

# AEROMEDICAL FACTORS



# LESSON OUTLINE

## CONTENT

Medical Certificates  
Hypoxia  
Hyperventilation  
Middle Ear and Sinus  
Congestion  
Spatial Disorientation  
Motion Sickness  
Carbon Monoxide Poisoning  
Fatigue and Stress  
Scuba Diving

## TIMEFRAME

**45-60 MIN**  
*approximately*

## SOURCES

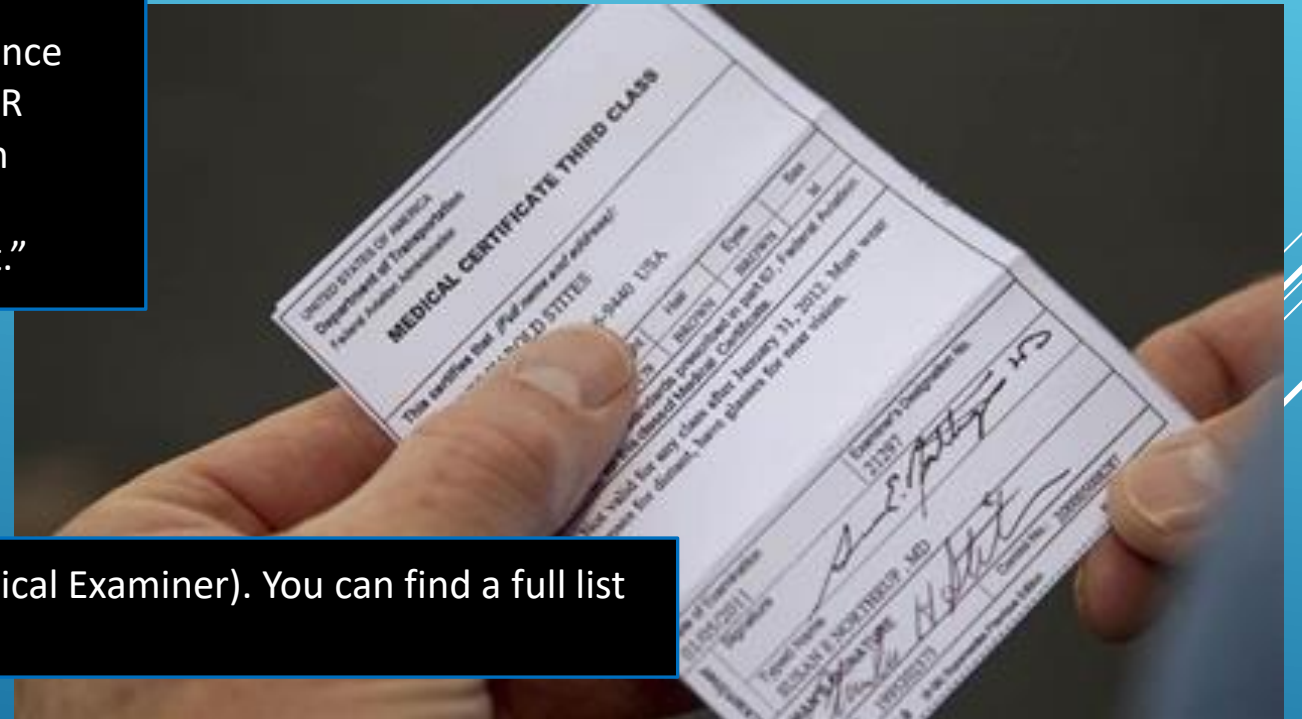
Federal Aviation Regulations  
Parts 61 and 91  
Aeronautical Information  
Manual  
Pilot's Handbook of  
Aeronautical Knowledge  
FAA.gov

# MEDICAL CERTIFICATES

Pilots must have a medical certificate, with few exceptions, to exercise the privileges of their airmen certificates. However, once you obtain a medical certificate, you still must comply with FAR 61.53 which states “a pilot cannot act as a crewmember on an aircraft if they know, or have reason to know, of any medical condition that would make them unsafe to operate an aircraft.”

## How to Obtain One

Medical Certificates are obtained from an AME (Aviation Medical Examiner). You can find a full list of AMEs in your area on the FAA’s website.



# MEDICAL CERTIFICATES

## 1<sup>st</sup> Class

Used to exercise the privileges of an ATP Certificate

### Privilege Durations

<40 = 12 months  
>40 = 6 months

### Total Durations

<40 = 60 months  
>40 = 24 months

## 2<sup>nd</sup> Class

Used to exercise the privileges of a Commercial Certificate

### Privilege Durations

<40 = 12 months  
>40 = 12 months

### Total Durations

<40 = 60 months  
>40 = 24 months

## 3<sup>rd</sup> Class

Used to exercise the privileges of a Student Pilot (solo) or Private Pilot Certificate

### Privilege Durations

<40 = 60 months  
>40 = 24 months

### Total Durations

<40 = 60 months  
>40 = 24 months

# MEDICAL CERTIFICATES

Remember, Medical Certificate Privileges will degrade as time passes. However, this does not change the Medical Certificates Class.

## Example

A 42 year old gentleman provides you with a 1<sup>st</sup> Class Medical Certificate. The certificate is 18 months old..

Which Class is the Medical Certificate?

1<sup>st</sup> Class

Which privileges are still valid?

3<sup>rd</sup> Class Privileges



# BASICMED

BasicMed is an alternate way for pilots to fly without holding an FAA Medical Certificate as long as they meet certain requirements.

## What are the Requirements?

1. Comply with the general BasicMed requirements and possess a U.S. Driver's License.
2. Get a physical exam with a state-licensed physician using the Comprehensive Medical Examination Checklist that can be printed on the FAA's website.
3. Complete a BasicMed Education Course (these are free and can also be found on the FAA's website).

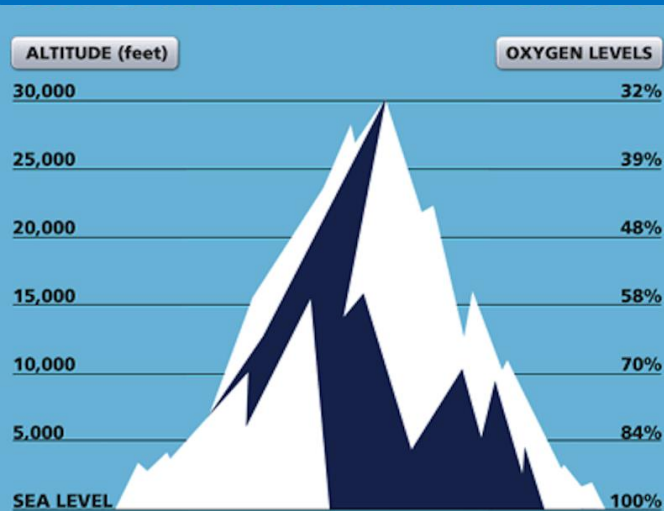
## What are the Restrictions?

