Spring 1970

A Survey of Aerospace Education in Grades Nine through Twelve in the State of Washington

Judith Ann Isaac
Central Washington University

A SURVEY OF AEROSPACE EDUCATION IN GRADES NINE THROUGH TWELVE IN THE STATE OF WASHINGTON

A Thesis

Presented to

the Graduate Faculty

Central Washington State College

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

---

by

Judith Ann Isaac

June 1970

APPROVED FOR THE GRADUATE FACULTY

_____

J. Wesley Crum, COMMITTEE CHAIRMAN

_____

John L. Shrader

_____

Althea Adams

ACKNOWLEDGMENTS

The writer wishes to express sincere appreciation to Dr. J. Wesley Crum who assisted greatly through his time, consideration, and valuable suggestions and to Dr. John Shrader and Dr. Dan Unruh for their cooperation and assistance.

The writer also wishes to extend particular and unreserved thanks to her husband, Gerry, and to Mrs. Evelyn Isaac for their understanding, forbearance, assistance and encouragement throughout this study.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM, LIMITATIONS OF THE STUDY AND METHODS OF RESEARCH

Man hurled himself into a great unknown with the launching of the space program in 1957. The resulting era of continuous and accelerating change has had a tremendous influence on the public school system of the United States, as well as on the entire civilization and culture of this country. Aviation has had a profound impact on instruction in elementary and secondary schools, as well as in colleges and universities.

In light of these developments, there has been concern recently with the need for aerospace education. In the State of Washington, for instance, little research has been conducted so far pertaining to the teaching of aerospace science, especially on the secondary level.

I. THE PROBLEM

Statement of the problem. The purposes of this study were: (1) to survey the incidence of aerospace education in grades nine through twelve of Washington State schools, (2) to discover what courses and units include such education in the curriculum, (3) to determine who the teachers are, and the nature of their preparation, (4) to gain a description

of what kind of education is attempted under this heading, and (5) to discover what the opportunities are for expanded aerospace education within the schools surveyed.

Significance of the study. Aerospace-oriented curriculums are not new to public schools in the United States. As early as 1908 a course entitled "Aviation Craftsmanship and Learning to Fly" was offered at Polytechnical High School of Los Angeles. Later, only seven years after the Wright brothers' historic flight, a private academy in Alabama provided formal flight training. By 1915 Massachusetts Institute of Technology had awarded its first Master of Science Degree in Aeronautical Engineering (31:39).

In 1968, more than 15,000 teachers and administrators attended summer workshops in aerospace education throughout the fifty states (31:40). During the 1969 summer, five such workshops were held in the State of Washington, involving approximately 235 teachers (16).

Federal Way School District Number 210 in King County developed and began offering aerospace education programs on both the elementary and secondary levels in 1968. These programs grew to such proportions that a full-time director of aerospace education was necessary (31:42).

Farther south, in the Clover Park High School in Pierce County, courses in aircraft mechanics and flight training were being offered to the students. The curriculum of the

school has included courses in aerospace education since 1945 (31:42).

Although there has been a growing interest in aerospace education in the State of Washington, there has been little information compiled about different programs in the schools. No previous attempt has been made to assess the situation accurately and systematically in Washington secondary schools. There was an absence of a systematic and comprehensive understanding of what the needs were in the field of aerospace education, as well as a dearth of specific knowledge concerning the actual courses being offered on this subject. Another undetermined area had to do with the methods used in teaching the various phases of this science.

II. DEFINITIONS OF TERMS USED

Aerospace. Throughout the report of this investigation, the term "aerospace" was interpreted as meaning the region extending outwardly from the surface of the earth.

Aerospace education. Crum, President, National Aerospace Education Council, defined "aerospace education" as (15):

> 1. Aerospace Education includes that portion of General Education that enables children, youth, and adults to appreciate and to understand the full significance of the economic, social, cultural, political, vocational, technological and scientific impacts of aviation and space activities, and helps to prepare citizens to manage these impacts wisely.

2. Aerospace Education is sometimes distinguished from highly particularized vocational, technical, and professional training in aviation and space specialities. However, in some of the broader definitions, such training is included in the term 'aerospace education.'

3. Aerospace Education is the utilization of the interest children and youth have in aviation and space activities to motivate learning in any (all) subject field(s) at any (all) grade level(s).

4. Aerospace Education is primarily a teaching-learning or curricular emphasis rather than a subject field. It permeates all, or nearly all, subject fields.

5. Aerospace Education includes study of that which exists or takes place in the region above the surface of the earth, or supports such activities. NOTE: It is much too limiting to consider aerospace education as concerned exclusively with airplanes and space vehicles.

6. Aerospace Education is the study of man's power to act in the region above the surface of the earth.

Aerospace education was interpreted for the study as including both the general and vocational definitions as used in the broader term. Vocational, technical, and professional training were included in the definition as stated by Crum in number 2 above.

Aerospace course. For the purposes of this study, an aerospace course was defined as a special, credited course dealing with some aspect of aerospace taught in a public school for one or more semesters.

Aerospace unit. For the purposes of this study, an aerospace unit was defined as a unit of study, lasting twenty or more class periods, covering some aspect of aerospace offered by a public school, as part of a natural science course.

III. LIMITATIONS OF THE STUDY

The complete investigation of the teaching of aerospace courses in the State of Washington was beyond the scope of this study. Therefore, the study had the following limitations:

1. The secondary schools in the State of Washington surveyed in this study were those which involved students in grades nine through twelve, including junior, junior-senior, and senior high schools.

2. Secondary teachers studied were those teaching aerospace science as a separate subject for one or more periods per day, during one or more semesters, and also those teaching any natural science course containing one or more significant units on some aspect of aerospace.

3. Investigation of the formal training which the teachers had received was limited to college degrees held by the teachers, including information on their undergraduate work in major and minor fields, their specific preparation in aerospace studies, social sciences, natural sciences,

mathematics, and science-teaching-methods courses. Also included in the summary of teacher training was the extent of their aerospace experiences gained through attendance at conferences, conventions, and institutes, together with actual aeronautical ratings held and "pilot in command" flight hours.

4. Teaching assignments were identified in terms of course titles, unit titles, grade levels, number of semesters offered, hours per week, number of sections, and number of pupils in each class. The year the course was initiated, and whether the course was required or was elective were also identified.

5. Thirty-seven selected aerospace topics were used to determine the content of the aerospace courses and units.

6. Twenty-seven selected items were used to determine the teaching techniques, equipment, and materials used in teaching the aerospace courses and units.

IV. METHODS OF RESEARCH

To obtain quantitative data needed for this study, the survey method was used.

The initial questionnaire to all secondary principals (see Appendix A) and the questionnaire to aerospace education teachers (see Appendix B) were constructed after studying similar research techniques. Also, suggestions were obtained

from staff members at Central Washington State College and from a school principal and science teacher in the Ellensburg Public Schools. Suggestions from these persons were evaluated and incorporated into the questionnaires which were mailed out.

The initial questionnaire was mimeographed and mailed to all principals of secondary schools. The mailing list was compiled from the names and addresses of junior and senior high school principals obtained from the Washington Education Directory, 1968-1969 edition (34:27-93).

Due to a large percentage of principals indicating that their schools were not involved in aerospace education, a listing of schools offering general science and earth science courses was obtained from the Washington State Department of Public Instruction. In order to determine if all aerospace units had been listed on the original questionnaire, a second questionnaire (see Appendix C) was sent to the principals who had indicated when replying to the first questionnaire that their schools were not involved in aerospace education.

From the responses on both questionnaires to school principals, a mailing list was developed using the names of 183 teachers who were involved in aerospace education. The questionnaire for the aerospace teachers was mimeographed and mailed to 180 teachers. The names of three teachers

involved in aerospace education were submitted too late to be used in the study.

