THE DEVELOPMENT OF AN AEROSPACE EDUCATION

TEACHER PREPARATION PROGRAM

By

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TABLE OF CONTENTS

Chapter Page

I. INTRODUCTION 1

Problem 6
Purpose of the Study 7
Objectives of the Study 7
Significance of the Study 8
Conceptual Assumptions 8
Definition of Terms 11
Outline of Work 12

II. REVIEW OF THE LITERATURE 14

The Role of Science Education in American Education 14
History of Current Standards of Student Achievement Scores 22
Project 2000 and Oklahoma State Science Standards 28
Talented Science Teachers in Every Classroom 30
The Future of Teacher Preparation with Respect to Aerospace Science Education 33
NASA's Education Program 35
Oklahoma State Department of Education Priority Academic Skills . . . 37

III. METHODOLOGY 40

Problem 40
Purpose 41
Research Design 41
Data Collection Plan and Recording 42

IV. FINDINGS 45

Problem 45
Purpose 46
Findings of Aerospace Engineering Programs 46
Findings of Aerospace Education Programs Founded by Government Agencies 48

Chapter Page

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 62

Introduction 62
Problem 63
Purpose 63
Objectives of the Study 64
Summary of Findings 65
Conclusion 66
Model Aerospace Education Teacher Preparation Program Proposed Courses 67
Recommendations 105

BIBLIOGRAPHY 109

APPENDIXES 115

APPENDIX A - THE PRESIDENT AND GOVERNORS' NATIONAL EDUCATION GOALS BY THE YEAR 2000 116

APPENDIX B - INSTITUTION REVIEW BOARD FORM 118

APPENDIX C - QUESTIONNAIRE OF ELECTRONIC SURVEY TO AEROSPACE EDUCATORS 120

APPENDIX D - MODEL AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM 123

LIST OF TABLES

Table Page

1. Universities with Aerospace Engineering Curriculum 47

2. NASA Education Framework Components 49

3. Model Aerospace Education Teacher Preparation Courses 54

4. Aerospace Education Specialists Responses to Model Aerospace Education Teacher Preparation Program Courses 56

5. Percentage of Aerospace Education Specialists Responses to Model Aerospace Education Teacher Preparation Program Courses 57

6. Aerospace Education Specialists Narrative Responses to the Open-Ended Question in the Questionnaire 60

7. Aerospace Education Teacher Preparation Proposed Course Titles 66

8. History and Development of Spacecraft and Spaceflight 67

9. Space Science I: Sun, Inner Planets, and Asteroid Belt 71

10. Space Science II: Outer Planets and Deep Space Probes 77

11. Earth Observations I-Land 80

12. Earth Observations II-Air 83

13. Earth Observations III-Water 86

14. Lunar Sciences and the Apollo Missions 89

15. Gemini Missions and Rocketry 91

16. Gravitation and Mechanics, Ellipses and Newtonian Mechanics 94

Table | Page

17. Space Flight Projects, Missions, Experiments, Space Craft 97

18. Forces of Flight, Launch, Cruise, Encounter, Return, Land 102

CHAPTER I

INTRODUCTION

In the beginning of the 1900s, no aerospace science education programs existed, much less an aviation school or university. The concept of human-powered flight did not even become a tangible thought until December 3, 1903. The Wright brothers achieved sustained, controlled flight by a powered aircraft and, in so doing, changed life for humankind forever (Bilstein, 1989, p. 2). From that point on the field of aviation grew.

Over time, aviation reached maturity. By 1914, regular passenger service had been implemented in Florida between St. Petersburg and Tampa. Later, the United States Aerofleet came to the European skies. The combined effect of military and commercial demands produced a dynamic new industry (Bilstein, 1989, p. 2).

At the end of the Industrial Revolution, aviation mechanics and aviators required a special education—learning about flying, safety, weather, and engines from skilled maintenance to the outer limits of performance.

The need for trained pilots and mechanics quickly led to the establishment of a new type of school, one focused completely on aviation. These organizations were often referred to as ground school, an airplane dealership, airmail service, flight training, and mechanic school.

During the 1930s the aviation industry suffered because of the globally felt financial pains of the Great Depression. By the end of the decade, however, World War II erupted in Europe and the demand for skilled aviators and mechanics grew significantly (Bilstein, 1989, p. 7). Many flight-training centers were the result of this demand.

After the Wright brothers' invention of the Wright *Flyer*, flying became an activity for man. The *Flyer* created interest in the spirit of invention within individuals, and the airplane evolved. With the 1939 monoplane jet, Americans became fascinated with the capabilities of the jet engine and worked towards reaching greater speeds with more efficiency. At approximately the same time, Werner von Braun was experimenting with the V-2 rocket in Germany, which was Hitler's highest priority. The rocket he launched barely cleared some low clouds. After World War II, von Braun received political asylum in the United States and continued to develop the V-2 rocket, which was renamed the A-2 rocket. Scientists, engineers, and technologists working with von Braun were constructing better engines and developing a rocket engine. In 1947, Chuck Yeager's flight of the rocket-powered Bell X-1 broke the sound barrier, and it became evident that flight with the use of rocket engines was a reality (Bilstein, 1989, p. 39).

Robert Goddard was known for his remarkable rocketry patents (DeVorkin, 1973, p. 406). He left behind 215 patents in rocketry and his estate still collects royalties. Goddard pursued the engineering technology needed to propel space rockets, experimenting with fuels and multi-staging devices. Goddard was the first to create solid rockets (those in which the fuel is in solid form) and from the 1920s he experimented with liquid-fueled engines (Bilstein, 1989, p. 14). Robert Goddard died in 1945, yet his contributions to space science are eternal.

The Cold War with the Soviet Union accelerated rocket research to enable long-range delivery of both conventional and nuclear bombs. Werner von Braun was convinced that these powerful machines could place satellites into orbit. The United States military first attempted orbital flights in 1956, but before they were successful, the Soviet Union changed the world with the launch of *Sputnik 1* on October 4, 1957 (Bilstein, 1989, p. 44). During the last 35 years, enormous numbers of satellites have been launched. In addition, numerous satellites are scheduled to be launched up to the year 2005. This is now a very serious situation because this collection of satellites is producing a ring around the Earth referred to as space debris.

The United States National Aeronautics and Space Administration (NASA) can now routinely send space flights anywhere within the known solar system. The NASA Space Shuttle program has taken many astronauts into space to conduct numerous science experiments to help humankind learn as much as possible in order to benefit ourselves and our world (Bilstein, 1989, p. 84). One global cooperative effort is the International Space Station. Countries have joined together to produce a science laboratory in space. All the data from these experiments will be shared with the seven participating countries, and technologies beyond our imaginations will be developed.

These great aerospace developments we have experienced in the last 10 years have made a great impact on our lives and have put strains on our youth. Students need to have science, mathematics, and technology in their curriculum to become future explorers of the Space Age. Educators are placed under great scrutiny to develop formal abstract thinkers that are articulate in aerospace principles and the pure sciences. Times have come and gone from the Expansion Era, Industrial Age, to the current Space Age. NASA has missions scheduled to Mars, International Space Station Missions that span into the next two decades, and a plan to begin hiring entry level science students in the year 2000. While the need for highly trained young minds becomes critical in the evolution of our world's needs, students are falling short on tests in Earth/Space Science categories.

The United States Department of Education has made mathematics and science a top priority. Our nation's Goals 2000 states that American students will be first in mathematics and science (See Appendix B). Mathematics and science are placed in top priority amongst our nation's leaders and should be held at a top priority in all 50 states across America. The United States Department of Education published a document entitled *Goals 2000* which listed the national goals in education to be accomplished by the year 2000. In *Goals 2000*, goal 4 states "The American students will stand first in mathematics and science." Aerospace science is understood to be completely physical science and is primarily focused on mathematics and scientific principles. Therefore, if students are to reach this goal mandated by the United States Department of Education, then the proper training must first take place with the teachers, and aerospace science is the most obvious to cover both areas. Because that there are no teacher training programs focused on aerospace science as a major, this poses a problem towards attaining this goal.

High-performing science students require highly trained teachers. Teacher training programs that develop first-rate teachers to better prepare our youth, especially in low-performing schools, are essential. Students' scores are directly related to the education they receive from their teachers. Students will have a better chance to perform highly if their teachers are trained thoroughly. This is crucial to the success of Goals 2000. If

America is going to stand first in mathematics and science, then teachers need to be highly trained specialists in their areas, and they can be with aerospace training.

There are a few universities that offer a space science class or two and may consider this aerospace science education. A void appears to exist in the United States for highly trained aerospace science educators. Universities across America are rich in developing aerospace engineers, mechanical engineers, orbital mechanics, and pure scientists in aerospace studies. Universities across America do offer teaching degrees in general science. These universities explain that the teacher must take 30 credits of science subjects in a pre-approved plan. A pre-approved plan means that the student and advisor schedule a set of science courses, and the student could theoretically take 30 credits all in one science subject. A student who is well versed in biology could discuss with the advisor that he or she would be more interested in taking all biology classes and then take 30 credits of biology classes. The student could earn all 30 credits and graduate as a general science teacher when in all actuality that teacher is a biology teacher. This teacher may have never once taken any physics or chemistry classes but on the job might be responsible for teaching these subjects. A biology teacher who is classified as a general science teacher may have to teach aerospace science subjects and may have never experienced any space science courses in his or her education. It is pertinent to our nation's Goals 2000 that teachers be trained explicitly in their areas and be prepared to teach American children to attain that goal of being first in the world in mathematics and science.

It is essential for American children to be educated thoroughly in aerospace science, because earth and space sciences are subjects frequently tested in the Iowa Tests of Basic Skills and the National Assessment Education Progress Reports, and because aerospace science skills are in high demand amongst aerospace businesses. Space sciences are recurrently topics of concern on assessments across the United States. NASA has made education a top priority and has established teacher resource centers in strategic places to better reach a greater number of America's educators. The teacher resource centers are in existence primarily to assist teachers in planning and preparing quality hands-on and minds-on activities. Even those organizations not directly involved in education realize how crucial it is for America's teachers to be armed with a strong background of sciences in order to help our students reach the mark of being first in the world in mathematics and science.

Problem

At present, the review literature uncovered no documented aerospace education teacher preparation program for teacher certification at the masters' degree level. There are many teacher preparation institutions that offer an astronomy class and may consider this an adequate aerospace education teacher preparation. Colleges of Education across the United States offer a general science major for elementary teachers. These teachers may choose to major in science education, for which they are required to take between 24 and 30 credits. There are few Colleges of Education that offer Aerospace Science Education majors across the United States. Americans must be given the opportunity to choose the highest standards of aerospace teacher preparation for themselves.

A need exists to identify a set of key elements that can be used to develop coursework required to create an aerospace education teacher preparation program.

These elements would become a knowledge base of aerospace science skills that could be used in establishing curricula within the Aviation and Space Education Program at Oklahoma State University. Teachers and students could benefit from such training.

Purpose of the Study

The purpose of this study was to develop an aerospace education teacher preparation program geared toward training future teachers in the specialized field of aerospace science education at the masters' degree level. The development of an aerospace education teacher preparation program is important because no such program was discovered in the review of literature in the United States for teacher certification at the masters' degree level. The developed aerospace education teacher preparation program should prove of value to those teacher colleges that have an aviation training program, the education community, the aerospace industry, students interested in pursuing careers in the space science fields, and those looking to develop future curricula for aerospace education teacher preparation programs of their own.

Objectives of the Study

The objectives of the study were to:

1. Identify Aerospace Education Programs.
2. Identify aerospace elements essential to an aerospace education teacher preparation program.
3. Identify universities that offer aerospace engineering curricula.

4. Research the elements that the Aerospace Education Specialists consider as key elements in an Aerospace Education Teacher Preparation Program.
5. Survey the Aerospace Education Specialists to find which courses they would consider as essential to the development of an Aerospace Education Teacher Preparation Program.
6. Develop an Aerospace Education Teacher Preparation Program for the masters' degree level.

Significance of the Study

The significance of this study is that after reviewing the volumes of materials supporting Aerospace Education and the need for such a program, one can infer that it is necessary to develop an Aerospace Education Teacher Preparation Program at the masters' level in education. This type of program is essential to the education of American children and to the promotion of qualified future aerospace industry employees. The Aerospace Education Teacher Preparation Program is intended for teacher training at the Oklahoma State University Aviation and Space Education Program, because in the review of literature no such teacher certification aerospace education teacher preparation program was discovered to exist in the United States today.

Conceptual Assumptions

First, if we truly expect American students to "be first in the world in science and mathematics" (Goals 2000, 1994, p. 8), we must allow more time for science learning and teacher preparation at all grade levels. Educators are described in numerous teaching journals, as being pressed for time to meet a variety of demands including the curriculum, school improvement, grading, and planning. The problem is that teachers' responsibilities increase; however, the number of hours in their teaching day remains the same. Teachers are responsible for covering increasing amounts of curriculum, with fewer teaching hours due to increased special events (gym, art, music, and sports). Many assume that teachers get the proper planning time to meet with department members, grade level teacher advisors, and curriculum specialists. In reality, rarely do teachers find enough time on a daily basis even to plan their lessons and prepare for the next day's event (Goals 2000 ACT, Teacher Planning Time, 1991). An aerospace education teacher preparation program curriculum would encompass; mathematics, science, and technology, and would reduce separate subject planning for the educator.

Second is the assumption that during professional development seminars or sessions, teachers are receiving what they need to advance education which is perceived as needing improvement, in their classrooms (Goals 2000, 1991). Professional development programs must provide the knowledge and skills that teachers need to make good decisions, including an understanding of the nature of science and of learners, as well as new ways of providing science education. Hands-on experiences are a great beginning. Various science education groups have used aerospace science education as a tool to stimulate interest. NASA has a teacher resource center for every state in America to further promote and practice aerospace science education in the classroom. An aerospace education teacher preparation program would develop hands-on and minds-on educators.

Third, in American education classrooms, one would imagine that science is taking place with state-of-the art laboratory equipment in state-of-the-art science classrooms.

The facilities used in science learning, both inside and outside of the school, should be up to date and available for students' use. To obtain a first-rate aerospace education teacher preparation program, a school should equip laboratories and add laboratories if needed, open existing facilities outside of the schools for greater student access, and collaborate in designing new facilities that will benefit students both during and after the regular school day.

Fourth is a conceptual assumption that involves technology. Technology is crucial in the evolution of all education programs today. An aerospace education teacher preparation program requires a developed technology program. It might be assumed that teachers are great technological advisors; however, many prefer not to be involved in the technology area at all. Instead of assuming that teachers take plenty of technology classes and that they are certified to teach technology courses, schools should increase access to technology by making the technology delivery system more friendly and providing easy access to data for learners of all ages.

Finally, when discussing conceptual assumptions, it is important that we consider the teachers and their relationship goals in their own personal development. Teachers need to be involved in the programs that take place in their school. They need to be involved in the planning of the schools' program development throughout their careers. To develop a thorough aerospace education teacher preparation program, teachers, as well as administrators, should engage in strategic planning to implement the new vision for science education.

Definitions of Terms

The following definitions are given to provide a clear and concise meaning of the terms used in the field of aerospace science education:

National Assessment of Educational Progress (NAEP) – Congress authorized the National Assessment of Educational Progress to assess those states that volunteered on a trial basis to see what their science progress was.

National Aeronautics and Space Administration (NASA) – National Aeronautics and Space Administration works to explore and conduct space science experiments, conduct research to promote life on earth, and to improve aeronautics technology.

National Science Teachers Association (NSTA) – National Science Teachers Association is an organization for educators that focuses on educating America's youth to be the first in the world in science, by following our nation's set goals in science education.

Committee for Education and Training (CET) – Committee for Education and Training, formerly the Committee on Education and Human Resources (CEHR), was established in 1990 and chartered under the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) reestablished in 1993. The CET has developed a federal strategy for science, mathematics, engineering, and technology education that will ensure United States world leadership in science and technology, build a highly trained workforce, and increase public understanding of science.

Outline of Work

I. RESEARCH

A. Research Aerospace Education Programs – NASA

B. Research universities with aerospace engineering curricula (Pure sciences)

C. Research National Science trends reported by NAEP

II. RELATIONSHIP

A. What are the essential elements for an aerospace education teacher preparation program?

III. DEVELOPMENT

A. From the information gathered, design an aerospace education teacher preparation program.

B. Design course descriptions to demonstrate aerospace education teacher preparation programs.

IV. FINDINGS

A. Introduction

B. Universities with aerospace engineering curricula (Pure Sciences)

C. NASA Aerospace Education Programs

D. Goals 2000

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. Introduction

B. Conclusions

C. Recommendations

CHAPTER II

REVIEW OF LITERATURE

A review of the literature regarding aerospace education programs, national educational standards, and education reform reveals an almost fanatical desire to change old systems into an evolved education program for an evolving society (Bell, 1984). The massive amount of literature and research on education reform and national standards provides interesting reading and critical insight for running aerospace programs theoretically. Few, however, offered ideas on aerospace education teacher preparation programs. None of the literature offered suggestions for developing an aerospace education teacher preparation program for teacher certification at the masters' level. Additionally, the literature seemed conflicting because state standards differed; however, our nation's goals seemed to govern the standards set by most states.

The Role of Science Education in American Education

Many changes in the American educational enterprise have occurred during the last century. After World War II, education had been characterized by a great deal of growth – growth in terms of school enrollment, teacher preparation, and curriculum development (Bureau of Census, 1980). The Bureau of Census, Statistical Abstract of the United States 1982-83, shows that between 1940-1980 the total population of public and private school enrollment doubled from 29,751,000 to 58,529,000 students. This increase in the student population quickly created a need to produce highly skilled teachers. As Allyn and Bacon (1988) expressed, "In this situation teacher certification requirements were lowered sometimes to the point at which no professional education training was required at all" (p. 14). From the 1950s through the 1980s, however, the nation seemed to meet the demand for more teachers. The quantity of teachers increased, but questions remain regarding the quality of these teachers. The requirements for teacher training programs differ across the nation to this day. The National Educators Association is currently creating a National Teachers Certificate that will hold a set standard and will be granted only after a teacher can prove excellence in numerous ways.

The school curriculum also experienced considerable growth during the past 60 years. This curricular growth, like most change, was the result of accumulation of many smaller events. The events included publication of the Eight Year Study showing that students attending progressive schools achieved as well as students in traditional schools, report Allyn and Bacon (1988). This report stimulated revision and experimentation of school curricula, teaching strategies, and teacher preparation programs. The 1938 Purposes of Education in American Democracy and the 1952 Imperative Needs of Youth helped to broaden our nation's school curricular offerings (Goldman, 1981).

Many issues in American history have encouraged evolution of teaching philosophy and pedagogy. From the beginning of the "Space Race" with the launch of *Sputnik I*, education has been pushed to the front of our nation's concerns. President Kennedy demonstrated this and made American education a top priority in his 1960 inaugural address (Kennedy, 1960, p. 1).

The Soviet Union on October 4, 1957, successfully launched and placed the world's first satellite into orbit around the earth. *Sputnik 1* had two radio transmitters on it, and it ushered the world into the space age. At that point in time, mathematics, science, and technology were the subjects brought into the attention of educators.

The launch of *Sputnik I* and the Soviet lead in rocket technology disturbed many in the United States. Intense debate about America's standing led to several important political decisions to bolster science and technology, among them establishment of the National Aeronautics and Space Administration in 1958 and passage of the National Defense Education Act as stated in the Science in Russia Exhibition of National Achievement, Smithsonian Institute (National Defense Education Act, 1958, p. 4).

Shortly after President John F. Kennedy announced in 1961 bold plans to fly Americans to the moon, Congress approved plans to develop the "space coast" of Florida for spacecraft launch and recovery purposes. This development urged Americans to direct their attention to the development of science education programs in elementary and secondary schools. In John F. Kennedy's Inaugural Address on January 20, 1960, he stated, "Let both sides [meaning the Soviets and Americans] seek to invoke the wonders of science instead of its terrors. Together let us explore the stars, conquer the deserts . . ." (Kennedy, 1960, p. 1). This statement spurred American educators to look more seriously at the science programs that were in existence and search for new approaches to master the art of science education.

After Congress passed the National Defense Education Act in 1958, a massive infusion of federal dollars went into improving United States science, mathematics, engineering, and foreign language programs. Eventually, innovative curricula grew out of this funding. Other programs such as guidance and gifted education were later funded through this act. Schools across the nation became more student-oriented.

If one were to compare today's school and role of the educator with the 1940s' school and educator, one would find impressive changes, according to Allyn and Bacon (1988). The 1940s' curriculum was very narrow and the role of the educator was very conservative and traditional, whereas today's curriculum is clearly broader and designed for students of all abilities. This 50-year growth in all areas of education has come through the work of many dedicated and extremely professional master educators. This expansion represents one of the truly significant historical accomplishments in American education.

The National Aeronautics and Space Act (NASA: Strategic Plan for Education, 1958, p. 14), signed by President Eisenhower on July 29, 1958, provided the way for NASA to devote research and development of science and engineering in numerous scientific arenas (NASA's Strategic Plan for Education, 1958). The next generation of scientists and engineers now in classrooms need to be educated about the scientific principles that govern the research being conducted today. This is why NASA developed its Strategic Plan for Education (1938-1998).

NASA and the nation's education system share the same goals – exploration, discovery, the pursuit of new knowledge to serve America and benefit mankind – and the achievement of these goals is interdependent. NASA depends on the United States education system to produce a skilled and knowledgeable workforce. The education community uses the space program to motivate and encourage students to study science, mathematics, engineering, and technology, and to offer students and educators unique research experience in those fields, through involvement in NASA's endeavors (NASA: A Strategic Plan for Education, 1958).

The release of "A Nation at Risk" in 1983 gave rise to hundreds of studies pointing to the need for fundamental improvements in our educational system. During the same period, NASA's education program underwent similar inspection and scrutiny in response to increased demand on our programs by both NASA management and the education community. The number and variety of new initiatives reflect an unprecedented importance placed on education both within NASA and across the nation (NASA: A Strategy for Change, 1938-1998). It became so important that NASA's Core Education Program became a program for continual revisions and a place to strive for excellence.

NASA's education vision includes three major goals that are broken down into five general objectives. The obvious vision NASA holds for itself is that it promotes excellence in America's education system through enhancing and expanding scientific and technological competence and literacy (NASA: A Strategy for Change, 1938-1998).

In doing so, NASA strives to be recognized by the education community as the premier mission agency in support of National Education Goals and in the development of education standards (NASA: A Strategy for Change, 1938-1998). The first goal set by NASA is the goal that maintains NASA's Education Program. Goal one is stated: to maintain that segment of NASA's current education program--hereinafter referred to as the base or core program--that is judged to be effective, based on internal and external customer measures of success. Such maintenance involves program revision, expansion, or elimination (NASA: A Strategy for Change, 1938-1998).

Goal 2 focuses on education reform and seeks to implement new education reform initiatives, which specifically address NASA mission requirements, national education reform, and National Science Technology Curriculum priorities (NASA: A Strategy for Change, 1938-1998).