1. Any aircraft authorized to carry not more than 6 occupants.
2. Any aircraft that has a maximum certificated takeoff weight of not more than 6,000 pounds.
3. Cannot carry more than 5 passengers.
4. Must operate the flight below 18,000' MSL and less than 250 knots.
5. Flight can not be operated for compensation or hire.

# HYPOXIA

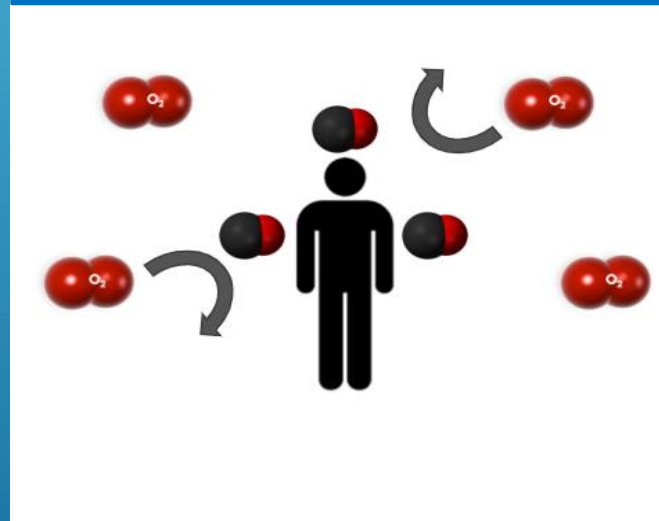
Hypoxia means “reduced oxygen” or “not enough oxygen.” If the brain is subjected to oxygen deprivation it will affect a pilots decision making processes and can lead to life-threatening errors in judgement.

## Hypoxic Hypoxia



Caused by a decrease in partial pressure when flying at higher altitudes. The oxygen molecules are spread further apart so the lungs receive less oxygen when inhaling.

## Hypemic Hypoxia

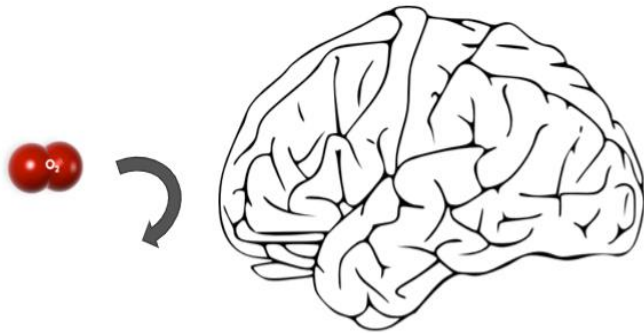


Occurs when the blood cells in the body are unable to take up and transport oxygen molecules. Most common cause in aviation is Carbon Monoxide (CO) Poisoning.

# HYPOXIA

Hypoxia means “reduced oxygen” or “not enough oxygen.” If the brain is subjected to oxygen deprivation it will affect a pilots decision making processes and can lead to life-threatening errors in judgement.

## Histotoxic Hypoxia



Occurs when the brain rejects the oxygen molecules being delivered by the blood stream. Most common cause is alcohol and drugs.

## Stagnant Hypoxia



Blood Pooling in the Lower Extremities

Occurs when the blood is not flowing to the brain. It is pooling in the lower extremities. Most commonly caused by G-Forces.

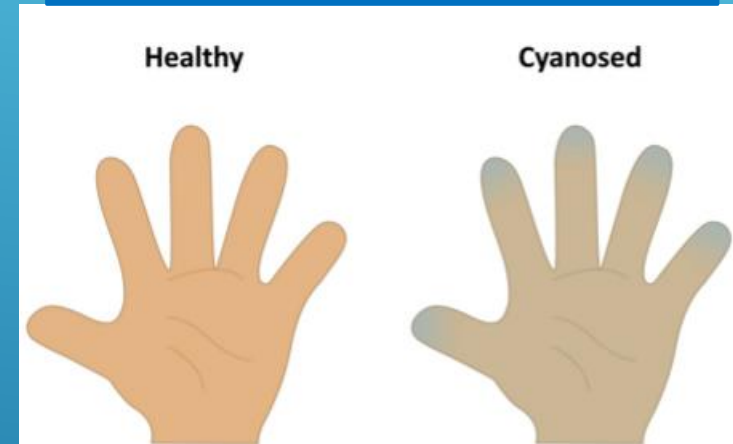


# HYPOXIA SYMPTOMS

Symptoms of Hypoxia can include things such as:

- Peripheral Cyanosis
- Headache
- Decreased Response Times
- Impaired Judgement
- Euphoria
- Visual Impairment
- Drowsiness
- Dizzy Sensations
- Numbness
- Tingling in Fingers and Toes

## Peripheral Cyanosis



# HYPOXIA CORRECTIVE ACTIONS

**Descend to Lower Altitude**



**Stop Pulling G-Forces**



**Don an Oxygen Mask**



# HYPERVENTILATION

Hyperventilation is essentially the opposite of Hypoxia. It is the excessive rate and depth of respiration that leads to an abnormal loss of Carbon Dioxide from the blood (too much oxygen).

## Causes

Too fast and too shallow breathing. Can be caused by fear, stress, and anxiety among other factors.



## Treatment

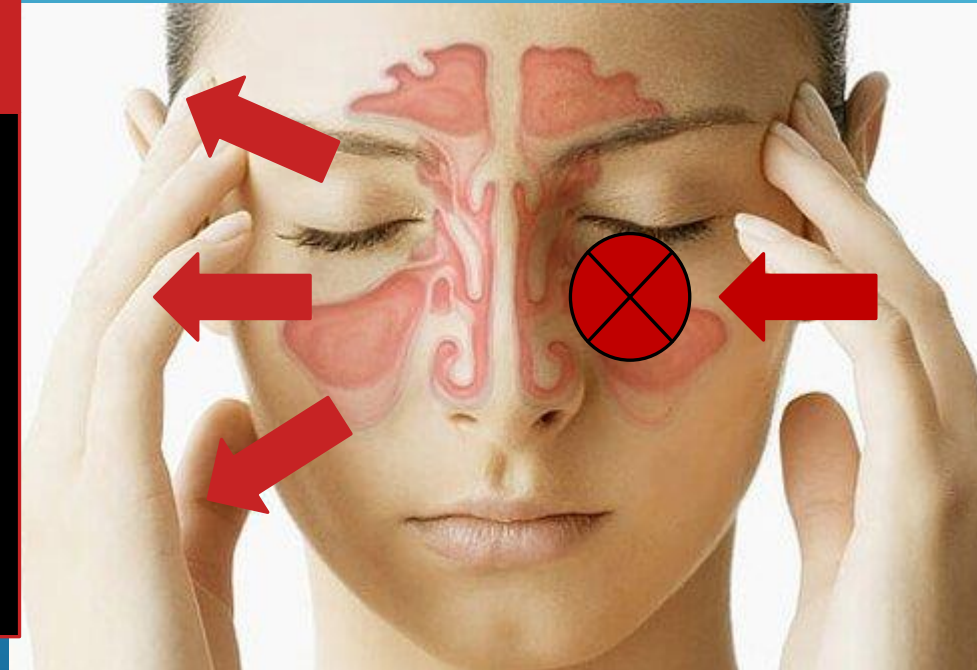
Return the breathing rate to normal. You can do this by singing, talking aloud, or breathing into a paper bag.

