Human Factors

Objective

To become familiar with and apply the knowledge related to aeromedical and human factors.

Motivation

Understand the risks and mitigations for aeromedical factors that can effect flight safety, as they may happen to you, another pilot, or your passengers.

Hypoxia

Hypoxia is a state of oxygen deficiency in the body sufficient to impair functions of the brain and other organs

Symptoms

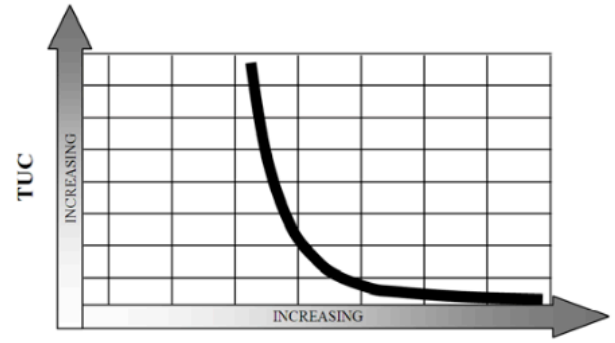
Cyanosis, headache, dizziness, euphoria, impaired vision, drowsiness

Corrective Actions

- Use supplemental oxygen
- Fly at a lower altitude
- Address any pollution in the air

Time of Useful Consciousness

FIGURE 2-3. TIMES OF USEFUL CONSCIOUSNESS VERSUS ALTITUDE



ALTITUDE	TUC/EPT	Following Rapid Decompression
18,000	20–30 min	10–15 min
22,000	10 min	5–6 min
25,000	3–5 min	1.5–2.5 min
28,000	2.5–3 min	1–1.5 min
30,000	1–2 min	30 s–1 min
35,000	30 s–1 min	15–30 s
40,000	15–20 s	Nominal
43,000	9–12 s	Nominal
50,000	9–12 s	Nominal

- From AC 61-107B

Types of Hypoxia

- **Hypoxic**: Caused by the reduction in partial pressure of oxygen at high altitude
- **Hypemic**: Caused by the blood not being able to take up and transport a sufficient amount of oxygen; CO poisoning
- **Stagnant**: Caused by a lack of circulation of oxygenated blood in the body; can occur during high-G maneuvers

Hyperventilation

Excessive rate and depth of respiration, leading to a condition where the body eliminates more carbon dioxide than the body can produce.

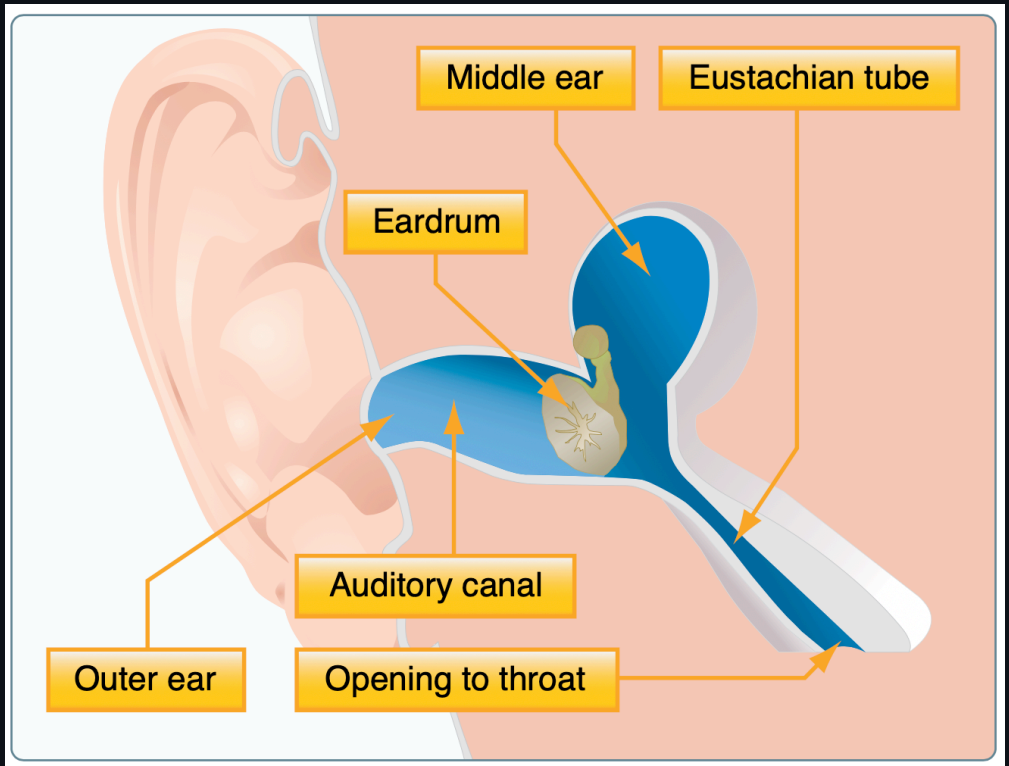
Symptoms

- Rapid breathing, visual impairment, sweaty skin, dizziness
- Often occurs with stress or anxiety