Goal 3 is geared towards meeting the needs of large numbers of students. It is focused on significantly expanding the impact of the NASA education program by developing partnerships with external constituencies (NASA: A Strategy for Change, 1938-1998).

NASA has broken down these three goals and identified five objectives that meet the needs of teacher preparation and dissemination of scientific information to students across the United States. Objective one focuses attention toward the teacher and faculty preparation programs or enhancement where, through the use of NASA-related topics, programs are designed to increase teacher and faculty knowledge, research, and teaching skills and hence to increase teacher effectiveness (NASA: A Strategy for Change, 1938-1998).

Objective two deals with curriculum and material support. It states, "Curriculum support where programs create instructional materials based on NASA's unique mission and resources in the areas of science, engineering, and mathematics is crucial leading to increased student interest and achievement"(NASA: A Strategy for Change, 1938-1998, p.15).

Objective three focuses on comprehensive organization reform and systematic change, as well as institutional change. It states,

> Comprehensive organizational reform and systematic change as well as institutional require cooperative efforts. Typically involving collaborative efforts with a range of partners, seek to change and enhance multiple aspects of educational process including teaching, research, assessment, administration, and increasing student interest and involvement in the areas of science, engineering, and mathematics (NASA: A Strategy for Change, 1938-1998, p. 15).

Objective five is extremely thorough about education technology research and development. The objective states:

> Education technology research and development; programs and projects which use advanced technologies for education including, but not limited to, internet services, CD-ROM databases, live or taped video, computer software, multimedia systems, and virtual reality. Involves programs which support educational technology research and development, multimedia curricula, databases, and dissemination systems (NASA: A Strategy for Change, 1938-1998, p. 16).

This plan also delineates three "enabling systems" which support all of NASA's education programs and contribute to the achievement of the goals and objectives. Evaluation provides agency direction and plans to ensure documentation of program outcomes (both long term and short term). Educational technology outlines objectives to ensure that NASA maximizes our limited resources and expands the development and delivery of programs and materials to the broadest possible audience through the appropriate use of educational technologies. Dissemination provides a three-component system approach to ensure that information and materials are known by and available to the broadest segment of the educational community (NASA: A Strategy for Change, 1938-1998, p. 16).

This NASA education program focuses directly on teacher and faculty preparation and enhancement, curriculum support, comprehensive organization reform and systematic change, student support, education technology research and development, enabling systems that support each goal, and management priorities to guide the change process.

The NASA Strategic Plan puts forward a vision that sees the agency as an investment in America's future. NASA explains, "As explorers, pioneers, and innovators, NASA boldly expands frontiers in air and space to inspire and serve America and to benefit the quality of life on earth. NASA involves the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds" (NASA: A Strategy for Change, 1938-1998, p. 14). This clearly depicts the changing role of the educator as being an instrument who produces literate and efficient future scientists, engineers, and technicians. Today, science teachers are expanding their science backgrounds to include more than biology. With NASA Education Programs and teacher centers ready to serve teachers in all 50 states, teachers are given more opportunity to explore new ideas and projects provided by NASA.

In September 1989, President George Bush met with the nation's governors in Charlottesville, Virginia, to discuss the education crisis. Various department secretaries and the NASA administrator participated in this historic summit which outlined a set of national education goals.

In the 1990s the United States Department of Education focused on writing standards that could be met by educators and students across the nation. By 1994, *Goals 2000* was the main education reform tool used to advance education in America's youth.

In 1994, the Congress passed the Goals 2000: Educate America Act (Goals 2000, p. 38) which set forth eight goals. In brief summary they included: enhancing student achievement and citizenship, teacher education and professional development, making the

United States students first in the world in science and mathematics achievement, and advancing adult literacy and lifelong learning (see Appendix A).

In order to define the role of federal government in the implementation of the national education goals as they relate to science, mathematics, engineering, and technology, the science advisor to the President formed an interagency committee of those federal departments and agencies. The committee's missions are dependent upon a highly skilled science, engineering, and technology workforce. The Committee for Education and Training (CET) has developed a federal strategy for science, mathematics, engineering, and technology education which work toward ensuring United States world leadership in science and technology, building a highly trained workforce, and increasing public understanding of science.

The CET and NSTA first strategy focuses on federal research and development in education and training. The second strategy is to promote the use of technology to enhance lifelong learning. The third strategy in this effort is to promote excellence in science, mathematics, and engineering education (NASA's Strategic Plan for Education, 1993-1998). These federally-funded agencies, along with NASA, motivate teachers to better prepare themselves as conduits to funnel science, mathematics, and technology into the classroom.

History of Current Standards of Student Achievement Scores

The United States has established a goal that all students should achieve scientific literacy. The National Science Education Standards are designed to enable the nation to achieve this goal. Many types of individuals will play a critical role in improving science education. Those individuals are teachers, science supervisors, curriculum developers, publishers, those who work in museums, zoos, and science centers, science educators, scientists, engineers, school administrators, school board members, parents, members of business and industry, legislators, and other public officials.

Individuals from all of these groups have been involved in the development of the National Science Education Standards, and now must act together in the national interest. The National Science Education Standards are based on the premise that all students deserve and must have the opportunity to become scientifically literate.

Setting national goals and developing national standards to meet them are recent strategies in our education reform policy. Support for national education standards by state governments originated in 1989, when the National Governors Association endorsed national education goals. President George Bush immediately added his support by forming the National Education Goals Panel. The support for standards was continued by the new administration after the election of President William Clinton. These standards are being taught and assessed in classrooms across America today.

The document, *A Nation at Risk* (1983), caused reconsideration and reform of the United States education system, and the National Science Education Standards became involved with many science associations to address the issue. In 1989, the American Association for the Advancement of Science (AAAS), through its Project 2061, published *Science for all Americans,* which defined scientific literacy for all high school graduates. Later, the National Science Teachers Association (NSTA), through its Scope, Sequence and Coordination Project, published *The Content Core* (1992).

After many suggestions for improving the documents was analyzed, an extensive revision was prepared as a public document. This draft was released for nationwide review in December 1994. More than 40,000 copies of the draft *National Science Education Standards* were distributed to approximately 18,000 individuals and 250 groups. Their comments helped revise the draft into the final *National Science Education Standards* that are used and taught today.

The *National Science Education Standards* focuses great detail on organizing the standards, teaching methods, professional development, and assessment.

Assessments are the primary feedback mechanism in the science education system. They provide students with feedback on how well they are meeting expectations, teachers with feedback on how well their students are learning, school districts with feedback on the effectiveness of their teachers and programs, and policymakers with feedback on how well policies are working. This feedback in turn stimulates changes in policy, guides the professional development of teachers, and encourages students to improve their understanding of science.

Ideas about assessments have undergone important changes in recent years. Assessment and learning are two sides of the same coin. Assessments provide an operational definition of standards, in that they use measurable terms to define what teachers should teach and students should learn. When students engage in assessments, they should learn from those assessments.

Assessments should also measure the opportunity of students to learn science. Such assessments might measure teachers' professional knowledge, the time available to teach science, and the resources available to students.

The United States has a strong history of assessing the progress of education programs. One such assessment is called the *Nation's Report Card*. The National Center for Education Statistics publishes a report on policies and practices in schools across the United States (Nation's Report Card, 1969, p. 3). Schools voluntarily choose to participate in the assessment and evaluation. The *Nation's Report Card*, founded by the National Assessment of Educational Progress (NAEP), is the only nationally representative and continuing assessment of America's students', knowledge and performance in various subject areas including science. Since 1969, assessments have been conducted periodically in regard to reading, mathematics, science, writing, history/geography, and other fields. By making only objective information on student performance available to policymakers at the national, state, and local levels, NAEP is an integral part of our nation's evaluation of the condition and progress of education. Only information related to academic achievement is collected under this program. NAEP guarantees the privacy of individual students and their families.

In 1988, Congress established the National Assessment Governing Board (NAGB) to formulate policy guidelines for NAEP (1988). The Board selects subject areas to be assessed from among those included in the National Education Goals; sets appropriate student performance levels; develops assessment objectives and test specifications through a national consensus approach; designs the assessment methodology; develops guidelines for reporting and disseminating NAEP results; develops standards and procedures for interstate, regional, and national comparisons; determines the appropriateness of test items and ensures that they are free from bias; and takes actions to improve the form and use of the national assessment.

The current push in educational reform has its historical footings in a report entitled *A Nation at Risk* that was issued in 1983 by the National Commission on Excellence in Education. The report was critical of education in the United States and raised the concern that national student achievement across core subject areas was eroding. In the 15 years since the publication of *A Nation at Risk,* many studies have been conducted that identify deficiencies in the educational system and suggest how they can be rectified (*Commission on Pre-College Education in Mathematics, Science, and Technology, Educating America for the 21st Century: A Report to the American People)* written by the National Science Board (1983). Some evidence for these deficiencies can be found in reports such as NAEP 1996 *Trends in Academic Progress,* which has been tracking student performance since 1969.

The NAEP trend report revealed declines in overall science performance of 9-, 13-, and 17-year-olds during the late 1970s, followed by improvements in the 1980s. While the average performance of 9-year-olds was higher in 1996 than in 1970, the performance of 13-year-olds was the same as in 1970, and the performance of 17-year-olds was still below its 1969 level (NAEP, 1997).

Two documents that offered consensus on what content is most important to teach were published by the American Association for the Advancement of Science and the National Research Council of the National Academy of Sciences. In 1993 the American Association for the Advancement of Science published *Benchmarks for Science Literacy,* which consisted of statements of what all students should know and be able to do in science, mathematics, and technology. In 1995 the National Research Council of the National Academy of Sciences released *National Science Education Standards,* which articulated a vision of science education that makes scientific literacy for all students in the United States a reality by the 21stcentury. The *National Science Education Standards* also includes recommendations for teachers and other science educators on teacher education, assessment, and professional development.

Americans recognize the need for science education reform. A second concern is how science education can equip students with the knowledge and skills necessary for success in a technological world. Americans are also concerned about how the United States can remain competitive in a global economy. Given these concerns, educators, politicians, and stakeholders have been especially interested in findings of the *Third International Mathematics and Science Study* (TIMSS). *TIMSS* studied the educational systems in a large number of countries in terms of student achievement, curriculum coverage, and teaching methodologies as covered in *Science Achievement in the Primary School Years: IES's Third International Mathematics and Science Study* (1997). At the fourth grade-level, results revealed that students in the United States performed above the international average in science and were outperformed only by students from Korea. Twenty-six countries took part in this study at the fourth grade level, 17 of which satisfied study guidelines. At the eighth-grade level, United States students performed above the international average in science; however, students in 11 other countries had significantly higher average scores than the students in the United States. Forty-one countries participated in TIMSS and 25 countries satisfied guidelines. At the 12th grade-level, United States students performed significantly below the international average in "science literacy." Additionally, in physics, the United States had significantly lower achievement scores than all but one of the participating countries. At the 12th grade level, 21 countries participated in the science literacy component, eight of which satisfied study guidelines. Sixteen countries participated in the physics component, of which 10 satisfied the study guidelines. These scores are broken down into great detail in TIMSS 1995.

The TIMSS study will be repeated at the eighth grade level in 1999 and will assess the same cohort as was assessed in 1995 at the fourth grade level. It will provide a valuable comparison of student scale scores between 1995 and 1999 as well as a new indicator of how well the nations' eighth graders are doing in science and mathematics when compared to their counterparts in other countries.

At the state level, state and school policies and practices regarding how science is taught, how science teachers are prepared, and the emphasis science receives in school are some of the factors that determine how well students achieve. While it is too soon to ascertain whether reforms proposed for science education are achieving their desired goals at state and local levels, the NAEP 1996 science assessment provides an opportunity to examine current policies and practices. This report was written using data collected from students, teachers, and school administrators during the NAEP 1996 science assessment. It is intended primarily for policymakers, school administrators, and educators concerned with state- or school-level practices. The data provides a picture of current teacher practices, school policies, and student achievement that will allow comparisons to be made when the NAEP science assessment is re-administered in the year 2000 and beyond.

Project 2000 and Oklahoma State Science Standards

President Clinton and the governors of every state in America mandate the National Education Goals Act of 1998 and expect that these goals will be accomplished by the year 2000. The goals are that all children in America will start school ready to learn; the United States high school graduation rate will increase to at least 90%; all students will leave grades 4, 8, and 12 having demonstrated competency over challenging subject matter including English, mathematics, science, foreign languages, civics and government, economics, art, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our nation's modern economy; United States students will be the first in the world in mathematics and science achievement; every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship; every school in America will be free of drugs, violence, and the unauthorized presence of firearms and alcohol and will offer a disciplined environment conducive to learning; the nation's teaching force will have access to programs for the continued improvement of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students into the next century; and every school will promote partnerships that will increase parental involvement and participation in promoting the social, emotional, and academic growth of children (See Appendix A).

The focus of this study centers around our nation's fourth goal, which is all United States students will be first in the world in science and mathematics. The sub-categories beneath this goal state that mathematics and science education, including the metric system of measurement, will be strengthened throughout the system, especially in the early grades. The number of teachers with a substantive background in mathematics and science, including the metric system of measurement, will increase by 50%. The number of United States undergraduate and graduate students, especially women and minorities, who complete degrees in mathematics, science, and engineering will increase significantly. These are crucial factors when considering national science programs.

Talented Science Teachers in Every Classroom

In President Clinton's *Call to Action for American Education in the 21st Century*, (United States Department of Education, 1997) the President made it clear that his number one priority for the next four years was to ensure that Americans have the best education in the world. He issued a ten-point call to action for American education in the 21st century to enlist parents, teachers, students, business leaders, and local and state officials in this effort.

The second point in the ten-point action plan states American educational institutions will make sure that a talented and dedicated teacher is in every classroom. It stated that, in addition to the talented and dedicated teachers already in the classroom, 2 million new teachers will be needed throughout the next decade to replace retirees and accommodate rapidly growing student enrollments. The plan also states that the nation must take advantage of this opportunity to encourage teaching as a career, setting high standards for entering the teaching profession, and providing the highest quality preparation and training. The action plan states that the nation must reward good teachers, and quickly and fairly remove those few who don't measure up. The President's education budget will make it possible for 100,000 master teachers to achieve national certification from the National Board for Teaching Standards during the next ten years.

President Clinton continued to explain that every community should have a talented and dedicated teacher in every classroom and at least one master teacher certified by the National Board for Professional Standards in every school. Our most promising young people also must receive encouragement and support to become teachers.

The nation faces several challenges in sustaining and upgrading the quality of our teachers. This presents an enormous opportunity for ensuring teacher quality well into the 21st century, if we recruit promising people into teaching and give them the highest quality preparation and training (A Call to Action for American Education in the 21st Century, United States Department of Education, 1997).

As the nation demands higher levels of knowledge and skills from our students, society must honor and support our teachers in the classroom today, equipping and expecting them to master the basics and be prepared for employment and good citizenship. Without quality teachers and teaching, the most serious efforts to raise standards and improve schools will not succeed.

Americans all have a role to play in helping our teachers become the best in the world. Parents, schools, community leaders, universities, state leaders – and most importantly, current and future teachers – can take many steps to address this challenge.

In order to identify and reward our most talented master teachers, there must be a set of standards by which they can be accurately measured. For many years, educators, led by North Carolina Governor Jim Hunt and the National Board for Professional Teaching Standards, have worked diligently to establish nationally accepted credentials for excellence in teaching. More than 500 of these master teachers have been certified since 1995. Under the President's budget, 100,000 more teachers during the next 10 years will be able to seek certification from the National Board as highly accomplished master teachers – enabling at least one teacher in every school to receive certification from this board. States, school districts, and the private sector can also establish rewards for master teachers and other excellent teachers they identify in such ways as through teacher-of-the-year competitions. School districts can call on these teachers to become mentors for other teachers.

In *Achievement in Mathematics and Science* Ward (1983) reports that the number of qualified secondary mathematics and science teachers is declining. According to Ward, teaching has lost its allure for many qualified graduates; sizable numbers of those in the profession are leaving, attracted by the higher salaries and better working conditions in business and industry. In many states, mathematics and science requirements for elementary teachers are far from stringent, leaving teachers not as well qualified as they could be in these areas.

Ward (1983) also states, "Support for teaching mathematics and science has not been high over the past decade. Science educators noted that science had been almost universally de-emphasized during the seventies, with less time and money devoted to science at the lower grades and fewer required science courses at the senior high school level" (p. 20).

Science College entrance requirements were relaxed considerably in the 1970s. As a result, many students were understandably reluctant to tackle subjects often perceived as difficult without the incentive of requirements. This is a concern today, in the late 1990s, because it is these 1970s students who are now the parents of the current student population. It is pertinent to stress positive attitudes towards science education and a space science program because they could in fact stimulate the imaginations and initiatives in the current 1990s science student population.

Ward (1983) suggests that an essential first step must be to increase public awareness of potential shortcomings in science and mathematics achievement. Steps in this direction are being taken with Goals 2000. Other suggestions include: examining the strategies that work for science teachers, teaching analytical skills, upgrading teaching salaries, re-instituting and strengthening science requirements, and raising expectations for students' performance.

The Future of Teacher Preparation with Respect To Aerospace Science Education

Teacher preparation directly affects students' performance and if we expect our nation to be the first in mathematics and science, we should expect to have only first-rate teachers in each and every classroom across the United States. With space science coming to the forefront of educational programs, it is important that teachers become prepared to foster the imagination of American students in the arena of space sciences.

When the Ninety-eighth Congress passed the National Aeronautics and Space Act of 1958, it made the expansion of human knowledge of phenomena in the atmosphere and space, a specific objective of our nation's space program. In so doing, Congress recognized the importance of scientific research to the full utilization of space for peaceful purposes for the benefit of all humankind. "The space and Earth sciences have clearly demonstrated a major contribution to society's well-being through past accomplishments. These accomplishments have not only yielded a bounty of practical applications that have improved our quality of life, but have also been a major influence on our perspective of our place in the universe," explains the National Aeronautics and Space Administration in the Act of 1958 (NASA: Space Act of 1958, p. 1).

Dr. Noel Hinners of NASA Goddard Space Flight Center presented a broad overview of the fundamental advantages of investments in space sciences (NASA: A Strategy for Change, 1938-1998) He emphasized that a major achievement in such endeavors is one of stimulating our youth. Future science missions may benefit educational objectives to an even greater degree through an extensive tele-science network in which student involvement in experiments can be maximized through remote endeavors.

A report of the International Commission on Education for the Twenty-First Century, held in Paris, France, in January of 1994, states that there is an intense concern about the quality of teacher training. At present, teachers are too often trained in establishments where they have no opportunity of seeing science in the making and, at the primary levels, many teachers have received no training whatsoever in the natural sciences.

The solution lies within the methods of teaching being project-based, like science itself. The International Commission on Education for the Twenty-First Century (1994) states that science teaching must be project-based, since this type of establishment must be the nursery for future scientists and teachers of science. The beauty of science, as well as the human and social responsibilities of the scientist, must be made clear to the students. This is particularly important when developing curriculum in science education, no matter what discipline of science this may be.

NASA's Education Program

In the 1990s, America is challenged with reforming its education system to improve the competitiveness of our nation in the world community. NASA's education vision is to promote excellence in America's education system, access to informative materials, and engagement in NASA's exciting mission.

As a government agency whose basic product is the advancement of human knowledge, NASA hopes that the inspiration and intellectual excitement inherent in the Aeronautics and Space Program will enrich the study of social sciences, life sciences, physical sciences, mathematics, and technology at all levels of education. NASA is committed to promoting excellence in education, supporting the teaching profession, and increasing awareness of the impact science, mathematics, and technology will have on the quality of life in the 21^{st} century (NASA: Strategic Plan for Education, 1938-1998, p. 2).

NASA's education program is guided by its Strategic Plan for Education and is carried out through its nine field centers and the Jet Propulsion Laboratory. Its science, mathematics, and technology education programs and activities at all levels of education leverage NASA's inspiring missions, unique facilities, and specialized workforce.

At the elementary level, NASA seeks to enhance the knowledge, skills, and experience of teachers and capture the interest in science, mathematics, and technology through the demonstration of integrated applications of related subject matter.

At the higher education level, NASA provides undergraduate and graduate student incentives and opportunities and supports faculty preparation and enhancement through programs featuring active participation in NASA research.

NASA's education vision is ambitious, but the next generation of science, engineering, technology, and research will be only as good as the next generation of scientists, engineers, technicians, and teachers. To ensure the availability of a well-educated future workforce, NASA has committed the Agency's unique resources to promote excellence and diversity in the education system through enhancing and expanding scientific and technological excellence and equity.

As stated in *Strategy for Change,* 1938-1998, NASA will build upon the strength of the existing base program to contribute to educational excellence in a broader context. NASA has begun a number of initiatives that directly support the National Education Goals, the National Science Teachers Association, the Education and Training Committee implementation priorities, and the emerging national education standards. NASA will pursue efforts through partnerships with professional education associations, aerospace education organizations, industry, and other federal agencies. NASA's enabling systems will help ensure that high quality educational programs and materials are available to educators nationwide. For each of these areas, NASA has identified specific objectives and milestones against which NASA will measure their progress over the next five years. NASA has also identified four management priorities to focus NASA's internal efforts in the future. These management priorities are the first steps along the road to excellence in all areas of education (NASA: Strategy for Change, 1998, p. 2).

The scope of NASA's role in education is small when compared financially to that of the Department of Education or the National Science Foundation. Yet, by utilizing NASA's unique resources--its facilities and personnel--NASA has the opportunity to use its inspiring mission as an effective vehicle for teaching and for learning. As a federal agency with a vested interest in the nation's scientific and technological health, education is not only an opportunity for NASA, it is viewed as an obligation.

Oklahoma State Department of Education

Priority Academic Skills

The Oklahoma State Department of Education has a document titled Priority Academic Student Skills and is commonly referred to as PASS. This document is the core guideline for teachers to implement as the core curriculum being taught across the state in each and every classroom. The Priority Academic Student Skills for science identify what Oklahoma students should demonstrate at specified grade levels in this core curriculum area. Oklahoma educators should integrate the science processes with district-selected content to develop a complete curriculum.

The Priority Academic Student Skills should be taught during the early grades and learned by investigating broad, integrated content, concepts, and principles in Earth/Space, Life and Physical Sciences. This is the main statement written in the Priority Academic Student Skills document throughout the early grades until the 12^{th} grade level without any specific content strands sited in Earth/Space, Life and Physical Sciences area. The skills that are identified are skills that fall under these classifications, observing and measuring, classifying, experimenting, communicating, interpreting, and safety.

The State of Oklahoma mandates two kinds of tests for students: Norm-Referenced and Criterion-Referenced. The Iowa Test of Basic Skills is the Norm-Referenced Test and the Oklahoma Priority Academic Student Skills Test is the Criterion-Referenced Test. The manner in which the results are reported is different for each test.

The Oklahoma State Department of Education experts, Kathy Thomas and Barbara Howe, explained this testing methodology and pedagogy as its' common practice.