# MIDDLE EAR AND SINUS CONGESTION

During climbs and descents, the free gas formerly present in various body cavities expands due to a difference between the pressure of the air outside the body and that of the air inside the body.

## During the Climb

During climb a pilot (or the passengers) are flying toward Lower Pressure Air. This means there is relatively Higher Pressure Air in the sinuses. Air flows from areas of High to Low Pressure so it can equalize and the pilot or passenger may feel better.



## During Descent

During descent a pilot (or the passengers) are flying toward Higher Pressure Air. This means there is relatively Lower Pressure Air trapped in the sinuses. This Lower Pressure Air cannot equalize with the outside air due to sinus congestion and may cause extreme pain.

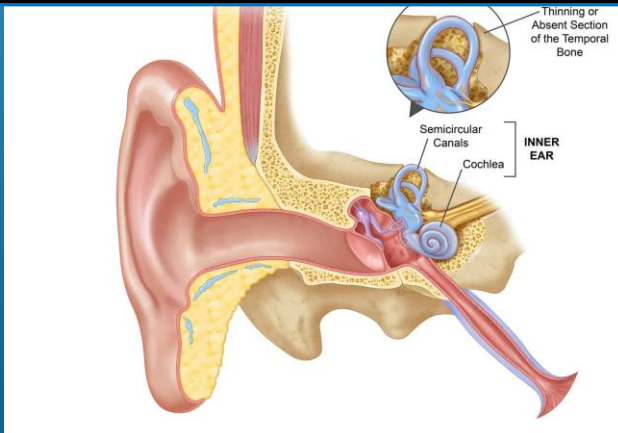


# SPATIAL DISORIENTATION

Spatial Disorientation specifically refers to the lack of orientation with regard to the position, attitude, or movement of the airplane in space.

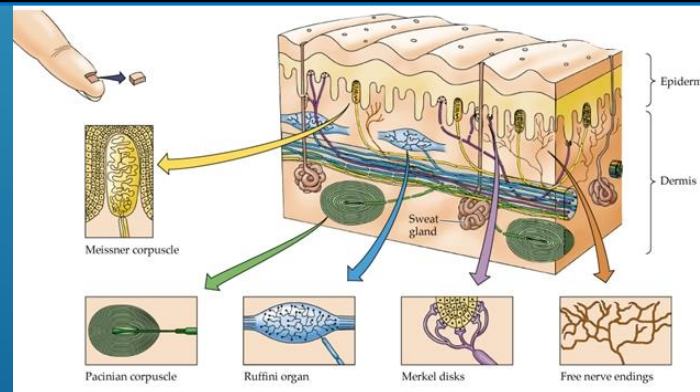
## Vestibular System

Organs found in the inner ear that sense position by the way we are balanced.



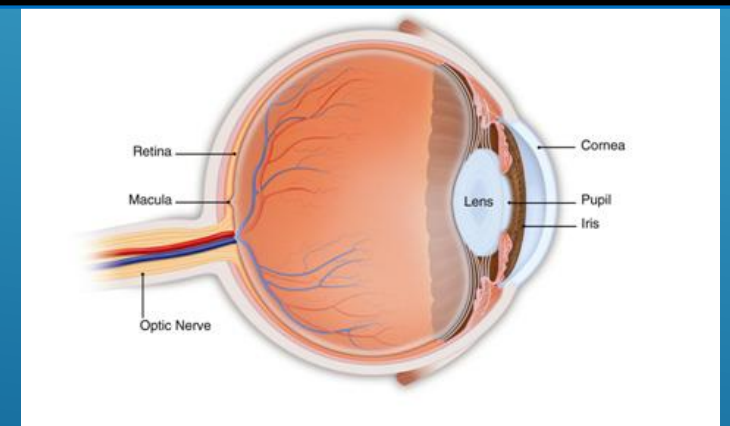
## Somatosensory System

Nerves in the skin, muscles, and joints that sense position based on gravity and feeling.



## Visual System

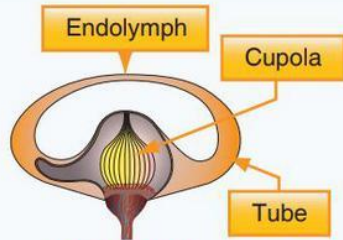
Eyes – which sense position based on what is seen.



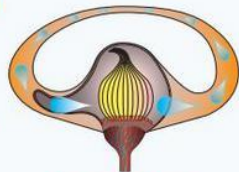
# VESTIBULAR ILLUSIONS

## The Leans

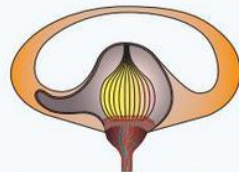
A condition called The Leans is the most common illusion during flight and is caused by a sudden return to level flight following a gradual and prolonged turn that went unnoticed by the pilot.



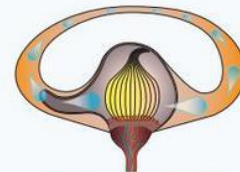
**No turning**  
No sensation.



