

4-H AEROSPACE PROGRAM



# FLYING



## On The Cover

Thousands of people are flying today, both for business and pleasure. Aviation offers something for everyone. Youth can learn about flying by using this publication and enrolling in a 4-H aerospace program through a local 4-H Club or special interest 4-H group. (Photograph by Stephan Wilkinson, courtesy of "Flying" magazine.)

### Introduction

Flying is an adventure. Perhaps you have already had this adventure by building flying model airplanes. Now you are ready for bigger adventure, learning about full-scale aircraft.

There is much to learn! Men have been designing and flying airplanes for centuries. Some men and women have devoted their lives to making airplanes.

Aviation can grow into a career for you, or it can always be a hobby. That's the nice part about aviation — there is something for everyone.

Is it really for me? Will I fit into the picture? Why not? Everyone is affected by aviation. Airplanes carry people, mail, freight, and food. You may fly for business, pleasure, or work. You may be part of a ground team to keep airplanes flying. Remember, aviation is an opportunity waiting for you!

#### Things You Can Do:

Exercises at the beginning of each chapter will challenge you to further interests and study. The exercises are not difficult. Don't be discouraged if they are not possible in your area. Do all you can, and have fun.

### 4-H Aviation Project Flight Level 01 The History Of Flight

#### Things You Can Do:

1. Study and tell about one of the following airplanes:

Fokker D-7	DC-3 (Douglas Skytrain)
"Spirit of St. Louis"	Zero
Sopwith Camel	Spitfire

2. Study and tell about one or more of the following people:

Orville and Wilbur Wright	Charles Lindberg
Curtis Langley	"Hap" Arnold
Amelia Earhart	Jacqueline Cochrane
Admiral Byrd	

3. Other suggested activities:

- Build a model of an early airplane or a series of famous warplanes.
- Name five manufacturers of airplanes.
- List several "firsts" in the aviation field — such as the first flight across the English Channel.
- Make a poster showing the history of flight.

One of the earliest airplane designers was Leonardo da Vinci, the 15th century artist. Da Vinci designed gliderlike airplanes, but he never built them. In fact, it was almost 400 years later that the first glider was built.

Those late 18th century glider flights must have been frustrating! Men such as Germany's Otto Lilienthal barely got their gliders into the air before the gliders were grounded again.

Frustration was common for men experimenting with powered flight. One pioneer, Samuel Langley of Washington, D.C., built two successful

flying machines. Neither was big enough to carry a man. When he built a passenger-size plane in 1903, it crashed at takeoff.

But frustration didn't keep these men from trying.

The first big success was in 1903 when Orville and Wilbur Wright flew their invention at Kitty Hawk. The plane flew 120 feet while Orville lay in the lower wing. That small distance was a big move ahead.

In 1907, the U.S. Army bought a plane from the Wright brothers. By 1918, the Post Office was using air-

planes. Two years later, passengers were flying between Florida and Cuba. In 1927, Charles Lindberg flew across the Atlantic Ocean — nonstop and all by himself. The air age had begun!

The wood and fabric airplanes of World War I have been surpassed by generations of fighters, transports, and space vehicles. World War I's famous "Jennies" and "Fokkers" have given way to jumbo and supersonic jets.

Power plants have improved from the 30-horsepower engines of the early 1900's to today's jets providing thousands of pounds of thrust.



The DC-3 was one of the early airplanes that helped establish the commercial airlines. The first models were used in the 1930's. This airplane is still being used today in many developing nations.

**4-H Aviation Project  
Flight Level 02  
How Safe Is Private Flying?**

**Things You Can Do:**

1. List recent aircraft improvements that insure safer flying.
2. Study an aircraft flight manual and report on what a pilot looks for in a preflight check.
3. There are three pieces of information (manuals or certificates) that must be kept in the airplane. What are they?
4. What are some safety items checked during an aircraft's annual inspection?
5. All pilots must have medical examinations. Learn and report on pilots' physical requirements for various pilot licenses.



