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AUTHOR Rademacher, Jean, Ed.; Williams, Mary H., Ed.
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ABSTRACT

This curriculum guide, funded under ESEA Title 3, is designed to help students in English and social studies classes develop a global frame of reference and increase their awareness of advances in air and space technology. The history of aerospace technology from the first mythological references to flight to the space exploration of the future is covered in six units, each containing introductory materials, ideas to be developed, background information, suggested activities, and a bibliography: (1) Wings in Mythology, (2) Speculation and Experimentation, (3) Balloons and Airships, (4) Winged Flight Becomes a Reality, (5) The Space Age, and (6) Benefits of Space Exploration. Additional materials include a list of distributors and publishers and lists of books, films, film clips, and records on the subject. (DD)

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AEROSPACE-ORIENTED UNITS

FOR USE IN

HUMANITIES CLASSES

Grades 7-12

Compiled and Edited by

Mrs. Jean Rademacher
Dr. Mary H. Williams

Lincoln Aerospace Curriculum Development Project
Lincoln Public Schools
Lincoln, Nebraska

1968-69

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The material in this book was developed as part of the Lincoln Aerospace Curriculum Development Project, funded under Title III of the Elementary-Secondary Education Act of 1965.

The units were produced during the summer of 1968 by teachers in the secondary schools, in an eight-week workshop-seminar conducted by the Lincoln Public Schools in cooperation with the University of Nebraska. Professor Frank E. Sorenson, Chairman of the Department of Educational Services and Professor of Secondary Education, University of Nebraska, was the general chairman of the institute. He was assisted by Dr. Jean McGrew, Miss Evelyn Sedivy, Mr. Larry Barnes, and Mr. Jerry Beckman.

Cooperating with the Lincoln Public Schools in this project designed to help bring the curriculum up-to-date are:

The Catholic Diocese Schools, Lincoln, Nebraska

Grand Island Public Schools, Grand Island, Nebraska

Hastings Public Schools, Hastings, Nebraska

Kearney Public Schools, Kearney, Nebraska

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Westside Community Schools, Omaha, Nebraska

John Prasch, Superintendent
Lincoln Public Schools
Jean M. Rademacher, Supervisor
Aerospace Curr. Dev. Project

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During the summer of 1968, teachers from both junior and senior high schools worked on aerospace-oriented teaching materials for use in humanities classes. Dr. Jean McGrew, Principal, East High School, Lincoln, Nebraska, and summer staff member at the University of Nebraska, served as the workshop coordinator.

It is hoped that these aerospace-oriented materials will enrich the humanities programs at the secondary level and will increase the students' awareness of advances which are being made in air and space technology.

The following teachers contributed to this book of aerospace-oriented units for humanities classes:

Gerald Christensen, Lincoln
Robert Hughes, Lincoln
Lavonne Lorenzen, Omaha
Gerald Roslawski, Omaha
Mary Schmidt, Lincoln
Gary Sup, Millard
Dianne Williams, Lincoln
Sarol Wiltse, Omaha

> To see the earth as it truly is, small and blue and
> beautiful in that eternal silence where it floats,
> is to see ourselves as riders on the earth together,
> brothers on that bright loveliness in the eternal
> cold--brothers who know now they are truly brothers.

Archibald McLeish wrote these words shortly after the flight of the Apollo 8.

During the past quarter century advances in science and technology have led to increasing social and economic interdependence between nations and men. In addition to complex systems of communications and transportation, man has developed nuclear weapons which could result in total destruction. Thus, travelers on the spaceship called Earth are dependent on each other for their very survival.

Education for the space age demands that man view the social and cultural aspects of his world as well as its physical and geographical features. This guide, for use in secondary English and social studies classes, provides suggestions which will help students develop a global frame of reference, a realization that we are citizens of the world as well as citizens of the United States of America.

The guide is divided into five sections, which trace the development of flight from mythological times to the present, and a sixth which explores the possibilities of future space exploration. Each section includes (1) an introduction, the significance and purpose of the content; (2) concepts, suggested ideas to be developed; (3) background information, points of importance or interest which will help develop the concepts; and (4) activities, suggested work for the entire class, for small

groups, or for individual assignments. Activities are listed for English and social studies classes, and occasionally, appropriate art or music is suggested. Resource materials are listed at the end of each section. A complete bibliography of resource materials is found at the back of the book.

TABLE OF CONTENTS

WINGS IN MYTHOLOGY

I. Introduction

Early history of man's attempts to fly is entwined with legend and religion. Records of man's desire to fly date back to the beginnings of recorded history. This fascination with the sky and the freedom it seemed to offer soaring birds, apparently free of the constraints of gravity, caused man to ascribe the power of flight to his gods. Primitive art and religion used wings as representations of supernatural power. To be able to fly was equated with the ability to conquer, to dominate, to be a god. Man was challenged to improve himself, and longed to conquer the air.

II. Concepts

A. In mythology, wings symbolize possession of supernatural power.

B. The wonder and intrigue of flight are reflected in the art, religion, and literature of cultures throughout the world.

C. The ability to fly was a quality which early man ascribed only to gods and supernatural beings. He did not dare to conceive of mortals being able to fly until approximately 2000 B.C.

D. Many words in the vocabulary of air and space travel today are related to characters and locations mentioned in the ancient myths.

III. Background Information

A. Greek mythology

1. Best-known myth about flying is the story of Daedalus and Icarus.

   Daedalus and his son, Icarus, were imprisoned in the labyrinth. Daedalus devised two pairs of wings by which they were to fly away to safety, but Icarus, ignoring his father's warnings, flew too near the sun. The wax which held the wings melted, and Icarus fell into the sea.

2. Phaeton, Son of Apollo, is killed because of his wild desire to drive the chariot of the sun across the sky.

   Phaeton had often watched his father, the Sun, driving across the sky. One day he asked if he might drive the chariot. Apollo, because of a foolish promise, could not deny this request. Phaeton proudly mounted the car, and the horses' flying feet carried him wildly into the sky. The horses, realizing that their master was not in control, plunged headlong toward the earth and set the mountains on fire.

In order to save the world, Jove hurled a thunderbolt which killed Phaeton, shattered the chariot, and drove the wild horses into the sea.

3. Pegasus, the wonderful winged horse.

   Pegasus was "A winged steed, unwearying of flight, sweeping through air swift as a gale of wind." One day while he was drinking at the spring a handsome young man, Bellerophon, with the help of Athena, bridled the wonderful horse and became his master. Pegasus was not only a joy, but a help in time of need. When Bellerophon became too ambitious and aspired to living with the gods, Pegasus refused to try the flight to Mount Olympus. He threw Bellerophon and went to live with the steeds of Zeus.

B. Roman mythology

1. Mercury wears winged sandals and a winged helmet. He appears more often in the tales of mythology than any other god.

   Zeus was his father and Maia, daughter of Atlas was his mother. A very popular statue has made Mercury one of the best known gods. He was shrewd and cunning, and as the messenger for Zeus, he "flew as fleet as thought to do his bidding."

2. Venus, the goddess of love and beauty was carried from place to place by a flock of doves, or in a chariot drawn by swans.

   Many stories are told about Venus flying to the aid and assistance of lovers. She was supposed to bring beauty and loveliness wherever she went. However, Venus had another side. She could be treacherous and vindictive. Refer to the stories of Venus and Adonis, and Cupid and Psyche. (Bulfinch's Mythology is a good source for these stories.)

3. The lesser gods were numerous and many were endowed with the ability to travel far and fast.

   Cupid (Eros in Greek mythology)
   The Muses or Graces who attended the more important figures
   Pluto, God of the Underworld, who traveled in a flying chariot

C. Norse and Teutonic mythology

1. The Valkyries were the wild and beautiful maidens who attended Odin, the sky-father.

   The Valkyries' chief task was to go to the battlefield and choose the soldiers who should die. In their flying chariots they carried the slain heroes to Valhalla, the great hall of Odin.

2. Thought and Memory are the two ravens who serve Odin.

   The ravens Thought (Hungin) and Memory (Munin) perch on Odin's shoulders. Each day they fly through the world and bring back news of all that men are doing. While the other gods feast and drink Odin considers the things that his ravens have taught him.

3. Thor, god of thunder, rode through the sky in a goat-drawn chariot.

   Thor possesses a magic hammer which he hurls into the air to destroy his enemies. When the hammer has finished its work it flies back to him.

D. Egyptian and Hindu mythology

1. Horus, the son of Isis and Osiris.

   Horus was called "the great king of gods, king of the land, and king of the world who spans the sky with his wings and covers the land with his pinions." He is pictured as either a falcon or a human body with a falcon's head.

2. Re, the ancient Egyptian god of the sun.

   Re flew through the heavens in his fiery chariot. He was represented as a human being with the head of a falcon.

3. Kai Ka'us, an ancient king of Persia.

   Kai Ka'us had a flying throne drawn by four eagles.

4. The Arabian Nights is a collection of famous stories in which various flying devices provide transportation.

E. Aerospace vocabulary related to mythology

The following chart lists some of the aerospace terms which originated in ancient mythology.

Name and Type of Vehicle	Purpose of Vehicle	Mythological Reference
<u>Aircraft</u>		
Orion	Anti- submarine patrol	Orion was the son of Neptune, and had the power of walking over the sea.
Neptune	Anti-submarine patrol	Roman name for the ruler of the sea.

