Primary Flight Control Surfaces - Airplane movement, Axes of rotation, Stability

A lesson on Primary Flight Control on an Aircraft. Friends, Romans, and Student Pilots. Lend me your EAR.

I just took a hearing test and being old and hanging around jet engines most of my adult life, I have a very slight loss of a high frequency which just happens to be in the range of a female voice. My wife did NOT buy into this when I do not quite seem to hear her. (Instead She calls it: "husband's selective hearing"). Which bring me to a lesson in what primary flight control surfaces of an aircraft are, what they do, the axes they make the airplane move around and Stability. Start with the word EAR. Each letter of EAR happens to be the first letter of the three primary flight control surfaces of most aircraft. A FAA test question for Private Pilot: primary flight control surfaces on an aircraft are:

answer: Elevator Aileron Rudder.

If you can remember the word EAR and you had a good kindergarten or 1st grade teacher that taught you your alphabet, you can write down the rest of the answers to the questions Pitch, Roll, and Yaw and Lateral axis, Longitudinal axis, and Vertical axis of an airplane in alphabetical order. Ready: Write down the word EAR vertically and the rest of the words are in alphabetical order vertically (see figure).

Primary flight control surfaces	Next column: Aircraft movement:	Next column: Axes of an airplane:
Elevator →	**P**itch →	**La**teral,
Aileron →	**R**oll →	**Lo**ngitudinal,
Rudder. →	**Y**aw →	**V**ertical.

Pitch is an interesting word if you do not know its meaning in aviation.

A sport's guy would tell you about it in Baseball and Soccer. (pitch the ball to the batter. Soccer - the width of the field) A sales person would pitch you an idea on buying something. A singer - the right note. Lots of definitions of "Pitch".

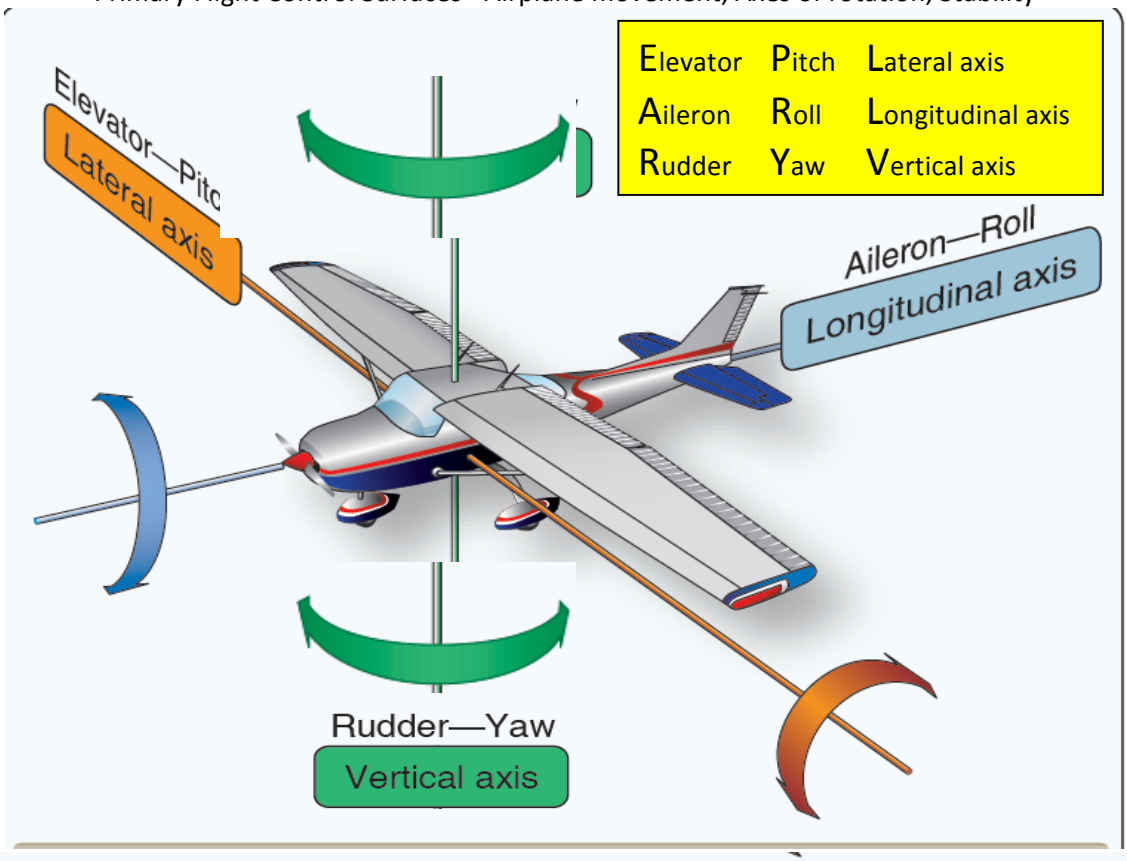
Pitch is done with the Elevator which is the movable primary flight control surfaces on the horizontal stabilizer (part of the aircraft's tail). When the aircraft is right side up -(Wheels are closer to the earth than you are) Pressure back on the yoke with two of your fingers (yoke - in a car would be a funny looking steering wheel) **E**levator goes Up and nose of the aircraft goes up. (pitches up) Pressure the yoke forward with your thumb and the **E**levator moves down and the nose moves down (pitches down). So the joke is: pitch up (Pressure back)on the yoke and the houses get smaller. Pitch down (pressure forward) on the yoke and the houses get bigger. I scared my little sister when the Ferris Wheel we were riding stopped at the top and I pitched the chair down (rocked forward) to see the other people in the chairs in front and below us.

