INSTRUMENT GROUND SCHOOL

ADVANCED HUMAN FACTORS

Aeronautical Decision Making
Risk Management
Task Management
Situational Awareness
Controlled Flight Into Terrain
Automation Management
Aviation Physiology

Aeronautical Decision Making

Created by Steve Reisser

SPRM Skills?

- Aeronautical Decision Making
- Risk Management
- Task Management
- Automation Management
- Controlled Flight into Terrain
- Situational Awareness

What is ADM

Aeronautical Decision Making (ADM) is a "**systematic approach** to the mental process used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances."

FAA Advisory Circular AC 60-22 in jewel box

There is also more to consider …..

Part of ADM is risk management. You must manage risks associated with:

- Yourself as The Pilot in Command
- Your Aircraft
- The Environment (surface and airborne)
- The Operations of Flight (safety first)

ADM means managing risk elements for all situations.

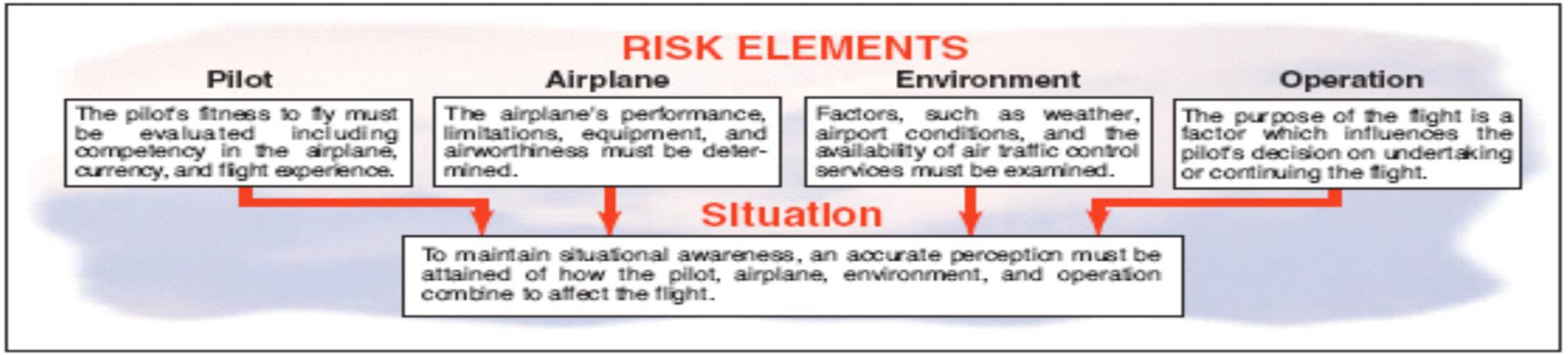


Figure 16-3. When situationally aware, the pilot has an overview of the total operation and is not fixated on one perceived significant factor.

***Pilot**: A pilot had only 4 hours of sleep the night before. The boss then asked the pilot to fly to a meeting in a city 750 miles away. The reported weather was marginal and not expected to improve. After assessing fitness as a pilot, it was decided that it would not be wise to make the flight. The boss was initially unhappy, but later convinced by the pilot that the risks involved were unacceptable.*	***Airplane**: During a preflight, a pilot noticed a small amount of oil dripping from the bottom of the cowling. Although the quantity of oil seemed insignificant at the time, the pilot decided to delay the takeoff and have a mechanic check the source of the oil. The pilot's good judgment was confirmed when the mechanic found that one of the oil cooler hose fittings was loose.*	***Environment**: A pilot was landing a small airplane just after a heavy jet had departed a parallel runway. The pilot assumed that wake turbulence would not be a problem since landings had been performed under similar circumstances. Due to a combination of prevailing winds and wake turbulence from the heavy jet drifting across the landing runway, the airplane made a hard landing. The pilot made an error when assessing the flight environment.*	***Operation**: On a ferry flight to deliver an airplane from the factory, in marginal weather conditions, the pilot calculated the groundspeed and determined that the airplane would arrive at the destination with only 10 minutes of fuel remaining. The pilot was determined to keep on schedule by trying to "stretch" the fuel supply instead of landing to refuel. After landing with low fuel state, the pilot realized that this could have easily resulted in an emergency landing in deteriorating weather conditions. This was a chance that was not worth taking to keep the planned schedule.*

Human Factors-AERONAUTICAL DECISION MAKING

PILOT IN COMMAND RESPONSIBILITY

RESPONSIBILITY = **E V E R Y T H I N G**

PRE-FLIGHT YOURSELF – **IF YOUR NOT READY THEN DON'T FLY TODAY !**

Created by Steve Reisser

Human Factors-AERONAUTICAL DECISION MAKING

- Communications
  - Actively Listen and communicate as needed
- Resources: Utilize all available resources provided to and for you including other pilots, instructors, and www resources (Join AOPA for free as a student pilot)
- Workload Management also called Plan, Prioritize, Prepare to prevent overload. In a multiperson crew configuration, effectively use all personnel and material assets available.
- Situational Awareness: be aware of all factors (self, airplane, environment, and operations of aircraft. Also keep your eye on the sky - Scan, Observe and Fly the airplane first above all things

Please see “AC 60-22” ADM on CD for full details.

Human Factors-AERONAUTICAL DECISION MAKING

Poor Judgment (PJ) Chain is a series of mistakes that may lead to an accident or incident. Two basic principles generally associated with the creation of a PJ chain are:

(1) One bad decision often leads to another; and

(2) as a string of bad decision grows, it reduces the number of subsequent alternatives for continued safe flight. ADM is intended to break the PJ chain before it can cause an accident or incident.

RECOGNIZE AND DEAL with problems while they are small before they get BIG.

Task Management

Flying an airplane is a multitasking operation. We are constantly starting new tasks, monitoring ongoing tasks, prioritizing tasks, giving more attention to more critical tasks than other less critical tasks, interrupting tasks and ending tasks.

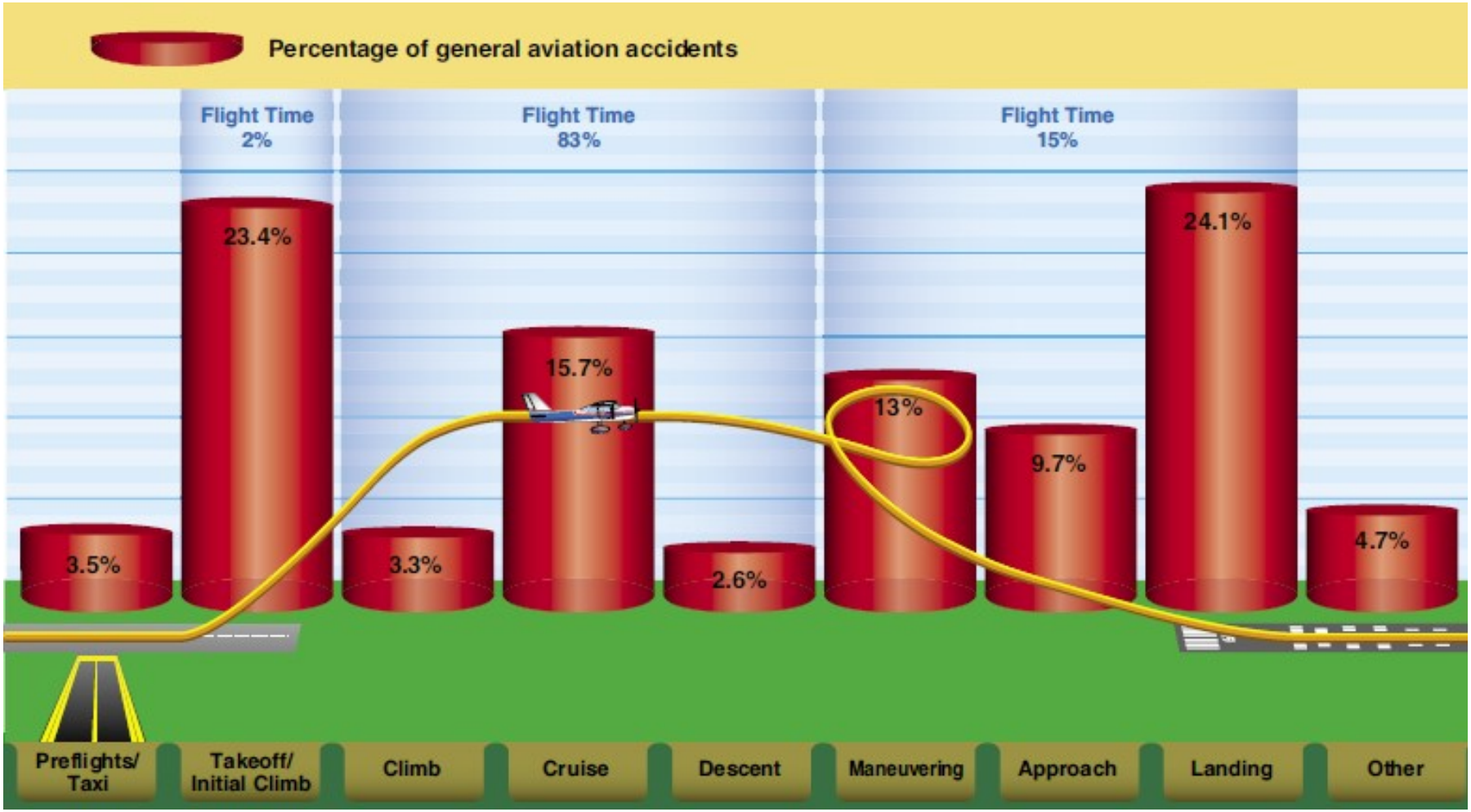
- If we become “task saturated” we miss important input that can lead to the poor judgment chain, after which “the airplane doesn’t cause an accident, the pilot does”.

