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Come Fly With Me—An Invitation to Flight: Its History Science, Careers and Safety

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by Benjamin A. Gorman

The age old human wonder at birds soaring, flying free from the earth's grasp . . . the dreams of how humans could imitate flight . . . the inventors' imaginations that sketched fantastic flying machines . . . the experiments, the models, the balloons, the gliders—all were a prelude to December 17, 1903. The ability of flight, once reserved for the birds was then made possible for human experience by the brothers Wright. A new chapter in human progress was begun and this achievement would help shape the modern world. In a single life time, people were released from earth bound travel and were able to journey towards the stars. A topic dealing with achievement of human flight would find a natural home in a science class. Yet there is a social studies ”apartment” in which the study of flight can dwell. The textbook, *The Western Hemisphere* by Drummond and Hughes provides information on the development of American resources, transportation and industry; it relates the major role that they play in helping shape our landscape and our society. This represents the possibility of expanding on the role of transport by closely examining flight—its history, its industry and its impact upon modern society. Thus the interesting opportunity exists whereby history and technology can be combined. Science could be understood within the context of history and present social concerns could be used to explore future technology.

Come Fly With Me is an invitation to the realization that airflight has some a common element in American life. A study of air travel history and what makes air travel possible may help students expand their view of the world. Students may not become pilots, privately or professionally, but they need to be aware of the skills and knowledge needed to obtain a pilot's license. The students should realize the changes brought by the airplane, issues concerning safe flying and the legacy left by the Wright brothers. As Melvin B. Zisfein remarks in his forward to *The Wright Brothers* , "By their triumph, they changed both our world and us dramatically—and for all time."

This unit is designed to be used with upper eighth grade social studies classes in conjunction with the textbook, *The Western Hemisphere* .

The unit's objectives are:

1. to present an overview of the early history of flight and the Wright brother's achievement.

2. to become aware of aircraft instruments, atmospheric factors and pilot qualifications.

3. to identify post-Wright brother achievements in air travel and to investigate air travel safety. The story of the Wright brothers is an exciting beginning because they were the first to make the dream of human flight with power of reality. Others, such as Lilienthal and Chanute, had flown gliders which in a sense went "down-hill"; they were not sufficiently light to "soar". The Wright brothers achieved first: powered, sustained (landing above or at the starting altitude), and controlled flight which was especially unique with them. The brothers were brilliant flight researchers who put theory into experimentation and realized the first successful airplane.

Ever since, scientists, technicians and pilots have been improving, learning and training; the have been expanding the realm of flight for commercial, military and public interests. Science and its engineers have developed the technology, decade by decade, creating an industry in which the pilot has become an airship captain. As children of the air age, students must understand that aviation has changed the way that we live in our society. They must be aware of the social concerns that air transportation has raised for the environment. As well, they should learn of opportunities in aviation and be conscience of questions of personal safety in the air. Through this unit, students can become acquainted with the science of aerodynamics and technology making history.

Teacher Notes

Because the subject of flight is a vast topic, this unit deals with three major concepts—the Wright brother's achievement, the role of the pilot and aviation developments. Related concepts include the science of flight, career awareness and air travel safety; they allow the presenter opportunity to expand according to student interest. For each topic, there is introductory information and a fictional story that relates to the human element with follow-up questions. Subsequent information, some of which can be duplicated, can be used for continued discussion; as well, there is an activity to reinforce student learning. The material can be taught in a six to eight day block depending on the class and on whether the activity sheets are assigned for homework. The teaching of this unit should take place before the material in the text, *Western Hemisphere* , on the aircraft industry is covered. The class activities and stories may also be given to students using *The United States and the Other Americas* (1885 edition) when the section "Coming of Airplanes" page 206 is taught. To open the unit, the section on technology presents the framework by which social studies and science can be combined; it provides for immediate student involvement with the topic and serves as an introduction to flight as a remarkable achievement in human transportation.

To sharpen the focus and increase interest, the three fictional stories, which can be duplicated, give students a "you are there" perspective. First, from the "Watchers", students might learn of that historic moment of December 17, 1903 and peak their interest in how planes fly. In the second story, students may become acquainted with the roles of the flight crew and how an in-flight emergency is solved. Lastly the story of the "Travelers" reveals in brief an airport experience while providing history and introducing the issue of air safety. These vignettes will be read against the background information provided by the teacher and lead into related topics and activities.

* * *

***Technology* . . . .Start your engines**

Technology includes the tools and techniques that people develop to help them get what they need. The spark of human genius is kindled by technology into the fire of civilization; it allows mankind to exist in and to conquer nature' s world. From doorknobs to calculators, technology moves our progress forward, not always enhancing, but always changing our lives and our environment. At this point, it may serve the students to take a closer look at technology. The word is often used to refer to such devices as computers, lasers or other complex machines, but simple devices such as pens, hammers, safety pins and pencil sharpeners are examples of technology. The students may be asked to list examples of technology that they use. It might prove interesting for them to reveal and discuss their examples. The object is to identify tools and techniques that change simple actions. It should be noted that technology is more than just tools and methods; it is arithmetic, traffic tickets, banking and even rain dances. We can hardly make a move that is not affected in some way by technology. As it changes, so do our lives.

Students growing up in the late twentieth century American society often do not notice how technology affects their behavior. We live so close to it or it has become too ordinary for us to reflect much about it. A way of realizing how our actions might be affected ia to consider how tools and techniques have changed the way that we live. Students can speculate on how human behavior has been changed by the technological developments of:

1. Instant replay as opposed to spectator speculation.

2. Microwave ovens as opposed to gas or electric ones.
3. Weather forecasts as opposed to the use of weather vanes.

4. Antibiotics as opposed to natural herbs and tonics. The next step would be to investigate how life may be different without a particular tool. The objective is to examine the relationship between technology and human behavior patterns. Students can be asked to react to the affect on their lives with the absence of:

1. A refrigerator.

2. Motorized vehicles.
3. Timekeeping devices.

4. Electricity. This exercise in the subtraction of technology will demonstrate how much taken for granted technology has become in our lives.

As a final lesson, a look into the future could underline how people adjust their behavior to new technology. Consider this scenario borrowed from Isaac Asimov.

Your city is without cars, buses, trucks or trains. Instead of sidewalks and streets upon which to travel, there are moving strips or belts arranged side-by-side. The outside strip moves the slowest and can be stepped onto from a stationary platform. The center strip moves faster up to 50 miles per hour.

Ask the students:

1. When would it be best to learn how to use this transport?

2. What skills would be needed?
3. How would you know and give directions?
4. What would be the benefit of no cars or buses?
5. What would be the affects upon parking, traffic congestion, police and crime, shopping and going to school?

6. How would the lack of other transportation affect life in the city? The technology of transportation, an element of the Industrial Revolution, has propelled people through a series of developments in travel on land and water. The canal systems, steamboats, railroads, trucks, autos and other motorized vehicles have been achievements in moving materials and people, in spreading social habitation and in influencing cultural interaction. Each step forward and every improvement resulted in faster, more efficient and more comfortable modes of transportation. As these remarkable advancements were fulfilling their potentials, dreamers and technicians were working to unlock yet another door for human travel—the world of aviation.