**Start of turn**  
Sensation of turning  
as moving fluid deflects  
hairs.



**Constant rate turn**  
No sensation after fluid  
accelerates to same  
speed as tube wall.



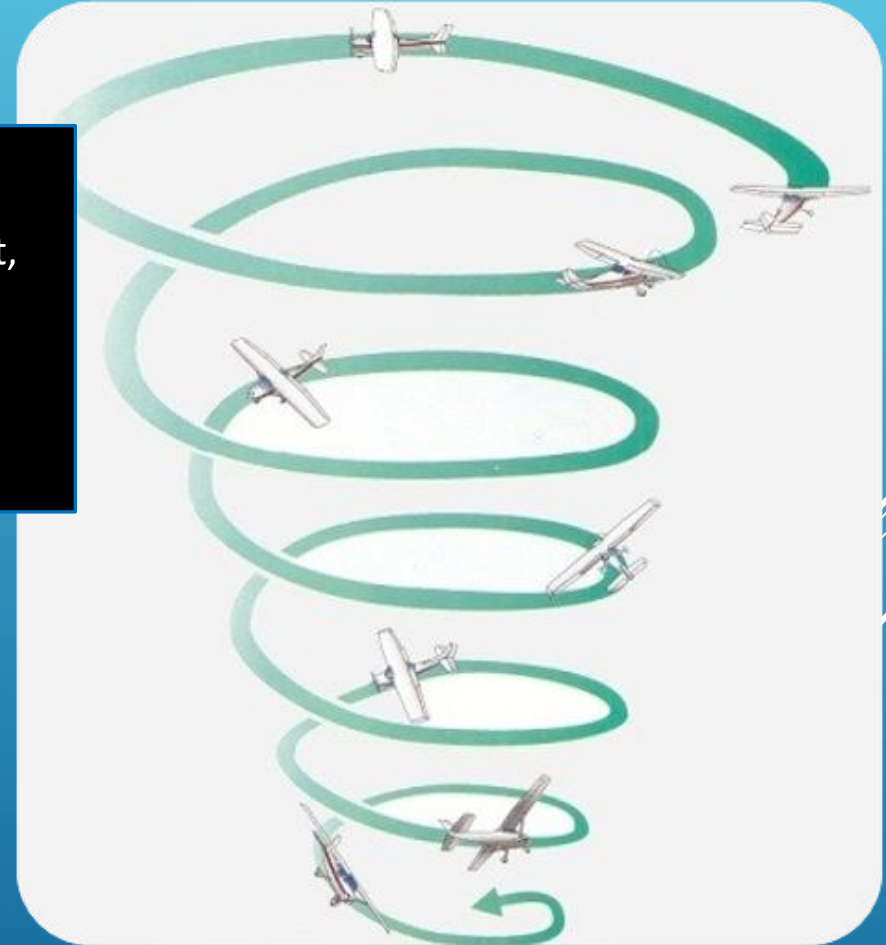
**Turn stopped**  
Sensation of turning in  
opposite direction as moving  
fluid deflects hairs in opposite  
direction.



# VESTIBULAR ILLUSIONS

## Graveyard Spiral

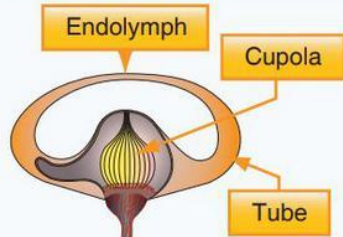
As in other illusions, a pilot in a prolonged coordinated, constant-rate turn may experience the illusion of not turning. During the recovery to level flight, the pilot will then experience the sensation of turning in the opposite direction causing the disoriented pilot to return the aircraft to its original turn. This gradual turn is often accompanied by a loss in lift and altitude.



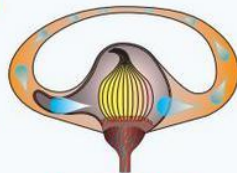
# VESTIBULAR ILLUSIONS

## Coriolis Illusion

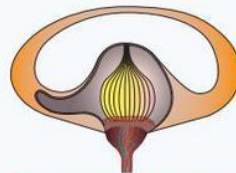
This occurs when a pilot has been in a turn long enough for the fluid in the ear canal to move at the same speed as the canal. A movement of the head in a different plane, such as looking at something in a different part of the flight deck, may set the fluid moving, creating the illusion of turning or accelerating on an entirely different axis.



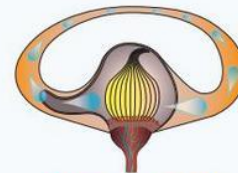
**No turning**  
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**Turn stopped**  
Sensation of turning in  
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fluid deflects hairs in opposite  
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# VESTIBULAR ILLUSIONS

## Somatogravic Illusion

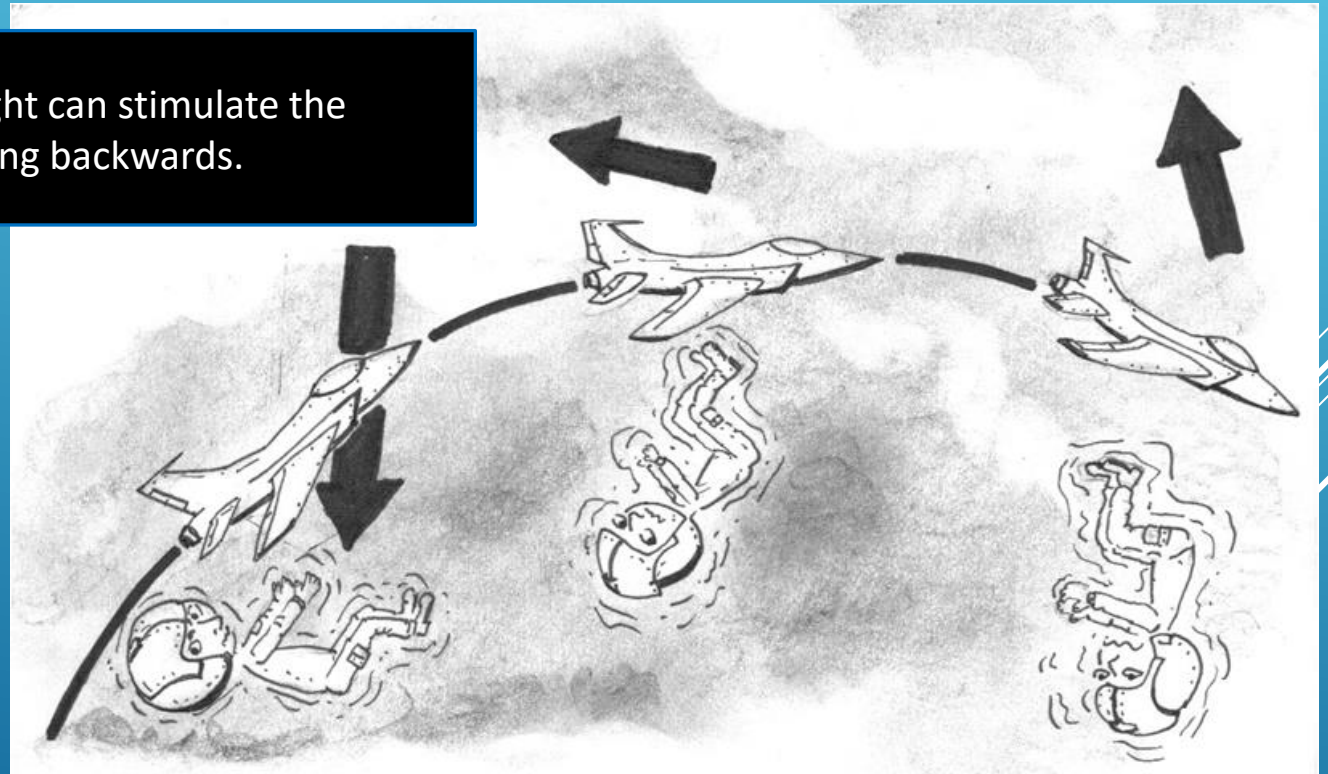
A rapid acceleration, such as experienced during takeoff, stimulates the otolith organs in the same way as tilting the head backwards. This action may create what is known as the Somatogravic Illusion. The reverse happens in a rapid deceleration.