The Norm-Referenced Test called the Iowa Test of Basic Skills is designed to indicate relative rankings of student performance in the academic skills and knowledge tested as Barbara Howe explained from the Oklahoma State Department of Education. Design of the test begins with clusters of skills and/or knowledge to be measured. The test is commercially produced and developed by test publishers on objectives commonly used by local school districts throughout the nation. Scores on norm-referenced tests are interpreted in a way that compares an individual student's performance with that of the class, school, district, state, or nation norm group.

Howe explained, results of the Iowa Test of Basic Skills are reported to parents, teachers, and school administrators. The State Board of Education, Governor, Speaker of the House of Representatives, and the President Pro Tempore of the Senate receive a copy of these results, as well. This type of testing gives individuals a relative indicator as to how the student population is performing relative to the rest of the nation.

The second test is a Criterion-Referenced test that is designed to measure specific skills and knowledge as Kathy Thomas from the Oklahoma State Department of Education explained. The objectives measured are written by the test user and in some cases by commercial test writers. Scores on these tests are interpreted in a way that compares an individual student's performance with a proficiency level reflecting satisfactory performance. The Oklahoma State Department of Education has two offices that are very concerned with these results, the assessment office and science department. Both of the personnel directors for these offices, Barbara Howe and Kathy Thomas, explained that the state issues the Priority Academic Student Skills Test, and then they are analyzed to determine which districts need improvement and which districts do not need improvement. Because the Oklahoma State Department of Education groups the students by district and then categorizes the students into two groups, either *satisfactory* or *needs improvement*, the State is reluctant to share that information for the purpose of this study. The State of Oklahoma has declined to share that information but shared the Iowa Test of Basic Skills results for the years 1997, 1996, 1995, 1994 and 1993. The science coordinator for school improvement in the Oklahoma State Department of Education, Kathy Thomas, selected the most recent data and was reluctant to verbally comment on the means by which she selected these years. When asked, "What means did you use to discriminate among them?" Thomas responded, "We have always identified schools as *needs improvement* or *satisfactory*. It is the way business has been done."

CHAPTER III

METHODOLOGY

Problem

At present, the review of literature did not uncover an aerospace education teacher preparation program for teacher certification at the masters' degree level. There are many teacher preparation institutions that offer an astronomy class and may consider this an adequate aerospace science education teacher preparation. Colleges of Education across the United States offer a general science major for elementary teachers. These teachers may choose to major in science education, for which they are required to take between 24 and 30 credits. There are few Colleges of Education that offer Aerospace Science Education majors across the United States. Americans must be given the opportunity to choose the highest standards of aerospace education teacher preparation for themselves.

A need exists to identify a set of key elements that can be used to develop coursework required to create an aerospace education teacher preparation program. These elements would become a knowledge base of aerospace science skills that could be used in establishing curricula within the Aviation and Space Education Program at Oklahoma State University. Teachers and students could benefit from such training.

Purpose

The purpose of this study was to develop an aerospace education teacher preparation program geared toward training future teachers in the specialized field of aerospace science at the masters' degree level. Developing an aerospace education teacher preparation program is important because currently no such program was found in the review of literature to exist in the United States. The developed aerospace education teacher preparation program should prove of importance to those teacher colleges that have an aviation training program, the education community, the aerospace industry, students interested in pursuing careers in the space science fields, and those looking to develop future curricula needed to develop aerospace education teacher preparation programs of their own.

Research Design

This was an action research and historical research combination study that took data from various aerospace science education materials, programs, and agencies in the United States. Materials were evaluated in order to find common curricular essential elements to develop an aerospace education teacher preparation program intended for colleges and universities to implement at the masters' degree level. Course work, concepts, and ideas could be adapted to meet the needs of students at the undergraduate level. The steps involved a thorough research of the literature in the education and aerospace field. The major aerospace education resources that are publicly available were found in a variety of areas, namely, earth science, space science, human exploration, development of space, and aero-space technology. One very helpful resource is a handbook titled *A Guide to Aviation Education Resources*, (National Coalition for Aviation Education, 1997). This book lists 32 different aerospace associations, foundations, organizations, and societies. The book describes each organization, the organization representative, gives the organization's address, telephone number, and a brief description of the organization. It is intended to be a support manual for teachers who wish to request materials and/or information about their organization. This book was used to identify the major aerospace agencies.

Curricula and education plans for teacher preparation were requested from the 32 different aerospace associations. Content analysis was the primary method employed to identify common essential elements in aerospace programs. The essential elements were identified from information received and researched from college curriculum guides or handbooks, NASA education programs, and the National Coalition for Educators of Aviation.

Data Collection Plan and Recording

Committee members volunteered input toward the development of an electronic mail survey to the 35 Aerospace Education Specialists that are in the NASA Education Program conducted by Oklahoma State University. The survey consisted of 12 questions and is contained in Appendix C. The first 11 questions consist of class subjects suggested to be taught in an aerospace education teacher preparation program. The Aerospace Education Specialists were to respond by checking one of three choices as their answer. The answers they were to choose among were: *include*, *include if time permits,* and *do* *not include*. The 12th question was an open-ended question that asked: Are there any other subjects that are essential to an aerospace teacher certification program that are not listed here? If so, what are they?

The Oklahoma State University NASA Aerospace Education Services Program (AESP) was instrumental in locating, instructing, and facilitating the development of the electronic survey by utilizing the skills of the AESP Technology Specialist in developing the interactive survey. The survey was electronically mailed to the 35 Aerospace Education Specialists by the Oklahoma State University NASA AESP Office so that their identities remained anonymous. The responses were returned to the Oklahoma State University AESP Office and forwarded to the researcher. The responses of the participants in the survey were never identified to the researcher. The Institutional Review Board (IRB) approved the study on March 1, 1999. The IRB # ED-99-092 approval is contained in Appendix B.

From the recorded surveys and literature review containing essential elements, a revised list of aerospace education teacher preparation program courses was generated. This process was completed by identifying repetitive comments that were consistent with the methods of content analysis. Looking for the pedagogical strategies and philosophical beliefs consistent in educational practices, an aerospace education teacher preparation program was formulated that was consistent with the suggestions from the Aerospace Education Specialists, the literature review, aerospace agencies, associations, and industry. The decision rules used to revise the list were: (a) Aerospace Education Specialists had to make sound pedagogical and philosophical statements to be considered valid. (b) They were held and comparatively reviewed with educational recommendations from the aerospace agencies, associations, and industry (c) The statements were kept and utilized in the model if they fell under recommendation by experts and were discarded if they had no proof to verify the statement. This process lead to the development of an Aerospace Education Teacher Preparation Program intended to be implemented at the masters' degree level. This aerospace education teacher preparation program is also intended to be implemented in colleges and universities across the United States. The Model Aerospace Teacher Preparation Program is located in Chapter V. See Tables 8 through 18.

CHAPTER IV

FINDINGS

Problem

At present, the review of literature did not uncover an aerospace education teacher preparation program for teacher certification at the masters' degree level. There are many teacher preparation institutions that offer an astronomy class and may consider this an adequate aerospace education teacher preparation. Colleges of Education across the United States offer a general science major for elementary teachers. These teachers may choose to major in science education, for which they are required to take between 24 and 30 credits. There are few Colleges of Education that offer Aerospace Science Education majors across the United States. Americans must be given the opportunity to choose the highest standards of aerospace education teacher preparation program for themselves.

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Purpose

The purpose of this study was to develop an aerospace education teacher preparation program geared toward training future teachers in the specialized field of aerospace science at the masters' degree level. The purpose of developing an aerospace teacher education program is important because currently no such program exists in the United States. The developed aerospace education teacher preparation program should prove of value to those teacher colleges that have an aviation training program, the education community, the aerospace industry, students interested in pursuing a career in the space science fields, and to those looking to develop future curricula for an aerospace education teacher preparation program of their own.

Findings of Aerospace Engineering Programs

Numerous universities across the United States have Aerospace "pure science" programs. These universities are pure science programs in the sense that aerospace engineering, mechanical engineering, and electrical engineering are the main areas of focus. A table has been devised to identify universities that offer aerospace engineering degrees and that have aerospace curricula specifically illustrating the master's degree program credit requirements. See Table 1.

TABLE 1

UNIVERSITIES WITH AEROSPACE ENGINEERING CURRICULUM

University	Degree	Credits in Approved Plan
Auburn	Master of Science	48
California Polytech State	Master of Science	45
Caltech	Master of Science	54
Embry-Riddle Aeronautical	Master of Science	30
Florida Institute of Technology	Master of Science	34
Iowa State	Master of Science	21
North Carolina State	Master of Engineering Master of Science	33 30
Oklahoma State	Aerospace Engineering Master of Science	30
Old Dominion	Aerospace Engineering Master of Science	30
Purdue	Master of Science	30
Rensselaer Polytechnic Institute	Master of Engineering, Aerospace Engineering Master of Science	30
St. Cloud	Aviation	30
Stanford	Master of Science	30
Syracuse	Master of Science	30
University of Arizona	Master of Science	32
University of Colorado at Boulder	Master of Science	30
University of Maryland	Master of Science	30
University of Michigan	Master of Science in Engineering	30
University of Oklahoma	Master of Science	30
University of Texas at Austin	Master of Engineering	30
University of Washington	Master of Aeronautical Engineering	37 + 8 credits of independent or team project work
Virginia Tech	Master of Science	30
West Virginia	Master of Science in Aeronautical and Mechanical Engineering	30

The above named universities all have described 30+ credit plans of academic preparation to become an aerospace engineer at the masters' level. When reading the course descriptions and university catalogs, the individual is faced with numerous decisions to make regarding course selection. The students are advised to select classes that the advisor has recommended as part of their plan of work. Every aerospace engineer could have taken a variety of science, mathematics, and technology classes. The important point made is that these universities recommend a strong foundation of pure sciences in the fields of science, mathematics, and technology. Therefore, the same holds true for an aerospace education teacher preparation program.

Findings of Aerospace Education Programs Founded By Government Agencies

Today, an infinite number of student aerospace education programs and materials are published globally. Teachers across the United States use these materials to supplement the curriculum guidelines in their districts. Some teachers use more materials than other teachers do and some teachers may choose to not seek out any supplemental materials at all. The important point is that many teachers make use of such education materials and recognize their need to enhance their aerospace background or professional training.

Since an aerospace education teacher preparation program for masters' level students was not found in the review of literature, teachers turn to nationally recognized experts in the field. NASA is the most obvious agency with respect to this domain. The programs explained below are in effect today because of NASA's Education Program that is guided by its Strategic Plan for Education and its Strategy for Change written in December 1992. NASA has created a framework that is organized into four rows of subject content, each progressing through five grades of education and grade level. See the Table 2.

TABLE 2

NASA EDUCATION FRAMEWORK COMPONENTS

Strategic Enterprises	Content				
Earth Science	X	X	X	X	X
Space Science	X	X	X	X	X
Human Exploration/Development of Space	X	X	X	X	X
Aero-Space Technology	X	X	X	X	X
Level of Study	K-4	5-8	9-12	UG	G

All the areas of content are researched and developed by NASA from kindergarten throughout the graduate level. NASA has many categories of programs: Research and Development, Educational Technology, Student Support, Support for Systematic Change, Curriculum Support and Dissemination, and Teacher/Faculty Preparation and Enhancement. These are in place to develop education programs for all levels of education. The following is a summary if these six program categories.

Teacher/Faculty Preparation and Enhancement can be described as NASA using its missions, facilities, human resources, and programs to involve educators and faculty ti advance their knowledge and skills (NASA: Implementation Plan for Education 1999-2000, p.3). NASA also provides access to information in science, mathematics, technology, engineering, and geography. These programs are designed to provide professional development experiences for K-12 educators and higher education faculty that are involved in pre-service education. Some programs are designed to provide research opportunities. The educators and faulty (a) participate in NASA research and development activities, (b) apply methods for integrating these resources into their teaching, and (c) are informed about available NASA resources.

Curriculum Support and Dissemination can best be described as NASA developing, utilizing, and disseminating science, mathematics, technology, engineering, and geography instructional materials based on NASA's unique mission and results and supports the development of higher education curricula (NASA: Implementation Plan for Education 1999-2000, p. 5). Because education is primarily a State and local issue, NASA seeks to broadly understand common curricula topics or standards, collaborate with outside education experts, and work with NASA Strategic Enterprise content experts to translate the NASA mission into supplementary instructional materials. These materials are derived from the mission activities conducted by the four NASA Strategic Enterprises. A comprehensive dissemination system has been developed to ensure that individuals have access to these products. The system is composed of (a) a physical presence in each State providing access to and training in the use of NASA's instructional products, (b) electronic networking resources, (c) integration of NASA's instructional products into teacher/faculty workshops, and (d) partnerships with organizations involved in systemic reform.

Support for Systemic Improvement of Education can best be described as NASA utilizing its unique assets to support local, State, regional and national science, mathematics, technology, engineering, and geography education efforts through collaboration with internal and external stakeholders (NASA: Implementation for Education 1999-2000, p. 6). As the United States continues to reform science, mathematics, technology, and geography instruction in its K-12 schools, NASA has placed emphasis on coordinating all of the NASA assets in a given State toward assisting meeting its goals for improvement of the state's system of education. By establishing a variety of partnerships, NASA seeks to convene NASA Principal Investigators, NASA trained teachers, and commercial contractors with the State's educational leadership to determine how these assets may best be utilized within the State.

Student Support can best be described as NASA using its mission, facilities, human resources, and programs to provide information, experiences, and research opportunities for students to support the enhancement of knowledge and skills in the areas of science, mathematics, technology, and geography (NASA: Implementation for Education 1999-2000, p. 8). Student support programs are intended to involve students in the intrinsically interesting and informative NASA mission.

Educational Technology can best be described as NASA researching and developing products and services that facilitate the application of technology to enhance the educational process for formal and informal education. NASA's Educational Technology program supports two of the four components of the National Educational

Technology Initiative. NASA addresses the development of innovative learning tools and strategies, as well as teacher training.

Research and Development can best be described as NASA researching and developing activities that occur primarily, though not exclusively, at the graduate level and involve graduate students and faculty who make substantive contributions to NASA's mission, the four Strategic Enterprises, and the Generate Knowledge process (NASA: Implementation for Education 1999-2000, p. 10). In addition to directly supporting NASA programs, these activities promote the development of new collaborations with the academic community and significantly enrich graduate education and research.

NASA has an Aerospace Education Services Program (AESP) that is administered through the Department of Aviation and Space Education at Oklahoma State University. The AESP is a nationwide, free program for teachers, students, and the general public (NASA: AESP, 1999, p.1). A specialist can provide workshops for teachers or work with state education officials. Presenting ways in which aerospace topics may be applied or integrated into subject matter.

NASA's Ames Aerospace Encounter's main objective is to provide an interactive computer tutorial designed to teach students and educators about science, mathematics, and technology. The earth system science tutorial features color, sound, animation, and images of earth taken from aircraft and satellites. Using a mouse to point and click buttons on the computer screen, students learn about remote sensing, light, color, and geography. Using remotely-sensed images, the students attempt to find their way to Moffett Field, California, by clicking on specific geographic features, and identifying North America, California, the San Francisco Bay area, and finally the runway on Moffett

Field at NASA Ames Research Center. This strategy helps students learn to recognize geographic features across many scales and become familiar with remote-sensing techniques.

The Challenger Center for Space Science Education: Encounter Earth's main objective uses space exploration as a theme. It was founded to create positive student experiences, excite students about the impact of technology on their future, and inspire students to pursue math, science, and technology.

Global Learning and Observations to Benefit the Environment's main objective is to join students, educators, and scientists from around the world in studying the global environment.

The main objective for Project Sun is to develop and supply middle and high school student teams with Sun kits, enabling them to collect and provide the NASA Jet Propulsion Laboratory with daily, time-resolved insulation and ultraviolet radiation data on a continuing basis.

The objective for Space Science Student Involvement Program was to address the need for greater literacy in the area of science, critical and creative thinking, mathematics, and technology.

The Space Science Enterprise Strategic Plan mission is to solve the mysteries of the universe, explore the solar system, discover planets around other stars, and search for life beyond Earth.

Key elements that repeatedly appear in these programs are subjects strong in science, mathematics, and technology. An Aerospace Education Teacher Preparation Program must contain strong subject training in these areas. The programs and literature mention many subjects of concentration. Subjects that are common among the programs are: Flight, Satellite Observations, Space Science (Astronomy), Lunar Science, Rocketry, Gravity, Ellipses, Newtonian Physics, Space Flight Programs, Missions, Experiments, Spacecraft, Forces of Flight, Launch, Cruise, Encounter, Return, and Landing. See Table 3.

TABLE 3

MODEL AEROSPACE EDUCATION TEACHER PREPARATION COURSES

	Model Course Titles
1)	History and Development of Space Craft and Space Flight
2)	Earth Observation System I-Land
3)	Earth Observation System II-Water
4)	Earth Observations III-Air
5)	Space Science I-Sun, Inner Planets and Asteroid Belt
6)	Space Science II-Outer Planets and Probes
7)	Lunar Sciences and Apollo Missions
8)	Gemini Missions and Rocketry
9)	Gravitation and Mechanics, Ellipses, and Newton's Principles
10)	Space Flight Projects, Missions, Experiments, and Space Craft
11)	Forces of Flight/Launch/Cruise/Encounter/Return/and Landing

The elements were categorized into logical cohesive groups that would lend themselves to being developed into an Aerospace Education Teacher Preparation Program. The categories were developed into a model program of classes (Table 3) that could be taught in the College of Education-Aviation and Space Science Education Department at Oklahoma State University. The Model Aerospace Education Teacher Preparation Program is contained in Appendix D. The course objectives and class activities may be found later in the Model Aerospace Education Teacher Program in Chapter V.

An electronic survey was developed to question the 35 existing Aerospace Education Specialists in the United States. The purpose of this survey was to determine whether or not they felt the above courses were essential to an Aerospace Teacher Preparation Program. A total of 12 Aerospace Education Specialists responded to the electronic survey. Their responses are illustrated in Table 4.

The information given above can be translated into percentages by dividing the number of teachers that made a response from the number of total teachers. Calculation: number of teachers with same response divided by the total number of teachers equals percent of teachers making the response. The percentages are illustrated in Table 5.

Table 5 identifies the percentage of Aerospace Education Specialist's response to all 11 courses. Three courses were unanimously identified as being essential to *include* in an Aerospace Teacher Preparation Program. The three courses were Space Science I-Sun, Inner Planets, and Asteroid Belt, Space Science II-Outer Planets and Probes, and Lunar Sciences and Apollo Missions.

TABLE 4

AEROSPACE EDUCATION SPECIALISTS RESPONSES TO MODEL AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM COURSES

Model Course Titles	1	2	3	4	5	6	7	8	9	10	11	12
History and Development of Space Craft and Space Flight	I	I	I	T	D	T	I	I	I	I	T	I
Earth Observation System I-Land	I	T	T	I	T	T	I	I	I	I	T	I
Earth Observation System II-Water	I	T	T	T	D	T	I	I	I	I	T	I
Earth Observation System III-Air	I	T	T	I	D	T	I	I	I	I	T	I
Space Science I – Sun, Inner Planets and Asteroid Belt	I	I	I	I	I	I	I	I	I	I	I	I
Space Science II – Outer Planets and Probes	I	I	I	I	I	I	I	I	I	I	I	I
Lunar Sciences and Apollo Missions	I	I	I	I	I	I	I	I	I	I	I	I
Gemini Missions and Rocketry	I	I	I	I	D	I	I	I	I	T	T	I
Gravitation and Mechanics, Ellipses, and Newton's Principles	I	I	I	I	T	I	I	I	I	I	I	I
Space Flight Projects, Missions, Experiments, and Space Craft	I	I	I	T	I	I	I	I	I	I	I	I
Forces of Flight, Launch, Cruise, Encounter, Return and Landing	I	I	I	I	T	I	I	I	I	I	I	I

Note: I = Include, D = Do Not Include, T = Time Permitting.

TABLE 5

PERCENTAGE OF AEROSPACE EDUCATION SPECIALISTS RESPONSES TO MODEL AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM COURSES

Title of the Aerospace Education Teacher Preparation Course	Percent Include	Percent Do Not Include	Percent Include If Time Permits
History/Dev. Space Craft & Flight	67	25	8
Earth Obs. I-Land	58	42	
Earth Obs. II-Water	50	42	8
Earth Obs. III-Air	58	33	8
Space Science I	100		
Space Science II	100		
Lunar Science	100		
Gemini/Rocketry	75	17	8
Gravity/Mechanical	92	8	
Space Flight Project	92	8	
Forces of Flight	92	8	

A second highly favorable response was found for the class entitled Forces of Flight/Launch/Cruise, Encounter/Return/ and Landing. Eleven out of 12 Aerospace Education Specialists (83%) responded that this topic should be *included* in the Model Aerospace Education Teacher Preparation Program. One respondent replied, *include if* *time permits,* which is a favorable response to include this course in a Model Aerospace Education Teacher Preparation Program.

History and Development of SpaceCraft and Space Flight course had an overall favorable response to include this course in the Model Aerospace Education Teacher Preparation Program. Eight out of 12 responses replied, *include* this class, representing 2/3 or 67% of the responding population. Three out of 12 responses replied, *include if time permits,* that is 25% of the population. One out of 12 respondents replied, *do not include,* which is 8% of the population. Overall, this class was viewed as essential to the Model Aerospace Education Teacher Preparation Program.

The Earth Observation Systems I-Land had 7 out of 12 respondents reply that this course must be *included,* which was 58% of the responding population. Five out of 12 respondents replied, *include if time permits,* which was 42% of the responding population. None of the responding population replied, *do not include.* Overall, this class was viewed as essential in a Model Aerospace Education Teacher Preparation Program.

The Earth Observation Systems II-Water course had 6 out of 12 respondents say that this course must be *included,* which was 50% of the responding population. Five out of 12 respondents replied *include if time permits,* which was 42% of the population. One out of 12 respondents replied *do not include,* which was 8% of the population. Overall, this class was viewed as essential to the Model Aerospace Education Teacher Preparation Program.

The Earth Observation Systems III-Air course had 7 out of 12 respondents reply that this course must be *included,* which was 58% of the responding population. Four out of 12 respondents replied, *include if time permits,* which was 33% of the population. One out of 12 of the respondents replied, *do not include,* which was 8% of the population. Overall, this course was deemed essential to the development of a Model Aerospace Education Teacher Preparation Program.

The Gemini Missions and Rocketry course had 9 out of 12 respondents reply that this course must be *included,* which was 75% of the responding population. Two out of 12 replied, *include if time permits,* which was 17% of the population. One out of 12 respondents replied, *do not include,* which was 8% of the population. Overall, this course was deemed essential to the development of a Model Aerospace Education Teacher Preparation Program.

Courses: Gravitation and Mechanics, Ellipses, and Newton's Principles, Space Flight Projects, Missions, Experiments and SpaceCraft, and Forces of Flight, Launch, Cruise, Encounter, Reentry, and Landing had identical responses. Eleven out of 12 respondents replied, this course must be *included,* which was 92% of the population. One out of 12 respondents replied, *include if time permits,* which was 8% of the population. Overall, this course was viewed as essential to the development of a Model Aerospace Education Teacher Preparation Program.