V. OVERVIEW OF THESIS

A brief summary of literature pertinent to the study is given in Chapter II. Chapter III presents information regarding teaching assignments, pre-service training, and number and type of aerospace experiences of the teachers involved in aerospace and related science courses. Chapter IV presents the number, size, and duration of the aerospace courses and units, as well as the content taught in them. Chapter V includes a summary of the study, with conclusions and recommendations based on the data assembled.

CHAPTER II

REVIEW OF THE LITERATURE

Scientists have estimated that man's world of knowledge has been doubling approximately every ten years. This knowledge explosion has caused tremendous innovations in curriculum content. An air and space-oriented world has caused educators to introduce aerospace education concepts and aerospace content into the school programs in order to meet the needs of children and youth.

Spectorsky (30:1), in 1956, dreamed of space travel:

> From the Montgolfier balloon to the supersonic plane is a time span covering two hundred years and the realization of an ancient dream. With the strange mingling of awe and excitement which the pre-Columbian explorers must have felt, we have just begun to set sail from our island, the earth, into the unchartered oceans of the sky. Into the substance of our ship are molded the wings of Icarus, the tenacious faith of the Wright brothers, the instruments that first recorded a plane flying faster than the speed of sound, the speculations of imaginary travelers to the moon. The ship is manned by those who for a thousand years have been exploring a dream. Our destination is the stars.

For the youth of 1969, Spectorsky's dream was a reality. Man was no longer just a land or sea explorer. He was capable of plunging into space and returning, adding to his wealth of knowledge.

Much has been written during the last ten years concerning the preparation of aerospace teachers and the content they taught. Some of the literature is summarized in this chapter.

I. TEACHER PREPARATION

The need for teachers to acquire a reasonable understanding of aerospace concepts can be fulfilled in several ways (31:229):

1. Individual research
2. Articles, materials, and services
3. Short programs
4. Seminars and conferences
5. Institutes
6. Extension courses
7. Workshops

There may be some overlap and considerable latitude within each of these categories. The majority of teachers would most frequently come in contact with the first two ways listed above.

In the State of Washington, there were twelve two-year community colleges offering a variety of thirty majors in aerospace education in 1969. Two four-year institutions were involved in four programs leading to baccalaureate and higher degrees in some aspect of aerospace (8:1-13).

Additional ways for a teacher to acquire aerospace information would be as a member or participant in aerospace activities such as:

1. National Aerospace Education Council
2. Civil Air Patrol
3. Junior Air Force ROTC
4. Soaring clubs
5. Flying clubs
6. Meteorology clubs
7. Model rocket clubs
8. Building and flying aerospace craft
9. Astronomy clubs
10. Washington Aerospace Association

According to Crum (15), schools included aerospace education in their curriculum in the following ways:

1. All teachers emphasize aerospace topics at appropriate places in all subject fields at all grade levels.
2. Broad comprehensive units in which an aerospace topic serves as the central theme and all subjects contribute to the overall development of the unit.
3. Specific units in separate subject fields.
4. Enrichment assignments.
5. Special aerospace education classes.
6. Summer school programs in aerospace education.

A study by Byers in 1956 indicated that 46 per cent of the 120 secondary schools surveyed in North Dakota, South Dakota, and Minnesota were involved to some degree in aerospace education. Eighty per cent of this involvement was by integration of aerospace material into other courses in the curriculum. Of the schools not offering aerospace education, 89 per cent felt that the main reason was the lack of qualified staff (14).

A survey made by Sanderson Films, Inc. in 1969 of every public and private high school in the United States identified as conducting some form of aviation or aerospace program yielded a return of 222 questionnaires. This number was considered to represent 45 per cent to 50 per cent of existing programs. The following data was reported concerning teacher preparation (22:11-15):

1. Fifty-two per cent of the aviation/aerospace teachers held a Master's Degree, 44% had earned a Bachelor's Degree only, and 1% held Doctorates. Three per cent did not possess a college degree.

2. The undergraduate major fields of study of the teachers included 30% in science and 16% in industrial arts. The remaining 54% was distributed over more than 15 areas.

3. Sixty-two per cent of the teachers had never attended a college-level workshop or course designed to prepare teachers to teach the subject.

4. Of the reporting teachers, 14% held a student pilot license, 34% held a private pilot license, and 37% had earned their commercial pilot certificate.

5. Thirteen per cent of the teachers had qualified for the FAA advanced ground instructor certificate, while another 18% held a basic ground instructor license.

According to a guide published in 1956 by the office of Washington State Superintendent of Public Instruction, the "utilization of this course depends on time and facilities available and the qualifications of the instructor" (11). No attempt was made in the guide to define necessary qualifications of the aerospace course instructor. This same office in 1967 published a position paper for aerospace education, listing the following ways in which school districts were attempting to help teachers to become and to remain current in a practical understanding of the broad significance of the aerospace enterprise (28):

1. Districts conduct one to three-day institutes or conferences on aerospace education for all teachers to provide an initial stimulus.

2. Extended college-credit or professional credit workshops are designed to enable teachers to become more knowledgeable about aerospace matters and their implications for the curriculum.

3. Summer quarter study provides opportunities for thorough preparation for aerospace education activities.

4. Speakers, conferences, demonstrations, programs and visits to aerospace installations help teachers to keep current in this field.

5. Memberships and active participation in organizations devoted to the furtherance of aerospace education are encouraged.

6. A wide variety of current reference materials, instructional aids and curricular guides are provided.

II. AEROSPACE CONTENT IN SECONDARY SCHOOLS

At a Wright Memorial Dinner in 1953, General James H. Doolittle praised the efforts of 151 classroom teachers in promoting aerospace education by saying, "What you have done in developing among your students a greater interest in aviation is a public service of the highest order. . . . The future of freedom in this country and peace on earth will be determined in large part by our progress in aviation" (27:62).

The American Association of School Administrators stated the following as a case for enrichment of school programs through an aerospace-oriented curriculum (31:39):

> Aviation is having a profound effect upon the institutions and peoples of the world. Technology has given mankind a vehicle capable of transporting men, their goods, and their ideas through aerial pathways at fantastic rates of speed. Frequently, in the past, science and invention have speeded ahead of social adjustment, producing dislocations in society. The invention of the airplane and the discovery of atomic

> energy threaten to produce another period of social lag. Already aviation has influenced events and conditions of life and transformed old patterns of social living. Every objective of education, every social, scientific, and economic area with which education deals has been affected.

Aerospace topics could be included in the curriculum as broad comprehensive units, specific units in separate subject fields, and as special aerospace education courses. Webb (31:138-149) stated the following subjects as possible approaches to the organization of a separate course:

1. General aerospace education
2. Social studies emphasis
3. Earth and space sciences
4. Astrosciences
5. Aviation science
6. Career orientation or exploration
7. Vocational and technical training
8. The Air Force Junior ROTC Program

The following outline for a two-semester, general aerospace education course was developed under the auspices of the Civil Air Patrol (31:139-141):

Introduction to Aerospace
Theory of Flight
Aircraft Powerplants
Airports, Airways, and Electronics
Navigation and Weather
The Challenge of Aerospace Power
The Space Age

The Civil Air Patrol has prepared a package of coordinated materials of instruction, visual aids, supplementary resource materials, and guides for the above course.

Aviation Science--Guide for an Elective High School Course, published by the Washington State Superintendent of

Public Instruction in 1956, suggested the following two-semester outline for an elective high school course (11:1-4):

Background of Aviation
Aviation at Work
Navigation
Radio
Civil Air Regulations
Aircraft
Engines
Meteorology
Laboratory Flight Experience

This approach included both general aerospace education and an aviation science emphasis. A variety of reference materials and audio-visual aids was recommended for the course.

An entirely different approach to aerospace education involved vocational-technical programs. Aviation High School in New York offered its students both the FAA-approved airframe and powerplant mechanic's program with an approved airplane repair station. Clover Park Education Center at Lakewood City, Washington, used World War II surplus facilities in operating a series of aviation programs. They included airframe and powerplant mechanics training and flight operations (31:183-187).

