



Commercial Pilot Ground School

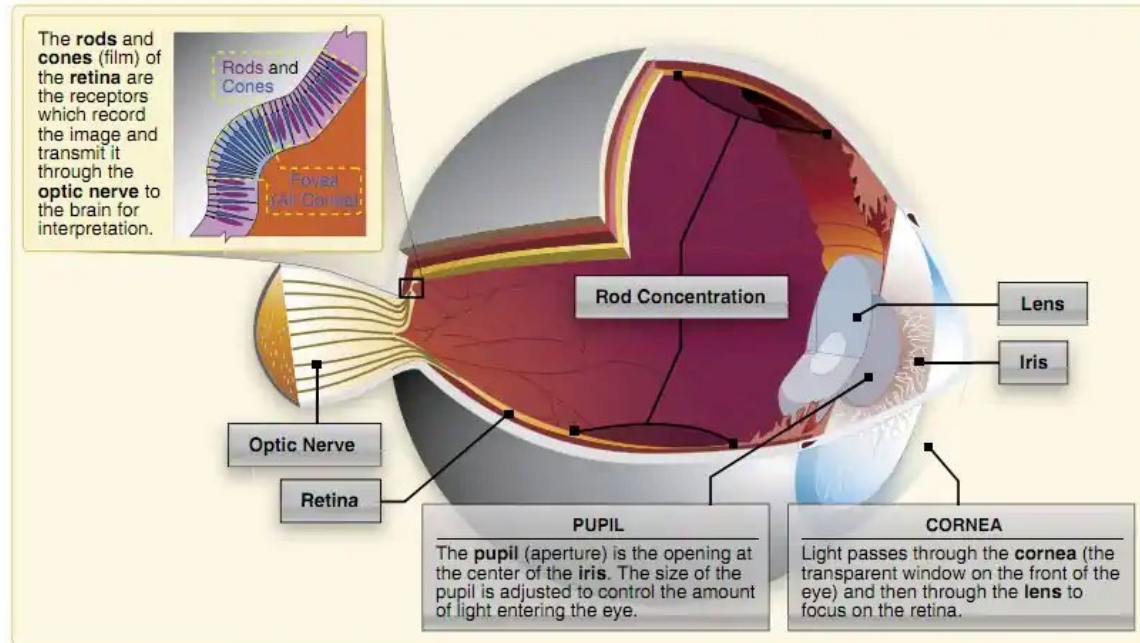
Day 2
Aviation Physiology



Agenda

- The Human Eye
- Preparations for night flying
- Visual Illusions
- The Human Ear
- Vestibular system
- Vestibular Disorientation
- Respiration system
- Hypoxia
- Hyperventilation
- Decompression sickness
- Drugs and Alcohol

Human Eye: Working



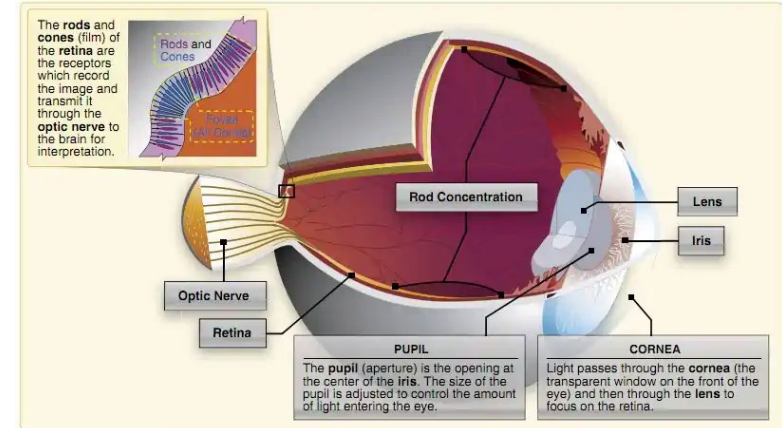
The Human Eye

Cones

- Works best in bright light
- Able to distinguish colors
- Perceive finer details and more rapid changes in images

Rods

- More active when it's dark
- More sensitive to light than cones
- Less detailed images
- Gives night vision and peripheral vision.
- Rods are activated by a pigment called Rhodopsin
- Takes approx. 30 min for rods to adjust

