



## Highways In The Sky: Flight Control

Curriculum Unit 88.06.08  
by Carolyn C. Smith

The unknown has always been a mystery to man. Although experiments and technology have made it easier for us to explore these unknowns, the sky and/or space will continue to fascinate man. There is and always will be the ever present dangers of the air because of the constant changes found in this mass. Man's undying conquest of the sky brings with it the necessity to make it safe for him to maneuver and continue to probe the sky. This unit is designed to share with you the basics of AIR TRAFFIC CONTROL in order to make flying of aircraft safe, enjoyable, quick, and adventurous. The topics listed in the Table of Contents will be addressed with the hope that they will be of great interest to the students. There is that great possibility that one of them may wish to choose a career which would be related to "Highways In The Sky".

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## Introduction

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The dynamic nature of the growth of science and technology in our century, and their impact on society as well as on the individual, are nowhere better evident than in the fulfillment of man's ancient dream to fly through the air. Born within the lifetime of many of us, aviation has also grown. First it was slow and as time went on it became more rapid. Today, it has removed the barriers of space and time between the peoples of the earth. Aviation was one of the earliest of the technologies of this century to require the intimate partnership of scientists, engineers, and industrialists of many skills to accomplish rapid progress at the frontiers of knowledge. No single human mind could comprehend all the knowledge embodied in the design, construction, and operation of a jet transport. Today we have many such difficult and complex technological developments. Included in these developments are nuclear energy, high-speed electronic computers and space vehicles. Keeping in mind all of this, aviation was one of the earliest to move from the individual creation of the pioneer inventor to the product of a new social invention. The design team of specialists working in harmony like the members of a symphony orchestra were able to produce a result far beyond the capability of any individual.

Through the knowledge of many we have become acquainted with navigation and traffic control along the airways. Electronic devices are used to guide pilots through darkness and fog. These electronic devices have been used to improve stability and control aircraft.

When this unit, "Highways in the Sky", is completed the following objectives will be accomplished.

The students will be able to.:

1. discuss how air traffic control can prevent collisions between aircraft in flight.
2. discuss how air traffic control can prevent collisions between aircraft in the taxiing area of an airport and obstructions in that area.
3. discuss how air traffic control can expedite and maintain an orderly flow of air traffic.
4. discuss how air traffic control can provide advice and information useful for the safe and efficient conducts of flights.
5. discuss how air traffic control can notify appropriate organizations regarding aircraft in need of search and rescue aid.
6. discuss how air traffic control can assist organizations during times of disaster and distress. In order for an air traffic control service to be effective the following basic facilities are needed.

Centers—They are used to provide en route and area traffic control services.

Towers—They control traffic on and in the vicinity of airports.

Flight Service Stations—They feed flight plan information into centers and towers as well as provide briefing services to pilots. In general, the Air Traffic Control (ATC) System includes: <sup>1</sup>

1. Aircraft

- 2. Airports
- 3. Navigations and Communications Services
- 4. Airborne and Ground Equipment
- 5. Weather Services
- 6. Rules, Regulations and Procedures

7. Controllers and Pilots The limitations of this unit will not permit me to address all of these topics, therefore, I will concentrate mainly on 1) airports, 2) navigation, 3) weather services, and 4) rules and regulations. I will show you the effects they have on the safety of “Highways in the Sky”.

The teaching strategies of this unit will provide a strong correlation of Reading, Math, English, Science, Social Studies, and Art. The unit is designed to be completed in 4 6 weeks for students of grades 5-8. The abilities, strengths, and weaknesses of the students will increase or decrease the teaching time.

