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AUTHOR Butler, Richard T.; Smith, William J.
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ABSTRACT

The guidelines for an aviation education program give directions and provide coordination and correlation for the program in Pennsylvania's schools. Chapter 1 discusses the approach to aviation education--the problem, procedure, and definition of terms. Chapter 2 briefly outlines teacher responsibilities and student advantages. Focusing on teaching procedures for applied aviation education, Chapter 3 presents the curriculum plan structure that emphasizes theoretical application (methodology), practical application, simulated flight experiences, and actual experiences (aviation and aerospace materials, field trips, and personal activities). Chapters 4 and 5 present the lesson structure and a course outline, annotating the course of study with behavioral objectives covering the following unit topics: methodology--the nature of the universe, aviation in retrospect, geo--natural habitat of man, aeronautical science, flight technology, economic opportunities and problems, and flight techniques (simulation). The teachers' planning chart, in Chapter 6, incorporates units within a time sequences for a flexible 36-week course of study based on five 45-minute classes per week. A summary concerning applied aviation education is found in Chapter 7. (JB)

Guidelines for Aviation Education In Schools of Pennsylvania With Annotated Teacher's Course of Study and Planning Chart

By Richard T. Butler
Aviation-Aerospace Education Consultant
Chalfont, Pa. and

William J. Smith, Aviation Adviser
Bureau of General and Academic Education
Pennsylvania Department of Education

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Milton J. Shapp, *Governor*

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Division of Highway and Aviation Education
Ray M. Fulmer, *Coordinator*
William J. Smith, *Aviation Adviser*

Pennsylvania Department of Education
Box 911
Harrisburg, Pa. 17126

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Richard T. Butler
William J. Smith

"I think that you in aerospace education have a unique opportunity that must not be fumbled. You begin with a new curriculum desperately needed in these critical times; you have no tradition to limit you and no precedents to restrict. If you can put that new curriculum into some radically different structures, you will have made a major impact on our students, our schools and our society."

Alan A. Glatthorn

Allan A. Glatthorn, Ed. D., Abington High School, Abington, Pennsylvania. From a lecture entitled "New Wine in New Bottles" written for The Pennsylvania Workshop and Curriculum Institute in Aviation and Aerospace Education, July 1, 1970.

Introduction

Aviation education is not new to the public school system in America but after several false starts and a long period of dormancy, it is now emerging with a new surge of interest. This interest is expressed not only by the aviation industry, but also by educators, parents and students.

One deficiency noted in the program up to now has been the lack of standardization in the presentation of subject matter. This publication is being presented to give direction and provide coordination and correlation of the program in the schools of Pennsylvania.

Commensurate with the growing importance of aviation in the scheme of today's living, we feel that the youth of our nation will be motivated and stimulated by teacher interest in aviation using modern techniques, up-to-date equipment and materials, innovative ideas and concepts, as encompassed in this publication. The scope of aviation and aerospace activities in the future is virtually unlimited.

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Chapter I

Approach to Aviation Education

Subtopics:

The Problem
The Procedure
Definitions of Terms

SUPERSONIC flight, man on the moon and other space accomplishments representing significant scientific endeavors undreamed of a generation ago are today's realities and destined to become even more a way of life in the foreseeable future. In the light of these achievements it becomes increasingly difficult to project what specific endeavors will take place. It is certain, however, that aviation and aerospace activities will persist in a variety of forms as a meaningful way of modern life. As a means to this end, aviation and aerospace education encompasses all areas relating to aviation and aerospace activities which involve a large segment of our economy, our working force, our armed services, our governmental agencies and our scientific endeavors.

The Problem

Statement of the Problem. It was the purpose of this curriculum to present (1) applied aviation education as an acceptable and valid curriculum guide for the high schools of Pennsylvania, (2) to develop a teachers' curriculum structure that would transcend traditional discipline lines, (3) to introduce the general aviation simulator as an intermediary between classroom and actual flight experience, and (4) to provide a teacher's annotated course of study outline for use in applied aviation education.

Scope of the Problem. It is within the scope of this curriculum to provide for integration of subject

content, interdisciplinary relationships, use of multimedia and application of simulation.

A functional approach is used in the respect that laboratory, research writing and reading, large and small group seminar, textual material and the modular schedule correlate in proper sequence as a means to which an end might be pursued by each individual at his or her own speed. The entire curriculum attempts to provide motivation for the individual to seek pertinent knowledge in an age when applied science is part of the accepted environment.

Importance of the Guide. This guide deals with a particular aspect of aviation education: the substance and application of curriculum.

The express purpose of an aviation program in the schools of Pennsylvania is to prepare modern students for living in the air and space age. This involves many facets of educational knowledge and many areas of investigation. It includes concepts relating to the airplane, the aviation industry, aviation and aerospace activities. Flight, while an important part of the picture, is not the only phase of aviation education. The student must gain an overall look at the whole picture so he can utilize those portions beneficial to him in the future. He may pick aviation or one of the aerospace areas for a career. He may use the airplane as a business tool. He may use the airplane privately as transportation for himself or his products, or he may fly only for recreation and social benefits. He may never fly but use the knowledge gained in aviation education as an asset in any of his pursuits.

The knowledge and awareness of applied aviation education and its place in the scheme of life will enable the student to be a better citizen, more of a participant in community affairs and better informed voter regarding issues of the day.

The Procedure

From 1959 to 1962 Richard T. Butler designed and structured a course of study for aerospace education. He field tested this course from 1962 to 1965, offering one Carnegie unit of credit in the Commonwealth of Pennsylvania. In 1966 he became affiliated with the Abington School District where new methods of education were incorporated into the curriculum. In 1969, a secondary center for aviation and aerospace education was established at Abington South Campus in conjunction with the Pennsylvania Department of Education, Division of Highway and Aviation Education under the direction of Mr. Butler working with William J. Smith, aviation education adivser for the Department of Education. This center was equipped with multimedia, mock-ups, actual flight material and a GAT-1 Simulator. The course is elective and offers one full credit to eleventh and twelfth grade students.

Final. New structures, techniques and materials established and tested within the Abington Center were incorporated into a preliminary guide for the Commonwealth of Pennsylvania by Mr. Butler and Mr. Smith. This guide was evaluated by teachers and college professors during the Institute portion of the Pennsylvania Workshop and Curriculum Institute in Aviation and Aerospace Education held in July, 1970 at the Altoona Campus of the Pennsylvania State University. The present guide was written incorporating the suggestions offered by the workshop participants and staff.

