Ex. 6 Straight and Level Flight

AIM:

Upon completion of this exercise you will be able to:

- ✓ **Fly the aircraft in balanced flight**
  - At a Selected Height
  - In a constant Direction
  - At a Constant Air Speed
- ✓ **Control Yaw**

Why learn this?

- ✓ Majority of time spent flying is straight-and-level flight.

- ✓ May seem like a simple exercise, but becomes not so simple during times of high workload such as flying in rough air…

Review:

- What is angle of attack?
- What is a trim tab?
- What are the three axes and the corresponding movements, and how does the pilot produce and control those movements?

Theories & Definitions

- ✓ Straight-and-Level Flight Definition
- ✓ Trim
- ✓ Effects of Power
  - on pitch (Attitude + Power=Performance)
  - on yaw
- ✓ Instruments
  - Magnetic Compass, Heading Indicator.
    - how it works, advantages and disadvantages
    - magnetic dip and compass errors

Straight-and-Level Flight: Definition

- ✓ steady direction
- ✓ wings level
- ✓ coordinated flight
- ✓ constant altitude
- ✓ constant airspeed

controlling heading

controlling bank

controlling yaw

controlling altitude

controlling airspeed

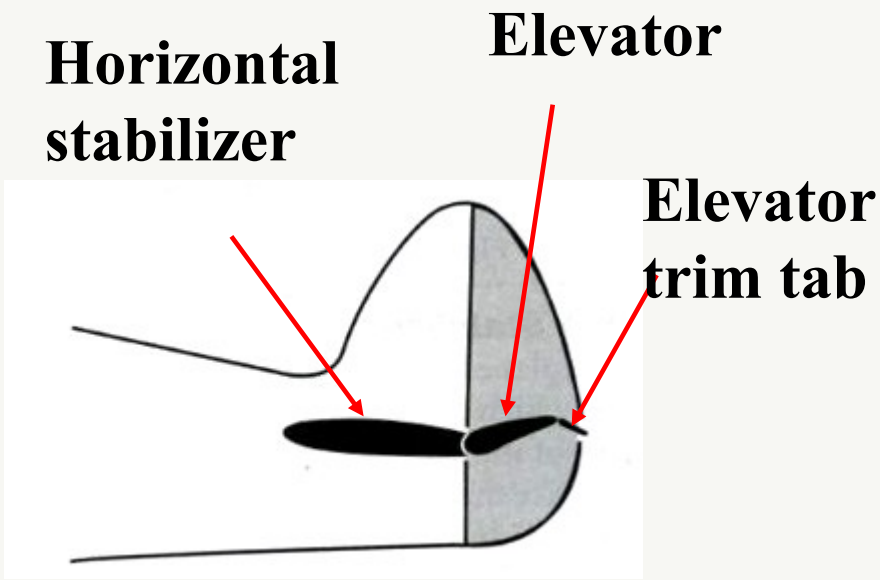
Achieved through a combination of:

control surfaces movements

+

power setting

Trim



- ✓ Elevator acts like a small wing
- ✓ It's hinged onto the horizontal stabilizer, free to rotate around the hinge
- ✓ Trim tab is a control surface hinged onto the elevator, position set by the pilot
- ✓ Adjusting trim tab position helps "trim off" control pressures: you won't have to keep pulling or pushing on the yoke to keep elevators where you want them to be

Effect of Power: Pitch

Airplane is trimmed for a certain angle of attack

In straight-and-level flight, a specific angle of attack corresponds to a specific airspeed