- If overwhelmed STOP, THINK, SLOW DOWN, and PRIORITIZE. (delegate if someone is there to assist)

How can *tasks be completed in a timely manner without causing a distraction* from flying?

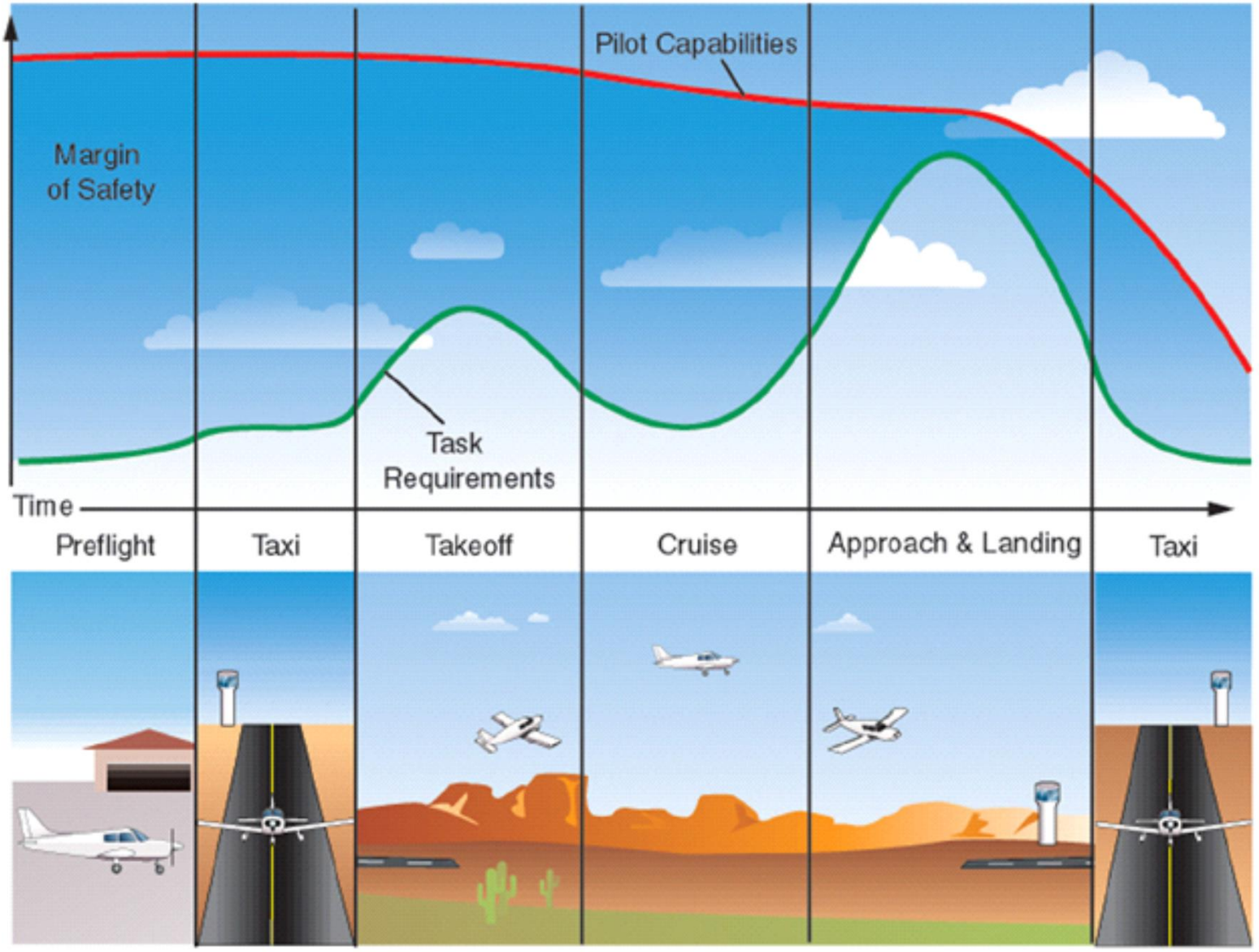
By planning, ***prioritizing***, and ***sequencing*** tasks, a potential work overload situation can be avoided. As experience is gained, a pilot learns to *recognize future workload requirements* and can prepare for high workload periods during times of low workload.

Remember Aviate, Navigate, Communicate!


Percentage of general aviation accidents
Flight Time
2%
Flight Time
83%
Flight Time
15%
23.4%
15.7%
24.1%
13%
9.7%
3.5%
3.3%
2.6%
4.7%
Preflights/
Taxi
Takeoff/
Initial Climb
Climb
Cruise
Descent
Maneuvering
Approach
Landing
Other