# VESTIBULAR ILLUSIONS

## Inversion Illusion

An abrupt change from climb to straight and level flight can stimulate the otolith organs enough to create the illusion of tumbling backwards.



# VESTIBULAR ILLUSIONS

## Elevator Illusion

An abrupt upward vertical acceleration, as can occur in an updraft, can stimulate the otolith organs to create the illusion of being in a climb.

An abrupt downward vertical acceleration, usually a downdraft, can create the illusion of being in a nose low attitude.



# VISUAL ILLUSIONS

## False Horizon Illusion

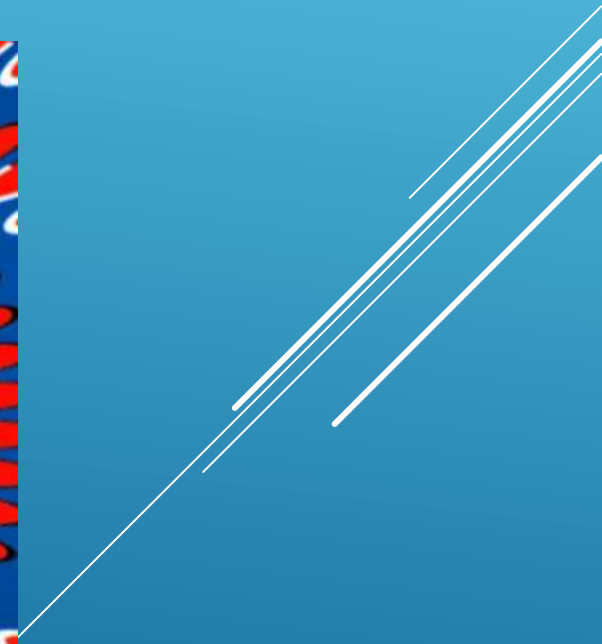
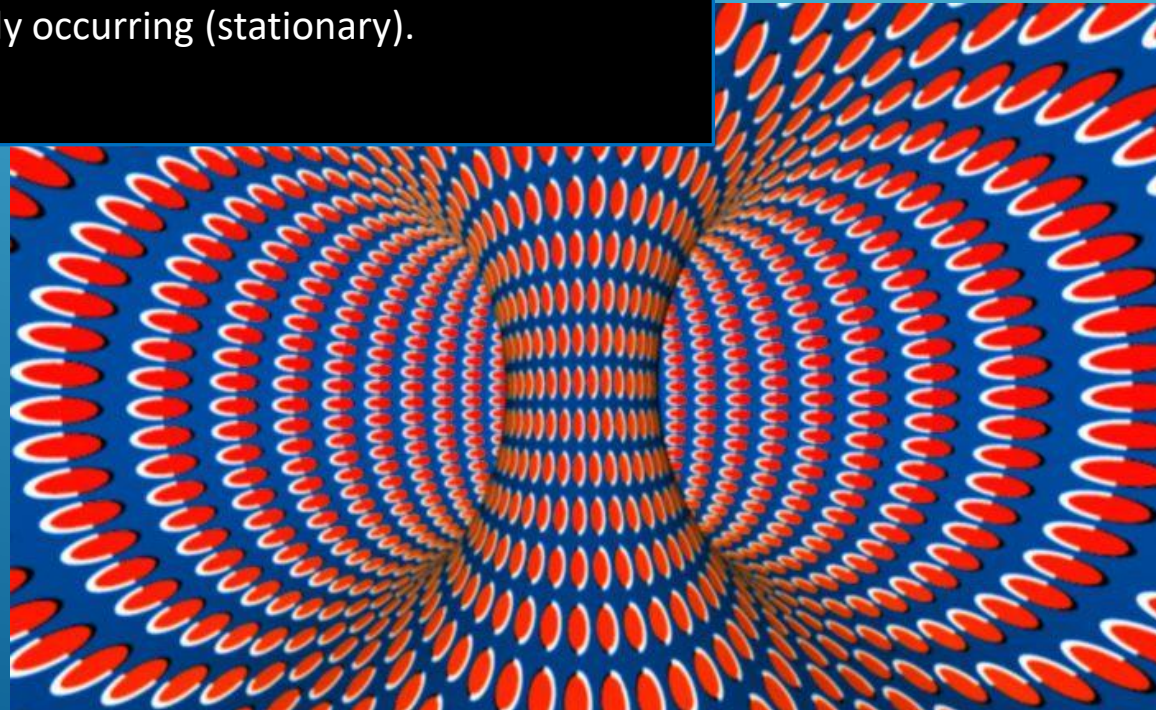
A sloping cloud formation, an obscured horizon, an aurora borealis, a dark scene spread with ground lights and stars, and certain geometric patterns of ground lights can provide inaccurate visual information, or “false horizon,” when attempting to align the aircraft with the actual horizon.



