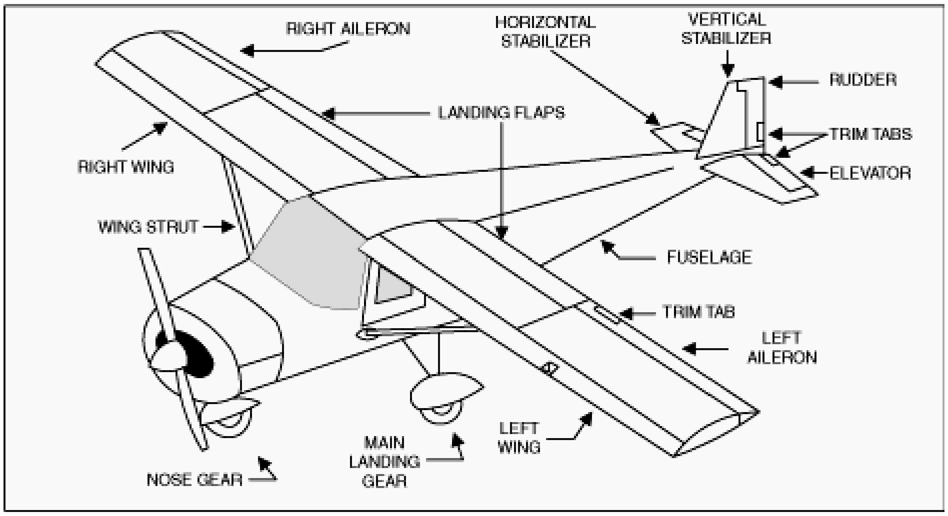
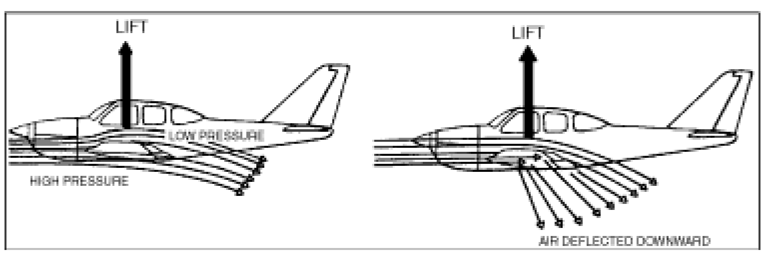
The Airplane

The purpose of this section is to introduce you to the parts of the airplane and to aerodynamics, i.e., the forces acting on the airplane in flight. Remember, this is technical material which will make more sense as you begin your flight lessons.

The first figure below is a high-wing aircraft, such as a Cessna 152. On low-wing airplanes, such as the Beech Skipper and the Piper Tomahawk, the wings are affixed to the bottom rather than the top of the fuselage, as indicated in the second figure below.



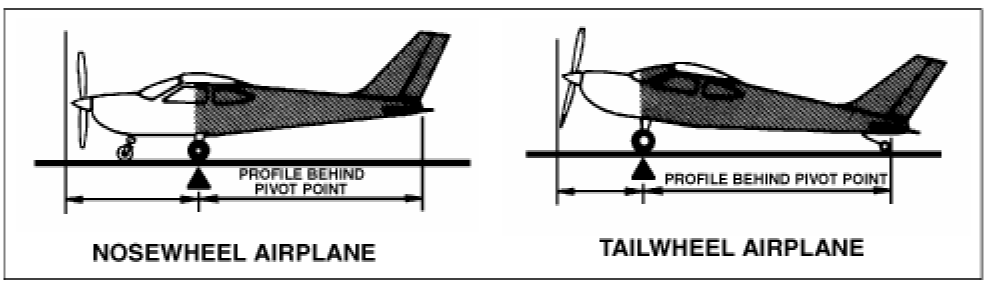
1. **Wing** -- Provides lift by creating a low pressure area on the top of the wing and a high pressure area on the bottom. The top of the wing is curved, which provides a longer distance for air to flow over the wing than under the wing. As the air on top of the wing travels a further distance in the same amount of time, it moves faster than the air flowing under the wing, which results in less pressure on top than on the bottom of the wing. At the same time, the bottom of the wing deflects air downward, which also produces lift.



2. **Fuselage** -- The main component of the airplane. Its function is to act as a carrier for the wings and tail section. It also is designed to produce a limited amount of lift.
3. **Horizontal stabilizer** -- This structure, located in the rear of the airplane, is designed to provide continuous longitudinal (from front to rear) stability. It prevents uncontrolled up and down movements of the nose (pitching).
4. **Elevator** -- A movable part on the rear of the horizontal stabilizer. It is used to move the airplane about the lateral axis. It provides the input of pitch and helps control altitude. Note the axes of rotation are discussed and illustrated futher on below.
5. **Vertical stabilizer** -- This surface provides directional (right or left) stability. It acts like a weathervane. It prevents uncontrolled left or right movements of the nose (yawing).
6. **Rudder** -- This surface, which is connected to the vertical stabilizer, moves the airplane

around its vertical axis and is used to yaw (move the tail to the left or right) the airplane.