Name and Type of Vehicle	Purpose of Vehicle	Mythological Reference
Hercules	Transport and airfreight	The strongest man on earth. His great strength placed him on a level equal with the gods.
<u>Spacecraft</u>		
Mercury	First spacecraft in the American man-in-space program.	Mercury presided over every activity which required skill and dexterity. He wears winged sandals and a winged helmet.
Gemini	Second spacecraft in the man-in-space program.	Castor and Pollux, the inseparable twins. They were assigned to Poseidon's service.
Apollo	The spacecraft which will carry American astronauts to the moon.	Apollo, the epitome of masculine beauty and athletic prowess, drives the golden chariot of the sun across the sky.
Pegasus	Meteoroid technology satellite.	Wonderful winged horse who never tired of flying swiftly through the sky.
Venus 4	Ejected capsule for Venus soft landing. 10/67	Goddess who traveled in a chariot drawn by swans or doves. Sometimes Venus was carried by the breeze.
Aurora I	In orbit. Investigating formation of Aurora Borealis	Goddess of the dawn.
Echo	Passive communications satellite. Relayed voice and TV signals.	Echo was a beautiful wood nymph who had one failing; she talked too much. Juno, angered by Echo's talk, punished her by limiting her power of speech to reply only.

Name and Type of Vehicle	Purpose of Vehicle	Mythological Reference
Missiles and Launch Vehicles		
Atlas	Launch vehicle for free world's first intercontinental ballistic missile.	Atlas was an enormous god of incredible strength. He bore the world on his shoulders.
Titan	A family of launch vehicles. The Titan II is an ICBM with a nuclear warhead and an inertial guidance system.	The Titans were believed to be the Elder Gods, or the parents of the gods of mythology.
Poseidon	A submarine-based missile.	(Neptune) Ruler of the sea. He had a palace beneath the sea, but was often in Olympus.
Nike Hercules	High altitude air defense weapon.	Nike is the goddess of victory. Hercules represents great strength.
Saturn V	A super-booster which will send the Apollo to the moon.	Saturn was the most important of the Titans. When he was dethroned by Zeus, Saturn fled to Italy and brought in the Golden Age, a time of perfect peace and happiness.
Thor	A family of extremely reliable and versatile vehicles.	A Norse god, the thunderer, with divine might.

IV. Activities

A. Language arts and social studies activities.

1. Select a myth in which a character's ability to fly is essential to the story. Discuss the significance and symbolism of wings and flying as they occur in the selected myth.

2. Write a story about flying in the style of the ancient myth.

3. Select an airplane, spacecraft, launch vehicle, or missile which is named for a character in mythology. Relate the myth to the class, and explain the way in which the name of the vehicle is related to the mythological character.

4. Using the techniques of television production, prepare and present a program about flying creatures and objects which occur in myths of many cultures.

5. Make a bulletin board illustrating a selected myth and its relationship to flight.

6. Look for cartoons in which some reference to mythological flights is made.

7. On a world map indicate regions where myths about flying originated. Show changes which have occurred in the names of the countries and in their boundaries.

8. Look for examples in which mythological figures are used in trademarks or emblems to symbolize speed or strength. For example: The Winged Horse--Socony Mobil Oil Co.; Mercury--Florists Telegraph Delivery Association; Minerva, Goddess of Wisdom--Equitable Life Insurance Co.; The Eagle, bird of Zeus--United States Seal; Department of State; various coats of arms.

9. In 1970 the Air Force is slated to add a new launch vehicle to its inventory. The new missile is called the Athena H. Find out about the Athena H, and compare its characteristics with those of the mythological Athena (Minerva).

B. Additional activities

1. The power of flight has been represented in man's artistic expressions since earliest times. If study pictures of this type are unavailable, illustrations in books of history, art, or mythology will serve. The following examples are suggested.

   Greek and Roman art:

   Winged Victory -- statue
   Daedalus and Icarus -- oil sketch -- Rubens
   Aphrodite riding a swan -- Greek drinking cup
   Hypnos (Sleep) and Thanatos (Death) -- detail on a bowl
   Mercury (Hermes in Greek mythology) -- statue

   Norsemen represented in art

   In Battle (Valkyries flying into battle)
   Arriving at Valhalla (mural)

   Egypt, Mesopotamia, Persia, and the Orient

   Isis, winged Egyptian goddess -- sarcophagus of Ramses III
   Ashur, Assyrian god
   Kai Ka'us on his flying throne

Egypt, Mesopotamia, Persia, and the Orient

Lions, griffins, and other animals represented with wings
Illustrations of the eagles and magic carpets of the Arabian Nights stories
Winged Lion -- Chinese sculpture

2. Sketch or paint a scene from a myth in which flying of some sort contributes to the story. Suggested themes:

"Phaeton's Chariot Ride"
"Pegasus at the Well of Pirene"
"Bellerophon and Pegasus find the Chimaera"
"The Harpies, Hounds of Zeus"
"The Messengers of Odin"
"Thor's Chariot"
"Kai Ka'us on his Flying Throne"

3. Draw a cartoon about flying which might have reflected the attitude or opinion of a mortal creature about 2500 B.C. (Example: p. 40, Science Digest, January, 1969.)

4. Listen to Richard Wagner's Die Walkure.

Resource Materials

Books

Above and Beyond; The Encyclopedia of Aviation and Space Sciences, 14 volumes.

Bulfinch, Thomas, Bulfinch's Mythology, rev. ed., il.

Donovan, Frank, The Early Eagles.

Emme, Eugene M., A History of Space Flight.

Fraser, Chelsea, The Story of Aircraft.

Gombrich, E. H., The Story of Art.

Grimal, Pierre, Larousse World Mythology.

Hamilton, Edith, Mythology.

Josephy, Alvin Jr. (ed.), The American Heritage History of Flight.

Miller, Francis Trevelyan, The World in the Air; The Story of Flying in Pictures, Vol. I

"New Athena H Missile," Space World, December, 1968, p. 28-29.

"New Version of Athena Readied for ABRES," Aerospace Technology, April 8, 1968, p. 37.

Science Digest (Cartoon), January, 1969, p. 40.

Films

Man in Flight (c, 30 min.)

Filmstrips

Space and the Atom Series, "Man Learns to Fly"

The Story of Flight

Transparencies

Daedalus and Icarus

SPECULATION AND EXPERIMENTATION

I. Introduction

World civilization swirled toward maturity as it was swept into the stream of new ideas about man and his destiny. The Crusades, the contacts with China, the expansion of trade and growth of cities, the chivalry and squalor of feudalism, explorations of the New World, the invention of the printing press, the rise of humanism, the Renaissance and Reformation were some of the waves of this stream. Lining the shores of this river of thought were the men of the Middle Ages, some eager and enthusiastic for growth, some fearful and skeptical of change. This unit is the story of the men who participated in the expansion of scientific knowledge about flight.

II. Concepts

A. Man's attempts to master the techniques of flight began centuries ago.

B. The art and literature of this period give evidence that man's interest in flight was increasing.

C. Fiction has often presaged inventions and events.

III. Background Information

A. Some attempts to fly involved totally impractical techniques.

1. The "Sage of Spain," an Arabian intellectual, covered his body with feathers and fell through a roof while attempting to fly.

2. A Saracen from Constantinople in about 1100 dressed himself in a long white gown stiffened with willow poles. He attempted to glide from a high tower and fell to his death.

3. At about the same time an English monk, named Oliver from Malmesbury, crashed to the ground after putting on wings and jumping from a great height.

4. Joseph of Cupertino, an Italian monk, earned the nickname "The Flying Monk," by flying (it was said) without any type of mechanical assistance.

5. In 1507, John Damian, an Italian adventurer, attempted to fly to France dressed in chicken feathers. He crashed and wryly commented that his failure was due to the fact that he was wearing "the feathers of a ground bird when he should have worn feathers of an eagle."

B. Some serious and scientific contributions were made.

1. Roger Bacon (1212-1292), a Franciscan friar who developed the first scientific concepts concerning flight, wrote that man would not fly by attaching wings to his body; he believed that mechanical assistance would be necessary for flight.

2. Leonardo da Vinci, a master sciertist, sculptor, musician and painter, drew plans for a flying machine, helicopter and parachute.

3. John Wilkins, Bishop of Chester, wrote two books related to flight and space travel. His Discovery of a New World, published in 1648, was concerned with scientific principles presented by Archimedes.

4. Robert Hooke, an English Philosopher and scientist, who believed that man needed more than his own muscle power for flight, constructed a small helicopter powered by a spring.

C. Art and literature of this period reflect man's increasing interest in flight.

1. Marco Polo wrote of wonderful kites and airships flown at the court of Kublai Khan.

2. William Shakespeare, referred to attempts to fly in Hamlet, Merchant of Venice, and A Midsummer Night's Dream.

3. Jonathan Swift's Gulliver's Travels, published in 1727, describes a flying island--a foreshadowing of today's satellites.

4. Cyrano de Bergerac, in 1649, wrote A Voyage to the Moon. This early science-fiction includes the description of a rocket flight to the moon.

5. Albrecht Durer, a famous German artist, made a woodcut of the ancient flight of Daedalus and Icarus.

6. In 1606, Dr. Simon Stevin of Bruges, Holland, painted a colorful picture of a flying chariot for Prince Maurice of Orange.

IV. Activities

A. Language arts and social studies activities.

1. Find out about Roger Bacon's theories of flight (Mirror of Alchemy). Discuss the ways in which his ideas were received in terms of the political and religious climate at that time.