A unique education concept, the "Flying Classroom," introduced students to the geography of their state, acquainted future agriculturalists with the benefits of aviation when linked with agriculture, and stressed the importance of aerospace. The Federal Way, Seattle, Kent,

and Renton School Districts in Washington (21) and the State of Montana (26) have developed outstanding "Flying Classroom" programs. These have been offering hundreds of high school students the opportunity to learn first-hand, rather than in the typical classroom situation.

The Sanderson Films, Inc., survey in 1969 revealed the following information concerning aerospace courses (22: 15-22):

1. There may be some degree of course content standardization, but there appears to be little agreement on course titles.

2. The majority of the high school aviation/ aerospace courses are quite young, with 68% in their first or second year of operation.

3. Few schools have more than one aviation/ aerospace class per day.

4. Most of the aviation/aerospace courses are designed as full-year programs, and offer students at least one credit applicable toward graduation.

5. Of the total responding schools, 73% utilize a commercially-produced audio-visual training course as instructional material.

6. Aviation-aerospace courses are offered predominately to the upper grade levels.

7. Most teachers feel that student orientation flights should be an integral part of an aviation/aerospace course. Such flights would afford students a practical application laboratory for classroom concepts.

8. Educators feel that the initial impetus to start a new aviation/aerospace offering in a high school comes from an interested teacher.

9. In terms of course content, programs offered primarily as a "ground school" account for 36%, while courses described as "general aviation" made up 41%.

10. Educators feel that the most urgent major problems confronting schools in the operation of an aviation/aerospace education program are: money, finding qualified teachers, and disinterest on the part of administrators.

III. SUMMARY

The review of the literature was concerned with two aspects of aerospace education; namely, the preparation of aerospace education teachers, and the content they teach.

The literature pertaining to teacher preparation indicated that there were few college curricula which included specific education for the preparation of teachers of aerospace subjects. In those high schools in which a course in aerospace was offered, the teacher also taught other subjects. However, there was a need for broader training of those teachers to prepare them specifically for teaching aerospace assignments.

The literature on content showed a substantial amount of material had been written concerning course outlines and the need for aerospace education. The works pointed out, however, that there was little agreement on course titles and on what the content of the aerospace courses should be.

CHAPTER III

TEACHER PREPARATION

The data presented in this chapter pertain to pre-service training, and in-service training of aerospace teachers. In the survey, 491 letters and questionnaires were sent to school principals. Fourteen principals indicated that their schools did not include pupils in any of the grades 9 through 12. Nineteen principals did not respond at all. Three hundred and eleven principals reported that their schools were not involved in teaching aerospace science units or courses. The principals of the remaining 147 schools submitted the names of 183 teachers involved in aerospace education. Three of these names were submitted too late to be used in conducting the survey.

Of the 180 questionnaires mailed to teachers, 119 or 66.5 per cent were returned. Thirty-seven of the questionnaires that were returned were not usable. Therefore, 82 (119 minus 37) or 69 per cent of the returned questionnaires were used in tabulating data. The returned questionnaires came from 82 teachers in 76 secondary schools. The data were derived from the responses on 60 unit questionnaires and 22 course questionnaires. Three of the course teachers also taught aerospace units in other science courses.

I. TRAINING

Degrees held by the aerospace teachers. All teachers who responded to the unit and course questionnaires held at least a bachelor's degree. Forty-five per cent of the total teachers held master's degrees. Table I presents the distribution of the degrees.

TABLE I

ACADEMIC DEGREES HELD BY AEROSPACE TEACHERS

Degrees held	Number of unit teachers	Number of course teachers
Bachelor's only	12	6
Fifth year	20	3
Master's	25	12
Doctor's	3	1

Major and minor fields of study of the aerospace teachers. Ninety-five percent of the unit teachers and 62 per cent of course teachers reported they had either a major and/or minor area of emphasis in science. Thirteen per cent of the total indicated they had not completed either a major or a minor in science areas. Table II summarizes the information.

TABLE II

AEROSPACE TEACHERS GROUPED ACCORDING TO PREPARATION IN SCIENCE

Preparation of the teachers in science	Unit teachers		Course teachers	
	Number	Per cent	Number	Per cent
Neither a major nor a minor in science	3	5	8	36
Major in science	48	80	10	45
Minor in science	31	51	7	33
Major and minor in science	22	36	8	36

Credits earned by the aerospace teachers. Fifty-eight per cent of the unit teachers and 54 per cent of the course teachers indicated they had no college credits in aerospace studies. A high percentage of the respondents had an emphasis in natural sciences and mathematics. Five teachers provided insufficient information. The distribution of the credits earned is presented in Table III.

Aerospace teachers completing a science methods course. Forty-six unit teachers and 12 course teachers reported they had completed a course in science methods. This represented 76 per cent of the unit teachers and 54 per cent of the course teachers, or 71 per cent of the total teachers.

Aerospace teachers completing a social science methods course. Nine unit teachers and 8 course teachers reported they had completed a course in social science methods. This represented 15 per cent of the unit teachers and 38 per cent of the course teachers, or 21 per cent of the total teachers.

Non-credit aerospace related conferences, conventions, institutes, or programs attended by aerospace teachers. Sixty-six per cent of the unit teachers and 33 per cent of the course teachers indicated they had not attended any

TABLE III

QUARTER CREDITS EARNED BY AEROSPACE TEACHERS
IN AEROSPACE STUDIES, SOCIAL SCIENCES, AND MATHEMATICS

Aerospace studies credits earned	Social sciences credits earned	Natural sciences, matematics credits earned	Number of unit teachers (60)	Number of course teachers (22)
Over 40	Over 40	21-40	0	1
21-40	Over 40	Over 40	2	0
1-20	Over 40	Over 40	3	2
1-20	Over 40	21-40	1	1
1-20	21-40	Over 40	2	0
1-20	21-40	1-20	0	1
1-20	1-20	Over 40	4	2
0	Over 40	Over 40	10	0
0	Over 40	21-40	1	0
0	21-40	Over 40	19	4
0	1-20	Over 40	13	5
0	1-20	21-40	0	1
0	1-20	1-20	0	1
0	0	Over 40	3	1
Insufficient data	--	--	2	3

special non-credit aerospace activities. Only one per cent of the unit teachers and 14 per cent of the course teachers reported having attended more than fifteen aerospace activities. Table IV summarizes these data.

Aeronautical ratings held by the aerospace teachers. Ninety-three per cent of the unit teachers and 52 per cent of the course teachers indicated they held no aeronautical ratings. Three unit teachers and seven course teachers held more than one type of rating. Table V presents the distribution of the ratings.

TABLE IV

AEROSPACE TEACHERS GROUPED ACCORDING TO NUMBER OF NON-CREDIT AEROSPACE-RELATED CONFERENCES, CONVENTIONS, INSTITUTES OR PROGRAMS ATTENDED

Number of activities attended	Per Cent of unit teachers	Per Cent of course teachers
None	66	33
1-5	28	43
6-10	5	5
11-15	0	5
More than 15	1	14

TABLE V

AERONAUTICAL RATINGS HELD BY AEROSPACE TEACHERS

Aeronautical rating held	Per cent of unit teachers	Per cent of course teachers
None	93	52
Private Pilot	1	31
Commercial Pilot	5	19
Instrument	3	5
Flight Instructor	1	19
Air Transport	1	0
Previous Military Pilot	5	9
Basic Ground Instructor	3	24
Advanced Ground Instructor	0	5

Pilot-In-Command hours accumulated by aerospace teachers. Fifty-eight of the unit teachers and 12 of the course teachers responded that they had not logged any Pilot-In-Command hours in the last twelve months. This represented 85 per cent of the total teachers. Six per cent of the total teachers had logged more than sixty hours. Table VI presents a distribution of these hours.

TABLE VI

PILOT-IN-COMMAND HOURS ACCUMULATED BY AEROSPACE TEACHERS DURING LAST TWELVE MONTHS

Number of hours	Number of unit teachers	Number of course teachers
None	58	12
1-10	0	1
11-20	1	1
21-30	0	0
31-40	0	1
41-50	0	1
51-60	0	2
More than 60	1	4

II. SUMMARY

All of the aerospace teachers held the bachelor's degree. Forty-five per cent of the combined unit and course teachers held a master's degree.