The Industrial Revolution of the 18th century redefined human work by introducing power machines. Beside the increasing urbanization due to the factory system and the social-economic benefits, a new class of self-trained inventors emerged. Eli Whitney, Samuel F. B. Morse, Thomas Edison, Elisha Otis, Henry Ford and other gave innovation to machines and methods that sustained the growth of modern technology. To the list of genius inventors, the names of Orville and Wilbur Wright would be added because of their technological triumph.

* * *

The Wright Brothers **. . . .Prepare for take off**

On the eve of the twentieth century, Americans were fascinated with speed, national growth and the productive miracles of applied science. The publics' love affair began when a single-cylinder "motor carriage" chugged its way down the streets of Springfield, Massachusetts in 1893. Its builders were Frank and Charles Duryea, who incidentally were bicycle mechanics. At the same time, there was great interest in aeronautics. Humane like other animals had the capability to walk, crawl, run and swim, but had been denied the means to fly at will. The centuries were full of poets give humane the ability of flight. Four hundred years earlier, Leonardo da Vinci (145215-19) had studied the flight of birds, the movements of the air, and designed several flying machines. He recorded that "a bird is an instrument working according to mathematical laws which it is within the capacity of man to reproduce." His drawings of birds includes notes on lift, thrust, equilibrium, steering and stability. He evaluated their wing design by dissecting the bird's body and concluded that an angular blade with net inserts would overcome air resistance. But da Vinci's imitation of bird flight proved unsuccessful; he concentrated on human power instead of power generated by machines. The drawings in his note book reveal strange flying machines—men running like hamsters on a wheel to give power and oarlike wings that flapped up and down to provide lift. The failure to launch his flying machines led him to abandon muscle-powered flight. Yet da Vinci's achievements remain as the first scientific study of flight. Among his elaborate fantasies can be found his vision of the parachute, a helicopter like aerial screw and retractable landing gear. Da Vinci, the giant among geniuses, knew that human flight would be realized through engineering but it would be the technology of a different age that would make his visions come true.

For more than a hundred years before the Wright brothers' success, other pioneers had attempted flight successfully in balloons and in gliders. Sir George Cayley, in England at the turn of the 1800's, suggested the first modern airplane configuration of fixed main wings, a tailunit with elevator and rudder, and a separate propulsion system. Cayley deserves the title "Father of Aerial Navigation. " In the 1870's Hermann von Helmholtz concluded that man had a poor chance of flying by using his own muscle power. His study of the wings of birds showed that curved surfaces were more advantageous. This was confirmed by Otto Lilienthal in Germany by his glider experiments; he also discovered that natural wind is better than a uniform airflow due to a cross-velocity gradient that exists in the lower atmosphere. Lilienthal's work on hang gliders using his recently developed air pressure data benefited a growing enthusiasm for aeronautics. In the United States, the French born, engineer Octave Chanute spread interest in aviation through his lectures and manned glider tests. Samuel P. Langley made successful tandem-wing, steam powered models with wing spans up to fourteen feet. In 1903, he attempted to catapult launch an "Aerodrome" but it plunged into the Potomac River because it was underpowered and complicated by a launch system that added to the structural load.

The Wrights began so experiment with kite-like gliders in 1900. They devoted themselves to detailed study of the earlier engineering experiences; the Wrights' ability to learn the most from the lessons of the past was one of the marks of their genius. They sought advice from Langley and from Chanute who became a close associate in the science of aeronautics. The Wrights were not professional scientists but they became familiar with the practical aerodynamical ideas developed by others. Their early gliders were models of Chanute's biplane designs. Their work used Lilienthal air pressure tables and when the data proved inaccurate, they turned to using the wind tunnel developed by Wenham and Phillips. The Wright brothers added their own talent to the research tradition by using models to test their full-scale design in wind tunnels and carrying out almost a thousand gliding flights.

Wilbur (1867-1912), older of the brothers, was born on a farm in Milville, Indiana; Orville (1871-1948) was born in Dayton, Ohio where the family had settled permanently. Their father, a United Brethren bishop, and his daughter raised the boys after their mother's death and encouraged their scientific interests. Neither brother received a high school diploma, as their mechanical ability led them at an early age into practical enterprise. While in their teens, they started a printing business, issuing a weekly newspaper with Wilbur as editor. In 1892, they opened a bicycle sales and repair shop; three years later they began to manufacture bicycles of their own design. Interested in aviation since boyhood they avidly read pamphlets by engineers and aeronauticists. Their successful business provided the funds for their aviation experiments. Their first gliders introduced a revolutionary means of achieving lateral control in flight. The forerunner of the aileron, the device consisted of a cable arrangement whereby the wing tips could be twisted (warping) to change the angle presented to the wind. In 1902, the Wrights mastered glider flying and established control by co-ordinating rudder and warping. Elated by the success, the Brothers were determined to build a powered airplane.

Two challenges faced them: the development of a lightweight powerful engine and the provision of propellers. The Wrights designed and constructed a light 4-cylinder engine, weighing only 170 lbs. with 12 h.p. They developed an efficient propeller aerodynamically similar to a wing. The completed flying machine was a biplane weighing 750 lbs. including pilot with a skid under carriage. From Dayton, they were now ready to return to the site of their glider testing, Kitty Hawk in North Carolina.

* * *

Watchers from the Shadows

I wasn't sure that the noises and shouts were part of my dream. I just lay in the straw waiting. Soon it became quiet except for the December wind and the sleeping sounds of my brother. How far had we walked last night? I had been so tired from walking, but my brother kept insisting that if I wanted to see the ocean, we had to keep going. I had never seen the ocean, not in all my thirteen years of living in North Carolina. I was still so exhausted that I wish that I hadn't listened to Mark. Because he was two years older, being born in 1888, he acted like he knew everything.

Two days. It had been a journey of over eighty miles from our farm in Murfreesboro to get to Albemarle Sound. We had taken two days of walking, dawn to dusk, to get here. I wasn't even sure where "here" was. Mark had said that I would see something worth remembering. I thought that he had meant the ocean—its waves, the foam, the salt water, but he was so determined to come here that I suspected that he had another reason.

I could feel the hunger in my stomach. I was cold and so tired. Fortunately this barn attic gave us some shelter from the biting wind. Now that it was daylight, I wanted to see the ocean's surf and then go home.

The noises started again. It sounded like a motor. It was time, I decided, to investigate.

Carefully I climbed down the ladder and silently walked over to a small window. The late morning sun was coming through the panes. My eyes suddenly widened. Outside there was a group of men standing around what seemed to be . . . I didn't know. It had . . . .

"See I told you that you would see something worth remembering," said Mark with a wide grin. He had crept on me and pushed me out of the way.

"What is it?" I stammered.

"That," he responded all-knowingly, "is an airplane!"

"A what?"

"Airplane, you dimwit. See the wings, the propellers, the motor. They're going to fly!"

"Fly," I almost shouted. "People Can't fly; that's dumb!"