Tasks. As a result of the preliminary and final procedures the following tasks are included within the curriculum guide:

A. Development of the major concept, subconcepts, behavioral objectives and required skills.
B. Pre-test preparation and analysis, interim quizzes, and final evaluation.
C. Analysis of learning conditions and sequences based on the following:
   1. Teaching methods
      a. Subject interrelationship
      b. Laboratory centered
      c. Individualization
      d. Independent study
      e. Large and small group conference
      f. Modular schedule
D. Development of teaching plans and lesson structure with which the teacher can build a complete course of study.
E. Suggestions and recommendations for balanced aviation and aerospace education programs.

Definitions of Terms

The following terms are defined here for convenience.

Aerospace. The total expanse extending upward and outward from the surface of the earth and the study of that expanse which includes the sciences and man's related activities pertaining to the earth's atmosphere and space.

Aviation. The science dealing with the principles of flight and the related concepts pertaining to the earth's atmosphere.

Chapter II

The Responsibilities of the Teacher and Advantages for the Student

Responsibilities. The teacher must decide the kinds of instruction, units of work and the individual needs in terms of ability and motivation. He must perceive and correct student misconceptions and encourage critical thinking and creative response. The teacher must introduce points of view not recognized by the student, new facts and local events of significance. He must also be prepared to offer guidance and conduct evaluative functions for an absent student, a disturbed student, a failing student, a slow learner or a fast learner. The teacher must draw content from various fields and cooperate with colleagues in departments other than his specialty. He must also include in the program a study of values. Finally, the teacher should achieve flexibility by establishing a schedule that would maximize the amount of individualization a student may achieve.

Advantages. The student is able to retain contact with the teacher, and yet has an opportunity for an individualized rate of study. The program provides for maximum independence and simplifies scheduling of individual conferences. The student is able to contribute his own talents and in the process, gain important skills of value, judgment, communication, concepts and group problem solving.

Chapter III

Teaching Procedures for Applied Aviation Education

IN order for students to benefit fully from applied aviation education and allow a full 180 days time to explore its vast domain, concepts from all related subjects must grow and carry through the entire year in proper sequence and in proper perspective. A few examples of direct relationship are: (1) research procedures and writing mechanics from language arts, (2) aesthetic values and appreciation of design from art, (3) concepts of ratio, proportion and mathematical skills from algebra and trigonometry, (4) concepts in the study of astronomical space, distance and time from spherical geometry, (5) contributions of literary works from English, (6) laws and principles from physics, chemistry, aeronautical engineering and biology, (7) concepts of safety from safety education, (8) manipulative skills from industrial arts, (9) synthesis of earth sciences and economics through geography and (10) historical background, government functions and human interest from social studies.

It should be noted at this time that the writers' approach has been eclectic in nature and the originality lies within the selection, organization and application involving philosophy, methodology, facts, concepts and associations within the aviation and aerospace dimensions. These dimensions attempt to provide for personal experience, critical thinking and motivation for the understanding and advancement of knowledge as well as a sense of international understanding.

Teaching Plans

A teacher's curriculum structure involves a great deal of original thought and versatility on the part

of each educator and plans built on basic concepts must be flexible and of a broad scope, therefore, the following teaching plans, lesson structure and course of study are presented in a construct method of writing and application.

Schedule. With basic curriculum and supplemental materials available, the teacher should begin work to establish a schedule to provide maximum flexibility within the school structure. This schedule may form around the teacher's available time and what tasks the students are to undertake during specified class periods; or a block of five 50-minute periods per week which can be revised into separate three 15-minute modules each day; or a schedule in which all students meet as a group once a week; or have small groups meet the teacher once a week and the remaining periods schedule for individualized investigations.

Once a schedule is established, the teacher should correlate the work and direct the students' rate of learning after ascertaining the individual's needs in terms of ability and motivation. He then can offer counseling and perceive and correct student misconceptions and encourage critical thinking and creative response.

Time Structure. Applied aviation education is basically designed for a 180-day school year offering one unit of credit and has been tested within the standard 50-minute period, broken into three segments of 15 minutes each. Classes should meet, based on schedule patterns, for five periods each week, progressing in four blocks of nine weeks each. Although the nine-week blocks are primarily for evaluative summaries, the teaching plans progress and interrelate at a prescribed time and sequence to achieve maximum learning of each concept and skill.

Plan Structure. Experience has shown that some concepts and investigations are terminated during a sequence in order to achieve a common background for more involved studies and it is therefore necessary to plan within at least three general sessions. Each session would include:

A. Theoretical application (methodology)
   1. Technology (natural laws, sense extension, calculation).
   2. Time scale (vertical, horizontal effect)
   3. Human factors (contributions, implications, applications)

B. Practical application
   1. Technical investigations
   2. Concept applications from subject areas
   3. Humanities

C. Simulated experience
   1. General aviation simulator
   2. Mock-ups (cut away and operational)
   3. Models (wind tunnel, aircraft, boost gliders)

D. Actual experience
   1. Aviation and aerospace materials (actual parts)
      a. Primary industries
      b. Support industries
   2. Field trips
      a. Flight
      b. Support activities
   3. Personal activities
      a. Related clubs and organizations
      b. Work-study programs
      c. Projects, writings, art work

Session Format. Existing within each curriculum are soundly conceived objectives and learning activities. It is the intent of a basic session format to interrelate the teacher plan structure for each session to achieve meaning through association and analization. The teacher can develop a course of study from such a conceptual approach and make adjustments in daily work to combine all elements of learning into the total education of the individual.

A course of study would be incorporated into three basic sessions covering a total of 180 days.

Included in the sessions would be concepts developed using the following outline:

A. Major elementary concepts are building blocks for more involved studies or to establish a common knowledge base.

B. Major sequential concepts are those that interrelate and in which total understanding depends on various levels of achievements and skills over the entire year.

C. Subconcepts are used to define, in more specific terms, the interrelationship of concepts from disciplines which are contributing to the total education of the individual. These are categorized into: (1) Instructional subconcepts, (2) Discipline content subconcepts.

D. Behavioral objectives and required skills are used to establish on a personal basis, those learnings, activities and achievements that are based on student needs and abilities.