**Preflight inspection requires many safety checks before the pilot even climbs into the cockpit. Above, the pilot is checking a sample of the fuel for dirt and water. For this check, a special drain is provided at low points in the fuel system. Below, the pilot is inspecting control surfaces and attachments.**



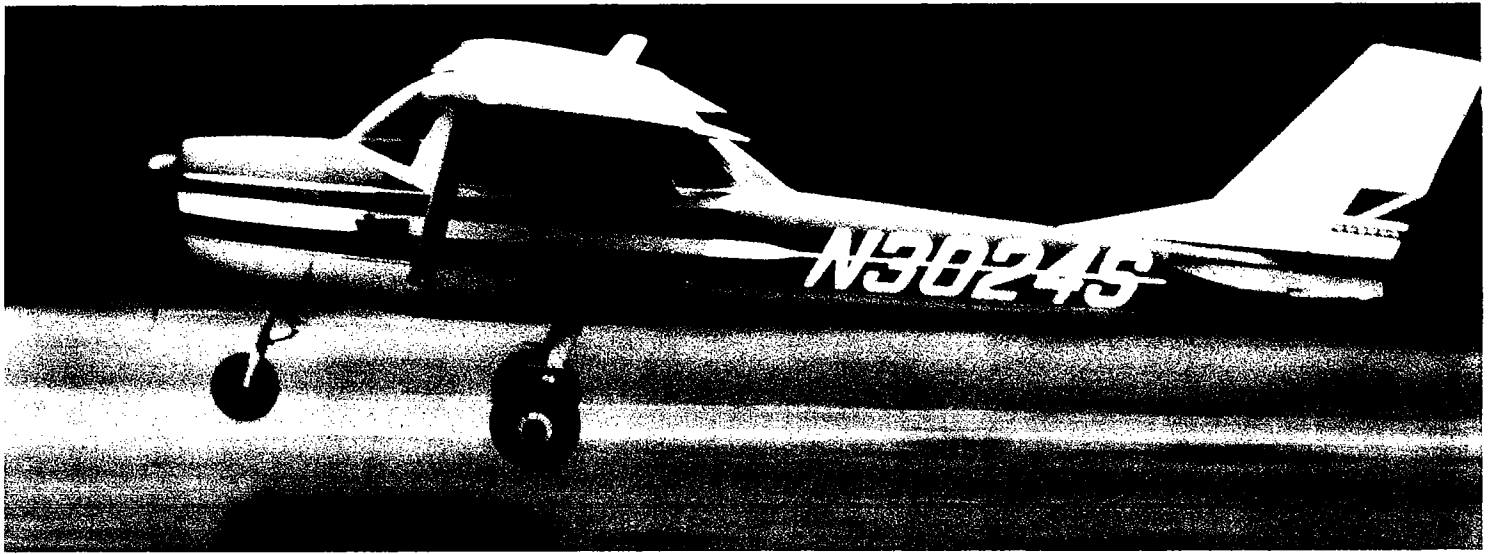
Safety is one of the first considerations for anyone thinking about learning to fly. The real story of general aviation safety lies not in statistics, but in recent changes in airplanes and fliers.

Safety contributions include:

