



Aeromedical Factors

Overview

- What
 - A number of health and physiological factors that can influence a pilot's ability to fly safely
- Why
 - Many of these factors not only affect the health and well-being of the pilot, but can quickly lead to inflight emergencies

Content

- Hypoxia
- Hyperventilation
- Middle Ear and Sinus Problems
- Spatial Disorientation
- Illusions
- Motion Sickness
- Carbon Monoxide Poisoning
- Fatigue and Stress
- Dehydration
- Alcohol and Drugs
- Nitrogen and Scuba Diving
- IMSAFE Checklist

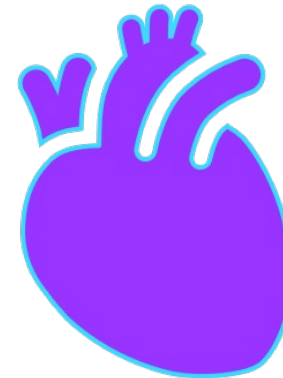
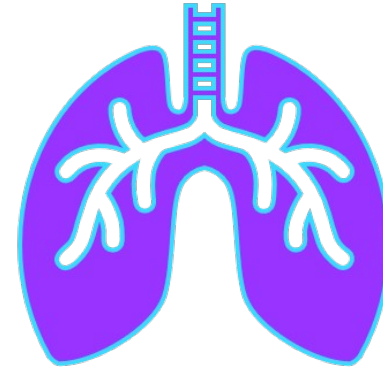


Hypoxia

Lack of Oxygen

- 4 Types
 - Hypoxic: Lack of oxygen to the lungs
 - Hypemic: Not enough blood
 - Stagnant: Not flowing
 - Histotoxic: Inability of the cells to use oxygen
- Symptoms
 - Cyanosis, headache, impaired judgement & reactions, euphoria, visual impairment, drowsiness, lightheaded, tingling, numbness
- Time of Useful Consciousness

Altitude	Time of Useful Consciousness
40,000'	15 to 20 seconds
30,000'	1 to 2 minutes
22,000'	5 to 10 minutes



- Treatment: Supplemental oxygen & lower altitudes



Hyperventilation

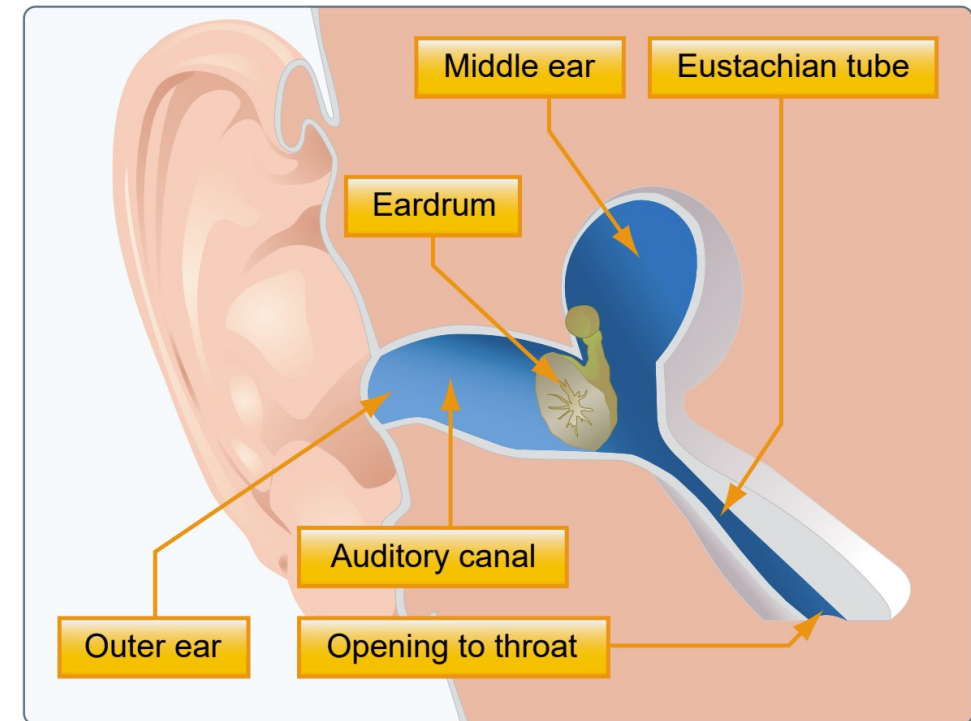
Excessive loss of carbon dioxide from the blood