2. Find out what contributions Leonardo da Vinci made to aviation. How are his ideas reflected in modern aviation?

3. Read about Francesco de Lana's "flying boat." Why would his plan have failed if he had tried to build the boat? (The atmosphere would have collapsed the copper balls.)

4. Read and discuss Locksley Hall by Lord Alfred Tennyson.

5. Read and discuss selections from Edgar Allen Poe's science fiction.

6. Read about Jules Verne's balloon "The Victoria."

7. Using map pins, indicate on a world map countries where serious thought was being given to manned flight, 1100-1750.

8. Using the style of an epic, write a poem about an adventure in flying.

B. Additional activities

1. Find and display pictures of early attempts to fly.

2. Draw a cartoon satirizing the idea of manned flight.

3. Draw or paint a picture of a flying machine which might have appeared in the period 1100-1750.

Resource Materials

Books

Above and Beyond; The Encyclopedia of Aviation and Space Sciences, 14 vols.

Becker, Beril, Dreams and Realities of the Conquest of the Skies.

Floherty, John J., Whirling Wings.

Josephy, Alvin Jr. (ed.), The American Heritage History of Flight.

Miller, Francis Trevelyan, The World In the Air; The Story of Flying in Pictures. Vol. I.

Polo, Marco, Travels of Marco Polo.

Films

Man in Flight (c, 30 min.)

Filmstrips

Space and the Atom Series--"Man Learns to Fly"

Records

Great Men of Science Series "Issac Newton and Galileo"

BALLOONS AND AIRSHIPS

I. Introduction

On June 4, 1783, two Frenchmen, the Montgolfier brothers, inflated a huge balloon with hot air. When released from its moorings, the balloon rose in history's first successful flight. Later the same year, two men were carried aloft in a basket gondola lifted by a hydrogen-filled balloon. After thousands of years of dreaming, man, at last, had flown.

Numerous adventurous Europeans and Americans experimented with these fragile contraptions, carried aloft by the lifting power of hot air or hydrogen. Knowledge gained through balloon flight was applied to the development of the dirigible, an airship which could be steered, and regularly scheduled passenger flights became a reality.

II. Concepts

Experimentation with balloons resulted in man's first successful attempts to control ascent and descent.

Experimentation with balloons provided much information concerning the nature of air.

The French dominated early balloon activity, but the Germans developed more advanced craft called dirigibles.

With the advent of the dirigible (meaning "steerable"), lighter-than-air craft aroused increasing interest in flight.

Lighter-than-air craft proved to have many disadvantages and its usefulness is limited.

III. Background Information

A. Scientists in several countries began experimenting with lighter-than-air craft.

1. England. Henry Cavendish, English chemist, discovered that hydrogen is lighter than oxygen.

   Balloon flights across the English Channel. A high-altitude flight (over 21,000 ft.) provided the information that man cannot survive at high altitude without protection against the cold and without a supply of oxygen.

2. Scotland. Joseph Black, Scottish professor, concluded that a hydrogen-filled balloon could rise through the air.

3. France. Montgolfier brothers built and experimented with several hot-air balloons, sending animals and men into the air.

J. A. C. Charles and M. N. Robert built and ascended in a hydrogen-filled balloon.

4. United States. George Washington was present when the first balloon ascent was made in the United States.

B. Fire, explosion, damaging winds, and unreliable means of controlling lighter-than-air craft resulted in general discouragement of those interested in the balloon as a developing means of air travel.

C. Potential of aerial warfare was recognized by some people.

1. In 1793, the French Government authorized an air arm.

2. In 1846, John Wise (United States) suggested that a balloon be used to bomb the Mexican fortress at Vera Cruz.

3. In 1849, the Austrians bombed Venice by releasing small hot-air balloons which carried time-bombs.

4. Observation balloons were used during the Civil War (United States).

5. In 1870-71, balloons were used in the Franco-Prussian war.

6. Balloon ascensions provided excitement at county and state fairs in the early 1900's.

D. Development of airships--engine-powered and steerable.

1. In 1885, more than 100 years after the invention of the balloon, Alberto Santos-Dumont, a Brazilian, designed and flew a powered, steerable airship.

2. In 1902, the French industrialists, Paul and Pierre Lebaudy, developed a practical dirigible.

3. In 1904, Captain Thomas S. Baldwin of the United States Army flew a dirigible at the St. Louis World Fair. It was powered by a Curtiss engine.

4. By 1910, Germany had taken the lead in developing lighter-than-air craft. After designing a type of dirigible which was named after him, Count Ferdinand von Zeppelin formed the German Airship Transportation Company which operated a fleet of these dirigibles.

5. During World War I, Germany used airships for scouting, observation, supply, and bombing.

6. In 1933, the German airship, Graf Zeppelin became the first airship to fly around the world. It furnished commercial service between Germany and South America until 1937.

7. In 1937, the Hindenburg (German) exploded while approaching Lakehurst, New Jersey. This ended regualr airship service from Germany.

8. After World War I, some airships were built by Great Britain, Italy, and Russia. They were mostly for military purposes, and nearly all of them crashed.

9. The best-known airships built by the United States, The Shenandoah, The Akron, and The Macon, crashed and burned.

10. In 1961, the United States Navy ended its lighter-than-air craft program.

E. Balloons are used to collect meteorological data.

1. In 1934, weather balloons were launched from Lambert Field, St. Louis, Missouri. Instruments automatically recorded atmospheric pressure, temperature, and humidity. At about 65,000 ft., the balloon burst and floated back to earth. Finders were offered $5.00 for returning the instruments to Lambert Field.

2. The advent of the computer made it possible to utilize the thousands of bits of data collected by weather balloons.

3. Climbing at the rate of 1,000 feet per minute, radiosonde balloons from more than 500 stations in the northern hemisphere, report on conditions in the stratosphere and troposphere.

a. Sensors collect data about the temperature, pressure and humidity.

b. Tiny radios transmit information to teletypewriter banks at the National Meteorological Center (NMC) in Suitland, Maryland.

c. The data collected is fed into computers which analyze it and make weather forecasts which are broadcast throughout the day.

IV. Activities

A. Language arts and social studies activities

1. Have a group of class members plan and conduct a panel discussion. Students might present various opinions about the significance and future of air travel as they were held by such men as Benjamin Franklin, Samuel Johnson, George Washington, and Napoleon.

2. Read a newspaper account of one of the early balloon ascents. Compare stories of the aeronauts of earlier days to those of the astronauts of today. The class might also compare the styles of writing.

3. Write a daily log as it might have been written by a balloonist during a cross-country race.

4. Write an editorial which might reflect a popular opinion of the times concerning the balloon ascension of Madame Thible (first woman passenger, 1784) or Mrs. L. A. Sage (first English woman to dare an ascent, 1785).

5. Write an editorial which might reflect a popular opinion concerning Jeannette Piccard's contributions to the work of Jean and August Piccard (1930's).

6. Construct a time line beginning with 1750. Use symbols cut from construction paper to mark the chronology of significant dates in the history of balloons and dirigibles.

7. Write a ballad about the crash of the Hindenburg.

8. Pretend you are on the crew of a German dirigible during World War I. Write a letter to a member of your family describing your observations.

9. Report on modern uses for balloons and airships. Current newspapers and magazines are useful reference materials.

10. Read and discuss Jules Verne's Around the World in 80 Days.

B. Additional activities

1. Paint a balloon designed in the style of the first manned Montgolfier balloon.

2. Draw a cartoon satirizing the advancement of balloon flight.

3. Design and prepare a poster publicizing a balloon ascension at a state fair as it might have appeared in the late 1890's.

4. Paint an aeronaut's-eye view of the Paris Exposition, 1867.

5. Listen to a recording of the music from the film "Around the World in 80 Days."

Resource Materials

Books

Above and Beyond; The Encyclopedia of Aviation and Space Sciences, 14 volumes.

Burchard, Peter, Balloons.

Dollfus, Charles, Book of Balloons.

Douty, Esther M., Ball in the Sky; The Story of John Wise.

Dwiggins, Don, The Air Devils; The Story of Balloonists, Barnstormers, and Stunt Pilots.

Glines, C. V., Lighter Than Air Flight.

Miller, Francis Trevelyan, The World in The Air; The Story of Flying in Pictures, Vol. I

Poole, Lynn and Gray, Balloons Fly High.

Poole, Lynn and Gray, Ballooning in The Space Age.

Richards, Norman, Giants in the Sky.

Rolt, L. T. C., The Aeronauts; A Dramatic History of the Great Age of Ballooning.

Stehling, Kurt R. and William Beller, Skyhooks.

Films

From Balloon Gondola to Manned Spacecraft (c, 27 min.)

Other Media

America Drops Zep Program #22 (Film Clip)

Hindenburg Crash Ends Era #61 (Film Clip)

Space and the Atom Series, "Man Learns to Fly" (Filmstrip)

Science packet - Balloons and dirigibles # 29 0 (Transparency)

WINGED FLIGHT BECOMES A REALITY

I. Introduction

With the Wright brothers' historic flight at Kitty Hawk in 1903, winged flight, the dream of ages past, became a reality. Foundations laid by experimentation in the 19th century enabled men of the twentieth century to reach this long sought goal as the air age began. The economic, political, and social implications of air transportation are real and often staggering. The use of aircraft in war and peace has almost completely revolutionized man's life. It continues to transform the shrinking world and affect man's interaction with man upon this earth.

II. Concepts

A. Research and experimentation by some of the nineteenth century scientists became the foundation for modern aerodynamics.