The final question in the electronic mail survey was, "Are there any other subjects that are essential to an aerospace teacher certification program that are not listed here? If so, what are they? (Please list them)" The questionnaire is contained in Appendix C. This was an open-ended question intended to solicit feedback on the development of an Aerospace Education Teacher Preparation Program from NASA certified Aerospace Education Specialists. Three NASA Aerospace Education Specialists chose not to answer this open-ended question. The responses that were given by the Aerospace Education Specialists may be read in Table 6.

TABLE 6

AEROSPACE EDUCATION SPECIALIST NARRATIVE RESPONSES TO THE OPEN ENDED QUESTION IN THE QUESTIONNAIRE

Aerospace Education Specialist	Response
1	Aeronautics, Astronomy, and Astronomy Tool
2	No Response Given
3	Space Environment-How to Live in Space
4	No Response Given
5	The Historical and Economic Perspective and Impact of Aviation on our Society
6	I might not separate the Earth Observing categories the way that you did. I do think Earth Observing is essential though. Also some information about how remote sensing works, image processing, get some Math in there.
7	I think the list below is sufficiently general enough to cover most of the range of aerospace topics that should be in a certification program. I would include them all but structure them differently. For example, I would combine History and Development of SpaceCraft and Space Flight, Lunar Science and Apollo Missions with Gemini Missions and Rocketry because they are all history focused. I would also combine the Earth Observation Systems I, II, and III, and I would combine Space Science I with Space Science II.
8	Gravity, More about Gravity, Lots More about Gravity, Motions of the Earth.
9	Life Sciences, History of Aviation-airplane, aircraft, LTA, etc.
10	Deep Space Structure and some idea of stellar dynamics and types.
11	No Response Given.
12	I would include all the topics but structure the courses differently in order to relate to the 4 NASA Enterprises.

From the Aerospace Education Specialists' responses to the electronic survey, all of the courses were considered important and necessary to be included in an Aerospace Education Teacher Preparation Program. Using this feedback, a Model Aerospace Education Teacher Preparation Program was developed into courses recommended for the college of education. Universities may choose to structure the courses differently; however, the key essential elements should remain the same. The Model Aerospace Education Teacher Preparation Program is contained in Chapter V in Tables 8 through 18.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

In the review of literature, no documentation of an aerospace education teacher preparation program geared for teacher certification at the masters' level of education was found, despite an ever-increasing need for such. Its development is becoming imperative. There are many teacher preparation institutions that offer an astronomy class and may consider this an adequate aerospace education teacher preparation. In general, Colleges of Education across the United States offer a general science major for elementary teachers. These teachers may choose to major in science education, for which they are required to take between 24 and 30 credits. There are no Colleges of Education that offer Aerospace Education Teacher Preparation Program Certificates across the United States for the masters' degree level. It is important that Americans be given the opportunity to choose the highest standards and highest quality aerospace education teacher preparation programs for themselves.

There is a need to identify a set of key elements that can be used to develop coursework required to create an aerospace education teacher preparation program. These elements would become a knowledge base of aerospace science skills that could be used in establishing curricula within the Aviation and Space Education Program at the masters' level in Oklahoma State University. Teachers and students could benefit from such training.

Problem

At present, the review of literature did not uncover an aerospace education teacher preparation program for teacher certification at the masters' degree level . There are many teacher preparation institutions that offer an astronomy class and may consider this an adequate aerospace science education teacher preparation. Colleges of Education across the United States offer a general science major for elementary teachers. These teachers may choose to major in science education, for which they are required to take between 24 and 30 credits. There are few Colleges of Education that offer Aerospace Science Education majors across the United States. Americans must be given the opportunity to choose the highest standards of aerospace education teacher preparation for themselves.

A need exists to identify a set of key elements that can be used to develop coursework required to create an aerospace education teacher preparation program. These elements would become a knowledge base of aerospace science skills that could be used in establishing curricula within the Aviation and Space Education Program at Oklahoma State University. Teachers and students could benefit from such training.

Purpose

The purpose of this study was to develop an aerospace education teacher preparation program geared toward training future teachers in the specialized field of aerospace science at the masters' degree level. This is important because, currently, no such comprehensive or all-encompassing aerospace education preparation program intended for the master's level was found in the review of literature. The developed aerospace education teacher education program should prove of value to: those teacher colleges that have an aviation training program, the education community, the aerospace industry, students interested in pursuing careers in the space science fields, and to those looking to develop future curricula needed to develop aerospace education teacher preparation programs of their own.

Objectives of the Study

The objectives of the study were to:

1. Identify Aerospace Education Programs.
2. Identify aerospace elements essential to an aerospace education teacher preparation program.
3. Identify universities with aerospace engineering curricula.
4. Research the elements that the Aerospace Education Specialists consider as key elements in an Aerospace Education Teacher Preparation Program.
5. Survey the Aerospace Education Specialists to find which courses they would consider as essential to the development of an Aerospace Education Teacher Preparation Program.
6. Propose an Aerospace Education Teacher Preparation Program.

Summary of Findings

There are an infinite number of Aerospace Education Programs that are designed to respond to a need by the aerospace industry and are capable to ignite excitement in a student's mind. There are many teacher workshops, internships, and supplemental guides to enhance a teacher's curriculum. However, there is no university in the United States that offers an Aerospace Education Teacher Preparation Program for Certification at the master's degree level of education. With the wealth of programs and expertise available to the Universities, an Aerospace Education Teacher Preparation Program should be developed.

A review of pertinent literature has revealed a need for stronger science, mathematics, and technology programs in teacher training. Therefore, any newly developed teacher preparation program should have its roots heavily grounded in science, mathematics, and technology.

The programs reviewed mention many subjects that were heavily weighted in science, mathematics, and technology. Subjects that are common among these programs are: Flight, Satellite Observations, Space Science (Astronomy), Lunar Science, Rocketry, Gravity, Ellipses, Newtonian Physics, Space Flight Programs, Missions, Experiments, Spacecraft, Forces of Flight, Launch, Cruise, Encounter, Return, and Landing. The Model Aerospace Education Teacher Preparation Program contained in Appendix D has illustrated this point. Course Objectives and suggested class activities may be found in Tables 8 through 17.

Conclusion

A course of study was proposed then verified by Aerospace Education Specialists. The study identified 11 Aerospace Education Teacher Preparation courses that were verified by Aerospace Education Specialists. The class titles may be found in Table 7.

TABLE 7

AEROSPACE EDUCATION TEACHER PREPARATION
PROPOSED COURSE TITLES

	Course Titles
1)	History and Development of Space Craft and Space Flight
2)	Earth Observation System I-Land
3)	Earth Observation System II-Water
4)	Earth Observations III-Air
5)	Space Science I-Sun, Inner Planets and Asteroid Belt
6)	Space Science II-Outer Planets and Probes
7)	Lunar Sciences and Apollo Missions
8)	Gemini Missions and Rocketry
9)	Gravitation and Mechanics, Ellipses, and Newton's Principles
10)	Space Flight Projects, Missions, Experiments, and Space Craft
11)	Forces of Flight/Launch/Cruise/Encounter/Return/and Landing

Overall, the Aerospace Education Specialists found these courses to be essential and would recommend them to be a part of any Aerospace Education Teacher Preparation Program.

Those courses all require a solid foundation in science, mathematics, and technology. Universities across the United States have teacher preparation programs that certify teachers in science, mathematics, and technology; however, there are no universities that certify teachers in Aerospace Education.

Should a university choose to begin an Aerospace Education Teacher Preparation Program of its own, the Model Aerospace Education Teacher Preparation Program may be used as a tool. The Aerospace Education Teacher Preparation Program is intended for the masters' level of education but can be modified to meet the needs of an undergraduate program. The Aerospace Education Teacher Preparation Program is summarized in Tables 8 through 17. The following information identifies the course objectives and suggested course activities. The entire course syllabi may be found in Appendix D.

Model Aerospace Education Teacher Preparation Program Proposed Courses

TABLE 8

HISTORY AND DEVELOPMENT OF SPACECRAFT AND SPACEFLIGHT

COURSE OBJECTIVES: By the end of this course, the student will be able to:
1. Identify the Early Airplanes and describe their significance to the history of spaceflight in The United States of America.
2. Identify the Pioneers in Rocketry.
3. Discuss the importance of the German Rocket Team with respect to The American Rocket Team.
4. Identify what were the major contributions of the Space Race.

TABLE 8 – Continued

COURSE OBJECTIVES:	
5. Describe the functions and roles of NASA.	
6. Explain the concept and function of America's Space Transportation System.	
7. Complete an extensive research project on a specific Space Shuttle Mission and give a presentation summarizing your study.	
8. Participate as an active research member for the latest spaceflight news important to the chronology of spaceflight evolution and write a record data/fact sheet on twenty-five dates of aerospace significance.	
9. Construct a historical time line of the major spaceflight events and contributors.	
10. Evaluate the role of the International Space Station (ISS).	
BRIEF COURSE OUTLINE:	
Class 1:	Orientation and Class Procedures Objectives Outline Course Contract In-Class Activities Class Expectations Grading System Academic Honesty Discuss the time line of the classes projects and assignments
Class 2:	History recounts many who envisioned ways to fly. History of Daedalus and Icarus. Chinese invention of the kite 1000 B.C. Leonardo Da Vinci imagined the orinthopter for travel. Montgolifier Brother's. <u>Construct: Flying Apparatus</u>
Class 3:	1804, British Scientist and Inventor Sir George Cayley built the first toy airplane. Airscrew Propellar 1903, American brothers, Orville and Wilbur Wright invent Flyer 1. 1907, Louis Bleroitt flew the world's first monoplane. 1910, Louis Bleriott flew across the English Channel. <u>Activity: Construct Wright Flyer</u> <u>Activity: Pop Rockets</u>

TABLE 8 – Continued

BRIEF COURSE OUTLINE:	
	Discussion: How did we get from gliders to rockets?
Class 4	1919, Aviation had established itself around the world. World War I, aircraft flew at speeds of 113-129 kilometers per hour (70-80 miles per hour) at an altitude of 3,048 meters (10,000 feet). Charles Lindberg, a barnstormer and mail order pilot, flew The Spirit of St. Louis. (flight completed in 33.5 hours) Group Presentation 1
Class 5:	1939, The Jet Age, the HE 178 monoplane designed by the German Engineer, Ernst Heinkel, made its first flight reaching a speed of 700 kilometers per hour (435 miles per hour). 1963, the X-15 set speed and distance records that stand to this day, reaching speeds of07 kilometers per hour (4,354 miles per hour) and altitudes of 107,899 meters (354,000 feet). 1947, Chuck Yeager's flight of the rocket-powered Bell X-1, which broke the sound barrier, it became evident that flight with the use of rockets was now a reality. Group Presentation 2
Class 6:	1882-1945, Robert Goddard, Rocketry. 1954, Robert Goddard died leaving behind 215 patents in rocketry which still produce royalties for his estate. 1912-1977, Wernher von Braun, Rocketry. 1932, the German Army was beginning to show an interest in German Rocket Society's efforts and in July of that year, a Mirak rocket was launched. Liquid propellant rockets for the German Army were constructed. Group Presentation 3
Class 7:	1937-1941, von Braun's group launched some 70 A-3 and A-5 rockets. 1939, World War II, research for the A-4 rocket began. 1942, the A-4 flew in March. The rocket barley cleared some low clouds.

TABLE 8 – Continued

BRIEF COURSE OUTLINE:	
	1942, August, the second launch of the A-4 saw the rocket rise 7 miles before exploding.
	1942, October, another A-4 roared aloft from Peenemuende, followed its programmed trajectory perfectly, and landed on target 193 kilometers (120 miles) away.
	Group Presentation 4
Class 8:	Adolf Hitler assigned the highest priority to the V-2 program.
	1943, Production of the A-4 began, now renamed V-2.
	1944, V-2 rocket launched in London. The Germans had launched approximately 3,000 V-2's against England and other targets.
	Review for the Mid-Term Exam
Class 9:	The German Rocket Team
	Mid-Term Exam
Class 10:	The "Space Race" Begins. October 4, 1957 launched Sputnik (meaning "space traveler"), the world's first satellite, into space.
	January 31, 1958, the U.S. launched Explorer 1. The United States Rocket Team. April 12,1961, when Yuri Garuarin the first human in space into orbit aboard the Vostok spacecraft. (108 minutes)
	Group Presentation 5
Class 11:	October 7, 1958 the U.S. approved the Mercury program.
	May 5, 1961. A Mercury redstone rocket launched Alan Shepard into a sub-orbital flight, making him the first American in space.
	July 21, 1961, Virgil "Gus" Grissom was launched into a sub-orbital flight.
	February 20, 1962, John Glenn became the first American to achieve orbit.
	May 25, 1961. President Kennedy intensified the Space Race when he committed the United Sates to being the first on the moon.
	Group Presentation 6
Class 12:	June 16, 1963, The Soviet Union launched Valentina Tereshkova, the first Woman in space.
	December 7, 1961, The United States announced the Gemini space program.

TABLE 8 – Continued

BRIEF COURSE OUTLINE:	
	June 3, 1965, Ed White became the first American to perform an EVA and remained outside the capsule for 21 minutes.
	Group Presentation 7
Class 13:	The Apollo Mission.
View Lunar Rocks on loan from NASA and a Meteorite Sample Disk.	
	Countdown rehearsal tragedy; the Apollo 1 crew perished in a fire inside their spacecraft at the Kennedy Space Center. (Grissom, White, Chaffee) Apollo 7-17 Missions.
Class 14:	Apollo Missions 7-17 Development
	Space Stations; Mir, and the International Space Station, Skylab Satellites. Group Presentation 8
Class 15:	The Space Shuttle Anatomy and Missions.
	Written Research Paper Due
	Review for the Final Exam
Class16:	Final Examination and Class Closure

TABLE 9

SPACE SCIENCE I: SUN, INNER PLANETS AND ASTEROID BELT

COURSE OBJECTIVES: By the end of the course the student will be able to:

1. Discuss the importance of the distances from the Sun to where the Inner Planets and Asteroid Belt are found.
2. Discuss the importance of distances with in the Solar System.
3. Identify the major elements and effects of the Sun.
4. Discuss the identifying factors of the Terrestrial Planets.

TABLE 9 – Continued

COURSE OBJECTIVES:	
5. Identify the major elements of the Asteroid Belt.	
6. Describe the similarities and differences of Asteroids, Comets, and Meteoroids.	
7. Demonstrate teaching strategies to illustrate a science concept.	
BRIEF COURSE OUTLINE:	
Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
Class 2:	Introduction to The Celestial Sphere
	Activity: The Positions of Celestial Objects
	The Sun's Motion: How Long is a Year?
	The Ecliptic
	The Seasons
	Scientific Models—A Geocentric Model
	The Greek Celestial Model
	Observations: The Planets
	Video: NASA: A Trip Through the Solar System
	Activity: Why is East on the Left in the Sky Photographs?
Class 3:	Criteria for Scientific Models
	Introduction and Development of A Sun-Centered System
	The Relationship of Aristotle and Christianity
	Nicholas Copernicus
	Motion of Planets
	Parallax
	Activity: Measuring Parallax
	Comparing the Two Models
	Copernicus's Revolution
	Tycho Brahe

TABLE 9 – Continued

BRIEF COURSE OUTLINE:	
	Johannes Kepler
	The Ellipse
	Activity: NASA: Ellipse
	Kepler's First Two Laws of Planetary Motion
	Kepler's Third Law
Class 4:	Galileo Galilei and the Telescope
	Activity: Construct a Telescope
	The Moon, the Sun, and the Stars
	Satellites
	The Phases of Venus
	Isaac Newton
	Isaac Newton's Two Laws of Motion
	Mass and Weight
	Newton's Third Law
	Motion in a Circle
	The Law of Universal Gravitation
	Newton's Laws and Kepler's Laws
	Activity: The Rotating Earth
Class 5:	The Center of Mass
	The Tides
	Rotation and Revolution of the Moon
	Precession of the Earth
	The Importance of Newton's Laws
	Beyond Newton: How Science Progresses General Relativity
	Space Warp
	Activity: Travel to the Moon
Class 6:	Gravitation and Einstein
	The Orbit of Mercury
	Activity: Circular Motion
	Measuring the Size of the Earth and Moon
	The Distance to the Moon
	Activity: Two Measuring Techniques
	The Moon's Changing Size

TABLE 9 – Continued

BRIEF COURSE OUTLINE:	
	The Moon's Phases
	Lunar Eclipses
	Types of Lunar Eclipses
	Solar Eclipses
	The Partial Solar Eclipse
	The Annual Eclipse
	Activity: Observing a Solar Eclipse
	Activity: Lunar Sample Identification
	View Moon Rocks and Become Lunar Sample Certified
Class 7:	Lunar Sample Viewing
	Earth
	The Interior of the Earth
	Earth's Magnetic Field
	Video: The Earth from Space
	Plate Tectonics
	Earth's Atmosphere
	The Moon's Surface
	Activity: NASA: Crater Maker
	Review for Mid Term Exam
Class 8:	Photo: The Far Side of the Moon
	Theories of the Origin of the Moon
	The Large Impact Theory
	History of the Moon
	Mid Term Exam
Class 9:	Activity: Do-It-Yourself-Phases
	Activity: Observing Phases
	Distances in the Solar System
	Measuring Distances in the Solar System
	Titius-Bode Law
	Activity: Measuring the Mass of a Solar System Object
	Planetary Motions
	Classifying the Planets

TABLE 9 – Continued

BRIEF COURSE OUTLINE:	
	Size, Mass, Density
	Satellites and Asteroids
	Comets and Meteors
	Activity: Construct a Comet
Class 10:	Rotations
	Planetary Atmospheres
	Gases and Escape Velocity
	The Atmosphere of Planets
	The Formation of the Solar System
	Evidential Clues from Data
	Evolutionary Theories
	Catastrophic Theories
	Present Evolutionary Theories
	Activity: Life Elsewhere?
Class 11:	Mercury
	Mercury as Seen from Earth
	Mercury via Mariner—Comparison with the Moon
	Size, Mass, and Density
	Venus
	Size, Mass, and Density
	Venus's Motions
	The Surface of Venus
	Photo: Our Changing View of Venus
	The Atmosphere of Venus
	A Hypothesis Explaining Venus/Earth Differences
Class 12:	Mars
	Mars as Seen from Earth
	Size, Mass, and Density
	Mar's Motions
	Life on Mars
	Invasion and Its Results
	Video: ET Live IV—Viking's Search for Life
	Atmospheric and Surface Conditions

TABLE 9 – Continued

BRIEF COURSE OUTLINE:	
	The Moons of Mars
	The Discovery of Marian Moons
	Why Explore?
	Mars Pathfinder/Sojourner Data
	Activity: Viewing Mercury, Venus, and Mars
	Group Teaching Strategy
Class 13:	The Sun
	Solar Data
	Distance to the Sun
	The Source of the Sun's Energy
	Solar Nuclear Reaction
	Fission and Fusion Power on Earth
	The Sun's Interior
	Pressure, Temperature, and Density
	Hydrostatic Equilibrium
	Energy Transport
	The Neutrino Problem
	The Solar Atmosphere
	The Photosphere
	The Chromosphere and Corona
	The Solar Wind
	Sunspots and Solar Activity Cycle
	A Model for the Sunspot Cycle Solar Flares
	Activity: Observing Sunspots
	Activity: Measuring the Diameter of the Sun
	Activity: Helioseismology
	Group Teaching Strategy
Class 14:	Asteroids
	The Orbit of Asteroids
	Activity: You Can Name an Asteroid
	The Origin of Asteroids
	Comets

TABLE 9 – Continued

BRIEF COURSE OUTLINE:	
	Chaos Theory
	Comet Orbits—Isaac Newton and Edmund Halley
	The Nature of Comets
	Comet Tails
	The Oort Cloud and Kuiper Belt
	Group Teaching Strategy
Class 15:	Meteors and Meteor Showers
	Meteors
	Meteoroids
	Meteorites and Craters
	Activity: Hit by a Meteorite?
	Activity: Meteors and Dinosaurs
	Activity: Observing Meteors
	Group Teaching Strategy
	Review for Final Exam
Class 16:	FINAL EXAMINATION

TABLE 10

SPACE SCIENCE-II: OUTER PLANETS AND DEEP SPACE PROBES

COURSE OBJECTIVES: By the end of this course you will be able to:

1. Discuss the evolution of deep space probe exploration.
2. Identify the different space probes as inner or outer planetary probes.
3. Complete an extensive research project on one specific space probe and document its' contributions to modern astrophysics and aerospace science.
4. Construct a chronological time line of United States of America Space Probes.

TABLE 10 – Continued

COURSE OBJECTIVES:	
5. Present an oral presentation using visuals and taking a creative approach to illustrating the life of specified projects. (Apollo, Pioneer, Voyager, Mariner, Galileo, Magellan, and Viking)	
BRIEF COURSE OUTLINE:	
Class 1:	Orientation and Class Procedures
	Objectives
	Outline
	Course Contract
	In-Class Activities
	Class Expectations
	Grading System
	Academic Honesty
	Rocket Power
	Orbital Velocity
	Sputnik 1
	Orbital Mechanics
Class 2:	Satellite Orbits (ERS-1, NOAA-8, Intelsat 6 F-4, Lunar Orbiter 1)
	Moon Rocket (Apollo Project)
	Lunar Studies
	Research Report Requirements
	Orbital Mechanics
	NASA ACTIVITY: STARDUST; JPL
Class 3:	Sky Laboratory
	Solar Max
	Ulysses
	Solar Studies
	Group Project Requirements
Class 4:	Escape velocity
	Sling Shot Orbits
	Mariner Project (4,7, 9, 10)
	Venera Project (13)
	Magellan Project

TABLE 10 – Continued

BRIEF COURSE OUTLINE:	
	Viking Project (1 and 2)
	Planetary Observer (Mars Observer)
	Mars Pathfinder/Soujourner
	Construct: Meat-Tray Mars Pathfinder/Soujourner
Class 5:	Giotto (Deep Space Probe to encounter Halley's Comet)
	Vega 1
	Probing Halley's Comet
	Probing the Outer Planets
	Anatomy of the Outer Planets as seen by the probes
	Pioneer Project (10 and 11)
	Galileo Project
	Comet Demonstration:"Live Comet"
Class 6:	STARDUST
	Power for Probes
	Voyager Missions
	Discussion of Time Line Requirements
Class 7:	STARDUST
	Deep Space Communications
	Sounds of Earth
	ACTIVITY: Communications and PIXELS (NASA)
	Review for Mid-Term Exam
Class 8:	Mid Term Exam
Class 9:	The Shuttle Revolution
	View Space Shuttle Anatomy
	Construct-A-Shuttle
Class 10:	Hubble Space Telescope
	STARDUST
	ACTIVITY: Earthdust
	Time Line Due
Class 11:	International Space Station
	Toward Tomorrow
	Photon-Driven Starship

TABLE 10 – Continued

BRIEF COURSE OUTLINE:	
	X-33
	Research Reports Due
Class 12:	Group Presentations
Class 13:	Group Presentations
Class 14:	Group Presentations
Class 15:	Final Exam Review
Class 16:	Final Examination and Class Closure

TABLE 11

EARTH OBSERVATIONS I-LAND

COURSE OBJECTIVES: By the end of this course you will be able to:

1. Compare and contrast the functions of different satellites, namely Moderate Resolution Multi-Spectral Imager (MODIS) designed to measure biological and physical processes globally, Land Satellites (LandSat), Advanced Space-born Thermal Emission and Reflection Radiometer (ASTER), and Global Position Satellites (GPS).
2. Discuss the applications of satellite employment.
3. Explain how satellites report data for agriculture industries, forestry agencies, fisheries, and insurance agencies.
4. Explain disaster management and insurance applications considered with satellite technology.
5. Describe hazard assessment and damage assessment that results from satellite data.
6. Identify the major landforms from LandSat 7 photos.
7. Identify major geological features and processes that are taking place and are being documented from LandSat 7.
8. Employ teaching strategies that are modeled in class.
9. Develop a middle school or high school mini-lesson on a theme taught in this course and present it to the class.