Ninety-five per cent of the unit teachers and sixty-two per cent of the course teachers reported they had either a major or a minor in science. Less than one out of four of the respondents indicated they had earned credits in the aerospace studies. Half of the total group reported they had not attended any special non-credit aerospace activities, nor had they acquired any aeronautical ratings.

CHAPTER IV

THE NUMBER, SIZE, DURATION, GRADE LEVELS, AND CONTENT OF THE AEROSPACE UNITS AND COURSES

The data presented in this chapter pertained to aerospace units and courses taught in 76 secondary schools. These schools were located in all parts of the state, in large and small communities.

Information regarding the units of study is presented first, and information regarding the courses is presented in a separate section.

I. AEROSPACE UNITS

Number and size of unit classes. Sixty-two teachers from 60 schools submitted usable information regarding aerospace units taught. Two of these teachers also taught aerospace courses. The total group taught 86 aerospace units in which 4,026 students were enrolled. Nine teachers who reported teaching a unit failed to indicate class size. The group responding showed an average class size of 47. The range in class size for the group was 5 to 208. Fifty-seven per cent of the classes had an enrollment over 30. Table VII shows the units grouped by grade level taught.

Type of courses in which units were taught. Fifty-eight of the units were taught in earth science courses.

TABLE VII

NUMBER AND SIZE OF AEROSPACE UNIT CLASSES
GROUPED BY GRADE LEVEL TAUGHT

	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9-10	Grades 11-12	Grades 9-12	Grades 10-12	Insufficient Information	Summary
Number of units	48	3	3	1	3	4	13	11	9	86
Number of pupils	2,670	90	75	120	60	65	447	499	--	4,026
Average class size	57	45	25	120	30	16	41	45	--	47
Range in class size	12-208	45	23-29	120	20-40	5-20	10-96	16-147	--	5-208
Number of classes over 30	29	2	0	1	1	0	5	3	--	41

This represented 67 per cent of the total units. The remaining 33 per cent were distributed over 7 different types of courses. Table VIII presents the distribution of this data.

TABLE VIII

UNITS GROUPED ACCORDING TO TYPE OF COURSE IN WHICH TAUGHT

Type of course	Number of units
Earth Science	58
General Science	8
General Physics	4
Physical Science	2
Earth and Space Science	2
Life Science	1
Chemistry	1
Geology	1
Insufficient Data	9
	86

Unit length reported in class periods. Thirty-three of the aerospace units reported were taught for 20-25 class periods. Twenty-two of the units continued for 26-30 periods. These two groups represented 64 per cent of the total. Table IX shows the number of units grouped according to length.

Number of units offered in required courses. Eighteen of the units were offered in required courses and 58 in elective courses. Ten teachers failed to supply sufficient information.

TABLE IX

UNIT LENGTH REPORTED IN CLASS PERIODS

Number of class periods	Number of units
20-25	33
26-30	22
31-35	3
36-40	6
41-45	4
Over 45	16
Insufficient data	2
	86

Additional aerospace units planned. Five of the teachers offering aerospace units planned to add additional aerospace units to the courses they were presently teaching. Fifty teachers stated they were not planning additional units. Five teachers failed to respond.

Content of the aerospace units. The majority of aerospace units dealt with the aerospace environment. Fifty-seven of the 86 units spent an average of 17 days on the topic of astronomy. The second most-emphasized topic was weather (meteorology). Fifty teachers spent an average of 15 days on the topic. No teacher reported teaching topics in the area of military aviation and space activities. The following four topics were included in more than one-half of the units: (1) astronomy, (2) conditions in space, (3) atmosphere, and (4) weather. Fourteen of the topics were taught in less than ten per cent of the units. Teachers of 10 units failed to supply sufficient information. Data from the 37 topics taught by unit teachers are recorded in Table X.

Techniques, equipment, and materials used by aerospace unit teachers. Fifty-one of the 62 aerospace unit teachers used audio-visual aids in their teaching. Forty-eight teachers reported using lecture and discussion methods. No teacher reported using orientation flights as a means of teaching. Table XI shows the distribution of these and other techniques used by the teachers.

II. AEROSPACE COURSES

Number and size of special aerospace courses. Twenty-two teachers, all from different schools, reported teaching

TABLE X

THIRTY-SEVEN TOPICS TAUGHT BY THE TEACHERS OF 86 AEROSPACE UNITS, LISTED ACCORDING TO NUMBER OF UNITS IN WHICH TOPIC WAS INCLUDED, THE RANGE OF DAYS, AND THE AVERAGE TIME SPENT ON THE TOPIC

Topic	Column 2 No. of units in which no response was received for the topic	Column 3 No. of units in which topic was not included	Column 4 No. of the 86 units in which topic was taught	Column 5 No. of units (also included in preceding col.) in which topic was taught, yet teacher failed to indicate no. of days	Column 6 Range of days spent on the topic	Column 7 Average no. of days spent on topic
Area I. Aerospace Environment						
1. Astronomy (earth, moon, solar system, universe)	10	19	57	5	2-60	17
2. Conditions in space (e.g., solar winds, radiation)	10	31	45	4	1-40	6
3. Atmosphere (structure, composition, phenomena)	10	29	47	4	1-30	8

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
4. Weather (meteorology)	10	26	50	5	1-45	15
5. Aerospace geography	10	65	11	3	1-25	12
6. Time	10	46	30	4	1-10	5
Area II. Historical Development of Flight						
1. Mythology, legend, dreams and fiction	10	65	11	2	1-5	2
2. Pre-powered flight (e.g., kites, balloons, gliders)	10	64	12	2	1-8	2
3. Powered flight (e.g., dirigibles, planes, helicopters, autogyros)	10	63	13	2	1-15	4
4. Rocketry	10	56	20	2	1-10	3

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area III. Aerospace Medicine (Biology)						
1. Medical aspects of flight (psychological, physiological)	10	60	16	2	1-5	2
2. Pilot and astronaut psychological and physiological qualifications and training	10	64	12	3	1-5	2
3. Life support (e.g., food, oxygen, temperature, water, wastes, comfort, protection)	10	56	20	3	1-15	3
Area IV. Aviation Vehicles and Operations						
1. Aircraft (categories, classes, types, structure, parts)	10	72	4	1	2	2

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
2. Aircraft manufacturing and utilization (general, commercial, military)	10	71	5	1	1-2	1
3. Aircraft power plants and fuels	10	66	10	1	1-3	2
4. National airspace system, airports, air traffic control, and regulation	10	74	2	0	1-2	1
5. Aircraft communications	10	70	6	0	1-5	2
6. Aircraft instruments	10	71	5	0	1-2	2
7. Air navigation	10	68	8	0	1-5	3
8. Theory and principles of flight	10	62	14	1	1-10	3
9. Research and development	10	73	3	0	1-5	4

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area V. Space Vehicles and Operations						
1. Space vehicles (spacecraft, launch vehicles)	10	56	20	3	1-10	3
2. Space programs (manned, unmanned)	10	62	14	3	1-10	4
3. Space vehicle propulsion system	10	62	14	3	1-10	4
4. Space tracking and communication	10	63	13	3	1-10	3
5. Guidance and control systems	10	67	9	3	1-10	3
6. Space navigation	10	70	6	1	1	1
7. Astronaut training	10	67	9	2	1-5	1
8. Theory and principles of orbits and trajectories	10	65	11	2	1-10	3
9. Research, development, and manufacturing	10	72	4	1	1-5	2

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area VI. Aerospace and Society						
1. Impacts of aviation and space activities (economic, educational, legal, political, social, and technological)	10	67	9	1	1-5	2
2. Vocational opportunities in aerospace	10	69	7	1	1-3	2
3. Societies, organizations and associations in aviation and space	10	72	4	0	2	2
4. Governmental involvement in aerospace (promotion, regulation, financing)	10	71	5	1	2-5	3

