



The Axes of Flight

Suggested Grades: K-8

Activity Overview

In this activity, you will learn about motions, forces and energy transfer by studying the three axes of flight. You will be able to see how the three axes of flight work together to allow an aircraft to fly.

Do you know the parts of an airplane and what they do? Before you begin, take a look at the parts of an airplane found at the end of this activity.

Time: 45 minutes

Materials

- Three pencils
- Tape
- Scissors
- Hole punch
- Airplane template (part of this document)

Steps

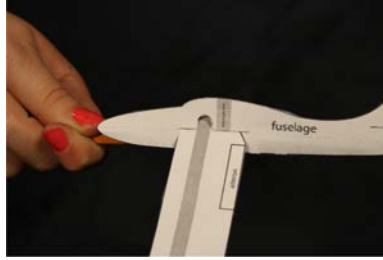
1. Cut out each of the airplane components. Make holes in the center of the wing and fuselage where directed on the diagram.



2. Tape one pencil to the fuselage as marked on the diagram.



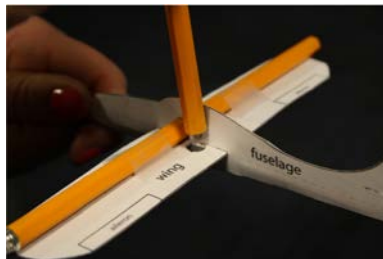
3. Slide the wing through the slot in the fuselage.



4. Insert a pencil through the hole in the fuselage, and tape it to the wing.



5. Insert the third pencil through the hole made in the left wing, again taping it to the fuselage.

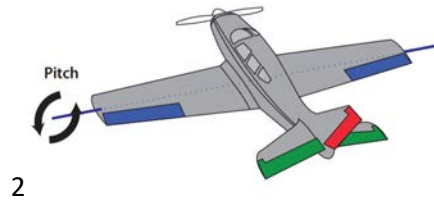


6. Slide the elevator into the slot in the tail and tape it in place on each side.

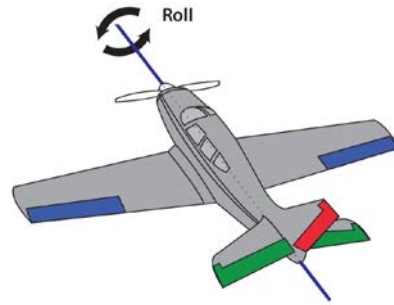


7. The pictures below show the three axes of motion for an airplane. Each pencil in the airplane model represents one of these axes. Identify which pencil represents each axis.