TABLE 11 – Continued

BRIEF COURSE OUTLINE:	
Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
	Questions and Answers
	Introduction to Global Position Satellite System (GPS)
Class 2:	Review of GPS
	Introduction to Multi-Spectral Imager (MODIS)
	Introduction to LandSat 7
	Introduction to Advanced Spaceborn Thermal Emission and Reflection
Class 3:	MODIS Development
	LandSat 7 Development
	Surface Temperature
	Concentration of Chlorophyll
	Vegetative Conditions
	Leaf Area Index
	Fire Occurrence, Size, and Temperature
	Cloud Cover
	Cloud Properties
	Teaching Strategies/Demonstrations: Ecology and Weather Methods
Class 4:	Development of LandSat 7 and ASTER Agricultural Applications: Measuring Crop Acreage, Classifying Crop Vegetation Type, Estimating Crop Yields and Optimizing Fertilization, Determining Vegetation and Crop Health, and Analyzing Pest Migration and Planning Pesticide Application.
	Activity: Ecology, Agriculture, and Geology

TABLE 11 – Continued

BRIEF COURSE OUTLINE:	
Class 5:	Agricultural Applications: Determining Range Readiness and Health and Maturity, Monitoring Fallow Land, Determining Soil Moisture and Drainage, Optimizing Irrigation—Aerial Distribution and Timing, Mapping and Monitoring Droughts and Floods, Timing Harvest Before Destructive Weather Events, Mapping Soil, Nutrient and Landscape Spatial Variability, Monitoring Soil Erosion, and Improving Climate Forecasts.
Guest Speaker: Ecological Society Representative	
Class 6:	Forestry Applications Measuring Timber Acreage, Classifying Forest Age, Serial Stages, and Timber Type, Monitoring and Migrating Timber Disease, Monitoring Forest Fire and Assessing Fire Hazard, and Analyzing Watershed.
Activity: Using Forestry Maps, Chart Timber Acreage, Age, Serial Stages and Type.	
Class 7:	Forestry Applications: Understanding Forestry Infrastructure and Transportation, Analyzing Droughts and Floods, Mapping Soil Erosion, Mapping and Monitoring Wetlands, Estimating Global and Regional Deforestation, and Studying the Environmental Impact.
Class 8:	Mid Term Exam
Class 9:	Fisheries Applications: Color Mapping of Currents and Circulation Patterns, Measuring Sea Surface Temperature, Mapping Ocean Wind Patterns, Observing Ocean, River and Lake Sediment Concentrations, Improving Bathymetry, Identifying Chlorophyll and Phytoplankton, Managing Coral Reefs, Monitoring Pollution, and Improving Weather and Storm Prediction.
Class 10:	Disaster Management-Insurance Natural Hazard, Storms, Blizzards, Floods. Web Site: http://earth.jsc.nasa.gov/atmo.html
Class 11:	Damage Impact Assessment: Floods, Landslide, Avalanche, Volcanic
Class 12:	Transportation: Land and Aviation: Monitoring Marine Ice, Improving Web Site: http://earth.jsc.nasa.gov/geon.html Web Site: http://earth.jsc.nasa.gov/land.html
Class 13:	Video: Landsat(s) NASA 2:37 Discussion of importance and necessity to human interaction with the Earth (Land Formations, Air, Water Cycle, Space Debris, Evolution of Plant and Animal Life, and Ecosystems) Can satellites track this?

TABLE 11 – Continued

BRIEF COURSE OUTLINE:	
Class 14:	Activity: GPS-Group Activity from NASA Landsat 7-Terrestrial Surface GLAS-Ice (Glacier) Topography and Altimetry
Glass 15:	Review for Final Exam
Class 16:	FINAL EXAMINATION

TABLE 12

EARTH OBSERVATIONS II: WATER

COURSE OBJECTIVES: By the end of the course the students will be able to:

1. Identify the water cycle satellites.
2. Explain the primary function of atmospheric satellites.
3. Describe the impact of air and water satellites on humans in the 21st century.
4. Discuss the abilities that the latest satellites posses.
5. Complete a comparative discussion on atmospheric, ice, and water sensing satellites.
6. Demonstrate a strategy employed in monitoring ocean circulation.
7. Explain the relationship between the oceans and the atmosphere.
8. Discuss the latest technologies employed to improve global climate predictions.
9. Explain the TOPEX/Poseidon satellite mission and its' major contributions to science.

BRIEF COURSE OUTLINE:	
Class 1:	Class Orientation Objectives Outline Course Contract In-Class Activities

TABLE 12 – Continued

BRIEF COURSE OUTLINE:	
	Class Expectations
	Grading System
	Academic Honesty
	Discussion of course paper requirements
	Introduction to TOPEX/POISEDON satellite that has mapped over 95% of the world's ice-free seas. Web site: http://topex-www.jpl.nasa.gov/discover/ocean_planet.html
	Activity: Ocean Topography Mapping
Class 2:	Development of TOPEX/POISEDON-From Sailing Ships to Satellites
	Our Oceans' Seasons
	Oceans, Climate, El Nino
	Using TOPEX/POISEDON Data for Practical Operational Applications
	Web Site: http://topex-www.jpl.nasa.gov/discover/ocean_planet.html
	Introduction to Advanced Spaceborn Thermal Emissions and Radiometer (ASTER) High Resolution Images of Land Surface, Water, Ice and Clouds
	Data Analysis: Vegetation, Land Cover Type, and Soils
	Activity: Watch TOPES/POISEDON video and ASTER video and describe similarities and differences of capabilities.
Class 3:	Develop ASTER
	Introduce Sea-viewing Wide Field-of-view Sensor (Sea WiFS) SeaWiFS; Marine Transportation
	Marine Applications
	Monitoring Marine Ice
	Improving Marine Forecasts
	Managing Inland Waterway Logistics
Class 4:	Develop SeaWiFS
	Introduce Tropical Rainfall Measuring Mission (TRMM)
	TRMM-Energy Budgeting and Lightening
	Rainfall Radar
	Agriculture, Forestry, Insurance, and Disaster Management by State, Country, Regional Planners and Managers.

TABLE 12 – Continued

BRIEF COURSE OUTLINE:	
	Activity: Construct a Hydrological Environment and Monitor it throughout the rest of the course.
Class 5:	Introduce METEOR Satellite Launched on 7/99 to Measure Aerosol Gases SAGE III METEOR Satellite Mission to Measure Aerosol Trace Gases in the Stratosphere TES Satellite Launched 12/02 Mission to Measure Trace Gases in the Mesosphere Activity: Moist Gases, Dry Gases and What's in Between? Demonstration: Pressure, Density and Volume
Class 6:	Introduce ACRIM Satellite Launch 10/99 to Measure Solar Output in the Mesosphere Present Hydro-Cycles to the Class. Show Measurements of Rainfall.
Class 7:	Develop ACRIM Satellite Introduce GLAS Satellite Glacier Satellite Launch 7/01 for Topography and Altimetry Introduce ICESAT-1 Satellite Launch 7/01 for Topography and Altimetry Review for Mid Term Exam
Class 8:	Introduction to JASON-1 Satellite /00 Ocean and Land Altimetry MID TERM EXAM
Class 9:	JASON-1 Satellite 5/00 Ocean and Land Altimetry Web Site: http://topex-www.jpl.nasa.gov/jason1/ Guest Speaker-Meteorologist
Class 10:	Develop JASON-1 Introduction to Atmospheric Sounders and Satellites that Measure Atmospheric Conditions/Hydro-Cycle Real Time Imaging Present Hydro-Cycles to Class. Show Measurement of Rainfall.
Class 11:	JASON-1 Atmospheric Dynamics and Chemistry Oceans' Role in Atmospheric Conditions and Chemistry

TABLE 12 – Continued

BRIEF COURSE OUTLINE:	
	Predictions: Demonstrate a Meteorological Prediction to the Class in Teams
Class 12:	Meteorology and Methods
	Capabilities of Satellites Launched in the Year 2000
Class 13:	Activity: Meteorology Methods
	Field Trip: Meteorology Weather Station
Class 14:	Operational Environmental Satellites
	Visibility of Satellites
	Charting Satellites
Class 15:	Research Paper Due
	Review for Final Exam
Class 16:	FINAL EXAMINATION

TABLE 13

EARTH OBSERVATIONS III-AIR

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Compare and contrast the functions of the different satellites, namely, MODIS, Landsat, ASTER, GPS.
2. Discuss applications of satellite employment.
3. Explain how satellites report data for Agricultural Industries, Forestry.
4. Agencies, Fisheries, and Insurance Agencies.
5. Explain a Disaster Management Plan and Insurance Applications considered with satellite technology.
6. Describe hazard assessment and damage assessment that results from satellite data.
7. Identify the major landforms from Landsat 7 photos.
8. Identify major geological features and processes that are taking place and being documented by Landsat 7.

TABLE 13 – Continued

BRIEF COURSE OUTLINE:	
Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
	Introduction to Global Position Satellite System (GPS)
Class 2:	Develop GPS
	Activity: NASA GPS-Group Work
	Introduction Multi-Spectral Imager (MODIS)
	Introduction to Landsat 7
Class 3:	Develop Landsat 7
	Activity: Landsat 7 Mapping
	Introduce Advanced Spaceborn Thermal Emission and Reflection Radiometer (ASTER).
Class 4:	Develop ASTER
	Introduce Moderate Resolution Multi-Spectral Imager (MODIS)
	Surface Temperature
	Concentration of Trace Gases
Class 5:	Motions of Air Masses
	Cold Front
	Warm Front
	Activity: Cloud-in-a-Can, Cloud Chart
Class 6:	Air Mass Movements over Oceans
	Air Mass Movements over the Continents
	Air Mass Movements over the Poles
	Activities: Map and Predict Weather from two NASA Videos

TABLE 13 – Continued

BRIEF COURSE OUTLINE:	
Class 7:	MODIS Applications to Air Mass Movements over Agricultural Communities Agriculture Applications Activities: Draw Air Masses over Agricultural Community
Class 8:	Atmospheric Pressure Changes Review for Mid Term Exam Activity: Demonstrate Changes in Atmospheric Pressure can affect the Sea Level.
Class 9:	Review for Mid Term Exam Wind-Drive Storm Surge Satellite detection of Influencing Factors Guest Speaker: Meteorologist
Class 10:	Mid Term Exam MODIS Video Analysis
Class 11:	MODIS Analysis and Applications Disaster Management Natural Hazard Storms Blizzards Floods
Class 12:	Hazard Assessment and Risk Exposure Damage Impact Assessment MODIS Analysis
Class 13:	Transportation: Land and Aviation Mapping Road Networks
Class 14:	Activity: Video: Landsat NASA 2:37 Discussion of Importance and Necessity to Human Interaction with the Landsat 7-Terrestrial Surface GLAS-Ice Topography and Altimetry
Class 15:	Guest Speaker from Boeing on GPS in industry Review for Final Exam
Class 16:	Final Examination

TABLE 14

LUNAR SCIENCES AND THE APOLLO MISSIONS

COURSE OBJECTIVES: By the end of the course the student will be able to:

1. View Lunar Samples.
2. Compare and Contrast Moon Rocks with Earth Rocks.
3. Identify the Launch Vehicles of the Apollo Missions.
4. Explain the History of The Space Race
5. Construct Lunar Model of a Proposed Lunar Colony
6. Write a Research Paper on the Importance of Missions to the Moon.

BRIEF COURSE OUTLINE:

Class 1:	Class Orientation and Procedures Objectives Outline Course Contract In-Class Expectations and Activities Class Expectations and Participation Grading System Academic Honesty Introduce Spacecraft: Saturn IB, and Saturn V
Class 2:	Introduce Apollo Command and Service Module Introduce Apollo Lunar Module Apollo 7
Class 3:	Rocket Science Forces and Mass Apollo 8
Class 4:	From the Ground to Orbit Who Launches Rockets? Apollo 9
Class 5:	Apollo 10 and Apollo 11 Video: Apollo 11 Analysis of Apollo 11
Class 6:	Apollo 12

TABLE 14 – Continued

BRIEF COURSE OUTLINE:	
	Apollo 13
	Video: Apollo 13
	Analysis of Apollo 13
	Comparison of Apollo 11 and 13
Class 7:	Apollo 14
	Apollo 15
Class 8:	Apollo 16 and 17
	Review for Mid Term Exam
Class 9:	Topography of the Moon
	Charting the Moon
	Mapping Activity
	Mid Term Exam
Class 10:	Anatomy of the Moon
	Theories of the Origin of the Moon
	Fission Theory
	Binary Accretion Theory
	Capture Theory
	Formation of Planets and Satellites
Class 11:	Planetismals
	Other Satellites of Catastrophic Origin: Charon and Selected Asteroids
	Activity: Crater Maker
Class 12:	Giant Impact Theory
	Mineralogy
	Activity: Identify Earth Rocks/Minerals
Class 13:	Activity: Identify Minerals Earth Rocks/Minerals Continued
	View: Lunar Samples
	Activity: Identify Minerals in Lunar Samples
Class 14:	Compare the Lunar Samples with Earth Samples
	Complete Lunar/Earth Identification Data Table
Class 15:	Lunar Sample Certification

TABLE 14 – Continued

BRIEF COURSE OUTLINE:	
	Review for Final Exam
Class 16:	Turn in Research Paper
	Final Examination

TABLE 15

GEMINI MISSIONS AND ROCKETRY

COURSE OBJECTIVES: By the end of the course, the student will be able to:

1. Discuss the Gemini Missions 3-12.
2. Identify the Anatomy of the Gemini Spacecraft.
3. State the Launch Date, Astronauts, Mission Duration, Miles Traveled and Launch
4. Explain How a Rocket Moves.
5. Discuss Newton's Laws of Motion.
6. Identify the Forces involved in Rocketry.
7. Produce Teaching Strategy Units in Rocketry.
8. Construct various Rockets and Models.

BRIEF COURSE OUTLINE:	
Class 1:	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
	Introduce the Gemini Missions
Class 2:	Anatomy of Gemini Spacecraft
	Differences between Mercury Spacecraft and Gemini

TABLE 15 – Continued

BRIEF COURSE OUTLINE:	
	Video: McDonnell Douglas, Gemini
	Gemini 3, 4, 5, and 6: Launch Date, Astronauts, Mission Duration, Miles Traveled and Recovery Ship.
Class 3:	Gemini 7, 8, 9, 10, 11, and 12: Launch Date, Astronauts, Mission Duration, Miles traveled, and Recovery Ship.
	Mission Purpose and Data
Class 4:	Introduction to Rocketry
	Anatomy of a Rocket
	History of Rockets
	Rocket Principles
	Activity: NASA: Hero Engine
Class 5:	Chinese Fire-Arrows
	Surface-Running Torpedo
	Step Rocket
	Rocketry becomes Science
	Modern Rocketry
	Goddard's 1925 Rocket
	Sputnik I
Class 6:	Newton's First Law
	Rest
	Motion
	Unbalanced Force
	Activity: Newton's First Law
Class 7:	Newton's Second Law
	Acceleration
	Force
	Mass
	Activity: Newton's Second Law
	Review for Mid Term
Class 8:	Newton's Third Law
	Action

TABLE 15 – Continued

BRIEF COURSE OUTLINE:	
	Reaction
	Activity: Newton's Third Law
	Mid Term Exam
Class 9:	Putting Newton's Laws of Motion Together
	Practical Rocketry
	Rocket Engines and Their Propellants
	Solid Propellant Rocket
	Engine Thrust Control
Class 10:	Stability and Control Systems
	Center of Pressure and Center of Mass
	Movable Fins
	Gimbaled Nozzle
	Weight
	Staging
	Construction Activity: Paper Rockets and Applications (Stability)
Class 11:	Construction Activity: Rocket Pinwheel
	Construction Activity: Build a Rocket Car
	Analysis of Rocket Car
	Applications of Rocket Car (Newton's Third Law)
Class 12:	Construction Activity: Water Rockets and Applications (Newton's Second Law)
	Video: NASA: Rocketry
Class 13:	Construction Activity: Balloon Staging (Rocketry Staging)
	Step Rockets to Staging Rockets
Class 14:	Construction Activity: Newton Cart (Newton's Laws of Motion)
	Discussion Tying all Principles Together.
Class 15:	Construction Activity: Pencil Rockets
	Flight and Rocketry
	Weather
	Review for Final Exam

TABLE 15 – Continued

BRIEF COURSE OUTLINE:	
Class 16:	Construction Activity: Space Shuttle Model
	Building Models
	Final Examination

TABLE 16

GRAVITATION AND MECHANICS, ELLIPSES
AND NEWTONIAN MECHANICS

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Define and illustrate an ellipse.
2. Define the parts of an ellipse.
3. Explain Newton's Principles of Mechanics
4. Define acceleration in orbit.
5. Define Kepler's Laws.
6. Define gravity gradients and tidal forces
7. Explain how orbits work.
8. Explain what an interplanetary trajectory is.
9. Calculate SpaceMathematics Formulas: Calculations of Measurement, Geometry, Algebra, Probability, Statistics, Trajectories, Conic Sections, Trigonometry, Exponential and Logarithmic Functions.
10. Discuss the Aspects of Recent NASA Missions and the Relationship to Mathematical Functions.

BRIEF COURSE OUTLINE:	
Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities

TABLE 16 – Continued

BRIEF COURSE OUTLINE:	
	Class Expectations and Participation
	Grading SysteM
	Academic Honesty
	Introduction to Ellipses
Class 2:	Kepler's Laws of Planetary Motion
	Law of Elliptic Orbit
	Law of Areas
	Law of Periods
	Parts of an Ellipse
Class 3:	Newton's Principles of Mechanics
	Tidal Forces
Class 4:	Orbital Mechanics
	Vectors
	Acceleration
Class 5:	Applications of Orbital Mechanics
	Universal Law of Gravitation
Class 6:	How Orbits Work
	Hohmann Transfer Orbits
	Gravity Assist Trajectories
Class 7:	Planetary Orbits
	Orbital Parameters
	Orbital Elements
	Types of Orbits
	Review for Mid Term
Class 8	Applications of Orbital Mechanics Review
	Mid Term Exam
Class 9:	Newtonian Physics
	Activity: Newton's First Law
Class 10:	Newtonian Physics
	Activity: Newton's Second Law

TABLE 16 – Continued

BRIEF COURSE OUTLINE:	
Class 11:	Newtonian Physics Activity: Newton's Third Law
Class 12:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Computation and Measurement Algebra
Class 13:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Geometry Probability and Statistics
Class 14:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Exponential and Logarithmic Functions
Class 15:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Trigonometry
Class 16:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Matrix Algebra
Class 17:	NASA: *SpaceMathematics*, 1985 Mathematical Aspects of Some Recent NASA Missions Conic Sections Review For Final Exam
Class 18:	Final Examination

TABLE 17

SPACE FLIGHT PROJECTS, MISSIONS, EXPERIMENTS, SPACECRAFT

COURSE OBJECTIVES: By the end of the course the Student will be able to:

1. Discuss the tasks involved in Entering Space.
2. Explain what an Orbit is.
3. Explain Orbital Mechanics without the Math.
4. Identify Elements of Spacecraft: Mercury, Gemini, Apollo, and the Space Shuttle.
5. Explain how to Perform Space Maneuvers
6. Explain the Story of the Race to the Moon.
7. Describe how the Space Shuttle Works.
8. Explain what the Astronauts do in Orbit.
9. Describe the Role of STARDUST.
10. Discuss the Importance of the International Space Station.
11. Discuss Future Piloted Mars Missions.

BRIEF COURSE OUTLINE:

Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
	Introduce Spacecraft
	Mercury
	Gemini
Class 2:	Introduce Apollo Command and Service Module
	Introduce Apollo Lunar Module
	Define an Orbit
	Define Circular Orbit, Elliptical Orbit, and Generalized Concepts
	Boundary of Space
Class 3:	Rocket Science

TABLE 17 – Continued

BRIEF COURSE OUTLINE:	
	Forces and Mass
	Newton's Laws and Rocket Thrust
	How a Simple Rocket Works
	Propellants and Specific Impulse
	Liquid Propellants
	Solid Propellants
	Staging
Class 4:	From the Ground to Orbit
	Who Launches Rockets?
	Major Launch Systems in Use Today
	Activity: Build and Launch a Rocket
Class 5:	Orbital Mechanics without the Math
	How Elliptical Orbital Motion Works
	Elliptical Geometry
	Equal Areas and Equal Times
	Orbital Periods
	How to Describe an Orbit
	Geocentric M50 Coordinate System
	Classical Orbital Element Set
Class 6:	Nodal Regression
	Common Types of Earth Orbits
	Low Earth Orbit
	Polar Orbits
	Geosynchronous Orbits
Class 7:	How to Perform Space Maneuvers
	Launch Site Considerations
	Launch Site Location
	Launch Azimuth
	Review for Mid Term
Class 8:	Mid Term Exam
	How to Change an Orbit

TABLE 17 – Continued

BRIEF COURSE OUTLINE:	
	Impulsive Burn Assumption
	Components of Motion
	Horizontal Burns
	Radial Burns
	Combined Burns
	Simple Plane Change Maneuver
	Perturbation Sources
Class 9:	How to Transfer between Orbits
	Hohmann Transfer
	Faster Transfer Techniques
	General Transfers
Class 10:	The Story of the Race to the Moon
	The Cold War Connection
	First Steps into Space
	Project Mercury
	A Small Jump
	Redemption
Class11:	The Intermediate Step
	Project Gemini
	Upstaged Again
	Vaulting into the Lead
	Rendezvous in Orbit
	Docking with Disaster
	Tying up Loose Ends
Class 12:	Fulfilling the Dream
	The Mode Decision
	A Plan for Reaching the Moon
	A Fiery Beginning
	Preparing to Meet the Kennedy Challenge
	A Giant Leap
	Unlucky 13

TABLE 17 – Continued

BRIEF COURSE OUTLINE:	
	The J Missions
	After the Moon
Class 13:	How the Space Shuttle Works
	What is the Space Shuttle?
	Preparing for Flight.
	Ground Processing
	Countdown to Launch
	How do Shuttles Get into Orbit?
	What Happens During a Launch Emergency?
	Who Flies in the Space Shuttle?
	What do Astronauts do in Orbit?
	Attitude Control
	Orbit Changes
	Satellite Deployment
	Robot Arm
	Extra Vehicular Activity
	Spacelab
	Reentry
	The Future of the Space Shuttle Program
Class 14:	The Role of Satellites in the Age of Information
	Communications Satellites
	Before the Space Age
	Reflectors in Space
	Weather Satellites
	Current Systems
	Global Positioning System
Class 15:	A Look at a Future Piloted Mars Mission
	Dispelling Old Myths
	Canals?
	Marnier and the Ghoul
	Reaching Utopia and the Search for Life
	Launch Windows

TABLE 17 – Continued

BRIEF COURSE OUTLINE:	
	Flight Scenarios
	Conjunction Class
	Opposition Class
	Sprint Mission
	A Different Idea: Spacecraft Design and Aerobraking
Class 16:	NASA: STARDUST Mission
	Comet Wild 2
	Bringing samples of Cometary Material Back to Earth
	A Trip There and Back
	Catching Bullets in Space
	A New Way to do Space Missions
	Video: NASA: STARDUST-Bringing Cosmic History to Earth (7:49)
	Web Site: http://stardust.jpl.nasa.gov
Class 17:	Introduction to the International Space Station
	Microgravity research
	Life Sciences
	Space Sciences
	Earth Sciences
	Space Product Development
	Engineering and Technology
	Who is Involved?
	Video: NASA: ISS Progress Report
	Web Site: http://station.nasa.gov/science
	Review for Final Exam
Class 18:	Final Examination

TABLE 18

FORCES OF FLIGHT, LAUNCH, CRUISE, ENCOUNTER, RETURN, LAND

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Identify the Four Forces of Flight.
2. Explain the Physical Principles in Spacecraft Launch, Cruise, Encounter, Return, and Landing.
3. Perform Teaching Strategies in Aeronautics.
4. Perform/Demonstrate Mathematics and Scientific Calculation/Principles in Aeronautics.