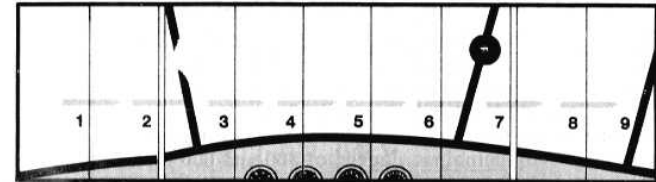


How the Human Eye Works — Daytime

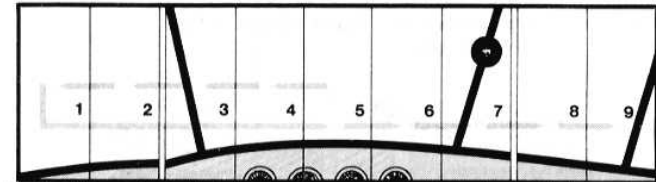
Techniques for scanning for traffic during daytime

- Make a series of short, regularly-spaced eye movements
- Movements should not exceed 10°
- Make an effort to observe each area for ~1 second

Two scanning methods that have proved to be the most effective for pilots involve the "block" system of scanning, which is based on the theory that "traffic detection can be made only through a series of eye fixations at different points in space." In application, the viewing area (windshield) is divided into segments, and the pilot methodically scans for traffic in each block of airspace in sequential order.



Side-to-Side scanning method. Start at the far left of your visual area and make a methodical sweep to the right, pausing in each block of viewing area to focus your eyes. At the end of the scan, return to the panel.



Front-to-side scanning method. Start in the center block of your visual field (center of front windshield); move to the left, focusing in each block, then swing quickly to the center block after reaching the last block on the left and repeat the performance to the right.

FIGURE 2

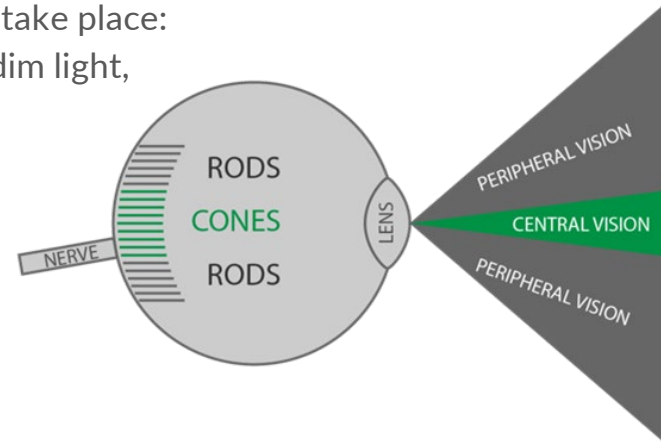
How the Human Eye Works — Night time

Preparations for night operations

- Don't look at white light at least 30 minutes prior to your flight!
- When adjusting your eyes for night flight, the following events take place:
- After 5-10 minutes, the cones in our eyes become adjusted to dim light, but they become 100x more sensitive
- After 30 minutes, the eyes become 100,000x more sensitive, and now much more can be seen

Techniques for scanning for traffic at night

- Fly <5,000 MSL to assure good oxygen pressure
- Close one eye when exposed to bright light
- Don't wear sunglasses!
- Blink your eyes if they become blurred
- Force your eyes to view objects "off-center" (use your peripheral vision)