- Causes
 - Emotional stress, fright or pain, leading to increased breathing rate and depth
- Symptoms
 - Very similar to Hypoxia
 - Lightheaded/dizzy, tingling, visual impairment, hot and cold, muscle spasms
- Treatment
 - Breathe normally (best prevention and cure)
 - Breathe into a paper bag, or talk out loud
 - If unsure, treat for Hypoxia (more dangerous condition)



Middle Ear & Sinus Problems

- Middle Ear
 - Air pressure difference in the middle ear & outside
 - Symptoms: Pain, reduced hearing sensitivity
 - Treatment: Chew gum, stretch jaw, valsalva, medicine
 - Valsalva only in a descent
- Sinus
 - Normally, sinus pressure equalizes with cockpit pressure
 - Congestion can prevent pressure from equalizing
 - Symptoms: Sinus and/or upper tooth pain, bloody mucus
 - Treatment: Slow descent rates, Do Not Fly

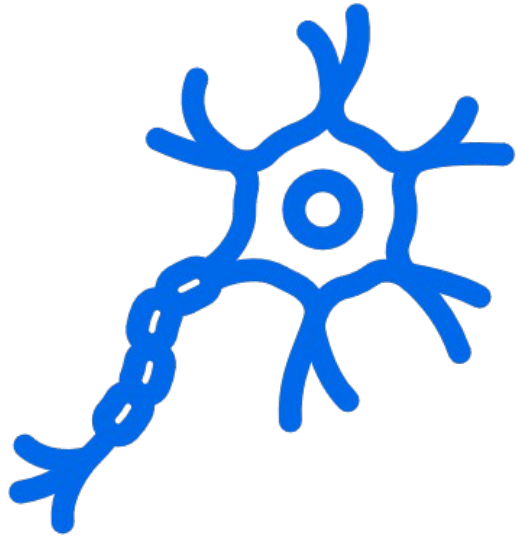


Source: PHAK, FAA





Spatial Disorientation



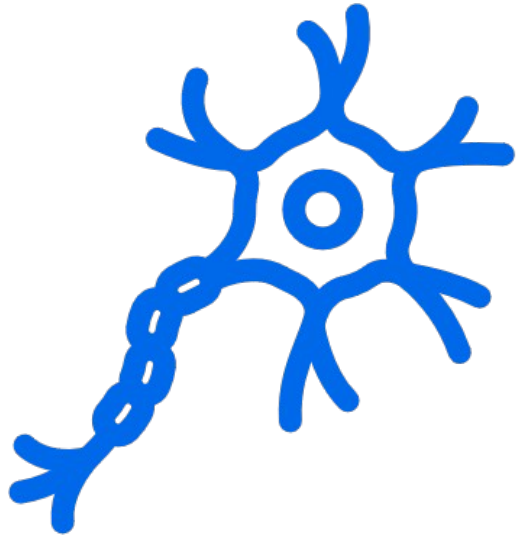
Lack of orientation with the position, attitude, or movement of the plane in space

- Orientation Systems
 - Visual
 - Eyes (largest source of information)
 - Somatosensory
 - Nerves, that along with hearing, sense position based on gravity, feeling, and sound
 - Vestibular
 - Motion sensing system located in the inner ears
- Brain combines 3 systems for orientation
 - Conflicting information can lead to disorientation