BRIEF COURSE OUTLINE:

Class 1:	Class Orientation and Procedures
	Objectives
	Outline
	Course Contract
	In-Class Expectations and Activities
	Class Expectations and Participation
	Grading System
	Academic Honesty
	Introduction to Space Flight Operations
Class 2:	Introduction of Launch Phase
	Mathematics Formula: Bernoulli's Equation
	Mathematics Formula: Force of Gravity
	Mathematics Formula: Lift
	Mathematics Formula: Reynolds Number
	Lighter-than-air-craft
Class 3:	Develop Bernoulli's Equation
	Principles of Flight
	Lift
	Angle of Attack
	Gravity
	Thrust
	Drag

TABLE 18 – Continued

BRIEF COURSE OUTLINE:	
	Activity: Construct-a-Craft
Class 4:	Problems of Flight
	Develop Gravity Equation
	Sound Barrier
	Heat Barrier
	High-Altitude Flight
	Drag Reduction
	Runway Length
Class 5:	Develop Lift Equation
	Activity: Air…What Gives?
	Activity: Air Has Weight.
	Activity: Lung Power
	Launch Vehicles
	Launch Sites
	Launch Windows
Class 6:	Develop Reynolds Number Equation
	Preparations for Launch
	Cruise Phase
	Spacecraft Checkout and Characterization
	Real-Time Commanding
	Typical Daily Operations
	Preparations for Encounter
	Activity: Construct a Rocket
Class 7:	Activity: Launch Rockets
	Analyze Rocket Flights
	Video: NASA Spacecraft
	Review for Mid Term Exam
Class 8:	Mid Term Exam
	Video: NASA: Space Basics
	Mechanical Universe Tapes Navigating in Space, Inertia, and Newton's
Class 9:	Encounter Phase

TABLE 18 – Continued

BRIEF COURSE OUTLINE:	
	Flyby Operations
	Planetary Orbit Insertion
	System Exploration and Planetary Mapping
	Occulations
	Gravity Field Surveying
	Atmospheric Entry and Aerobraking
	Activity: Group Teaching Strategy
Class 10:	Landing
	Balloon Tracking
	Sampling
	Mars Pathfinder Data
	Future Mars Missions
	Activity: Group Teaching Strategy
Class 11:	Extended Operations Phase
	Completion of Primary Objectives
	Additional Science Data
	End of Mission
	Activity: Group Teaching Strategy
Class 12:	Return
	Reentry Window
	Landing
	Aerodynamics
	Activity: Group Teaching Strategy
Class 13:	Gravitation and Mechanics
	Ellipses
	Newton's Principles in Mechanics
	Activity: Group Teaching Strategy
Class 14:	Acceleration in Orbit
	Kepler's Laws
	Gravity Gradients (Tidal Forces)
	How Orbits Work

TABLE 18 – Continued

BRIEF COURSE OUTLINE:	
	Activity: Group Teaching Strategy
Class 15:	Orbiter Spacecraft
	Atmospheric Probe Spacecraft
	Lander Spacecraft
	Surface Penetrator Spacecraft
	Surface Rover Spacecraft
	Current Flight Projects at JPL
	Future Flight Projects at JPL
	Review for Final Exam
Class 16:	FINAL EXAMINATION

Recommendations

As a result of this study the researcher's recommendations are:

1. Develop an Aerospace Education Teacher Preparation Program in every College of Education across the United States.
2. Train teachers to motivate students in their classrooms by employing the strategies taught in the Aerospace Education Teacher Preparation Program.
3. Meet the challenge of the producing talented and proficient teachers in every classroom by educating teachers of Aerospace Education principles through the proposed Aerospace Education Teacher Preparation Program.

4. Motivate teachers with an Aerospace Education Teacher Preparation Program to integrate science, mathematics, and technology into the classroom.
5. Meet the challenge of moving American students to stand first in science and mathematics by employing the principles of the proposed Aerospace Education Teacher Preparation Program.
6. Develop an Aerospace Education Teacher Preparation Evaluation System.
7. Participate in the Nations Assessment of Education Progress Program in order to track student performance in aerospace education over the years.
8. Track Aerospace Education Teachers who have been educated with this Aerospace Education Teacher Preparation Program and perform a causal comparative study with their preparation to their students performance on science, mathematics, and technology exams.
9. Conduct a Cost-Benefit Analysis Study of this Aerospace Education Teacher Preparation Program for identified colleges and universities.
10. Conduct a Qualitative Analysis of disconnect between the colleges of the Arts and Sciences with the colleges of the Applied Sciences.

President Clinton called *Americans to action for American Education in the 21st Century* (United States Department of Education, 1998). He called for talented and proficient teachers in every classroom and stated that American students will be first in science and mathematics. In recent years, debate about the quality of education has focused attention on the need for more and better science instruction to enable young people to cope with rapidly changing and ever expanding technology. The world of aerospace science is one in which science, mathematics, physics, chemistry, and technology skills and proficiency are of paramount importance. Moreover, aerospace and aviation, more than any other disciplines, has an ability to inspire youth and create an excitement in a classroom setting that can spill over into all academic areas.

Because of its high motivational value, aerospace and aviation education can contribute measurably to the development of skills in the instruction program. The activities and experiences in an aerospace program are valuable tools that all teachers across America should possess. The science, mathematics, and technology skills that one would acquire through such an Aerospace Education Teacher Preparation Program are an imperative requisite to compete in a world whose sum total of knowledge is doubling at ever-shorter intervals.

Teachers in every classroom across the United States should be specialists in their fields. Science, mathematics, and technology teachers should be trained in aerospace education because this discipline is integrated, encompassing all subjects. This would allow them to experience the excitement which the Aerospace program can ignite in their classrooms and to rekindle the innate eagerness to learn that students instinctually possess, especially in matters dealing with Aerospace Science Education.

Every College of Education across the United States should offer the Aerospace Education Teacher Preparation Program at the masters' level. Future teachers should be able to choose an Aerospace Education Teacher Preparation Program for certification because they would obtain the science, mathematics, and technology skills necessary to elevate students' scores in these disciplines across the nation.

Finally, colleges and universities must recognize the disconnect between the colleges of arts and sciences with the colleges of applied sciences. In the 1800s, subjects were taught separately. That is, biology was only the subject taught in a biology class, just as, physics was only taught in a physics course. Over the last 100 years, educational needs and policies have evolved. However, the policies and pedagogy in the colleges of arts and sciences have failed to evolve with educational needs. Educational needs are now being met by integrating subjects. The Aerospace Education Teacher Preparation Program in this study integrates the subjects to meet the needs of the educators and students. This is important when considering the amount of educational material a teacher must cover in a school year and aerospace science can be the vehicle that is employed to cover these subjects.

Policies with in the colleges of arts and sciences and educational institutions must be reevaluated in order to meet the needs of educators and students. Congruity between subjects is crucial and a sound pedagogical practice in education. Yet, colleges still separate their subjects and students are expected to produce a bridge in the gap of their education they were given by the experts. It is important to consider these recommendations because it is the responsibility of the experts to offer educational programs that will launch learning into a top priority for all.

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APPENDIXES

APPENDIX A

THE PRESIDENT AND GOVERNORS' NATIONAL

EDUCATION GOALS BY THE YEAR 2000

GOALS 2000

1. The children in America will start school ready to learn.

2. United States high school graduation rate will increase to 90 %.

3. American students will leave grades 4, 8, and 12 having demonstrated competency in challenging subject matter including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy.

4. United States students will be first in science and mathematics achievement.

5. Every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.

6. Every school in America will be free of drugs and violence and will offer a disciplined environment conducive to learning.

APPENDIX B

INSTITUTIONAL REVIEW BOARD FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

DATE: 03-01-99 **IRB #: ED-99-092**

Proposal Title: DEVELOPMENT OF AN AEROSPACE SCIENCE TEACHER PREPARATION PROGRAM

Principal Investigator(s): Steve Marks, Heidi M. von Oetinger-Reed

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Signature: Date: March 2, 1999

Carol Olson, Director of University Research Compliance
cc: Heidi M. von Oetinger-Reed

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX C

QUESTIONNAIRE OF ELECTRONIC SURVEY

TO AEROSPACE EDUCATORS

AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM QUESTIONNAIRE

Please answer the following questions using your expertise in aerospace science education programs and understanding of educating teachers in the field of aerospace science.

From the literature that is currently available in aerospace science, essential key elements have been identified and over the years, many teacher education programs have been developed to promote aerospace science education in these key areas. A teacher certification program for Aerospace Science has never been developed however! If you were to act as an Aerospace Science Education Specialist committee member on an Aerospace Science Teacher Certification Panel, which key elements of aerospace science would you identify as essential? Indicate this below.

Please respond to this questionnaire in an EXPEDIENT fashion since your response will be used this winter term to develop an aerospace teacher program.

1. History and Development of Aerospace Craft
Include Include if Time Permits Do Not Include

2. Space Science I –Sun, Inner Planets, and Asteroid Belt
Include Include if Time Permits Do Not Include

3. Space Science II-Outer Planets and Probes
Include Include if Time Permits Do Not Include

4. Earth Observing Systems-Land
Include Include if Time Permits Do Not Include

5. Earth Observing Systems-Air
Include Include if Time Permits Do Not Include

6. Earth Observing Systems-Water
Include Include if Time Permits Do Not Include

7. Lunar Sciences/Apollo Missions
Include Include if Time Permits Do Not Include

8. Gemini Missions/Rocketry
Include Include if Time Permits Do Not Include

9. Gravitation and Mechanics/Ellipses/Newton's Principles
Include Include if Time Permits Do Not Include

10. Space Flight Projects/Missions/Experiments/Spacecraft
Include Include if Time Permits Do Not Include

11. Four Forces of Flight/Launch/Cruise/Encounter/Return/Land
Include Include if Time Permits Do Not Include

12. Are there any other subjects that are ESSENTIAL to an aerospace teacher certification program that are not listed here? If so, what are they? (Please List Them)

APPENDIX D

MODEL OF AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM COURSES

COURSE NUMBER AND TITLE: AVSED 6313, HISTORY AND DEVELOPMENT OF SPACECRAFT AND SPACEFLIGHT

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITES AND SUPPORT COURSES

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Identify the Early Airplanes and describe their significance to the history of spaceflight in The United States of America.
2. Identify the Pioneers in Rocketry.
3. Discuss the importance of the German Rocket Team with respect to The American Rocket Team.
4. Identify what were the major contributions of the Space Race.
5. Describe the functions and roles of NASA.
6. Explain the concept and function of America's Space Transportation System.
7. Complete an extensive research project on a specific Space Shuttle Mission and give a presentation summarizing your study.
8. Participate as an active research member for the latest spaceflight news important to the chronology of spaceflight evolution and write a record data/fact sheet on twenty-five dates of aerospace significance.
9. Construct a historical time line of the major spaceflight events and contributors.
10. Evaluate the role of the International Space Station (ISS).

BRIEF COURSE OUTLINE:

Class 1: Orientation and Class Procedures
Objectives
Outline
Course Contract
In-Class Activities
Class Expectations
Grading System
Academic Honesty
Discuss the time line of the classes projects and assignments

Class 2: History recounts many who envisioned ways to fly. History of Daedalus and Icarus. Chinese invention of the kite 1000 B.C. Leonardo Da Vinci imagined the orinthopter for travel. Montgolifier Brother's.
Construct: Flying Apparatus

Class 3: 1804, British Scientist and Inventor Sir George Cayley built the first toy airplane. Airscrew Propellar
1903, American brothers, Orville and Wilbur Wright invent Flyer 1.
1907, Louis Bleroitt flew the world's first monoplane.
1910, Louis Bleriott flew across the English Channel.
Activity: Construct Wright Flyer
Activity: Pop Rockets
Discussion: How did we get from gliders to rockets?

Class 4 1919, Aviation had established itself around the world.
World War I, aircraft flew at speeds of 113-129 kilometers per hour (70-80 miles per hour) at an altitude of 3,048 meters (10,000 feet).
Charles Lindberg, a barnstormer and mail order pilot, flew The Spirit of St. Louis. (flight completed in 33.5 hours)
Group Presentation 1

Class 5: 1939, The Jet Age, the HE 178 monoplane designed by the German engineer, Ernst Heinkel, made its first flight reaching a speed of 700 kilometers per hour (435 miles per hour).
1963, the X-15 set speed and distance records that stand to this day, reaching speeds of07 kilometers per hour (4,354 miles per hour) and altitudes of 107,899 meters (354,000 feet).
1947, Chuck Yeager's flight of the rocket-powered Bell X-1, which broke the sound barrier, it became evident that flight with the use of rockets was now a reality.
Group Presentation 2

Class 6: 1882-1945, Robert Goddard, Rocketry.
1954, Robert Goddard died leaving behind 215 patents in rocketry which still produce royalties for his estate.
1912-1977, Wernher von Braun, Rocketry.
1932, the German Army was beginning to show an interest in German Rocket Society's efforts and in July of that year, a Mirak rocket was launched.
Liquid propellant rockets for the German Army were constructed.
Group Presentation 3

Class 7: 1937-1941, von Braun's group launched some 70 A-3 and A-5 rockets.
1939, World War II, research for the A-4 rocket began.
1942, the A-4 flew in March. The rocket barley cleared some low clouds.

1942, August, the second launch of the A-4 saw the rocket rise 7 miles before exploding.
1942, October, another A-4 roared aloft from Peenemuende, followed its programmed trajectory perfectly, and landed on target 193 kilometers (120 miles) away.
Group Presentation 4

Class 8: Adolf Hitler assigned the highest priority to the V-2 program.
1943, Production of the A-4 began, now renamed V-2.
1944, V-2 rocket launched in London. The Germans had launched approximately 3,000 V-2's against England and other targets.
Review for the Mid-Term Exam

Class 9: The German Rocket Team
Mid-Term Exam

Class 10: The "Space Race" Begins. October 4, 1957 launched Sputnik (meaning "space traveler"), the world's first satellite, into space.
January 31, 1958, the U.S. launched Explorer 1. The United States Rocket Team. April 12,1961, when Yuri Garuarin the first human in space into orbit aboard the Vostok spacecraft. (108 minutes)
Group Presentation 5

Class 11: October 7, 1958 the U.S. approved the Mercury program.
May 5, 1961. A Mercury redstone rocket launched Alan Shepard into a sub-orbital flight, making him the first American in space.
July 21, 1961, Virgil "Gus" Grissom was launched into a sub-orbital flight.
February 20, 1962, John Glenn became the first American to achieve orbit.
May 25, 1961. President Kennedy intensified the Space Race when he committed the United Sates to being the first on the moon.
Group Presentation 6

Class 12: June 16, 1963, The Soviet Union launched Valentina Tereshkova, the first woman in space.
December 7, 1961, The United States announced the Gemini space program.
June 3, 1965, Ed White became the first American to perform an EVA and remained outside the capsule for 21 minutes.
Group Presentation 7

Class 13: The Apollo Mission.

View Lunar Rocks on loan from NASA and a Meteorite Sample Disk.

Countdown rehearsal tragedy; the Apollo 1 crew perished in a fire

inside their spacecraft at the Kennedy Space Center. (Grissom, White, Chaffee)
Apollo 7-17 Missions.

Class 14: Apollo Missions 7-17 Development
Space Stations; Mir, and the International Space Station, Skylab
Satellites.
Group Presentation 8

Class 15: The Space Shuttle Anatomy and Missions.
Written Research Paper Due
Review for the Final Exam

Class16: Final Exam and Class Closure

STYLE/MODE OF TEACHING: Activity/Hands-on learning activities, lecture, demonstration, and discussion.

FEE IN ADDITION TO TUTION: None

EXAMS AND MAJOR ASSIGNMENTS:

Significant Dates	15%
Group Presentation	20%
Written Research Report of a Space Shuttle Mission	15%
Mid-Term Exam	20%
Final Exam	30%

Written Research Report:

This report must be written on one Space Shuttle Mission (your choice).
It must explain NASA's function and role in space flight history as well as, include the missions' focus and purpose. The report must detail the findings of the mission and describe the roles of the Astronauts on board the Shuttle.
A bibliography/source page and visuals of the shuttle or mission must be included.

OTHER REQUIREMENTS (FIELD TRIPS,ETC.): Attendance is essential to understanding and mastering the material in this class. Therefore, it is expected.

GRADING PROCEDURES:

Grading Scale:
100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D

POLICY ON ATTENDANCE: Attendance is strongly encouraged and it is up to the student to notify the instructor of any absence.

TEXT MATERIALS: Flight in America by Roger Bilstein. (Please return the text to the instructor upon completion of the course.
Orders of Magnitude: A History of the NACA and NASA, 1915-1990 by Roger Bilstein

REFERENCE LITERATURE:
Reserved at Library in the reserve location.

To Rise From Earth: An Easy to Understand Guide to Space Flight
Wayne Lee

Exploring the Unknown Volume I: Organizing for Exploration John M. Logsdon

Exploring the Unknown Volume II: External Relationships John Logsdon

Exploring the Unknown Volume III: Using Space John Logsdon

SIGNIFICANT DATES

There is a list of twenty-five dates. Those dates are required and due on the dates specified in the schedule.

To complete each significant date find that day's edition of the *New York Times*, *Washington Post*, *Time of London*, or *Daily Oklahoman* newspaper in the library's microfilm room. Using the attached forms, give a summary of what was going on that day to include:

Headline Story
Foreign and domestic news headlines
Prices for food, clothing, houses, cars, etc.
Social trends such as fashion, music, etc.

The objective of these significant dates is to place each event into historic context. What was the reaction to the event at the time? Has the significance of the event changed since then? Did it change society? If so, how? What else was going on then?

TWENTY FIVE SIGNIFICANT DATES

October 1903 Langley's first attempt to fly

8 December, 1903	Langley's second and last attempt to fly
17 December, 1903	Wright Brothers fly
25 July, 1909	Louis Bleriott crosses the English Channel
5 November, 1911	Calbraith Rodgers crosses the USA
16 April, 1912	Harriet Quimby crosses the English Channel
3 May, 1923	First non-stop coast to coast flight
21 May, 1927	Charles Lindberg crosses Atlantic solo
1 July, 1931	Wiley Post flies around the world with Harold Gatty
21 May, 1932	Ameila Earhart crosses Atlantic solo
23 May, 1933	Wiley Post flies around the world solo
6 May, 1937	Hindenburg "burns and crashes"
1 September, 1939	German "blitzkrieg" Poland-WWII begins
7 December, 1941	Japanese attack on Pearl Harbor
6 & 9 August, 1945	Hiroshima and Nagasaki destroyed with A -bombs
14 October, 1947	Chuck Yeager achieves Mach 1.06
4 October, 1957	Sputnik 1 launched
31 January, 1958	Explorer 1 launched
12 April, 1961	Yuri Gagarin orbits earth three times
6 May, 1961	Alan Shepard-Freedom 7 in a sub-orbital flight
21 February, 1962	John Glenn-Friendship 7 makes three orbits
20 July, 1969	Apollo XI-Neil and Buzz walk on the moon
20 July, 1976	Viking I lands on Mars
12 April, 1981	First Space Shuttle Flight
28 January, 1986	Space Shuttle Challenger explodes
10, December. 1998	International Space Station
January 1999	International Space Station

COURSE NUMBER AND TITLE: SPACE SCIENCE I: SUN, INNER PLANETS AND ASTEROID BELT.

FACULTY: HOME:
OFFICE:
EMAIL:

PREREQUISITES AND REQUIREMENTS: Approval of Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of the course the student will be able to:

1. Discuss the importance of the distances from the Sun to where the Inner Planets and Asteroid Belt are found.
2. Discuss the importance of distances with in the Solar System.
3. Identify the major elements and effects of the Sun.
4. Discuss the identifying factors of the Terrestrial Planets.
5. Identify the major elements of the Asteroid Belt.
6. Describe the similarities and differences of Asteroids, Comets, and Meteoroids.
7. Demonstrate teaching strategies to illustrate a science concept.

BRIEF OUTLINE:

Class 1: Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty

Class 2: Introduction to The Celestial Sphere
Activity: The Positions of Celestial Objects
The Sun's Motion: How Long is a Year?
The Ecliptic
The Seasons
Scientific Models—A Geocentric Model
The Greek Celestial Model
Observations: The Planets
Video: NASA: A Trip Through the Solar System
Activity: Why is East on the Left in the Sky Photographs?