The chair was "laterally" attached to both side of the chair therefore we were moving around the chair's lateral axis. (Mom was not very happy with me that day.) So the wings are what the lateral axis is going through.(think of the ends of the wings attached like the chair of the Ferris Wheel).

The Ailerons: French for small wing. This movable primary flight control surface is attached near the end and aft part of both wings. Pressure the left side of the yoke with your thumb down (turn the yoke to the left) and the left wing **A**ileron moves up, right wing **A**ileron moves down. The aircraft rolls to the left. Pressure the left side of the yoke with your finger up (turn the yoke to the right) and the right wing **A**ileron moves up and left **A**ileron moves down and aircraft rolls right. As we **roll** right a**long**. "Long" Longitudinal axis. (axis runs nose to tail)

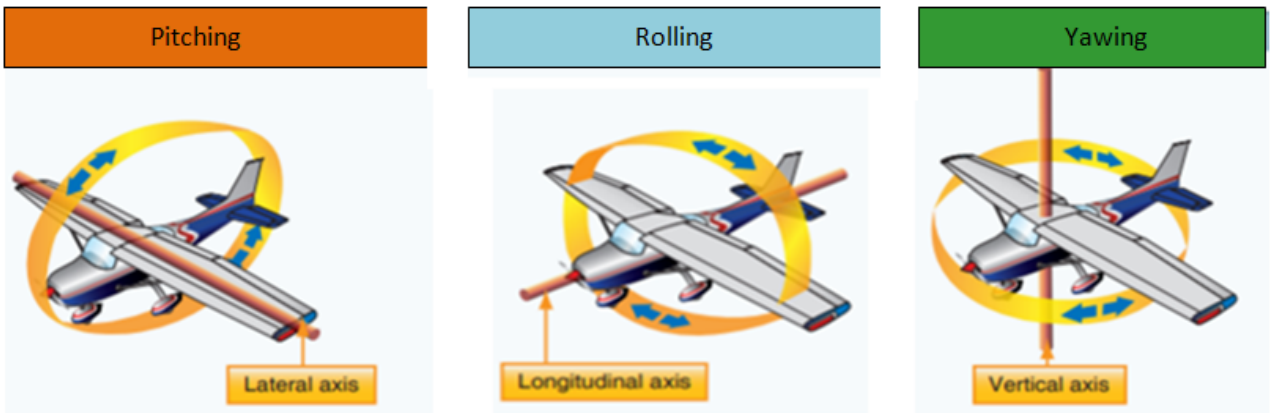
The Rudder. I think that is the only word a Flight Instructor knows from the English language. When all else fails and he/she can't think of any other word, he/she says **R**udder **R**udder **R**udder. Ok, calm down. just kidding. I know it is the vertical movable primary flight control surface on the tail. The **R**udder makes the airplane "yaw".