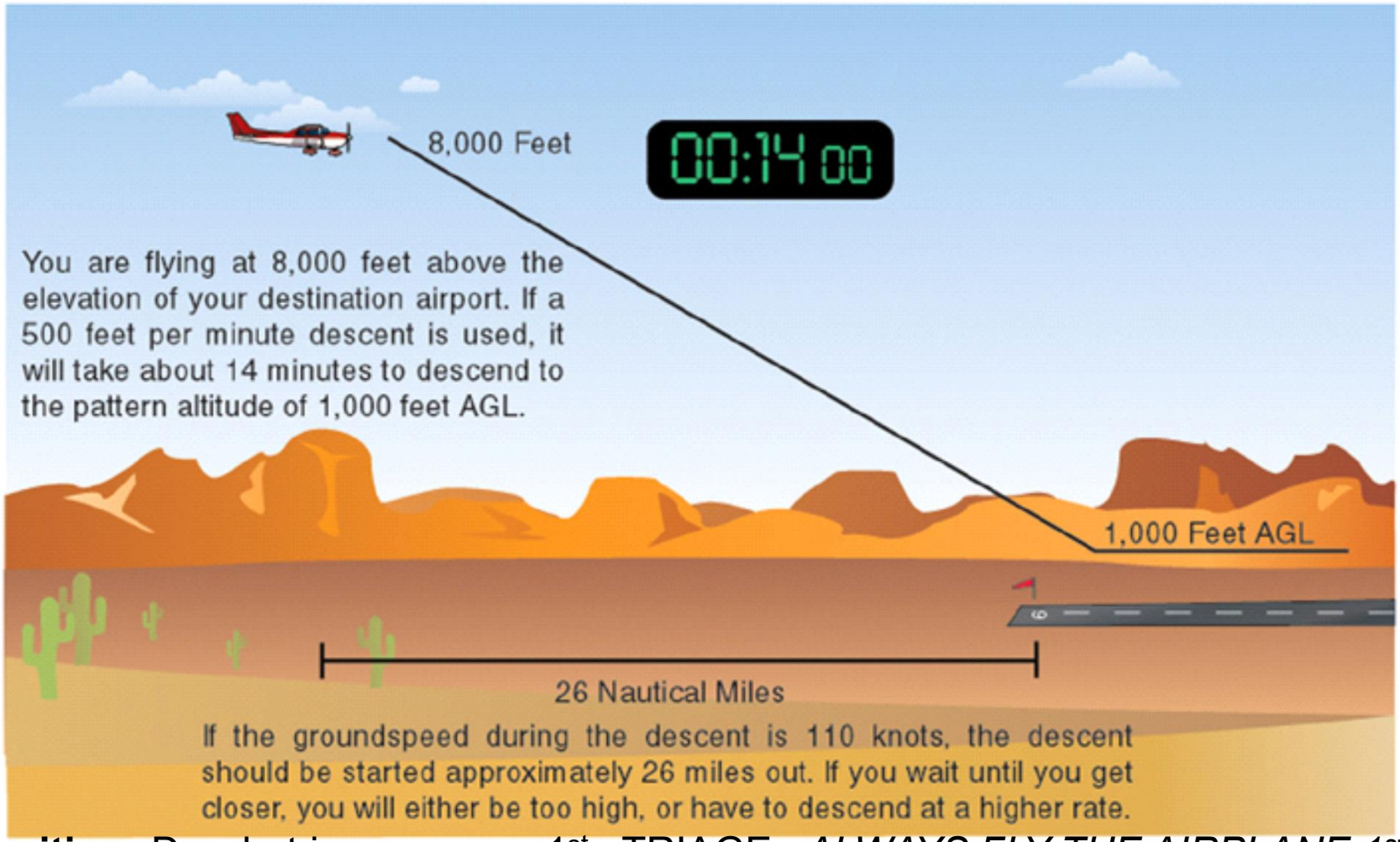
Workload Management

MANAGE THE LOAD NOT TO EXCEED YOUR CAPABILITY



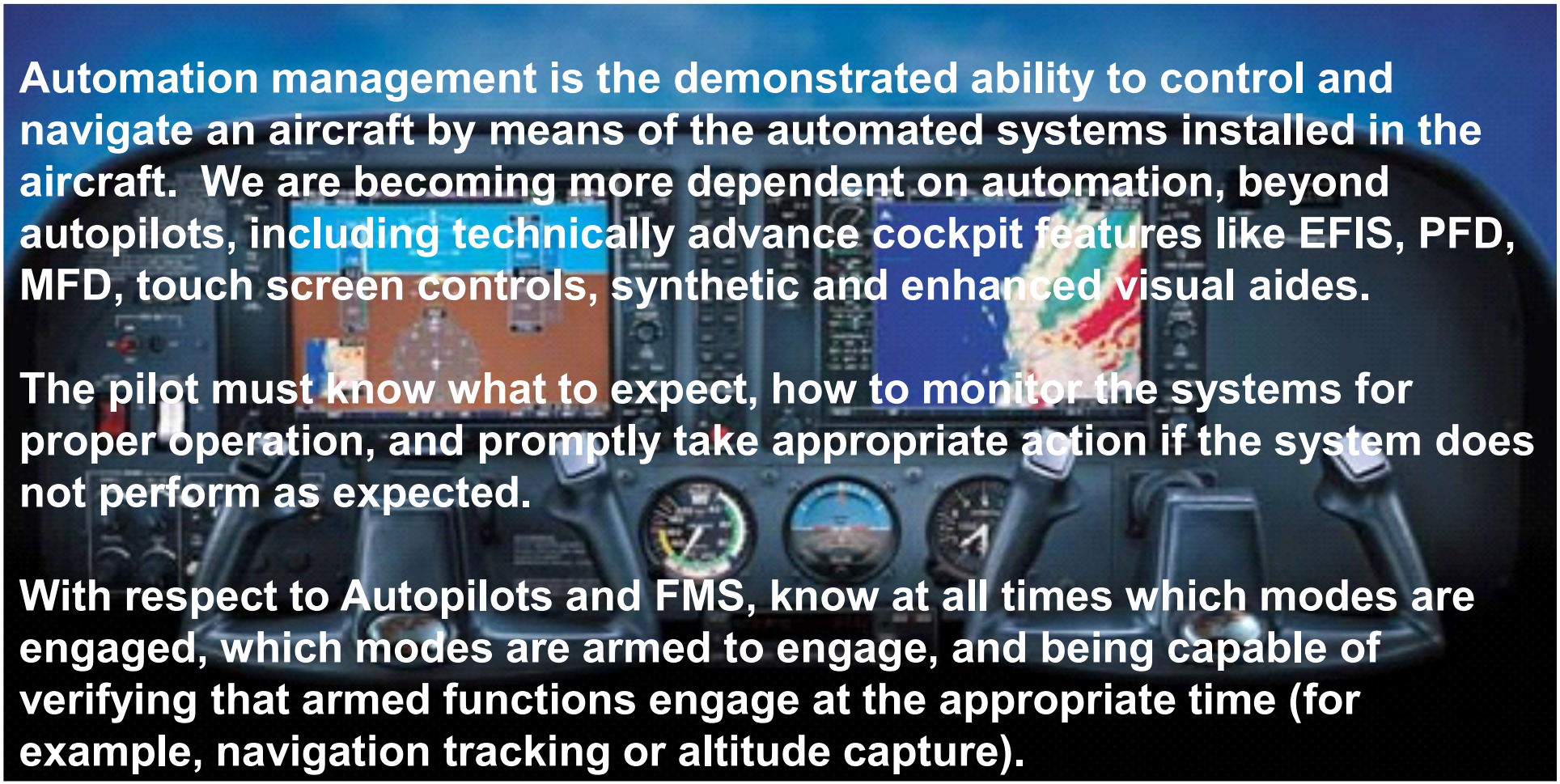
Workload Management

Planning and Preparation: Always be "ahead," on the ground and in the air. Never get "behind the power curve."



Prioritize: Do what is necessary 1st. TRIAGE. *ALWAYS FLY THE AIRPLANE 1st*.

Automation Management



Automation management is the demonstrated ability to control and navigate an aircraft by means of the automated systems installed in the aircraft. We are becoming more dependent on automation, beyond autopilots, including technically advance cockpit features like EFIS, PFD, MFD, touch screen controls, synthetic and enhanced visual aides.

The pilot must know what to expect, how to monitor the systems for proper operation, and promptly take appropriate action if the system does not perform as expected.

With respect to Autopilots and FMS, know at all times which modes are engaged, which modes are armed to engage, and being capable of verifying that armed functions engage at the appropriate time (for example, navigation tracking or altitude capture).

At a minimum, the pilot flying with advanced avionics must know how to manage the course deviation indicator (CDI), the navigation source, and the autopilot.

Problem Solving

- When on the ground and flying, if you have the feeling that something isn't quite right with either you or the airplane – it is time to do something…..
- DON'T WAIT

STRATEGIES

The DECIDE model
New and improved 3-P model

Use the 'DECIDE' Model for Making Systematic Decisions

Detect the change that is occurring or has occurred.

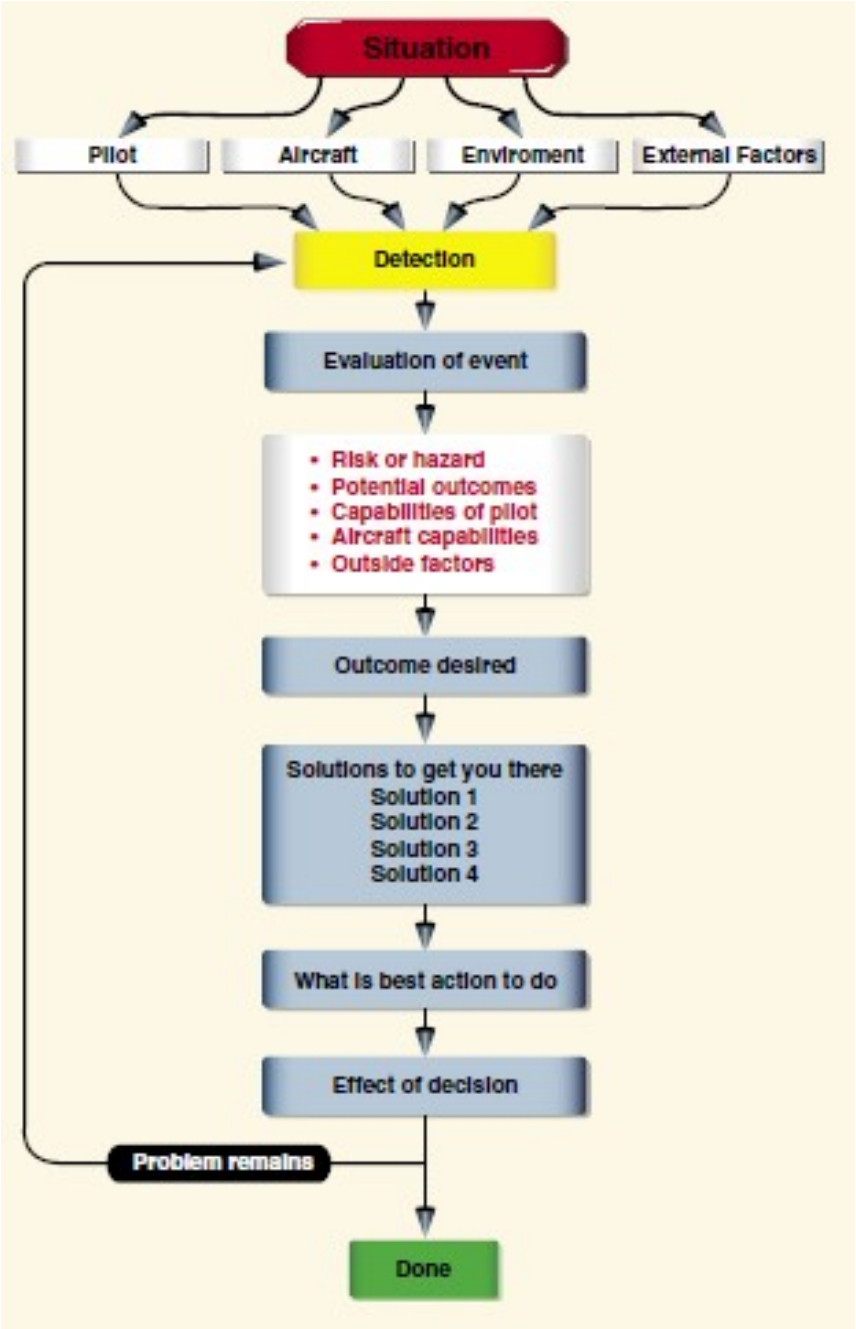
Estimate the effect of the change (what happens if I ignore it) – You "**define** the problem"

Choose a **desirable outcome** +Communicate + Climb

Identify suitable **courses of action/s** to achieve outcome

Do the action/s. **Take action now** – don't let situation deteriorate.

Evaluate the effect of your actions. If the outcome is not what you expect or does not accomplish the desired objective, then go back to "I"dentify a different course of action/s.


Situation
Pilot
Aircraft
Enviroment
External Factors
Detection
Evaluation of event
• Risk or hazard
• Potential outcomes
• Capabilities of pilot
• Aircraft capabilities
• Outside factors
Outcome desired
Solutions to get you there
Solution 1
Solution 2
Solution 3
Solution 4
What is best action to do
Effect of decision
Problem remains
Done

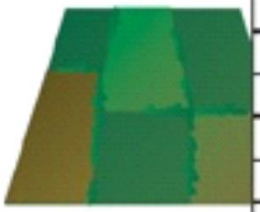
The acronym DECIDE is used by the FAA to describe the basic steps in the decision-making process.