Corrective Actions

- Breath slowly
- Speak something slowly
- Breathe into a bag

Middle Ear and Sinus Problems



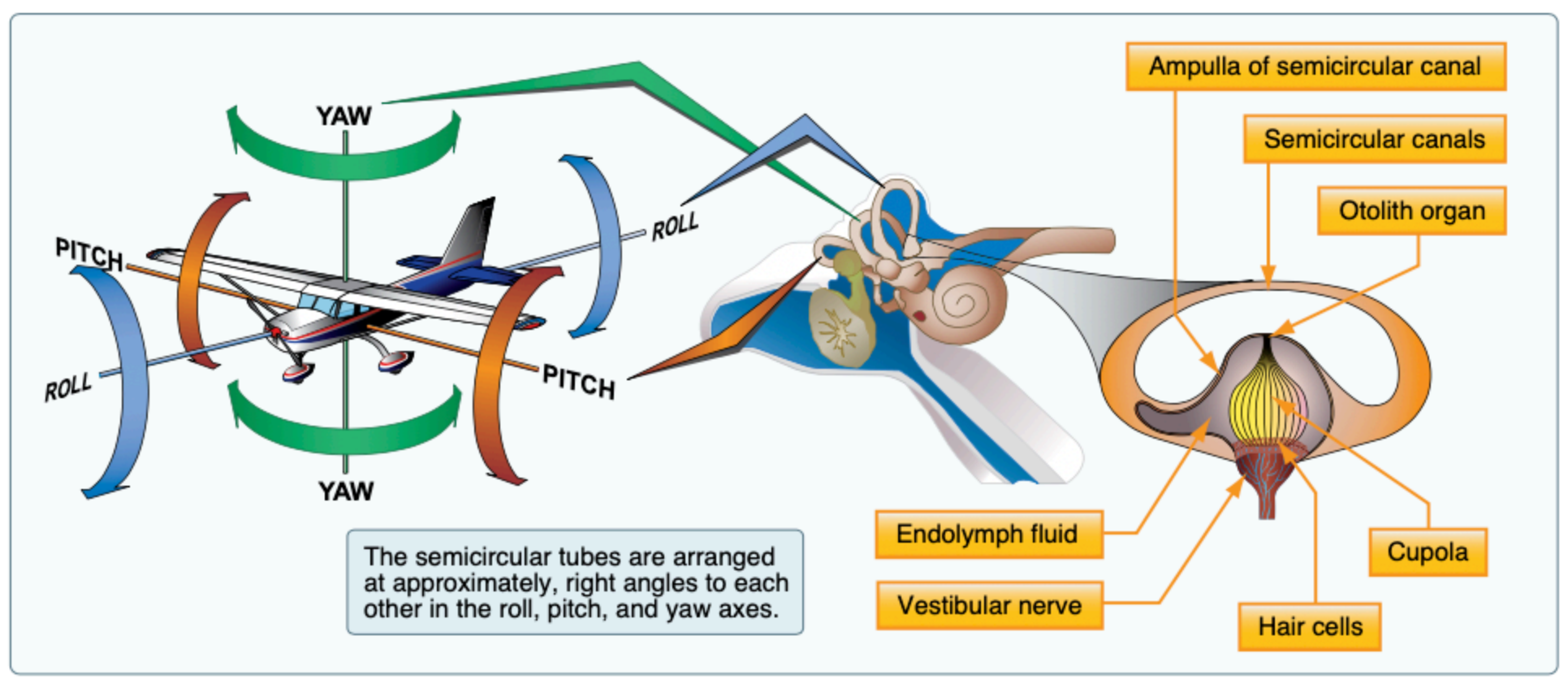
- Blockage of the Eustachian tube which equalizes pressure between both sides of your ear drum, which often happens with inflammation

Middle Ear and Sinus Problems

- **Symptoms**:
  - Ear pain and pressure
  - Muffled hearing
- **Corrective Actions**
  - Valsalva method
  - Descend slowly
  - Avoid flying with any sinus blockage
    - Decongestants can be helpful (for passengers)

Spatial disorientation

Disagreement or confusion between your sensory systems about the aircraft's position, attitude, or movement.