Spatial Disorientation



Flying can result in conflicting information in the brain

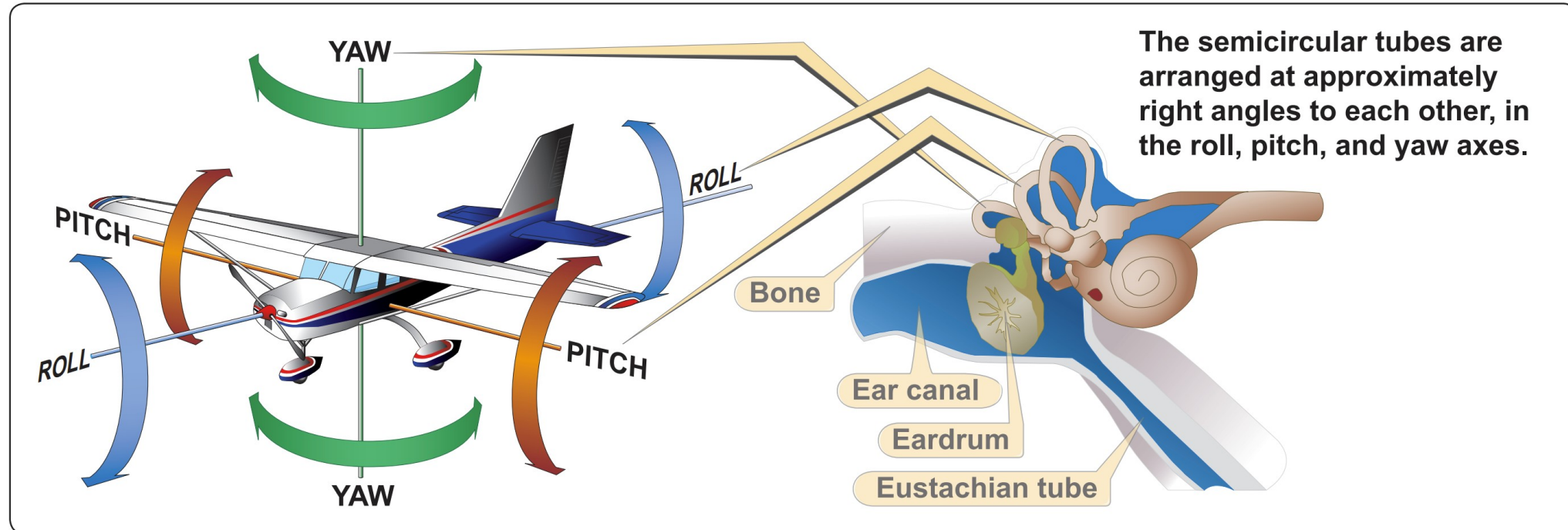
- Visual System (eyes)
 - Primary orientation system
 - Prevails over false sensations from other systems
 - In IMC, the eyes cannot correct for false sensations
- Somatosensory System (nerves)
 - Forces in flight can lead to false sensations of the direction of gravity
 - The brain cannot differentiate between forces in turns and gravity
 - Turbulence can confuse the brain
- Vestibular System (ears)
 - Semicircular Canals: Detect angular acceleration
 - Otolith Organs: Detect linear acceleration



Spatial Disorientation in Flight

Semicircular Canals

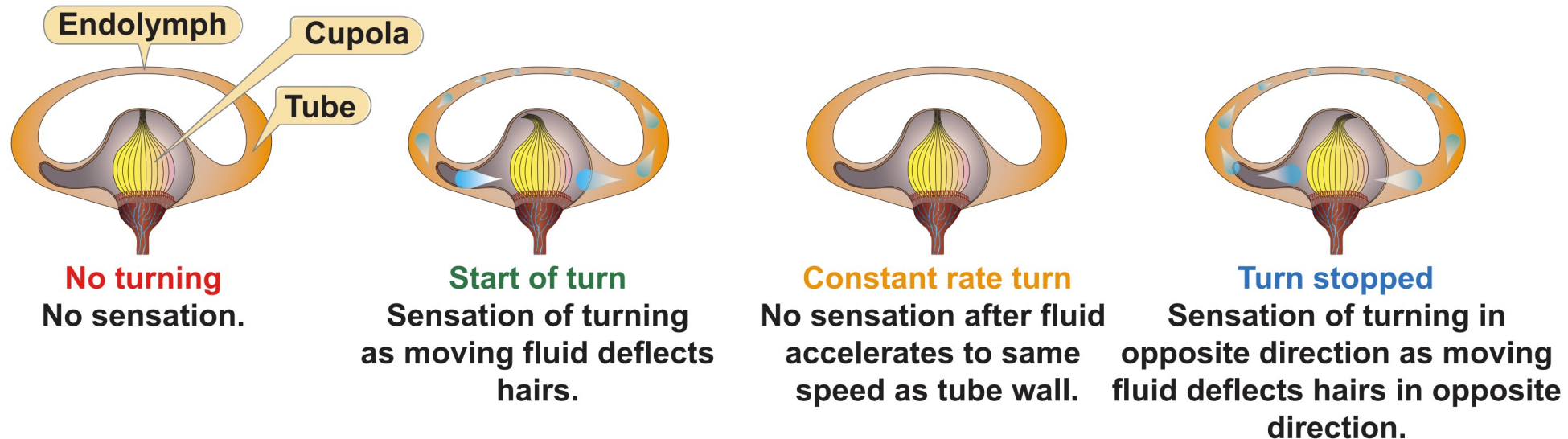
- 3 tubes, 1 on each axis, at right angles to each other
- Canals are filled with endolymph fluid
- Cupola (gelatinous structure on sensory hairs) at the center of the canal



