km (1 ton of 1" x 1" x 36" for 100 miles), by hand, wagon, car, truck, or train.
   b. Identify some third-world countries which do not have good railroads and/or a good highway system. Have students compare yearly earnings of laborers in those countries to those of the United States.
   c. Discuss the probable impact on our daily lives if all employees of common carriers were to quit their jobs at one time.
   d. Discuss the effect of prime interest rates on loans to companies wanting to expand their businesses by buying more rolling stock, to develop a new model car, etc.
   e. Have students use the school's media center to research worldwide transportation systems and compare: (a) how personal and national economic gains foster the development of transportation systems, and (b) how transportation systems foster personal and national economic gains.
   f. Have students collect various media articles that pertain to transportation systems, the automotive industry, and government issues/decisions pertaining to land transportation. Share and discuss the information in class.
   g. Review and discuss the following questions in class or assign them as a report:
      (1) Has the world become one big trading center? Will countries specialize in certain products, such as Germany in steel, Japan in electronics, United States in computers, and so on?
      (2) Will car parts be manufactured around the world and assembled in the country of their intended sale, such as Ford's Escort, "the world car"?

2. (P. O. #2)

   a. Invite a representative of the New York State Department of Environmental Conservation to lecture and discuss petrochemical emissions and their control.
   b. Have students use various reference books to research the amounts of common fuel reserves that are left in the world and to discover the worldwide rate of consumption of common fuels.
   c. Using information from the Environmental Protection Agency (EPA), have students determine which hazardous wastes result from manufacture or use of land transportation vehicles.
   d. Using information from the Department of Commerce, have students research the known worldwide reserves of such resources as iron, aluminum, copper, oil, coal, zinc, chromium, tungston, silica, etc.
   e. Have students determine how much land an interstate highway system requires per mile, and then by computer extrapolate that figure to the whole U.S.A.
   f. Discuss the impact on food production and costs if highway expansion continues over the next 80 years as it has in the last 80.
   g. Have students create a simulation to show the effects of the by-products from a transportation system on roadside vegetation.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

3. (P. O. #3)

a. Distribute pamphlets from various organizations and government agencies that deal with consumer protection.
b. Lead the class in a discussion on what consumers must do and know to insure they get the best prices, products, and services.
c. Have students select a land vehicle and develop a list of product requirements.
d. Review the purpose of the New York State Consumer Protection Board.
e. Have students research cases of land vehicle problems that have been, or are currently being, investigated by the New York State Attorney General's Office.
f. Have students review ads in newspapers and magazines for discounts available from different retailers supplying the same manufacturer's product.
g. Discuss periodicals and services which are available to the consumer as sources of product information.
h. Research New York State "automobile lemon laws."

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS
TOPIC: Monitor/Control

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe and/or demonstrate various types of human and machine monitor/control devices, to the satisfaction of the instructor.

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

   a. Differentiate between human and automatic monitoring and control devices
   b. Intrepret information received from simple monitor and control devices and make appropriate adjustments
   c. Identify common automatic control systems

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. As a class, compile a list of monitor/control devices found on land vehicles.
   b. Observe simple instrumentation attached to an engine or vehicle and make appropriate adjustments utilizing:
      (1) Two- and four-cycle engines
      (2) Computer simulation
   c. Identify and discuss common automatic control systems on late model automobiles, lawn mowers, recreational vehicles, etc.

COURSE: TRANSPORTATION SYSTEMS
MODULE: LAND TRANSPORTATION SYSTEMS

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Overman, Michael. Roads, Bridges and Tunnels. New York, NY: Doubleday and Company.

***Rawson, Christopher. How Machines Work. London, UK: Usborne, 1976.

Stephenson, George E. Power Technology. Albany, NY: Delmar Publishers, Inc., 1984.

Stephenson, George E. Small Gasoline Engines. Albany, NY: Delmar Publishers, 1984.

Suess, Alan R., William E. Dugger, Dale R. Patrick, and James T. Ziegler. Introduction to Power Systems. Encino, CA: Glencoe Publishing Co., 1976.

TEACHER RESOURCES, continued

Tecumsech Engine Mechanics Hand Book. Grafton, WI: Tecumsech Products Company, 1984.

The Maintenance of Bicycles. NY: Readers Digest, 1983.

Webster, Jay. Small Engine Operation and Service. Alsip, IL: American Technical Publishers, Inc.

Wetzel, F. F. Automotive Diagnosis and Tune-up. Bloomington, IL: McKnight Publishing Co., 1980.

Supplies

PITSCO, Inc., Box 1328, Pittsburg, KS 66762

Hobby Shack, 18480 Bandilier Circle, Fountain Valley, CA 92708

Tower Hobbies, P.O. Box 778, Champaign, IL 61820

Films

Chrysler Corp., c/o RHR Filmedia Inc., 17th Floor, 49 West 37 Street, New York, NY 10018

General Motors Film Library, General Motors Bldg., Detroit, MI 48202

Software

Briggs & Stratton Specs AP2-AG300, Small Gas Engine & Related Review AP2-AG301, Hobar Publications, 1234 Tiller Land, St. Paul, MN 55112

Car Builder, Weekly Reader Family Software, 245 Long Hill Rd., Middletown, CT 06457

Chevy Tech, General Sales and Service Manager, Chevrolet Motor Division, General Motors Corporation, 30007 Van Dyke Ave., Warren, Michigan 48090

Cross Country USA, Didatech Software Ltd., 3812 William St., Burnaby, B.C., Canada, V5C 3H9

Four Stroke Cycle Engine, Photocom Productions, P.O. Box 3135, Pismo Beach, CA 93449

TEACHER RESOURCES, continued

Hill Railway, ALB 5005A, Queve Inc., 562 Boston Avenue, Bridgeport, CT 06610

Injured Engine, 729910-1, IMagic, 981 University Ave., Los Gatos, CA 95030

Science Tool Kit, Master Module, Broderbund, 17 Paul Drive, San Raefel, CA 94903-2101