TABLE X (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area VII. Military Aviation and Space Activities						
1. Military organization, functions, and operations	10	76	0	0	--	--
2. Military aerospace educational systems	10	76	0	0	--	--

TABLE XI

TECHNIQUES, EQUIPMENT AND MATERIALS
USED BY AEROSPACE UNIT TEACHERS

	Number of teachers
Audio-visual aids	51
Lectures	48
Discussions	48
Textbooks	44
Problem solving	43
Demonstrations	40
Experiments	38
Reviews	33
Student reports	28
Class projects	26
Reference work	26
Weather station activities	26
Field trips	23
Modifying work for slow learners	18
Local resources	18
Modifying work for superior students	16
Workbooks	15
National resources	14
Astronomy clubs or observations	9
Panels and committees	7
Model rocketry	7
Model airplane building and flying	3
Model ballooning	3
Kite building and flying	2
Amateur radio clubs or activities	2
Flying classroom	1
Orientation flights	0
Insufficient information	7

28 special aerospace courses in which 1,056 students were enrolled. The average section size was 22 students. Table XII shows the courses grouped by grade level. Table XIII shows the 28 courses grouped by the 20 different course titles.

Length of courses in semesters and days per week. Eighteen of the courses reported lasted for one semester, while the remaining 10 continued for two semesters. Twenty-one of the courses were held five days per week, 5 courses were held four days per week, and one was held two days per week. One course was held only one day per week.

Content of special aerospace courses. Seventeen of the 22 teachers included the topic of theory and principles of flight in their courses for an average of seven class periods. Seventeen teachers also taught the history of powered flight for an average of three class periods. These two topics were taught by most of the teachers, yet the topics of astronomy and weather had the highest average length, 14 and 12 class periods, respectively. Fifteen of the teachers included over half of the topics in their courses. All topics were taught by at least one of the reporting teachers. Data from the 37 topics taught by the course teachers are recorded in Table XIV.

TABLE XII

NUMBER AND SIZE OF AEROSPACE COURSES
GROUPED BY GRADE LEVELS

	Grade 9	Grade 10	Grade 10-11	Grade 11	Grade 9-12	Grade 10-12	Grade 11-12	Totals
Number of courses	4	1	1	1	7	6	8	28
Number of sections	7	2	2	2	9	11	12	45
Number of pupils	210	27	50	25	195	279	270	1,056
Average section size	30	13	25	13	22	25	22	22

TABLE XIII

NUMBER OF AEROSPACE COURSES
GROUPED BY COURSE TITLES

Course title	Number of courses
Aerospace I	1
Aerospace II	1
Aeronautics	3
Aerospace Education	2
Aerospace Education I (Jr. AFROTC)	1
Aerospace Science	1
Astronomy	2
Astroscience	1
Aviation	3
Aviation Education	1
Aviation Science	2
Aviation Technology	1
Flight Instruction	1
Fundamentals of Aerospace	1
Introduction to Aerospace	1
Introduction to Aviation	1
Meteorology	1
Navigation	1
Theory of Flight	2
Space Science	1
	28

TABLE XIV

THIRTY-SEVEN TOPICS TAUGHT BY THE TEACHERS OF 28 AEROSPACE COURSES, LISTED ACCORDING TO NUMBER OF UNITS IN WHICH TOPIC WAS INCLUDED, THE RANGE OF DAYS, AND THE AVERAGE TIME SPENT ON THE TOPIC

Topic	Column 2 No. of courses in which no response was received for the topic	Column 3 No. of courses in which topic was not included	Column 4 No. of the 28 courses in which topic was taught	Column 5 No. of courses (also included in preceding col.) in which topic was taught, yet teacher failed to indicate no. of days	Column 6 Range of days spent on topic	Column 7 Average no. of days spent on topic
Area I. Aerospace Environment						
1. Astronomy (earth, moon, solar system, universe)	5	16	7	3	2-40	14
2. Conditions in space (e.g., solar winds, radiation)	5	16	7	2	2-5	4
3. Atmosphere (structure, composition, phenomena)	5	9	14	3	1-20	4

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
4. Weather (meteorology)	5	9	14	4	2-20	12
5. Aerospace geography	5	14	9	4	3-20	8
6. Time	5	14	9	3	1-10	3
Area II. Historical Development of Flight						
1. Mythology, legend, dreams, and fiction	5	11	12	2	1-20	3
2. Pre-powered flight (e.g., kites, balloons, gliders)	5	9	14	5	1-5	2
3. Powered flight (e.g., dirigibles, planes, helicopters, autogyros)	5	6	17	5	1-30	4
4. Rocketry	5	10	13	5	2-5	3

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area III. Aerospace Medicine (Biology)						
1. Medical aspects of flight (psychological, physiological)	5	11	12	2	1-5	2
2. Pilot and astronaut psychological and physiological qualification and training	5	15	8	1	1-3	1
3. Life support (e.g., food, oxygen, temperature, water, wastes, comfort, protection)	5	19	4	1	1	1
Area IV. Aviation, Vehicles and Operations						
1. Aircraft (categories, classes, types, structure, parts)	5	8	15	2	1-14	4

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
2. Aircraft manufacturing and utilization (general, commercial, military)	5	12	11	2	1-5	3
3. Aircraft powerplants and fuels	5	8	15	2	2-13	5
4. National airspace system, airports, air traffic control and regulation	5	7	11	2	1-20	0
5. Aircraft communication	5	7	16	3	2-10	4
6. Aircraft instruments	5	8	15	2	2-14	7
7. Air navigation	5	8	15	2	5-35	9
8. Theory and principles of flight	5	6	17	4	2-15	7
9. Research and development	5	15	8	2	1-5	2

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area V. Space Vehicles and Operations						
1. Space vehicles (spacecraft, launch vehicles)	5	18	5	1	1-10	4
2. Space programs (manned and unmanned)	5	17	6	2	2-5	3
3. Space vehicle propulsion systems	5	16	7	3	1-3	1
4. Space tracking and communications	5	20	3	1	2-3	2
5. Guidance and control systems	5	20	3	1	2-3	2
6. Space navigation	5	18	5	2	1-3	2
7. Astronaut training	5	15	8	4	1-3	2
8. Theory and principles of orbits and trajectories	5	17	6	3	1-5	3

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
9. Research, development and manufacturing	5	20	3	1	1-3	2
Area VI. Aerospace and Society						
1. Impacts of aviation and space activities (economic, educational, legal, political, social, and technological)	5	10	13	2	1-10	4
2. Vocational opportunities in aerospace	5	14	9	2	1-10	4
3. Societies, organizations, and associations in aviation and space	5	14	9	2	1-4	2
4. Governmental involvement in aerospace (promotion, regulation, and financing)	5	15	8	2	1-8	3

TABLE XIV (continued)

Topic	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Area VII. Military Aviation and Space Activities						
1. Military organization, functions, and operations	5	20	3	1	2-7	4
2. Military aerospace educational systems	5	20	3	1	1-8	4

Techniques, equipment, and materials used by aerospace course teachers. Nineteen of the teachers reported using audio-visual materials in their classrooms. Eighteen teachers stated they used problem-solving, lectures, and field trips as a means of instruction. One teacher reported using the flying classroom, and one teacher taught a course involving flight instruction. Table XV shows the distribution of these data.

III. SUMMARY

Of the 491 secondary schools surveyed, 76 schools (or 15 per cent) reported being actively involved in aerospace education. Sixty-two teachers reported they included 86 aerospace units in science courses they taught, and 22 teachers reported teaching special, credited aerospace courses. Five thousand and eighty-two students were enrolled in both the units and courses.

Slightly over one-half of the units were offered to ninth graders, and 67 per cent of the total units were taught in earth science courses. Sixty-four per cent of the units lasted between 20 and 30 class periods. Only five per cent of the teachers planned to add additional aerospace units to their courses.

The majority of aerospace units being taught emphasized astronomy and/or meteorology.