## II. What Is Air Traffic Control?

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Air traffic control is a system designed to ensure the safe, orderly and prompt flow of commercial, private, and military aircraft through the use of communications, navigational aids, and flight rules. The primary purpose of air traffic control is to prevent collisions between aircraft while in the air and during takeoff and landing at airports. (See Diagram Below)

*(figure available in print form)*

The degree of air traffic control exercised by centers, towers, and flight stations depends basically on the weather conditions in which an aircraft is flown. If an aircraft can be flown clear of clouds and the pilot has good visibility, the flight is conducted in accordance with “visual flight rules”. Visual Flight Rules (VFR) flights are subject to little or no control by the ground facilities. The pilots have to make sure they adhere to their assigned altitude. (See Diagram Below) It is the responsibility of the pilot who has been qualified for VFR flight to watch out for the safety of his flight. However, if a flight can’t be conducted in accordance with VFR, it must be conducted under “instrument flight rules” or (IFR). The ground facilities exercise positive separation control over all flights of this nature.

*(figure available in print form)*

Air Traffic Control is a responsibility of national governments. In the United States, Air Traffic Control is assigned to the Federal Aviation Administration (FAA). The FAA is an agency of the Department of Transportation. In Canada, the Air Transportation Administration provides this service.

Airplanes travel highways in the sky. They obey traffic signals and follow traffic laws much as automobiles do. Air Traffic Control might not seem necessary since the sky extends from horizon to horizon and up to outer space. In bad weather, however, airplanes that are allowed to fly at any altitude or along any course might collide. Even in good weather, the many planes landing at an airport might cause a traffic jam.

Air Traffic Control is necessary to make flying safe as well as to avoid delays. The regulation of airplanes along airways, or air routes between airports is called air-route traffic control. Controlled air space at an airport is called a control zone.

### III. The Start of Air Traffic Control

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In the beginning, the air traffic control was an attempt to organize flight operations through the application of rules, regulations, and procedures. These rules were supposed to be carried out by pilots and were mainly derivations of existing ground and marine rules of the roads and water. Since the earlier flights were of short duration the rules basically were to enforce a “keep to the right” connotation. The early development of the airplane in Europe made it apparent that there should be a more standardized means of enforcing air traffic rules. This came about to facilitate a larger number of aircraft in different countries. At the Versailles Peace Conference in 1919, following World War I, the International Convention for Air Navigation was agreed upon internationally. As a result of this meeting, the International Commission for Air Navigation (ICAN) was created to develop the general rules and regulations for air traffic. <sup>2</sup>

Perhaps the grandfather of today’s Instrument Flight Rules was the following ICAN admonition: “Every aircraft in a cloud, fog, mist, or other condition of bad visibility shall proceed with caution, having careful regard to the existing circumstances.” <sup>3</sup> Since ICAN existed as the only international agency concerned with the operation of aircraft, its rules and procedures were applied in most countries where aircraft were operated.

The United States was not one of the signers of the ICAN convention, however, it followed some of the concepts when it developed a program to established air traffic rules for the navigation, protection and identification of aircraft. It included rules as to safe altitude of flights and rules for the prevention of collisions between vessels and aircraft. In 1927, a program was inaugurated to establish a Federal Airways System, a network of radio beacons and later a similar network of four-course low frequency radio ranges were laid out to connect principle cities in the United States. <sup>4</sup> The installation of light beacons was a major part of this program. These lights were used to assist in the identification of airways at night.

The first airway traffic control center was established at Newark in 1935 for the main purpose of providing a unified coordination mechanism to handle the airline traffic for the Chicago, Cleveland, and Newark airports. <sup>5</sup> The Newark Center was used as a training ground for personnel scheduled to operate the three centers under the cooperative plan of the airlines. In April of 1936, the second center was placed in operation in Chicago, and the third at Cleveland during the month of June during that same year. (See Diagram Below)