Science Tool Kit, Module 1: Speed and Motion, Broderbund, 17 Paul Drive, San Raefel, CA 94903-2101

Small Gas Engines Parts Identification, American Association for Vocational Instructional Materials, 120 Driftmier Engineering Center, Athens, GA 30602

Trains, Spinnaker Software Corp., 215 First Street, Cambridge, MA 02142

Two Stroke Cycle Engine, Photocom Productions, P.O. Box 3135, Pismo Beach, CA 93449

***These resources contain material relevant to all modules in this course.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS

SUGGESTED INSTRUCTIONAL TIME: 4½ weeks

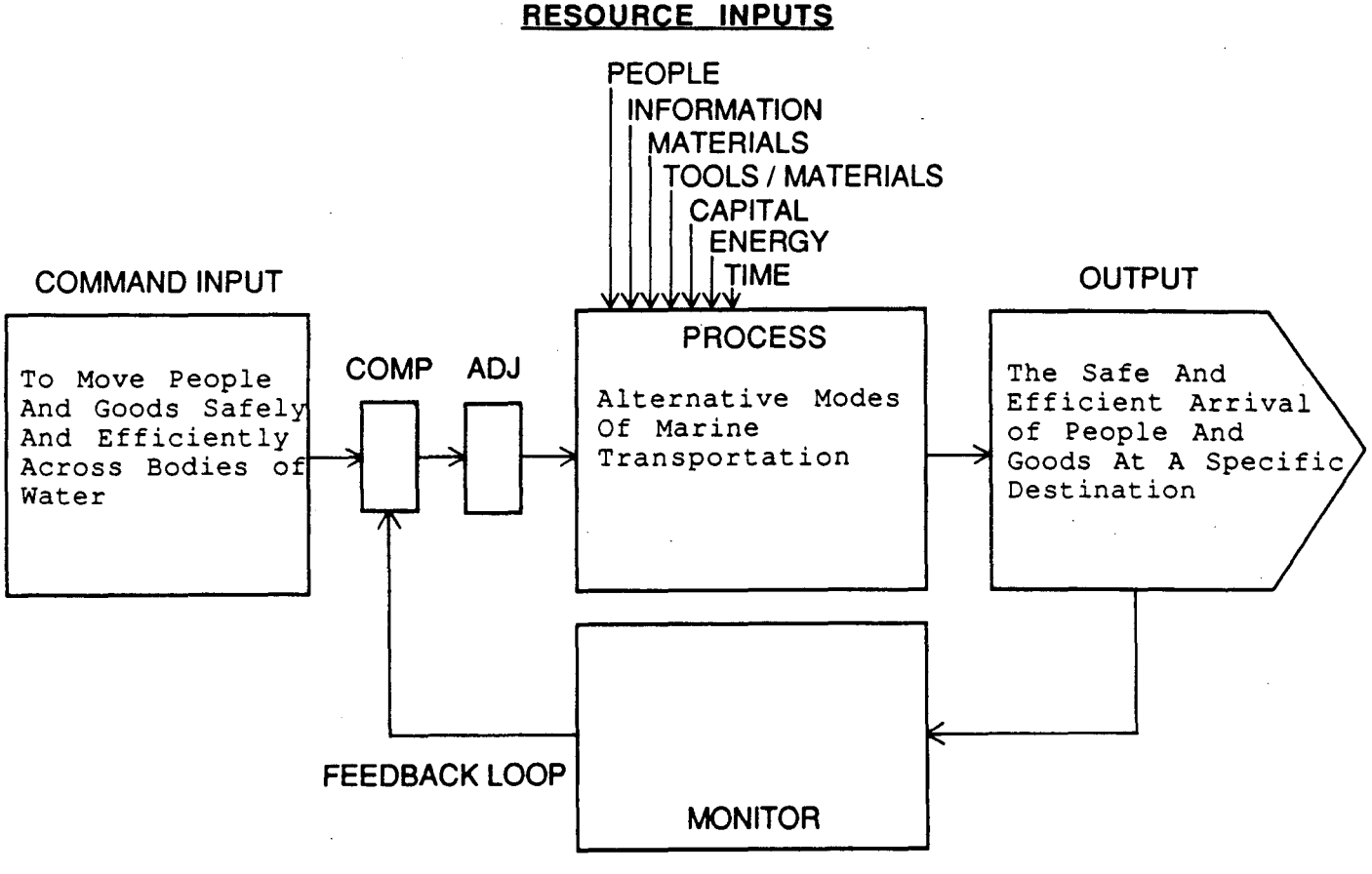
OVERVIEW OF MODULE

Goals

The three topics included in this module are designed to achieve the following student outcomes:

1. Develop insights and understanding of marine transportation and its place in our culture
2. Provide experience with a wide variety of materials, products, tools, and procedures common to the field of marine transportation
3. Develop an understanding of the many careers in marine transportation and their requirements

SYSTEMS DIAGRAM



OVERVIEW OF MODULE, continued

Description

This Marine Transportation Systems module is organized around the systems concept. Module content is based upon the following: Inputs, Resources, Process, Outputs, and Monitor/Control.

Water covers about 70 percent of the Earth's surface. From the earliest of times, people have used rivers, lakes, and the oceans to transport themselves and their goods from one destination to another. Various forms of boats, propelled by currents, oars, wind, and propellers, or driven by steam, diesel engine, or turbines, have been created and used.

There are two major types of marine transport: inland waterways and maritime. Inland waterways include canals, domestic lakes, and coastal waters. Maritime includes transport in large inland lakes and oceans. Both inland and maritime waterways continue to grow in tonnage transported, primarily because of their economy in moving bulk commodities such as coal, grain, ore, and petroleum.