B. The Wright brothers' achievement of winged, powered flight was the first step toward making flight practical.

C. The development of the airplane brought about great changes in international relationships.

D. The use of aircraft in warfare has great strategic and psychological significance.

E. Development of aircraft and related industries has great economic implications.

III. Background Information

A. Early accomplishments in aeronautical science

1. 1800's. The research and experiments of George Cayley (England) laid the foundation of all modern aerodynamics.

2. 1890's. Otto Lilienthal (Germany) was the first to demonstrate that, with or without power, the air could support man in winged flight.

3. 1890-early 1900's. Octave Chanute (United States) prepared background information about stability and structural strength which helped the Wright brothers build an effective machine.

4. 1890-early 1900's. Samuel Langley (United States) pioneered in aviation research. Hampton, Virginia, is the site of a NASA research center named for Samuel Langley.

B. The first successful major flights

1. 1903. Wright brothers (United States) successfully took off, flew, and landed several times.

2. 1906. Santos-Dumont (Brazil) was recognized in Europe as the first man to make a successful airplane flight.

3. 1905-1908. In Europe many men were making airplane flights, but aviation in the United States was far ahead of that in Europe.

4. 1907. Glenn Curtiss (United States) earned many trophies and prizes in early aviation history. He established a flight training school near San Diego, and built the first aircraft for the U. S. Navy.

5. 1909. Louis Bleriot (France) made the first airplane flight across the English Channel.

6. 1908-1914. Aviation meets in Europe and the United States capture the interest of the public. Many flying contraptions were built; exhibition flyers set records and thrilled crowds.

C. World War I

1. 1914. Airplanes were in the war from the beginning; however, their principal use was for observation and scouting.

2. As the war progressed both sides began to use aircraft for carrying bombs, as fighter planes, and for psychological warfare.

3. 1915. Roland Garros (France) mounted a rifle behind the propeller of his airplane.

4. Anthony Fokker (Germany) improved on this arrangement by synchronizing the machine gun with the revolving propeller, so that the pilot wouldn't shoot himself down.

5. Hugo Junkers (Germany) produced an all-metal airplane with no external struts or bracing.

6. 1916. The United States had only two army airplanes, and they were declared unfit for service.

7. 1918. American fliers were in combat for the first time, and they had to fly French-built airplanes.

8. 1918. After a painfully slow start, the United States gained superiority in the air.

D. World War I had important effects on aviation

1. Control of the air became a necessary requisite for successful ground or sea operations.

2. A surplus of pilots and airplanes after the war greatly enhanced and expanded the aviation industry.

3. The value of air strategy became apparent as the Allies used formation flying, strategic bombing, and saturation attack.

E. Development of aviation between World War I and World War II

1. 1918. Airmail routes were established in the United States. (Although mail had been carried by air before, this was the first regularly scheduled airmail service.)

2. 1926. Richard Byrd and Floyd Bennett (United States) flew a Fokker tri-motor over the North Pole.

3. 1927. Transatlantic flights were being made. Charles Lindbergh (United States) made the first solo transatlantic flight.

4. 1932. Amelia Earhart (United States) made the first transatlantic solo flight by a woman. (Her disappearance over the Pacific in 1937 has never been completely explained.)

5. 1935 Over 150 aircraft manufacturers were building many different models of aircraft to serve different purposes.

6. 1936. The Douglas DC-3 scored a major triumph as it carried 30 passengers from Chicago to New York in a heated, pressurized cabin.

7. 1937. The Hindenburg, a German airship, crashed and burned minutes after landing at Lakewood, New Jersey, thus ending the era of travel by airship.

8. 1935-1939. Aggressor nations used air power in small wars in China, Ethiopia, and Spain.

   a. Proved that civilians were no longer exempt from the horrors of war

   b. Awakened unprepared nations to the need for developing air power

F. World War II, the air war

1. 1939. The German Luftwaffe was the strongest air force in Europe.

2. 1940. The air power of France consisted mostly of obsolete planes.

3. 1940. The Royal Air Force, England, proved the importance of superiority in the air at Dunkirk.

4. 1941. Pearl Harbor, Hawaii. The United States fleet was attacked by Japanese raiders, bombers, and torpedo planes.

5. 1942. Col. James Doolittle, United States, led a group of B-25's in a bombing raid on Tokyo, Japan.

6. 1945. B-29's, United States, dropped atomic bombs on Hiroshima and Nagasaki, Japan, bringing the war to an end.

7. 1939-1944. Jet aircraft were being built by Germany and England, but they were not in time to be used in WWII.

G. The Jet age

1. 1948-49. Airplanes proved effective in the Cold War as the United States carried life-saving cargo to Berlin, Germany.

2. 1947-52. Charles Yeager (United States) made the first supersonic flight in the Bell X-1, an experimental aircraft. Additional flights of experimental planes tested various features of aircraft design, including the variable-sweep wing now incorporated in the design of the F-111.

3. 1952. The X-15 program (United States), designed to help scientists study the problems of very high altitude, hypersonic manned flight, prepared the foundation for manned space flight. The last of the three X-15's made its final flight on October 24, 1968. The X-15's made 199 flights, reached altitudes of more than 67 miles, attained a top speed of 4,520 mph and logged about 30 hours of time in the air.

4. 1960. A U-2, high-flying United States reconnaissance airplane was brought down in Russia, again dramatizing the importance of the air as an international arena.

5. 1961-62. Commercial aviation expanded rapidly, but in 1962, two-thirds of the American people had yet to make their first flight.

6. 1964. The SR-71, United States Air Force reconnaissance aircraft, capable of flying more than 2000 mph, flew.

7. 1968. Airborne multitudes around the world.

   a. The aerospace industry remains the largest manufacturing employer in the United States, with over 1.4 million workers.

b. Airlines around the world provide an important market for American-built airplanes.

c. Between 1967 and 1968 production of utility and executive aircraft increased from 13,577 to 14,000 units.

d. Civilian helicopter production increased from 455 units to 511 units between 1967 and 1968. Value of this type of aircraft production rose from $43 million to $57 million.

e. Vertical and/or short takeoff and landing craft (V/STOL's) and helicopters serve specific purposes.

H. Jet transports: the third generation

1. Advanced technology jets will have powerful turbofan engines, be capable of attaining great speeds, and have high-volume interiors.

2. Different models will serve different purposes:

Boeing 747	300-490 passengers
McDonnell Douglas DC-10 (airbus)	250-350 passengers
Lockheed L-1011 (airbus)	250-350 passengers
Boeing 747-F	215,000 lbs. of cargo
Lockheed C-5 (USAF)	270,000 lbs. of cargo

I. Airplanes of the future

1. 1968 (flew December 31) Russia's Tupolev 144 (TU-144)

2. 1969 Anglo-French Concorde flew March 2, 1969

3. 1972 (?) United States. The Boeing SST has developed many problems.

J. Progress brings problems

1. Inadequate terminal buildings

2. Jet engine noise

3. Air traffic control

4. Transportation from airport to city

5. Need for improved navigation systems

6. Possibilities of excessive G-loads and dangerous radiation levels

7. Need for smoother runways

8. Legal questions related to the Civil Aeronautics Board (CAB) decisions awarding air routes.

9. Inadequacies of cockpit and passenger sections' air-conditioning systems

IV. Activities

A. Language arts and social studies activities

1. Read about the contributions which George Cayley, or some other pioneer, made to the study of aeronautics. Report to the class using diagrams, transparencies, and/or other visuals.

2. Display a collection of models of historic airplanes or pictures of early aircraft. Discuss the personal qualities which early fliers must have had.

3. Make a time line beginning with the year 1900. Using symbols, show the progress of aviation as it developed in various countries of the world.

4. Make a list of the developments in aviation which could only become possible after powered flight became a reality.

5. Report to the class on the history of the United States Air Force. Include information about the court-martial of Billy Mitchell.

6. Read an account of a sailplane pilot's experiences and impressions as he soars over the land. Write a poem expressing the exhilaration and beauty of flying an unpowered craft.

7. Make a bulletin board which tells the story of aviation in Nebraska. Include information about early aircraft manufacturing, Lindbergh's flight training, carrying airmail, etc.

8. Find out how many employees work at the world's largest airports. Discuss the complications arising from the increasing number of workers, and some of the possibilities for reducing the problems.

9. Make a list of words which, when used in connection with flying, have a different meaning than they do in common usage. For example, buzz, holding, clearance, scan, guppy, ceiling.

10. Write and present a play which will inform the audience about the conditions under which the Berlin Airlift was conducted and the impact which it had on the Communist world at that time.

11. Listen to a recording of excerpts from Sir Winston Churchill's war messages. Discuss his tribute to the Royal Air Force.

12. Have a class debate the topic: "The atomic bomb was the best means to bring World War II to an end."

13. Discuss the impact of the increase in general aviation. Include both benefits and problems which it causes.

B. Additional activities

1. Design an airport for the twenty-first century.

2. Have a paper glider contest, emphasizing the creative construction of each entry.

3. Find out about the aviation art which is exhibited at the Smithsonian Institution, The U. S. Air Force Academy, and the Air Force Museum at Wright-Patterson Air Force Base. If possible, secure prints for a classroom exhibit.

4. Paint a picture which expresses your impression of some aspect of space exploration. (NASA commissioned several outstanding artists to do this kind of an assignment. Pictures ranged from representations of a rocket launch to abstract representations of the universe.)