*(figure available in print form)*

## IV. The Users of Air Traffic Control

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Flying is now an important part of life and progress. In today's society, airplanes, military aviation, and aeronautical industry are now taken for granted. It is quite strange to realize that at the beginning of the twentieth century these things were unheard of. Ever since two planes problems in the sky just as on the ground. Those problems have been eliminated through the development of the Air Traffic Control System. Who are the primary users of the airspace? They are classified as: 1) air carriers, 2) general aviation, and 3) military. Each of these users contains subcategories identified by various types of transportation application. Air carriers provide scheduled service to the general public for hire. Air carriers put forth great efforts to meet their schedules on time at their predetermined arrival points. They follow the instrument flight rules at all times, regardless of the weather. There are three subcategories of the air carriers. The first one is the trunk air carrier which is the large jet aircraft. These usually travel in a range of 1000 miles or more with a minimum of 150 passengers. The second subcategory is the regional. These air carriers basically serve medium size communities with a flight distance between 500-1000 miles. Their flight time is about 1-2 hours with a passenger capacity of 125 or less. The third subcategory is referred to as the short haul air carrier. These carriers are also referred to as your commuter flights. Their main use is to satisfy the needs of both metropolitan and rural communities. The short haul service may operate into an existing city jet port or a central business-district landing facility. Our growing population along with suburban cities are calling for a large number of short haul air services.

General aviation is comprised of personal flying, business flying, commercial flying, and instructional flying. The progress of general aviation has been rapid due to encouragement and lack of restrictive regulations by the government.

The effect that military operations have on Air Traffic Control Systems all over the world is extremely varied. The reason for this is the priority of the operation. The military services usually provide their own air traffic control service within reserved areas. They also have their own airports. Military air traffic controllers in the United States meet qualifications similar to civilian controllers. The volume of military air traffic fluctuates according to the political situation at any given location and time. A form of military airspace reservation which is used extensively in the United States is the Central Altitude Reservation Facility (CARF). It is operated by the FAA with the full responsibility to coordinate and to approve altitude reservations in the airspace of the continental United States and its possessions. It also deals with the Air Traffic Control facilities of foreign countries. <sup>6</sup>

## V. Basic Procedures of Air Traffic Control

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The control of air traffic follows many concepts similar to those involved in the control of land traffic. They both have the same basic objective the prevention of collisions between vehicles involved. An efficient Air Traffic Control System would be one in which aircraft flow is restricted only by volume and not by limitations of the system. There are two principle methods which have been employed to provide protection from the hazard of collisions between aircraft. <sup>7</sup> The first method is based on the concept that when aircraft are being flown in weather conditions where pilots can see and be seen, the individual pilot is responsible directly for avoiding collisions with other aircraft. This follows the same connotation that each automobile driver looks out

for other traffic.

The other principle method relies on the ground based Air Traffic Control Management Service. This service is designed to provide separation between aircraft operating in accordance with the instrument flight rules, primarily when weather conditions don't warrant the pilot to see and be seen. The system then provides instructions to the pilot as to altitudes and flight paths to be followed. (See Diagram Below)

*(figure available in print form)*

One important factor of the Air Traffic Control System is reliability. This means that equipment such as aids to navigation, radar, and communications must be properly maintained to meet the needs of the user. As you can very well see, the Air Traffic Control System depends upon the cooperation of both the pilot and the controller.

The provisions of Air Traffic Control Service throughout the world are applied in various degrees. A lot depends on the needs and the capability of each country to supply those services needed. As sophisticated as the world has become, there are many portions of the world's airspace and many airports which have no form of Air Traffic Control Service.

Those facilities providing area or en route control service are usually the same everywhere. These centers are provided with a complex communication network which connects them to all the airports and other aviation facilities which are within their area as well as adjacent centers. The workload of the controllers can be heavy at times. In order to maintain a controller's workload at a level in which he can handle or maintain, the centers are divided into sectors. This airspace is a defined geographical area which is made up of a number of airways or routes, airports, and navigation aids. Each sector is assigned a certain number of controllers and assistants who are responsible for all aircraft in their designated sector. During periods of low traffic density, provisions are made to combine sectors. (See Diagram Below)

*(figure available in print form)*

Flow control has been developed over a number of years as a method of monitoring the flow of air traffic into busy airports. The main objective of the flow control service is to regulate or restrict the flow of Instrument Flight Rule traffic within an affected area. It also regulates or restricts air flow at a specific altitude. Flow control forecasts are issued from time to time to indicate the anticipated delays expected during given periods of time. Flow control normally is applied when 1) arrival delays will exceed 15 minutes and are expected to prevail for an extended period of time; 2) when route segments require prevention action to avoid traffic jams; 3) when traffic flow is disrupted due to a breakdown of navigation facilities; or 4) where weather conditions have caused excessive delays in executing normal landing procedures.