Skills, Knowledge and Behavior to be Developed

The student will be able to:

1. Develop and evaluate the components of a marine transportation system
2. Identify basic skills necessary for careers in marine transportation
3. Understand the technical advances in marine transportation systems
4. Design and construct a model of a vessel
5. Use, analyze, and maintain marine subsystems
6. Understand laws, regulations, and safety procedures related to marine transportation
7. Understand the impacts of a marine transportation system
8. Understand human and machine monitor/control devices
9. Select and use appropriate tools, techniques, and devices related to marine transportation

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS

CONTENT OUTLINE

I. System Command Input

- A. Desired Result
  1. Specifications for movement of goods and people
  2. Relationship to existing technology
  3. Economics

II. Resources

- A. People**
  1. Job classifications
  2. Career opportunities
- B. Information
  1. Historical Evolution
     a. Maritime
     b. Inland
  2. Operating and service manuals
  3. Physics principles
  4. Safety
- C. Materials
  1. Hull
  2. Characteristics and design considerations
- D. Tools/Machines**
  1. Identification
  2. Function and selection
  3. Utilization and safe operating procedures
  4. Maintenance
- E. Capital**
- F. Energy**
- G. Time**

III. Processes

- A. Marine Subsystems
  1. Propulsion (engines, types of drives)
  2. Structure (hull)
  3. Suspension (air cushion, hydro foils)
  4. Guidance and control

IV. Outputs

- A. Service Provided/Goods Delivered
- B. Impacts
  1. Environmental
  2. Economic
  3. Societal
  4. Personal

CONTENT OUTLINE, continued

V. Monitor and Control

A. Navigation
B. Instrumentation

**Refer to Land Transportation module for appropriate performance objectives, supporting competencies, and instructional strategies.

COURSE:TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS
TOPIC: Inputs

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will identify the technical advances that have been made in the way people move themselves and their goods across bodies of water, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify the development of various ships on a timeline
   b. Describe the physical make-up of various ships used in marine transportation

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students research and bring in pictures of hulls, identifying various propulsion systems, hull origins, use, and construction.
   b. Discuss cargo on board the vessels.
   c. Discuss the development of hulls from a specific country, such as Norway, from past to present.
   d. Give a picture quiz. Ask for approximate date, area of the world, and principal use of the vessel.
   e. Have students research the development and use of the various waterways in New York State.
   f. Organize a field trip to a museum to discover the types of marine transportation which have historical importance in the development of the economy of New York State.
   g. As a class, create an historic map showing the expansion of the United States via waterways, indicating routes used by explorers and the timeframe of exploration.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS
TOPIC: Resources

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction and given tools and materials, the student will demonstrate how a ship's hull is constructed, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify various hull types
   b. Demonstrate the safe and proper use of tools, machines, equipment, and materials
   c. Analyze and select the correct technical processes

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students build a displacement hull and calculate where the waterline should be on the hull.
   b. Have students build small air boats with glow-plug engines.
   c. Have the class design rubber band powered hulls and have a competition to see which boat can cover a measured distance in the shortest time.
   d. Have students design and build a model hull using wood, fiberglass, or other material.
   *e. As a class project, build a model hull, using various plastics and woodworking tools.
   f. Have students build a model wind-powered vessel and have a competition.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS
TOPIC: Process

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Given appropriate materials for the maintenance of the hull of a marine vessel, the student will select, use, and store equipment and materials for the maintenance operations, with a degree of proficiency and understanding acceptable to the instructor.

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

   a. Recognize and evaluate the condition of a hull
   b. Follow correct maintenance procedures
   c. Perform simple hull repairs
   d. Demonstrate procedures for storing tools and unused materials
   e. Demonstrate "winterizing" procedures
   f. Demonstrate "spring-ready" procedures

2. Following instruction and given materials, the student will demonstrate an understanding of the subsystems that make up the propulsion system of a marine vessel, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify and describe the subsystems of a given marine propulsion system
   b. Understand how each subsystem contributes to the functioning of the propulsion system
   c. Demonstrate "trouble-shooting" procedures

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Saw a hole in a piece of wood, fiberglass, or sheetmetal. Have students repair the hole using wood and/or fiberglass cloth and resin and prepare and finish (paint) the repaired areas.
   b. Have students use cleaning chemicals, rubbing compounds, and waxes on a hull.
   c. Develop a chart of compounds and have students explain the advantages and disadvantages of each material.
   d. Demonstrate test procedures to determne if a hull is sound. Review tests for dry rot, cracks in fiberglass, hook in keel, and paint chalking.
   *e. Have students contact local marinas to determine preventive maintenance procedures that are used to control organisms that grow on hulls.
   f. Build mock-ups of lapstrake, mahogany, plywood, and fiberglass hulls. Demonstrate and have students practice caulking, patching, and finishing the hulls.
   g. Assign students an engine to either winterize or get spring-ready.
   h. Using various manufacturers' service manuals, develop a list of maintenance operations and then have students perform them on a marine engine.
   i. Develop a "log book" for the purpose of identifying preventive maintenance using a time frame.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

2. (P. O. #2)

a. Using a two-cycle marine engine, have students dissassemble and reassemble the engine. Explain the parts, fuel, tooling, ignition, and lubrication system.
b. Have students operate and adjust two- and four-cycle engines.
c. Have students disassemble and reassemble a carburetor and/or ignition system on a two- or four-cycle engine.
d. Have students operate and test a glow-plus engine.
e. Have students disassemble and reassemble a drive system for a marine engine.
f. Have students test and plot horsepower and torque of a selected marine engine using a dynamometer.
g. Design and build model sail boats that use "breath" power to propel them. Conduct a contest to see which boat is the fastest.
h. Visit a local marina and obtain information on their winterizing and spring-ready processes.
i. "Bug" the carburation or ignition system on a marine engine and have students trouble-shoot the engine.
j. Have students store wind-powered vessel equipment.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS
TOPIC: Outputs

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will demonstrate an understanding of how marine transportation systems have already affected the environment and project how they may affect the environment in the future, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify short-term and long-term impacts of marine transportation on the environment
   b. Suggest steps that are or may be taken to alleviate negative impacts on the environment

2. Following instruction for the New York State Young Boatman's Safety Course, the student will demonstrate an understanding of how to operate a vessel safely on the NYS inland waterways, with a degree of accuracy and proficiency acceptable to the instructor.