Detect the fact that a change has occurred.
Estimate the need to counter or react to the change.
Choose a desirable outcome for the success of the flight.
Identify actions which could successfully control the change.
Do the necessary action to adapt to the change.
Evaluate the effect of the action.

1 Recognize a change.

While on a cross-country flight, you discover that your time enroute between two checkpoints is significantly longer than the time you had originally calculated.

ETE	ETA	Fuel
ATE	ATA	Rem.
4+5		9:19
11		
13		9:02
16		9:0
15		9:4
18		9:15
20		10:07
		31.9



2 Define the problem.

Based on your insight, your cross-country flying experience, and your knowledge of weather systems, you consider the possibility that you have an increased headwind.

You verify that your original calculations are correct and consider factors which may have lengthened the time between checkpoints, such as a climb or diversion off course. To determine if there is a change in the winds aloft forecast and to check recent pilot reports, you contact flight watch.

After weighing each information source, you conclude that your headwind has increased. To determine the severity of the problem, you calculate your new groundspeed, and reassess fuel requirements.

3 Choose a course of action.

After considering the expected outcome of each possible action and assessing the risks involved, you decide to refuel at an airport prior to your original destination.

4 Implement your decision.

You plot the course change and calculate a new estimated time of arrival, as well as contact the nearest FSS to amend your flight plan and check the weather conditions at your new destination.

5 Ensure that your decision is producing the desired result.

To evaluate your decision and determine if additional steps need to be taken, you monitor your groundspeed, aircraft performance, and the weather conditions as the flight continues.

Newest Info on ADM from FAA

The 3-P Model for ADM

Perceive, Process, Perform

To help pilots put the concept of ADM into practice, the FAA Aviation Safety Program developed a new framework for aeronautical decision-making and risk management:

Perceive – **P**rocess – **P**erform.
This model offers a simple, practical, and systematic approach to accomplishing each ADM task during all phases of flight. To use it, you:

Perceive the “given set of circumstances” for your flight.

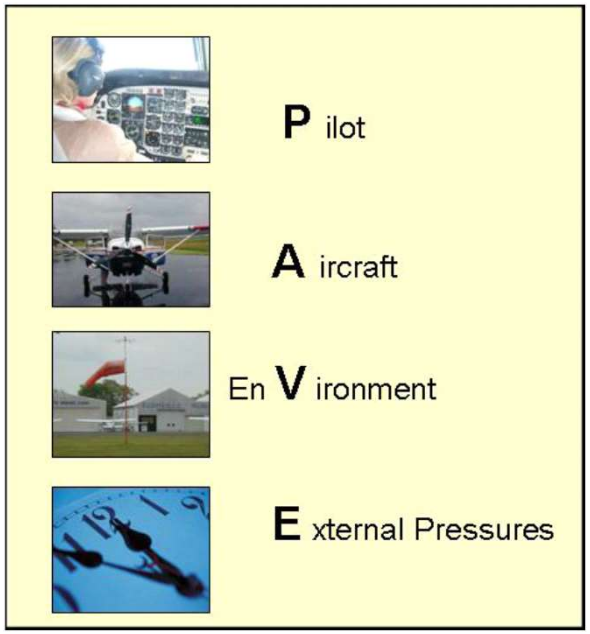
Process by evaluating their impact on flight safety.

Perform by implementing the best course of action.

PERCEIVE - Develop Situational Awareness

To navigate to a particular destination, the first step is to determine exactly where you are right now. The same principle applies in ADM: to navigate to a safe outcome, you first need to understand the "given set of circumstances" you face.

The first step in the 3-P model, **PERCEIVE,** is about developing a clear and comprehensive awareness of your particular situation. Consider:



For each element, ask "what could hurt me, my passengers, or my aircraft?"

All four elements combine and interact to create a unique situation for any flight. Pay special attention to the pilot-aircraft combination, and consider whether the combined "pilot-aircraft team" is capable of the mission you want to fly. For example, you may be a very experienced and proficient pilot, but your weather flying ability is still limited if you are flying a 1970s-model aircraft with no weather avoidance gear. On the other hand, you may have a new technically advanced aircraft with moving map GPS, weather datalink, and autopilot – but if you do not have much weather flying experience or practice in using this kind of equipment, you cannot rely on the airplane's capability to compensate for your own lack of experience.

The PAVE Checklist

Another way to mitigate risk is to perceive hazards. By incorporating the PAVE checklist into preflight planning, the pilot divides the risks of flight into four categories: **P**ilot-in-command (PIC), **A**ircraft, en**V**ironment, and **E**xternal pressures (PAVE) which form part of a pilot's decision-making process.

RISK ASSESSMENT

Pilot's Name _____ Flight From _____ To _____

SLEEP

1. Did not sleep well or less than 8 hours	2
2. Slept well	0

HOW DO YOU FEEL?

1. Have a cold or ill	4
2. Feel great	0
3. Feel a bit off	2

WEATHER AT TERMINATION

1. Greater than 5 miles visibility and 3,000 feet ceilings	1
2. At least 3 miles visibility and 1,000 feet ceilings, but less than 3,000 feet ceilings and 5 miles visibility	3
3. IMC conditions	4

Column total _____

HOW IS THE DAY GOING?

1. Seems like one thing after another (late, making errors, out of step)	3
2. Great day	0

IS THE FLIGHT

1. Day?	1
2. Night?	3

PLANNING

1. Rush to get off ground		3
2. No hurry		1
3. Used charts and computer to assist		0
4. Used computer program for all planning	Yes	3
	No	0
5. Did you verify weight and balance?	Yes	0
	No	3
6. Did you evaluate performance?	Yes	0
	No	3
7. Do you brief your passengers on the ground and in flight?	Yes	0
	No	2

Column total _____

PAVE

P = Pilot in Command (PIC)

The pilot is one of the risk factors in a flight. The pilot must ask, “Am I ready for this trip?” in terms of experience, recency, currency, physical and emotional condition. The IMSAFE checklist provides the answers.

A = Aircraft

What limitations will the aircraft impose upon the trip? Ask the following questions:

- Is this the right aircraft for the flight?
- Am I familiar with and current in this aircraft? Aircraft performance figures and the AFM are based on a brand new aircraft flown by a professional test pilot. Keep that in mind while assessing personal and aircraft performance.
- Is this aircraft equipped for the flight? Instruments? Lights? Navigation and communication equipment adequate?
- Can this aircraft use the runways available for the trip with an adequate margin of safety under the conditions to be flown?
- Can this aircraft carry the planned load?
- Can this aircraft operate at the altitudes needed for the trip?

V = EnVironment

Weather

Weather is an major environmental consideration. Earlier it was suggested pilots set their own personal minimums, especially when it comes to weather. As pilots evaluate the weather for a particular flight, they should consider the following:

PAVE

(V = enVironment, WEATHER: continued.)

- What are the current ceiling and visibility? In mountainous terrain, consider having higher minimums for ceiling and visibility, particularly if the terrain is unfamiliar.
- Consider the possibility that the weather may be different than forecast. Have alternative plans and be ready and willing to divert, should an unexpected change occur.
- Consider the winds at the airports being used and the strength of the crosswind component.
- If flying in mountainous terrain, consider whether there are strong winds aloft. Strong winds in mountainous terrain can cause severe turbulence and downdrafts and be very hazardous for aircraft even when there is no other significant weather.
- Are there any thunderstorms present or forecast?
- If there are clouds, is there any icing, current or forecast? What is the temperature/dew point spread and the current temperature at altitude? Can descent be made safely all along the route?
- If icing conditions are encountered, is the pilot experienced at operating the aircraft's deicing or anti-icing equipment? Is this equipment in good condition and functional? For what icing conditions is the aircraft rated, if any?

TERRAIN

Evaluation of terrain is another important component of analyzing the flight environment.

- To avoid terrain and obstacles, especially at night or in low visibility, determine safe altitudes in advance by using the altitudes shown on VFR and IFR charts during preflight planning.
- Use maximum elevation figures (MEFs) and other easily obtainable data to minimize chances of an inflight collision with terrain or obstacles.

PAVE

(V = enVironment, continued.)

Airport

• What lights are available at the destination and alternate airports? VASI/PAPI or ILS glideslope guidance? Is the terminal airport equipped with them? Are they working? Will the pilot need to use the radio to activate the airport lights?

• Check the Notices to Airmen (NOTAMS) for closed runways or airports. Look for runway or beacon lights out, nearby towers, etc.

• Choose the flight route wisely. An engine failure gives the nearby airports supreme importance.

• Are there shorter or obstructed fields at the destination and/or alternate airports?

Airspace

• If the trip is over remote areas, are appropriate clothing, water, and survival gear onboard in the event of a forced landing?

• If the trip includes flying over water or unpopulated areas with the chance of losing visual reference to the horizon, the pilot must be prepared to fly IFR.

• Check the airspace and any temporary flight restriction (TFRs) along the route of flight.

Night Flight

Night flying requires special consideration.

• If the trip includes flying at night over water or unpopulated areas with the chance of losing visual reference to the horizon, the pilot must be prepared to fly IFR.