# VISUAL ILLUSIONS

## Autokinesis

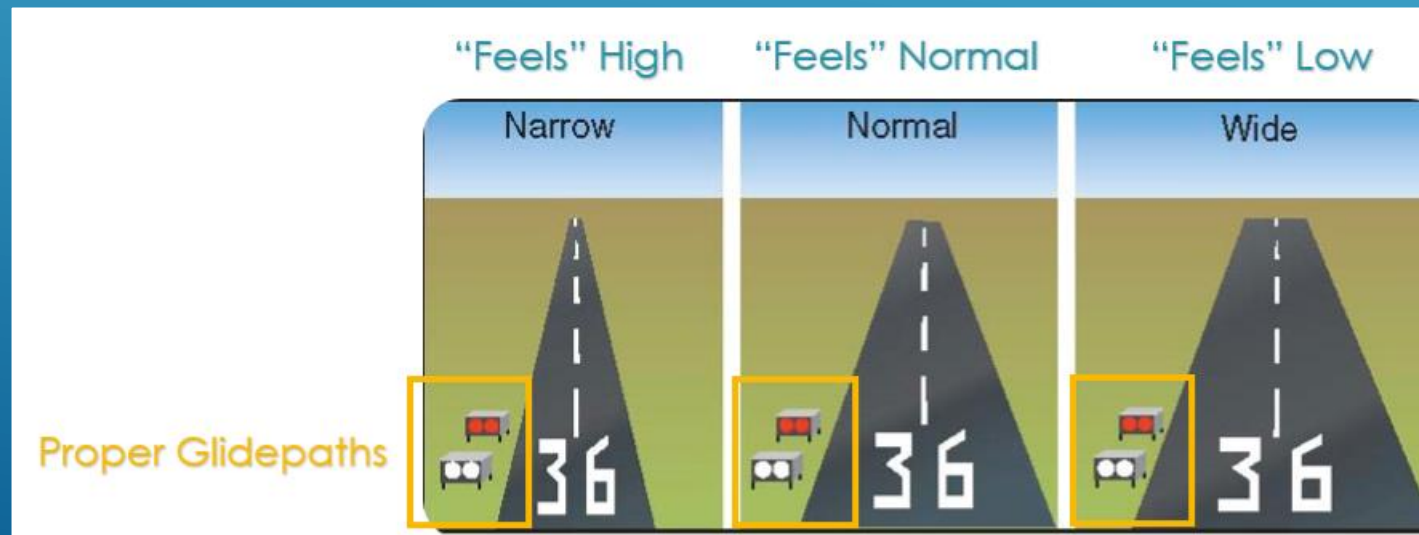
When flying in the dark, a stationary light may appear to move if it is stared at for a prolonged period of time. Autokinesis occurs when our brain sees motion or movement that is not actually occurring (stationary).



# VISUAL ILLUSIONS

## Runway Width Illusion

A narrower-than-usual runway can create an illusion that the aircraft is at a higher altitude than it actually is. A wider-than-usual runway can have the opposite effect with the risk of the pilot leveling out the aircraft high and landing hard or overshooting the runway.





# VISUAL ILLUSIONS

## Runway Slope Illusion

An upsloping runway, upsloping terrain, or both can create an illusion that the aircraft is at a higher altitude than it actually is. Downsloping runways will have the opposite effect.



## Runway slope illusion

- A downsloping runway can create the illusion that the aircraft is lower than it actually is, leading to a higher approach.
- An upsloping runway can create the illusion that the aircraft is higher than it actually is, leading to a lower approach.

# VISUAL ILLUSIONS

## Featureless Terrain, Water Refraction, and Haze

All of these phenomena can make the pilot feel higher and/or further away from objects and from the surface. This is due to the pilot's lack of being able to see details.

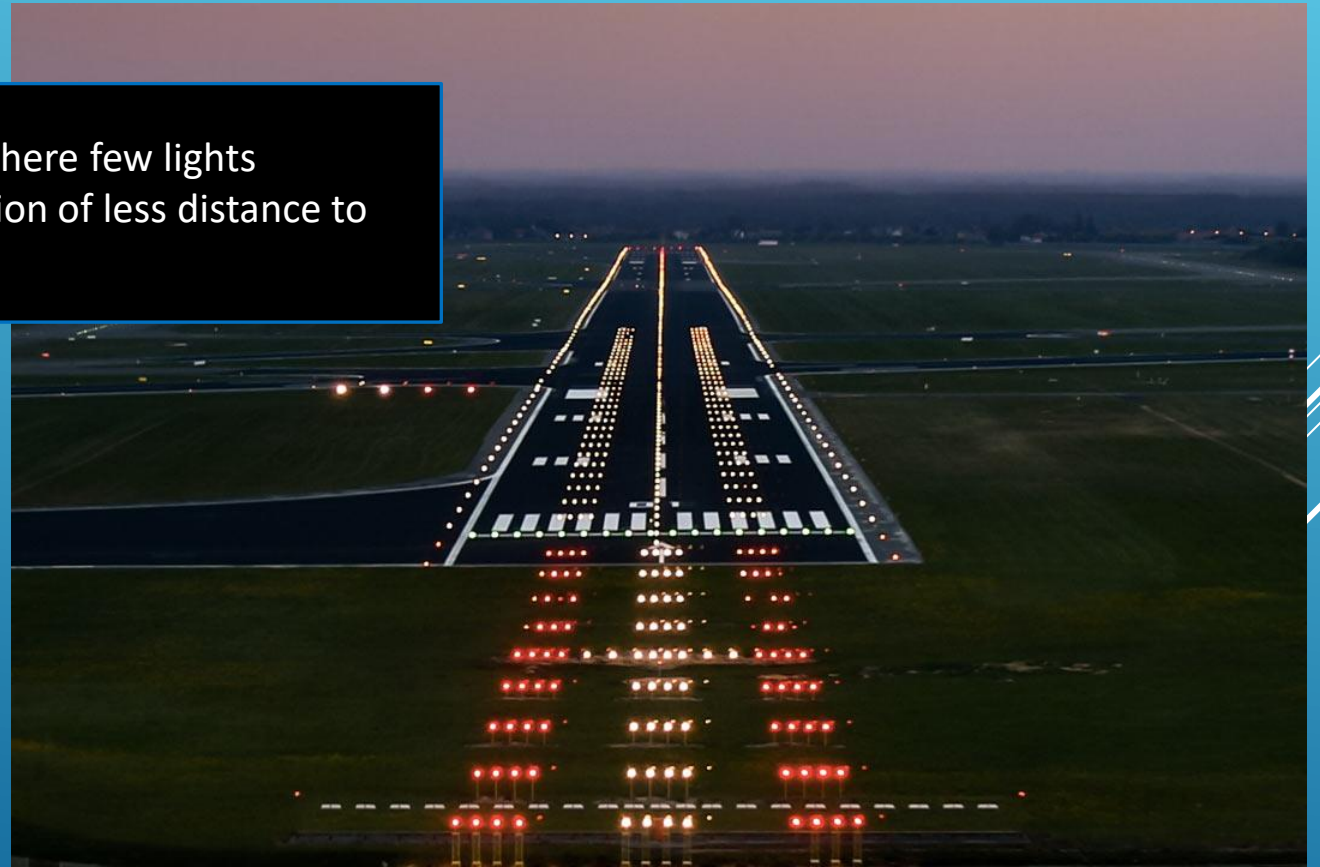




# VISUAL ILLUSIONS

## Ground Lighting

Bright runway and approach light systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway.