Illusions that contribute to spatial disorientation

"The Leans"

- After a long gradual turn, the airplane is returned to level
- The plane may feel as though it's banking in the opposite direction

Graveyard Spiral

- The pilot erroneous banks back into the turn
- The airplane will tend to lose altitude, so the pilot pulls back on the elevator
- The result is a nose-low, descending, high-G turn

Illusions that contribute to spatial disorientation

Coriolis illusion

- Rapid head movement during a turn
- The plane may feel as though it's banking in the opposite direction

Somatogravic Illusion

- Acceleration may feel like a pitching-up movement
- Especially true with limited visual reference, like at night
- Pilot may consequently push into a nose-low attitude
- Likewise, deceleration may cause the sensation of pitching down

Illusions that contribute to spatial disorientation

Inversion illusion

- Abrupt change from climbing to straight-and-level flight can create the illusion of tumbling backwards
- Pilots may then push the aircraft into a nose-low attitude

Elevator Illusion

- Upward vertical acceleration like an updraft can create the illusion of being in a climb
- Pilots may push the aircraft into a nose-low attitude
- Likewise a downward acceleration can create the illusion of being in a descent

Overcoming Disorienting Illusions

- Trust flight instruments
- Limit maneuvering, especially high-load factor maneuvers
- Limit rapid head movements
- Use autopilot if needed

Motion Sickness

Discomfort caused by the brain receiving conflicting messages about the state of the body's position in space.

- **Symptoms**
  - Paleness, sweaty, clammy skin
  - Nausea, vomiting, dizziness
- **Corrective Actions**
  - Fresh air
  - Focus on objects outside the airplane
  - Avoid unnecessary head movements
  - Always have a bag

Carbon monoxide poisoning

Hypemic hypoxia caused by the presence of CO in the air, which attaches to hemoglobin in the blood.

- **Symptoms**
  - Headache, drowsiness
  - Blurred vision
  - Loss of muscle power
- **Corrective Actions**
  - Close heater vent
  - Land and ventilate the cabin
  - Open fresh air vents

Stress

The body’s response to physical and psychological demands placed upon it. Stress can be chronic or acute.

- **Symptoms**
  - Agitation
  - Not thinking well
  - Fatigue
- **Corrective Actions**
  - Correct underlying stressors
  - Chronic stress require medical treatment

Fatigue

- Acute fatigue is caused by lack of sleep
- Chronic fatigue usually has medical underpinnings

Symptoms

- Drowsiness
- Errors in judgment, timing, computation
- Loss of muscle control

Corrective Actions

- Chronic fatigue: correct underlying issues, may require medical attention
- Acute fatigue: Rest

Dehydration

A critical loss of water or electrolytes from the body.

- **Symptoms**
  - Headache
  - Fatigue
  - Drowsiness
  - Cramps
- **Corrective Actions**
  - Drink plenty of fluids and electrolytes
  - Drink before you become thirsty

Hypothermia

- **Cause**: Exposure to cold temperature for extended periods.
- **Symptoms**:
  - Coldness, shivering
  - Drowsiness
  - Loss of consciousness
- **Corrective Actions**
  - Move to a warmer environment
  - Add clothing, blankets, or coats
  - Cover exposed areas

Alcohol

Effects

- Symptoms similar to that of hypoxia
- Impaired judgement, coordination, reaction time

Regulations

Part 91.17:

- 8 hours "bottle to throttle"
- 0.04% BAC limit
- Cannot carry drunk passengers, except in an emergency

Drugs

Regulations

Part 61.53:

A pilot cannot act as PIC if:

- They have any known condition that would make them ineligible for a medical
- Are receiving treatment or taking medication that would make them ineligible for a medical

AOPA Drug Database

https://www.aopa.org/go-fly/medical-resources/medications-database

- Check the half-life of any drug you intend to take

Drugs

Substances to Avoid

- Nicotine: Impaired night vision, CO poisoning
- Amphetamines: Impaired vision, impaired judgement
- Caffeine: Impaired judgement, dehydration, headaches
- Antacids: Release CO2 at altitude
- Antihistamines: Drowsiness, dizziness
- Aspirin: Contribute to hypoxia
- Prescription pain killers
- Illicit drugs

Dissolved Nitrogen After SCUBA dives

Dissolved nitrogen in the blood being forced out of the body's tissues.