The control of air traffic on or in the vicinity of the airport is provided by an airport traffic control tower. For the most part towers are located on top of a high building. The controllers are able to observe aircraft movements anywhere on the airport surface as well as the surrounding airspace. The lookout point of the building is sometimes referred to as the tower cab. It is a completely enclosed glass room. The size of the tower cab depends on the number of controllers who will operate from it. (See Diagram Below)

*(figure available in print form)*

Those departing aircraft are given instructions regarding when and how they may taxi from loading ramp to the runway. They are also given instructions of takeoff clearance when the pilot is ready and the traffic at the airport permits. Arriving aircrafts are handled by the same control tower in a similar manner by clearing the aircraft to land and by issuing appropriate taxi instructions to guide the aircraft to its unloading point.

Some airports are very busy and they utilize the Automatic Terminal Information Service (ATIS) to give instructions to pilots of departing and arriving aircraft. This service consists of a continuous radio broadcast on a special frequency of recorded and periodically updated noncontrol congestion and controller workload. This broadcast includes information regarding altitude, visibility, wind directions, wind speed, altimeter settings, and runways in use.

## VI. Airports

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Airports play an integral part of the Air Traffic Control System in order to provide adequate service to the public. This adequacy makes it possible for air transportation to bring its vital contributions to economic development and progress to the greatest number of people throughout the world. The efficiency of the Air Traffic Control System is directly affected by the adequacy of the landing and takeoff areas. Airports must constantly be improved in order to accommodate new aircraft as well as the expanding air traffic volume. Unless airports' progress keeps pace with all of the technological advances in aviation, airports can become one of the most serious bottlenecks in the path of efficient and safe air transportation.

Generally, airport capacity does not keep up with the demands of the world's increasing air traffic. This deficiency has the direct effect of causing delays in the arrival and departure of aircraft which can vary in proportion to an airport's particular deficiencies. There may be several solutions to solve this problem, however, an easy solution to the delay problem is to limit the volume of air traffic which can use the airport under specified conditions or periods of time. This perhaps would not eliminate the problem completely but could provide less frustration to the consumer.

Another factor in measuring the adequacy of airports is the efficiency of an airport and related facilities in handling the flow of passengers and cargo to and from the arriving and departing aircraft.

Over the years the airport has become a focal point in urban economic growth. Its importance in this area will continue to increase. Many cities and towns have developed around transportation terminals which were in great use at a given time. Also many smaller rural airports are being developed to take care of the needs of suburban communities. There are many commercial and industrial complexes which have been developed near metropolitan airports. Airport industrial parks have been constructed where corporate aircraft have access directly to their business establishments. Regardless of the size and location of an airport, air traffic control service is essential. All airports must provide runways and taxiways as well as landing and takeoff areas adequate enough to handle the aircraft which will be using the facilities. The parking areas for aircraft and automobiles must also be sufficient to handle the anticipated traffic. In general, the design of an airport must look toward the future use of its complex based on geographic location and possible increase of industrial and population demands.

When an airport is being designed there are certain elements which have to be considered for such a complex structure. Those elements are: 1) access facilities, 2) passenger and cargo handling buildings, 3) airport airside to accommodate different categories of aircraft such as CTOL, RTOL, STOL, and VTOL, and 4) terminal airspace which involves airport accessibility, airspace restrictions of traffic patterns which might conflict with neighboring airports and airspace to facilitate arriving and departing aircraft. The characteristics of these elements determine the airport's capabilities and efficiency of the total Air Traffic Control System.