5. In the style of Milton Caniff, draw a picture representing some aspect of the air war in Viet Nam.

6. Design a poster which urges traveling by air.

7. Have class members find out the titles of some songs which tell stories of the men in the Air Force and the planes they flew during WWII. Discuss the way in which music reflects the mood of a country. (Examples: Comin' in on a Wing and a Prayer; Rosie the Riveter.)

Resource Materials

Books

Above and Beyond; The Encyclopedia of Aviation and Space Sciences, 14 volumes.

Anders, Curt, Fighting Airmen.

Clark, Arthur C., and the editors of Life, Man and Space.

Cooke, David C., Flights That Made History.

De Leeuw, Adele, The Story of Amelia Earhart.

De Leeuw, Hendrik, Conquest of the Air.

Donovan, Frank, The Early Eagles.

Duke, Neville and Edward Lanchbery (ed.), The Saga of Flight.

Frank, F. Jr., Experimental Planes, Subsonic and Supersonic.

Gibbs-Smith, Charles H., The Invention of the Aeroplane (1799-1909).

Gurney, Gene, Test Pilot.

Haggerty, James J. and Warren R. Smith, U.S. Air Force;A Pictorial History In Art.

Holland, Maurice, Architects of Aviation.

Johnson, S. Paul, Horizons Unlimited.

Josephy, Alvin Jr. (ed.), The American Heritage History of Flight.

Lindbergh, Charles A., The Spirit of St. Louis.

Mason, Herbert, Bold Men, Far Horizons; The Story of Great Pioneer Flights.

National Aeronautics and Space Administration, X-15; Research at the Edge of Space.

Reynolds, Quentin, The Wright Brothers; Pioneers of American Aviation.

Rickenbacker, Edward V., Rickenbacker.

Robinson, William, "Employees are a Big Congestion Factor," American Aviation. November 25, 1968, pp. 16-17.

Smith, Leroi, "At Once With the Eagle," Aviation Graphic. 1968, p. 7-11

Stever, H. Guy, James J. Haggerty, and the editors of Life, Flight.

Still, Henry, To Ride the Wind; Biography of Glenn Martin.

Thomas, Shirley, Men of Space; Profiles of the Leaders in Space Research.

Whitehouse, Arch, Legion of the Lafayette.

Films

Air Age (b/w, 30 min.)

Flight of the Spirit of St. Louis and Friendship 7 (c, 24 min.)

We Saw It Happen; Wright Brothers to 1960, Parts I and II. (b/w, 58 min.)

X-15 Documentary (b/w, 24 min.)

8 mm. Single Concept Films

Lindbergh's Atlantic Flight

The M-2 Spacecraft

Filmstrips

Space and the Atom Series, "Man in Flight"

The Wright Brothers

Film Clips

The Amelia Earhart Story #230
Barnstormers Storm U.S. #23
Byrd Flies Over North Pole #360
Famous First in Aviation #103
Howard Hughes Flies Around the World #313
Lindy Flies Alone #34
1919--NC-4 in First Trans-Atlantic Flight #290
R.A.F. Over Britain #356
Ruth Elder Flies Atlantic #153
San Diego to Hawaii...Non-Stop Flight, 1925 #215
U.S. Bombers Over Europe #187
The "Wrong" Brothers #57
Scenes of early flying machines, with humorous commentary.

Pictures

NASA Art Exhibit - reproduction of paintings

TRW Aviation Lithographs (12 pictures to a set)

Air Power-1955 - military planes and helicopters of U.S.
Aviation Hall of Fame - feats of aviation's flying heroes
The Barnstormers - early exhibition fliers

TRW Aviation Lithographs (continued)

Before Kitty Hawk - experimentation prior to Wright Brothers
Dawn of Wings - pioneer planes of the world
The Early Birds - men and women who flew solo before December 17, 1916
Famous Firsts - planes and pilots, 1908-1919
The Fledglings, World War I - WWI military planes and pilots
For the Record - WWII military planes of Axis Powers
The Golden Decade - historic flights (1920-1930)
Jet Argosies - 1964 - Turbojet transport planes
Pioneer Mail Wings - U.S. Mail planes, 1911 to 1931
Rescue - missions of Air Rescue Service
Salute to a Giant - U.S. commercial planes
Sky Servant - personal planes after WWII
The Thompson, Postwar - planes in Thompson Trophy race 1946-1961
USAF...50 years - history of U.S. military aviation
Wings of the OX5 - planes of the twenties which used OX5 engine

Records

I Can Hear It Now 1919-1932
Side 2, Band 2 "Lindbergh's Flight"

I Can Hear It Now Set MM-800
Side 2 "Hindenburg Disaster"
Side 7, "U.S. Declaration of War by Franklin D. Roosevelt"
Side 10, Chaplain Wm. Downey, U.S. Air Force, says a prayer at Tinian before the takeoff of the Enola Gay, which carried the first atomic bomb used in warfare. (Truman's voice.)

Winston Churchill Speaks--Excerpts from fifteen addresses with emphasis on the messages given between 1940 and 1941.

World War I Fighter Planes in Action, Riverside 95508 Stereo, (R. L. P5508 Mono) - Sounds of old planes.

Other Media

Historical Aircraft (slides)

Cayley's Flying Machine (transparencies)
Chanute's Glider
Lilenthal's Glider
Modern Delta Wing
"Spirit of St. Louis" - Charles A. Lindbergh
Wright Brothers - First Successful Flight, 1903, Kitty Hawk, N.C.

THE SPACE AGE

I. Introduction

The space age began with the launching of Sputnik by the U. S. S. R. on October 4, 1957. Man has now been thrust into a new era of exploration and discovery as he attempts to probe the secrets of the universe lying beyond the earth's lower atmosphere.

A necessary precursor to space flight, the development of rocketry, had been a long slow process dating back to the early Chinese use of rockets in warfare. From the erratic, unreliable, early rocket has come the launch vehicles capable of lifting man into space.

II. Concepts

A. Nations of the world were very slow to (realize) recognize the potential of rockets.

B. The modern age of rocketry (beginning about 1900) developed as a result of the efforts of Russian, American, and German scientists.

C. October 4, 1957, the date of the launching of Sputnik, is generally regarded as the beginning of the Space Age.

D. The benefits of space exploration are extensive.

E. Maintaining superiority in space technology is essential to national defense.

III. Background Information

A. Early stage of rocketry

1. 1200. The Chinese use rockets in warfare, thus leading to the development of rockets by others.

2. 1400-1600. Scientists in England, France, and Italy were experimenting with rockets as weapons.

3. 1800's. England's use of Congreve's rockets in battle, helped bring about Napoleon's defeat.

B. About 1900 scientists began seriously to consider rockets as a means of achieving space travel.

1. 1903. In Russia, Konstantin Tsiolkovsky published a treatise on liquid fuel for space propulsion.

2. 1919. In the United States, Robert Goddard published a report, "A Method of Reaching Extreme Altitudes."

a. 1926. Goddard launched the first liquid-fuel rocket.

b. 1929. Launched first instrumented rocket.

3. 1923. Professor Herman Oberth, an Austro-Hungarian, published his theories on liquid fuel propulsion.

a. 1938. Oberth was requested to help Germany develop rockets.

b. His work is still accepted as a guide for rocket experts.

4. Rocket societies were formed independently, by interested scientists.

a. 1927. In Germany, the VFR -- Society for Space Travel -- included some of the world's outstanding scientists, including Willy Ley and Wernher Von Braun.

5. Rockets in World War II

a. 1940. In Germany, rapid progress was being made, but greatest accomplishments were in the area of ballistic missiles.

b. 1940. Rocket production began in the United States with the armed forces, universities, and manufacturers cooperating.

c. 1940. Russia, England, France and Italy were working on rockets for launching missiles. Japan produced a rocket propelled suicide airplane.

C. Early post-war rocketry

1. 1945. The United States and Russia emerged as leaders in developing rockets.

a. Russia's rocket and space flight programs were highly secret.

b. The United States and England felt no sense of urgency, and misconstrued Russia's silence.

2. 1945-1950. Immediately after the war, sounding rockets were developed by the United States, Russia, and many other countries.

D. The first satellites

1. 1957. International Geophysical Year

2. 1957. October 4, 1957, Russia launched Sputnik and the space age.

3. 1957. November, 1957, Russia launched Sputnik II, which carried a live dog.

4. 1957. In December, 1957, the United States made its first attempt to launch a satellite. Vanguard TV-3 was a failure.

5. 1958. In January, 1958, Explorer I was successfully launched by the United States.

E. The race for space

1. 1961. At the end of Eisenhower's administration the Russians were far ahead of the U. S. in developing rocket thrust.

2. 1961. Incoming President Kennedy appointed James Webb as the new administrator of the National Aeronautics and Space Administration. Under his vigorous direction, NASA gained renewed support and confidence.

3. In April, 1961, Russian Cosmonaut Yuri Gagarin orbited the earth.

4. On May 5, 1961 (23 days after Gagarin's flight), Alan Shepard, an American astronaut, made a sub-orbital flight in the Freedom 7.

5. May 26, 1961. President Kennedy urged the United States to commit itself to the goal of landing a man on the moon and returning him safely to Earth by 1970.

   a. Leadership in space is important to our national prestige, and it is essential to military security.

   b. Kennedy believed the space program would result in improved communications, better weather forecasting; have economic and social benefits; reap technological benefits for industry; serve as a stimulus to science and education.

6. February 20, 1962. John Glenn aboard the Friendship 7, proved that the United States, too, could place a manned spacecraft in orbit and return it safely to the earth.