Plane wants to maintain established airspeed at any power setting

Add power ➔ Plane pitches up and starts to climb

Reduce power ➔ Plane pitches down and starts to descend

Attitude + Power = Performance

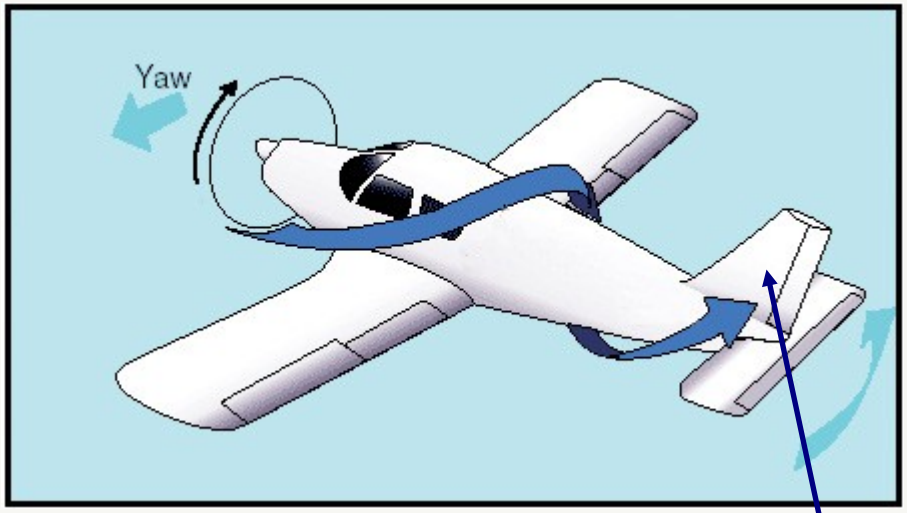
- ✓ Position of the Nose and Wings with respect to the horizon
  - nose up or nose down?
  - level or banked
- ✓ Controlled by elevators

- ✓ How much work is the engine doing?
- ✓ Controlled by throttle

- ✓ How fast is the plane going?
- ✓ Climbing, descending or level? How fast is the climb/descent?
- ✓ Is the plane turning? How quickly?