Airports have grown worldwide as the result of widespread use of air transportation. As air traffic continues to increase there will be a great demand for additional conventional airport to absorb some of the traffic which will also increase. Real estate for large jetports is becoming less available and more expensive especially in the densely populated areas where they are needed. We are slowly but surely running into a serious problem for the future. The design and operation of the Air Traffic Control System will need to keep pace with the inevitable growth in airport production which will be taking place as the demand for air transportation services continue to increase.

The International Civil Aviation Organization has set standards as a guide to member countries for classifying landing operations in accordance with specified weather minima. The Air Traffic Control System play a major role in the safety of passengers and aircraft during inclement weather. We as a society don't see their importance until we are caught in the middle of our own scheduled delayed flight or a loved one's scheduled flight during such disastrous time. Knowing the affects of weather and flying will open our eyes to many unanswered or mysteries of the sky.

Navigators of the sea, land, and air depend on the weather to get them from a departure point to an arrival point safely and on time. Before the advancement of technology as we know it today, we did more flying during the summer months. As man expanded his distance and area, it was important to know the weather conditions in all the zones of the world.

A good pilot has the training and skills to fly cross country. National weather stations are able to keep controllers abreast with the conditions for good flight control. Pilots are sensitive to seasonal changes in the sky because they are the ever-changing balance of nature. Knowing the weather conditions and wind directions enable the pilot to fly leisurely around storms instead of trying to punch holes through them.

One concept which we must keep in mind is the fact that air pressure drops more quickly with altitude in a high pressure cell than in a low pressure cell. This decrease or increase in pressure affects the speed of the wind. As a result of the change in pressure there are winds in the upper troposphere that reach speeds greater than 250 mph. These winds are generally found between 35,000 and 40,000 feet above the ground and are called the jet streams. <sup>8</sup> (See Diagram Below) These jet streams were discovered by high flying pilots during World War II, when they found themselves being blown violently off course or pushed forward at twice the speed at which they were supposed to be flying. It has been noted that one hapless pilot found himself flying directly into an oncoming jet stream and standing still in midair.

*(figure available in print form)*

Differences in pressure make the wind blow. Differences in temperature create differences in pressure. Differences in humidity causes differences in precipitation. All of these differences are very important to the weather process. Pilots are aware of these differences. The meteorologist of the Air Traffic Control System is of great help in advising pilots through turbulent weather changes.

## **VII. Conclusion**

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As you can see visiting and working in places near and far have become a way of life in today's society. As we travel through the time machine from the past to the future, there is much knowledge that we have to rely upon and much more that we have to study and/or experiment with if we are to avoid disaster. Air Traffic Control and its updated facilities have and will continue to provide for us the safety factors we need to know in



order for us to continue to make the progress we are making. There is no sure proof answer to avoid accidents but knowing that there are rules and regulations for us to follow gives us confidence when we make our plans to travel to our destinations in the shortest and safest time provided. Let us continue to forge forward and remember: "Safety depends on the cooperation of all personnel involved as we travel especially *The Highways in the Sky*".

*(figure available in print form)*

## VIII. Teaching Strategies

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### Sample Lesson

*Air Traffic Control*

**Objective** *The students will be able to discuss the primary purpose of Air Traffic Control.*

### Materials Needed

Newspaper

Vocabulary:

collision, aircraft, visibility, facilities, control, routes, traffic, communication, navigation, rules, and regulations

### Brainstorming Questions

1. Why is it important to follow the rules of walking to your right in hallways or drive in the right lane of a two-way street?
2. Name a situation in which you did not follow a rule and you were hurt or someone else was hurt as a result of it.
3. Other than an accident, name three causes of traffic jams.

**Procedures** *Introduce the vocabulary to the students to make sure they understand the meaning of those words.*

Discuss with the students the purpose of following rules in general. Direct the students to the concept that if rules are not properly carried out by everyone, it could be dangerous and in some cases fatal.

Make sure the students understand that ever since the Wright Brothers' experiment with flying an aircraft, there has been a need to control the traffic in the air. Discuss with the students the objectives of the Air Traffic

Control listed in the unit.