Teacher Dissemination and Direction are needed to establish guidelines for progressional organization in relation to school programs and schedules, logistics of proper classroom facilities and materials, student direction, evaluation and counseling on a daily and long-term basis and the cooperation of colleagues in subject disciplines in developing collaborative units that can be taught simultaneously or by team teaching.

Evaluation Program for Student Progress. The various techniques and approaches employed to help the individual learn requires constant evaluation beginning with a background analysis of the student and continual feedback on all phases of progress, both individual and inter-group, throughout the year. Subjective evaluation as well as objective evaluation are necessary and must be kept in proper perspective to achieve the desired attitudes, skills and conceptual learning.

Standardized and Teacher Prepared Achievement Tests can be adapted to the immediate feed-back system of Prgssy cards or some similar method and patterned into pretest, interim exam, conceptual quizzes, session exam and final exam.

Written Research can be of an open end or structured form which may involve various means of expression such as laboratory investigation, independent research projects, article and book analysis and descriptive writings.

Subjective Evaluation combines in some measure within the testing program in areas of performances, seminars, equipment operation and construction of projects and models.

Differentiated Exams can be used to encourage students to achieve beyond the required medium standard.

Chapter IV

Lesson Structure and Outline for Applied Aviation Education

THE ideals, aspirations and independence of youth can best be channeled into effective learning situations through realism within their natural or classroom (artificial) environment. It is, therefore, suggested that realistic simulation be used in the lesson structure as the central theme. Realistic simulation utilizes media such as the General Aviation Simulator and real aircraft and space materials converted to mock-ups or research units. This does not preempt field trips or community classroom ideologies but establishes a practical and economical base for school districts to begin a program herein outlined. Use of community resources and field trips are included in the session format previously discussed.

Using the teaching plan previously developed as a guide, the teacher should now incorporate the methods and materials into the lesson structure.

Lesson Structure. The following is not intended to be a comprehensive, indisputable guide, but merely a beginning point for constructing individual teacher plans based on the total environment of the school and community. Several texts and programmed units may be used as reference and adapted within the structure, but the lesson structure should not be limited to any one textual format at this time.

As a guide, the standard 50-minute/five period per week schedule will be used as an illustration for lesson sequence and planning.

Student schedules, enrollment, class tone, and school requirements are incorporated as a matter of necessity during the first full week of school. Dur-

ing this time much of the explanation of approach and orientation to this program can be integrated and the pre-testing completed.

Some areas of study require continuous data collection and a sequence learning, from basic to advanced, and others require the development of skills. To properly combine the level of achievement of the student with the level of instruction being given at the correct point in the lesson structure is the key to the lesson unit sequence. In directing a learning sequence it should be noted that a continuous pattern or singular elementary approaches in instruction soon may disrupt the lesson structure sequence and polarize student response. Just as trying to saturate students' minds during the first month of school may lead to a lack of confidence and frustration on the part of the student and teacher alike.

An illustration of topics from lesson units placed within the lesson structure beginning the first full week in the school year would be:

Meteorology on the first and third day during the first fifteen minutes of each period for a twenty-three week sequence.

Flight Computer on the second and fourth day during the first fifteen minutes of each period for a twenty-three week sequence.

Simulation each day during the first fifteen minutes of each period as dual time with the simulator.

Force and Motion on the first through fourth days during the second and third module of each period for a variation of 18-week sequence.

Investigations during the entire period on the fifth day. Investigations are begun on a concept rational basis which also allows time for simulation, practical experience and actual applications.

This basic illustration involves teacher plan structures:

A. Theoretical application
B. Practical application
C. Simulated experience
D. The initiation of actual experience sequences

*The teacher, in developing and determining individual and class learning experience can gauge achievement of expected performance capabilities by applying the concepts and behavioral objectives established under the session format guide. Student progress must be constantly evaluated, both as an individual guide and peer standard and as an indicated level of achievement within the realm of total knowledge and experience gained.

As further illustration, a typical first full week topic outline as it relates within the lesson structure would appear as follows:

First Day (50 minute periods)
Module 1, 2 (30 minutes); introduction to meteorology and structuring of data collection.
Module 3 (15 minutes); discussion: weather satellites.

Second Day
Module 1, 2; introduction to the flight computer and mathematical skills and units of measure.
Module 3; simulator procedure demonstration.

Third Day
M-1 (Dual Simulator); temperature, humidity, barometric pressure data collection.
M-2, 3; history of technology regarding force, mathematics and meteorology.

Fourth Day
M-1 (Dual Simulator); problem solving on units and fuel using computer.
M-2, 3; study of aerodynamic lift, pressure and force vectoring.

Fifth Day
M-1, 2, 3 (Simulator); practical application beginning with force investigations; actual experience in using instruments.

As the days progress, concepts and experiences from all related subjects are involved as well as variations of small group discussions, individual study and the application of multimedia approaches.

Lesson Unit Outline. The following units are suggested for use within an applied aviation education course of study when written using the framework of teaching plans and lesson structure previously outlined. It is the teacher's responsibility to establish a balance within disciplines and prevent the categorization that would diminish the scope of aviation education. Many topics may be used simultaneously within the broad concept scheme and therefore units herein listed should not be considered as having equal weight nor is it suggested that units should be stressed within equal time patterns.

I. Methodology—The Nature of the Universe
A. Philosophical foundations
B. Changing ideas and theories

*(See Comprehensive Course of Study and Teachers Planning Chart—Chapters V and VI, Pages 13 and 23.