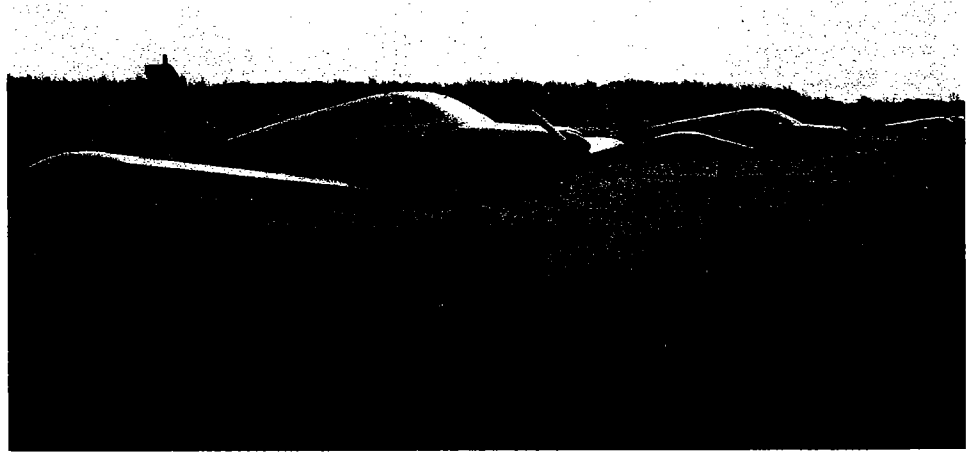
- **EXTENSIVE DESIGN IMPROVEMENTS** that have made airplanes easier to fly.
- **IMPROVEMENTS IN EQUIPMENT** that have made the pilot's job simpler and safer.
- **BETTER INSTRUCTION METHODS AND PILOT AIDS** that have improved pilots' capabilities.

The Federal Aviation Administration (FAA) originated "safety watch" guard. "Safety watch" begins at factories where airplanes are designed and built. Each plane must meet safety requirements. Airports, pilots, mechanics, navigational aids, and aviation researchers are all checked by the FAA.

FAA makes sure all pilots can control airplanes properly. Students must pass a written and flight examination to receive their private pilot's licenses. Before they receive their licenses, students must spend 35 hours in the air in a FAA approved flight school or 40 hours under the supervision of a certified flight instructor not associated with an approved school. Pilots must also pass a physical examination. Private pilots must pass a



Most aircraft manufacturers today put tricycle landing gear on their airplanes. Most pilots feel that tricycle landing gear, with a wheel under each wing and the turning wheel under the nose of the airplane, is safer and easier to control than older conventional gear having two main wheels and a small tail wheel or skid. (Top photograph by Stephan Wilkinson, courtesy of "Flying" magazine.)



physical examination every 2 years. Other pilots, such as commercial, military, business, and executive pilots, have examinations more frequently.

### The Airplane

Today's private aircraft bears little relationship to its older brothers which were designed primarily for the skilled pilot who was interested in sport flying and acrobatics.

However, the entire concept of the private airplane has changed. Today's private airplanes have a new mission: cross-country flying and transportation of people or cargo.

Private airplanes are now more stable, safe, comfortable, and simplified. Contrary to public belief, flying today requires little more physical skill than driving an automobile. Major design improvements include:

**TRICYCLE LANDING GEAR** – This is now standard on most airplanes. It has done more than any other design change to make flying easier and safer. Tricycle landing gear makes ground handling easy, provides positive steering with the nose wheel, and improves

directional control during takeoff and landing.

**STABILITY AND CONTROL** have been greatly improved. Controls respond quickly and easily.

**BETTER ENGINES** offer greater reliability and more power. The FAA requires aircraft engines to be inspected at specified intervals.

### Pilot Aids

All pilots have many aids which contribute to safe flying:

**WEATHER BRIEFINGS** are available at almost any airport. These give current weather conditions at hundreds of places throughout the country. With reasonable accuracy, weather forecasts also predict conditions within the next few hours.

**FLIGHT SERVICE STATIONS**, operated by the FAA, continually serve pilots. These stations accept flight plans filed by pilots. They broadcast current weather for airborne pilots and may be contacted anytime by telephone or radio for flight, airport, and weather information.

**RADIO NAVIGATIONAL AIDS** are almost always within range of an airplane. These make navigation possible almost any place in the country using only basic navigational aids for directional reference.

**DETAILED MAPS** of the United States and other countries show towns, cities, railroads, major roads, rivers, prominent landmarks, and other navigational aids.