• Will the flight conditions allow a safe emergency landing at night?

• Preflight all aircraft lights, interior and exterior, for a night flight. Carry at least two flashlights—one for exterior preflight and a smaller one that can be dimmed and kept nearby.

E = External Pressures

External pressures are influences external to the flight that create a sense of pressure to complete a flight—often at the expense of safety. Factors that can be external pressures include the following:

- Someone waiting at the airport for the flight's arrival.
- A passenger the pilot does not want to disappoint.
- The desire to demonstrate pilot qualifications.
- The desire to impress someone. (Probably the two most dangerous words in aviation are "Watch this!")
- The desire to satisfy a specific personal goal ("get-home-itis," "get-there-itis," and "let's-go-itis").
- The pilot's general goal-completion orientation.
- Emotional pressure associated with acknowledging that skill and experience levels may be lower than a pilot would like them to be. Pride can be a powerful external factor!

Managing External Pressures

- Allow time on a trip for an extra fuel stop or to make an unexpected landing because of weather.
- Have alternate plans for a late arrival or make backup airline reservations for must-be-there trips.
- For really important trips, plan to leave early enough so that there would still be time to drive to the destination.
- Advise those who are waiting at the destination that the arrival may be delayed. Know how to notify them when delays are encountered.
- Manage passengers' expectations. Make sure passengers know that they might not arrive on a firm schedule, and if they must arrive by a certain time, they should make alternative plans.
- Eliminate pressure to return home, even on a casual day flight, by carrying a small overnight kit containing prescriptions, contact lens solutions, toiletries, or other necessities on every flight.

The pilot's goal is to manage risk, not create hazards !

Pilot

A pilot must continually make decisions about competency, condition of health, mental and emotional state, level of fatigue, and many other variables. For example, a pilot may be called early in the morning to make a long flight. If a pilot has had only a few hours of sleep and is concerned that the congestion being experienced could be the onset of a cold, it would be prudent to consider if the flight could be accomplished safely.

A pilot had only 4 hours of sleep the night before being asked by the boss to fly to a meeting in a city 750 miles away. The reported weather was marginal and not expected to improve. After assessing fitness as a pilot, it was decided that it would not be wise to make the flight. The boss was initially unhappy, but later convinced by the pilot that the risks involved were unacceptable.

Environment

This encompasses many elements not pilot or airplane related. It can include such factors as weather, air traffic control, navigational aids (NAVAIDS), terrain, takeoff and landing areas, and surrounding obstacles. Weather is one element that can change drastically over time and distance.

A pilot was landing a small airplane just after a heavy jet had departed a parallel runway. The pilot assumed that wake turbulence would not be a problem since landings had been performed under similar circumstances. Due to a combination of prevailing winds and wake turbulence from the heavy jet drifting across the landing runway, the airplane made a hard landing. The pilot made an error when assessing the flight environment.

Aircraft

A pilot will frequently base decisions on the evaluations of the airplane, such as performance, equipment, or airworthiness.

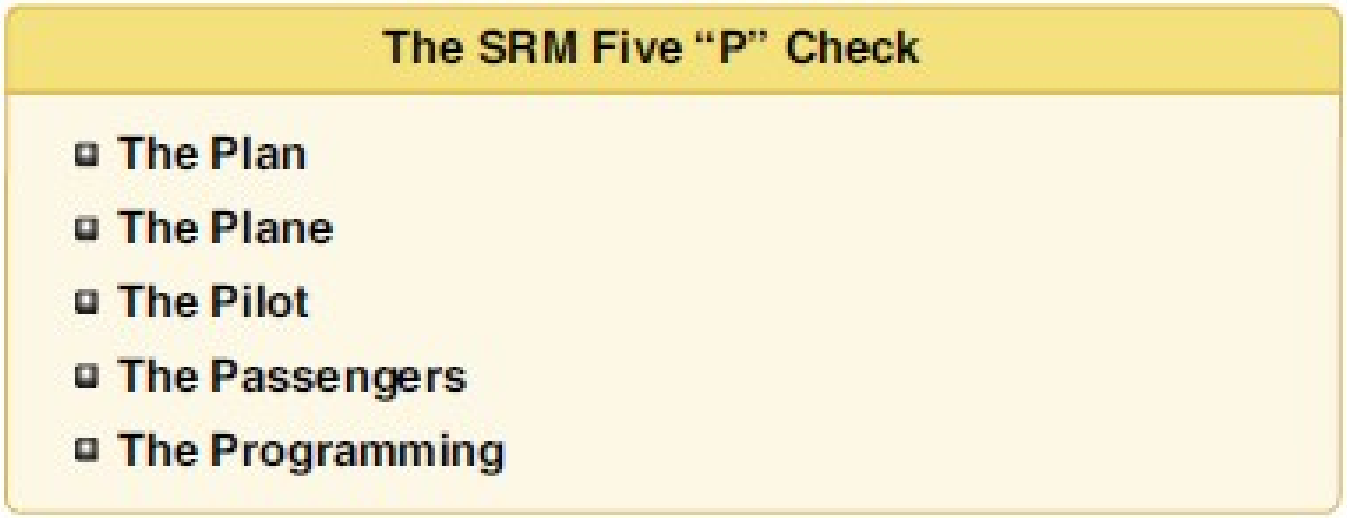
During a preflight, a pilot noticed a small amount of oil dripping from the bottom of the cowling. Although the quantity of oil seemed insignificant at the time, the pilot decided to delay the takeoff and have a mechanic check the source of the oil. The pilot's good judgment was confirmed when the mechanic found that one of the oil cooler hose fittings was loose.

External Pressures

The interaction between the pilot, airplane, and the environment is greatly influenced by the purpose of each flight operation. The pilot must evaluate the three previous areas to decide on the desirability of undertaking or continuing the flight as planned. It is worth asking why the flight is being made, how critical is it to maintain the schedule, and is the trip worth the risks?

On a ferry flight to deliver an airplane from the factory, in marginal weather conditions, the pilot calculated the groundspeed and determined that the airplane would arrive at the destination with only 10 minutes of fuel remaining. The pilot was determined to keep on schedule by trying to "stretch" the fuel supply instead of landing to refuel. After landing with low fuel state, the pilot realized that this could have easily resulted in an emergency landing in deteriorating weather conditions. This was a chance that was not worth taking to keep the planned schedule.

MITIGATING RISK



The 5 Ps are used to evaluate the pilot's current situation at key decision points during the flight, or when an emergency arises. These decision points include, preflight, pre-takeoff, hourly or at the midpoint of the flight, pre-descent, and just prior to the final approach fix or for visual flight rules (VFR) operations, just prior to entering the traffic pattern.

1. the easiest point to cancel a flight due to bad weather is before the pilot and passengers walk out the door and load the aircraft.
2. the second easiest point in the flight to make a critical safety decision is just prior to takeoff.

The third place to review the 5 Ps is at the mid point of the flight before entering the highest workload.

3. just prior to descent into the terminal area and
4. just prior to the final approach fix, or if VFR just prior to entering the traffic pattern, as preparations for landing commence.

MITIGATINGI RISK

The Plan

The “Plan” can also be called the mission or the task. It contains the basic elements of cross-country planning, weather, route, fuel, publications currency, etc. The “Plan” should be reviewed and updated several times during the course of the flight

The Plane

Both the “plan” and the “plane” are fairly familiar to most pilots. The “plane” consists of the usual array of mechanical and cosmetic issues that every aircraft pilot, owner, or operator can identify. With the advent of advanced avionics, the “plane” has expanded to include database currency, automation status, and emergency backup systems that were unknown a few years ago.

The Pilot

Flying, especially when used for business transportation, can expose the pilot to high altitude flying, long distance and endurance, and more challenging weather. An advanced avionics aircraft, simply due to their advanced capabilities can expose a pilot to even more of these stresses.

The Passengers

One of the key differences between CRM and SRM is the way passengers interact with the pilot. The pilot of a highly capable single-engine aircraft has entered into a very personal relationship with the passengers. In fact, the pilot and passengers sit within an arm’s reach all of the time. (Briefings, Sterile Cockpits and Active SA.)

The Programming

The advanced avionics aircraft adds an entirely new dimension to the way GA aircraft are flown. The electronic instrument displays, GPS, and autopilot reduce pilot workload and increase pilot situational awareness.

5P CHECKLIST	Use to identify and manage your risk during pre-flight			
PILOT				
SUMMARY OF TRAINING		YES	NO	N/A
Do I have a current flight review (BFR)?				
Am I “current” to carry passengers?				
Have I had recent refresher training in this airplane?				
Am I instrument current?				
Have I had recent mountain flying training or experience?				
EXPERIENCE	Personal Minimums	YES	NO	N/A
Hours				
Landings				
Instrument Approaches				
LAST 6 MONTHS	Personal Minimums	YES	NO	N/A
IFR Hours				
Instrument Approaches				
Night Hours				
Night Landings				
Strong/Gusty Crosswind Landings				
Mountain Flying Hours				
FITNESS-IM'SAFE		YES	NO	N/A
Illness-Am I healthy?				
Medications-Am I free of prescription or OTC drugs?				
Stress-Am I free of pressures(job, home, finance, health,etc)?				
Alcohol-Have I consumed within the previous 24 hours?				
Fatigue-Did I get at least 7 hours of sleep?				
Eatinig-Am I adequately nourished?				
Emotions-Am I free of emothional upset?				
PASSENGERS				
EXPERIENCE		YES	NO	N/A
Are my passengers comfortable flying? (spent time in small aircraft, certified pilots, etc)				
FITNESS		YES	NO	N/A
Are my passengers feeling well? (sickness, or likely to feel airsick during flight, etc.)				
FLEXIBILITY		YES	NO	N/A
Are my passengersf flexible and well informed about the possible changing conditions of flight?				