7. **Rudder and elevator trim tabs** -- These small, movable surfaces decrease control pressures and help to establish hands-off flight (i.e., when the airplane will almost fly by itself). All airplanes have elevator trim tabs controllable from the cockpit.
8. **Right and left ailerons** -- These surfaces, located on the outside trailing edges of the wings, control the airplane around its longitudinal axis, i.e., the degree of bank, or whether one wing is higher or lower than the other wing (rolling).
9. **Aileron trim tab** -- This small movable section of one or both ailerons permits adjustment so the wings remain level; i.e., you can compensate for more weight on either side of the airplane. Not all airplanes have Aileron trim tabs.
10. **Landing flaps** -- These surfaces are located on the inside trailing edges of the wings. They can be extended to provide greater wing area at slower speeds. This provides more lift and drag and allows an airplane to land, take off, or fly at slower speeds.
11. **Main landing gear** -- The component of the airplane that touches the runway first during a normal landing. It is designed to take large loads and impacts.
12. **Nose gear** -- This component is designed to steer the airplane on the ground. It is not designed for excessive impacts or loads. However, it is designed to carry the weight of the forward portion of the airplane.
13. **Nosewheel (tricycle) vs. tailwheel (conventional)** -- Nosewheel airplanes have the "third" wheel in front of the main landing gear (i.e., under the nose) as pictured below. Nosewheel airplanes have much better handling (because there is less airplane behind the pivot point) and visibility characteristics while taxiing. Almost all new airplanes are nosewheel design.
    a. Tailwheel airplanes have the "third" wheel under the tail. Tailwheel airplanes can land on much rougher terrain and, consequently, are used by bush pilots. In a tailwheel airplane, this gear supports the weight of the rear portion of the airplane.



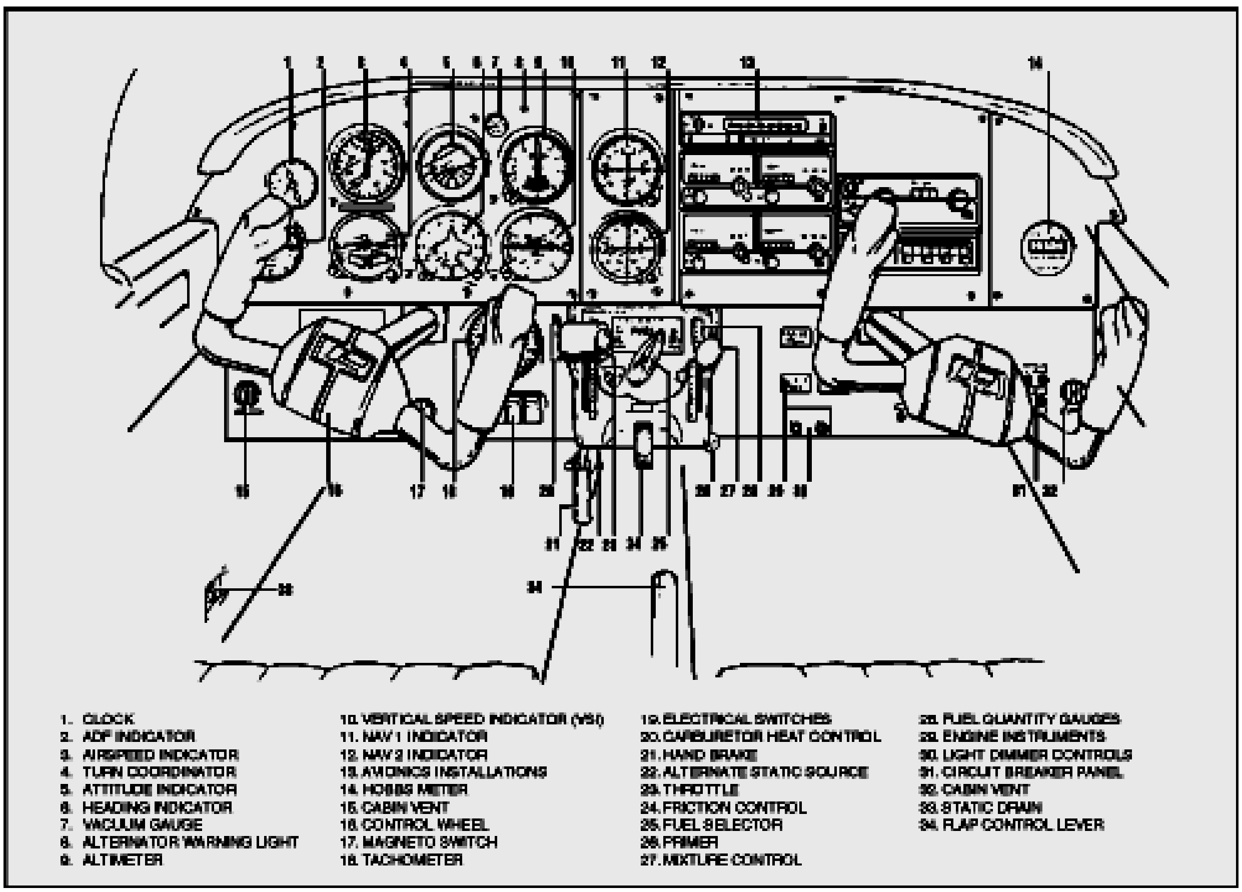
14. **Retractable landing gear** -- Retracting the gear reduces drag and increases airspeed without the need for additional power. The landing gear normally retracts into the wing or fuselage through an opening which may be covered by doors after the gear is retracted. The smooth door will provide for the unrestricted flow of air across the opening that houses the gear. The retraction or extension of the landing gear is accomplished either electrically or hydraulically by landing gear controls from within the cockpit. Warning indicators are usually provided in the cockpit to indicate whether the wheels are extended and locked, or retracted. In nearly all airplanes equipped with retractable landing gear, a system is provided for emergency gear extension in the event landing gear mechanisms fail to lower the gear.