II. Aviation in Retrospect
- A. A study of vertical time unit before 1957
  1. Terrestrial records—history and background
  2. Exploration methods—vehicle development
  3. Technological advances—systems and values
  4. Aviation and aerospace pioneers—national and international
- B. A study in vertical and horizontal time units from 1957 to the present
  1. Part "A" studies
  2. Human interest
  3. Economics of aviation activities
  4. Uses of aircraft and space vehicles

III. Geo—The Natural Habitat of Man
- A. Selected study of geophysical sciences
- B. Man's existence in space and adaption of the technology of flight
- C. The terrestrial problem of location involving mathematical patterns and aeronautical charts
- D. Terrestrial and celestial navigation involving methods and air and space ports

IV. Aeronautical Science
- A. Facts, concepts and areal associations
  1. Inquiry and method
  2. Sources of information and their application
- B. Patterns and Processes
  1. Aerodynamics
  2. Fluid mechanics and predicted performance
  3. Aircraft, boost glider and rocket stability and control
  3. Dynamics of subsonic relationships
  5. Laws of motion (Newton, Kepler, Galileo)
  6. Bernoulli's equation
  7. Atomic structure and states of matter

V. Flight Technology
- A. Types of aircraft, missiles and satellites
- B. Pre-flight and countdown procedures
- C. Navigation using computer and radar
- D. Communications
- E. Aircraft and space control regulations and systems
- F. Safety and facilities of air and space ports
- G. Meteorology
- H. Structures, instruments and propulsion systems
- I. Aerial photography
- J. Guidance systems

VI. Economic Opportunities and Problems
- A. Civilian and military implications and applications
- B. Air and space laws
- C. Problems and benefits of aviation and aerospace programs
- D. Personal flying
- E. Business, military and commercial flying
- F. Careers and job opportunities
- G. The role of research and manufacturing
- H. Political implications and values

VII. Flight Technique (General Aviation Simulator)

Ground Training
- A. Flight and safety procedures
- B. Control and instrument familiarization
- C. Control and instrument association
- D. Control and air foil theory
- E. Avionic familiarization

Flight Training
- A. Pitch, climb and descend maneuvers
- B. Instrument and visual interpretation
- C. Yaw and bank maneuvers
- D. Instrument turns, climbs, level flight and glides
- E. Basic radio communications
- F. Traffic pattern procedures
- G. Slow flight showing torque and flap effect
- H. Enroute procedures and navigation (VOR)
- I. ADF navigation
- J. Radio navigation and approach procedures

Within the lesson structure are many topic outlines and laboratory investigations which are available through subject areas and adaptable, during specific times, to classroom instruction. They can also be used as a structured guide in note taking and in some cases in-depth independent research projects. The teacher may also wish to follow a particular topic through all levels of investigations and time elements although a continual sequence in proper perspective is recommended. Selected topics may be of particular interest to an individual student who in turn may wish to make such presentations to the entire class within a seminar situation, or as an investigation written and directed by the student.

Chapter V

Purpose of the Teachers' Annotated Course of Study

TO provide the classroom teacher with a detailed and annotated course of study to accompany the Pennsylvania Curriculum for Applied Aviation Education.

To provide the classroom teacher a workable base for individualizing a secondary school course in aviation education.

To provide latitude and versatility so the teacher is free to adapt this course of study to the particular situation and student requirements.

To provide references regarding detailed information to enable the teacher to prepare lesson plans applicable to this course of study.

To indicate areas in which the teacher might utilize a simulator to reinforce and stimulate the learning process.

To provide the classroom teacher with a broad-based, interdisciplinary approach to this new, timely, area of instruction for challenging the minds of selected students.

To supply the classroom teacher with a time sequence chart for a five class per week, 36-week course which is flexible in nature.

Objectives of the Teachers' Annotated Course of Study

THE objectives of this course of study are to provide students in an aviation program with a basic background knowledge of the overall aviation-aerospace industry.

To give the student a comprehensive picture of

aviation and aerospace as it exists in today's living pattern, to make him appreciative of the widespread influence of this phase of our economy on local, state, national and international levels, to stimulate interest in aviation as a career or occupational field, either as a fulfillment of man's natural desire to fly, as a recreational pursuit, or as a multipurpose tool adaptable to many phases of his future endeavors in life. To develop an understanding in the student of the political scope of the program and the opportunities and limitations of the governmental role in aviation and aerospace. To give the student an appreciation of the future possibilities and probabilities existent within the aviation and aerospace programs and the resultant effects on the future.

The students should be aware of the problems, the solution, the facts, the skills, the conditions, and the opportunities inherent to this special scientific field. They should be given some actual flight experience to develop an appreciation of the skills and knowledge necessary for a successful career in this field. They should develop the educational knowledge and tools as well as the skill to solve problems, answer questions, interpret facts and data, understand writings, form opinions and develop conclusions regarding the various phases of aviation. They should become aware of the scope of aviation and aerospace and the social, economic and political values of these programs in relation to society as a whole in today's world.

Unit I

Methodology—The Nature of the Universe

Student Behavioral Objectives

The student will list and identify the contribution of each of seven early scientists or writers to the theory of flight before 1800 A.D.

The student will tell to the class or write a paragraph to tell the effect that superstition and religion had on the early theories of flight.

The student will list at least five scientific concepts which changed in nature and understanding between 1500 A.D. and 1900 A.D. and discuss the change.

The student will correctly answer questions about changes and developments brought about by the scientific endeavors of specific people during the historical period covered in Unit I.

Outline

I. Methodology—The Nature of the Universe

A. Philosophical foundations
   1. "Cicero's Republic"
      a. Concept of a whole universe — Misenhimer, Man in Space Unit, P. 526
      b. Realization of the insignificance of the earth
   2. Stories of flights to the moon
      a. Lucian of Greece
      b. Godwin in the Early 17th Century

B. Changing ideas and theories
   1. Renaissance of science
      a. Copernicus
      b. Kepler
      c. Voltaire — Mercer, Aviation History, Section I
      d. Verne
      e. Poe
      f. Wells — Van Sickle, P. 1-3
   2. Mythology and religion
      a. Daedulus and Icarus — Misenhimer, History of Aviation, P. 626
      b. Pegasus
      c. Biblical accounts of flight
      d. The early use of kites
      e. Superstition
   3. Changing concepts
      a. Our changing world — Bernardo, Chapter 2
      b. Space-age geography
      c. Maps, old and new
      d. Geography and air-world developments

Unit II

Aviation in Retrospect

Student Behavioral Objectives

The student will list in chronological order the progression of successful flight from the kites to the airplane. To be done without aids of textual materials of any kind.

The student will write the story of rocket development including names of early scientists involved and the contribution of each to the total development of spacecraft as we have today.

The student will identify with accuracy various types of aircraft from photographs or models.

The student will classify five different types of air vehicles and list at least one advantage for each.

The student will correctly answer questions concerning the material covered in Unit II.

The student will recall and explain various contributions to aviation progress by civil, military and commercial flight.

The student will classify the use of aircraft in different categories.