"Be quiet; we aren't supposed to be here," Mark said moving me farther out of the way for a better view. "I heard the men talking at the General Store back home about two brothers who were flying gliders here at the Kitty Hawk dunes. They're from Ohio and have been experimenting with gliders for a couple of years. Last week I heard that they had built an engine to power an air machine and were going to test it out. I had to come and see . . . Look!" he said.

I peered out and saw the men moving the flying machine onto a wooden rail. To the side, two men were flipping a coin; then one of them went to the machine and lay down on the center of the bottom wing while the other steadied the right wing. The two wooden propellers began to turn faster as the motor roared over the wind. The machine began to move forward, faster into the wind and . . . and up! It was flying!

I heard my breath as the airplane rose; it traveled through the air well over a hundred feet in just seconds and then landed on its skids. The men began to shout and wave their arms in victory.

Almost to himself Mark said, "We've seen history." Taking a deep breath he continued, "That was Orville who flew, the one with the mustache. Wilbur is his brother, who held the wing steady. Their family name is Wright. We witnessed the first successful flight, a powered, sustained flight and the wings didn't twist or turn. Orville was controlling them with wires attached to the wing tips and the rudder. Others have been up in balloons and have flown gliders—planes without motors—over short distances. We saw a powered, heavier-than-air machine fly."

"But how? How could it go up?" I tested him.

"Lift," He answered. "The air flowed under the wings slower than above them and gave lift. The motor gave the power to the propellers and the wires allowed the pilot to control the airplane."

"How do you know about that stuff?"

"I've read some," he replied.

"No one will believe this," I muttered.

"Didn't you see the man near the camera at the end of the rail? He took a photograph. Come on, let' s see the ocean."

* * *

After reading the story, answer the questions below. Choose the best answer from the choices given.

1. In what year does the story take place?

   A. 1888
   B. 1890
   C. 1901
   D. 1903

2. Where does the story take place?
   A. Murfreesboro, North Carolina
   B. Kitty Hawk, North Carolina
   C. on a fag in North Carolina
   D. on a farm in Ohio
3. At what time of day did the flight take place?
   A. Afternoon
   B. Dawn
   C. Morning
   D. Noon
4. Which of the following does *not* belong?
   A. Rail
   B. Rudder
   C. Wings
   D. Skids
5. Choose the correct verb for the sentence: Before the Wright Brothers nobody had actually _____ heavier-than-air machine.
   A. Fly
   B. Flew
   C. Flown

D. Flow The epoch making first flight at Kill Devil, a sandy dune near the tiny fishing village of Kitty Hawk covered a distance of 120 feet in i2 seconds and was witnessed by five people, who the brothers had arranged to be there. The Wrights were perspective enough to have witnesses because of the controversy and claims attached to other attempts at flying. That Thursday morning, December 17, 1903, marked the beginning of a new age. With Orville at the controls, the Wrights had coupled mind and spirit and had satisfied a longing that mankind had had for thousands of years—to fly like the birds. They made the first powered, sustained and controlled flight in a machine that was heavier than air.

On the fourth and last flight of that day, Wilbur flew for 59 seconds and covered 852 feet, over a half mile in the air. It would not be until 1906 that any other airplane except the Wright Flyer could remain in the air for more than 20 seconds. The airplane was the beginning of a new type of transportation. It would bring people of the world within a day's journey; within a lifetime the earth's size would shrink under the impact of the airplane.

* * *

The Science of Flight

Now that the history has been established, there is a need to turn to science to explain how the Wrights were able to accomplish their feat of flying. To understand what makes an airplane fly requires some knowledge of aerodynamics, a branch of fluid dynamics. For an eighth grader in a social studies course, the approach may be what a student needs to know in simple terms. First an understanding of the forces that act upon an airplane in flight. They are (1) lift—the upward acting force, (2) weight—the downward acting force, (3) thrust—the forward acting force, and (4) drag—the backward acting force. Lift and thrust are the two forces that airplane designers must consider so as to overcome the forces of weight (gravity) and drag (air resistance). Lift is created by the way airplane wings are designed so that the pressure of the air over the wings is less than the pressure under them. The difference in pressure—less above the wing and greater below—causes the wing to lift. Thrust is provided by a motor-driven propeller or jet engine that pulls the plane forward. The Swiss scientist, Daniel Bernoulli in the l8th century, discovered the fact that the pressure of a fluid decreases at points where the speed of the fluid increases. He found that the high speed of flow is associated with low pressure and low speed with high pressure. The application of this to the wing of an airplane will result in lift. The wing or airfoil is designed to increase the velocity of the airflow above the surface, thereby decreasing pressure above the airfoil. The air must go faster over the curved edge of the top than under the bottom. Therefore the air pressure is lower above the wing where it moves faster. Lift is more complicated than explained here. It also includes the factor of air circulation which is needed to enhance the flow speed and lower the pressure above the wing. (Note student activity one). Other interacting features of fluid dynamics are involved as well. But for the purpose of this unit, lift is presented in simple terms only.

A propeller is a shaped structure or airfoil that provides lift when air is forced over its leading edge. The propeller works by creating greater air pressure on one side of its surface than the other. As its twisted blades cut through the air, they pull the plane along, because the pressure behind them is greater than the pressure in front.

If an airplane wing is tilted upwards, it will produce greater lift than if it were level. A wing is always mounted on the fuselage at a very slight angle so that it will produce lift when the plane is moving. As the plane flies and changes the angle at which the wing meets the air, the plane will go up or down. This angle is called the angle of attack; the greater this angle is up to a certain point, the more lift and drag there will be. When the angle of attack becomes about 18-20 degrees, the air cannot flow smoothly over the wings' upper surface. It has to flow straight over the top surface and this causes a churning of air behind the wing as it tries to follow the surface. There is a sudden increase in pressure on the upper wing surface. This immediately cuts down lift and increases drag and the plane is said to "stall". When this occurs, the plane does not have enough airspeed or lift to hold it up and it may slide side ways or backward into a spin. Lift and drag are also affected by several other factors: the size of the wing, the shape of the airfoil, the speed of the plane, and the density of the air itself.

* * *

***The Pilot* . . . .Flight check.**

The science of flying and the Wrights' technical adaptations produced an aircraft that worked. The continued experimentation and the application of aerodynamics have resulted in the modern air travel that we can experience today. One aspect of that first flight at Kitty Hawk, that marked it as a true first flight, was that Orville Wright was in control of the Flyer. Early pilots flew by their reactions to what they could see from their open cockpit and what their feelings of weight or weightlessness told them about whether the plane was climbing or descending. Most flying today is done by a combination of reference to instruments and visual observations. The instruments give information about altitude, speed, direction, attitude and how the engine is operating. Students may be asked what information a pilot would need to know in order to get them thinking about being "in the driver's seat." In a small private plane, the instrument panel is not much more complicated than the dashboard of a car. Using the instruments, a pilot could fly entirely without looking out the windshield except for takeoff and landings assuming proper radio communication.

The altimeter is one of the most important instruments; it measures the height of the aircraft above a given level. The altimeter is a barometer that measures the air pressure and converts the readings into feet of altitude. The pilot must know that the plane is flying high enough to clear the highest terrain or obstruction along the way. To reduce the potential of a midair collision, the pilot must be sure to fly the correct altitudes in accordance with air traffic rules especially on flights at more than 3, 000 feet. The altimeter has a knob to adjust the instrument to take into account changes in barometric pressure at different points of the flight as reported by weather stations.