Categories of Aircraft

A. The four categories of aircraft and their subdivision into classes are listed below.
   1. ***Airplanes***
      a. Single-engine land
      b. Multiengine land
      c. Single-engine sea
      d. Multiengine sea
   2. ***Gliders***
   3. ***Rotorcraft***
      a. Gyroplanes -- Thrust is provided by a pusher propeller and lift by an unpowered rotorblade.
      b. Helicopter -- Rotorblade is powered to obtain lift and thrust.
   4. ***Lighter-than-air***
      a. Airship
      b. Gas balloon
      c. Hot air balloon

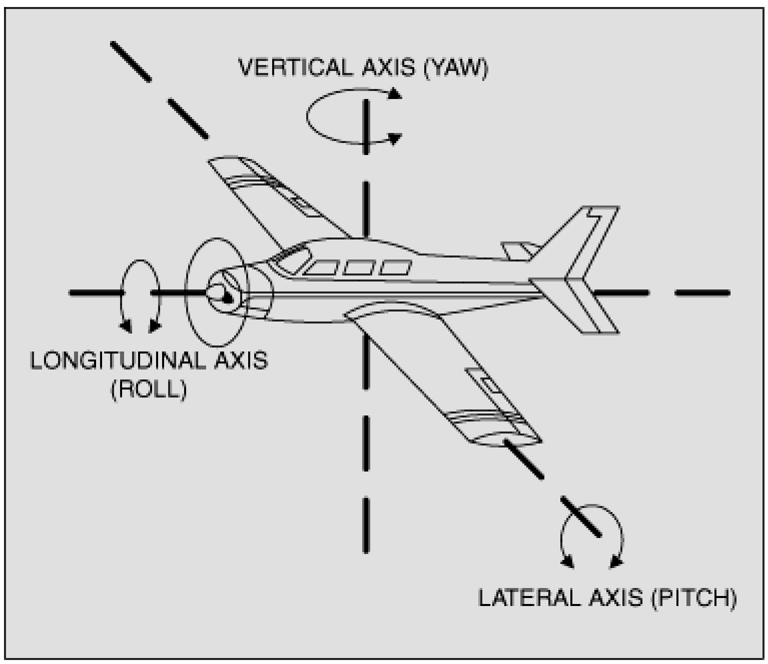
Inside the Airplane

The following is a diagram of a Piper Tomahawk control panel. It may contain more equipment than is found in some trainer-type airplane used by student pilots.



Axes of Rotation

A. The airplane has three axes of rotation around which it moves. See the illustration below.
   1. **Lateral (pitch) axis** -- an imaginary line from wingtip to wingtip
      1. Rotation about the lateral axis is called **pitch** and is controlled by the elevator.
      2. The rotation is similar to a seesaw. The bar holding the seesaw is the lateral axis.
      3. The angle between the airplane's nose and the horizon is known as the airplane's **pitch attitude**.
   2. **Longitudinal (roll) axis** -- an imaginary line from the nose to the tail
      a. Rotation about the longitudinal axis is called **roll** and is controlled by the ailerons.
      b. The rotation is similar to a barbecue rotisserie, in which the spit is the longitudinal axis.
      c. The angle between the airplane's wings and the horizon is known as the airplane's bank.
   3. **Vertical (yaw) axis** -- an imaginary line extending vertically through the intersection of the lateral and longitudinal axes
      . Rotation about the vertical axis is called **yaw** and is controlled by the rudder. This rotation is referred to as directional control or directional stability.
      a. The rotation is similar to a weather vane, in which the post holding the vane is the vertical axis.

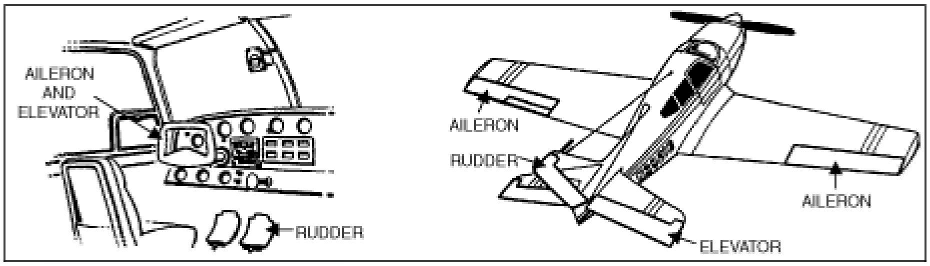


B. The airplane can rotate around one, two, or all three axes simultaneously. Think of these axes as imaginary axles around which the airplane turns, much as a wheel would turn around axles positioned in these same three directions.