Class 3: Criteria for Scientific Models
Introduction and Development of A Sun-Centered System
The Relationship of Aristotle and Christianity
Nicholas Copernicus
Motion of Planets
Parallax
Activity: Measuring Parallax
Comparing the Two Models
Copernicus's Revolution
Tycho Brahe
Johannes Kepler
The Ellipse
Activity: NASA: Ellipse
Kepler's First Two Laws of Planetary Motion
Kepler's Third Law

Class 4: Galileo Galilei and the Telescope
Activity: Construct a Telescope
The Moon, the Sun, and the Stars
Satellites
The Phases of Venus
Isaac Newton
Isaac Newton's Two Laws of Motion
Mass and Weight
Newton's Third Law
Motion in a Circle
The Law of Universal Gravitation
Newton's Laws and Kepler's Laws
Activity: The Rotating Earth

Class 5: The Center of Mass
The Tides
Rotation and Revolution of the Moon
Precession of the Earth
The Importance of Newton's Laws
Beyond Newton: How Science Progresses General Relativity
Space Warp
Activity: Travel to the Moon

Class 6: Gravitation and Einstein
The Orbit of Mercury
Activity: Circular Motion
Measuring the Size of the Earth and Moon
The Distance to the Moon
Activity: Two Measuring Techniques

The Moon's Changing Size
The Moon's Phases
Lunar Eclipses
Types of Lunar Eclipses
Solar Eclipses
The Partial Solar Eclipse
The Annual Eclipse
Activity: Observing a Solar Eclipse
Activity: Lunar Sample Identification
View Moon Rocks and Become Lunar Sample Certified

Class 7: Lunar Sample Viewing
Earth
The Interior of the Earth
Earth's Magnetic Field
Video: The Earth from Space
Plate Tectonics
Earth's Atmosphere
The Moon's Surface
Activity: NASA: Crater Maker
Review for Mid Term Exam

Class 8: Photo: The Far Side of the Moon
Theories of the Origin of the Moon
The Large Impact Theory
History of the Moon
Mid Term Exam

Class 9: **Activity: Do-It-Yourself-Phases**
Activity: Observing Phases
Distances in the Solar System
Measuring Distances in the Solar System
Titius-Bode Law
Activity: Measuring the Mass of a Solar System Object
Planetary Motions
Classifying the Planets
Size, Mass, Density
Satellites and Asteroids
Comets and Meteors
Activity: Construct a Comet

Class 10: Rotations
Planetary Atmospheres
Gases and Escape Velocity

The Atmosphere of Planets
The Formation of the Solar System
Evidential Clues from Data
Evolutionary Theories
Catastrophic Theories
Present Evolutionary Theories
Activity: Life Elsewhere?

Class 11: Mercury
Mercury as Seen from Earth
Mercury via Mariner—Comparison with the Moon
Size, Mass, and Density
Venus
Size, Mass, and Density
Venus's Motions
The Surface of Venus
Photo: Our Changing View of Venus
The Atmosphere of Venus
A Hypothesis Explaining Venus/Earth Differences

Class 12: Mars
Mars as Seen from Earth
Size, Mass, and Density
Mar's Motions
Life on Mars
Invasion and Its Results
Video: ET Live IV—Viking's Search for Life
Atmospheric and Surface Conditions
The Moons of Mars
The Discovery of Marian Moons
Why Explore?
Mars Pathfinder/Sojourner Data
Activity: Viewing Mercury, Venus, and Mars
Group Teaching Strategy

Class 13: The Sun
Solar Data
Distance to the Sun
The Source of the Sun's Energy
Solar Nuclear Reaction
Fission and Fusion Power on Earth
The Sun's Interior
Pressure, Temperature, and Density
Hydrostatic Equilibrium
Energy Transport

The Neutrino Problem
The Solar Atmosphere
The Photosphere
The Chromosphere and Corona
The Solar Wind
Sunspots and Solar Activity Cycle
A Model for the Sunspot Cycle Solar Flares
Activity: Observing Sunspots
Activity: Measuring the Diameter of the Sun
Activity: Helioseismology
Group Teaching Strategy

Class 14: Asteroids
The Orbit of Asteroids
Activity: You Can Name an Asteroid
The Origin of Asteroids
Comets
Chaos Theory
Comet Orbits—Isaac Newton and Edmund Halley
The Nature of Comets
Comet Tails
The Oort Cloud and Kuiper Belt
Group Teaching Strategy

Class 15: Meteors and Meteor Showers
Meteors
Meteoroids
Meteorites and Craters
Activity: Hit by a Meteorite?
Activity: Meteors and Dinosaurs
Activity: Observing Meteors
Group Teaching Strategy
Review for Final Exam

Class 16: **FINAL EXAM**

STYLE/MODE OF TEACHING: Activities, Lectures, and Group Projects.

FEE IN ADDITION TO TUITION: None.

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	30%
Final Exam	30%
Teaching Strategy	20%
In-Class Activities	20%

OTHER REQUIRMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled in the course.
2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth

*the grade that you have set for yourself.
*how you will achieve that objective.
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS: Kuhn, K.F. (1994) *In Quest of the Universe.* Minneapolis, St. Paul: West Publishing Company.

INTERNET REFERENCE SITES:
http://www.nasa.gov
http://www.hq.nasa.gov/office/aero
http://www.osf.hq.nasa.gov/heds
http://www.hq.nasa.gov/office/oss/osshome.htm
http://www.cotf.edu/
http://spacelink.nasa.gov/

COURSE NUMBER AND TITLE: AVSED 5843; SPACE SCIENCE: OUTER PLANETS AND DEEP SPACE PROBES

FACULTY:.

HOME:
OFFICE:
EMAIL:

PREREQUISITES AND REQUIRMENTS:

COURSE OBJECTIVES: By the end of this course you will be able to:

1. Discuss the evolution of deep space probe exploration.
2. Identify the different space probes as inner or outer planetary probes.
3. Complete an extensive research project on one specific space probe and document its' contributions to modern astrophysics and aerospace science.
4. Construct a chronological time line of United States of America Space Probes.
5. Present an oral presentation using visuals and taking a creative approach to illustrating the life of specified projects. (Apollo, Pioneer, Voyager, Mariner, Galileo, Magellan, and Viking)

BRIEF COURSE OUTLINE:

Class 1:
Orientation and Class Procedures
Objectives
Outline
Course Contract
In-Class Activities
Class Expectations
Grading System
Academic Honesty
Rocket Power
Orbital Velocity
Sputnik 1
Orbital Mechanics

Class 2:
Satellite Orbits (ERS-1, NOAA-8, Intelsat 6 F-4, Lunar Orbiter 1)
Moon Rocket (Apollo Project)
Lunar Studies
Research Report Requirements
Orbital Mechanics
NASA ACTIVITY: STARDUST; JPL

Class 3:	Sky Laboratory Solar Max Ulysses Solar Studies Group Project Requirements
Class 4:	Escape velocity Sling Shot Orbits Mariner Project (4,7, 9, 10) Venera Project (13) Magellan Project Viking Project (1 and 2) Planetary Observer (Mars Observer) Mars Pathfinder/Soujourner **Construct: Meat-Tray Mars Pathfinder/Soujourner**
Class 5:	Giotto (Deep Space Probe to encounter Halley's Comet) Vega 1 Probing Halley's Comet Probing the Outer Planets Anatomy of the Outer Planets as seen by the probes Pioneer Project (10 and 11) Galileo Project **Comet Demonstration:"Live Comet"**
Class 6:	STARDUST Power for Probes Voyager Missions Discussion of Time Line Requirements
Class 7:	STARDUST Deep Space Communications Sounds of Earth **ACTIVITY: Communications and PIXELS (NASA)** **Review for Mid-Term Exam**
Class 8:	**Mid Term Exam**
Class 9:	The Shuttle Revolution View Space Shuttle Anatomy **Construct-A-Shuttle**
Class 10:	Hubble Space Telescope STARDUST **ACTIVITY: Earthdust**

<u>Time Line Due</u>

Class 11: International Space Station
Toward Tomorrow
Photon-Driven Starship
X-33
<u>Research Reports Due</u>

Class 12: Group Presentations

Class 13: Group Presentations

Class 14: Group Presentations

Class 15: **Final Exam Review**

Class 16: **<u>Final Exam and Class Closure</u>**

<u>STYLE/MODE OF TEACHING:</u> Lecture, Activities, Videos, Group Presentations, and Demonstrations.

<u>FEE IN ADDTION TO TUITION:</u> None

<u>EXAMS AND MAJOR ASSIGNMENTS:</u>

MID TERM EXAM	20%
FINAL EXAM	20%
TIME LINE	05%
GROUP PRESENTATIONS	20%
RESEARCH REPORT	20%

<u>OTHER REQUIREMENTS:</u> Active Participation

1. Class Attendance is expected of each person enrolled in the course.
2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth
    *the grade that you have set for yourself.
    *how you will achieve that objective.

*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

Grading Procedures: Your final grade will be an individual/team effort determined as follows:

Class attendance:	10%	
Class participation:	05%	
Time Line		05%
Written research report:	20%	
Group presentation:		20%
Mid-term Exam:		20%
Final Exam:		20%

Scale: 100%-90%=A, 89%-80%=B, 79%-70%=C, 69%-60%=D and 59% or below =F.

POLICY ON ATTENDANCE: Attendance is mandatory.

TEXT MATERIALS:

*Located in the reserve section of the Oklahoma State University Library.

*Exploring the Unknown Volume I: Organizing for Exploration by John M. Logsdon

*Exploring the Unknown Volume II: External Relationships by John M. Logsdon

*Exploring the Unknown Volume III: Using Space by John M. Logsdon

INTERNET REFERNCE SITES:

http://www.nasa.gov
http://www.nasa.spacelink
http://www.nasa.jsc.gov

COURSE NUMBER AND TITLE: AVSED 5813; EARTH OBSERVATIONS I-LAND

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITES AND SUPPORT COURSE: Approval of Advisor and Faculty

COURSE OBJECTIVES: By the end of this course you will be able to:

1. Compare and contrast the functions of different satellites, namely Moderate Resolution Multi-Spectral Imager (MODIS) designed to measure biological and physical processes globally, Land Satellites (LandSat), Advanced Space-born Thermal Emission and Reflection Radiometer (ASTER), and Global Position Satellites (GPS).
2. Discuss the applications of satellite employment.
3. Explain how satellites report data for agriculture industries, forestry agencies, fisheries, and insurance agencies.
4. Explain disaster management and insurance applications considered with satellite technology.
5. Describe hazard assessment and damage assessment that results from satellite data.
6. Identify the major landforms from LandSat 7 photos.
7. Identify major geological features and processes that are taking place and are being documented from LandSat 7.
8. Employ teaching strategies that are modeled in class.
9. Develop a middle school or high school mini-lesson on a theme taught in this course and present it to the class.

BRIEF COURSE OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Questions and Answers
Introduction to Global Position Satellite System (GPS)

Class 2:
Review of GPS
Introduction to Multi-Spectral Imager (MODIS)

Introduction to LandSat 7
Introduction to Advanced Spaceborn Thermal Emission and Reflection Radiometer (ASTER)

Class 3: MODIS Development
LandSat 7 Development
Surface Temperature
Concentration of Chlorophyll
Vegetative Conditions
Leaf Area Index
Fire Occurrence, Size, and Temperature
Cloud Cover
Cloud Properties
Teaching Strategies/Demonstrations: Ecology and Weather Methods

Class 4: Development of LandSat 7 and ASTER
Agricultural Applications: Measuring Crop Acreage, Classifying Crop Vegetation Type, Estimating Crop Yields and Optimizing Fertilization, Determining Vegetation and Crop Health, and Analyzing Pest Migration and Planning Pesticide Application.
Activity: Ecology, Agriculture, and Geology

Class 5: Agricultural Applications: Determining Range Readiness and Health and Maturity, Monitoring Fallow Land, Determining Soil Moisture and Drainage, Optimizing Irrigation—Aerial Distribution and Timing, Mapping and Monitoring Droughts and Floods, Timing Harvest Before Destructive Weather Events, Mapping Soil, Nutrient and Landscape Spatial Variability, Monitoring Soil Erosion, and Improving Climate Forecasts.
Guest Speaker: Ecological Society Representative

Class 6: Forestry Applications Measuring Timber Acreage, Classifying Forrest Age, Serial Stages, and Timber Type, Monitoring and Migrating Timber Disease, Monitoring Forest Fire and Assessing Fire Hazard, and Analyzing Watershed.
Activity: Using Forestry Maps, Chart Timber Acreage, Age, Serial Stages and Type.

Class 7: Forestry Applications: Understanding Forestry Infrastructure and Transportation, Analyzing Droughts and Floods, Mapping Soil Erosion, Mapping and Monitoring

Wetlands, Estimating Global and Regional Deforestation, and Studying the Environmental Impact.

Class 8: **Mid Term Exam**

Class 9: Fisheries Applications: Color Mapping of Currents and Circulation Patterns, Measuring Sea Surface Temperature, Mapping Ocean Wind Patterns, Observing Ocean, River and Lake Sediment Concentrations, Improving Bathymetry, Identifying Chlorophyll and Phytoplankton, Managing Coral Reefs, Monitoring Pollution, and Improving Weather and Storm Prediction.

Class 10: Disaster Management-Insurance
Natural Hazard, Storms, Blizzards, Floods.
Web Site: **http://earth.jsc.nasa.gov/atmo.html**

Class 11: Hazard Assessment and Risk Exposure: Hydrologic Modeling of Flood Prediction, Monitoring Land Use/Land **Condition Change, Landslide Probability, Forecasting** Severe Storms, and Predicting Weather and Climate. Damage Impact Assessment: Floods, Landslide, Avalanche, Volcanic Eruption, Drought/Crop Failure, Beach Erosion, Shoreline Change, Pollution Retrodiction.

Class 12: Transportation: Land and Aviation: Monitoring Marine Ice, Improving Marine Forecasts, Managing Inland Waterway Logistics, Mapping Road Networks, Land and Aviation Scenarios, Analyzing Urban Growth/Market, Analyzing Cost-Surface Construction, and Improving Aviation Forecasting.
Web Site: **http://earth.jsc.nasa.gov/geon.html**
Web Site: **http://earth.jsc.nasa.gov/land.html**

Class 13: **Video: Landsat(s) NASA 2:37**
Discussion of importance and necessity to human interaction with the Earth (Land Formations, Air, Water Cycle, Space Debris, Evolution of Plant and Animal Life, and Ecosystems) Can satellites track this?

Class 14: **Activity: GPS-Group Activity from NASA**
Landsat 7-Terrestrial Surface
GLAS-Ice (Glacier) Topography and Altimetry

Class 15: Review for Final Exam

Class 16: **FINAL EXAMINATION**

STYLE/MODE OF TEACHING: Activities, lectures, Videos, and Group Work

FEE IN TUITION: None

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	20%
Final Exam	30%
In-Class Activities	10%
Paper	20%
News/Journal Articles	20%

OTHER REQUIREMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled into this course.
2. Each class member is expected to actively participate in class discussion.
3. Each member will submit in writing a research report and news/journal articles.
4. Each member will develop a personal course contract with the faculty member setting forth: *the grade you have set for yourself. * how you will achieve that objective. *Any additional work that you purpose to do to achieve your objective.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
50% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is mandatory.

TEXT MATERIALS:

Internet References:

http://spacelink.nasa.gov/index.html
http://spacelink.nasa.gov/Instructional
http://earth.jsc.nasa.gov/
http://earth.jsc.nasa.gov/geon.html
http://carth.jsc.nasa.gov/mm.html
http://liftoff.mfsc.nasa.gov/academy/rocket_sci/satellites

COURSE NUMBER AND TITLE: 5833 EARTH OBSERVATIONS II: WATER

FACULTY

HOME:
OFFICE:
EMAIL:

PREREQUISITES AND SUPPORT COURSES: Approval of advisor or faculty.

COURSE OBJECTIVES: By the end of the course the students will be able to:

1. Identify the water cycle satellites.
2. Explain the primary function of atmospheric satellites.
3. Describe the impact of air and water satellites on humans in the 21st century.
4. Discuss the abilities that the latest satellites posses.
5. Complete a comparative discussion on atmospheric, ice, and water sensing satellites.
6. Demonstrate a strategy employed in monitoring ocean circulation.
7. Explain the relationship between the oceans and the atmosphere.
8. Discuss the latest technologies employed to improve global climate predictions.
9. Explain the TOPEX/Poseidon satellite mission and its' major contributions to science.

BRIEF COURSE OUTLINE:

Class 1:
Class Orientation
Objectives
Outline
Course Contract
In-Class Activities
Class Expectations
Grading System
Academic Honesty
Discussion of course paper requirements
Introduction to TOPEX/POISEDON satellite that has mapped over 95% of the world's ice-free seas.
Web site: http://topex-www.jpl.nasa.gov/discover/ocean_planet.html
Activity: Ocean Topography Mapping

Class 2:	Development of TOPEX/POISEDON-From Sailing Ships to Satellites Our Oceans' Seasons Oceans, Climate, El Nino Using TOPEX/POISEDON Data for Practical Operational Applications **Web Site: http://topex-www.jpl.nasa.gov/discover/ocean_planet.html** Introduction to Advanced Spaceborn Thermal Emissions and Radiometer (ASTER) High Resolution Images of Land Surface, Water, Ice and Clouds Data Analysis: Vegetation, Land Cover Type, and Soils **Activity: Watch TOPES/POISEDON video and ASTER video and describe similarities and differences of capabilities.**
Class 3:	Develop ASTER Introduce Sea-viewing Wide Field-of-view Sensor (Sea WiFS) SeaWiFS; Marine Transportation Marine Applications Monitoring Marine Ice Improving Marine Forecasts Managing Inland Waterway Logistics
Class 4:	Develop SeaWiFS Introduce Tropical Rainfall Measuring Mission (TRMM) TRMM-Energy Budgeting and Lightening Rainfall Radar Agriculture, Forestry, Insurance, and Disaster Management by State, Country, Regional Planners and Managers. **Activity: Construct a Hydrological Environment and Monitor it throughout the rest of the course.**
Class 5:	Introduce METEOR Satellite Launched on 7/99 to Measure Aerosol Gases SAGE III METEOR Satellite Mission to Measure Aerosol Trace Gases in the Stratosphere TES Satellite Launched 12/02 Mission to Measure Trace Gases in the Mesosphere **Activity: Moist Gases, Dry Gases and What's in Between?** **Demonstration: Pressure, Density and Volume**
Class 6:	Introduce ACRIM Satellite Launch 10/99 to Measure Solar Output in the Mesosphere

Present Hydro-Cycles to the Class. Show Measurements of Rainfall.

Class 7: Develop ACRIM Satellite
Introduce GLAS Satellite Glacier Satellite Launch 7/01 for Topography and Altimetry
Introduce ICESAT-1 Satellite Launch 7/01 for Topography and Altimetry
Review for Mid Term Exam

Class 8: Introduction to JASON-1 Satellite /00 Ocean and Land Altimetry
MID TERM EXAM

Class 9: JASON-1 Satellite 5/00 Ocean and Land Altimetry
Web Site: http://topex-www.jpl.nasa.gov/jason1/
Guest Speaker-Meteorologist

Class 10: Develop JASON-1
Introduction to Atmospheric Sounders and Satellites that Measure Atmospheric Conditions/Hydro-Cycle
Real Time Imaging
Present Hydro-Cycles to Class. Show Measurement of Rainfall.

Class 11: JASON-1
Atmospheric Dynamics and Chemistry
Oceans' Role in Atmospheric Conditions and Chemistry
Predictions: Demonstrate a Meteorological Prediction to the Class in Teams

Class 12: Meteorology and Methods
Capabilities of Satellites Launched in the Year 2000

Class 13: **Activity: Meteorology Methods**
Field Trip: Meteorology Weather Station

Class 14: Operational Environmental Satellites
Visibility of Satellites
Charting Satellites

Class 15: **Research Paper Due**

Review for Final Exam

Class 16: **FINAL EXAM**

STYLE/MODE OF TEACHING: Lecture, Activities, and Participation in Groups

FEE IN ADDITION TO TUITION: None

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	30%
Final Exam	30%
Hydrological Environment	10%
Meteorology Prediction	10%
Research Paper	20%

OTHER REQUIREMENTS: Attendance and Active Participation.

1. Class attendance is expected of each person enrolled in the class.
2. Each Member is expected to actively participate in class discussions.
3. Each member develop a personal course contract with the faculty member setting forth:
   *the grade you have set for yourself.
   *how you will achieve that objective.
   *any additional work that you purpose to do to achieve your objective.

FIELD TRIP: Trip to the Weather Station is mandatory and can not be rescheduled.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS:

Reference Materials may be found in the reserve section of the Oklahoma State University under this course number.

Internet References:

http://www.podaac.jpl.nasa.gov/topex/www
http://topex-www.jpl.nasa.gov/science/jacobs.html
http://topex-www.jpl.nasa.gov/discover/ocean_planet.html
http://www7300.nrlssc.navy.mil/surge_page/represent.html
http://www.ghcc.msfc.nasa.gov/GOES
http://rsd.gsfc.nasa.gov/goes/text/gao97.goes.pdf
http://www.nasa.gov
http://www.nasa.spacelink

References:

Born, G. H., Geosat-ERM Mission Design, J. Astronomy. Sci., 35, 119-134, 1987.

Carnes, M.R. Synthetic Temperature Profiles from Geosat Altimetry: Comparison with Air Dropped Expendable Bathythermograph Profiles, J. Geophysics. Res., 95, 17, 979-17,992, 1990.

Cheney, R.L. TOPEX/POSEDION: The 2-cm Solution, J. Geophysics. Res., 99, 24, 555-25,564, 1994.

Gill, A. E. Atmosphere-Ocean Dynamics, Academic Press, New York, 1982.

COURSE NUMBER AND TITLE: AVSED 5813; EARTH OBSERVATIONS III-AIR

FACULTY:
HOME:

OFFICE:

EMAIL:

PREREQUISITES AND SUPPORT COURSE: Approval of Advisor Faculty.

COURSE OBJECTIVES: By the end of this course, the student will be able to:
1. Compare and contrast the functions of the different satellites, namely, MODIS, Landsat, ASTER, GPS.
2. Discuss applications of satellite employment.
3. Explain how satellites report data for Agricultural Industries, Forestry
4. Agencies, Fisheries, and Insurance Agencies.
5. Explain a Disaster Management Plan and Insurance Applications considered with satellite technology.
6. Describe hazard assessment and damage assessment that results from satellite data.
7. Identify the major landforms from Landsat 7 photos.
8. Identify major geological features and processes that are taking place and being documented by Landsat 7.

BRIEF COURSE OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduction to Global Position Satellite System (GPS)

Class 2:
Develop GPS
Activity: NASA GPS-Group Work
Introduction Multi-Spectral Imager (MODIS)
Introduction to Landsat 7

Video: Landsat (NASA) 1:60

Class 3: Develop Ladsat 7
Activity: Landsat 7 Mapping
Introduce Advanced Spaceborn Thermal Emission and Reflection Radiometer (ASTER).

Class 4: Develop ASTER
Introduce Moderate Resolution Multi-Spectral Imager (MODIS)
Surface Temperature
Concentration of Trace Gases

Class 5: Motions of Air Masses
Cold Front
Warm Front
Activity: Cloud-in-a-Can, Cloud Chart

Class 6: Air Mass Movements over Oceans
Air Mass Movements over the Continents
Air Mass Movements over the Poles
Activities: Map and Predict Weather from two NASA Videos

Class 7: MODIS Applications to Air Mass Movements over Agricultural Communities
Agriculture Applications
Activities: Draw Air Masses over Agricultural Community

Class 8: Atmospheric Pressure Changes
Review for Mid Term Exam
Activity: Demonstrate Changes in Atmospheric Pressure can affect the Sea Level.