An air speed indicator tells how fast the plane is traveling in relation to the air around the plane. It works by measuring air pressure. But the pressure it measures is the impact the plane has on the air. In other words, how hard the air is hitting the instrument as it moves through the air or the difference between pilot, or impact pressure, and static pressure. The impact is calibrated to give the airspeed in miles per hour, or knots, or both. The indicator is marked according to a standard color-coded system for safe operation. For example, air speed needs to be controlled for normal cruising, maneuvering, landing or stalling.

The magnetic compass may be familiar with its cardinal headings and graduations for every five degrees. Remember that it will not point to True North Pole but to the Magnetic North Pole some 1,300 miles away. Thus the variation must be accounted for and can only be read when the plane is flying straight and level. The gyro compass uses a gyroscope to keep the course and is adjusted to correspond with the magnetic compass indicator after a short period of level flight.

The turn and bank indicator was one of the first modern instruments used for controlling an aircraft without visual reference to the ground or horizon. It tells the pilot when he is turning and how well he is executing the turn, whether he has too much or too little bank for the rate of turn, Coordination and balance in straight and level flight can be checked. This indicator is actually two instruments, a ball and a turn needle. The ball part is simply an agate or steel ball which is free to move inside a curved, sealed glass tube filled with kerosene. The lowest point of the glass tube is in the center. In straight and level flight, gravity keeps the ball there, centered between two wires. In a turn the ball will be kept centered by centrifugal force if the aircraft is neither skidding or slipping. If the rate of turn is too great for the angle of bank (skidding), the ball will fall to the high or outside of the turn. If the rate of turn is too slow for the angle of bank (slipping), the ball will move to the low side or inside of the turn. The turn needle indicates the rate at which the aircraft is turning about its vertical axis.

Besides the flight instruments, other indicators show the aircraft' s engine is operating; they include the tachometer, the oil pressure gauge, and the oil temperature gauge. These instruments are basic to any airplane; the larger or more sophisticated the craft, the more instruments, each revealing position and condition of the plane.

But even before the pilot leaves the runway, he must have a fundamental knowledge of the atmosphere and weather behavior. Consideration of air density is important. Air has weight and substance; it tends to resist anything passing through it. But the air is constantly changing. Sometimes it is dense and heavy; at high altitudes, it is thin and light. A pilot must be aware of how and why the air changes so as to expect its effects on the lift of a plane. The density of the air is affected by altitude, temperature and humidity. The higher you travel the less pressure you feel. At 18,000 feet, the pressure is about one half of what it is on the earth's surface.

Temperature and humidity affect air density and make a difference in flying. When air is heated, it expands and has less density. Because this is true, a pilot needs a longer runway to take off from on a hot day than a cool day. Humidity is the amount of water vapor in the air. Water vapor weighs less than perfectly dry air, and thus, the air is denser on a very dry day when the humidity is high. A pilot will have to make a much longer run to take off on a warm, humid day than he will on a cool, dry one because the air will be less dense. At an airport high above sea level, a longer takeoff will be necessary because the density will be lower. For example, a takeoff in a small private plane from Denver in Colorado, about 5,000 feet above sea level, will require 2,000 feet of runway compared to 1,000 feet at one near sea level. The factors of altitude, temperature and humidity are interrelated; changes in one will affect the others. A pilot must know the effects of the factor to determine how the plane will fly in the air on a given day. These scientific considerations may be difficult for students to grasp but they do point out the range of knowledge that a pilot must have to fly safely and according to schedule.

Unlike Orville Wright, who was able to shift his weight and operate some wires to control his Flyer, the modern pilot has the benefit of years of technological improvements and refinements and hours of training. Pilots control the aircraft by increasing or decreasing speed and by movable surfaces on five of the plane' s airfoils: the two wings, the small sail wings and the fin. When these surfaces are moved, the air flow is changed and this changes the altitude and direction of the plane. On the wings, the movable surfaces are called ailerons; on the tail wings, (horizontal stabilizers) they are called elevators. They are connected to the wheel or stick in the cockpit.

The control stick can be moved in all directions; as it moves, it changes the position of the ailerons and elevators. Moving the stick to the right causes the left aileron to go down and the right one up; this rolls the plane to the right because the ailerons change the curvature of the wing surface. If the stick is pressed forward, the elevators move downward increasing lift and forces the tail upward, making the plane's nose drop. When the stick is pulled back, the elevators turn upward, decreasing the tail's assembly's lift. Thus the plane's nose is forced up.

Footpedals control the rudder which is the vertical stabilizer on the fin. The throttle controls the engine which increases or decreases the thrust. The control surfaces work together in maneuvering the aircraft. For example, in order to climb, the pilot would not just pull back the stick to lower the tail and raise the nose because the drag would rapidly increase and the wing would lose lift. So when the stick is pulled back, the pilot opens the throttle to gain more speed. This keeps the lift power high and helps the plane to climb.

Every pilot must also develop the ability to navigate with precision. To navigate successfully, a pilot must know the plane's position at all times no matter the weather or darkness and be able to calculate flight time and fuel consumption. Using charts, instruments and preparation, the pilot maps the flight course so that he knows at all times where he is, what direction he should be flying, and how long it will take him to get to the destination.

Pilots must be acquainted with the aircraft's airworthiness: its structural strength, stress factors, lifting capacity, and flight characteristics. These are important for safe aircraft and engine operation. Considerations of weight loads and balance conditions are added responsibilities fo *r* the pilot. While flying, pilots must have good radio communications especially with control towers at airports and know the language of the airwaves. The list of duties and requirements of a pilot does not end here; their skill and knowledge does not eliminate the need for good judgement.

Now it's time to take her up.

* * *

Flight 405

"What a day this is going to be!" I thought as I sat down and began to re-check the instruments. "First time that I get to work on this aircraft; first time that I get to fly with this crew; first time that I am making this flight course. Nervous? No! And an F.A.A. inspector is on board as well".

It is hard to concentrate as the preflight checklist continued between the captain and the co-pilot . . . ."flight and navigation instruments".

"Check," the co-pilot responded.

"Flaps," the captain asked? "Set," said the co-pilot.

"Fuel" . . . ."Set."

"Controls" . . . . "Checked, lights off".

"Warning lights" . . . ."All off".

As the flight engineer, I had completed the preliminary cockpit and preparations checks before they had boarded the plane. There jobs seemed easy—just navigate the craft, communicate with the control tower and fly this plane. My responsibilities included monitoring the electrical and hydraulic systems, checking the pressures and fuel, and communicating with the airline company's maintenance and dispatch. It seemed that I had more than enough to do.

The 195 passengers on board would not be getting off the ground, if my calculations were not correct. I had figured the V-1 or needed take off speed, 130 mph, based on the runway length, total weight of this Boeing 272 plane and the air density. We would have 2, 000 feet of runway to get up the 130 mph needed to lift the 178, 000 pounds of aircraft and under 30 seconds to reach V-1 or abort the takeoff.