Flight Controls and Control Surfaces (See the illustration below.)

A. **Primary Flight Controls.** The airplane is controlled by deflection of flight control surfaces. These are hinged or movable surfaces with which the pilot adjusts the airplane's attitude during takeoff, flight maneuvering, and landing (airplane attitude refers to whether the airplane is pointing up, down, etc.). The flight control surfaces are operated by the pilot through connecting linkage to the rudder pedals and a control yoke.

1. The **control yoke** is similar to the steering wheel of a car. However, you can push and pull it in addition to turning it. The push/pull movement controls the third dimension in which airplanes move (up and down). Remember, a car can only go straight or turn (move in two dimensions), but an airplane can go straight, turn, or move up and down.

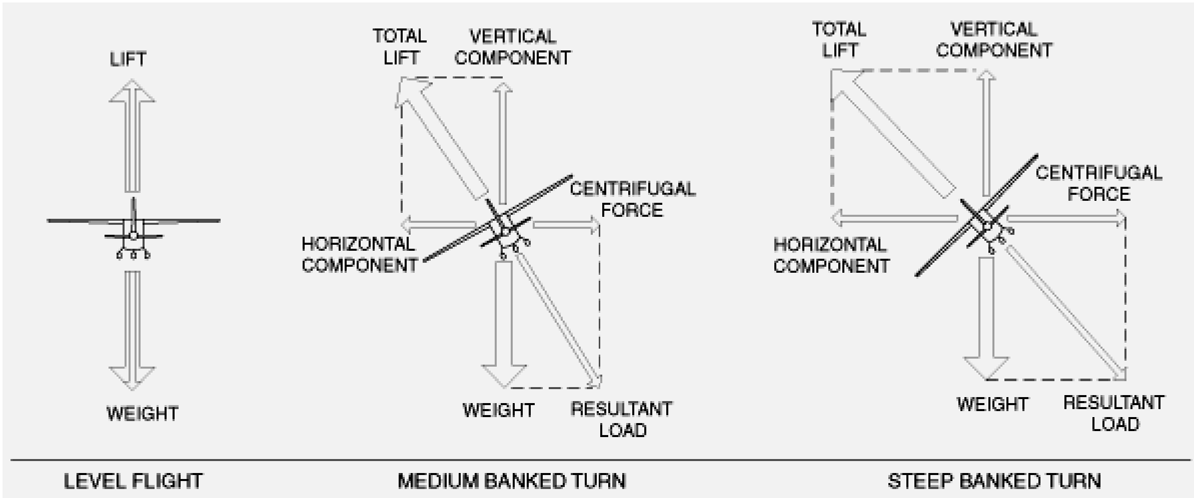


2. The **rudder** is attached to the vertical stabilizer. Controlled by the rudder pedals, the rudder is used by the pilot to control the direction (left or right) of yaw about the airplane's vertical axis for minor adjustments. It is NOT used to make the airplane turn, as is often erroneously believed. Banking the airplane makes it turn. See the next section, "How Airplanes Turn."
3. The **elevators** are attached to the horizontal stabilizer. The elevators provide the pilot with control of the pitch attitude about the airplane's lateral axis. The elevators are controlled by pushing or pulling the control yoke.
4. The outboard movable portions of each wing are the **ailerons**. The term "aileron" means "little wing" in French. Ailerons are located on the trailing (rear) edge of each wing near the outer tips. When deflected up or down, they in effect change the wing's camber (curvature) and its angle of attack. This changes the wing's lift and drag characteristics.
    a. Their primary use is to bank (roll) the airplane around its longitudinal axis. The banking of the wings results in the airplane turning in the direction of the bank, i.e., toward the direction of the low wing.
    b. The ailerons are interconnected in the control system to operate simultaneously in opposite directions of each other. As the aileron on one wing is deflected downward, the aileron on the opposite wing is deflected upward.
    c. The ailerons are controlled by turning the control yoke.

B. **Secondary Flight Controls.** In addition to primary flight controls, most airplanes have another group called secondary controls. These include trim devices of various types and wing flaps.
1. **Trim tabs** are commonly used to relieve the pilot of maintaining continuous pressure on the primary controls when correcting for an unbalanced flight condition caused by changes in aerodynamic forces or weight.
2. **Wing flaps** are installed on the wings of most airplanes. Flaps increase both lift and drag and have three important functions:
    a. First, they permit a slower landing speed, which decreases the required landing distance.
    b. Second, they permit a comparatively steep angle of descent without an increase in speed. This makes it possible to safely clear obstacles when making a landing approach to a small field.
    c. Third, they may also be used to shorten the takeoff distance and provide a steeper climb path.

How Airplanes Turn

A. The lift produced by an airplane's wings is used to turn the airplane. When banked, the horizontal component of lift turns the airplane.