Spatial Disorientation in Flight

Semicircular Canals & Turning

- Straight & Level: Sensory hairs are upright
- A turn puts semicircular canal and its fluid in motion, deflecting the cupola hairs
- Brain interprets movement as a turn, but only recognizes movement for about 20 seconds
- In long turns, the brain can incorrectly interpret a rollout as a turn in the opposite direction

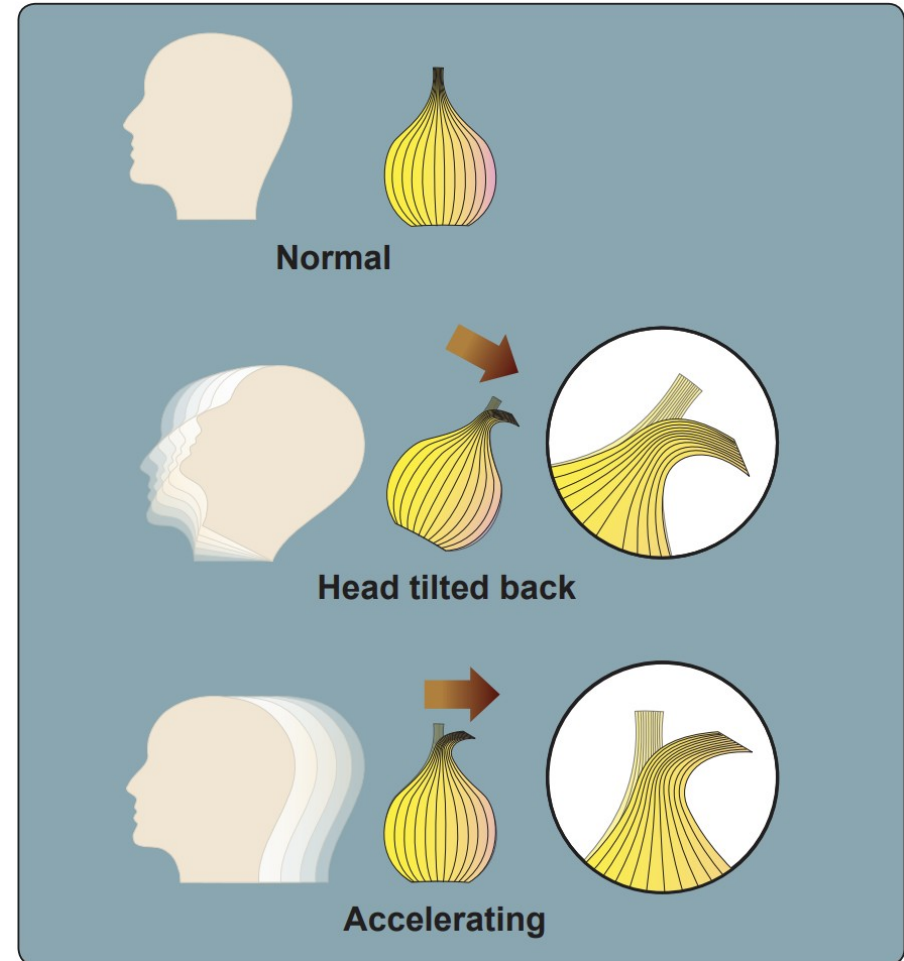


Spatial Disorientation in Flight

Otolith Organs

Gelatinous membrane with chalk like crystals covering sensory hairs

- When you tilt your head forward or backward:
 - Weight of the crystals causes the membrane to shift due to gravity
 - Sensory hairs detect the shift
 - Brain recognizes the movement
- Otolith Organs & Acceleration
 - Forward acceleration: Illusion of tilting backward
 - Deceleration: Illusion of tilting forward



Illusions

- The Leans
 - Reason: Abrupt correction after entering a turn too slowly to stimulate the inner ear
 - Illusion: Banking in the opposite direction
 - Result: Pilot rolls back to the original banked attitude, thinking it's straight-and-level
- Coriolis Illusion
 - Reason: Abrupt head movement in a prolonged constant rate turn
 - Illusion: Rotation or movement in an entirely different axis
 - Result: Pilot may maneuver into a dangerous attitude to stop the perceived rotation



Illusions

- Somatogavic Illusion
 - Reason: Rapid acceleration or deceleration
 - Illusion: Acceleration – Nose up attitude
Deceleration – Nose down attitude
 - Result: Pilot enters a nose low, dive attitude, or a nose high, stall attitude
- Graveyard Spin
 - Reason: Recovery from a spin that has stopped stimulating the inner ear
 - Illusion: Spinning in the opposite direction
 - Result: Pilot will return the aircraft into the original spin



Illusions

- Graveyard Spiral
 - Reason: Observed loss of altitude during a prolonged turn no longer stimulating the inner ear
 - Illusion: Wings level descent
 - Result: Pilot pulls back on the controls, tightening the spiral, and increasing altitude loss
- Inversion Illusion