Sloped Runways



Sloped Terrain



Narrower than Usual Runways





Wider than Usual Runways

“Black Hole” Approach Illusion







Visual Illusions

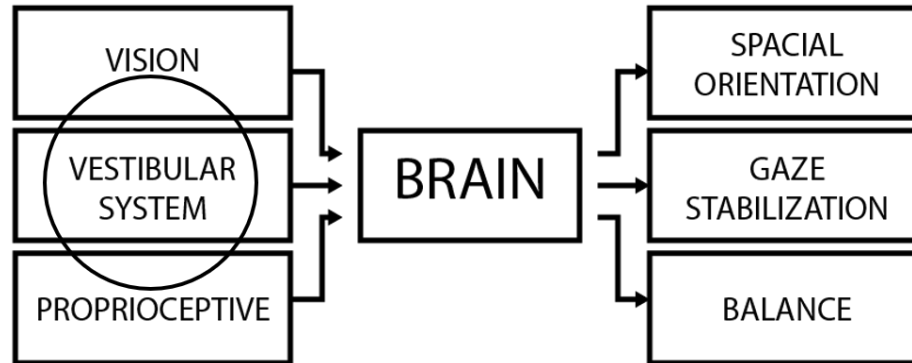
Illusions caused by

- Sloped Runway – illusion of being too high (upslope) or too low (downslope)
- Sloping Terrain – Being close to the terrain causing illusions of being high/low
- Unusually narrow or wide runways – creates the illusion of being too high/low
- Variable runway lengths – long runways create illusion of narrow runways
- “Black-Hole” Approach Illusion – No visual cues and illusion of an empty area
- Autokinetic Illusion – Still, lighted object may appear to move
- False Visual Reference / False Horizon Illusions
- Vection Illusion – conflict between peripheral and central vision

Vestibular System

Function of vestibular system

- Normally the system relies heavily on vision
- When less visual cues are available the brain relies on vestibular system