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

   a. Describe in general terms New York State boating laws and regulations
   b. Identify safety equipment for marine vessels
   c. Describe safety operating procedures for marine vessels

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Invite a conservation officer to speak on local, State, and national issues and problems.
   *b. Have students contact the Adirondack Mountain Club, Sierra Club, or other agencies for information.
   *c. Have students contact the EPA to determine the frequency and extent of hazardous wastes being dumped into waterways by industries.
   *d. Contact the local Coast Guard or Power Squadron for information or presentations concerning ecology and the environment.
   e. Have students write a simple program for the computer, listing causes and effects of pollution.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

2. (P. O. #2)

a. Obtain copies of Make Sure, Make Shore, New York State manual, and teach the course.
b. Use the tests from the Make Sure, Make Shore manual.
c. Paint a lake on a large panel and have students demonstrate safety rules in boating, using models.
d. Develop safety procedures to be used with handicapped individuals in boating.
e. Have students identify and tie knots used in mooring and docking.
f. Display examples of knots on a board, showing the many knots used in boating.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS
TOPIC: Monitor/Control

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will explain the purpose of recreational boating navigation and engine instrumentation, to the satisfaction of the instructor.

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

   a. Explain the importance of various marine instruments
   b. Correlate basic instrumentation to land and aerospace vehicles

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students chart the necessary instrumentation found on a sailboat, an outboard, and inboard/outboard, and a large inboard power craft.
   b. Simulate and have students diagnose problems based upon instrument readings.
   c. Compare and chart basic instrumentation found in a car, light plane, and a recreational boat.
   d. Have students use hydraulic experiments to demonstrate Bernoulli's Principle.
   e. Demonstrate the use of a compass, plotter, depth finder, and geodetic charts to solve a navigation problem. Have students practice using the instruments.

COURSE: TRANSPORTATION SYSTEMS
MODULE: MARINE TRANSPORTATION SYSTEMS

TEACHER RESOURCES

Print

Bell, Charles. 15 Fiberglass Boats. New York, NY: Coward-McCann, Inc., 1962.

Cobb, Boughton. Fiberglass Boats. New York, NY: Yachting Publishing, 1973.

Dunne, Charles. Outboard Boat and Motor Maintenance and Repair, 1976. Book Division of the Progressive Farmers Co., PO Box 2463, Birmingham, AL.

Edmunds, Arthur. Fiberglass Boat Survey Manual. New York, NY: John deGraff, Inc., 1979.

Felman, Anthony and Bill Gunston. Technology at Work. London, UK: Aldus, 1980

Glenn and Young. OMC Inboard/Outboard Repair and Tuneup. Chicago, IL: Henry Regnery Co., 1976.

Johannsen, Thomas J. One-Off Airex Fiberglass Sandwich Construction, 1973. Chemacryl Inc., 1051 Clinton Street, Buffalo, NY.

Make Sure, Make Shore. Albany, NY: Bureau of Marine and Recreational Vehicles, n.d.

Maloney, Elbert S. Chapman Piloting Seamanship and Small Boat Handling. New York, NY: Hearst Marine Books, 1983.

Marine Design Manual. Gibbs and Cox, Inc. New York, NY: McGraw-Hill Book Co., 1960.

Marine Survey Manual. Gibbs and Cox, Inc. New York, NY: McGraw-Hill Book Co., 1962.

McLeavey, Roy. Hovercraft & Hydrofoils. New York, NY: Arco, 1980.

Willis, Melvin. Boatbuilding and Repairing with Fiberglass. Camden, ME: International Marine Publishing Co., 1972.

Wynn, Peter. Foam Sandwich Boatbuilding. Camden, ME: International Marine Publishing Co., 1972.

Zadig, Ernest. The Complete Book of Pleasure Boat Engines. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1980.

Maintenance Manuals

ABOS Marine Publications, Intertec Publishing Corp., 1014 Wayandotte, Kansas City, MO 64105

Howard W. Sams and Co., 4200 West 62nd Street, Indianapolis, IN 46206

TAB Books, Inc., Blue Ridge, Summit, FL 17214

TEACHER RESOURCES, continued

Filmstrips

Mafex Associates, 90 Cherry Street, Box 519, Johnstown, PA 15907

Supplies

America's Hobby Center, 146 West 22nd Street, New York, NY 10011-2466

Industrial Arts Supply Co., 5724 West 36th Street, Minneapolis, MN 54416

PITSCO, Box 1328, Pittsburg, PA 66762

Hobby Shack, 18480 Bandilier Circle, Fountain Valley, CA 92728-8610

Software

The American Challenge: Sailing. Mindscape, 3444 Dundee Rd., Northbrook, IL 60062

Sailing Ships Game (ALB 5001A), Queue, Inc., 562 Boston Ave., Bridgeport, CT 06610