My thoughts were interrupted by the Control Tower, "United 405 cleared for take off, runway 311 left". The captain acknowledged and we began to roll. I held my breath.

"Gear up," the captain said suddenly.

I realized that we were airborne. The co-pilot pulled the gear handle into the up position which retracted the wheels. Next the flaps were retracted.

"United 405 contact Departure Control," the Tower announced.

"Roger, 405 switching. Announce to Departure Control, United 405 climbing through 1,200 feet".

"Roger 405, radar contact, climb to 31,000 feet, turn left to heading 280' and proceed on course," Departure Control directed us.

"Roger, climbing to 31,000 feet to intercept course," the captain responded.

The captain told me to turn off the seat belt sign and to welcome the passengers as he switched over to the automatic pilot and reached for a cup of coffee. In my best voice, I said over the intercom, "Welcome aboard United 405 from J.F.K. to O'Hare International Airport, Chicago. We will be cruising at 31,000 feet, at about 560 mph and our flight time is estimated at one hour and thirty minutes".

Everything was going smoothly. We were 45 minutes into the flight, about half way, nearing Cleveland, Ohio. "This F.A.A. inspector will be impressed," I said to myself.

Then it happened!

Engine fire! A red fire warning light began to flash. A loud, signal bell rang. Number three engine firelight came on.

Immediately the captain moved the throttle to idle, shut off the engine ignition, pulled the handle that stopped fuel to the engine, and pushed the Bottle Discharge button which sent freon gas into the engine to extinguish the fire.

The lights still flashed; I had to stay calm.

The captain stopped the tilting of the plane by pushing in the rudder pedal and was able to maintain course. The copilot was in contact with Cleveland Traffic Center. Emergency procedures ran through my mind.

The captain pushed the second Bottle Discharge button . . . “Fire out.”

“Cleveland Center, United 405, fire under control, request clearance to land, emergency equipment to stand by,” the co-pilot’s clear voice said.

“Roger United 405, turn to heading 300’ and headings into Cleveland, descend to 10,000 feet,” said the Traffic Controller.

I was busy figuring our approach speed, altimeter settings, flap requirements for a two engine landing, as well as, tuning in the local weather and talking to our dispatcher. In the background, I heard “ . . . clear for approach to runway 5;” . . . “Flaps 2 degrees, gear down, final descent checklist; “ . . . “Good luck”.

The wheels touched the runway; we were on the ground.

I was the first to emerge from the flight-out-door and climbed the eighteen stairs to the floor. “What a ride,” I said under my breath as my eyes became adjusted to the light in the flight simulation building. These simulated tests here in Denver, Colorado are always pressure filled, but a necessary part of my job. Over my shoulder, I heard the F.A.A. inspector say, “Nice ride, I’m satisfied with this performance”.

“Nice ride,” I repeated and headed for the debriefing room.

* * *

After reading the story, answer the questions below. Choose the best answer from the choices given.

1. The destination of United 405 was?

    A. J.F.K., New York
    B. O’Hare, Chicago
    C. Cleveland, Ohio
    D. Denver, Colorado

2. Who is responsible for calculating the needed take off speed?
    A. Pilot
    B. Co-pilot
    C. Engineer
    D. Inspector
3. On a Boeing 727, there are how many engines?
    A. One
    B. Two
    C. Three
    D. None of the above
4. When an engine is lost, which of the following does not happen?
    A. Fire light comes on
    B. Plane goes off course
    C. Warning bell sounds
    D. Loss of cabin pressure
5. The word “simulation” means?

A. Pretend
B. Real
C. At the same time
D. Kind of a building

The Pilot-Ratings and Careers

Ready for a test? Loading the family car requires little serious planning. You can cram in luggage, passengers and fill the gas tank without thoughts of gross weight or center gravity. A similar approach to loading an aircraft could result in a serious accident. Consider a four seater plane with a baggage allowance of 120 lbs., useable fuel capacity of 39 gallons and an oil supply of 8 quarts. On a hypothetical flight, you take on full fuel and oil, toss in four 30 lb. suitcases and four people averaging 180 lbs. each. What' s the total? 840 lbs. plus the fuel weighing 244 lbs. and the oil weighing 15 lbs. Now the total is 1099 lbs. The airplane shows an empty weight of 1,325 lbs. and a maximum allowable gross weight of 2,200 lbs. The Weight and Balance Data of 1,325 lbs. must be added to the weight of the load. The total of 2,424 lbs. is 224 lbs. excess! Your plane would have trouble getting off the runway. Weight and balance will effect the airplane's behavior and can cause actual danger.

Before a pilot can be licensed, he must receive flight instruction and practice actual flying. The following is a list of air transport ratings and their qualifications.

Private: 40 hours of flight time and instruction.

This is divided into: 20 hours of instruction and 20 hours of solo flying, 10 of which is solo cross-country to an airport more than 25 miles from the departure.

Commercial: 200 hours of flight time and 20 more hours of instruction in addition to the private license.

This includes: 100 hours flight time in powered aircraft, 100 hours of pilot command made up of 50 hours cross-country, takeoffs and landings from at least two airports under two way radio communication, one cross-country flight of at least 350 miles including a landing at an airport at least 150 miles from departure, 5 hours of night time flying including 10 takeoffs and landings as pilot, and 10 hours of flight instruction with reference only to instruments.

Instrument: At least 40 hours of instrument time under actual or simulated condition. This includes at least 20 hours in an airplane or simulator and at least 15 hours from a flight instructor.

Multi-Engine: At least 5 hours of instruction in a multi-engine airplane.

Air Transport: 1500 hours total.

This is made up of 300 hours of actual instrument time, 200 hours of night flying, 1000 hours as pilot in command, and 1000 hours of cross-country flying.

Each rating requires a written and practical examination by the Federal Aviation Administration.

Today's airline companies employ more than 500, 000 workers and the industry is growing fast. There are a variety of careers tied to air travel. Some jobs are hard to get because so many people apply. For example, as many as 10,000 people might put in application for one opening as an overseas flight attendant with a first year salary of about $22,000. The need for airline pilots is increasing and the traditional primary source, the military, is not producing the number that is needed. According to the Future Aviation Professionals of America, over the next ten years a total of 40,000 jet pilots will be needed and between 30,000 and 40,000 more for commuter and regional airlines. In 1987, the major airlines hired 7,018 pilots while the commuter/ regional carriers hired 4,073. Only 64 percent had military background. Besides the increased need for commercial pilots, there will be a demand for corporate pilots and for flight instructors.

Some U.S. commercial carriers have affiliated with universities to produce airline pilots. Students graduate with the appropriate ratings, a guaranteed interview and training specifically designed to meet the airline ' s standards. Most airlines require a college degree and the training programs include all ground school and flight training needed to graduate with commercial, multi-engine and instructor ratings.