The Human Ear

Outer Ear

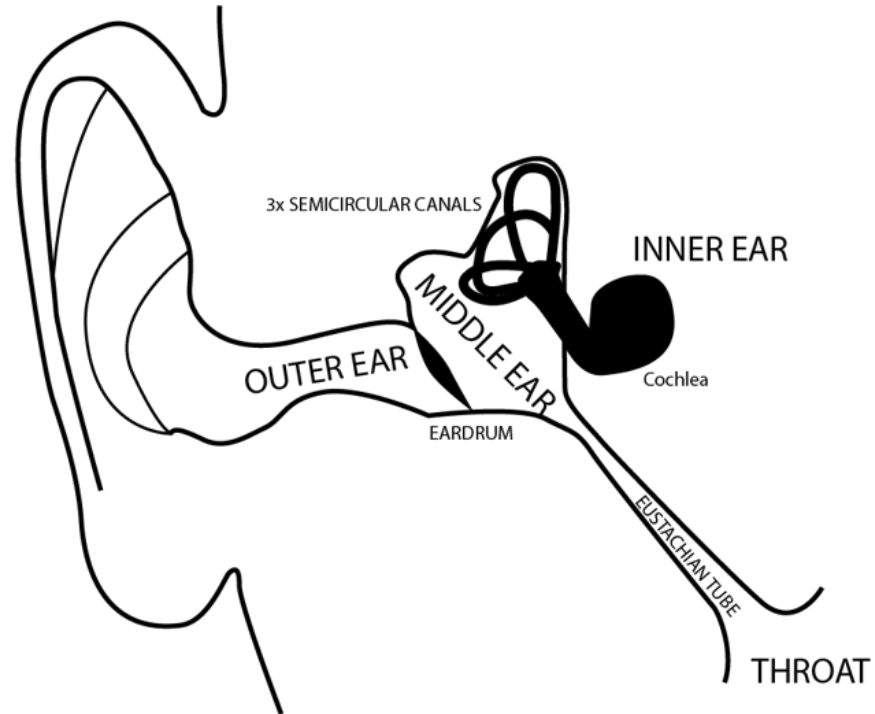
- Auditory canal
- Ends by the eardrum

Middle ear

- 3x semicircular canals
- Eustachian tube

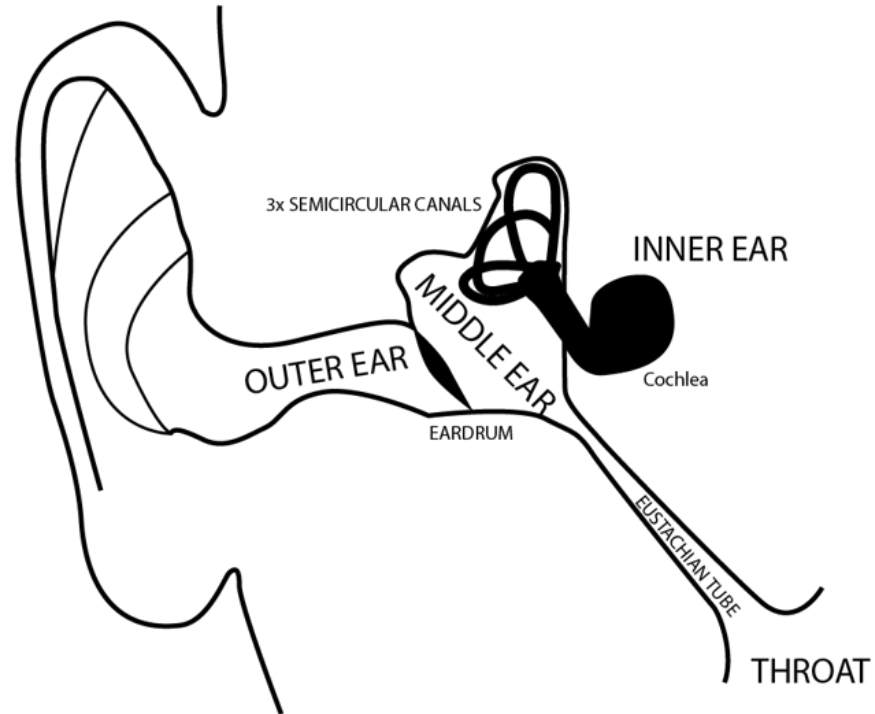
Inner ear

- Cochlea
- Sensory organ of hearing



The Human Ear

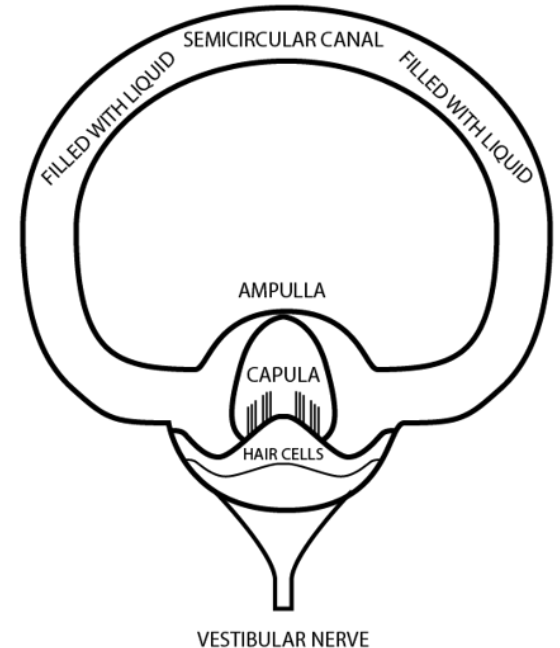
- Blockage of Eustachian tube may cause severe pain due to differential pressure between middle and outer ear
- It may also cause pain in sinuses



The Human Ear

The Vestibular System

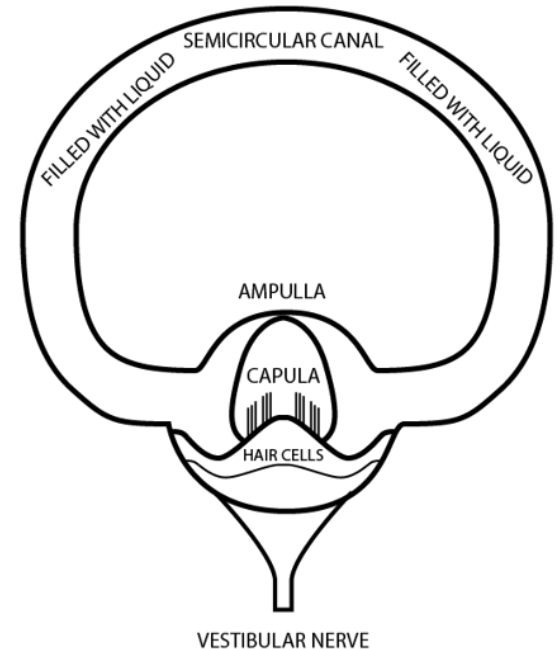
- 3x Semicircular Canals (3 axis)
- Filled with gel type liquid
- Hair cells detecting movement of liquid with movement
- Sends information to the brain
- Liquid reaches equilibrium after approx. 30 seconds