   President Kennedy spoke from the Rose Garden at the White House: "I know that I express the great happiness and thanksgiving of all of us that Colonel Glenn has completed his trip, and I know that this is particularly felt by Mrs. Glenn and his two children."

   "I also want to say a word for all of those who participated with Colonel Glenn at Canaveral. They faced many disappointments and delays--the burdens upon them were great--but I think their judgment has been vindicated."

"We have a long way to go in this space race. But this is the new ocean, and I believe the United States must sail on it and be in a position second to none."

F. Expanding the space program

1. 1960. Both the United States and Russia recognized that the greatest achievements in space can be made only through the combination of man and machine.

2. Unmanned scouts collect information about space and transmit it back to earth, thus making it possible to send man into space earlier and more safely.

3. Unmanned satellites facing the earth have provided comprehensive information about the earth and its environment.

G. Unmanned space flight: a new era in science

1. The artificial satellites which have been placed in earth-orbit have a variety of purposes, but can, in general, be placed in one of three categories: scientific, military, and earth-resource applications.

2. Weather and surveillance satellites

a. Handle data in two ways:

(1) Stored-data model takes pictures and stores them on magnetic tape for later readout to the World Meteorological Center at Suitland, Maryland, and the Air Force Global Weather Central in Nebraska.

(2) Automatic Picture Transmission (APT), takes and transmits pictures continuously.

b. Nimbus and TIROS programs have proved most successful, and form the nucleus for present and future weather-observation systems.

c. Uses of weather satellite data

(1) Extended long-range weather forecasts

(2) Meteorological investigation of remote areas

(3) Information about weather conditions for safe launching and landing of manned space shots.

d. TIROS Operational Satellite System (TOS) is a world-wide system of satellites, command and data acquistion stations, communications to link the system, a satellite control center, and a data-processing center.

3. Communications satellites

   a. Communication satellites are of two types--passive and active. Passive satellites generally have no instrumentation, but reflect a signal without amplifying it. Active satellites receive messages and re-transmit them to earth.

   b. Various agencies have built communication satellites.

      Military--Score, Courier, Advent
      NASA--Echo, Relay, Syncom
      Commercial organizations--Telstar, Early Bird
      Amateur radio operators--Oscar

   c. The 63-nation International Telecommunications Satellite Consortium (Intelsat) is developing a series of satellites which will provide a global system of communications. It is capable of handling 1,200 two-way telephone conversations or four television programs simultaneously. (Two additional satellites will complete this system.) A 4-satellite series, Intelsat 4, is planned for the early 1970's. It will carry as many as 44,000 conversations.

   d. A tri-service communications satellite was launched on February 9, 1969. Serving Air Force, Army, Navy, this Tactical Communications Satellite can carry 10,000 conversations simultaneously.

4. Navigation satellites can improve air traffic control, reduce the number of collisions involving aircraft, as well as ships, make search and rescue operations more efficient.

   a. Prime goal of navigation satellites is to make the crowded North Atlantic air corridor safer.

   b. U. S. Navy Navigation Satellite System (formerly called Transit) was opened to commercial shipping on July 29, 1968.

   c. Queen Elizabeth II will be the first passenger vessel capable of utilizing a satellite in navigation.

5. Geodetic exploration

   a. Scientists use three kinds of tools to explore the earth's environment: sounding rockets, Explorer satellites, and Orbiting Geophysical Observatories.

   b. International cooperation permits the United States (NASA) to launch foreign-built payloads.

      Alouette--Canada
      San Marco--Italy
      Ariel II--Great Britain
      Fr-1A--France

6. Interplanetary exploration

   a. Lunar explorations of Ranger, Surveyor, Lunar Orbiter, and Apollo provided pictures of the moon's surface and proved that the surface of the moon would support a spacecraft.

   b. Pioneer and Mariner spacecraft have probed the space between Venus and Mars, and have provided many pictures of Mars.

   c. Russia successfully launched a Venus shot which dropped a package of sensing instruments into the Venusian atmosphere. It detected winds of hurricane force, cloud temperatures of 104° to 536° F, an atmosphere containing 98.5% carbon dioxide, and a surface pressure 15 times that of earth.

H. Manned space flight

1. Each of the three major steps in NASA's plan for placing astronauts on the moon by 1970 had specific goals.

   a. 1958-1963. Project Mercury (6 manned flights) goals:

      (1) To investigate man's ability to survive and perform in space

      (2) To develop hardware for spaceflights to come

      (3) To explore the fundamentals of spacecraft reentry

      (4) Set up a round-the-world tracking system

   b. 1964-1966. Project Gemini (10 manned flights) goals:

      (1) To evaluate the capability to maneuver the spacecraft

      (2) To evaluate the worldwide tracking system

      (3) To evaluate the spacecraft systems

      (4) To evaluate the recovery system

      (5) To evaluate the effects of prolonged exposure to space

      (6) To demonstrate the feasibility of extravehicular activity

      (7) To evaluate the performance of the rendezvous guidance and navigation system

(8) To accomplish rendezvous and dock in space

(9) To use large propulsion systems in space

(10) In addition to the specific goals assigned to each Gemini mission, various experiments were scheduled for investigation

3. 1966. Project Apollo (6 manned flights) goals:

a. To land American explorers on the moon and bring them safely back to earth

b. To establish the technology required to meet other national interests in space

c. To achieve for the United States preeminence in space

4. Latest developments

a. January, 1967. Apollo 204, burned during a routine test, killing Astronauts Grissom, White, and Chaffee.

b. October, 1968. Apollo 7 orbited the earth for 11 days.

c. October, 1968. At the peak of the Apollo program approximately 20,000 firms and 350,000 people were working directly toward its completion.

d. December, 1968. Apollo 8. During this journey the astronauts became the first men to leave the gravitational field of earth. Astronauts Borman, Anders and Lovell orbited the moon.

e. February, 1969. Russians transfer cosmonauts in space

f. March, 1969. Apollo 9. The Lunar Module is tested in space for the first time.

IV. Activities

A. Language arts and social studies activities

1. Discuss the connotations in the words "realize" and "recognize" as they are used in the first concept.

2. Read the biographies of Robert Goddard, Wernher von Braun, and Konstantin Tsiolkovsky. Compare their backgrounds, training, and experience. Discuss the personal qualities and ideals which they share.

3. Read the biographies of several Russian cosmonauts. Discuss ways in which their background, personal qualities, and professional qualifications compare with those of American astronauts. (Space World, April, 1969)

4. Compare the heroic qualities of the astronauts with the qualities which made heroes in other eras of history and literature. (This could be an individual written assignment, a panel discussion, or, stated as a resolution, a question for debate.)

5. Make a list of aerospace-related words which have become part of our language since 1957.

6. Display pictures of the earth as seen by the Apollo 8 crew while they were in lunar orbit. Have students pretend they are visitors from another world, describing the appearance of Earth, and the possibility of life on that planet.

7. Discuss the implications of nuclear-armed satellites and/or celestial bodies used as military bases. Discuss the dual purposes of photography in space and extra-vehicular activity.

B. Additional activities

1. Exhibit pictures of rocketry as it has developed through the years.

2. Review the story of the writing of our national anthem, "The Star Spangled Banner."

Resource Materials

Books

Above and Beyond; The Encyclopaedia of Aviation and Space Sciences, 14 volumes.

Alexander, Thomas W., Project Apollo: Man To The Moon

Becker, Beril, Jules Verne

The Bell System, The Telstar Experiment

Bester, Alfred, The Life and Death of a Satellite

Caidin, Martin, Why Space? and How It Serves You in Your Daily Life

California State College at Long Beach, Model Spacecraft Construction

Clarke, Arthur C. and the editors of Life, Man and Space

Cortright, Edgar M., Unmanned Spacecraft of the United States

"Cosmonaut 13: Vladimir Shatalov," Space World, April, 1969 p.31

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Dewey, Anne Perkins, Robert Goddard, Space Pioneer

Dietz, David, All About Satellites and Space Ships

Dunlap, Orrin E., Communications in Space

Emme, Eugene M., A History of Space Flight

Goodwin, Harold Leland, The Images of Space

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Hill, Robert W., What The Moon Astronauts Will Do All Day

Hubert, Lester F. and Paul E. Lehr, Weather Satellites

Jaffe, Leonard, Communications in Space

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Levy, Lillian, Space: Its Impact on Man and Society

Ley, Willy, Missiles, Moonprobes, and Megaparsecs

Moore, Patrick, Space in the Sixties

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_____, "TIROS," NASA Facts, Vol. II, No. 12

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Newlon, Clark, Famous Pioneers in Space

Ordway, Frederick, III, History of Rocketry and Space Travel

Ordway, Frederick, III, and Ronald C. Wakeford, International Missile and Spacecraft Guide

Ovenden, Michael, Artificial Satellites

Poole, Lynn and Gray Poole, Scientists Who Work With Astronauts

Soloman, Louis, Telstar

Thomas, Shirley, Men of Space

Tyler, A. Edward, The Space Around Us

Vassiliev, M., Sputnik Into Space

Widger, William K., Meteorological Satellites

Williams, Beryl and Samuel Epstein, The Rocket Pioneers

Films

America in Space: The First Decade (c, 28 min.)

Debrief: Apollo 8 (c, 16 min.)

Father of the Space Age (b/w, 18 min.)

The Flight of Faith 7 (c, 28 min.)

The Four Days of Gemini 4 (c, 27 min.)

The John Glenn Story (c, 30 min.)

Man in Space (c, 31 min.)