It may be appropriate to ask students to list as many airline jobs as they can. All jobs may not hold the same appeal as that of flight attendant or pilot. The salaries vary from airline to airline and increase as experience is gained. The following is a list from United Airlines:

Airline pilot	Flies two and four engine jets.	$40,000-$50,000
Airline dispatcher	Communicates with control tower, responsible for ground clearance.	$20,000
Pilot instructor	Trains pilots in new equip ment and flying techniques.	$45,000
Flight attendant	Serves passengers, needs to be good with people.	$16,000-$18,000
Ramp agent	Manages gates to airplanes.	$15,000
Ticket agent	Works at ticket counter, needs to be good with people and computers.	$14,500
Airport manager	Oversees all airport activities.	$40,000
Airport security	Checks passengers and lug gage, must have police training.	$16,500
Air traffic controller	Needs experience with radar, computers and radio communication.	$30,000

When considering a career in the aviation field, the first step is to examine one's aptitudes. Are you mechanically minded? Do you work well with your hands? Do you like science? A mechanical aptitude could lead to a career as an instrument repairman, production technician or astronautical engineer. A verbal aptitude is required for airline sales, public relations and flight instructor. An aptitude for science could mean a career as an aeronautical engineer, metallurgist, chemist or lab technician. Manipulation is required by pilots, radar specialists and machine tool operators. A numerical aptitude is useful for an aircraft navigator, airline statistician or industrial accountant. Administrative skills are required for airport operators, management and administrative officers. Even artistic aptitudes can lead to careers as design engineers, airline architects, technical illustrators or scale model builders in research.

College degrees are necessary in many aviation careers.

Planning should begin when high school is entered because of the preparation needed in many fields. The following chart shows school subjects that must be mastered for various careers in aviation.

Careers and School Subjects:

(figure available in print form)
* * *

Then and Now **. . . .Clear for visual approach.**

Orville Wright wrote "that the beginnings of today will be mightily overshadowed by the complete successes of tomorrow." ("Future of the Aeroplane," *Country Li* fe). How far sighted he was when he made that comment in 1909, yet air transport would develop slowly. The first airplanes were hardly more than gasoline-powered box kites. The light framework of their wood was covered with canvas and held together by wires. A small engine turned the propeller that gave forward thrust while the pilot sat in an open cockpit. Before World War I, the airplane was greeted by skepticism among the American public; people had to see it fly in order to believe. The first commercial airplanes were built in 1907, but by 1910, only five had been sold. With only one or two seats and small engines, few people trusted the new flying machines. Brave pilots, women and men, dared each other to set records in distance and speed. In 19i1, Calbraith P. Rogers made the first transcontinental flight. It took 49 days of flying over the span of three months due to weather, daylight, wind conditions and crack ups. The public's interest was increased by pre-war aerial circuses that attracted crowds to watch pilots perform various stunts. These air-circuses traveled Europe and America putting on shows of stunt flying and giving cheap joy-rides. At Yale University, a flying club was organized in 1910. However, four years later it ceased operation due to dilettantism. "The time is coming when a knowledge of flying will be as much a part of an American gentleman's accomplishments as golf or automobiling," the club's president reported. (The New Journal, April 22, 1988). It was fortunate that aviation's future did not belong to only those with superficial interests.

During the War, the U.S. lagged behind other nations in building airplanes. Congress would only spend $125,000 for development. When the U.S. entered the war, American pilots had to learn to fly the better foreign planes. The government soon recognized the airplane as a military weapon; the planes were used for monitoring enemy movements, mapping terrain and bombing targets. The government ordered a number of 100 mile-an-hour planes for military purposes. The first American-trained squadron engaged in air combat on April 3, 19i8. The exploits of individual pilots who fought against German aviators often without parachutes made for good newspaper copy and a hero-hungry America made Captain Edward Rickenbacker, who shot down at least 26 German planes, more famous than the generals.

When the U.S. entered the war in 1917, Orville Wright predicted that besides combat, the airplanes would be used for business trips, to carry cargo and for air mail delivery. But because of the war, the aviation industry grew and the

National Advisory Committee for Aeronautics founded in 1915 by the government became a leader in research in the post war years. Many individual pilots were eager to prove that the airplane could provide an efficient passenger service though there were no civil aircraft and few airfields existed; the early flights were made in converted military bombers. Americans were ready to believe that the airplane had a place in their future. In 1918, the U.S. started the first air mail service between New York and Washington, D.C. Airmail service grew rapidly and gave the infant airlines a source of income to continue operations. In 1919, a Curtiss airplane flew from Newfoundland to England stopping at the Azores Islands and Lisbon, Portugal in the first stop and fly, flight across the Atlantic Ocean. In June 1919, Captain John Alcock and Lt. Arthur Whitten-Brown left North America; after 16 1/2 hours, they touched down in Ireland. The pilots had flown nonstop across the Atlantic Ocean blazing an important air route for the future. That same year, the world's first regular air service began when a passenger flew from London to Paris along with mail and other goods in an old bomber. This flight by Aircraft Transport and Travel Ltd. took two and one-half hours and cost the traveller L15 1919 was also the year that the Dutch airline, KLM, opened for service.

The 1920's saw a growth in civilian aviation and of pioneering flights across the world. Two American lieutenants, Kelly and Macready, flew non-stop across the U.S. in 1922. Two years later, a pair of Douglas bi-planes flew around the world in 15 days. Technology would introduce single wing planes designed to give better air-lift and light metal alloys took the place of fabric coverings on the wings and fuselage. In 1924, pilots set a record by flying between New York and San Francisco in 27 hours. That was great news for the U.S. Postal Service because the best time for coast-to-coast mail delivery before then was a speedy seven and a half days, by train. The future of aviation held great promise. By the end of the 1920's, all the continents and oceans would be spanned by the airplane.

On May 20, 1927, Charles A. Lindbergh took off from Roosevelt Field in New York in an aluminum monoplane, the “Spirit of St. Louis”. He traveled 125 mph over the Atlantic Ocean, non-stop to Paris in 33 1/2 hours. His solo flight captured the hearts and minds on both sides of the Atlantic and assured aviation’s future. The following year, Amelia Earhart made another non-stop flight across the Atlantic. Continuing to set records, she became the first to solo across the Pacific from Hawaii to California and the first to fly non-stop across the United States. In 1937, Earhart and navigator Fred Noonan disappeared in the South Pacific while attempting to fly round-the-world.

By 1928, the airline industry had the know-how to build planes with enough room and power to handle more than a few passengers. American Airlines and Trans World Airlines opened for business. Flights were noisy and uncomfortable and there were no flight attendants until Ellen Church was hired in 1930. By 1932, several commercial airlines were carrying passengers in planes that traveled at speeds up to 150 mph. By island hopping in 1937, passengers could fly from San Francisco to Hong Kong. The first airmail flight from New York to Spain and England was completed on a Boeing 314, “Yankee Clipper” in 1939.