The Human Ear

Vestibular Disorientation

- False “feelings” caused by limitations of the vestibular system
- System senses rate of change, but not prolonged change
- After 20-30 sec of standard rate turn the brain think it's level again
- Small accelerations are not detected



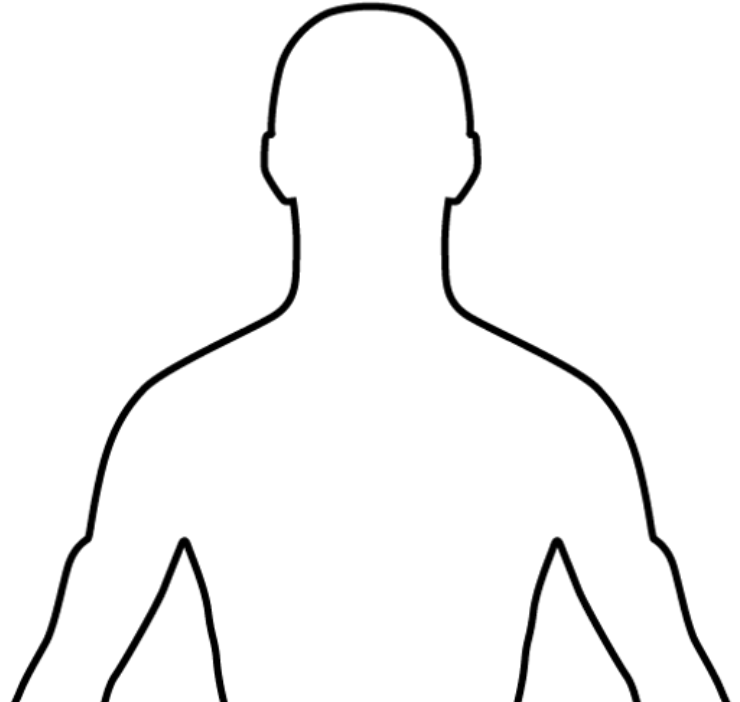


The Respiratory System

Our Brain needs oxygen to function!

Transporting Oxygen to the cells

- Inhaled oxygen is transferred to blood in the lungs
- Red blood cells carries the Oxygen
- The heart circulates the blood