The Mastery of Space (c, 58 min.)

Project Echo (c, 27 min.)

Road to the Stars (c, 30 min.)

Ten Years to Remember (b/w, 30 min.)

Filmstrips

A Ride In A Gemini Capsule (and record)

Space and the Atom Series, "Flight Around the Moon,"

Space and the Atom Series, "Man and the Moon,"

Film Clips

Astronaut Training #331. Shows some of the aspects of training in the early stages of our space program. Deke Slayton is the astronaut filmed.

Pictures

TRW Aviation Lithographs (12 pictures to a set)

Rockets' Red Glare - evolution of rocket power

BENEFITS OF SPACE EXPLORATION

I. Introduction

Space exploration has had an effect on nearly all facets of man's existence. Whole new industries have arisen as billions of dollars are spent in research, development and manufacture of tools, materials, and equipment for spaceflight. Politically, the nations of the world are faced with the necessity for devising a plan for peaceful, cooperative uses of space. Old academic disciplines broaden and new disciplines arise as data collected through space exploration cause an unprecedented explosion in man's knowledge of his earth and space environment.

II. Concepts

A. Space discoveries free man's intellect from traditional bonds.

B. Space research has practical value for science, industry, and medicine.

C. Aerospace industries have enormous impact on the world's economy.

D. A strong space program is essential to national defense.

E. International cooperation has taken place in certain aspects of the world's space programs. A space treaty, outlining legal policies and procedures, is the most realistic hope for international cooperation in space.

F. Educational programs in the United States changed radically with the advent of the space age and will continue to be influenced by it.

III. Background Information

A. The space age has a direct influence on the curricula of our schools.

1. 1957. When Russia launched Sputni , American education went into an all-out, overnight, crash program.

a. Federal programs were established to increase and expand science and foreign language programs.

b. Physical education programs and national standards of physical fitness were advanced.

c. New approaches to the teaching-learning situation were developed: programmed learning, language labs, revisions in science curricula, team-teaching, etc.

d. Scholarships, low-interest loans, and federal support will continue to help improve education and produce well-educated men and women in every field.

B. Technology for progress toward a better world.

1. Improving education. The development of computers has made it possible to analyze complex problems and show an optimum plan for achieving a solution.

a. Identifying problems in educating students with ethnic, cultural, or economic handicaps

b. Providing new ways to assist instruction

2. Crime-detection techniques

a. Electronic devices are used to match tire marks, hair samples, and fingerprints.

b. Chemistry is used in a method of "sniffing" outside a building to determine whether or not narcotics are inside.

3. Night lighting for emergencies

a. A system developed for nighttime military operations employs a high-intensity lighting system plus an air-to-ground communications link.

b. Nonmilitary uses include search and rescue operations on land and water, riot control, airborne traffic control, etc.

4. Information systems utilizing computers can be used to retrieve information very rapidly for many purposes.

a. Instantaneous research for medical and legal problems

b. Checking income tax returns

c. Keeping abreast of movements of known criminals

5. Industry utilizes space-age advancements in many ways.

a. Computer-controlled handling of cargo by air or surface transportation

b. Nuclear generators, gas turbines, fuel cells, and solar power plants will provide new sources of power

c. Improved methods of bonding metals and other materials; plastics which can withstand temperatures up to 650° F; light-weight, shock-resistant, non-corrosive pipe made from plastic and fiberglass.

d. Reclaiming of waste water and converting it into pure water; desalination of seawater; major air pollutants from coal-fired power plants can be processed to produce sulphur or sulphuric acid; sewage is fed to certain types of algae which are dried and used for poultry feed, and the water is returned to the community for non-potable uses.

6. Forestry, agriculture and geography

Space-based surveys which utilize infrared photography provide information about all types of vegetation observed; information for planning and development; data for detecting plant disease; and scientific data for research.

7. Oceanography

a. Space technology can be used to detect the location of fish and plankton areas. This has vast implications for feeding a hungry world.

b. Monitoring currents, storms, and icebergs can lead to more efficient and safer routing for ships.

8. Medical applications of space-age information

a. Methods of measuring physiological reactions in a person a great distance away

b. Electrocardiogram checks for post-coronary patients can be made by telephone.

c. Through a computerized system of management, blood banks can utilize their supplies much more efficiently, thus drastically cutting the waste of whole blood. (Blood can be used in transfusions until it is 21 days old. After that it is useful only in plasma and similar minor roles.)

d. Instrumentation and computer techniques are used in a system which simulates human patient systems. This life-size model reacts realistically to drugs, anesthetics, etc.

e. A heart-assist pump connected to the thigh arteries takes some of the load off a weak heart.

f. Laser technology is being used for "knifeless surgery" on eyes, and the process is being evaluated in dermatology, organ repair, amputation, and in microbiological studies.

g. A cross-spectral analysis computer program, which was developed to solve problems of rocket engine vibration, ignition and combustion, has been found to be useful in medical research and brain studies.

h. Computerized systems will store vast amounts of medical knowledge and logic, which will be instantaneously available to doctors, thus giving them the benefit of the experience and information collected by many. This will also allow doctors more time with patients and reduce the possibility of error in transferring information.

C. Over the past several years the aerospace industry has increased at approximately 10% per year, and trends indicate that this pace will continue or speed up.

1. According to Karl G. Harr, President of Aerospace Industries Association, in the Winter 1969 issue of Aerospace (official publication of the Aerospace Industries Association) the following growth has taken place:

a. Total aerospace sales reached $30.1 billion, an increase of almost $3 billion above 1967

b. Commercial aerospace sales increased by 39%

c. Aerospace exports rose 32%; to a $3 billion level

d. The total number of people employed in aerospace industries in 1968 exceeded 1,400,000.

2. Programs for very large aircraft, both military and commercial are moving ahead.

3. Scientific satellites will provide data for planning land use, earthquake detection, and better, more rapid location of water pollution.

4. Department of Defense expenditures for aircraft, missiles and space in 1968 were approximately $1,425,000,000.00. Contract awards for aircraft, missiles and space totaled $1,971,000,000.00.

D. An investment in security

1. A method of accomplishing satellite rendezvous in space will be important in advanced space travel; it also provides a means of inspecting suspicious satellites which could be armed.

2. A navigation satellite will be of assistance to all ships equipped to use it; it may also be useful for a submarine seeking a target for its missiles.

E. Law for space

1. As early as 1919 (Relating to the Regulation of Aerial Navigation, Paris) it was realized that it would be necessary to have international regulations on such matters as navigation, registration, flight operations, search, aid, investigation of accidents, criminal offenses, etc.

2. Existing agreements regarding the complete and exclusive sovereignty which a state has over the airspace above its territory did not apply to cosmic space.

3. 1959. The General Assembly of the United Nations established a committee on the Peaceful Uses of Outer Space to prepare an outline for a treaty.

4. The space treaty covers the following points.

   a. Outer space shall be free for exploration and use by all states; also, there shall be freedom of scientific investigation in space.

   b. The establishment of military bases, installations and fortifications; the testing of any type of weapon; and the conduct of military maneuvers on celestial bodies shall be forbidden.

   c. Outer space is not subject to national appropriation.

   d. Astronauts who have landed in foreign territory must be returned to their home countries safely and promptly.

   e. Liability and responsibility for damage arising from space activities are fixed upon the country of origin.

5. The space treaty has been in effect since 1967, but there are many unresolved points which could lead to contention.

   a. The word "peaceful" has never been defined. Does it rule out all military participation, or does it allow nonaggressive activity by members of the armed forces and the use of military equipment?

   b. Certain activities expressly forbidden on celestial bodies are not expressly forbidden in the space between them.

   c. If a country develops a means of rescuing astronauts stranded in space, another country may request such aid if it is needed. The treaty, however, merely provides that the petitioned country provide "all possible assistance." The interpretation of this phrase could mean that nothing would be done.

6. The future of the human race depends on man's ingenuity in meeting the needs of a rapidly increasing population.

   a. Based on current information, it is predicted that, within 100 years, man will not be able to house and feed himself unless he breaks away from Earth.

   b. New sources of energy-producing substances may be sought beyond the confines of earth in order to supplement the forests, oil, coal, iron ore, and other natural resources which are being rapidly and wastefully depleted.

   c. Pollution of the air and water is reaching dangerous levels, and waste disposal is rapidly becoming a serious problem.

7. It is essential to our national security and to the welfare of society in general that technological advances be used to help solve human problems.

   a. The free enterprise system permits the innovativeness and creativity necessary for the application of technology to social problems.

   b. The problems of the immediate future--the population explosion and increasing urbanization--place a tremendous responsibility on the free enterprise system.

IV. Activities

A. Language arts and social studies activities.

1. Read Tennyson's "Locksley Hall." Contrast the traditional ideas of travel of that time with Tennyson's predictions.

2. Conduct research to find out how science, industry, medicine, and society are benefitting directly from aerospace-generated technology.

3. Using current magazines as resource material, prepare a presentation which reports some aspect of aerospace industry in our economy. Graphs, transparencies, slides or other visual materials should be used.

4. Read current magazines to learn about the varying views which government officials hold concerning the development of an anti-ballistic missile system. Present a panel discussion.

5. Read the space treaty. Discuss the need for an international governing body to monitor and control activities in space.

6. Write a satirical poem or essay on "progress."

B. Additional activities

1. Design a dust cover for a book entitled "Beyond Tomorrow."

2. Design a stamp or an envelope cover commemorating some significant event in the exploration of space.

3. Listen to the record "The Planets" conducted by Leopold Stokowski. (Interprets the astrological character of each planet.)