TABLE XV

TECHNIQUES, EQUIPMENT AND MATERIALS
USED BY AEROSPACE COURSE TEACHERS

	Number of teachers
Audio-visual aids	19
Problem solving	18
Lectures	18
Field trips	18
Textbooks	17
Discussions	16
Reviews	16
Demonstrations	14
Student reports	13
Class projects	11
Reference work	10
Orientation flights	10
Model airplane building and flying	9
Model rocketry	8
Local resources	8
National resources	8
Experiments	7
Workbooks	7
Modifying work for slow learners	5
Modifying work for superior students	5
Panels and committees	3
Weather station activities	3
Kite building and flying	2
Astronomy clubs or observations	2
Model ballooning	1
Amateur radio clubs or activities	1
Flying classroom	1
Parachute jump	1
Aviation club	1
Flight instruction	1
Insufficient information	2

Only 10 of the reported 28 aerospace courses were taught for one full year. The course titles varied considerably, although the content seemed to be basic aviation and space material. The most-emphasized topics included astronomy, meteorology, theory of flight, and history of powered flight. A majority of the teachers used the general aerospace education approach as a guide for course content. Over 80 per cent of the courses were first initiated in 1968, and all courses were offered as an elective. Three additional courses were scheduled to begin in 1969-1970.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The purposes of this study were: (1) to survey the incidence of aerospace education in grades nine through twelve of Washington State schools, (2) to discover what courses and units included such education in the curriculum, (3) to determine who the teachers were, and the nature of their preparation, (4) to gain a description of what kind of education was attempted under the heading, and (5) to discover what the opportunities were for expanded aerospace education within the schools surveyed.

The study was limited to specifically-defined secondary high schools, and teachers who were teaching aerospace as a separate subject or as a specific unit in a natural science course.

The data were obtained by the use of questionnaires which were constructed after studying similar research techniques and obtaining suggestions from authorities. Eighty-two of the questionnaires, representing 57 per cent of the number sent to the teachers, were returned in a usable or partially usable form by 60 unit teachers and 22 course teachers. The returned questionnaires came from teachers involved in teaching 86 aerospace units and 28 aerospace

courses in 76 secondary schools.

Ninety-five per cent of the unit teachers and 62 per cent of the course teachers had either a major and/or minor area of emphasis in science. Slightly over half of both the unit and course teachers had not earned any college credits in aerospace studies. Most aerospace teachers had received training in methods of teaching science yet only about one-fifth had training in social science teaching methods.

Sixty-six per cent of the unit teachers and 33 per cent of the course teachers had never attended any special non-credit aerospace activities. Only seven per cent of the unit teachers and 48 per cent of the course teachers held aeronautical ratings.

The majority of aerospace units were taught in earth science courses and ranged from 20 to 30 class periods in length. The average class size was 47. Most units were part of courses offered as an elective. Only five of the unit teachers planned to add additional aerospace units to the courses they were presently teaching.

The majority of aerospace units dealt with aerospace environment. The units emphasized most were astronomy and meteorology. Only about 10 per cent of the topics were taught consistently by more than 50 per cent of the aerospace unit teachers.

The average size of the aerospace course classes was twenty-two. Little consistency was noted concerning course

titles. The majority of courses lasted for one semester, and all were offered as electives. Most of the aerospace courses were first initiated in 1968; only three additional courses were scheduled to begin in 1969.

The most-emphasized topics in the aerospace courses included astronomy, meteorology, theory of flight, and history of powered flight. About 50 per cent of the teachers included more than half of the topics in their curricula.

II. CONCLUSIONS

1. It seemed evident that both the aerospace teachers and secondary school principals were concerned about the teaching of aerospace, judging from their cooperation.

2. From the standpoint of academic degrees, aerospace teachers were well-qualified to teach school.

3. The large majority of aerospace teachers had completed a major and/or minor in science.

4. Slightly over one-half of the aerospace teachers had never attended non-credit aerospace-related conferences, conventions, institutes, or programs.

5. Only a small per cent of the aerospace teachers held aeronautical ratings.

6. From the standpoint of college credits earned in aerospace special non-credit aerospace activities attended, and aeronautical ratings held, aerospace teachers were not well-qualified to teach aerospace.

7. Few aerospace teachers made orientation flights available to students.

8. The teaching procedures used by the aerospace teachers were quite limited. There appeared to be a lack of concern for student participation.

9. Aerospace unit topics were taught with less consistency than was anticipated.

10. Topics dealing with aerospace environment were taught more consistently in both the units and courses than were the other topics.

III. RECOMMENDATIONS

The overall aerospace education background of the investigator and the findings of this study were used in the development of the following recommendations:

1. Studies similar to the present one should be conducted over a period of years to determine the fluctuation of content taught in aerospace courses. In this way it might be possible to design a suggested standard program for the preparation of aerospace teachers.

2. Prospective science teachers who may be expected to teach aerospace units should earn a minimum of a college minor in aerospace studies. Course teachers should earn a minimum of 30 credits in aerospace studies.

3. A prospective general science or earth science

teacher should receive training in meteorology and astronomy, since he will probably have the opportunity of teaching these topics as they are an integral part of general and earth science courses.

4. School districts should encourage their teachers to attend aerospace conferences and workshops, and, if possible, provide expense money for this purpose.

5. Steps should be taken on the state and district levels to build teacher interest in the field of aerospace education.

6. An attempt should be made to update the existing state Aviation Science--Guide for an Elective High School Course.

7. The size of aerospace sciences classes should be kept consistent with other comparable school offerings.

8. An attempt should be made to offer all aerospace course students an actual flight experience.

9. Aerospace education teachers should be creative in the procedures and techniques used in dealing with youth.

10. Aerospace education should be recognized as an integral, and very relevant, part of the modern secondary school curriculum, and adequate funds should be made available to support it.

11. Financial aid might well be sought from industry and/or agencies to subsidize the adequate training of aerospace teachers, and to launch a number of experimental and

creative aerospace programs.

The study has pointed out the need for further research toward determining an adequate course of study for prospective aerospace teachers.

Another need pointed out was for more consistency in content of aerospace education, both in units and courses.

An overall need for additional research was evident, so that a more consistent program could be developed and established in all the areas involved in aerospace education, from providing adequate and proper training for teachers to determining the content and emphasis needed in the classroom.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. "Aerospace," Compton's Pictured Encyclopedia (1964 ed.), Vol. I.

2. "Aerospace Education." Prepared for Civil Air Patrol by Air Force Personnel, H.Q. CAP-USAF, Ellington Air Force Base, Texas, 1626000-2.

3. Aerospace Education--A Frame of Reference. A report of a cooperative program in the public schools of Renton, Kent, Seattle, and Federal Way in Washington State, Roy R. Duncan, Director.

4. Aerospace Education Committee Annual Report. A report of the Aerospace Education Committee for the New York City Schools, 1967.

5. "A High School Aviation Program That Works," Flight. Reprint by the Federal Aviation Agency, GA-20-42-6R (n. d.).

6. "Air Education--Off They Go, Into the Wild Blue Yonder," School Management. Reprint by the Federal Aviation Agency, 1967.

7. A Tentative Study Guide in Aviation Science for Grades 11 and 12. Developed by the Aviation Science Guide Committee, State Department of Public Instruction and the Montana Aeronautics Commission, AV-47-2/65-600, 1965.

8. Aviation and Transportation Majors and Curricula Offered by Colleges and Universities. Office of General Aviation Affairs/Federal Aviation Administration/ Department of Transportation, GA-20-72, 1969.

9. Aviation Education Course--The Sanderson School Course Package. A collection of materials by Sanderson Films, Inc., Wichita, Kansas, 8365-C-66 (n.d.).

10. Aviation Education in the Schools. Statement by the Aviation Education Committee of the American Association of School Administrators. Washington, D.C.: National Aviation Education Council, 1955.

11. Aviation Science--Guide for an Elective High School Course. Superintendent of Public Instruction, Olympia, Washington, 1956.