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS

SUGGESTED INSTRUCTIONAL TIME: 4½ weeks

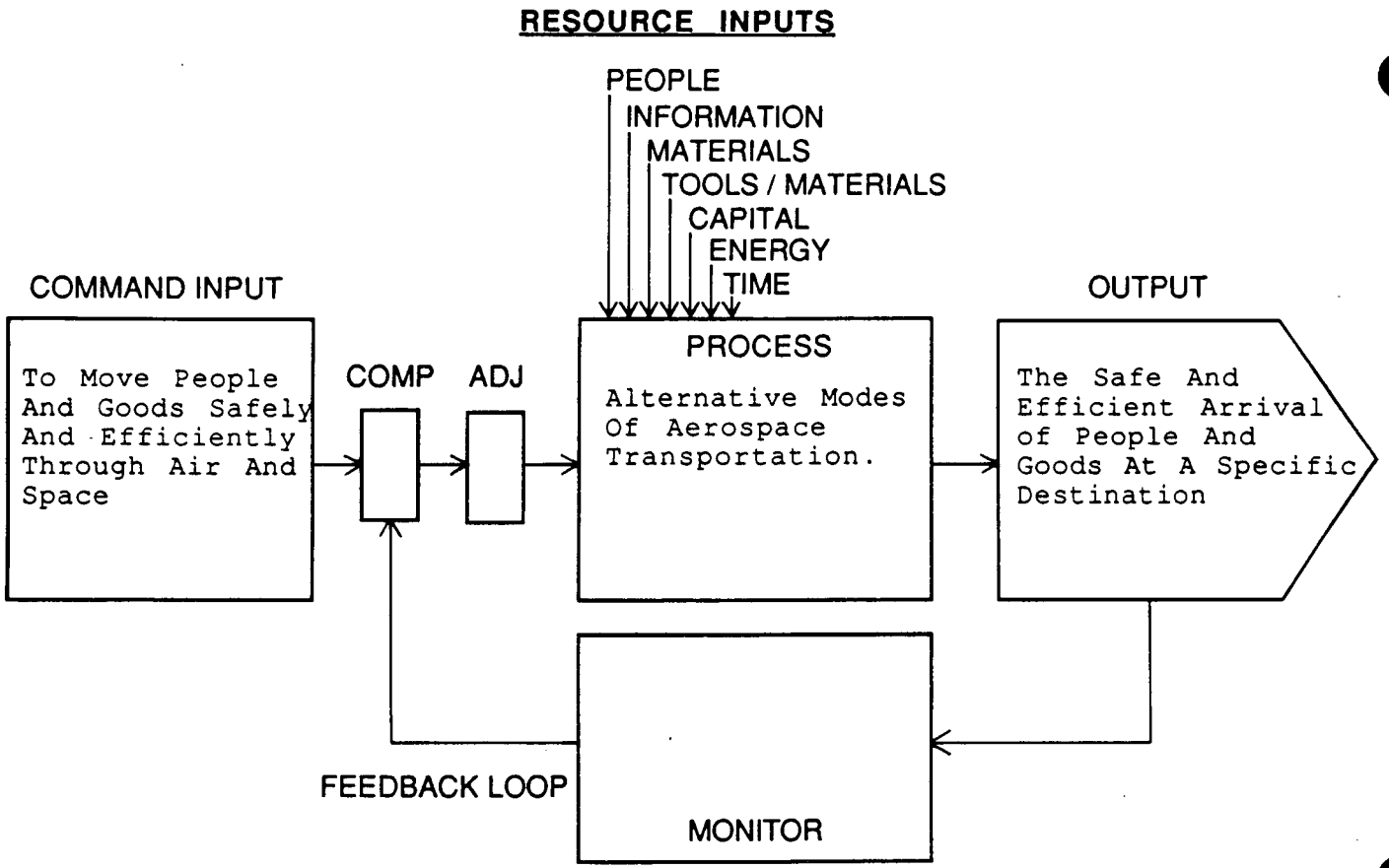
OVERVIEW OF MODULE

Goals

Aerospace Transportation Systems, the third module in the Transportation Systems course, is designed to achieve the following student outcomes:

1. Develop insights and understanding of aerospace transportation and its place in our culture
2. Provide experience with a wide variety of materials, products, tools, and procedures common to the aerospace transportation field
3. Develop an understanding of the many careers in the aerospace transportation field and their requirements

SYSTEMS DIAGRAM



OVERVIEW OF MODULE, continued

Description

The Aerospace Transportation Systems module is organized around the concepts of the systems approach. Module content is based upon the following components: Inputs, Resources, Process, Outputs, and Monitor/Control.

The module can be further divided into systems that operate in the atmospheric environment and the space environment. Vehicles used in atmospheric transportation are classified as either heavier than air or lighter than air. Space transportation systems consist of manned and unmanned systems.

Skills, Knowledge, and Behavior to be Developed

The student will be able to:

1. Identify and evaluate the components of aerospace transportation systems
2. Identify skills necessary for careers in aerospace transportation
3. Understand the technical advances in aerospace transportation systems
4. Design and construct a model of an aerospace vehicle
5. Use and analyze aerospace subsystems
6. Understand laws, regulations, and safety procedures related to aerospace transportation
7. Understand the impacts of an aerospace transportation system
8. Understand human and machine monitor/control devices
9. Select and use appropriate tools, techniques, and devices related to aerospace transportation

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS

CONTENT OUTLINE

I. System Command Inputs

- A. Desired Result
  - 1. Specifications for movement of people and goods
  - 2. Relationship to existing technology
  - 3. Economics

II. Resources

- A. People**
  - 1. Job classification
  - 2. Career opportunities
- B. Information
  - 1. History evolution
  - 2. Physics principles
- C. Materials
  - 1. Vehicle construction materials
  - 2. Characteristics and design consideration
- D. Tools/Machines**
  - 1. Identification
  - 2. Function and selection
  - 3. Utilization and safe operating procedures
  - 4. Maintenance
- E. Capital**
- F. Energy**
- G. Time**

III. Processes

- A. Flight
- B. Vehicle Types
  - 1. Design
  - 2. Operation
- C. Systems and Subsystems
  - 1. Propulsion (engine types)
  - 2. Structural (fuselage and body)
  - 3. Suspension (wings, landing gear)
  - 4. Guidance and controls

IV. Outputs

- A. Service Provided/Goods Delivered
- B. Impacts
  - 1. Environmental
  - 2. Economic
  - 3. Personal
  - 4. Societal

CONTENT OUTLINE, continued

V. Monitor and Control

A. Navigation
B. Instrumentation

** Refer to Land Transportation Systems module for appropriate performance objectives, supporting competencies, and instructional strategies.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS
TOPIC: Inputs

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe key historical events in aviation and aerospace development over the past 200 years, with a degree of accuracy and completeness acceptable to the instruction.