The student will discuss intelligently the economic, social, political and recreational contributions of aviation to today's society.

Outline

II. Aviation in Retrospect
- A. A study of vertical time unit before 1957
  1. Part "A" studies (listed above) as related to developments since 1927 — Mercer Section 12
  2. Human interest
     - a. Government manned space program
     - b. News media coverage of events
  3. Economics of aviation and acrospace activities — Bernardo Part 9
     - a. Civil flight contribution
     - b. Military contribution
     - c. Commercial aviation development — Mercer Section 2, Section 12
     - d. Industrial development
     - e. "Spinoffs" from space research
  4. Uses of aircraft and space vehicles — Misenhimer p. 753-782
     - a. Unmanned and manned vehicles
     - b. Economics — Bernardo Part 5
     - c. Political
     - d. Recreational

Unit III

Geo—Natural Habitat of Man

Student Behavioral Objectives

The student will identify those elements in the overall environment which affect flying and explain the effect they produce.

The student will explain the medical hazards to persons in flight and discuss the solutions to these hazards.

The student will read maps and charts used in aviation and interpret the symbols thereon.

The student will plot courses for cross-country flight.

The student will interpret aircraft instrument readings into appropriate action.

The student will convert navigational information and data into usable terms for flight purposes.

The student will discuss the correlation between the earth and the solar system.

The student will demonstrate his knowledge of Unit III by answering specific questions regarding material covered in this unit.

The student will identify the physical forces exerted on man in flight and the appropriate counter action necessary to nullify the force.

Outline

III. Geo—Natural Habitat of Man
- A. Selected study of geophysical sciences
  1. Terrestrial records—history and background
     - a. Physical properties of the Earth — Pa. Guide for Earth and Space Science
     - b. The relation of the Earth to the solar system
  2. Exploration methods—vehicle development — Misenhimer History of Aviation Unit
     - a. Balloons and gliders — Von Braun pp. 23-39, 40-59, 67-85
     - b. Heavier-than-air craft
     - c. Congreve's rockets
     - d. Modern rocketry
  3. Technological advances, systems and values — Misenhimer, pp. 655, 588
     - a. Aerial developments
     - b. Unmanned satellites and sounding rockets — Mercer Section 12
     - c. Geodesy in space
  4. Aviation pioneers—national and international — Mercer Section 1

a. Aviation records
b. Aces of World War I
c. World War II
d. Post World War II
e. Space Flight

Misenhimer History of Aviation Unit

B. A study in vertical and horizontal time units from 1957 to the present
1. Physical structure
a. Earth's crust
b. Atmosphere

Pa. Earth and Space Science Guide

2. Physical properties
a. Pressure
b. Temperature

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3. Science contributions
a. Geology
b. Oceanography
c. Meteorology

Misenhimer Basic Aeronautics Unit

C. Man's existence in space and adaption of the technology of flight
1. Medical aspects of flight
a. Hypoxia
b. Decompression sickness
c. Vision in flight
d. Aerial equilibration
e. Noise in flight

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Misenhimer Physiology of Flight Unit

2. Living in space
a. Major human problems in space
b. Basic elements of living in space

Misenhimer Man in Space Unit

D. The terrestrial problem of location involving mathematical patterns and aeronautical charts
1. The Earth's surface and mapping
a. Map projections and chart reading
b. Plotting and measuring on charts

Van Sickle Chapter 12

2. Navigator procedures and techniques
a. Instruments
b. Data information and interpretation

Mercer Section 8

Misenhimer Navigation Unit

E. Terrestrial and celestial navigation involving methods and air and space ports
1. Celestial sphere
a. Theory
b. Computations

Van Sickle Chapter 12

2. Solar system
a. Sun, earth, moon relationship
b. Navigation starts
c. Satellites

Misenhimer Man in Space Unit

Unit IV

Aeronautical Science

Student Behavioral Objectives

The student will demonstrate his knowledge by correctly answering specific questions on aerodynamic principles to the satisfaction of the teacher.

The student will demonstrate his knowledge of the mathematics of aerodynamics by solving correctly problems dealing with power, speed, airfoil theory and fluid dynamics prepared by the teacher.

The student will demonstrate his comprehension of aerodynamics by predicting outcomes and arriving at reasonable conclusions when given certain pertinent facts.

The student will solve weight and balance problems for given conditions.

The student will list the effective forces and explain resultant effect on an airplane in flight.

The student will list the contributions of Newton, Kepler, and Galileo, and explain their theories concerning motion.

The student will explain Bernoulli's theory regarding pressure and recall Bernoulli's equation.

The student will classify matter according to the atomic chart.

Outline

IV. Aeronautical science
A. Facts, concepts and areal associations
1. Inquiry and method
a. Investigative method
b. Areal associations
2. Sources of information and their application
a. Technical
b. Pure research

B. Patterns and processes

1. Aerodynamics
   a. Principles — Van Sickle Chapter 3
   b. Physical laws
   c. Force components
   d. Airfoils — Mercer Section 3
   e. Relative motion
2. Fluid mechanics and predicted performance
   a. Principles
   b. Aspect ratio — Mercer Section 3
   c. Ground effect
   d. Performance calculations — Van Sickle Chapter 9
   e. Performance instruments
3. Aircraft, boost glider and rocket stability and control
   a. Control surfaces — Mercer Section 3
   b. Center of gravity and pressure
   c. Load factor — Van Sickle Chapter 3
   d. Finite span wings
   e. Power effects on control — Misenhimer Basic Aeronautics Unit
4. Dynamics of subsonic relationships
   a. Subsonic flow — Van Sickle Chapter 3
   b. Drag
   c. Viscous effects
   d. Lift/drag relationships
5. Laws of motion (depth study)
   a. Newton
   b. Kepler
   c. Galileo
6. Bernoulli's equation
   a. Conservation of pressure — Mercer Chapter 3
   b. Application to airfoils
   c. Lift equations
   d. Wind tunnel — Misenhimer Basic Aeronautics Unit
   e. Resultant forces
7. Atomic structures and states of matter
   a. Atomic chart
   b. Organic-inorganic classification
   c. Fluid state of matter
   d. Organic structures
   e. Relationships to physical laws

Unit V

Flight Technology

Student Behavioral Objectives

The student will identify and classify different types of aircraft, missiles and satellites from pictures or description given.

The student will quote pre-flight procedures in the proper sequence.