12. Bernardo, James V. Aviation and Space in the Modern World. New York: E.P. Dutton & Co., 1968.

13. Bryan, Leslie A. and others. Fundamentals of Aviation and Space Technology. Illinois: University of Illinois, 1966.

14. Byers, Edgar M., Jr., "A Study of Aviation Education in the Secondary Schools of North Dakota, South Dakota, and Minnesota." Unpublished Master's Thesis, University of North Dakota, 1956.

15. Crum, J. Wesley, "Aerospace Education," Washington: Central Washington State College, 1969.

16. _____. Deputy for Aerospace Education, Washington Wing, Civil Air Patrol, in an interview on October 2, 1969.

17. "Curriculum Guide for the Air Force Junior ROTC Program of Aerospace Education in the High Schools of the United States, 1967-68." Air University, Maxwell AFB, Alabama, AFJROTC Manual 50-2, 1967.

18. Educational Guidance in the Space Age. Proceedings of the national conference for State Department of Education Guidance Directors, at the NASA Langley Research Center, Langley Station, Hampton, Virginia, April 13-16, 1964.

19. Exton, Eleine. "The Growing Importance of Aviation Education," The American School Board Journal. CXXVIII (May, 1954).

20. Falley, Richard Wayne, "An Analysis of Aviation Education in Selected Secondary Schools." Doctoral Dissertation, The University of Nebraska Teachers College, 1959 c. 1960.

21. "Flying Classroom-New Concept in Education Established in Washington School District," The Piper Pilot. Piper Air Science Education, reprinted and distributed through National Aerospace Education Council, Washington, D.C. (n.d.).

22. High School Aviation Aerospace Education Status Report. A report compiled by C.E. Neal, Sanderson Films, Inc., Wichita, Kansas, 1960.

23. Markowitz, Harold, Jr. "A Study of the Status of Aviation Education in the Public Schools of Florida." Unpublished Master's Thesis, University of Florida, 1955.

24. Mehrens, H. E. (ed.). Aviation in School and Community. Washington, D.C.: Judd & Detweiler, Inc., 1954.

25. _____. Education--Aviation--and the Space Age. A Handbook for the Modern Teacher. Civil Air Patrol, Bolling Air Force Base, Washington, D.C., 1959.

26. Montana's Flying Classroom. A report sponsored by the Montana Aeronautics Commission with the cooperation of the State Department of Public Instruction, 1966.

27. "National Committee to Observe the 50th Anniversary of Powered Flight," Flight. Washington, D.C., 1953.

28. Position Paper for Aerospace Education. Bulletin No. 142-67. Office of the Superintendent of Public Instruction, State of Washington, 1967.

29. Proposal for Research and/or Related Activities. Submitted to the Superintendent of Public Instruction for Support Through Authorization of the Research Coordinating Unit, Luther G. Baker, Jr., Initiator. Washington: Central Washington State College, 1968.

30. Spectorsky, A. C. (ed.). The Book of the Sky. New York: Appleton-Century-Crofts, 1956.

31. Strickler, Mervin K. (ed.). An Introduction to Aerospace Education. Chicago: New Horizons Publishers, Inc., 1968.

32. United States Aircraft, Missiles and Spacecraft 1968. Washington, D.C.: National Aerospace Education Council, 1968.

33. Van Deventer, C. N. An Introduction to General Aeronautics. American Technical Society, 1965.

34. Washington Education Directory, Washington Education Association, 1968-69 edition.

35. Zaharevitz, Walter. Curricular Experiences for a Summer Aviation Workshop. Published by the Federal Aviation Agency, GA-20-19-66-1,000.

APPENDICES

APPENDIX A

April 2, 1969

There has been much recent discussion in this state concerning aerospace education. A study is being conducted at Central Washington State College to determine the nature and extent of existing aerospace education programs which involve students in grades nine through twelve.

The schools to be studied are those which offer either a special accredited course in aerospace education (such as: Introduction to Aviation, Aerospace and Society, Meteorology, Astronomy, Flight Training, etc.) or science courses which include extensive units or areas (lasting twenty or more class periods) dealing with some aspect of aerospace education. If your school does not offer such work, please indicate below and return this letter.

If your school does offer aerospace work as described, please complete and return the enclosed form. A more detailed questionnaire concerning aerospace education at your school will be sent to the teacher(s) you list.

I have enclosed a stamped self-addressed envelope for your convenience. Thank you very much for your cooperation and assistance.

Sincerely,

Judith Ann Isaac
Graduate Student
Central Washington State College

Enclosure

_____ This school does not now offer a special aerospace course or other courses containing extensive aerospace units.

_____ This school does not now offer a special aerospace course but plans to do so within two years. If so, please complete the enclosed questionnaire, except for questions 1 and 2.

Name _____

School _____ District _____

Address _____

Number of years as principal _____ School enrollment _____

School grade level: _____ 7-9, _____ 7-12, _____ 9-12, _____ 10-12.

1. What special aerospace education course(s) does your school offer?

Course title	First Initiated	Instructors full name

2. How many semesters of special aerospace courses may a pupil complete in your school? _____

3. Is your school planning an additional aerospace course(s)?
_____ yes, _____ no, If yes, please complete the following.

   Course title _____ Grade level _____

   Number of semesters _____ Date to be initiated _____

   Brief description _____

4. Did your school sometime previously offer an aerospace course and then discontinue it? _____ yes, _____ no.
If yes, please state when and why it was discontinued. _____

5. Does your school offer science course(s) which include extensive units or areas (lasting twenty or more class periods) dealing with aerospace topics? _____ yes, _____ no. If yes, please complete the following.

Course title	Instructors full name

April 25, 1969

The study of aerospace education in the State of Washington would be greatly aided if you would complete and return as soon as possible the questionnaire which was sent to you concerning this matter. (If this letter reaches you after you have returned the questionnaire, please disregard.)

Realizing that as a principal your time is very limited, you have probably set the questionnaire aside.

Since this data which you can provide is vital to the study, I sincerely hope you will soon be able to give this matter your attention. If you have misplaced the original questionnaire, I have enclosed another for your use.

Again, I would like to express my gratitude for your cooperation and assistance.

Sincerely,

Judith A. Isaac
Graduate Student
Central Washington State College

Enclosure

APPENDIX B

April 28, 1969

There has been much recent discussion in this State concerning the need for aerospace education on the secondary level. A study is being conducted at Central Washington State College to determine the extent and nature of existing aerospace education programs.

Your principal has indicated that you are presently teaching a special aerospace course or a science course containing a significant unit (lasting twenty or more class periods) on some aspect of aerospace that involves students in grades nine through twelve. You are therefore in a position to provide the data requested. Will you kindly assist by filling out the enclosed questionnaire? A summary of the findings will be made available to all participants upon request.

It will be greatly appreciated if you will return your completed questionnaire within ten days. I am enclosing a stamped self-addressed envelope for your convenience.

Thank you very much for your cooperation and assistance.

Sincerely yours,

Judith A. Isaac
Graduate Student
Central Washington State College

Enclosure

Teacher's Name _____ School Position _____

School _____ District _____

Address _____

SECTION I. TEACHER PREPARATION

1. What degrees do you hold?
_____ None, _____ Bachelor's, _____ Fifth Year, _____ Masters, _____ Doctor's

2. What were your undergraduate major and minor fields or areas in college?

Major(s) _____ Minor(s) _____

_____ _____

3. Approximately how many quarter credits did you earn in each of these fields in college? (Convert semester credits to quarter credits by multiplying by $1\frac{1}{2}$.)