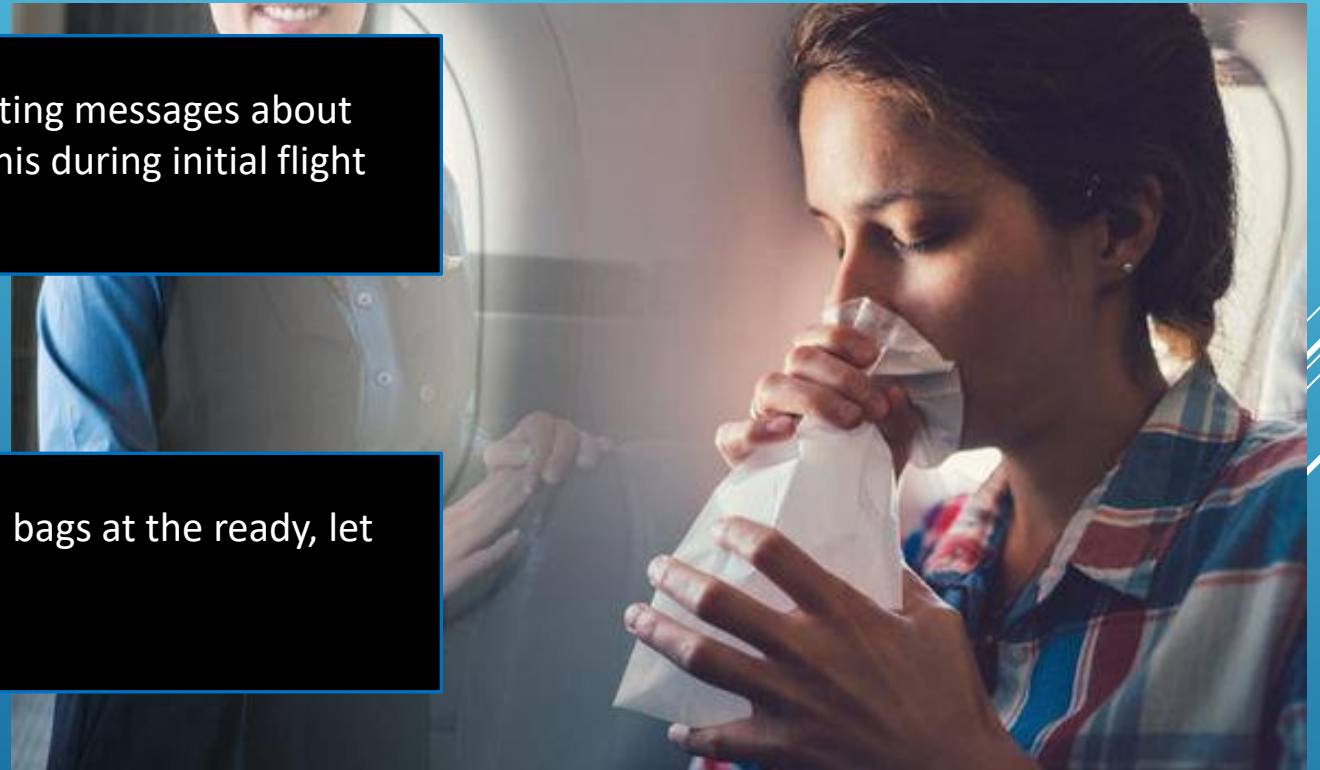
# MOTION SICKNESS

## Causes

Motion Sickness is caused by the brain receiving conflicting messages about the state of the body in flight. A pilot may experience this during initial flight training but it typically goes away after a few lessons.

## Corrective Actions

Fly straight and level, increase cool airflow, have brown bags at the ready, let students lightly place their hands on the flight controls.

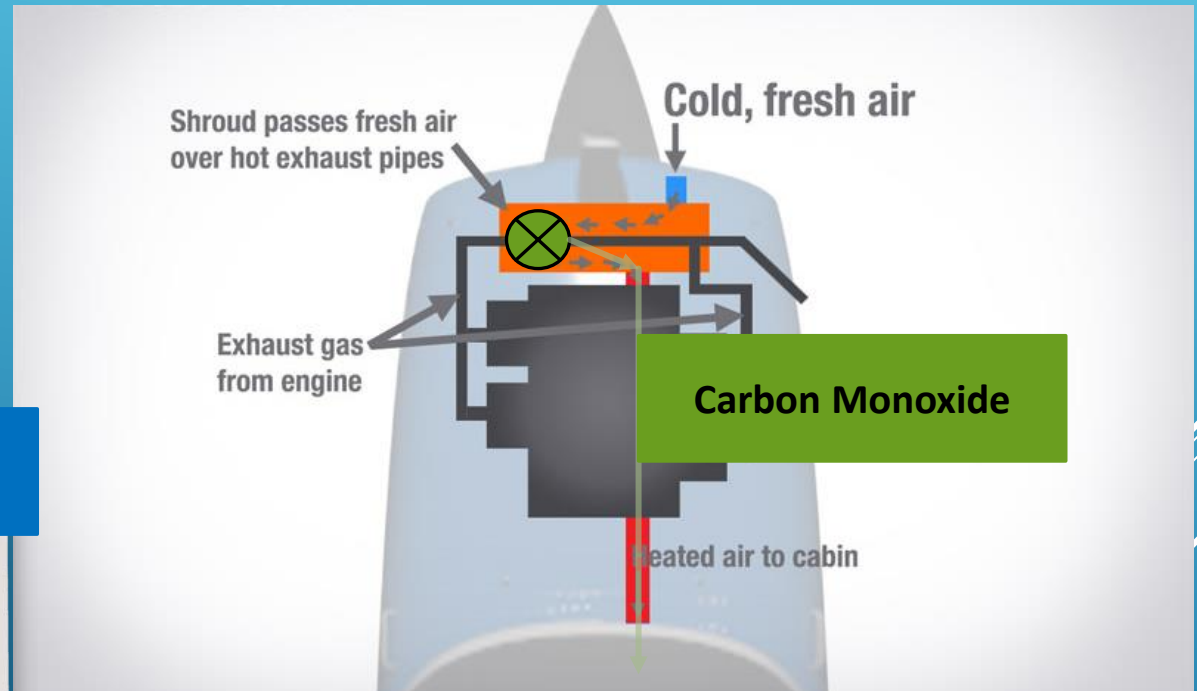


# CARBON MONOXIDE POISONING

## Causes

Most commonly, in flight, Carbon Monoxide Poisoning would come from the Aircraft Heater. This could happen if there was a crack or leak in the engine exhaust pipes.