The student will describe pre-launch procedures and systems check.

The student will demonstrate his skill with a flight computer by correctly solving time-distance speed problems, fuel consumption problems and wind vectors using the computer to do so.

The student will utilize radio navigation as an aid by flying true headings in a simulator or in an actual flight situation.

The student will demonstrate his understanding of radio communications by proper usage of radio to solve either a simulated problem or an actual one.

The student will identify different cloud formations from pictures or by looking at the clouds themselves and predict weather conditions resulting from such cloud formations.

The student will recognize and interpret the various symbols appearing on a surface weather map and teletyped weather reports.

The student will respond correctly to specific questions about types of aircraft structure, about types of propulsion systems and types of aircraft instruments.

The student will list uses of the hydraulic, electrical, and vacuum systems within a modern aircraft.

The student will explain maintenance and servicing procedures and the Federal Regulations regarding them including the time schedule requirements.

The student will list at least five situations where aerial photography would be beneficial.

The student will prepare a chart showing the advantages and disadvantages of rotary wing aircraft in comparison with conventional aircraft.

The student will explain in writing how a rocket guidance system works and how they are tracked in space.

Outline

V. Flight Technology

A. Types of aircraft, missiles and satellites

1. Aircraft
   a. Characteristics — Van Sickle Chapter 2
   b. Classification

2. Missiles	
a. Characteristics	Misenhimer
b. Classification	Basic Aeronautics
3. Satellites	Unit
a. Characteristics	
b. Classification	
B. Pre-flight and countdown procedures	
1. Pre-flight	
a. "Walk around"	
b. Cockpit procedures	Van Sickle
	Chapter 8
2. Countdown	
a. Systems check	
b. Pre-launch procedures	Mercer
	Chapter 5
C. Navigation using computer and radio	
1. Flight computer	
a. Time, distance, speed	Mercer
	Section 9
b. Fuel consumption	
c. Wind triangle	
2. Radio navigation	Misenhimer
a. Evolution	Navigation Unit
b. Basic radio principles	Mercer
	Section 10
c. Systems study	Van Sickle
	Chapter 6
D. Communications	
1. Aircraft	
a. Voice procedure	
b. Code and symbol interpretation	
c. Check points	Misenhimer
2. Space vehicles	Rules of Flight
a. Voice	Unit
b. Telemetry	Man in Space Unit
E. Meteorology	
1. Atmospheric circulation	
a. Air mass structure	Van Sickle
b. Cloud formation	Chapter 11
2. Surface weather map	Misenhimer
a. Map analysis	
b. Forecasts	Mercer
3. Teletype reports	Meteorology Unit
a. Circuits	Section 4
b. Sequence	
4. Winds aloft	
a. Transmission	
b. Jet streams	
5. Value determination of weather elements	
a. Visibility	Mercer
b. Severe turbulence	Section 4
6. Meteorological satellites and sounding rockets	Bernardo
a. Large and small sounding rocket equipment	Chapter 12
b. Synchronous satellite	
F. Structures, instruments and propulsion systems	
1. Structures	Van Sickle
a. Characteristics	Chapter 2
b. Classification	Chapter 4
c. Aircraft obsolescence	
2. Instruments	
a. Vacuum system	Mercer
b. Fuel system	Section 6
c. Electrical system	
3. Propulsion systems	Misenhimer
a. Reciprocating engines	Basic Aeronautics
b. Reaction engines	Unit
c. Ion engines	Van Sickle
	Chapter 5
4. Aircraft Maintenance	
a. Servicing	Van Sickle
b. Inspection	Chapter 15
G. Aerial photography	
1. Orientation and study of aerial photographs	Mercer
a. Principles of recognition	Chapter 5
b. Stereoscopic study	Avery
	Chapters 2, 8
2. Mapping from aerial photography	
a. Map projections	
b. Aerial photo mosaics	
H. Guidance systems	
1. General principles	Misenhimer
a. Tracking through space	Man in Space Unit
b. Ground tracking	
2. Rotary wing dynamics	
a. Gyroscopic precession	Van Sickle
b. Auto-rotation	Chapter 4

Unit VI

Economic Opportunities and Problems

Student Behavioral Objectives

The student will identify specific controlling agencies and explain the function of each regarding aviation.

The student will answer specific questions correctly pertaining to the Federal Rules and Regulations controlling flight and flight facilities.

The student will evaluate airport facilities and services in regard to civil aviation.

The student will analyze and discuss problems in the aviation field.

The student will identify and explain benefits to his community resultant from aviation and aerospace activities.

The student will list different uses of the various types of aircraft and space craft.

The student will list various flight oriented jobs and the specific requirements necessary to obtain such jobs.

The student will write a short paper concerning the roles of manufacturing organizations and their contribution to the development and expansion of aviation.

The student will explain details of the role of the Federal Aviation Administration and the National Aeronautics and Space Administration in regard to aviation and aerospace programs.

The student will write an opinion regarding the airport systems in use today.

Outline

VI. Economic Opportunities and Problems	
A. Civilian and military implications and applications	
1. Civilian implications and applications	Mercer
a. Agencies	Section 11
b. Manuals and procedure	Van Sickle Chapter 13
2. Military implications and applications	
a. Federal air ways	Bernardo Chapter 8
b. Security and traffic control	
c. Technical requirements	Misenhimer Rules of Flight Unit
B. Air and space laws	
1. Terrestrial	
a. History	
b. Organization	
2. Space laws	
a. Eminent domain	
C. Problems and Benefits of Aviation-Aerospace Programs	
1. Unmanned satellites and rockets	Misenhimer Man in Space Unit
a. Application satellites	
b. International cooperation	FAA Course of Study Man in Space Unit
2. Air transportation and public welfare	
a. Relation of aviation to health	Bernardo Chapter 5
b. The bad with the good	
D. Personal flying	
1. General aviation	
a. Recreation	
b. Transportation	
c. Business related	Van Sickle Chapter 16
2. Northern wilderness	
a. History	
b. Landing and take-off	
c. Emergency gear	
E. Business, military and commercial flying	
1. Business aviation	
a. Air taxi	
b. Industrial	Bernardo Chapter 4
c. Flying ranchers	
d. Wildlife management, fire control and highway traffic control	
e. Aerial photography	
f. Construction and real estate	
2. Military aviation	
a. Aerospace power	
b. Armed service aviation	Bernardo Chapter 8
c. New tools of air defense	
3. Commercial flying	
a. Airline transportation	Bernardo Chapter 3

b. Charter service
c. Airmail
d. Air freight

F. Careers and job opportunities
1. Civil aviation occupations
a. Pilots and co-pilots
b. Flight engineers
2. Employment outlook
a. FAA careers
b. Armed services
c. Airlines