Attitude and power control <u>every</u> aspect of performance <u>together.</u>

Effect of Power: Yaw



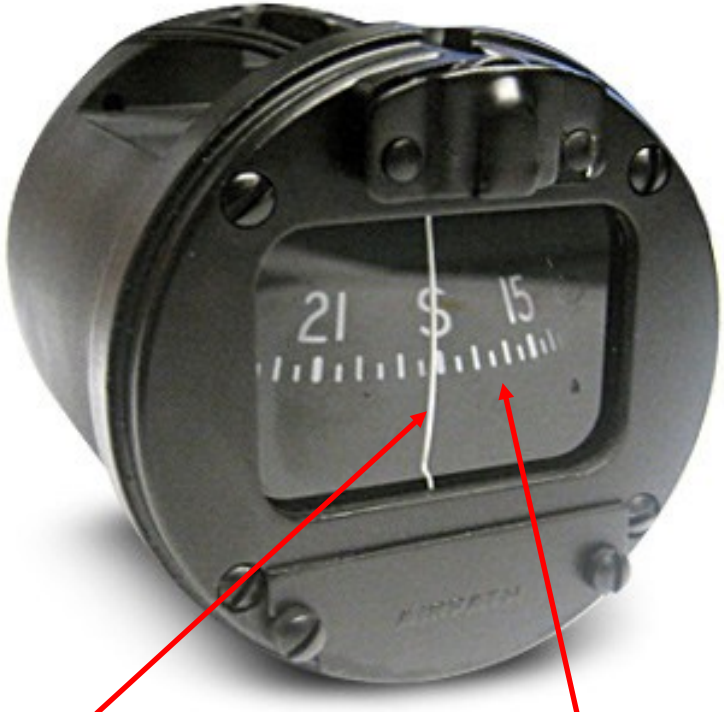
Add power➔ **Plane yaws to the left**

Reduce power ➔ **Plane yaws to the right**

Fin usually offset to compensate

Offset designed for typical cruise configuration

Magnetic Compass



Lubber line

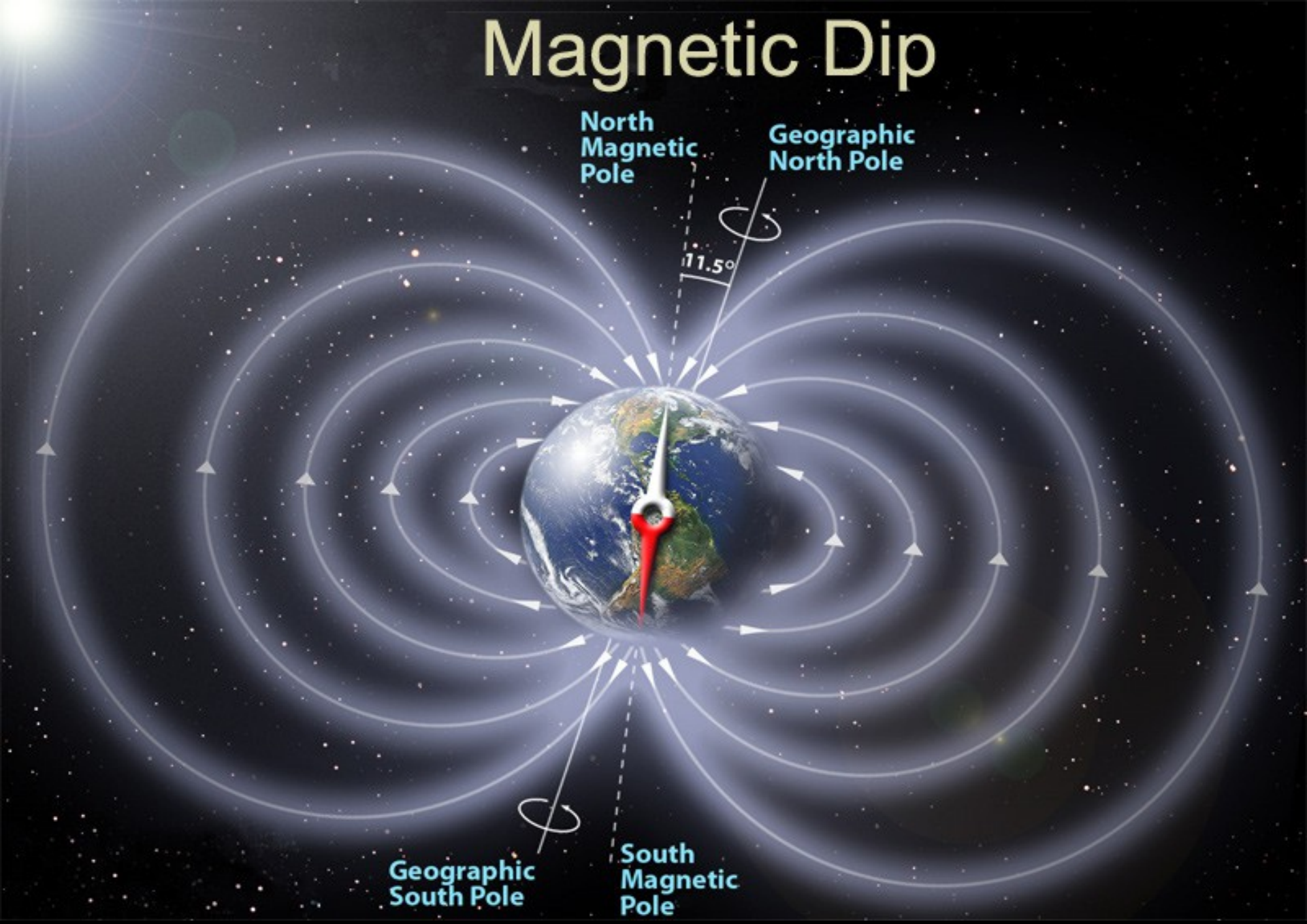
Compass card
- **mounted on a pivot**
- **floating in fluid**