### **Related Activities**

1. Have the students to set up rules for their classroom which could prevent accidents from happening.
2. Have the students to bring in articles from the newspaper of accidents and discuss what could have been done to avoid them.
3. Plan a field trip to Tweed Airport to see their Air Traffic Control System in operation.
4. Plan a field trip to Bradley International Airport to see their Air Traffic Control System in operation.
5. Plan a field trip to visit the Aircraft Museum located in Hartford.
6. Construct a model of an Air Traffic Control System for display in the classroom.

### **Sample Lesson**

*Usage of Air Traffic Control*

#### **Objectives The students will be able to:**

1. identify the basic users of Air Traffic Control.
2. identify the three subcategories of air carriers.
3. identify the categories of general aviation.
4. identify the purposes of military carriers.

#### **Materials Needed drawing paper and colored pencils**

**Vocabulary jets, commuter, schedules, categories, aviation, carrier, regional, short haul, metropolitan, rural, and capacity**

#### **Brainstorming Questions**

1. How long do you think it would take you to travel from New Haven to Los Angeles, Hartford, Washington, D. C., New York City, London, Philadelphia, and Seattle?
2. Would you be able to fly directly to those places from New Haven? Why or why not?
3. Have you ever taken a trip on a plane?
4. What kind of plane was it? (size, jet, commuter)

5. How long did it take you to reach your destination?

**Procedures** *Introduce the vocabulary above. Discuss the basic users of airspace -(Air Carrier, General Aviation, and Military). Make sure the students are aware that there are three subcategories of air carriers. (Trunk, Regional, and Short Haul) Discuss the differences of these types of aircraft. Point out the size of the aircraft, the maximum distance they usually fly, and the maximum number of passengers they carry. At this point the students can be told why Tweed New Haven Airport is considered a small airport and it only accommodates regional and short haul carriers. Display for the students pictures of the different types of aircraft so they will be able to see the difference in their structure and size. Allow the students to make a drawing of some of the aircraft.*

### **Related Activities**

1. Divide the students into groups of three or six. Allow each group to choose an aircraft or you may assign them one of the three users of Air Traffic Control. Using art paper, papier maché, or modeling clay, allow each group to construct a model of the aircraft they have chosen. Give their finished product an original name.
2. Write an imaginary history of their aircraft giving credit to the designer and the builder. Display their creations as a *Mini Aircraft Museum* .

### **Sample Lesson**

*Airports*

**Objectives** *The Students will be able to:*

1. discuss how airports are designed to accommodate specific aircraft.
2. identify some major airports in the world.
3. identify that the overall efficiency of the Air Traffic Control System is directly affected by the adequacy of the landing and takeoff areas of airports.

**Materials Needed** *Library Resource/Reference Materials*

**Vocabulary function, terminal, taxiway, runway, landing, takeoff, capacity, facilities**

**Brainstorming Questions**

1. Have you ever been to a major airport?
2. Do you have any idea how and why airports came to be?
3. Why do you think airports play a major part in the Air Traffic Control System?

**Procedures Introduce the vocabulary to the students. Explain to the students that the design and function of airports play an important role of our modern society. Discuss with them that the major function of the airport is to accommodate the demands of a metropolitan or rural community. Point out to them that the largest and busiest airport in the United States is O'Hare located in Chicago, IL.**

Have the students to complete the chart below concerning the leading airports of the world.

Newark International	John F. Kennedy International		
O'Hare International	Bradley International		
Dulles	Montreal		
London	Orly		
Shannon	LaGuardia		
NAME	LOCATION	NUMBER OF PLANES HANDLED A DAY	SPECIAL COMMENTS
O'Hare Chicago		Over 2,000	Largest and busiest airport in the U. S.

**Related Activities Have the students to develop a Jeopardy Game Show using the information gathered from the chart.**

**Sample Lesson**

*Aviation Careers*

**Objective The students will be able to recognize some of the careers that are associated with aviation.**

**Materials Needed Library Resource/Reference Materials**

**Vocabulary career, aviation, reference, resource, qualification**

**Brainstorming Questions**

1. What would you like to be when you grow up?

2. What would you have to do to be prepared for that career?
3. How many years do you think it would take you to achieve that goal once you have graduated from high school?