Aerospace Studies	Qt. Cr.
Aerospace Education Workshops or Courses	_____
Airframe and Powerplant Mechanics	_____
Federal Air Regulations	_____
Navigation	_____
Theory of Flight	_____
Other (specify)	_____
Social Sciences	
Geography	_____
Economics	_____
History	_____
Political Science	_____
Sociology	_____
Transportation	_____
Other (specify)	_____

Natural Sciences and Mathematics	Qt. Cr.
Astronomy	_____
Biology	_____
Botany	_____
Chemistry	_____
Geology	_____
Mathematics	_____
Meteorology	_____
Physics	_____
Zoology	_____
Other (specify)	_____

4. Did you complete a course in college in science teaching methods?
_____ yes, _____ no

5. Did you complete a course in college in social science teaching methods?
_____ yes, _____ no

6. How many non-credit aerospace related conferences, conventions, institutes or programs have you attended?
_____ none, _____ 1-5, _____ 6-10, _____ 11-15, _____ more than 15

7. What aeronautical ratings do you hold?

_____ None	_____ Flight Instructor	_____ Basic Ground Instructor
_____ Private Pilot	_____ Air Transport	_____ Advanced Ground Instructor
_____ Commercial Pilot	_____ Military Pilot	_____ Other (specify)
_____ Instrument		

8. How many "pilot in command" hours have you accumulated within the last twelve months?

_____ none	_____ 11-20	_____ 31-40	_____ 51-60
_____ 1-10	_____ 21-30	_____ 41-50	_____ more than 60

SECTION II. SPECIAL AEROSPACE EDUCATION COURSES

Complete this section and Section IV of the questionnaire if you teach a special aerospace course(s) such as; Introduction to Aviation, Space, Astronomy, or Aerospace Education. Other science courses in which you include an aerospace emphasis or unit are to be reported in Section III and IV. If you teach both types of courses, please complete all sections.

1. List all special aerospace courses included in your 1968-69 teaching schedule.

Title of Course	Grade Level Offered	No. of Sem.	Hrs. Per Wk.	No. of Sections	Total Students Enrolled in Class	Yr. First Initiated

2. Does any other teacher in your school teach an aerospace course? _____ yes, ___ no
If yes, please give full name. _____

3. How many semesters of special aerospace courses may a pupil complete in your school? _____

4. Are any of the courses you listed above required for graduation by your school?
_____ yes, _____ no. If yes, state course title. _____

5. Is your school planning to introduce an additional aerospace course (s)?
_____ yes, _____ no. If yes, please complete the following.
Course title _____ Date to be initiated _____
Grade level _____ Brief Description _____
_____

SECTION III. SCIENCE COURSES CONTAINING A SIGNIFICANT UNIT ON SOME ASPECT OF AEROSPAC

Complete this section and Section IV of the questionnaire if you teach a science course which contains a significant unit on some aspect of aerospace (meteorology, space, navigation, theory of flight, astronomy, etc.). Report only those units lasting twenty or more class periods. If one course has two or more such units, report each unit separately.

1. List all science courses in your 1968-69 teaching schedule which contain significant unit(s) on some aspect of aerospace.

Title of Course	Title of Unit	Grade Level Offered	Unit Length in Class Periods	Total Students Enrolled in Unit	Is Cours Required or Electiv

2. Are you planning to introduce additional aerospace units to the courses you indicate above? _____ yes, _____ no. If yes, please complete the following.
Course title _____ Unit title(s) _____
Date to be initiated _____

SECTION IV. NATURE AND EXTENT OF EXISTING AEROSPACE COURSES AND UNITS

Complete this section of the questionnaire if you teach either an aerospace course or a science course containing a significant unit on some aspect of aerospace.

Below is a list of topics which might be taught either in an aerospace course or a science course containing a significant unit on some aspect of aerospace. Please indicate, on the blank lines to the right, the titles of all aerospace courses and units which you are now teaching. In the blanks provided below the titles you list, indicate the approximate number of days you spend on each topic. If you do not happen to include a topic in the courses or units you teach, please put a zero in the proper space or spaces. Please scan the remainder of the questionnaire before completing it. This will help to see how the topics are organized.

	Special Aerospace Courses Course Titles	Science Courses with Significant Units Unit Titles
Area 1. Aerospace Environment		
1. Astronomy (earth, moon, solar system, universe)		
2. Conditions in space (e.g. solar winds, radiation)		
3. Atmosphere (structure, composition, phenomena)		
4. Weather (meteorology)		
5. Aerospace geography		
6. Time		
7. Other(s) _____		
_____		
Area II. Historical Development of Flight		
1. Mythology, legend, dreams and fiction		
2. Pre-powered flight (e.g. kites, balloons, gliders)		
3. Powered flight (e.g. dirigibles, planes, helicopters, autogiros)		
4. Rocketry		
5. Other(s) _____		
_____		
Area III. Aerospace Medicine (Biology)		
1. Medical aspects of flight (psychological, physiological)		
2. Pilot and astronaut psychological and physiological qualifications and training		
3. Life support (e.g. food, oxygen, temperature, water, wastes, comfort, protection)		
4. Other(s) _____		
_____		

Area IV. Aviation Vehicles and Operations

1. Aircraft (categories, classes, types, structure, parts)
2. Aircraft manufacturing and utilization (general, commercial, military)
3. Aircraft powerplants and fuels
4. National airspace system, airports, air traffic control and regulation
5. Aircraft communications
6. Aircraft instruments
7. Air navigation
8. Theory and principles of flight
9. Research and development
10. Other(s) _____

_____

Area V. Space Vehicles and Operations

1. Space vehicles (spacecraft, launch vehicles)
2. Space programs (manned, unmanned)
3. Space vehicle propulsion systems
4. Space tracking and communications
5. Guidance and control systems
6. Space navigation
7. Astronaut training
8. Theory and principles of orbits and trajectories
9. Research, development and manufacturing
10. Other(s) _____

_____

Area VI. Aerospace and Society

1. Impacts of aviation and space activities (economic, educational, legal, political, social, technological)
2. Vocational opportunities in aerospace
3. Societies, organizations and associations in aviation and space
4. Governmental involvement in aerospace (promotion, regulation, financing)
5. Other(s) _____

_____

Area VII. Military Aviation and Space Activities

1. Military organization, functions, and operations
2. Military aerospace educational systems
3. Other(s) _____

_____

REMARKS: (Write here any information you feel is needed to clarify your responses.)

_____

_____

_____

_____

Which of the following teaching techniques, equipment, and materials do you use in teaching aerospace? Please check those which you use.

_____ Problem solving
_____ Lectures
_____ Discussions
_____ Reviews
_____ Panels and committees
_____ Field trips
_____ Demonstrations
_____ Experiments
_____ Class projects
_____ Student reports
_____ Reference work
_____ Textbooks
_____ Workbooks
_____ Audio-visual aids
_____ Modifying work for slow learners
_____ Modifying work for superior students
_____ Orientation flights
_____ Flying classroom (instruction from an airplane)
_____ Model Rocketry
_____ Model airplane building and flying
_____ Model ballooning
_____ Kite building and flying
_____ Astronomy clubs or observations
_____ Amateur radio clubs or activities
_____ Weather station activities
_____ Local resources
_____ National resources
_____ Other(s) (specify) _____
_____
_____

APPENDIX C

May 6, 1969

On April 2nd, I sent a letter and questionnaire to you requesting information about: (1) special aerospace courses, and (2) science courses that devote a significant amount of time (20 days or more) to aerospace topics -- aviation, space, astronomy, weather, meteorology, etc. You reported that your school does not offer any science courses in grades 9, 10, 11 or 12 that fall in category No. 2. The State Department of Public Instruction has reported that your school offers an "Earth Science Course" in grades 9, 10, 11 or 12. We are finding that most such courses contain a significant amount of aerospace material. Therefore, we are requesting a supplementary report to make certain that we do not miss any possibilities.

Does your school offer an Earth Science Course in grades 9, 10, 11 or 12 that contains aerospace material (aviation, space, astronomy, weather, meteorology, etc.) to the extent of 20 class days or more?
_____ yes, _____ no. If yes, please complete the following.

Course Title	Instructor's Full Name

Please complete and return this letter as soon as possible. Enclosed is a stamped self-addressed envelope for your convenience.

Thank you most kindly.

Sincerely,

Judith A. Isaac
Graduate Student
Central Washington State College

Please note: An address and signature were redacted from this page due to privacy concerns.