\+ requires no external power

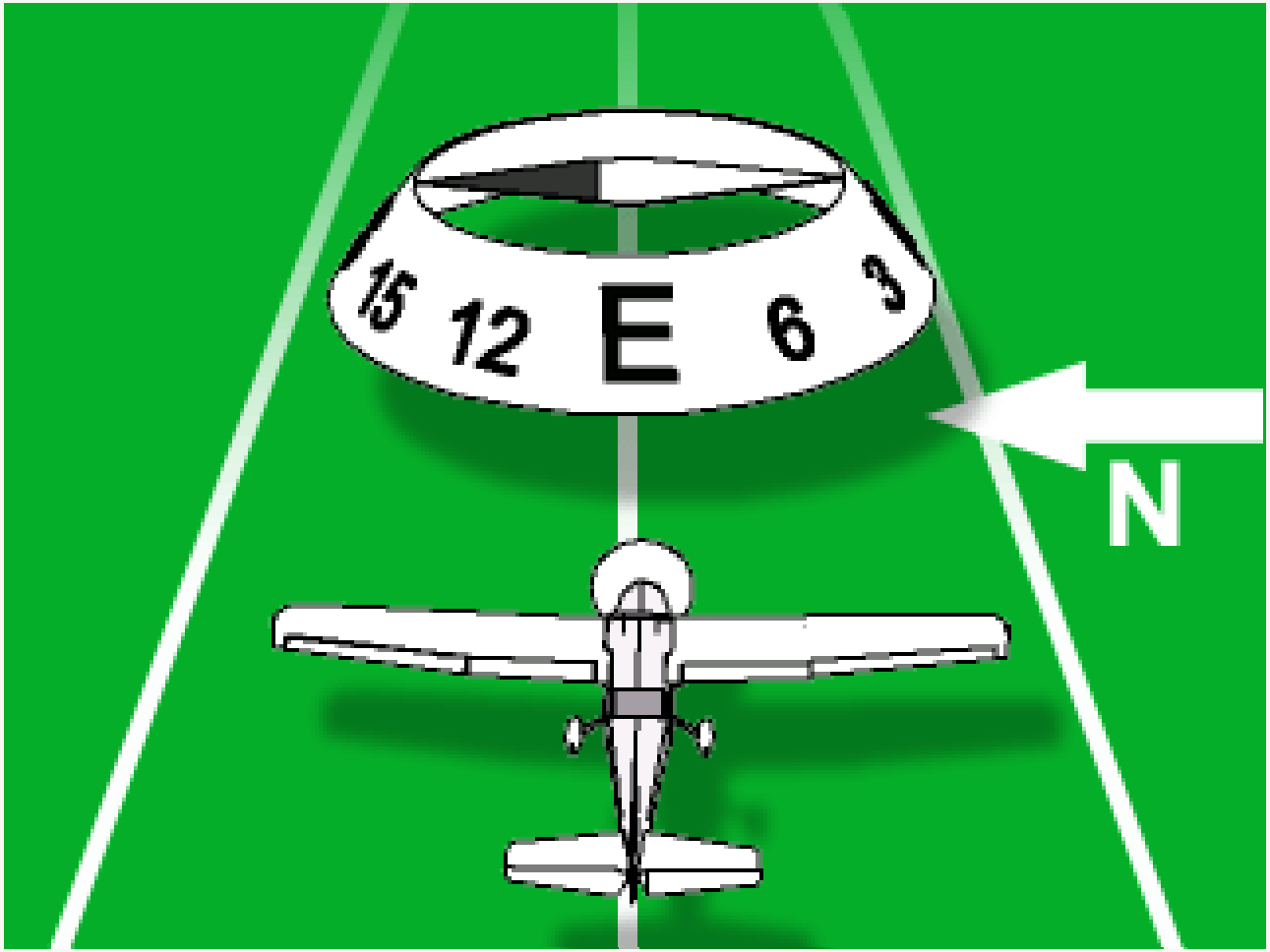
\+ simple (nothing to break)