**Procedures** *Introduce the vocabulary to the students. Tell the students that their classroom is going to become an imaginary college. Each one of them is studying for a career which deals with aviation. List the following careers on small pieces of paper and allow the students to pull a career to research.*

Flight Surgeon      Meteorologist  
Traffic Engineer    Plane Designer  
Pilot                Plane Builder  
Ecologist            Aerial Survey Flying  
Flight Dispatcher   Border Patrol  
Aircraft Mechanics Flight Tester  
Stewardess        Aerial Archeologist  
Nuclear Physicist   Air Traffic Controller  
Airport Personnel (Such as clerks, ticket agent, airport manager)

After they have chosen a career have the students to utilize the school or public library to answer the following questions about their chosen career.

1. How long were you in school?
  2. Where did you go to school?
  3. What are your duties at work?
  4. Do you travel a lot with your career?
  5. Do you have to wear special clothes?
  6. How much money do you make doing your job?
  7. Is it easy for you to change to another job dealing with aviation?
  8. Would you encourage other people to choose the same career as you have chosen? Why or why not?
  9. In real life would you choose this career? Why or why not?

**Related Activities** *Share these reports with the class. Also add them to the display in the Mini Aviation Museum.*

### **Sample Lesson**

*Geography: Latitude and Longitude*

**Objective** *The students will be able to identify lines of latitude and longitude on a map and/or globe.*

**Materials needed** *Wall map of the world, outline map of the world showing the equator and the prime meridian, colored pencils*

**Vocabulary** *latitude, longitude, parallel, prime meridian, equator, vertical, horizontal, North Pole, South Pole, hemisphere, north, south, east, and west.*

### **Brainstorming Questions**

1. If you are leaving New Haven on your way to Florida, what direction would you travel?
2. Using the prime meridian and the equator, how many parts is the world divided into?
3. What part of the world do you live in?
4. What continents do you find in each hemisphere?
5. What continent(s) is (are) located in all four hemisphere?

**Procedures** *Introduce the vocabulary to the students to make sure they understand the meanings of those words.*

Discuss with the students that parallels of latitude are imaginary circles that are parallel to the equator (0° latitude). Any point on one of these circles has the same latitude. Meridians of longitude are imaginary circles that pass through the North Pole and South Pole.

Inform the students that north latitude is measured north of the equator and south latitude is measured south of the equator. Point out that the west longitude extends from the prime meridian (0° longitude) westward halfway around the Earth to the International Date Line (180° longitude). The east longitude extends eastward from the prime meridian to the International Date Line. The letters N. and S. indicate north and south latitude and the letters E. and W. indicate east and west longitude.

### **Related Activities**

1. Have the students to use their desk outline maps to draw the equator and the prime meridian. Use a color code to identify the sections.

2. Have the students to identify the continents which are located in each part.
3. Have the students to tell what part of the world each of the following places are located.

Washington, D. C. Stockholm Sydney  
Egypt London Paris  
Brazil Hawaii Nigeria

## **IX. RESOURCES**

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Aviation Education Staff, GA-20

Office of General Aviation Affairs

Federal Aviation Administration

Washington, D. C. 20590

National Aerospace Education Association

Room 333, Shoreham Building

806 15th Street N. W.