Yaw is a mid 16th century word of unknown origin. A ship has a **R**udder and the **R**udder makes the ship's movements around the vertical axis so they brought it over to aviation. Vertical flight control surface - Vertical axis. Pressure the left **R**udder pedal forward, the **R**udder moves left and the nose moves (yaws) to the left about the Vertical axis. Pressure the right **R**udder pedal forward, the **R**udder moves right and nose yaws to the right about the Vertical axis. Things to remember about the **R**udder: WHEN FLYING, THE **R**UDDER IS USED WHEN THE AILERONS ARE MOVED OR THE THROTTLE IS MOVED TO ADD OR REDUCE ENGINE POWER. &: IT'S A WORD FLIGHT INSTRUCTORS LOVE TO SAY. The **R**udder is an important primary flight control surface you really need to learn how to use properly.



Primary control surface	Airplane movement	Axes of rotation
Elevator/stabilator	Pitch	Lateral
Aileron	Roll	Longitudinal
Rudder	Yaw	Vertical

AND if you are listening with your E.A.R.s, your answers to your primary flight control surfaces test questions should be heard clearly in your hearing frequency range. I have substituted the word pressure for the words: pull, push, and turn when moving the primary flight control surfaces. Use enough "pressure" on these controls to do what is needed and your passengers in the back seats will love you for it.



Primary control surface	Airplane movement	Axes of rotation	Stability
Elevator/stabilator	Pitch	Lateral	Longitudinal
Aileron	Roll	Longitudinal	Lateral
Rudder	Yaw	Vertical	Directional

Now for the fourth column which is called: STABILITY. The S word. We were doing so well with alphabetical order. Well we can still do that. I will take the definitions right out of the Pilot's handbook of Aeronautic Knowledge: FAA-H-8083-25B Read all about in Chapter 5.

Stability

Longitudinal stability is the quality that makes an aircraft **stable about its "lateral axis".**

Lateral stability: stability about the aircraft's "longitudinal axis".

Directional stability: Stability about the aircraft's "vertical axis" (the sideways moment).

Just remember on the test, ***read*** the questions ***carefully***. Do they want the Axis of rotation or Stability? Choose your answers carefully.

Remember: keep flying the aircraft until the airplane is tied down or in the hangar.

John Morgan, Sr./CFII

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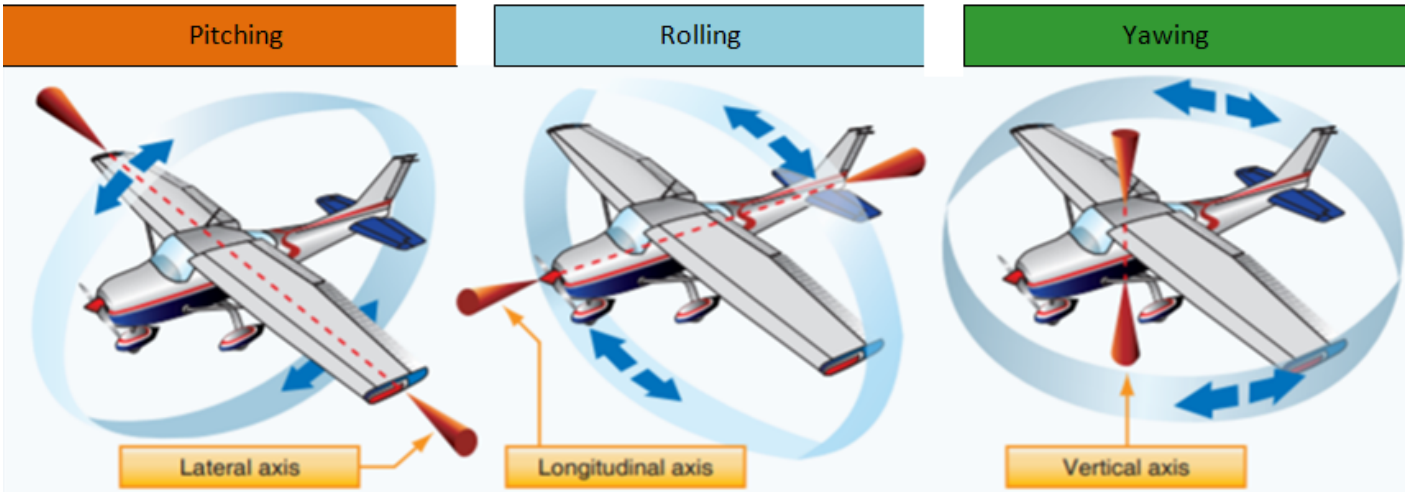

Longitudinal Stability | Lateral Stability | Directional Stability