Mercer Chapter 13

Aviation: Where Career Opportunities are Bright *Counselors Guide* National Acrospace Educational Council Washington, D. C. (also filmstrip)

G. The role of research and manufacturing
1. Human progress and research
a. Organized aeronautical
b. Experimental
c. Civil-military teamwork
2. Manufacturing
a. Surplus and demand
b. Specialized industries and products

Bernardo Chapter 10

H. Political implications and values
1. Government in aviation and space
a. The Civil Aeronautics Board
b. The National Aeronautics and Space Administration
2. The Airport System
a. The National Airport Program
b. The airport and the community

Bernardo Chapters 6, 7

FAA Private Pilots Manual pp. 121-128

Unit VII

Flight Technique (Simulation)

Student Behavioral Objectives

The student will prepare a check list for pre-flight inspection from memory.

The student will list the necessary safety precautions before starting the engine of an aircraft (simulator).

The student will explain and demonstrate proper take-off procedures.

The student will respond correctly to specific questions regarding control functions and instrument usage involved in flight of an aircraft (simulator).

The student will apply the use of radio and other navigational aids to provide solution to specific problems in navigation.

The student will correlate the controls and instruments used to perform specific maneuvers of an aircraft in the simulator.

The student will interpret instrument readings and respond with the correct control movement indicated by the instrument reading.

The student will demonstrate the ability to operate aircraft radio to obtain information regarding take-off procedure, weather, wind, position and landing instruction as required during flight (actual or simulated).

The student will prepare properly both IFR and VFR flight plans for projected flight.

The student will interpolate in-flight information into revisions of the flight plan when given changed conditions affecting the accuracy of the pre-filed plan.

The student will list available electronic navigational aids and explain the purpose of each.

Outline

VII. Flight Technique (Simulator)
A. Ground training
1. Flight and safety procedures
a. Safety precautions during starting
b. Starting malfunctions
c. Flight visual cues
d. Planned approaches
e. Gliding distance
f. Flying safety practices
2. Control and instrument familiarization
a. Control surface identification
b. Instrument configuration
c. Engine start procedure
d. Warm-up

Van Sickle Chapter 8

e. Pre take-off check
f. Taxi and radio technique
g. Parking and tie-down procedure

3. Control and instrument association
   a. Yaw axis—rudder—compass
   b. Pitch axis—elevator—artificial horizon
   c. Roll axis—aileron—artificial horizon
   d. Climb—throttle, rate of climb, airspeed indicator, altimeter
   e. Speed—airspeed indicator—tachometer (RPM)—throttle

4. Control and air foil theory — Van Sickle Chapter 10
   a. Skills of flight
   b. Acrobatic maneuvers
   c. Unconventional aircraft — Van Sickle Chapter 14
   d. Rotary wing aerodynamics

5. Avionic familiarization
   a. Basic theory
   b. Radio aids
   c. VOR/DME

B. Flight Training

1. Pitch, climb and descent — Van Sickle Chapters 8, 9
   a. Standard rate of climb and descent
   b. Instrument reading and cues

2. Instrument and visual interpretation — F.T.H. AC-61-16A Chapter VI
   a. Aircraft stability
   b. Aircraft control

3. Yaw and bank maneuvers — F.T.H. AC-61-21
   a. Level turns
   b. Straight and level flight

4. Instrument turns, climbs, level flight and glides
   a. Climb and descent turns
   b. Level flight and glides

5. Basic radio communication
   a. Station tuning and facility familiarization
   b. Phraseology, procedure and techniques

6. Traffic pattern procedures
   a. Traffic information
   b. Pattern departure and entry
   c. Final approach

7. Slow flight showing torque and flap effect
   a. Power and airspeed coordination
   b. Control—torque
   c. Recovery

8. Enroute procedure and navigation (VOR) — A.I.M. Current pub. part 1
   a. Flight service orientation
   b. VOR fix from two stations

9. A.D.F. navigation
   a. Flying procedure
   b. Time and distance problems

10. Radio navigation approach procedures
    a. Flying radial inbound and outbound
    b. VOR approach and radar vectors

Chapter VI

Teachers' Planning Chart

TEACHERS' planning chart: incorporating units within a time sequence for a flexible five classes per week, 36-week course of study based on a 45-minute period divided into three 15-minute modules per period. (Applied Aviation Curriculum, pp. 1-2 and Chapter IV.)

The chart represents the course of study units divided into periods and modules as seen on the following page.

The chart is further divided into four nine-week segments with unit modular application per segment. This method provides a means by which the teacher is provided flexibility for concept coverage.

Chart Interpretation

This chart has been structured to aid the classroom teacher of aviation education in placing the units in proper perspective within a 36-week school year. The teacher would prepare each unit in relation to this schedule incorporating the course of study previously outlined with emphasis on conceptual progression. The pattern evolved is a result of concepts and experiences from all related areas being utilized and interrelated and thereby preventing the categorization that would diminish the scope of aviation education.

Further clarification of Units V, VII and evaluation time is as follows:

Unit V—Flight Technology—involves the study of meteorology and the flight computer which can be learned most effectively over a span of time, therefore, the first module on Mondays through Thursdays is devoted to these subjects for 23 weeks. These activities coincide with training in the simulator and are coexistent with it.

UNIT	TITLE	PERIODS	MODULES
I	Methodology—The Nature of the Universe	7	20
II	Aviation in Retrospect	7	20
III	Geo—The Natural Habitat of Man	15	45
IV	Aeronautical Science	60	180
V	Flight Technology	65	190
VI	Economic Opportunities and Problems	10	30
VII	Flight Technique (Simulation)	60	180
	Evaluations	16	48

Unit VII represents time devoted to use of the simulator and runs concurrent with other scheduled activities. The simulator is utilized during the first module each day Monday through Thursday and all period Friday, except on days specifically indicated on the planning chart.