1. Until a force acts on the airplane, it tends to fly straight ahead due to inertia.
    a. Inertia is the phenomenon observed when moving objects continue to move in the same direction; i.e., they tend not to turn unless acted upon by an outside force.
2. When the airplane begins to turn, centrifugal force pulls the airplane away from the turn, i.e., tends to make it fly straight ahead.
3. The horizontal component of lift (in a bank) counteracts the centrifugal force.
    a. Therefore, the greater the bank, the sharper the turn or the greater the rate of turn because more of the total lift goes into the horizontal component.
4. The rudder does not turn the airplane. It controls the yaw about the vertical axis.
    a. This permits the "coordination" of the rudder and ailerons.
    b. **Coordinated flight** is when the airplane goes "straight ahead" through the relative wind.

B. In a bank, the total lift consists of both horizontal lift (counteracting centrifugal force) and vertical lift (counteracting weight and gravity).
1. Therefore, given the same amount of total lift, there is less vertical lift in a bank than in straight-and-level flight.
2. Thus, to maintain altitude in a turn, you must
    a. Increase back pressure on the control yoke (for a higher angle of attack to produce more lift), and/or
    b. Increase power.

C. The turn is stopped by decreasing the bank to zero (i.e., wings level).

Basic Flight Maneuvers

In this section, we have provided you with more detailed information on the basic flight maneuvers (straight-and-level, turns, climbs, and descents). Do not feel overwhelmed by the material. Just read and try to understand the basic concepts and write down questions to ask your instructor. At the beginning of each flight lesson, your instructor will sit down with you to go over what you will do during the lesson. This is called a preflight briefing. It is a discussion between you and your CFI that should answer all of your questions. Your home study before the lesson will reduce the time spent on the preflight briefing and provide you with quality flight training time -- all of which will help keep costs down.

OTHER AIR TRAFFIC

A. Always look for other aircraft. Your flight instructor will explain how to scan for other airplanes.
    1. Scanning the sky for other aircraft is a key factor in collision avoidance. You and your instructor should scan continuously to cover all areas of the sky visible from the cockpit.
    2. You must develop an effective scanning technique that maximizes your visual capabilities.
        a. While the eyes can observe an approximate 200° arc of the horizon at one glance, only a very small center area (the fovea) can send clear, sharply focused messages to the brain. All visual information that is not processed directly through the fovea will be less detailed.
        b. An aircraft that is 7 mi. away may appear in sharp focus within the foveal center of vision but must be as close as 7/10 mi. to be recognized by less central vision.

B. Effective scanning is accomplished with a series of short, regularly spaced eye movements that bring successive areas of the sky into the central visual field.
    1. Each eye movement should not exceed 10°.
    2. Each area should be observed for at least 1 sec. to enable detection.

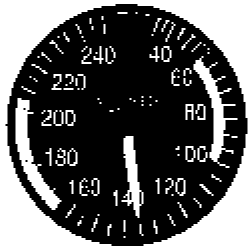
C. During your flight training, you should be requested to verbalize your clearing procedures to instill and sustain the habit of vigilance during flight.
    1. Call out "clear left" or "clear right" before turning and "clear above" or "clear below" before climbing or descending.
    2. In a high-wing airplane, momentarily raise the wing in the direction of intended turn and look.
    3. In a low-wing airplane, momentarily lower the wing in the direction of the intended turn and look.

INTEGRATED FLIGHT TRAINING

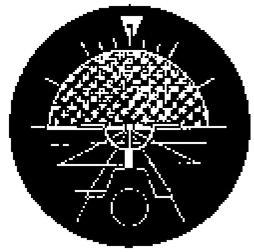
A. The FAA recommends integrated flight training, which means that each flight maneuver (except those requiring ground references) should be learned first by outside visual references and then by instrument references only (i.e., flight instruments).
    1. Thus, instruction in the control of the airplane by outside visual references is **integrated** with instruction in the use of flight instrument indications for the same operations.
    2. Integrated instruction will assist you in developing a habit of monitoring your flight and engine instruments.
        a. You should be able to hold desired altitudes, control airspeed during various phases of flight, and maintain headings based only on your flight instruments, i.e., without looking outside.

B. As a practical matter, your initial experience (i.e., introductory flight) with the flight controls will be based on outside visual references.

C. When you are sitting in the airplane, you will notice six flight instruments in front of you. Your instructor will refer to these instruments. The typical positions of these instruments are shown below.