**IMPROVED INSTRUCTIONAL METHODS** help students learn to fly and obtain advanced training.

### The Future

Safety is important to airplane manufacturers and pilots. Manufacturers work closely with the FAA whose duties include establishing safety standards for aircraft production and operation.

The risks inherent in flying will never be eliminated. However, a well-built and well-maintained airplane in the hands of a competent and prudent pilot makes flying as safe as any other form of transportation.

## 4-H Aviation Project Flight Level 03 What Is An "Airplane?"



### Things You Can Do:

1. Collect and display pictures of airplanes. High wing, low wing, twin engine, etc.
2. Report on one or more airplane manufacturers and name some of the airplanes they manufacture.
3. Build and fly a model airplane.
4. Visit a local airport and ask the fixed base operator to show the parts of an airplane and explain their functions.
5. See if your airport has the following:
  - Wind Sock
  - Beacon
  - Hangar
  - Runway lights
  - Fueling facilities
  - Tie downs

### Aircraft Engines

The throttle controls the airplane engine, and the engine provides thrust. Because the engine moves the plane forward, pilots call the engine the propulsion system.

Many early flights failed because airplanes did not have enough propulsion. Today there are several types of airplane engines. These are:

- The reciprocating engine turning a propeller.
- The turbine engine called a turbojet.
- The turbine engine turning a propeller and called a turboprop.

Let's take a look at each engine to see how it provides thrust:

The reciprocating engine is a piston-type engine similar to that in a car. Such an engine is used in most light airplanes having propellers.

The reciprocating engine is popular for small aircraft, but jet engines have advantages for larger airplanes. Jet engines are lighter and simpler for the same horsepower rating. Jet engines have less vibration, although they make much greater noise. Turboprops and turbojets are jet engines.

Turbojets are best for high speed and high altitude. A turbojet engine has only three main parts: the compressor; the combustion chamber; and the turbines. There are fewer moving parts compared to those in reciprocating engines. Jet engines give the

### Airplane Design – A Challenge

Airplanes have to be carefully designed. The design must balance the forces of weight, lift, drag, and thrust. Designers have many options when they create a new airplane. Where should the wing be placed? What should it be made of? What shape should the fuselage be? To answer such questions, the designer must understand airplanes and the forces of flight.

Airplane builders begin with the fuselage, the part that carries the pilot, cargo, controls, instruments, and passengers. All other parts of the plane are attached to this fuselage.

The wings are attached to the fuselage with heavy aluminum or steel fittings. The wings provide lift, but wings can do more than that. Wings can carry fuel and engines, house landing gear, and support the de-icing system. The designer selects the right wings for his airplane. He may use one of the thousands of designs that have been developed, or he may design a new kind of wing. (Note: In aviation language, each wing "section" may be called a "wing," i.e., right wing, left wing.)

Most designs include one wing section on each side of the fuselage. Together these make one full wing. Such planes are called monoplanes. Planes with two full wings are called biplanes. Monoplanes may have the wing attached on top of the fuselage, near the middle of the fuselage, or at the bottom of the fuselage. This gives them their titles of high-wing, mid-wing, or low-wing monoplanes.

The horizontal and vertical stabilizers are also attached to the fuselage. The horizontal stabilizer extends from both sides of the fuselage. It may be one piece or in separate sections. The vertical stabilizer extends upward from the top of the aircraft. It includes the rudder which assists turning.

The designer must also decide where to mount the engines. Sometimes it is best to mount an engine on the fuselage. Other times engines are mounted on the wings.

Most small planes have either conventional or tricycle landing gear. Airplanes sitting with their noses tilted upward have conventional landing gear – two main wheels and a tail wheel. Tricycle landing gear has the third wheel under the nose. Planes with this landing gear are level when they rest.



This is a high-wing monoplane which means it has the wing attached to the top of the fuselage. Other monoplanes may be mid-wing or low-wing. (Photograph by Stephan Wilkinson, courtesy of "Flying" magazine.)