Class 9: Review for Mid Term Exam
Wind-Drive Storm Surge
Satellite detection of Influencing Factors
Guest Speaker: Meteorologist

Class 10: Mid Term Exam
MODIS Video Analysis

Class 11: MODIS Analysis and Applications
Disaster Management

Natural Hazard
Storms
Blizzards
Floods

Class 12: Hazard Assessment and Risk Exposure
Damage Impact Assessment
MODIS Analysis

Class 13: Transportation: Land and Aviation
Mapping Road Networks

Class 14: **Activity: Video: Landsat NASA 2:37**
Discussion of Importance and Necessity to Human Interaction with the Earth.
Landsat 7-Terrestrial Surface
GLAS-Ice Topography and Altimetry

Class 15: Guest Speaker from Boeing on GPS in industry
Review for Final Exam

Class 16: Final Examination

STYLE/MODE OF TEACHING: Activities, Lectures, and Group Activities.

FEE IN ADDITION TO TUTITION: None.

EXAMS AND MAJOR ASSIGNMENTS:
Mid Term Exam
Final Exam
In-Class Activities
Paper
News/Journal Articles

OTHER REQUIREMENTS: Attendance is Mandatory.

GRADING PROCEDURES:
100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

<u>TEXT MATERIALS:</u> Gill, A. E. Atmosphere-Ocean Dynamics, Academic Press, New York, 1982.

Internet References:

http://topex-www.jpl.nasa.gov/science
http://www.nasa.gov

COURSE NUMBER AND TITLE: LUNAR SCIENCES AND THE APOLLO MISSIONS

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITIES AND REQUIREMENTS: Approval from Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of the course the Student will be able to:

1. View Lunar Samples.
2. Compare and Contrast Moon Rocks with Earth Rocks.
3. Identify the Launch Vehicles of the Apollo Missions.
4. Explain the History of The Space Race
5. Construct Lunar Model of a Proposed Lunar Colony
6. Write a Research Paper on the Importance of Missions to the Moon.

BRIEF OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduce Spacecraft: Saturn IB, and Saturn V.

Class 2:
Introduce Apollo Command and Service Module
Introduce Apollo Lunar Module
Apollo 7

Class 3:
Rocket Science
Forces and Mass
Apollo 8

Class 4:	From the Ground to Orbit Who Launches Rockets? Apollo 9
Class 5:	Apollo 10 and Apollo 11 **Video: Apollo 11** **Analysis of Apollo 11**
Class 6:	Apollo 12 Apollo 13 **Video: Apollo 13** Analysis of Apollo 13 Comparison of Apollo 11 and 13
Class 7:	Apollo 14 Apollo 15
Class 8:	Apollo 16 and 17 **Review for Mid Term Exam**
Class 9:	Topography of the Moon Charting the Moon **Mapping Activity** **Mid Term Exam**
Class 10:	Anatomy of the Moon Theories of the Origin of the Moon Fission Theory Binary Accretion Theory Capture Theory Formation of Planets and Satellites
Class 11:	Planetismals Other Satellites of Catastrophic Origin: Charon and Selected Asteroids **Activity: Crater Maker**
Class 12:	Giant Impact Theory Mineralogy **Activity: Identify Earth Rocks/Minerals**

Class 13:	**Activity: Identify Minerals Earth** **Rocks/Minerals Continued** **View: Lunar Samples** **Activity: Identify Minerals in Lunar Samples**
Class 14:	**Compare the Lunar Samples with Earth Samples** **Complete Lunar/Earth Identification Data Table**
Class 15:	**Lunar Sample Certification** **Review for Final Exam**
Class 16:	Turn in Research Paper **Final Exam**

STYLE/MODE OF TEACHING: Activities, Lecture, Videos, and Research.

FEE IN ADDITION TO TUITION: None.

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	30%
Final Exam	30%
Research Paper	20%
In-Class Activities	20%

OTHER REQUIRMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled in the course.
2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth

*the grade that you have set for yourself.
*how you will achieve that objective.
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS:

Hartman, W.K., (1999) *Moons and Planets: Fourth Edition.* Albany, New York: Wadsworth Publishing Company.

INTERNET REFERENCE SITES:

http://www.nasa.gov
http://www.hq.nasa.gov/office/oss/osshome.htm
http://spacelink.nasa.gov/
http://observe.ivv.nasa.gov/

COURSE NUMBER AND TITLE: GEMINI MISSIONS AND ROCKETRY

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITES AND REQUIREMENTS: Approval of Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of the course, the student will be able to:

1. Discuss the Gemini Missions 3-12.
2. Identify the Anatomy of the Gemini Spacecraft.
3. State the Launch Date, Astronauts, Mission Duration, Miles Traveled and Launch Vehicles of Gemini Missions 3-12.
4. Explain How a Rocket Moves.
5. Discuss Newton's Laws of Motion.
6. Identify the Forces involved in Rocketry.
7. Produce Teaching Strategy Units in Rocketry.
8. Construct various Rockets and Models.

BRIEF OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduce the Gemini Missions

Class 2:
Anatomy of Gemini Spacecraft
Differences between Mercury Spacecraft and Gemini
Video: McDonnell Douglas, Gemini
Gemini 3, 4, 5, and 6: Launch Date, Astronauts, Mission Duration, Miles Traveled and Recovery Ship.

Class 3:
Gemini 7, 8, 9, 10, 11, and 12: Launch Date, Astronauts, Mission Duration, Miles traveled, and Recovery Ship.
Mission Purpose and Data

Class 4: Introduction to Rocketry
Anatomy of a Rocket
History of Rockets
Rocket Principles
Activity: NASA: Hero Engine

Class 5: Chinese Fire-Arrows
Surface-Running Torpedo
Step Rocket
Rocketry becomes Science
Modern Rocketry
Goddard's 1925 Rocket
Sputnik I

Class 6: Newton's First Law
Rest
Motion
Unbalanced Force
Activity: Newton's First Law

Class 7: Newton's Second Law
Acceleration
Force
Mass
Activity: Newton's Second Law
Review for Mid Term

Class 8: Newton's Third Law
Action
Reaction
Activity: Newton's Third Law
Mid Term Exam

Class 9: Putting Newton's Laws of Motion Together
Practical Rocketry
Rocket Engines and Their Propellants
Solid Propellant Rocket
Engine Thrust Control

Class 10: Stability and Control Systems
Center of Pressure and Center of Mass
Movable Fins
Gimbaled Nozzle
Weight
Staging

	Construction Activity: Paper Rockets and Applications (Stability)
Class 11:	**Construction Activity: Rocket Pinwheel** **Construction Activity: Build a Rocket Car** Analysis of Rocket Car Applications of Rocket Car (Newton's Third Law)
Class 12:	**Construction Activity: Water Rockets and Applications (Newton's Second Law)** **Video: NASA: Rocketry**
Class 13:	**Construction Activity: Balloon Staging (Rocketry Staging)** **Step Rockets to Staging Rockets**
Class 14:	**Construction Activity: Newton Cart (Newton's Laws of Motion)** Discussion Tying all Principles Together.
Class 15:	**Construction Activity: Pencil Rockets** Flight and Rocketry Weather **Review for Final Exam**
Class 16:	**Construction Activity: Space Shuttle Model** Building Models **Final Exam**

STYLE/MODE OF TEACHING: Activities, Lecture and Group Work.

FEE IN ADDITION TO TUITION: None.

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	30%
Final Exam	40%
In-Class Activities	30%

OTHER REQUIRMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled in the course.

2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth:
*the grade that you have set for yourself.
*how you will achieve that objective.
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS:

Vogt, G. L. (1991) *Rockets: A Teaching Guide for an Elementary Science Unit on Rocketry.* NASA.

INTERNET REFERENCE SITES:

http://spacelink.nasa.gov/
http://www.nasa.gov
http://www.hq.nasa.gov/office/aero

COURSE NUMBER AND TITLE: GRAVITATION AND MECHANICS, ELLIPSES AND NEWTONIAN MECHANICS

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITIES AND REQUIREMENTS: Approval of Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Define and illustrate an ellipse.
2. Define the parts of an ellipse.
3. Explain Newton's Principles of Mechanics
4. Define acceleration in orbit.
5. Define Kepler's Laws.
6. Define gravity gradients and tidal forces
7. Explain how orbits work.
8. Explain what an interplanetary trajectory is.
9. Calculate SpaceMathematics Formulas: Calculations of Measurement, Geometry, Algebra, Probability, Statistics, Trajectories, Conic Sections, Trigonometry, Exponential and Logarithmic Functions.
10. Discuss the Aspects of Recent NASA Missions and the Relationship to Mathematical Functions.

BRIEF OUTLINE:

Class 1: Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduction to Ellipses

Class 2: Kepler's Laws of Planetary Motion
Law of Elliptic Orbit
Law of Areas

Law of Periods
Parts of an Ellipse

Class 3: Newton's Principles of Mechanics
Tidal Forces

Class 4: Orbital Mechanics
Vectors
Acceleration

Class 5: Applications of Orbital Mechanics
Universal Law of Gravitation

Class 6: How Orbits Work
Hohmann Transfer Orbits
Gravity Assist Trajectories

Class 7: Planetary Orbits
Orbital Parameters
Orbital Elements
Types of Orbits
Review for Mid Term

Class 8: Applications of Orbital Mechanics Review
Mid Term Exam

Class 9: Newtonian Physics
Activity: Newton's First Law

Class 10: Newtonian Physics
Activity: Newton's Second Law

Class 11: Newtonian Physics
Activity: Newton's Third Law

Class 12: NASA: *SpaceMathematics,* 1985
Mathematical Aspects of Some Recent NASA Missions
Computation and Measurement
Algebra

Class 13: NASA: *SpaceMathematics,* 1985
Mathematical Aspects of Some Recent NASA Missions
Geometry

	Probability and Statistics
Class 14:	NASA: *SpaceMathematics,* 1985 Mathematical Aspects of Some Recent NASA Missions Exponential and Logarithmic Functions
Class 15:	NASA: *SpaceMathematics,* 1985 Mathematical Aspects of Some Recent NASA Missions Trigonometry
Class 16:	NASA: *SpaceMathematics,* 1985 Mathematical Aspects of Some Recent NASA Missions Matrix Algebra
Class 17:	NASA: *SpaceMathematics,* 1985 Mathematical Aspects of Some Recent NASA Missions Conic Sections **Review For Final Exam**
Class 18:	**Final Exam**

<u>STYLE/MODE OF TEACHING:</u> Activities, Lecture, and Class Work.

<u>FEE IN ADDITION TO TUITION:</u> None.

<u>EXAMS AND MAJOR ASSIGNMENTS:</u>

Mid Term:	25%
Final Exam:	25%
Class Work:	50%

<u>OTHER REQUIRMENTS:</u> Active Participation.

Class Attendance is expected of each person enrolled in the course.
Each class member is expected to actively participate in class discussion.
Each class member will submit in writing a research report on one deep space probe.
Each class member will develop a personal course contract with the faculty setting forth:
*the grade that you have set for yourself,

*how you will achieve that objective, and
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS: Kastner, B., (1985) *SpaceMathematics, A Resource for Teachers.* NASA.

INTERNET REFERENCE SITES:

http://www.nasa.gov
http://www.hq.nasa.gov/office/aero
http://www.osf.hq.nasa.gov/office/oss/osshome.htm
http://www.nasa.gov/hqpao/q_a_subject.htm

COURSE NUMBER AND TITLE: SPACE FLIGHT PROJECTS/MISSIONS/EXPERIMENTS/SPACECRAFT

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITIES AND REQUIREMENTS: Approval from Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of the course the Student will be able to:

1. Discuss the tasks involved in Entering Space.
2. Explain what an Orbit is.
3. Explain Orbital Mechanics without the Math.
4. Identify Elements of Spacecraft: Mercury, Gemini, Apollo, and the Space Shuttle.
5. Explain how to Perform Space Maneuvers
6. Explain the Story of the Race to the Moon.
7. Describe how the Space Shuttle Works.
8. Explain what the Astronauts do in Orbit.
9. Describe the Role of STARDUST.
10. Discuss the Importance of the International Space Station.
11. Discuss Future Piloted Mars Missions.

BRIEF OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduce Spacecraft
Mercury
Gemini

Class 2:
Introduce Apollo Command and Service Module
Introduce Apollo Lunar Module
Define an Orbit

Concepts	Define Circular Orbit, Elliptical Orbit, and Generalized Boundary of Space
Class 3:	Rocket Science Forces and Mass Newton's Laws and Rocket Thrust How a Simple Rocket Works Propellants and Specific Impulse Liquid Propellants Solid Propellants Staging
Class 4:	From the Ground to Orbit Who Launches Rockets? Major Launch Systems in Use Today **Activity: Build and Launch a Rocket**
Class 5:	Orbital Mechanics without the Math How Elliptical Orbital Motion Works Elliptical Geometry Equal Areas and Equal Times Orbital Periods How to Describe an Orbit Geocentric M50 Coordinate System Classical Orbital Element Set
Class 6:	Nodal Regression Common Types of Earth Orbits Low Earth Orbit Polar Orbits Geosynchronous Orbits
Class 7:	How to Perform Space Maneuvers Launch Site Considerations Launch Site Location Launch Azimuth **Review for Mid Term**
Class 8:	**Mid Term Exam** How to Change an Orbit Impulsive Burn Assumption Components of Motion Horizontal Burns Radial Burns

Combined Burns
Simple Plane Change Maneuver
Perturbation Sources

Class 9: How to Transfer between Orbits
Hohmann Transfer
Faster Transfer Techniques
General Transfers

Class 10: The Story of the Race to the Moon
The Cold War Connection
First Steps into Space
Project Mercury
A Small Jump
Redemption

Class11: The Intermediate Step
Project Gemini
Upstaged Again
Vaulting into the Lead
Rendezvous in Orbit
Docking with Disaster
Tying up Loose Ends

Class 12: Fulfilling the Dream
The Mode Decision
A Plan for Reaching the Moon
A Fiery Beginning
Preparing to Meet the Kennedy Challenge
A Giant Leap
Unlucky 13
The J Missions
After the Moon

Class 13: How the Space Shuttle Works
What is the Space Shuttle?
Preparing for Flight.
Ground Processing
Countdown to Launch
How do Shuttles Get into Orbit?
What Happens During a Launch Emergency?
Who Flies in the Space Shuttle?
What do Astronauts do in Orbit?
Attitude Control
Orbit Changes

Satellite Deployment
Robot Arm
Extra Vehicular Activity
Spacelab
Reentry
The Future of the Space Shuttle Program

Class 14: The Role of Satellites in the Age of Information
Communications Satellites
Before the Space Age
Reflectors in Space
Weather Satellites
Current Systems
Global Positioning System

Class 15: A Look at a Future Piloted Mars Mission
Dispelling Old Myths
Canals?
Marnier and the Ghoul
Reaching Utopia and the Search for Life
Launch Windows
Flight Scenarios
Conjunction Class
Opposition Class
Sprint Mission
A Different Idea: Spacecraft Design and Aerobraking

Class 16: NASA: STARDUST Mission
Comet Wild 2
Bringing samples of Cometary Material Back to Earth
A Trip There and Back
Catching Bullets in Space
A New Way to do Space Missions
Video: NASA: STARDUST-Bringing Cosmic History to Earth (7:49)
Web Site: http://stardust.jpl.nasa.gov

Class 17: Introduction to the International Space Station
Microgravity research
Life Sciences
Space Sciences
Earth Sciences
Space Product Development
Engineering and Technology
Who is Involved?

Video: NASA: ISS Progress Report
Web Site: http://station.nasa.gov/science
Review for Final Exam

Class 18: **Final Exam**

STYLE/MODE OF TEACHING: Activities, Lecture, and Videos.

FEE IN ADDITION TO TUITION: None.

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term:	40%
Final Exam:	40%
Research Paper:	20%

OTHER REQUIREMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled in the course.
2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth:

*the grade that you have set for yourself.
*how you will achieve that objective.
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW=F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS:

Lee, W. (1994) *To Rise From Earth.* Austin, TX: Texas Space Grant Consortium.

INTERNET REFERENCE SITES:

http://stardust.jpl.nasa.gov
http://station.nasa.gov/science

COURSE NUMBER AND TITLE: FORCES OF FLIGHT/LAUNCH/CRUISE/ENCOUNTER/RETURN/LAND

FACULTY:

HOME:
OFFICE:
EMAIL:

PREREQUISITIES AND REQUIREMENTS: Approval of Advisor or Faculty Member.

COURSE OBJECTIVES: By the end of this course, the student will be able to:

1. Identify the Four Forces of Flight.
2. Explain the Physical Principles in Spacecraft Launch, Cruise, Encounter, Return, and Landing.
3. Perform Teaching Strategies in Aeronautics.
4. Perform/Demonstrate Mathematics and Scientific Calculation/Principles in Aeronautics.

BRIEF OUTLINE:

Class 1:
Class Orientation and Procedures
Objectives
Outline
Course Contract
In-Class Expectations and Activities
Class Expectations and Participation
Grading System
Academic Honesty
Introduction to Space Flight Operations

Class 2:
Introduction of Launch Phase
Mathematics Formula: Bernoulli's Equation
Mathematics Formula: Force of Gravity
Mathematics Formula: Lift
Mathematics Formula: Reynolds Number
Lighter-than-air-craft

Class 3:
Develop Bernoulli's Equation
Principles of Flight
Lift
Angle of Attack
Gravity
Thrust

Drag
Activity: Construct-a-Craft

Class 4: Problems of Flight
Develop Gravity Equation
Sound Barrier
Heat Barrier
High-Altitude Flight
Drag Reduction
Runway Length

Class 5: Develop Lift Equation
Activity: Air...What Gives?
Activity: Air Has Weight.
Activity: Lung Power
Launch Vehicles
Launch Sites
Launch Windows

Class 6: Develop Reynolds Number Equation
Preparations for Launch
Cruise Phase
Spacecraft Checkout and Characterization
Real-Time Commanding
Typical Daily Operations
Preparations for Encounter
Activity: Construct a Rocket

Class 7: **Activity: Launch Rockets**
Analyze Rocket Flights
Video: NASA Spacecraft
Review for Mid Term Exam

Class 8: **Mid Term Exam**
Video: NASA: Space Basics
Mechanical Universe Tapes Navigating in Space, Inertia, and Newton's Laws.

Class 9: Encounter Phase
Flby Operations
Planetary Orbit Insertion
System Exploration and Planetary Mapping
Occulations
Gravity Field Surveying
Atmospheric Entry and Aerobraking

Activity: Group Teaching Strategy

Class 10: Landing
Balloon Tracking
Sampling
Mars Pathfinder Data
Future Mars Missions
Activity: Group Teaching Strategy

Class 11: Extended Operations Phase
Completion of Primary Objectives
Additional Science Data
End of Mission
Activity: Group Teaching Strategy

Class 12: Return
Reentry Window
Landing
Aerodynamics
Activity: Group Teaching Strategy

Class 13: Gravitation and Mechanics
Ellipses
Newton's Principles in Mechanics
Activity: Group Teaching Strategy

Class 14: Acceleration in Orbit
Kepler's Laws
Gravity Gradients (Tidal Forces)
How Orbits Work
Activity: Group Teaching Strategy

Class 15: Orbiter Spacecraft
Atmospheric Probe Spacecraft
Lander Spacecraft
Surface Penetrator Spacecraft
Surface Rover Spacecraft
Current Flight Projects at JPL
Future Flight Projects at JPL
Review for Final Exam

Class 16: **FINAL EXAM**

STYLE/MODE OF TEACHING: Activities, Lectures, and Group Presentations.

FEE IN ADDITION TO TUITION: None.

EXAMS AND MAJOR ASSIGNMENTS:

Mid Term Exam	30%
Final Exam	30%
In-Class Activities	20%
Group Teaching Strategy	20%

OTHER REQUIREMENTS: Active Participation.

1. Class Attendance is expected of each person enrolled in the course.
2. Each class member is expected to actively participate in class discussion.
3. Each class member will submit in writing a research report on one deep space probe.
4. Each class member will develop a personal course contract with the faculty setting forth:

*the grade that you have set for yourself.
*how you will achieve that objective.
*any additional work that you purpose to do to achieve your objective.

Please return your contract to the faculty member at the end of the second course.

GRADING PROCEDURES:

100%-90%=A
89%-80%=B
79%-70%=C
69%-60%=D
59% OR BELOW= F

POLICY ON ATTENDANCE: Attendance is Mandatory.

TEXT MATERIALS:

Text Materials Supplied by Instructor.

General Aviation News & Flyer
8415 Steilacom Boulevard
Tacoma, WA 98498

(800) 426-8538

Soaring Society of America, Inc.
PO Box E
Hobbs, NM 88241-1308
(505) 392-1308

US Hang Gliding Association
PO Box 8300
Colorado Springs, CO 80933-8300
(719) 632-8300

INTERNET REFERENCE SITES:

http://www.hq.nasa.gov/office/aero/oatthp/edu/educate.htm
http://k12unix.larc.nasa.gov/flyingstart/
http://www.aero.hq.nasa.gov/edu
http://www.nasa.gov

VITA

Heidi M. von Oetinger-Reed

Candidate for the Degree of

Doctor of Education

Thesis: THE DEVELOPMENT OF AN AEROSPACE EDUCATION TEACHER PREPARATION PROGRAM

Major Field: Applied Educational Studies

Biographical:

Personal Data: Born in Detroit, Michigan, January 23, 1968, the daughter of Helmut K. and Patricia A. von Oetinger.

Education: Graduated from Bishop Foley High School, Madison Heights, Michigan in June 1986; earned Bachelor of Arts degree in Science Education from the University of Michigan, Dearborn, Michigan, June 1991; received Master of Arts degree in Administration from Wayne State University, Detroit, Michigan, December, 1993; received Education Specialist degree in Curriculum and Instruction, Wayne State University, Detroit, Michigan, May, 1997; completed requirements for Doctor of Education degree at Oklahoma State University in May, 1999.

Professional Experience: Science and Mathematics Instructor, Foreign Language Immersion and Cultural Studies School, 1991-1992; Instructor, L'Anse Creuse Public Schools, Macomb County, Michigan, Middle School Science, English and Social Studies, 1992-1993; Instructor, L'Anse Creuse Public Schools, Harrison Township, Michigan, Middle School Science, 1993-1998; Conference Presenter, Michigan Association of Middle School Educators, 1993-1998; Conference Presenter, National Science Teachers Association, 1994-1998; NASA Olympiad Facilitator, Young Astronaut Coach, L'Anse Creuse Public Schools, 1993-1998; Planetarium Director, L'Anse Creuse Public Schools in Cooperation with Mount Clemens High School, Harrison Township, Michigan, 1994-1998; Track and Cheerleading Coach, L'Anse Creuse Public Schools, Harrison Township, Michigan, 1993-1998; NASA Lunar Sample Presenter, NASA Lewis

Research Center, Cleveland, Ohio, 1993-present; NASA/NEWMAST, NASA Lewis Research Center, Cleveland, Ohio, 1997; Director of Mathematics, Oklahoma State Department of Education,1998; to present.