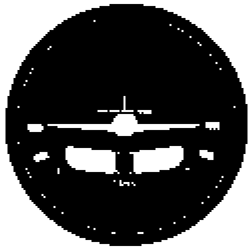


1. AIRSPEED INDICATOR

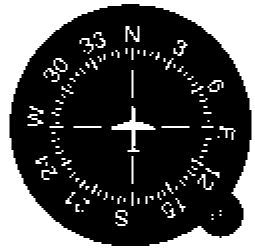


2. ATTITUDE INDICATOR

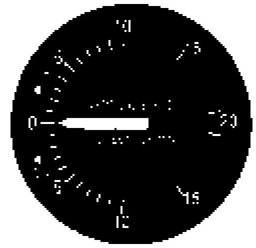
3. ALTIMETER



4. TURN COORDINATOR



5. HEADING INDICATOR



6. VERTICAL SPEED INDICATOR

1. Airspeed indicator (ASI) displays the speed at which the airplane is moving through the air. The ASI in the figure is indicating an airspeed of 135 knots.
2. Attitude indicator (AI) displays the attitude of the airplane (nose up, nose down, wings banked) in relation to the horizon. The AI in the figure is indicating level flight (nose and wings are level in relation to the horizon).
3. Altimeter (ALT) displays the altitude of the airplane above mean sea level (MSL) when properly adjusted to the current pressure setting. The ALT in the figure is indicating an altitude of 14,500 ft. MSL.
4. Turn coordinator (TC) displays the rate at which a turn is being made. The miniature airplane banks in the direction of the turn. At the bottom of the instrument is a ball in a glass tube called an inclinometer. The inclinometer indicates whether the airplane is in coordinated flight (centered) or uncoordinated flight. The TC in the figure is indicating wings level and coordinated flight.
5. Heading indicator (HI) displays the heading (direction) the airplane is flying. The HI in the figure is indicating a heading of north.
6. Vertical speed indicator (VSI) displays whether the airplane is in level flight, climbing, or descending. The rate of climb or descent is indicated in hundreds of feet per minute. The VSI in the figure indicates level flight.

AIRPLANE CONTROL

A. Airplane control is composed of three components: pitch control, bank control, and power control.
    1. **Pitch control** is the control of the airplane about its lateral axis (i.e., wingtip to wingtip) by applying elevator pressure to raise or lower the nose, usually in relation to the horizon.
    2. **Bank control** is the control of the airplane about its longitudinal axis (i.e., nose to tail) by use of the ailerons to attain the desired angle of bank in relation to the horizon.
    3. **Power control** is the control of power or thrust by use of the throttle to establish or maintain a desired airspeed, climb rate, or descent rate in coordination with the attitude changes.

4. For additional information [flight controls and control surfaces].

B. The outside references used in controlling the airplane include the relationship of the airplane's nose and wingtips to the horizon to determine the airplane's pitch and bank attitude (nose up or down and wings banked).
    1. By pointing the nose of the airplane toward a landmark (town, lake, etc.), you can control the direction of flight.
C. The objectives of these basic flight maneuvers are
    1. To learn the proper use of the flight controls for maneuvering the airplane
    2. To attain the proper attitude in relation to the horizon by use of visual and instrument references
    3. To emphasize the importance of dividing your attention and constantly checking all reference points while looking for other traffic

STRAIGHT-AND-LEVEL FLIGHT

A. Straight-and-level flight means that a constant heading and altitude are maintained.
    1. It is accomplished by making corrections for deviations in direction and altitude from unintentional turns, descents, and climbs.
B. The pitch attitude for **level flight** (i.e., constant altitude) is obtained by selecting some portion of the airplane's nose or instrument glare shield as a reference point and then keeping that point in a fixed position relative to the horizon.
    1. That position should be cross-checked occasionally against the altimeter to determine whether or not the pitch attitude is correct for the power setting being used.
        a. If altitude is being lost or gained, the pitch attitude should be readjusted in relation to the horizon, and then the altimeter should be checked to determine if altitude is being maintained.
    2. The application of forward or back elevator pressure is used to control this attitude.
        a. The term "increase the pitch attitude" implies raising the nose in relation to the horizon by pulling back on the control yoke.
        b. The term "decreasing the pitch" means lowering the nose by pushing forward on the control yoke.
    3. The pitch information obtained from the attitude indicator will also show the position of the nose relative to the horizon.
C. To achieve **straight flight** (i.e., constant heading), you should select two or more outside visual reference points directly ahead of the airplane (e.g., roads, section lines, towns, lakes, etc.) to form an imaginary line and then keep the airplane headed along that line.
    1. While using these references, you should occasionally check the heading indicator (HI) to determine that the airplane is maintaining a constant heading.
    2. Both wingtips should be equidistant above or below the horizon (depending on whether your airplane is a high-wing or low-wing type). Any necessary adjustment should be made with the ailerons to return to a wings level flight attitude.
        a. Observing the wingtips helps to divert your attention from the airplane's nose and expands the radius of your visual scan, which assists you in collision avoidance.
    3. The attitude indicator (AI) should be checked for small bank angles, and the heading indicator (HI) should be checked to note deviations from the desired direction.
D. Straight-and-level flight requires almost no application of control pressure if the airplane is properly trimmed and the air is smooth.
    1. Trim the airplane so it will fly straight and level without constant assistance.
        a. This is called "hands-off flight."
        b. The trim controls, when correctly used, are aids to smooth and precise flying.
        c. Improper trim technique usually results in flying that is physically tiring,

particularly in prolonged straight-and-level flight.

2. The airplane should be trimmed by first applying control pressure to establish the desired attitude, and then adjusting the trim so that the airplane will maintain that attitude without control pressure in hands-off flight.