Guidance

- Flights below 8,0000' MSL:
  - Dive does *not* require a controlled ascent: Wait at least **12 hours**
  - Dive require controlled ascent: Wait at least **24 hours**
- Flights above 8,000' MSL: At least **24 hours**

Knowledge Check

> You are flying at 7,500 feet and your passenger complains of fatigue and a headache.

- Suspect some form of hypoxia
- Check CO detector, if installed
- Use a pulse-oximeter if you have one
- Descend if possible

IMSAFE Checklist

Preflight self-evaluation:

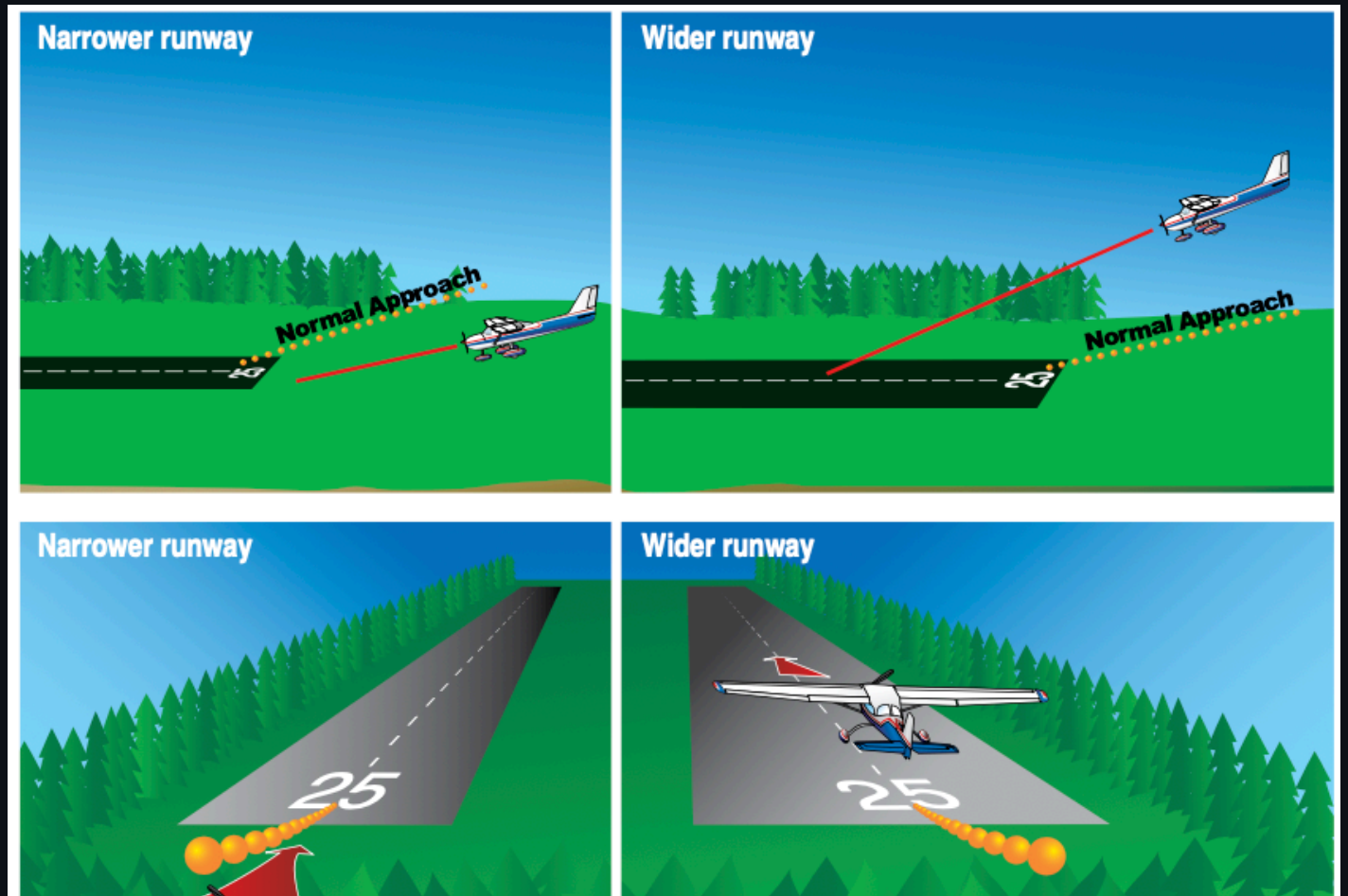
1. Illness
2. Medication
3. Stress
4. Alcohol
5. Fatigue
6. Emotion