Resource Materials

Books

Above and Beyond; The Encyclopedia of Aviation and Space Sciences, 14 Volumes

Aerospace Technology: Creating Social Progress

Chester, Michael and David McClinton, The Moon: Target for Apollo

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Alouette--Canada's First Satellite (b/w, 14 min.)

America in Space (c, 14 min.)

A New Look at an Old Planet (c, 26 min.)

The Shape of Things to Come (c, 21 min.)

Space Age (b/w, 24 min.)

Tomorrow's World: Beyond the Sky (c, 54 min.)

The World Beyond Zero (c, 28 min.)

Other Media

Space and the Atom Series, "Flight to Mars," (Filmstrip)

The Planets (Record)

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Alouette--Canada's First Satellite (b/w, 14 min.) NASA-Manned Spacecraft Center

America in Space (c, 14 min.) NASA-Manned Spacecraft Center

America in Space: The First Decade (c, 28 min.) NASA-Manned Spacecraft Center

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Father of the Space Age (b/w, 18 min.) NASA-Manned Spacecraft Center

The Flight of Faith 7 (c, 28 min.) NASA-Manned Spacecraft Center

Flight of the Spirit of St. Louis and Friendship 7 (c, 24 min.) Smithsonian Series

The Four Days of Gemini 4 (c, 27 min.) NASA-Manned Spacecraft Center

From Balloon Gondola to Manned Spacecraft (c, 27 min.) NASA-Manned Spacecraft Center

The John Glenn Story (c, 30 min.) NASA-Manned Spacecraft Center

Man in Flight (c, 30 min.) Association Instructional Materials

Man in Space (c, 31 min.) Society for Visual Education, Inc.

The Mastery of Space (c, 58 min.) NASA-Manned Spacecraft Center

A New Look at an Old Planet (c, 26 min.) NASA-Manned Spacecraft Center

Project Echo (c, 27 min.) NASA-Jet Propulsion Laboratory

Road to the Stars (c, 30 min.) North American Rockwell

The Shape of Things to Come (c, 21 min.) NASA-Ames Research Center

Space Age (b/w, 24 min.) Screen News Digest

Ten Years to Remember (b/w, 30 min.) Air Force Film Library

Tomorrow's World: Beyond the Sky (c, 54 min.) Sterling Educational Films Inc.

We Saw It Happen; Wright Brothers to 1960, Parts I and II (b/w, 58 min.) Shell Oil Company

The World Beyond Zero (c, 28 min.) NASA-Manned Spacecraft Center

X-15 Documentary (b/w, 24 min.) Air Force Film Center

Film Clips

The Amelia Earhart Story #230 Pathe News Inc.

American Drops Zep Program #22 Pathe News Inc.

Astronaut Training #331 Pathe News Inc.

Barnstormers Storm U.S. #23 Pathe News Inc.

Byrd Flies Over North Pole #360 Pathe News Inc.

Famous First in Aviation #103 Pathe News Inc.

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1919--NC-4 in First Trans-Atlantic Flight #290 Pathe News Inc.

R.A.F. Over Britain #356 Pathe News Inc.

Ruth Elder Flies Atlantic #153 Pathe News Inc.

San Diego to Hawaii...Non-Stop Flight, 1925 #215 Pathe News Inc.

U.S. Bombers Over Europe #187 Pathe News Inc.

The "Wrong" Brothers #57 Pathe News Inc.

Other Media

"A Ride In a Gemini Capsule" (Filmstrip and Record) Lincoln Public Schools--Audio-Visual

Space and the Atom Series Encyclopaedia Britannica (Filmstrip)

The Story of Flight Coronet Films (Filmstrip)

The Wright Brothers Jam Handy Organization (Filmstrip)

Lindergh's Atlantic Flight International Communication Films (8 mm. Single Concept Films)

The M-2 Spacecraft International Communication Films (8 mm. Single Concept Films)

NASA Art Exhibit Available to Lincoln Public Schools only. (Picture)

TRW Avation Lithographs 12 pictures to a set. TRW Inc. (Picture)

Great Men of Science Series "Issac Newton and Galileo" (Disneyland Records)

I Can Hear It Now 1919-1932; Side 2, Band 2 "Lindbergh's Flight" (Columbia Masterworks-single record)

I Can Hear It Now, Set MM-800; Side 2, "Hindenburg Disaster"; Side 7, "U.S. Declaration of War by Franklin D. Roosevelt"; Side 10, Chaplain Wm. Downey, U.S. Air Force, says a prayer at Tinian before the takeoff of the Enola Gay, which carried the first atomic bomb used in warfare. (Truman's voice.) (Columbia Masterworks)

The Planets, Gustav Holst. Los Angeles Philharmonic Orchestra conducted by Leopold Stokowski. (Capitol Records)

Winston Churchill Speaks (Enrichment World Landmark Records)

World War I Fighter Planes in Action Bill Grauer, Productions Inc. (Record)

Science Packet 3M Visual Products (Transparencies)

DISTRIBUTORS AND PUBLISHERS

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Washington, D. C. 20036

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United States Air Force
8900 South Broadway
St. Louis, Missouri 63125

American Aviation Publications, Inc.
1001 Vermont Avenue N.W.
Washington, D. C. 20005

American Educational Publications
Educational Division of Zerox Corp.
1250 Fairwood
Columbus, Ohio 43206

American Heritage Publishing Co., Inc.
551 Fifth Avenue
New York, New York 10017

Association Instructional Materials
600 Grand Avenue
Ridgefield, New Jersey 07657

Athenaum Publishers
162 E. 38th Street
New York, New York 10016

The Bell System
195 Broadway
New York, New York 10007

Blaisdell Publishing Co.
135 West 50th Street
New York, New York 10020

Bobbs-Merrill Co., Inc.
4300 West 62nd Street
Indianapolis, Indiana 46206

California State College at Long Beach
Long Beach, California 90800

Capitol Records
1750 North Vine Street
Hollywood, California 90028

Childrens Press, Inc.
1224 West Van Buren Street
Chicago, Illinois 60607

Chilton Co.
Book Division
East Washington Square
Philadelphia, Pennsylvania 19106

Columbia Records
1750 North Vine Street
Hollywood, California 90028

Coronet Instructional Films
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New York, New York 10016

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New York, New York 10016

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Dial Press, Inc.
750 Third Avenue
New York, New York 10020

Walt Disney Productions
800 Sonora Avenue
Glendale, California 91201

Dodd, Mead & Co.
432 Park Avenue South
New York, New York 10016

Doubleday & Co., Inc.
501 Franklin Avenue
Garden City, New York 11531

Duell, Sloan and Pearce Publishing Co.
Meredith Press
1716 Locust Street
Des Moines, Iowa 50303

Encyclopaedia Britannica Films
1150 Wilmette Avenue
Wilmette, Illinois 60091

Enrichment World Landmark Records
Enrichment Teaching Materials
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New York, New York 10001

Bill Grauer, Productions Inc.
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Grosset & Dunlap, Inc.
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Kingsport, Tennessee 37660

E. M. Hale & Co.
Eau Claire, Wisconsin 54701

Harper & Row, Publishers, Inc.
49 East 33rd Street
New York, New York 10017

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New York, New York 10017

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870 Monterey Pass Road
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Detroit, Michigan 48211

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4800 Oak Grove Drive
Pasadena, California 91103

NASA-Manned Spacecraft Center
Public Affairs Office AP-2
Houston, Texas 77058

New American Library of World Literature, Inc.
1310 Avenue of the Americas
New York, New York 10019

New Horizons Publishers, Inc.
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Chicago, Illinois 60611

W. W. Norton & Co., Inc.
55 Fifth Avenue
New York, New York 10003

North American Rockwell
Atomic International Division
Public Relations Department
P.O. Box 309
Canoga Park, California 91305

Orion Press
150 E. 35th Street
New York, New York 10016

Palmer Publications, Inc.
Amherst, Wisconsin 54406

Pathe News, Inc.
John C. Smith
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New York, New York 10019

Pelican Press
See Penguin

Penguin Books, Inc.
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Baltimore, Maryland 21211

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Chicago, Illinois 60602

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200 Madison Avenue
New York, New York 10016

Random House, Inc.
457 Madison Avenue
New York, New York 10000

Science Teacher
1201 Sixteenth Street, N.W.
Washington, D. C. 20036

Screen News Digest
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New York, New York 10017

Charles Scribner's Sons
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New York, New York 10017

Shell Oil Company
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Indianapolis, Indiana 46204

Simon & Schuster, Inc.
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New York, New York 10020

Smithsonian Press
Editorial & Publications Division
Washington, D. C. 20560

Society for Visual Education, Inc.
1345 Diversey Parkway
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Sterling Educational Films Inc.
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Taplinger Publishing Co., Inc.
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New York, New York 10019

Time Inc
540 North Michigan Avenue
Chicago, Illinois 60611

TRW Systems Group
TRW, Inc.
One Space Park
Redondo Beach, California 90278

U. S. Government Printing Office
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University of Michigan
Audio-Visual Education Center
Frieze Building
Ann Arbor, Michigan 48104

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Princeton, New Jersey 08540

Vantage Press, Inc.
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New York, New York 10001

Visual Products 3M Company
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Walker & Company
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New York, New York 10010

Franklin Watts, Inc.
575 Lexington Avenue
New York, New York 10010

Wehman Bros.
156-158 Main Street
Hackensack, New Jersey 07601