E. The airspeed will remain constant in straight-and-level flight with a constant power setting.
   1. Significant changes in airspeed (e.g., power changes) will, of course, require considerable changes in pitch attitude to maintain altitude.
   2. Pronounced changes in pitch attitude will also be necessary as the flaps and landing gear (if retractable) are operated.

TURNS

A. A turn is a basic flight maneuver used to change from, or return to, a desired heading. This maneuver involves the coordinated use of the ailerons, rudder, and elevator.
   1. Your CFI may use the terms shallow, medium, or steep turns to indicate the approximate bank angle to use.
      a. EXAMPLE: A shallow turn uses 20° of bank, a medium turn uses 30° of bank, and a steep turn uses 45° of bank.
   2. You will begin your training by using shallow to medium banked turns.

B. To enter a turn, you should simultaneously turn the control wheel (i.e., apply aileron control pressure) and rudder pressure in the desired direction.
   1. The speed (or rate) at which your airplane rolls into a bank depends on the rate and amount of control pressure you apply.
      a. The amount of bank depends on how long you keep the ailerons deflected.
   2. Rudder pressure must be enough to keep the ball of the inclinometer (part of the turn coordinator) centered.
      a. If the ball is not centered, step on the ball to recenter.
      b. EXAMPLE: If the ball is to the right, apply right rudder pressure (i.e., step on the ball) to recenter.
   3. The best outside reference for establishing the degree of bank is the angle made by the top of the engine cowling or the instrument panel with respect to the horizon.
      a. Since on most light airplanes the engine cowling is fairly flat, its horizontal angle to the horizon will give some indication of the approximate degree of bank.
      b. Your posture while seated in the airplane is very important in all maneuvers, particularly during turns, since that will affect the alignment of outside visual references.
         1. At first, you may want to lean away from the turn in an attempt to remain upright in relation to the ground instead of rolling with the airplane.
         2. You must overcome this tendency and learn to ride with your airplane.
      c. In an airplane with side-by-side seating, you will be seated in the left seat. Since your seat is to the left of the centerline of the airplane, you will notice that to maintain altitude the nose position will be different on turns to the left than to the right.
         1. In a turn to the left, the nose may appear level or slightly high.
         2. In a turn to the right, the nose will appear to be low.
   4. Information obtained from the attitude indicator (AI) will show the angle of the wings in relation to the horizon. This information will help you learn to judge the degree of bank based on outside references.

C. The lift produced by the wings is used to turn the airplane, as discussed in How Airplanes Turn
   1. To maintain a constant altitude, you will need to apply enough back elevator pressure (raise the nose of the airplane) to maintain constant altitude.

D. As the desired angle of bank is established, aileron and rudder pressures should be released. The bank will not continue to increase since the aileron control surfaces will be neutral in their streamlined position.
    1. The back elevator pressure should not be released but should be held constant or sometimes increased to maintain a constant altitude.
    2. Throughout the turn, you should cross-check the references and occasionally include the altimeter to determine whether the pitch attitude is correct.
    3. If gaining or losing altitude, adjust the pitch attitude in relation to the horizon, and then recheck the altimeter and vertical speed indicator to determine if altitude is now being maintained.

E. The rollout from a turn to straight flight is similar to the roll-in to the turn from straight flight except that control pressures are used in the opposite direction. Aileron and rudder pressures are applied in the direction of the rollout or toward the high wing.
    1. Lead your rollout by an amount equal to one-half your bank angle.
        a. If you are using a 30 bank, begin your rollout approximately 15 before your desired heading.
    2. As the angle of bank decreases, the elevator pressure should be released smoothly as necessary to maintain altitude. Remember, when the airplane is no longer banking, the vertical component of lift increases.
    3. Since the airplane will continue turning as long as there is any bank, the rollout must be started before reaching the desired heading.
        a. The time to begin rollout in order to lead the heading will depend on the rate of turn and the rate at which the rollout will be made.
    4. As the wings become level, the control pressures should be gradually and smoothly released so that the controls are neutralized as the airplane resumes straight-and-level flight.
    5. As the rollout is completed, attention should be given to outside visual references as well as to the attitude indicator and heading indicator to determine that the wings are leveled precisely and the turn stopped.

CLIMBS

A. Climbs and climbing turns are basic flight maneuvers in which the pitch attitude and power result in a gain in altitude. In a straight climb, the airplane gains altitude while traveling straight ahead. In climbing turns, the airplane gains altitude while turning.

B. Your CFI will introduce you to various climb airspeeds early in your flight training.
    1. **Best rate of climb (V_Y)** provides the greatest gain in altitude in the least amount of time.
    2. **Best angle of climb (V_X)** 2. Integrated instruction will assist you in developing a habit of monitoring your flight and engine instruments.
        a. You should be able to hold desired altitudes, control airspeed during various phases of flight, and maintain headings based only on your flight instruments, i.e., without looking outside.
            1. As a practical matter, your initial experience (i.e., introductory flight) with the flight controls will be based on outside visual references. provides the greatest gain in altitude in a given distance.
    3. **Cruise climb** is used to climb to your desired altitude. This speed provides better engine cooling and forward visibility.
    4. These airspeeds are listed in the airplane's Pilot's Operating Handbook (POH), Section 4, Normal Procedures.