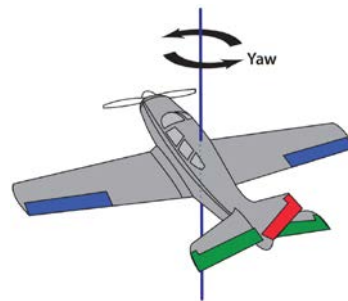
Lateral Axis -



Longitudinal Axis -



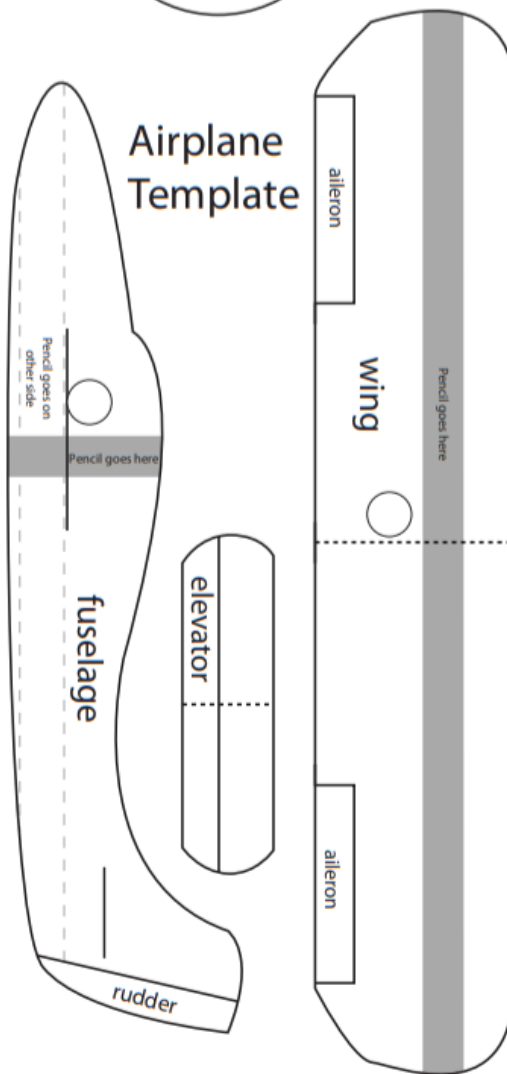
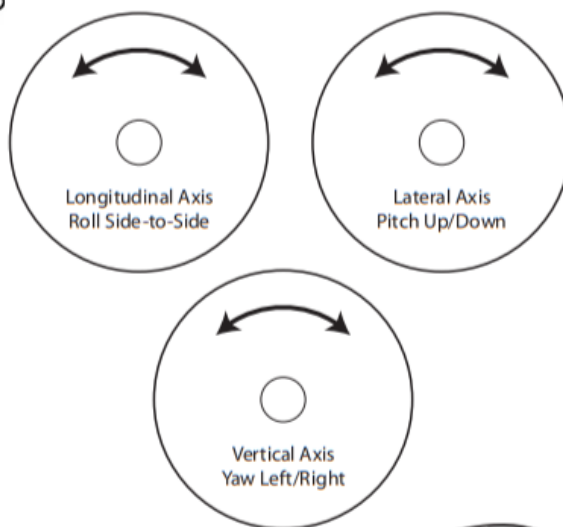
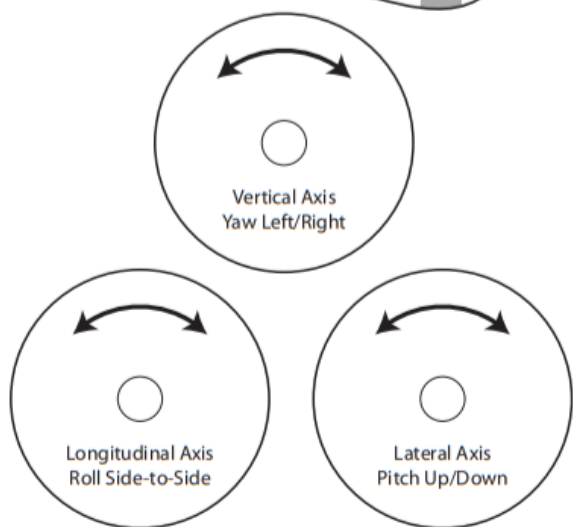
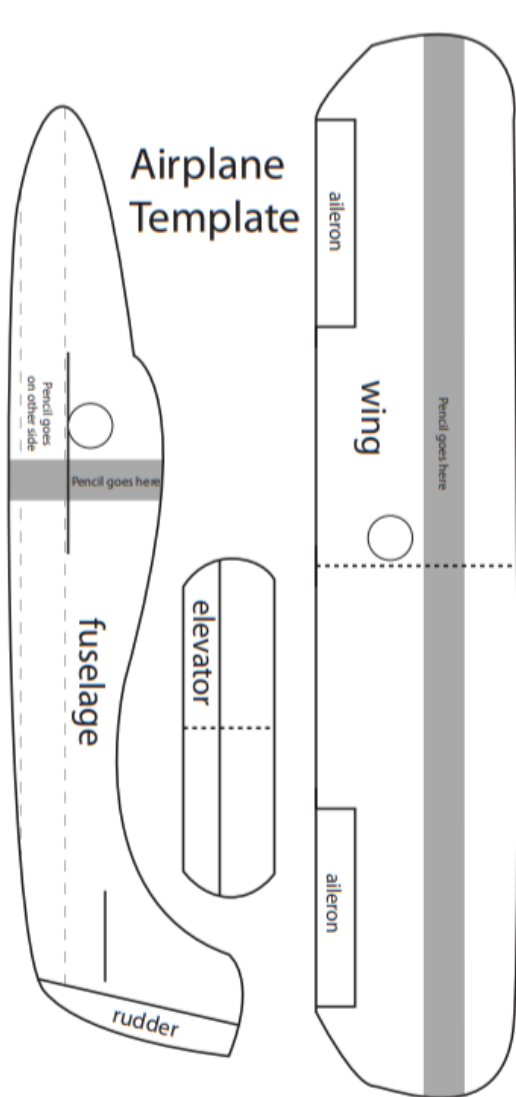
Vertical Axis -



8. Cut out the three circles from the airplane template and punch a hole in the middle where indicated. Place the labels for each axis at the end of the pencils.



9. Use this model to study how an airplane flies, turns and moves through the air. Can you figure out which axes of flight are involved in different aircraft movements? (Hint: There are often more than one at a time.)