PLANE				
AIRWORTHINESS		YES	NO	N/A
Are the aircraft inspections current and appropriate to the type of flight? (annual, 100-hour, VOR)				
Is the required equipment onboard for the type of flight? (lights for night flight, onboard oxygen, survival gear, etc.)				
Have all prior maintenance issues been taken care of? (sqawks resolved, inoperative equipment placarded, etc,)				
PERFORMANCE		YES	NO	N/A
Perfomance adequate for runways, DA, and terrain conditions? (TO, climb, etc)	Both engines operating One engine inoperative			
Can the aircraft be flown as planned load within proper CG limits?				
Is fuel capacity adequate for proposed flight legs, including alternate airport if required?				
PROGRAMMING				
AVIONICS AIRWORTHINESS		YES	NO	N/A
Is the avionics equipment working properly? (sqwalks resolved autopilot function)				
AVIONICS OPERATION		YES	NO	N/A
Are you proficient at working the avionics equipment?				
AVIONICS CONFIGURATION		YES	NO	N/A
Is the avionics configuration appropriate for the navigation required?				

PLAN					
AIRPORT CONDITIONS			YES	NO	N/A
Do NOTAMS indicate that I can proceed as planned?					
(no runway or NAVAIDs closed for proposed flight)					
TERRAIN and AIRSPACE			YES	NO	N/A
Does terrain/airspace allow me to fly planned route?					
(Check mountains terrain, TFRs, restricted-prohibited aispaces)					
MISSION			YES	NO	N/A
Do I have alternate plans for destination such as rescheduling					
or checking airline schedules should alternates be required?					
Did I tell people I'm meeting at destination that I could be late?					
Do I have an overnight kit containing any necessary toiletries					
and prescriptions?					
WEATHER		LOCATION	YES	NO	N/A
Are weather conditions acceptable?		Departure			
(no weather hazards such as icing,		Enroute			
thunderstorms, turbulance)		Destination			
Is there a suitable airport that meets the regulatory requirements					
for an alternate if the forecast at my destination requires one?					
WEATHER	PERSONAL	LOCATION	YES	NO	N/A
LIMITATIONS	LIMITATIONS				
Are the weather conditions for my flight within my limitations?					
- Minimim IFR approach ceiling and		Departure			
visibility?		Destination			
- Minimum ceiling and visibility for day		Departure			
VFR?		Destination			
- Minimum ceiling and visibility for night		Departure			
VFR?		Destination			
- Maximum surface winds and gusts?		Departure			
		Destination			
- Maximum direct crosswind?		Departure			
(cross-wind component determined)		Destination			

ADVANCED PREFLIGHT

I start ***in the cockpit***

- required documents present? (AROW)
  - **A**irworthiness Certificate,
  - **R**egistration,
  - **O**wners Manual (POH), and
  - **W**eight and Balance documents.
- parking brake set
- remove and control wheel lock and stow in side panel
- ignition switch OFF
- avionic switch OFF
- all fuses in proper position (not popped)
- master switch ON -Extend full flaps
- check fuel gauges
- check lights, exterior and interior if night])
- master switch OFF
- fuel selector valve – BOTH
- baggage door - Check
- remove drain sump fuel tester for fuel contamination inspection from flight bag.

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

FUEL CHECK

• Don't trust the fuel gauges, visually check by viewing mid-tank tabs, or if possible, measure exact quantity using a fuel dip tube (specific to each type aircraft) in each tank. If necessary, have ground crew refuel to desired quantity BUT verify. Don't presume the refueling truck is contaminant free. SUMP check after refueling! It is important to weight and balance, duration of flight, and overall safety that you verify the quantify and quality of fuel.

• You may have anywhere from 3 to 12 drains to check. SUMPS under the wing and on the bottom of the fuselage are drained before each flight. Drain the fuel sumps to insure no water has condense or other contaminants that may have settled in the bottom of the tanks. Contaminants can damage or cause engine failure.

• NEVER THROW DRAINED FUEL ON THE GROUND. Most pilots put drained GOOD fuel back in the tank. Make sure that the fuel is 100LL not Jet-A (kerosene, white, distinctive smell). Your 100LL is very, very pale blue and smells like gas.

• Make sure fuel caps are *tight* and in the *correct orientation*.

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

Cowling and Oil

- Open the cowling on the engine. Remove the oil cap (use a cloth if the engine is hot). Make sure you have sufficient oil for the flight. DIFFERENT procedure for Rotex engines (belching the engine is required). Never depart without the oil level above the minimum mark on the oil stick! (Check POH).

- Visually check the interior of the engine compartment for things like small animals, loose connections, leaking oil, etc). Fasten the cowl cover after checking the interior.

- Preflight inspection inside the engine compartment. Especially *if maintenance has been performed* on the engine or components, you must check that nothing was inadvertently been done incomplete, (i.e. loose cables). If you rent and maintenance logs are not in the airplane, ask if and what type of maintenance was recently performed on the airplane so you can visually inspect for problems.

- Check underneath the cowling for any signs of leaking oil. Note, overfilling oil will cause oil to be blown off and smoke appearing as though your aircraft engine is leaking oil. Don't overfill.)

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

Left Wing

Under left wing are some important structures

• Pitot tube (critical to static flight instruments) – clear of contaminants (bugs), ice, or dirt.
• Fuel Tank Sump Drain which you used earlier.
• Fuel tank vent – make sure it is open – no contaminants

Leading Edge (front part of wing)

• Stall warning opening (suction type) clear, or tab (electric switch) moves up and down freely
• remove contaminants along leading edge to insure smooth airflow.
• observe the top and bottom of the wing for any rivets that might be working loose.
• if landing and or taxi light are present, check for damage. If you are preparing for night operations, test that all lights are operational on your preflight check.

Wing Tip

• Check that navigation and strobe lights (if present) are undamaged. Verify operations for night flight.

Trailing Left Wing

• Verify free operation of **aileron**. Visually check cotter pins in place on hinges of aileron. View that upward and downward movement of aileron correspond to proper position of the yoke in the cockpit (up-yoke turns to left, down-to right)
•Visually inspect **Flaps**. Jiggle and make sure they are solid with fixed.

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

Main Landing Gear

As with the Nose Gear, you want check for proper inflation and excessive ware.

Cargo Door

Make sure cargo door is securely closed and locked.

Empennage (horizontal and vertical stabilizer)… a.k.a. The Tail

• As you move back from the wing towards the tail, look for the “static port”. A small circular object which is flush on the fuselage with a small hole at its center can be found along the fuselage. This is critical to correct flight displays. Make sure the hole in the center is free of dirt or wax that could obstruct airflow.

• Also check that all antennas and antenna cables appear secure as you work your way back to the tail.

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

Empennage (horizontal and vertical stabilizer)… a.k.a. The Tail

Horizontal Stabilizer and Elevator

The fixed (non-movable portion) is referred to as the horizontal stabilizer. Attached to the rear of that structure is a movable surface called an Elevator because it is critical to pitch (nose up and now) that like an elevator helps you orient the attitude of the aircraft either up or down. It is controlled by pushing forward or pulling back on the control yoke, full stick, or joystick.

The cables that control the elevator movement are in the tail and visible as you manually move the elevator up and down. Check that the pins and cables are affixed, and view forward to make sure that the yoke moves in the correct corresponding manner.

Piper aircraft use a Stabilator. They do not have elevators separate from horizontal stabilizers. The entire horizontal stabilizer moves without elevators.

ADVANCED PREFLIGHT

Generic Single Engine, Land, Cessna

Vertical Stabilizer and Rudder

- The fixed (non-movable portion is referred to as the vertical stabilizer. Attached at the rear of that structure is the Rudder which is critical in both flight and ground operations. This is controlled by the rudder pedals in the cockpit and must be verified for correct movement from within the cockpit. You may be able to view the cabling in some aircraft.

- Atop the vertical stabilizer is a "rotating beacon" - not many rotate, just blink red
- On the very top rear of the horizontal stabilizer is a white position light.

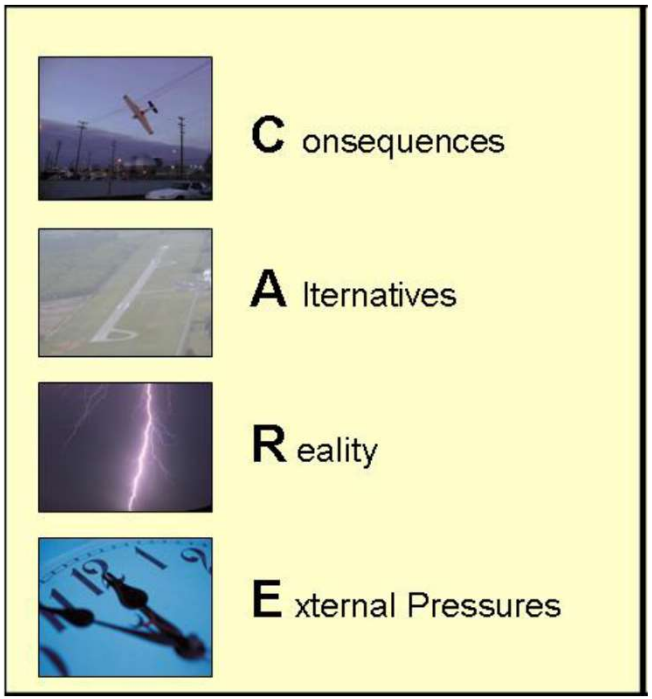
TRIM TABS: Trim tabs are small devices that help the aerodynamic pressures in controlling the aircraft. They may located on the rudder and ailerons, but ALWAYS present on the elevator. Do not manipulate these small structures.