C. To enter the climb, simultaneously advance the throttle and apply back elevator pressure.

1. As the power is increased to the climb setting, the airplane's nose will tend to rise to the climb attitude.
    a. In most trainer-type airplanes, the climb setting will be full power.
2. While the pitch attitude increases and airspeed decreases, progressively more right-rudder pressure must be used to compensate for torque effects and to maintain direction.
    a. Since the angle of attack is relatively high, the airspeed is relatively slow, and the power setting is high, the airplane will have a tendency to roll and yaw to the left.
        1. While right-rudder pressure will correct for the yaw, some aileron pressure may be required to keep the wings level.

D. When the climb is established, back elevator pressure must be maintained to keep the pitch attitude constant.
1. As the airspeed decreases, the elevators may try to return to their streamline or neutral position, which will cause the nose to lower.
    a. Nose-up trim will be required.
2. You will need to cross-check the airspeed indicator (ASI) since you want to climb at a specific airspeed and the ASI will provide to you an indirect indication of pitch attitude.
    a. If the airspeed is higher than desired, you need to use the outside references and attitude indicator to raise the nose.
    b. If the airspeed is lower than desired, you need to use the outside references and attitude indicator to lower the nose.
3. After the climbing attitude, power setting, and airspeed have been established, trim the airplane to relieve all pressures from the controls.
    a. If further adjustments are made in pitch, power, and/or airspeed, you must retrim the airplane.
4. If a straight climb is being performed, you need to maintain a constant heading with the wings level.
    a. If a climbing turn is being performed, maintain a constant angle of bank.

E. To return to straight-and-level flight from a climbing attitude, you should start the level-off a distance below the desired altitude equal to about 10% of the airplane's rate of climb as indicated on the vertical speed indicator.
1. EXAMPLE: If you are climbing at 500 feet per minute (fpm), start to level off 50 ft. below your desired altitude.
2. To level off, the wings should be leveled and the nose lowered.
3. The nose must be lowered gradually, however, because a loss of altitude will result if the pitch attitude is decreased too abruptly before allowing the airspeed to increase adequately.
    a. As the nose is lowered and the wings are leveled, retrim the airplane.
    b. When the airspeed reaches the desired cruise speed, reduce the throttle setting to appropriate cruise power setting and trim the airplane.

F. **Climbing Turns**. The following factors should be considered:
1. With a constant power setting, the same pitch attitude and airspeed cannot be maintained in a bank as in a straight climb due to the decrease in the vertical lift and airspeed during a turn.
    a. The loss of vertical lift becomes greater as the angle of bank is increased, so shallow turns may be used to maintain an efficient rate of climb. If a medium- or steep-banked turn is used, the airplane's rate of climb will be reduced.
    b. The airplane will have a greater tendency towards nose heaviness than in a straight climb, due to the decrease in the vertical lift.
2. As in all maneuvers, attention should be divided among all references equally.

G. There are two ways to establish a climbing turn: either establish a straight climb and then turn, or establish the pitch and bank attitudes simultaneously from straight-and-level flight.
    1. The second method is usually preferred because you can more effectively check the area for other aircraft while the climb is being established.

DESCENTS

A. A descent is a basic maneuver in which the airplane loses altitude in a controlled manner. Descents can be made
    1. With partial power, as used during an approach to a landing
    2. Without power, i.e., a glide
    3. At cruise airspeeds, during en route descents
B. To enter a descent, you should first apply carburetor heat (if recommended in the POH) and then reduce power to the desired setting or to idle.
    1. Maintain a constant altitude by applying back elevator pressure as required until the airspeed decreases to the desired descent airspeed.
    2. Once the descent airspeed has been reached, lower the nose attitude to maintain that airspeed and adjust the trim.
C. When the descent is established, cross-check the airspeed indicator (ASI) to ensure that you are descending at the desired airspeed.
    1. If the airspeed is higher than desired, then slightly raise the nose and allow the airspeed to stabilize to confirm the adjustment.
    2. If the airspeed is lower than desired, then slightly lower the nose and allow the airspeed to stabilize.
    3. Once you are descending at the desired airspeed, note the position of the airplane's nose to the horizon and the position on the attitude indicator (AI).
        a. Trim the airplane to relieve all control pressures.
    4. Maintain either straight or turning flight, as desired.
D. The level-off from a descent must be started before reaching the desired altitude.
    1. Begin the level-off at a distance equal to about 10% of the airplane's rate of descent as indicated on the vertical speed indicator (VSI).
        a. EXAMPLE: If you are descending at 500 fpm, start the level-off 50 ft. above your desired altitude.
    2. At the lead point, you should simultaneously raise the nose to a level attitude and increase power to the desired cruise setting.
        a. The addition of power and the increase in airspeed will tend to raise the nose. You will need to apply appropriate elevator control pressure and make a trim adjustment to relieve the control pressures.
E. **Turning Descents**
    1. As with climbing turns, you can either enter the turn after the descent has been established or simultaneously adjust the bank and pitch attitudes.
    2. At a desired power setting during a descending turn, maintain airspeed with pitch as you would in a straight descent.
    3.