Washington, D. C. 20005

Air Age Education

Cessna Aircraft Company

P. O. Box 1521

Wichita, Kansas 67201

Civil Air Patrol

Director of Aerospace Education

National Headquarters

Maxwell AFB, Alabama 36111

## **X. GLOSSARY**

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ATC—Air Traffic Control

CARF—Central Altitude Reservation Facility

CTOL—Conventional Takeoff and Landing

FAA—Federal Aviation Agency/Administration

FAR—Federal Air Regulations

ICOA—International Civil Aviation Organization

ICAN—International Convention for Air Navigation

IFR—Instrument Flight Rules

ILS—Instrument Landing System

RTOL—Reduced Takeoff and Landing

RVR—Runway Visual Range

STOL—Short Takeoff and Landing

TCA—Terminal Control Area

UHF—Ultra High Frequency

VFR—Visual Flight Rules

VHF—Very High Frequency

VLf—Very Low Frequency

VOR—Very-High-Frequency Omnidirectional Range

VSI—Velocity and Steering Indicator

V/STOL—Vertical and/or Short Takeoff and Landing

VTOL—Vertical Takeoff and Landing



## **XI. STUDENT'S ANNOTATED BIBLIOGRAPHY**

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Dean, Jennifer Brooks. *Careers With An Airline* . Lerner Publications Company. Minneapolis. 1975.

This book gives a brief introduction to the various careers available with an airline. Included in those careers are pilot, reservation clerk, tower agent, hanger mechanic, radio electronic mechanic, computer programmer and many other occupations.

Flohert, John J. *Aviation From the Ground Up* . J. B. Lippincott Company. New York. 1957.

This is the gleaning of a reporter who has seen aviation grow from a precarious sport to one of the world's most vital industry. It is a story that has resulted from one of the author's most thrilling assignments.

Rosenblum, Richard. *Wings: The Early Years of Aviation* . Scholastic Magazines, Inc. New York. 1980.

This is an illustrated history of airplanes from the days of the early aviators through the beginning of World War II. It discusses the pilots, their uniforms, famous planes, blimps, insignias, air races and circuses, passenger service and many other

related topics.

Ruthland, Jonathan. *See Inside An Airport* . Warwick Press. New York. 1978.

This book discusses the history, design, and construction of an airport.

Shay, Arthur. *What Happens When You Travel By Plane* . Reilly & Lee. Chicago. 1968.

This book gives you the view and excitement of a plane ride from a child's point of view.

Sikorsky, Igor I. *The Story of the Winged S* . Dodd, Mead & Company. New York. 1967.

This book is an autobiography with late developments and illustrations of the helicopter.

Wiesner, David. *Man From The Sky* . Warwick Press. New York. 1980.

In an almost fail proof scheme, a man parachutes from an airplane with a large amount of stolen money, only to be seen by a boy who has a reputation for seeing things in the clouds.

## **XII. TEACHER'S ANNOTATED BIBLIOGRAPHY**

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This book is about the complicated subject of weather especially for pilots by a pilot who is widely experienced in many types of aircraft from gliders to jets.

Buckwalter, Len. *The Pilot's Night Flying Handbook* . Garden City. Doubleday & Company, Inc. 1976.

This is a complete illustrated guide to the techniques and safety procedures of night flying for the private pilot.

Coombs, Charles. *Survival in the Sky* . United States. William Marrow & Company. 1956.

This is a completely honest and authentic book about the human factors involved in high speed and high altitude flight and their dependency for safety.

Dwiggins, Don. *The Sky Is Yours* . Chicago. Children's Press. 1973.

This book explores the many careers and hobbies open in general aviation. It also discusses the principles and challenges of building and/or flying a plane.

Gilbert, Glen A. *Air Traffic Control: The Uncrowded Sky* . City of Washington. Smithsonian Institute Press. 1973.

This book deals with the Air Traffic Control Team-Past, Present, and Future. It helps us to see how Air Traffic Control will be able to convert the unlimited potential of airspace into transportation capability that truly can be called the "uncrowded sky".

Hirsch, S. Carl. *On Course! Navigating in Sea, Air, and Space* . New York. The Viking Press. 1967.

This book leads the reader easily from the earliest and simplest Problems to the complex ones encountered by navigators of the sea, air, or space.

Steven, H. Guyford and James J. Haggerty. *Flight* . New York. Time, Inc. 1965.

This book deals with the world of manned flight from its primitive beginnings through the sophisticated present to the science-fiction future.

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