Evaluation time has been provided within the planning so that a pre-test, unit exams, interim exams, semester and final examinations are included. Other means of evaluation can be at the discretion of the individual teacher.

Laboratory periods are scheduled on Fridays throughout the year for investigation involving concepts within the units indicated. The simulator sessions will run concurrent with the laboratory investigations.

Teacher's Planning Chart

Applied Aviation for Education

Week	Module	Monday	Tuesday	Wednesday	Thursday	Friday	
1	1 2 3		IV	V	VII	LAB SIM V VII	*
2	1 2 3	V-VII II	V-VII I	V-VII II	V-VII I	LAB SIM IV VII	*
3	1 2 3	V-VII II	V-VII I	EXAM	V-VII I	LAB SIM V VII	*
4	1 2 3	V-VII IV	V-VII I	V-VII IV	V-VII I	LAB SIM IV VII	*
5	1 2 3	V-VII IV	V-VII I	V-VII I	V-VII IV	EXAM	
6	1 2 3	V-VII I	V-VII I	V-VII V	V-VII IV	LAB SIM IV VII	*
7	1 2 3	V-VII IV	EXAM	V-VII II	V-VII II	LAB SIM IV VII	*
8	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	LAB SIM V VII	*
9	1 2 3	V-VII IV	V-VII IV	V-VII II	V-VII II	LAB SIM IV VII	*

Unit Modular Application: 135 Modules

*Flight Simulator

I - 20 IV - 38 VII - 3
II - 14 V - 48 Evaluation - 12

Teacher's Planning Chart

Applied Aviation for Education

Week	Module	Monday	Tuesday	Wednesday	Thursday	Friday	
10	1 2 3	V-VII II	V-VII II	V-VII II	V-VII III	LAB SIM V VII	*
11	1 2 3	V-VII III	V-VII III	EXAM	V-VII III	LAB SIM III VII	*
12	1 2 3	V-VII V	V-VII III	V-VII V	V-VII IV	LAB SIM V VII	*
13	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	EXAM	
14	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII III	LAB SIM III VII	*
15	1 2 3	V-VII V	EXAM IV	V-VII V	V-VII III	LAB SIM V VII	*
16	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII III	LAB SIM III VII	*
17	1 2 3	V-VII IV	V-VII IV	V-VII IV	V-VII IV	LAB SIM IV VII	*
18	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	FINAL EXAM	

Unit Modular Application: 135 Modules

*Flight Simulator

II - 6 IV - 25 Evaluation - 12

III - 25 V - 67

Teacher's Planning Chart

Applied Aviation for Education

Week	Module	Monday	Tuesday	Wednesday	Thursday	Friday
19	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	LAB SIM * V VII
20	1 2 3	V-VII V	V-VII III	V-VII V	EXAM	LAB SIM * IV VII
21	1 2 3	V-VII IV	V-VII III	V-VII V	V-VII III	LAB SIM * III VII
22	1 2 3	V-VII IV	V-VII III	V-VII V	V-VII III	LAB SIM * III VII
23	1 2 3	V-VII IV	V-VII III	V-VII V	V-VII III	EXAM
24	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	LAB SIM * IV VII
25	1 2 3	V-VII V	V-VII IV	V-VII V	V-VII IV	LAB SIM * IV VII
26	1 2 3	VII IV	EXAM	VII IV	V-VII IV	LAB SIM * IV VII
27	1 2 3	VII VI	VII IV	VII IV	VII IV	LAB SIM * IV VII

Unit Modular Application: 135 Modules

III - 20 V - 53 Evaluation - 9

IV - 50 VI - 3 *Flight Simulator

Teacher's Planning Chart

Applied Aviation for Education

Week	Module	Monday	Tuesday	Wednesday	Thursday	Friday
28	1 2 3	EXAM	VII	VII IV	VII VI	LAB SIM * VI VII
29	1 2 3	VII VI	VII VI	VII VI	VII VI	LAB SIM * VI VII
30	1 2 3	VII VI	VII VI	EXAM.	VII IV	LAB SIM * IV VII
31	1 2 3	VII IV	VII IV	VII IV	VII IV	LAB SIM * IV VII
32	1 2 3	VII IV	VII IV	VII IV	VII IV	EXAM
33	1 2 3	VII IV	VII V	VII V	VII V	LAB SIM * V VII
34	1 2 3	VII V	EXAM	VII IV	VII IV	LAB SIM * IV VII
35	1 2 3	VII IV	VII IV	VII V	VII IV	LAB SIM * IV VII
36	1 2 3	VII V	VII VI	VII V	VII IV	FINAL EXAM

Unit Modular Application: 135 Modules

IV - 66 VI - 27 Evaluation - 15

V - 24 VII - 3

*Flight Simulator

Chapter VII

Summary Concerning Applied Aviation Education

IN considering the curriculum in Pennsylvania, there appears to be a definite need for emphasis on the individual student and a curriculum that will be relevant and meet the needs of our modern society. The writers propose that this need be satisfied by a curriculum in applied aviation education.

The curriculum herein presented appears adequate to provide vitally needed concepts and skills in aviation and aerospace for senior high school students. It also presents a challenge for teachers to expand their own knowledge and to present and utilize modern ideas and approaches in creating a relevant means of communicating concepts and values of the American people.

Credence for this program as suggested has been established through practical application at the Pennsylvania Aviation Education Development Center located at Abington High School, South Campus, under the direction of Mr. Butler. Further evaluation by educators on both secondary and higher education levels was conducted at the Pennsylvania Workshop and Curriculum Institute.

The general aviation training simulator has proven an adequate intermediary between class instruction and practical application of principles and concepts of flight-oriented experience. The simulator is available when it is needed for each phase of teaching and does not have flight disadvantages with high school students, such as high cost of maintenance, insurance, operation, pupil transportation and down time due to weather conditions. It also offers equal opportunity to all students regardless of financial background or denial of life goals due to refusal by

parents to grant permission for actual flight.

The criterion for selection and development of the lesson units should be the need of the individual in our modern world. Ideas and concepts which do not apply to our society can be reevaluated in the light of aviation and aerospace which is now an integral part of life and, therefore, very relevant.

Educators should spearhead curriculum development while in constant communication with technological advances and changing value patterns of the present time; therefore, the course of study outline presented in applied aviation education can be proposed for a progressive educational endeavor designed for modern American youth.

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