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

   a. Identify selected transitional aviation/aerospace vehicles
   b. Identify key events that expanded aerospace growth
   c. Identify individuals who made significant contributions to aviation/aerospace
   d. Describe the impact of aerospace technology on society

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Trace the history of the evolution of flight by building models of a hot-air balloon, glider, motorized airplane, and/or a rocket.
   b. Discuss scientists, engineers, designers, pilots, and strategists who had a significant impact on the aerospace field.
   c. Select ten pictures portraying events in aerospace history and have students rank them chronologically.
   d. As a class project, draw a timeline on craft paper depicting major events with pictures and diagrams. Use the completed timeline as a hall or wall display.
   e. Establish mathematical ratios comparing the distance of the Wright brothers' first flight to the wing span of a 747, a football field, or other relevant distances.
   f. Using distance formulas, have students calculate how long it would take the Wright brothers to make a transcontinental crossing in their flyer.
   g. Have students construct the propeller drive-mechanism found on the Wright Flyer as well as the Glen Curtis June Bug, using bicycle sprockets and chain. Discuss how this construction reflects the Wrights' and Glen Curtis' background.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS
TOPIC: Resources

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Upon completion of classroom discussion and student investigation, the student will describe resources necessary for the development of a selected aerospace vehicle, to a level of accuracy and completeness satisfactory to the instructor.

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

   a. Analyze and use the principal materials found in aerospace vehicle construction
   b. Identify construction and operational energy requirements
   c. Identify the major tools, machines, and operations necessary for constructing aerospace vehicles

2. Following instruction, the student will describe the principles of flight, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Describe the Venturi effect
   b. Describe Bernoulli's Principle and apply it to flight
   c. Cite Newton's Third Law and apply it to the lifting phenomenon
   d. Describe the basic four forces of level flight

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Make a drawing of a modern aircraft for the purpose of illustrating the diversity of materials used in the aircraft's manufacture. Have students follow along and illustrate their own copies.
   b. Obtain samples of aerospace materials to be labeled for display, showing their application for aerospace.
   c. Create a list or chart that identifies aerospace vehicular support systems and the types of energy they require for their operation.
   d. Have students perform tensile strength tests on sheets of aluminum and steel.
   e. Have students compare the qualities of various aircraft building materials through experimentation.
   f. Using toothpicks and model cement, see who can construct the strongest structure using truss type construction.
   g. Have students calculate horsepower/weight ratios of selected aerospace power plants and chart them chronologically.

2. (P. O. #2)

   a. Have students prove Bernoulli's Principle by curling a piece of paper down on the edge they are holding and blowing air over the top of the paper to fulfill the airfoil venturi effect.

SUGGESTED INSTRUCTIONAL STRATEGIES, continued

b. Have students prove Bernoulli's Principle by blowing air between two vertical pieces of paper, two inches apart, demonstrating inside and outside air pressure differential.
c. Place paper strips on the leading edge of an adjustable airfoil section and expose the airfoil to fan generated air. Have students identify air movement characteristics at five degree intervals, until stalling or the burbling effect is attained. Students should record their findings on a lab sheet.
d. Illustrate the association of the venturi tube with an airfoil by taking an overhead of a venturi tube and drawing it in an airfoiled shape, using one-half of the venturi.
e. Demonstrate venturi applications in a hose nozzle, garden sprayer, ram jet engine, and an atomizer.
f. Following instruction for the definitions of lift, thrust, and drag, have students identify these factors by building and demonstrating:
   - model hot-air balloons
   - model gliders
   - kites
   - airplanes
   - space vehicles
g. Have students construct three airfoils illustrating high lift, standard, and high-speed characteristics.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS
TOPIC: Process

PERFORMANCE OBJECTIVES/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe the subsystems of an aerospace vehicle, with a degree of accuracy and completeness acceptable to the instructor.

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

   a. Identify aerospace subsystems
   b. Describe the functions of each subsystem

2. Following instruction on spacecraft, the student will describe, or model, several types of spacecraft and their particular operation, mission, and design, with a degree of completeness and understanding acceptable to the instructor.

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

   a. Describe delivery systems in spacecraft
   b. Identify spacecraft configurations
   c. Identify several applied sources of energy

SUGGESTED INSTRUCTIONAL STRATEGY

1. (P. O. #1)

   a. Show the similarities between the cross section of a wing as compared to the cross sectional shape of a propeller. Explain how the same shape that creates lift will also, with a little modification, cause the aircraft to move forward.
   b. Have students operate a glow-plug engine mounted on a sliding apparatus, a wheeled carriage, or a track. Then measure the attained thrust in pounds, using a weight scale or similar device.
   c. Schedule a lab requiring students to investigate propeller shape and function, engine operation theory, implementation of safe procedures, and effective measurement of propeller thrust.
   d. Have students compare the operation of a glow-plug model engine to that of a four-cycle internal combustion engine. Break the engines down into parts, identify the fuels used, cooling methods, etc.
   e. Have students design and build a rocket or complete a rocket kit.
   f. With adequate ventilation, demonstrate in front of the class a model rocket set-up and launch, and/or safe preparation in the field. Include all phases of the rocket's systems, engine preparation, mounting, recovery, payload, and ignition considerations.
   g. Analyze a rocket's flight through the use of trigonometry and a rocket computer. Have students practice math analysis and computer skills and use these skills in the field during a rocket launch.

SUGGESTED INSTRUCTIONAL STRATEGY, continued

*h. Divide the class into rocket space teams. Examples: launch officers, safety engineers, communication team, recovery team, timers, down-range team, statisticians, and pad officials.
i. Have students construct a model with movable control surfaces.