 - Reason: Abrupt change from a climb to straight-and-level
 - Illusion: Tumbling backward
 - Result: Pilot will push the aircraft abruptly into a nose low attitude



Illusions

- Elevator Illusion
 - Reason: Abrupt vertical acceleration, usually due to an up/downdraft
 - Illusion: Upward = Climb, Downward = Descent
 - Result: Pilot will push the aircraft into a nose low or nose high attitude
- False Horizon
 - Reason: Sloping cloud formations, obscured horizon, dark scene with ground lights & stars, certain ground lighting patterns
 - Illusion: Not being aligned correctly with the horizon
 - Result: Pilot will put the aircraft into a dangerous attitude



Motion Sickness

- Causes
 - Brain receiving conflicting messages about the body's state
 - Anxiety and stress
- Symptoms
 - Discomfort, Nausea, Dizziness, Paleness, Sweating, Vomiting
 - Generally, goes away after the first few lessons
- Treatment
 - Open fresh air vents
 - Focus on objects outside the airplane
 - Avoid unnecessary head movement
 - Take control of the plane and fly smoothly



Carbon Monoxide (CO) Poisoning

- How it Happens
 - Colorless, odorless gas produced by the engine
 - Damaged, leaking exhaust system
 - Heater / defrost vents transport CO to the cockpit
- CO and the Body
 - CO attaches to the hemoglobin in the blood (200x easier than oxygen)
 - Prevents hemoglobin from carrying oxygen to cells (hypemic hypoxia)
- Effects
 - Headache, blurred vision, dizziness, drowsiness, loss of muscle power
- Detecting & Correcting
 - Carbon monoxide detectors
 - Turn off heater, open fresh air vents, use supplemental oxygen, land



Fatigue

- Effects
 - Degraded attention and concentration
 - Impaired coordination
 - Decreased ability to communicate
- Causes
 - Sleep loss, exercise/physical work, stress, prolonged cognitive work
- Acute Fatigue
 - Short term, normal occurrence in everyday life
 - Skill Fatigue: Special type of acute fatigue affecting piloting skills
 - Timing disruption
 - Perceptual field disruption
 - Causes: Physical & psychological stress, mild hypoxia
 - Prevention: Proper diet, adequate rest