– difficult to read in rough air

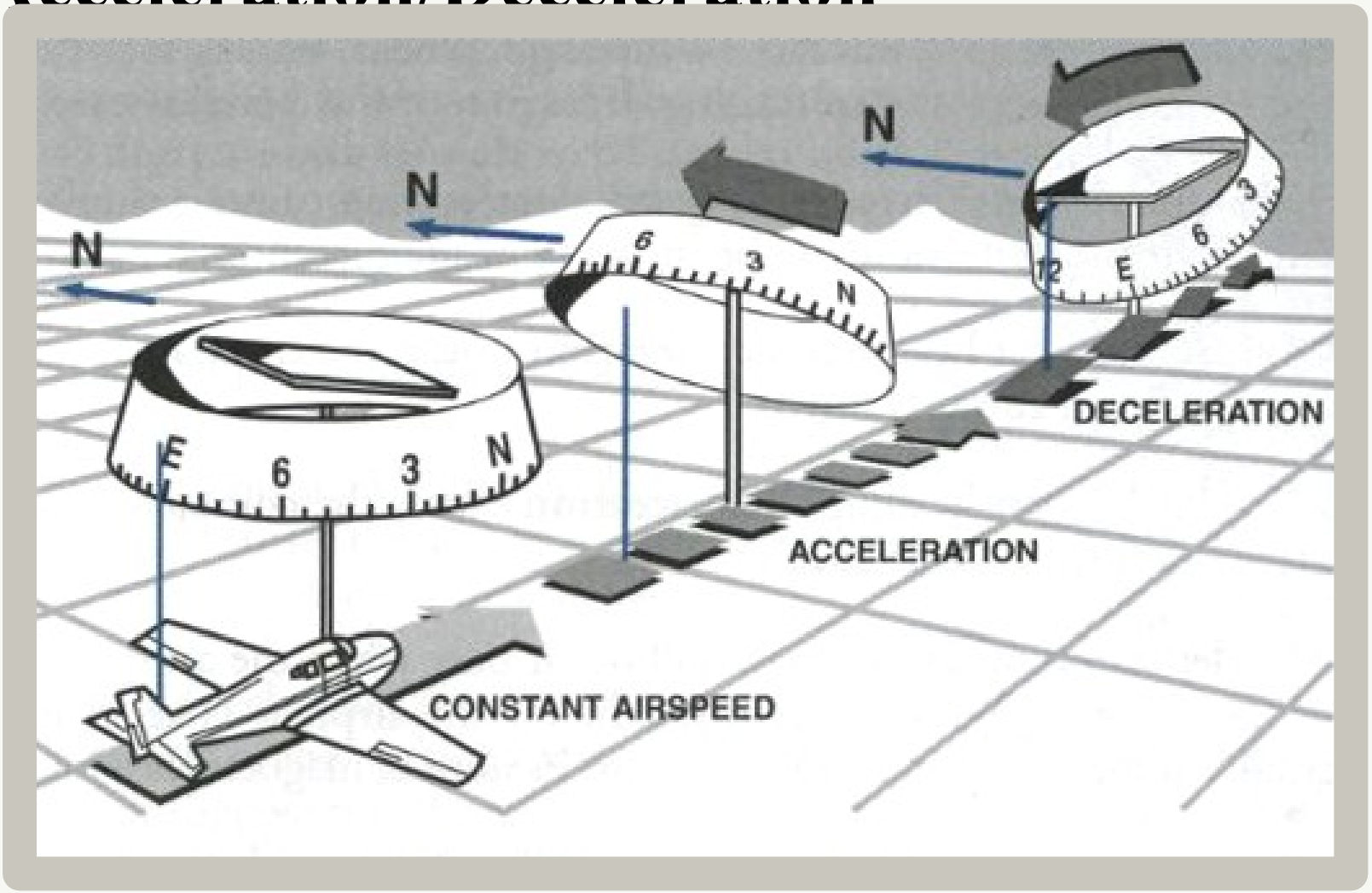
– not reliable in turns or when accelerating/decelerating


Magnetic Dip
North Magnetic Pole
Geographic North Pole
11.5°
Geographic South Pole
South Magnetic Pole

Compass Errors: Northerly Turning Error



Compass Errors:
Acceleration/Deceleration



Heading Indicator

+ works in turns and when accelerating/decelerating
+ stable, easy to read, intuitive interface

– should be reset every 10-15 minutes in straight-and-level flight

Set Up Normal Cruise

Keep a good look-out!

- ✓ Set up level flight at desired altitude and use trim wheel to eliminate control pressures
- ✓ Control yaw with rudder
- ✓ Keep wings level with ailerons

Increasing Power

Keep good look-out!

- ✓ Add power smoothly to estimated power setting
- ✓ Anticipate and prevent yaw with rudder
- ✓ Anticipate and prevent pitch change
- ✓ Retrim the aircraft

SAFETY: Lookout

- ✓ Must maintain constant systematic look-out for traffic
- ✓ Only glance at instruments for brief cross-checking
- ✓ Vigilant look-out especially critical when flying at nose-up attitudes.

Conclusion

- ✓ Flying straight and level is one of the most important and fundamental skills you will learn as a pilot
- ✓ Even something as seemingly simple as straight-and-level flight requires understanding and mastery of several interdependent controls
- ✓ As basic as this exercise is, perfection is a challenge! Hold yourself to a high standard from the beginning to keep improving
- ✓ For next lesson: read Exercise 7 - Climbing

QUESTIONS?