2. (P. O. #2)

a. Designate the planets and celestial bodies that have been investigated by space probes or landing vehicles. Mention some of the data that have been acquired from this kind of space exploration.
b. Provide information sheets to students that illustrate successful spacecraft configurations. These craft should include Nimbus, Skylab, the Shuttle, Venera, Vostok, Tiros, etc. Students should be able to identify some of these craft on a test.
c. Establish the need for energy in different forms within any satellite or space vehicle. Relate how solar and nuclear fuel cells, the laser, the electron beam, etc., will continue to play important roles in space explorations.
d. Introduce major space program delivery systems including: Delta Rockets, Saturn V, Shuttle Booster, Atlas, and Redstone Rockets. Have students describe in essay form one or more of these systems, including background information dealing with the craft's capabilities, limitations, and jobs performed (past or present).
e. As a class, create a timeline, illustrated with pictures, showing space exploration achievements.
f. Have students plot the amount of time a rocket would take to reach various planets at a given speed.
g. Have students construct a space capsule from available materials.
h. Have students construct and launch a model rocket.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS
TOPIC: Outputs

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will describe the impacts of aviation and aerospace on the environment, with a degree of accuracy and understanding acceptable to the instructor.

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

   a. Recognize environmental and ecological impacts
   b. Compare technological advancements with environmental implications

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Have students build a model airport that includes surrounding terrain. Examine the model to determine what ecological changes could possibly occur. Take into account birds, fish, water fowl, animals, insects, etc.
   b. Determine various kinds of pollution associated with a typical airport operation. Have students describe the environmental and ecological impacts. These should include oil, sewage, noise, carbon monoxide, wing vortices, etc.
   c. Familiarize students with equipment used to evaluate the environment. These devices should include temperature gauges, air-quality measurement devices, water-quality measurement devices, soil-analysis devices, barometric pressure devices, decibel meters, etc.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS
TOPIC: Monitor/Control

PERFORMANCE OBJECTIVE/SUPPORTING COMPETENCIES

1. Following instruction, the student will recognize basic flight instruments and describe their functions, with a degree of accuracy and understanding acceptable to the instructor.

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

   a. Demonstrate an understanding of scientific principles
   b. Explain the importance of various flight instruments
   c. Correlate basic instrumentation of land and marine vehicles with flight instruments

SUGGESTED INSTRUCTIONAL STRATEGIES

1. (P. O. #1)

   a. Go over the operation and interpretation of the altimeter, the VSI, the airspeed indicator, and the artificial horizon.
   b. Explain how the magnetic compass operates and identify the typical reading errors associated with compasses.
   c. Have students perform experiments with magnets and compasses so they can see, first-hand, acceleration/deceleration errors, turning errors, and magnetic dip.
   d. Using a bicycle wheel, demonstrate the principle of the gyro and how it is implemented into the artificial horizon.
   e. Identify engine monitoring instruments and show how they are read. Hand out an instrument panel sheet that includes the tachometer, fuel pressure gauge, oil pressure gauge, cylinderhead temperature gauge, and the manifold pressure gauge.
   f. Have students use a computer for the purpose of working through a flight simulation program that requires flight instrument interpretation under typical flight situations.
   g. Have students construct a turn-and-bank indicator using a plumb bob and level.
   *h. Assign each student a specific flight or engine instrument and have the student report on information derived from the instrument.

COURSE: TRANSPORTATION SYSTEMS

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 students with handicapping conditions to benefit from the instruction provided and to demonstrate their knowledge and skills in relation to the Performance Objectives and Supporting Competencies.

1. Simplify activities. Narrow the scope of material dealing with interpreting technical data and drawings.

2. Explain theories in simple terms.

3. Use demonstrations generously, making them concrete and tangible, rather than verbal and abstract.

4. Arrange for special education student to work with a more capable peer.

5. Provide ample time for task completion. Positively reinforce that part which is done well.

6. Be flexible with homework assignments.

7. Remember the special needs student will most likely require additional review and reinforcement of learned material. In order to facilitate the process, enlist the help of the student's special education teacher or building resource person to assist in providing supplemental instruction. Share manuals, textbooks, vocabulary lists and lesson outlines with this perosn.

8. When feasible, keep assignments brief. Consider that learning such a technological area may prove to be challenging yet very complex and difficult.

COURSE: TRANSPORTATION SYSTEMS
MODULE: AEROSPACE TRANSPORTATION SYSTEMS

TEACHER RESOURCES

Print

Aerospace. Aerospace Industries Association, Office of Public Affairs, 1725 DeSales St., Washington, DC 20036

Air and Space Smithsonian. Smithsonian Institute, 900 Jefferson Dr., Washington, DC 20560

AOPA Handbook for Pilots. Aircraft Owners and Pilots Associations, 7315 Wisconsin Avenue, Bethesda, MD.

Ayensu, Edward. The Timetable of Technology. New York, NY: Hearst Books, 1982.

Bacon, Harold, Warren Garthwright, and Issac Vass. Aerospace: The Challenge. Maxwell AFB, Alabama: Civil Air Patrol, 1983.

Bame, E. Allen and Paul Cummings. Activity Act Manual: Exploring Technology. Worcester, MA: Davis Publications, 1980.

Bame, E. Allen and Paul Cummings. Exploring Technology. Worcester, MA: Davis Publications, 1980.

Baster, Gordon. How to Fly. New York, NY: Summit Books, 1981.

Blake, John. Early Airplanes. London, England: Trewin Copplestone Publishing, 1980.

Botermans, Jack. Paper Flight. New York, NY: Holt, Rinehart, and Winston, 1984

Boyd, Grant. Centuri Model Rocket Design Manual. Phoenix, AZ: Centuri, 1975.

Boyne, Walter. Flying. Englewood Cliffs, NJ: Prentice Hall, Inc., 1980.

Bramston, Alan. Be A Better Pilot. New York, NY: Arco Publishing Co., 1980.

Collins, Richard. Flying Safely. New York, NY: Delacorte Press/Eleanor Freide, 1977.

Gilbert, James. The World's Worst Aircraft. New York, NY: St. Martins Press, Inc., 1975.