Fatigue

- Chronic Fatigue
 - Long term, usually with psychological roots or an underlying disease
 - Causes: Continuous high-stress levels
 - Symptoms: Weakness, tiredness, heart palpitations, breathlessness, headaches, irritability, aches and pains, emotional illness
 - Prevention: Treatment by a physician
- Preventing Fatigue
 - Acute Fatigue: Stay on the ground
 - Avoid flying :
 - Without a full night's rest
 - After working excessive hours
 - After an especially exhausting or stressful day
 - Chronic Fatigue: Should be treated by a physician. Do not fly



Stress

The body's response to physical and psychological demands placed upon it

- Stress & the Body
 - Releases chemical hormones (adrenaline) into the blood
 - Increased metabolism to provide more energy to the muscles
 - Blood sugar, heart rate, respiration, blood pressure, and perspiration increase
- Stressors
 - Physical stress (noise or vibration)
 - Physiological stress (fatigue)
 - Psychological stress (difficult work or personal situations)
- Categories of Stress
 - Acute Stress (short term)
 - Chronic Stress (long term)
 - DO NOT FLY



Stress

- Acute Stress
 - Short term
 - Involves an immediate threat that is perceived as a danger (fight or flight response)
 - Healthy person can cope with acute stress & prevent stress overload
 - On-going acute stress can develop into chronic stress
- Chronic Stress
 - Long term
 - Level of stress presenting an intolerable burden, exceeding the ability to cope
 - Performance falls sharply
 - Often caused by unrelenting psychological pressure – loneliness, financial/relationship worries, etc.
 - DO NOT FLY – Consult a physician



Dehydration

Critical loss of water from the body

- Causes
 - High temperatures, wind, humidity, diuretic drinks (coffee, tea, alcohol, caffeinated soda)
- Effects
 - Fatigue, headaches, cramps, tingling, sleepiness, dizziness
 - Degraded physical and mental performance
- Dehydration & Flying
 - Without proper hydration, fatigue progresses to dizziness, weakness, nausea, tingling, cramps & thirst
 - Flying skills diminish while attention is taken from flying
- Prevention
 - Stay hydrated – limit soda, caffeine, and avoid alcohol the day prior
 - Wear light, porous clothing, and a hat
 - Keep the cockpit ventilated



Alcohol & Drugs

- Alcohol
 - DON'T drink & fly
 - Even small amounts of alcohol impairs judgement & decreases performance and mental cognition
 - Altitude multiplies the effects of alcohol on the brain
 - [FAR 91.17](#) - 8 hours “from bottle to throttle”
- Medications / Drugs
 - Basic Guideline: Do not fly while taking medication, unless FAA approved
 - [FAR 61.53](#): Prohibits flying if taking medication that would prevent obtaining a medical certificate
 - [FAR 91.17](#): Prohibits drug use that affects safety
 - Drugs with no side effects on the ground may have serious effects airborne



Nitrogen & Scuba Diving

- Scuba Diving & Flying
 - Diving results in a significant increase in nitrogen dissolved in the body
 - At sea level, nitrogen in the body and outside the body is in equilibrium
 - Airborne, reduced pressure can release the excess nitrogen
 - If released too quickly, bubbles can form in the bloods, spinal cord, or brain
 - Symptoms: Severe pain and/or impairment – death in extreme cases
- Provide time to allow nitrogen to return to normal levels before flying
 - No Controlled Ascent: At least 12 hrs. before flight $\geq$ 8,000' MSL
 - 24 hours for flight above 8,000' MSL
 - Controlled Ascent: At least 24 hrs. before flight $\geq$ 8,000' MSL



IMSAFE

- Always perform your own preflight
- Self Preflight
 - Illness: Am I sick?
 - Medication: Am I taking any medications that might affect judgement or make me drowsy?
 - Stress: Am I under any psychological pressure from work? Money, health, or family problems?
 - Alcohol: Have I been drinking within 8 hours? 24 hours? Am I hungover?
 - Fatigue: Am I tired and not adequately rested?
 - Emotion: Am I emotionally upset?





Questions?