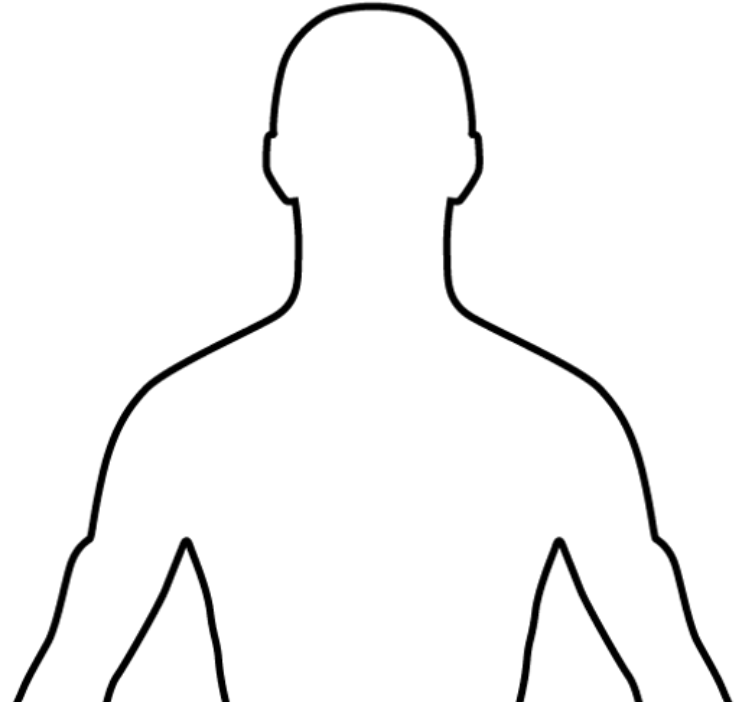




The Respiratory System

Types of Hypoxia

- Hypoxic Hypoxia
- Hypemic Hypoxia
- Stagnant Hypoxia
- Histotoxic Hypoxia

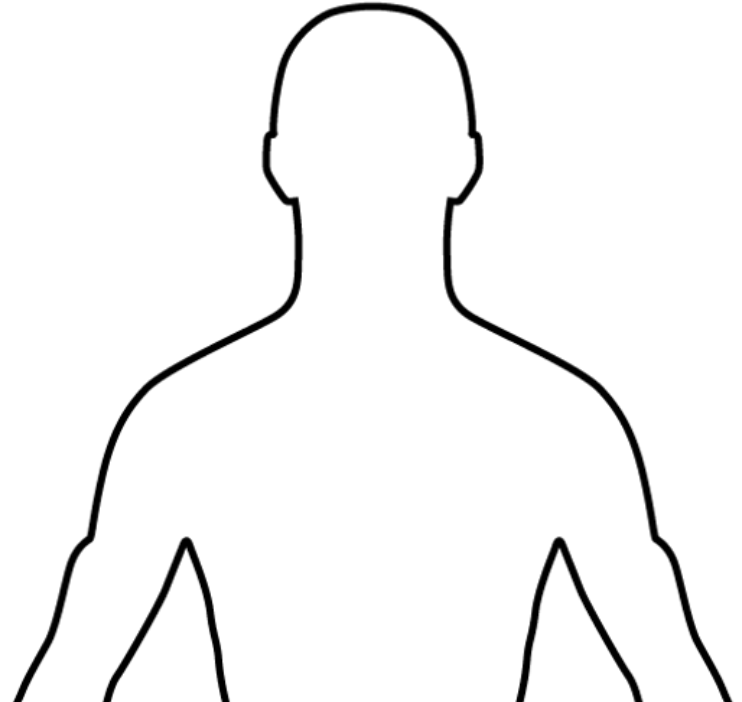




The Respiratory System

Hyperventilation

- Causes
- Symptoms
- Treatment





The Respiratory System

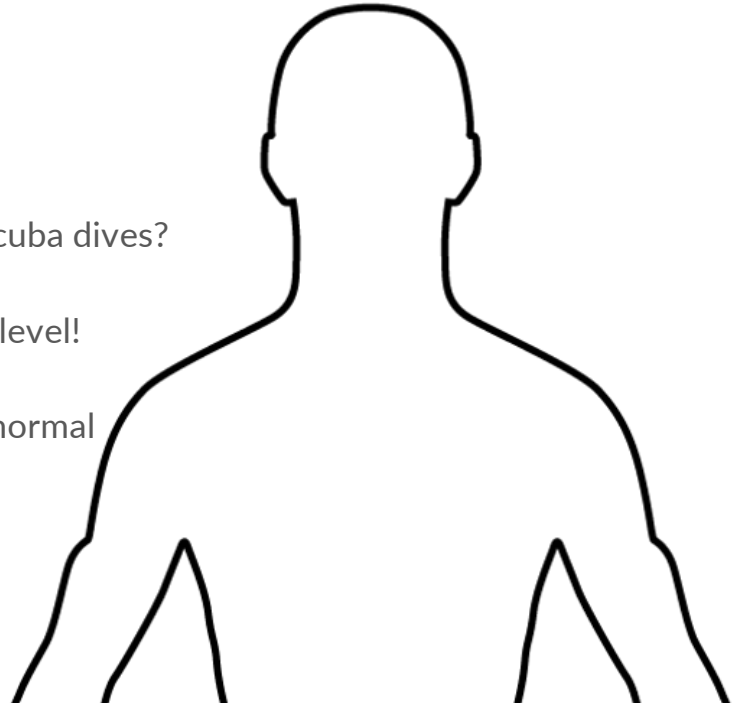
Decompression Sickness (DCS)

- Causes
- Symptoms
- Treatment

What pressures do we impose on ourselves when someone scuba dives?

ANSWER: A lot more than we do when we're standing at sea level!