Gunston, William. Hydrofoils and Hovercraft. New York, NY: Doubleday and Co., 1970.

Hammond, Allen, and Alison Fujino (eds.). The Paper Airplane Book. New York, NY: Vintage Books, 1985.

Hannan, Bill. Peanut Power. Temple City, CA: Historical Aviation Album, 1980.

TEACHER RESOURCES, continued

Iowa Industrial Arts Handbook for Introductory Level Energy and Power: Model Rockets. DesMoines, Iowa: State of Iowa, Department of Public Instruction, Career Education Division, 1982.

Kaufmann, John. Flying Hand-Launched Gliders. New York, NY: William Morrow Co., 1974.

McNeil, Mary Jean. Flying Models, London, UK: Usborne, 1975.

McNeil, Mary Jean. How Things Began. London, UK: Usborne, 1979.

Misenhimer, Ted. Aeroscience. Culver City, CA: Aeroproducts Research, Inc., 1970.

New York State Aerospace Resource Guide. Albany, NY: The State Education Department, Bureau of Home Economics and Industrial Arts Education, 1982.

Olivo, C. Thomas and Thomas P. Olivo. Fundamentals of Applied Physics. Albany, NY: Delmar Publishing Co., 1984.

Piggatt, Derek. Understanding Gliding. London, England: Harper and Row Publisher, Inc., 1977.

Powers, Robert, and Shuttle. The World's First Space Ship. Harrisburg, PA: Stackpole Books, 1979.

Rolfe, Douglas and Alexis Dawydoff. Airplanes of the World 1490-1976. New York, NY: Simon and Schuster, 1978.

Sheehan, Larry and Robert Waligienda. The Great American Balloon Book. Englewood Cliffs, NJ: Prentice Hall, Inc., 1981.

Smith, Harry and Henry Warden. Industrial Arts Teachers Manual for Model Rocketry. Penrose, CO: Estes Industries, 1980.

Steine, Harry. The Model Rocketry Manual. New York, NY: Sentinel Books Publishers, 1970.

Taylor, John, Michael Taylor, and David Monday. Air Facts and Feats. New York, NY: Bantam Books, 1979.

The Classic Collection of Model Rocketry. Penrose, CO: Estes, 1983.

The Epic of Flight. Time Life Books, 541 North Fairbanks Court, Chicago, IL.

Van Deventer, C.N. An Introduction to General Aeronautics. Alsip, IL: American Technical Publishers, n.d.

TEACHER RESOURCES, continued

Vrooman, Richard. Transportation Cluster. State Department of Vocational and Technical Education, Stillwater, OK, 1973.

Willard, Ken. 8 Easy Projects for 1/2 A Engines. Milwaukee, WI: Kalmbach Books, 1985.

Williams, Ron. Building and Flying Indoor Model Airplanes. Salt Lake City, UT: Penegrine Smith Books, 1984.

Software

Air Traffic Controller (2C-1050). Opportunities for Learning, 20417 Nordhoff St., Dept. H36P, Chatsworth, CA 91311

Flight: Aerodynamics of Model Rockets, Estes Industries, 1295 H. Street, Penrose, CO 81240

Flight Simulator (A2-FSI), Flight Simulator (DK 06CMC), Hindenburg Disaster (M460), World War I: The Airplane (M87). Guaranteed Software, 1610 Peoples Avenue, Troy, NY 12180

Gasperi, Michael. Model Rocket Computer Programs. Estes Industries, 1295 H. St., Penrose, CO 81240

GlidePath, HRM Software, 175 Tompkins Ave., Pleasantville, NY 10570

History of Space Flight, SEI Sliwa Enterprises Inc., 111 Fielding Lewis Dr., P.O. Box 978, Worktown, VA 23692

Insearch of Space: Introduction to Model Rocketry, Estes Industries, 1295 H. Street, Penrose, CO 81240

The Model Rocket Designer, 1021 Designs Inc., 19 Dahlia Rd., Somerset, NJ 08873

Navigation, Principles of Flight, Aviation, and our Environment. Aviation Education Program APA-6. Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC 20591

Tranquility Base (7445), The Great International Paper Airplane Kit (5315). Creative Learning Systems, 9889-E Hibert St., San Diego, CA 92131

TEACHER RESOURCES, continued

Films/Publications

Civil Air Patrol, Northeast Liaison Region, Aerospace Education, Bldg. 17-31, Stop 20-D, McGuire AFB, NJ 08641

Federal Aviation Administration, Eastern Region, JFK International Airport, Jamaica, NY 11430

NASA Goddard Space Flight Center, Greenbelt, MD 20771

National Audio-visual Center, General Services Administration, Washington, DC 20409

Teacher's Guide To Aviation Education Resources. Office of Public Affairs, Aviation Education Program, 800 Independence Ave., SW, Washington, DC 20591

US Department of Transportation, Federal Aviation Administration, Washington, DC 20591

Supplies

America's Hobby Center, Inc., 146 West 22nd St., New York, NY 10011

C.A. Zaic Co., Inc., 883 Lexington Avenue, Brooklyn, NY 12221

Cox Hobbies, Inc., 1525 E. Warner Avenue., Santa Anna, CA 92705

Discount Kites by Mail, 33 Evergreen Lane, Haddonfield, NJ 08033

Estes Industries, 1295 H Street, Penrose, CO 81240

G.J.'s Hobbies, 200 Front Street, Vestal, NY 13850

Hobby Shack, 18480 Bandilier Circle, Fountain Valley, CA 92728-8610

Indoor Model Supply, Box 39, Garberville, CA 95440-0039

Into The Wind, 2047 Broadway, Boulder, CO 80302

Midwest Products Co., Inc., 400 S. Indiana St., P.O. Box 564, Hobart, IN 46342

Peck-Polymens, P.O. Box 2498, La Mesa, CA 92041

Sanderson Times Mirror, 8025 East 40th Avenue, Denver, CO 80207

Tower Hobbies, P.O. Box 778, Champaign, IL 61820

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