## CO Detector



# CARBON MONOXIDE POISONING

## Why is it dangerous?

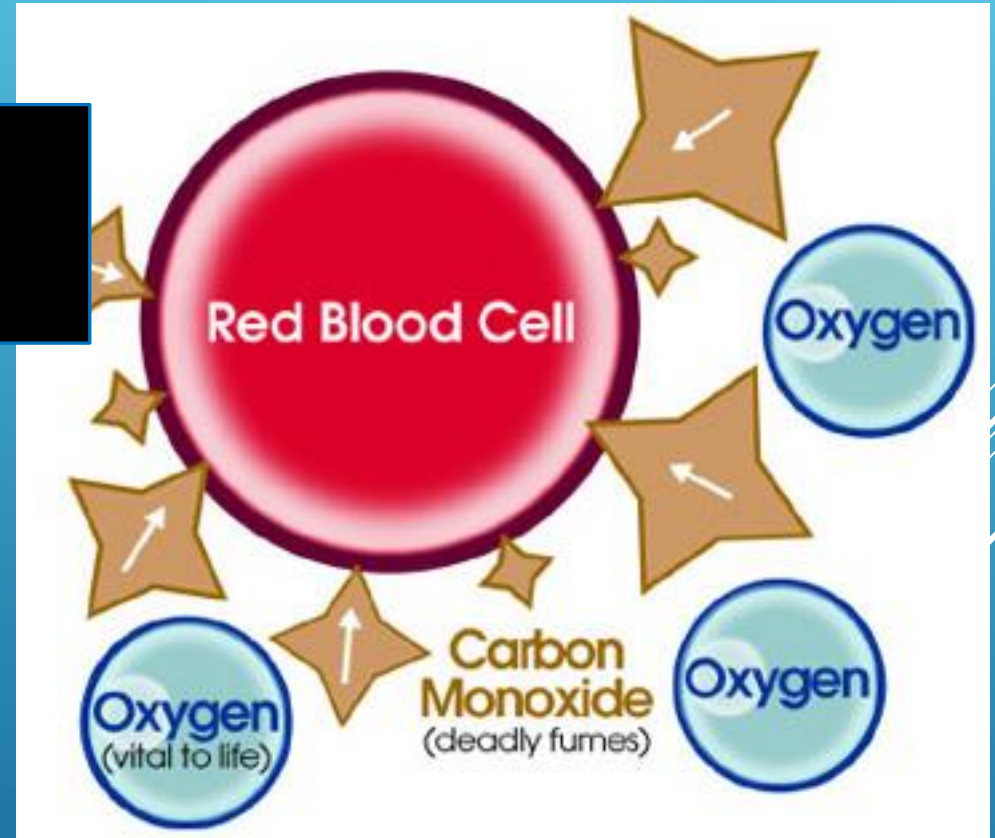
Carbon Monoxide Molecules attach themselves to the blood cells 200 times faster than Oxygen Molecules. This blocks Oxygen Molecules from entering the blood cells to be transported throughout the body.

## Symptoms

- Headache
- Blurred Vision
- Dizziness
- Drowsiness
- Euphoria
- Loss of Muscle Power
- Death

## Corrective Actions

- Turn off Aircraft Heater
- Open windows for fresh airflow.
- Land as soon as possible or practical.



# FATIGUE

Fatigue is frequently associated with pilot error. Some of the effects of fatigue include: degradation of attention and concentration, impaired coordination, and the decreased ability to communicate clearly.

## Acute Fatigue

This is short term and is a normal occurrence in everyday living. It is the kind of tiredness people feel after a period of strenuous effort, excitement, or lack of sleep.

## Chronic Fatigue

Chronic fatigue, extending over long periods of time, usually has psychological roots, although an underlying disease is sometimes responsible.





# STRESS

Stress is the body's response to physical and psychological demands placed upon it. Stress falls into 2 broad categories: acute and chronic.

## Acute Stress

Involves an immediate threat that is perceived as danger. This is the type of stress that triggers the "fight or flight" response in an individual.

## Chronic Stress

Chronic stress can be defined as a level of stress that presents an intolerable burden, exceeds the ability of an individual to cope, and causes individual performance to fall sharply.



# ALCOHOL

Studies have shown that consuming alcohol is closely linked to performance deterioration. The safe outcome of any flight depends on the pilot's ability to make correct and timely decisions.

## Alcohol Rules

- 8 hours bottle to throttle
- .04% BAC Max
- No flying while hungover or under the influence



# DCS AND SCUBA DIVING

## Decompression Sickness

DCS is a condition characterized by a variety of symptoms resulting from exposure to low barometric pressures that cause inert gases (mainly nitrogen), normally dissolved in body fluids and tissues, to come out of physical solution and form bubbles.



## Scuba Diving

Scuba diving subjects the body to increased pressure, which allows more nitrogen to dissolve in the body tissues and fluids.





# SCUBA DIVING WAIT TIMES

## Controlled Dive

A controlled dive is when a person dives deep enough that they cannot immediately return to the surface at will. They must return in stages to avoid bodily injury.

### Wait Times

**24 Hours**

**24 Hours**

## Uncontrolled Dive

An uncontrolled dive is when a person does not dive deep enough that they need to return to the surface in stages. They can return at will.

### Wait Times

**24 Hours**

**12 Hours**

# IMSAFE

One of the best ways pilots can mitigate risk is a self evaluation to ensure they are in good health. A standardized method used in evaluating health employs the IMSAFE Checklist.

I

## ILLNESS



Am I sick? Illness is an obvious pilot risk.

M

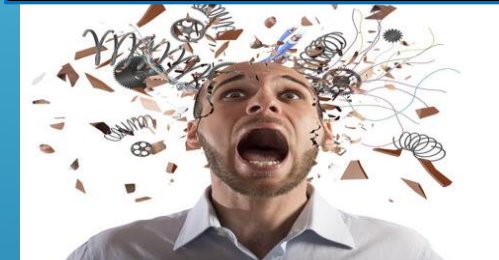
## MEDICATION



Am I taking any medications that might affect my judgement or make me drowsy?

S

## STRESS



Am I under psychological stress from the job? Do I have money, health, or family problems?

# IMSAFE

One of the best ways pilots can mitigate risk is a self evaluation to ensure they are in good health. A standardized method used in evaluating health employs the IMSAFE Checklist.

A

## ALCOHOL



Have I been drinking within 8 hours? 24 hours? Am I hungover/under the influence?

F

## FATIGUE



Am I tired or not adequately rested?

E

## EMOTION



Have I experienced an emotionally upsetting event recently?

# LESSON SUMMARY

In this lesson we covered Medical Certificate Privileges and Durations, differing aeromedical factors, their impact on flight safety and corrective actions, spatial disorientation, fatigue, stress, alcohol, and DCS and scuba diving.