This excess pressure causes the human body to absorb an abnormal amount of nitrogen





The Respiratory System

To resolve this, divers often need to perform a controlled ascent

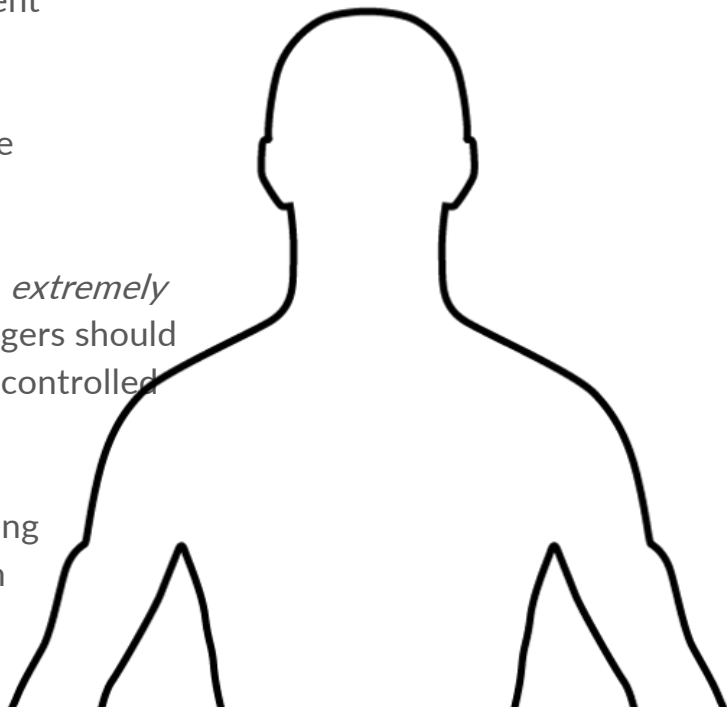
- Enables a diver's body to rid itself of excess nitrogen

This process of allowing excess nitrogen to dissolve takes time

- Flying can make this worse

To avoid painful experiences of transitioning from altitudes at *extremely high pressure* to altitudes at *lower pressure*, pilots and passengers should wait **at least 12 hours** before flying if the dive didn't require a controlled ascent, *assuming* the pilot can remain below 8,000 feet MSL

Pilots and passengers should wait **at least 24 hours** before flying if the dive required a controlled ascent, assuming the pilot can remain below 8,000 feet MSL





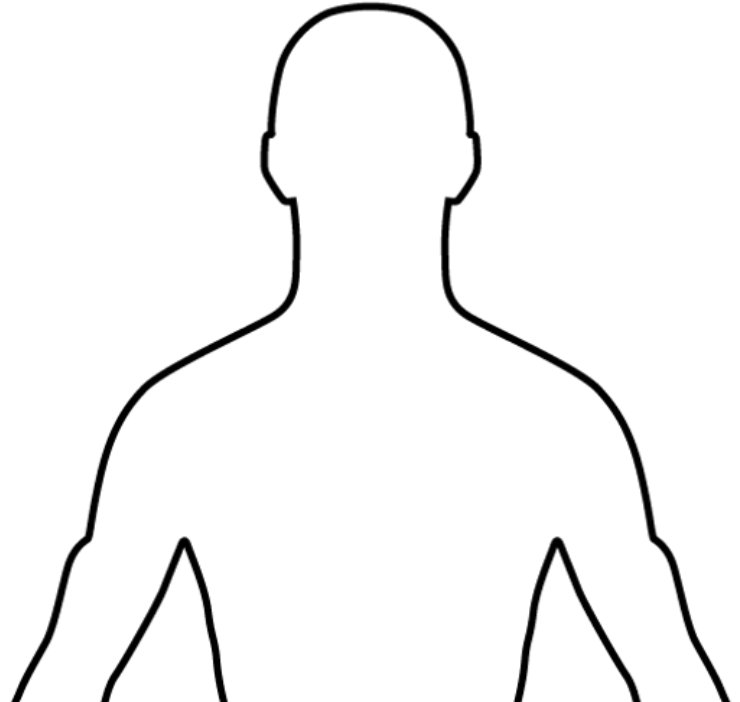
Fatigue

Acute Fatigue

- Short term lack of rest
- Easy to “fix”