World War II brought many improvements to air travel. During the war, Orville Wright invented the split wing flap used by dive bombers. Radar and computers would make planes safer to fly. All the developments gained through the war experience would be adopted by commercial planes and by the end of the war, airlines were carrying three million passengers a year. When Orville Wright died in 1948, at the age of 76, the industry was at the door of the jet age. Jetliners were using newly developed jet engines and aircraft companies were building turbojets. The Douglas DC-3 of 1935 with speeds of 180 mph was replaced by the Boeing 707 and DC-8 with speeds of 315 mph. By 1970, the Boeing 747 was able to approach the speed of sound, at a Mach number (flight speed divided by the speed of sound) of about 0.8, cruising at a speed of 570 mph. The speed of sound at sea level is 760 mph; in the stratosphere, over 35,000 feet, the speed of sound is 660 mph. The planes were not only faster, but able to carry more passengers; the Hughes aircraft built a plane that could carry 700 people. The airplane became second to the automobile as a means of intercity passenger transport. From the propeller planes to the jet to the jumbo jet to the supersonic transport, people found the highways in the sky a convenient, safe and fast means of travel.

And our sky was no longer the limit as the astronauts ushered in the aerospace age.

* * *

The Travelers

“Come on, don’t lag behind.”

I rushed into the Eastern terminal and caught up to my grandfather.

“Grandpa, this is such a giant building!”

“Yes . . . .It is only one of many here at the airport. Each major airline has its own terminal and share it with smaller airlines. International flights go in and out of another building here at J.F.K. Airport.”

This morning we were heading for the check-in counter which seemed like a mile away. As we got in line, I realized that it was probably the two over-stuffed suitcases that I had half carried, half dragged that made the check-in desk seem so far away.

“We’ll check the baggage, get our seat assignments and boarding passes; then we can relax before getting on the plane,” Grandpa said. “We have an hour before the plane takes off at 10:30.”

I was excited; I had never been to Florida. Now, I was going to live there . . . forever. Mom had always wanted to take me to Disney World, but never had the money. With her gone, Grandpa was taking me to live outside Miami. Wonder what school is like there?

We left the desk and walked toward Gate 42.

“Put your carry-ons on the belt,” the security guard said.

I did and then followed Grandpa through this “funny” doorway. “What’s that for?” I asked.

Grandpa answered, “Its an X-ray machine to check if anyone is carrying metal objects that aren’t allowed on the plane.”

“Like guns?” I asked.

“Yes,” he said sadly and I thought he added, “What a world.”

“38, 39, 40, 41 . . . Gate 42, here we are,” I announced. We entered the passenger boarding area and sat down. “Have you flown a lot, Grandpa?”

“Yes, during the war, World War II, I was a bombardier in the Navy on a SBD Dauntless dive bomber in the Pacific. It was a ‘prop’ plane used before jets and we often had to take off from dirty runways. Even major international airports were hardly more than large grass fields with terminal buildings and hangers. It was the war that showed that the heavier planes needed concrete runways to support their weight in all kinds of weather.”

“Did you know the Wright brothers?” I asked.

“No,” he said with a laugh. “They were before my time, but not much. But I do remember Charles Lindberg, ‘Lucky Lindy’, they called him. I was ten years old in 1927 when he made his one-man New York-to-Paris non-stop flight in a little over 33 hours. He became a hero with his plane, the ‘Spirit of St. Louis’; the plane is in the Smithsonian Museum of Air and Space in Washington, D.C.”

“Before the war,” he continued “I remember pilots, ‘barstormers’ they were called, in old World War I planes touring and offering joy rides for a dollar from a field in Hamden where I used to live. Flying circuses used to come to town also; they did loops, made parachute jumps, dropped bags of flour on cars in make-believe bombing runs, and shot at balloons from the air. Some aerobatics.”

“Eastern 810, now ready for boarding,” an announcement interrupted. We got up and walked into a hallway which was connected to our plane. I looked left and could see into the cockpit . . . rows and rows of dials, lights and switches, even on the ceiling.

“That’s called the flight deck,” grandpa said.

We walked past at least thirty seats before finding ours. “Is it safe to sit next to the window?” I asked.

“Of course . . . the pilots are just as concerned about a safe trip as anyone. You know that they are retested every six months at the Flight Training Center, in Denver, Colorado. The training takes place in a flight simulator . . . a boxy contraption on spider like legs—actually hydraulic legs that flex to give the real feel of flight. Inside is a fully instrumented flight deck and a TV tube, run by a computer; it shows the outside world as the pilots would really see it. Don’t worry they won’t let anything happen to this three million dollar aircraft or us.”

He paused and said, “we are ten times safer than if we drove to Florida”.

A seat belt sign lit up and I adjusted the belt, I could feel the plane begin to move.

* * *

After reading the story, answer the questions below. Choose the best answer from the choices given.

1. The Travelers’ flight to Florida was?

    A. In the morning
    B. At night
    C. On Thursday
    D. Left Gate 810

2. How old is Grandpa?
    A. 72
    B. 73
    C. 74
    D. not given
3. Lindberg’s “one man” flight means that?
    A. He flew non-stop.
    B. He was the only one ever to do it
    C. He flew solo
    D. He was the only man on the plane
4. Grandpa saw the Flying Circus or air show?
    A. At his home in Florida
    B. Between the wars
    C. In the Pacific
    D. In St. Louis
5. Which of the following is *not* true about the flight simulator tests?
    A. Pilots take them every six months
    B. They feel like real flights
    C. The simulator never leaves the ground

D. The flight deck is not real

***Safety* . . . .Clear for landing.**

The chances that a student has or will take an air trip are enhanced by the fact that American airlines carry over 150 million passengers each year. The trip may be made on a Boeing 747 airplane that is 228 feet long and can carry 490 people at speeds of 625 miles an hour. Cruising at an altitude of 30, 000 feet, familiar landmarks will rapidly diminish in size until they are small specks and the land will stretch out to a distant horizon. What should be the concerns of the air borne traveler? “Twice in the next two hours I awoke to find the aircraft thirty degrees off course and five hundred feet low. It became painful to stay awake. The aircrafts strange antics did not disturb the passengers, as they were all asleep as well.” This report is from a commercial pilot.

Between 1980 and 1984, 261 fatigue-related pilot errors were reported. The figure increased to 488 between 1984 and 1987. The errors can be major such as: flying off course and at the wrong altitude, landing without clearance or on the wrong runway, and making incorrect fuel calculations. Some experts blame the Federal Aviation Administration regulations for allowing pilots to fly too many hours; longhaul pilots can fly 16 hours a day or longer in some cases. Flying times differ from airline to airline and any reduction of flying hours would cost the airline money.

In 1979, a replacement engine that had been improperly mounted on the wing of a DC-10 broke free on takeoff from Chicago’s O’Hare International Airport, causing a crash that killed 275.

On April 28, 1988, an Aloha Airline 737 landed miraculously in Maui, Hawaii, after an 18 foot section of the fuselage tore away while the plane was traveling 330 mph at 24,000 feet. One flight attendant was killed and 61 passengers were injured many by chunks of metal and insulation that kept peeling off during the frightening descent.

During the same month, the FAA launched a special inspection of all jets operated by Continental and Eastern airlines in response to recurring accusations that their parent company, Texas Air Corp, was cutting corners on maintenance because of its financial troubles. Forty-three of Eastern’s planes were taken out of service to correct problems.

The Boeing 737 is the workhorse of many airlines. The 737 fleet exceeds 1,500 jets worldwide, has carried more than 1.7 billion passengers and flown more than 10 billion miles. The problem is one of age; it is a tired fleet. The average U.S. jet liner is more than twelve years old.