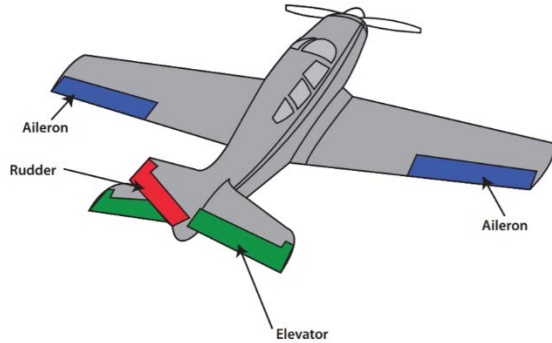


Figure 1. Aircraft control surfaces

Background Information

In order for an aircraft to reach its destination, the forces of flight have to be precisely manipulated. To do this, the aircraft has control surfaces (Figure 1) that can direct airflow in very specific ways.

Elevator/Pitch

As the name implies, the elevator helps elevate the aircraft. It is usually located on the tail of the aircraft and serves two purposes. The first is to provide stability by producing a downward force on the tail. Airplanes are traditionally nose-heavy, and this downward force is required to compensate for that. The second is to direct the nose of the aircraft either upwards or downwards, known as pitch, in order to make the airplane climb and descend (Figure 2).

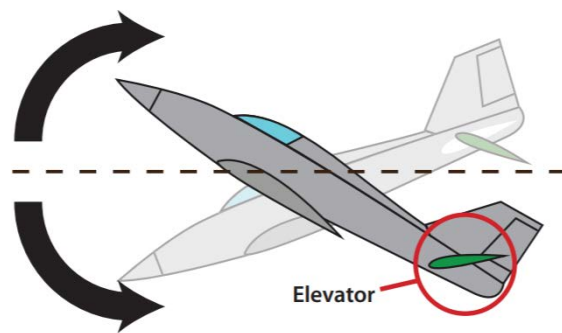


Figure 2. Elevator and pitch movement

Ailerons/Roll

The ailerons are located at the rear of the wing, one on each side. They work opposite to each other; so when one is raised, the other is lowered. Their job is to increase the lift on one wing while reducing the lift on the other. By doing this, they roll the aircraft sideways, which allows the aircraft to turn. This is the primary method of steering a fixed-wing aircraft (Figure 3).

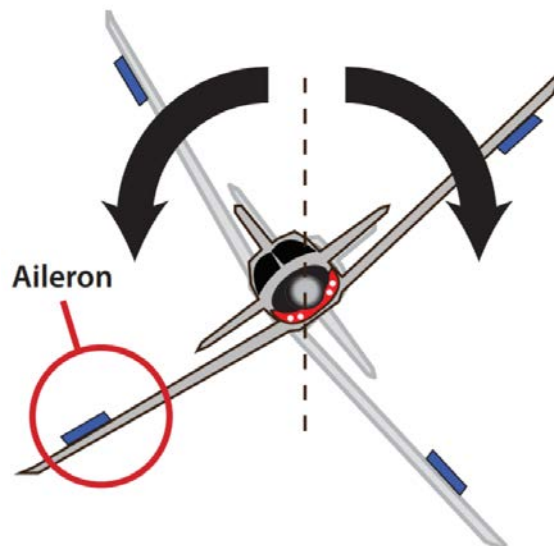


Figure 3. Ailerons and roll movement

Rudder/Yaw

The rudder is located on the tail of the aircraft. It works identically to a rudder on a boat, steering the nose of the aircraft left and right. Unlike the boat, however, it is not the primary method of steering. Its main purpose is to counteract the drag caused by the lowered aileron during a turn. This adverse yaw, as it is known, causes the nose of the airplane to point away, or outwards, from the direction of the turn. The rudder helps to correct this by pushing the nose in the correct direction, maintaining what is known as coordinated flight (*Figure 4*).

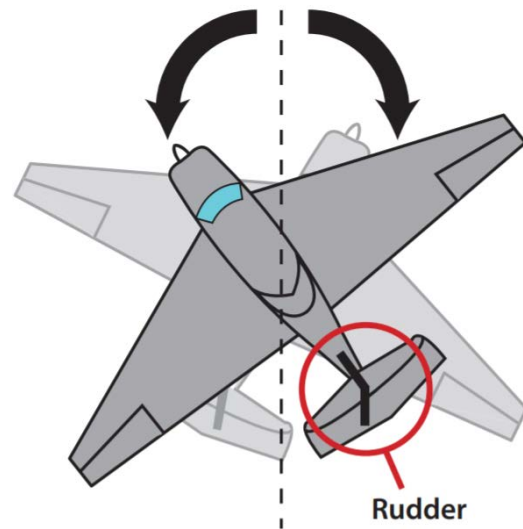


Figure 4. Rudder and yaw movement

Axes of Motion

Each axis of flight is an imaginary line around which an airplane can turn. Think of an airplane rotating around an axis like a wheel rotates around an axle. Regardless of the type of aircraft, there are three axes upon which it can move: Left and right, forwards and backwards, up and down. In aviation though, their technical names are the lateral axis, longitudinal axis and vertical axis.