Chronic Fatigue

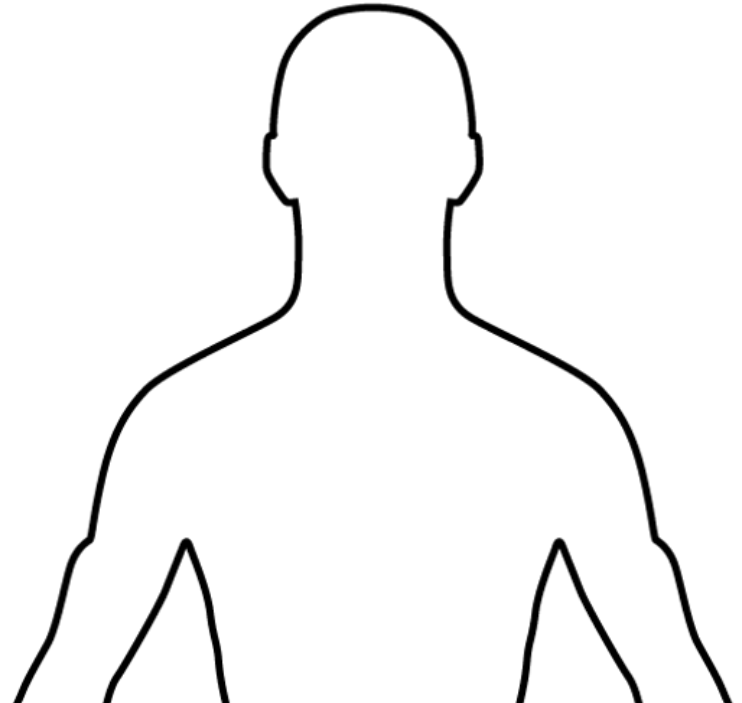
- Long term lack of rest / stress
- Takes more time to “fix”





Stress

- A physical and mental reaction to pressure
- Controllable doses of stress increases work capacity
- May cause total breakdown of thought process





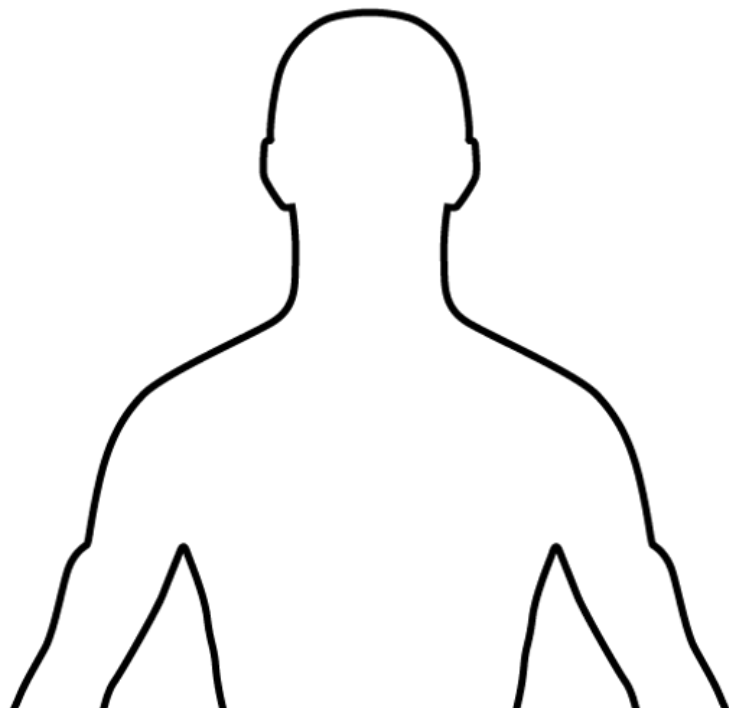
Drugs & Alcohol

Alcohol and many drugs will heavily affect you as a safe pilot

- Increased risk of hypoxia, fatigue, and stress
- Be careful with medications, ask an AME
- FAR §91.167

FAA Accepted Medications

- [Leftseat.com](https://www.leftseat.com)



Refer to:

AIM
Chapter 8
Section 1