Illusion

False Horizon

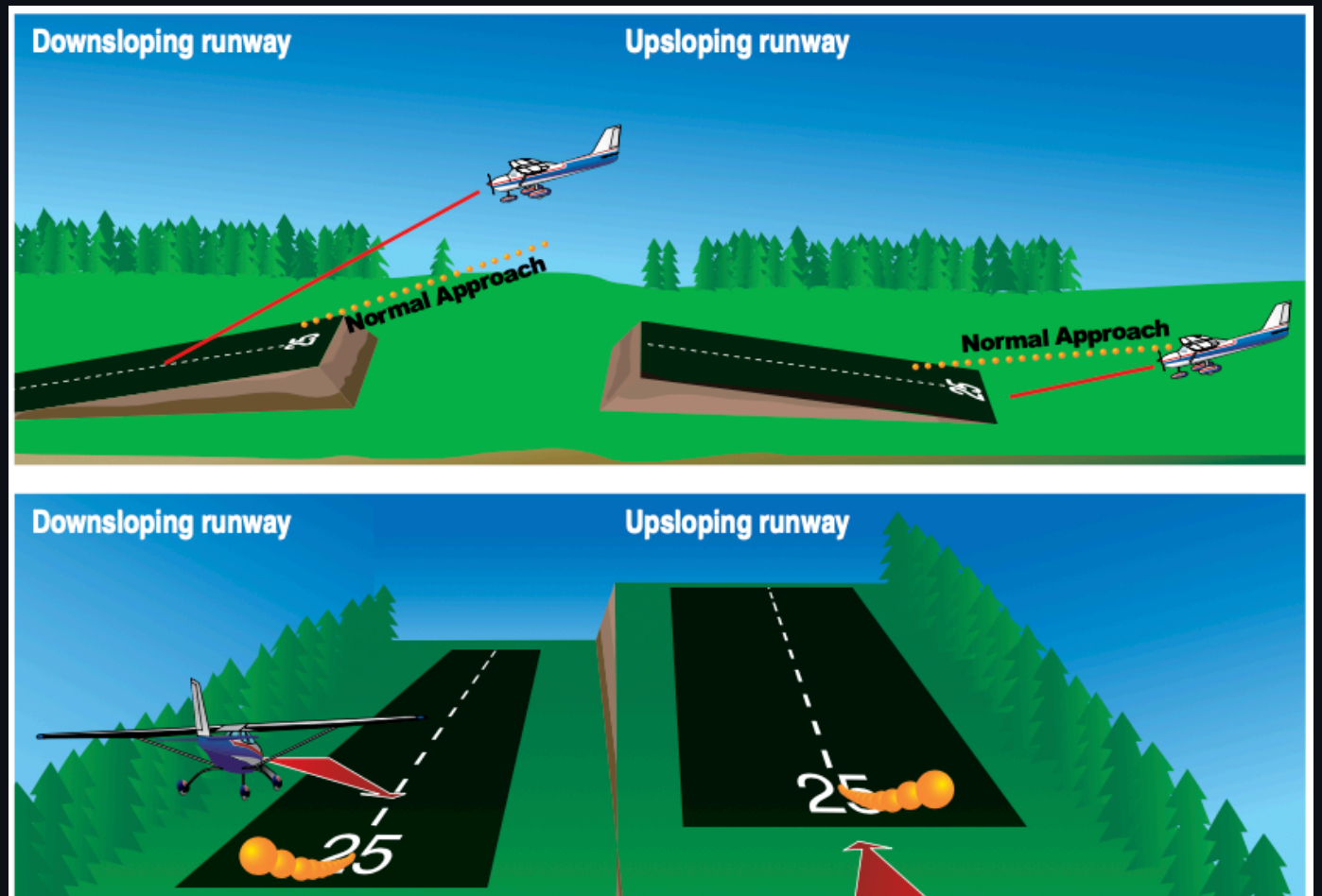
Illusion

Runway Width Illusion



Illusion

Sloping Runway Illusion



Other Illusions

- Featureless terrain
  - Over water at night
  - Aircraft may appear higher than it actually is
  - "Black hole" approach
- Water on windscreen
  - The aircraft may seem higher than it actually is
- Haze
  - Aircraft may appear to be further away
- Fog
  - Flying into fog: Illusion of pitching up
- Mistaking city lights for runway lights