Airline maintenance has become a sophisticated science when practiced at its best on today’s increasingly complicated aircraft. The Boeing 747 contains 4.5 million removable parts and 135 miles of electrical wiring. Mechanics have become specialists often inspecting many marts without removing them with technology borrowed from the medical profession. Yet airline maintenance has been accused of being sloppy and problems were left unsolved because supervisors overruled the mechanic. Pilots have flown when the instrument panel lights were out by using a flashlight. In one case, a pilot was grounded for refusing to fly a plane because the altitude alert system was not working. Some pilots claim that the limits of safety are being challenged; the airlines cut back maintenance in order to maintain profits, on time schedules and the cheaper fares.

Most air accidents are chain reactions involving the links of the system: pilots, weather, air-traffic controllers, airports and its facilities, and the airplane itself. Statistics indicate that air travel is safer. Fatalities in U.S.

commercial airline accidents declined from 2,669 in the years 1970-1978 to 2,000 in 1979-1987. The total flight hours increased by one-third during that time. The majority of accidents are attributed to pilot and controller errors and to bad weather. Mechanical faults accounted for about one-third of the mishaps. Although every four years a crew of 180 mechanics tears a plane apart, strips off its paint and examines every moving part and structural component.

All air traffic is carefully regulated. The U.S. government's Department of Transportation through the National Transportation Safety Board supervises the safety of air travel. The Federal Aviation Administration requires recurrent training every six months for airline pilots to keep their skills honed. With computer technology, flight simulators provide realistic training exercises. Frequent weather reports, radio and radar communication, and advanced instrumentation have helped to make the airlines a safe way to travel. Safer than the bicycle. More Americans were killed on bikes in 1979 than in U.S. air-carrier accidents in the four previous years.

Another analysis reveals that air transportation has brought other problems. More and more people are flying and the airports are jammed with air traffic, and people coming and going. Since airline deregulation, the number of passengers have doubled but no new airports have been added to the existing 10,000 airports and small landing fields in the U.S.

Airplanes may circle overhead for hours awaiting clearance to land. Yet proposals for new construction of airports or runway extensions are met with protest by area residents. They do not want to live with the roaring, earth-shaking noise of large jets taking off and landing. Some large airport facilities are miles from the city that you may want to visit and just getting into the cities may take longer than your flight to the airport.

These are some of the concerns that the airplane has given to our society. In an open-ended discussion, students may list the benefits of air travel, also the problems that the airplane has brought. This can be expanded by having students look for news articles dealing with airline travel, airports and economic concerns. What is the balance between the romance of flying and economic factors? For our students, air travel and its challenges are a central part of American life. The technology wrought by the dreamers of aviation' s past has given us the wonderful ability of human flight. We must be ready to call upon our imagination and science as we will continue to take to the sky.

Technology is as much a part of our environment as trees and buildings. It can solve some problems and will seem to cause others. Yet our society will progress and change. And what of the future of aviation? Orville Wright' s response to that question was, "I can not answer except to assure you that it will be spectacular". As long as we permit the extravagance of our imagination, it will be.

Activity One **. . . . ..Preflight Checklist**

An airplane in straight and level flight is acted on by four forces: Lift, Thrust, Weight and Drag. Label the drawing correctly.

As air moves past the wing, the pressure is increased on the bottom and decreased on the top surface.

Finish the drawing (fig. A) by adding the airflow lines and indicate the low (L) and high (H) pressure areas.

(figure available in print form)

Figure A The airflow makes a circular pattern around the wing and effects the flow at the end of the wing. The circulatory flow increases the flow speed above the wing and adds the upward force—lift.

Draw three lines to show the circular airflow on figure B.

(figure available in print form)

Figure B Figure C is a combination of the air flows in Figures A and B. As the wing moves through the airflow, lift is produced because the airspeed is

lower.

(figure available in print form)

Figure C As the wing moves into the air, the angle between the wind flow and the wings is called the "angle of attack". The pilot controls the angle of attack with the elevators on the tail section of the plane. If the air can not flow smoothly over the wing's upper surface, there will be a loss of lift and the plane will stall. Figure C shows a level flight. You, as pilot, draw a wing in Box 1 that shows that you want to climb and in Box 2, one that shows descent.

(figure available in print form)

Box 1 Box 2

***Activity Two* . . . ..Flight Number**

Directions Select from the answer column at the left the word which best answers each of the statements at the right. Put the number of the word in the proper space in the magic-square box. If your answers are correct, they will form a magic square. The total of the numbers will be the same in each row across and down to form a magic flight number.

ANSWERS *STATEMENTS*

1. Angle of incidence	A. Upward force
2. Stall	B. Loss of lift
3. Weight	C. Like a circle
4. Angle of attack	D. Elevators control
5. Thrust	E. Backward force
6. Drag	F. Moving air
7. Circular	G. Forward force
8. Airflow	H. Air pressure above the wing
9. Lift	I. Gravity
10. Low	
11. Airfoil	
12. High	

(figure available in print form)

The magic flight number is _____

Activity Four . . . ..Aviation Firsts

1. Number in order, 1 to 16, from the earliest to the latest.
2. Put the number on the time line at its correct year.

___ First U.S. designed and built jet fighter, 1944.
___ First airmail service, 1918.
___ First commercial flight to Europe by Pan Am in 1939.
___ Amy Johnson solos from England to Australia in 19 days, 1930.
___ First plane to take off and land vertically (VTOL), 1954.
___ First flight of over 2 hours, 1908.
___ First solo flight across the Atlantic by Lindbergh in 1927.
___ First solo flight around-the-world by Wiley Post in 7 days, 18 hours, the year 1933.
___ First Hawaii to California solo by Amelia Earhart in 1935.
___ First transcontinental flight, 191
___ First jet airliner service at speeds of 490 mph, 1952.
___ Charles Yeager's first super-sonic flight in 1947; "broke the sound barrier" by flying the speed of Mach 1.
___ Wright brothers first successful flight.
___ Anglo-French Concorde was introduced with cruising speeds of twice the speed of sound, 1969.
___ First transatlantic commercial jet crossing, 1958.
___ 490 passenger Boeing 747 introduced, in 1965.

Activity Three . . . . . . Pilot to Tower

(figure available in print form)

The altimeter measures the height of the aircraft above a certain ground level or altitude.

If your altimeter is the three-pointed type as shown at the left, the correct way to read the altimeter is to first glance at the smallest hand (10,000 feet hand); next read the middle hand (1,000 ft. hand); and last read the large hand (100 ft. hand).

Check your ability to read altitude quickly by recording the readings of the six altimeters shown. Allow Yourself 2 minutes.

1. _____

2. _____
3. _____
4. _____
5. _____
6. _____

(figure available in print form)

a b c d e

(figure available in print form)

a b c d e

(figure available in print form)

a b c d e

(figure available in print form)

a b c d e

Every job in the airline industry requires special skills. Try this test for Air Traffic Controller. Each exercise has two sets of symbols. The first set has three symbols. The second set has two and a? Choose ONE of the five symbols below each set that should go in place of the question mark.

Answers:

1. ___
2. ___
3. ___
4. ___

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