INSURE ALL LIGHTS, INTERIOR AND EXTERIOR FUNCTION PROPERLY FOR NIGHT OPERATIONS!

PROCESS - Evaluate with CARE

Next, you mentally **PROCESS** information about the circumstances that you have identified. The goal is to evaluate their impact on the safety of your flight, and consider "why must I CARE about these circumstances?"

For each hazard that you perceived in step one, process with CARE. Example: for a night flight to attend a business meeting:



C onsequences (e.g., departing after a full workday creates fatigue & pressure)

A lternatives (e.g., delay until morning; reschedule meeting; drive)

R eality (e.g., dangers and distractions of fatigue could lead to an accident)

E xternal pressures (e.g., business meeting at destination might influence me)

A good rule of thumb for the processing phase: if you find yourself saying that it will "**probably**" be okay, it is definitely time for a solid **reality check**.

If you are worried about missing a meeting, **be realistic about how that pressure will affect not just your initial go/no-go decision**, but also your inflight decisions to **continue the flight or divert**.

Perceive, Process, Perform with CARE and TEAM

Most flight training activities take place in the "time-critical" timeframe for risk management. *Figures 17-8* and *17-9* combine the six steps of risk management into an easy-to-remember 3P model for practical risk management: Perceive, Process, Perform with the CARE and TEAM models. Pilots can help perceive hazards by using the PAVE checklist of: Pilot, Aircraft, enVironment, and External pressures. They can process hazards by using the CARE checklist of: Consequences, Alternatives, Reality, External factors. Finally, pilots can perform risk management by using the TEAM choice list of: Transfer, Eliminate, Accept, or Mitigate. These concepts are relatively new in the GA training world, but have been shown to be extraordinarily useful in lowering accident rates in the world of air carriers.

The next two frames show the use of both CARE and TEAM. TEAM focuses on Tools of risk MITIGATION. What to do upon perception using CARE.

Pilots can perceive hazards by using the PAVE checklist:

Pilot

Gayle is a healthy and well-rested private pilot with approximately 300 hours total flight time. Hazards include her lack of overall and cross-country experience and the fact that she has not flown at all in two months.

Aircraft

Although it does not have a panel-mount GPS or weather avoidance gear, the aircraft—a C182 Skylane with long-range fuel tanks—is in good mechanical condition with no inoperative equipment. The instrument panel is a standard "six-pack."

EnVironment

Departure and destination airports have long runways. Weather is the main hazard. Although it is VFR, it is a typical summer day in the Mid-Atlantic region: hot (near 90 °F) hazy (visibility 7 miles), and humid with a density altitude of 2,500 feet. Weather at the destination airport (located in the mountains) is still IMC, but forecast to improve to visual meteorological conditions (VMC) prior to her arrival. En route weather is VMC, but there is an AIRMET Sierra for pockets of IMC over mountain ridges along the proposed route of flight.

External Pressures

Gayle is making the trip to spend a weekend with relatives she does not see very often. Her family is very excited and has made a number of plans for the visit.

Pilots can perform risk management by using the TEAM choice list:

Pilot

To manage the risk associated with her inexperience and lack of recent flight time, Gayle can:

- Transfer the risk entirely by having another pilot act as PIC.
- Eliminate the risk by canceling the trip.
- Accept the risk and fly anyway.
- Mitigate the risk by flying with another pilot.

Gayle chooses to mitigate the major risk by hiring a CFI to accompany her and provide dual cross-country instruction. An added benefit is the opportunity to broaden her flying experience.

Aircraft

To manage risk associated with any doubts about the aircraft's mechanical condition, Gayle can:

- Transfer the risk by using a different airplane.
- Eliminate the risk by canceling the trip.
- Accept the risk.
- Mitigate the remaining (residual) risk through review of aircraft performance and careful preflight inspection.

Since she finds no problems with the aircraft's mechanical condition, Gayle chooses to mitigate any remaining risk through careful preflight inspection of the aircraft.

Environment

To manage the risk associated with hazy conditions and mountainous terrain, Gayle can:

- **T**ransfer the risk of VFR in these conditions by asking an instrument-rated pilot to fly the trip under IFR.
- **E**liminate the risk by canceling the trip.
- **A**ccept the risk.
- **M**itigate the risk by careful preflight planning, filing a VFR flight plan, requesting VFR flight following, and using resources such as Flight Watch.

Detailed preflight planning must be a vital part of Gayle's weather risk mitigation strategy. The most direct route would put her over mountains for most of the trip. Because of the thick haze and pockets of IMC over mountains, Gayle might mitigate the risk by modifying the route to fly over valleys. This change will add 30 minutes to her estimated time of arrival (ETA), but the extra time is a small price to pay for avoiding possible IMC over mountains. Because her destination airport is IMC at the time of departure, Gayle needs to establish that VFR conditions exist at other airports within easy driving distance of her original destination. In addition, Gayle should review basic information (e.g., traffic pattern altitude, runway layout, frequencies) for these alternate airports. To further mitigate risk and practice good cockpit resource management, Gayle should file a VFR flight plan, use VFR flight following, and call Flight Watch to get weather updates en route. Finally, basic functions on her handheld GPS should also be practiced.

External Pressures

To mitigate the risk of emotional pressure from family expectations that can drive a "get-there" mentality, Gayle can:

- **T**ransfer the risk by having her co-pilot act as PIC and make the continue/divert decision.
- **E**liminate the risk by canceling the trip.
- **A**ccept the risk.
- **M**itigate the risk by managing family expectations and making alternative arrangements in the event of diversion to another airport.

Gayle and her co-pilot choose to address this risk by agreeing that each pilot has a veto on continuing the flight, and that they will divert if either becomes uncomfortable with flight conditions. Because the destination airport is still IMC at the time of departure, Gayle establishes a specific point in the trip—an en route VORTAC located between the destination airport and the two alternates—as the logical place for her "final" continue/divert decision. Rather than give her family a specific ETA that might make Gayle feel pressured to meet the schedule, she manages her family's expectations by advising them that she will call when she arrives.

Pilots can perceive hazards by using the CARE checklist:

Pilot

- **C**onsequences: Gayle's inexperience and lack of recent flight time create some risk of an accident, primarily because she plans to travel over mountains on a hazy day and land at an unfamiliar mountain airport that is still in IMC conditions.
- **A**lternatives: Gayle might mitigate the pilot-related risk by hiring a CFI to accompany her and provide dual cross-country instruction. An added benefit is the opportunity to broaden her flying experience in safe conditions.
- **R**eality: Accepting the reality that limited experience can create additional risk is a key part of sound risk management and mitigation.
- **E**xternal Factors: Like many pilots, Gayle must contend with the emotional pressure associated with acknowledging that her skill and experience levels may be lower than she would like them to be. Pride can be a powerful external factor!

Aircraft

- **C**onsequences: This area presents low risk because the aircraft is in excellent mechanical condition and Gayle is familiar with its avionics.
- **A**lternatives: Had there been a problem with her aircraft, Gayle might have considered renting another plane from her flight school. Bear in mind, however, that alternatives sometimes create new hazards. In this instance, there may be hazards associated with flying an unfamiliar aircraft with different avionics.
- **R**eality: It is important to recognize the reality of an aircraft's mechanical condition. If you find a maintenance discrepancy and then find yourself saying that it is "probably" okay to fly with it anyway, you need to revisit the consequences part of this checklist.
- **E**xternal Factors: Pilot decision-making can sometimes be influenced by the external pressure of needing to return the airplane to the FBO by a certain date and time. Because Gayle owns the airplane, there was no such pressure in this case.

Environment

- **C**onsequences: For a pilot whose experience consists mostly of local flights in good VMC, launching a long cross-country flight over mountainous terrain in hazy conditions could lead to pilot disorientation and increase the risk of an accident.
- **A**lternatives: Options include postponing the trip until the visibility improves, or modifying the route to avoid extended periods of time over the mountains.
- **R**eality: Hazy conditions and mountainous terrain clearly create risk for an inexperienced VFR-only pilot.
- **E**xternal Factors: Few pilots are immune to the pressure of "get-there-itis," which can sometimes induce a decision to launch or continue in less than ideal weather conditions.

External Pressures

- **C**onsequences: Any number of factors can create risk of emotional pressure from a "get-there" mentality. In Gayle's case, the consequences of her strong desire to visit family, her family's expectations, and personal pride could induce her to accept unnecessary risk.
- **A**lternatives: Gayle clearly needs to develop a mitigating strategy for each of the external factors associated with this trip.
- **R**eality: Pilots sometimes tend to discount or ignore the potential impact of these external factors. Gayle's open acknowledgement of these factors (e.g., "I might be pressured into pressing on so my mother won't have to worry about our late arrival.") is a critical element of effective risk management.
- **E**xternal Factors: (see above)

PERFORM - Mitigate, Eliminate, Evaluate

Once you have perceived a hazard (step one) and processed its impact on flight safety (step two), it is time to PERFORM by taking the best course of action, and then evaluating its impact. Your goal is to

M itigate or eliminate risk

E valuate outcome of action(s)

Your mental willingness to follow through on safe decisions, especially those that require delay or diversion is critical. You can bulk up your mental muscles by:

- Using **personal minimums checklist** to make some decisions in advance of the flight. If you are unsure of how to develop personal minimums, take a look at the methods presented in the three documents below. Choose one that works for you, and stick to it!

- Develop a list of **good alternatives** during your processing phase. In marginal weather, for instance, you might mitigate the risk by identifying a reasonable alternative airport for every 25-30 nm segment of your route.

- **Preflight your passengers** by preparing them for the possibility of delay and diversion, and involve them in your evaluation process.

Common Errors in ADM

Types of Pilot Error

Pilot mistakes are often called “pilot error,” formally defined as: An action or inaction that leads to a deviation from intentions and expectations .

Sometimes, pilot error involves deficiencies in aircraft control, or "physical airplane," skill. These errors can be prevented through maneuvers-based training and practice.

In other cases, accidents attributed to pilot error result from shortcomings in the pilot's "mental airplane" systems knowledge. Examples might include errors in programming the autopilot, or turning the wrong knob on the GPS navigator. Use of aircraft training devices, computer-based training, and regular practice in the aircraft can help prevent these errors.

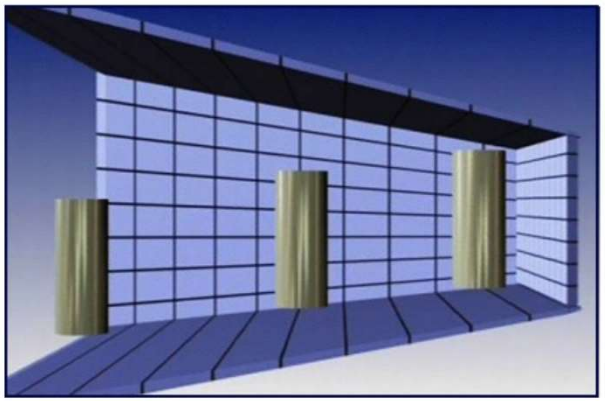
Effects of **Human Limitations**

Human limitations can play a significant role in how we perceive, process, and perform in complex activities, like flying. For example: Filtering, Filling in the gaps, Confirmation Bias, and Framing,

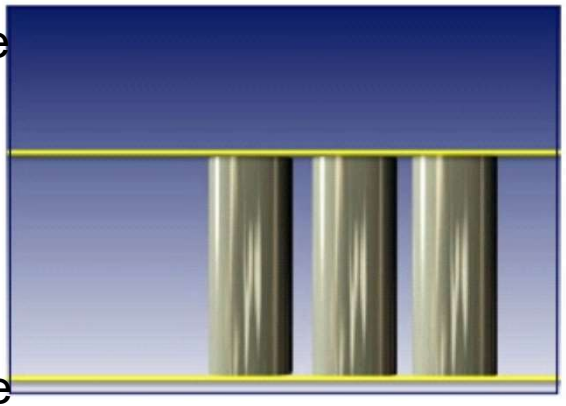
Human Limitations

Filtering: The brain's working memory capacity is limited to about seven (7) pieces, or "chunks," of information at one time, so one of the life skills we acquire is the ability to filter the flood of information arriving through our senses. In any flight, especially one with challenging weather, we may unconsciously screen out vital information. Use of the PAVE checklist as a guide to your ongoing mental hazard scan can help prevent inappropriate filtering, because it provides a comprehensive and methodological approach to the information gathering process.

Filling in the Gaps: When there is more information than the brain can accurately perceive and process, it compensates by filling in the gaps and producing an interpretation that is not correct. Take a look at the corridor illustration below on the left.



The brain quickly processes the information in this illustration and concludes that the cylinders in the picture are different heights, and that they appear to be growing larger from left to right. In fact they are the same size!



Runway illusions, which can result in unsafe decisions when flying an approach, are a good example of this type of human error.

Human Limitations

Patterns and Expectations: The brain uses existing knowledge and experience as a shortcut to processing new information. This tendency can be useful, but it can also be dangerous. Examples:

- When you are processing information from an unfamiliar GPS navigator, you might unconsciously make incorrect assumptions on the basis of how information is accessed or displayed on the one you normally use.
- If previous experience at a familiar airport leads you to expect a clearance to land on runway 10, you may "hear" a clearance to land

Confirmation Bias: Human beings also have a tendency to look for information that confirms a decision we have already made. For example, imagine that you have decided to continue a flight you have already started. You call Flight Watch for updated weather information on several nearby airports, but you might unconsciously give more weight to the information that supports your decision to press ahead.

The "reality" part of the systematic ADM process is especially useful in countering errors associated with patterns, expectations, and confirmation bias. **Make a conscious effort to identify your expectations**, **and then be alert to how reality differs**.

Human Limitations

Framing: When you evaluate options for a decision, be sensitive to how you state, or "frame," your alternatives. Assume you are deciding whether to continue a flight in deteriorating weather. If you frame the “continue” decision in positive terms (e.g., “I can save a lot of time and inconvenience if I go on”), you are probably more likely to decide on continuing. If, on the other hand, you frame the decision in negative terms (e.g., “I could get myself in real trouble if I push on”), you are more likely to divert to a safer destination.

Error Prevention, Detection, and Management

No matter how hard we try, it is simply **not possible for human beings to avoid errors** entirely, especially when complex systems are involved. By using a systematic approach to continuous ADM, however, and developing awareness of common types of human ADM error, we can seek to minimize mistakes.

Consistent use of these tools can also help with quick recognition of errors we do make, and safe management of the resulting situation.

USE PERSONAL MINIMUMS

PILOT

Experience/Recency

Takeoffs/landings ..... _____ in the last _____ days

Hours in make/model ..... _____ in the last _____ days

Instrument approaches (simulated or actual) ..... _____ in the last _____ days

Instrument flight hours (simulated or actual) ..... _____ in the last _____ days

Terrain and airspace ..... familiar

Physical Condition

Sleep ..... _____ in the last 24 hours

Food and water ..... in the last _____ hours

Alcohol ..... None in the last _____ hours

Drugs or medication ..... None in the last _____ hours

Stressful events ..... None in the last _____ days

Illnesses ..... None in the last _____ days

▶ _____

AIRCRAFT

Fuel Reserves (Cross-Country)

VFR Day ..... _____ hours
Night ..... _____ hours

IFR Day ..... _____ hours
Night ..... _____ hours

Experience in Type

Takeoffs/landings ..... _____ in the last
In aircraft type _____ days

Aircraft Performance

Establish that you have additional performance available over that required. Consider the following:

- Gross weight
- Load distribution
- Density altitude
- Performance charts

Aircraft Equipment

Avionics ..... familiar with equipment (including autopilot and GPS systems)

COM/NAV ..... equipment appropriate to flight

Charts ..... current

Clothing ..... suitable for preflight and flight

Survival gear ..... appropriate for flight/terrain

▶ _____

ENVIRONMENT

Airport Conditions

Crosswind ..... _____ % of max POH
Runway length ..... _____ % more than POH

Weather

Reports and forecasts ..... not more than _____ hours old

Icing conditions ..... within aircraft/pilot capabilities

Weather for VFR

Ceiling Day ..... _____ feet
Night ..... _____ feet

Visibility Day ..... _____ miles
Night ..... _____ miles

Weather for IFR

Precision Approaches

Ceiling ..... _____ feet above min.
Visibility ..... _____ mile(s) above min.

Non-Precision Approaches

Ceiling ..... _____ feet above min.
Visibility ..... _____ mile(s) above min.

Missed Approaches

No more than ..... _____ before diverting

Takeoff Minimums

Ceiling ..... _____ feet
Visibility ..... _____ mile(s)

▶ _____

EXTERNAL PRESSURES

Trip Planning

Allowance for delays ..... _____ minutes

Alternate Plans for Diversion or Cancellation

Notification of person(s) you are meeting

Passengers briefed on diversion or cancellation plans and alternatives

Modification or cancellation of car rental, restaurant, or hotel reservations

Arrangement of alternative transportation (airline, car, etc.)

Personal Equipment

Credit card and telephone numbers available for alternate plans

Appropriate clothing or personal needs (eye wear, medication...) in the event of unexpected stay

▶ _____

Self Assessment

- Pilots operating as single pilots need to be able to ***critique their own performance.***
- Hard to do.
- Several ways it can be done.
  - Take notes – **keep a journal**, what did you learn, what when wrong?.
  - Assess the different situations that occurred
  - What could have been done differently.
  - Use different scenarios.
- Analyze contributing factors:
  - Weather
  - Air Traffic Control
  - Aircraft
  - Workload
  - Flight conditions (VMC/IMC)
- Use all available resources to provide feedback
  - Passengers
  - Other pilots
  - Scenario based training
- Determine improvement areas
- Take measurements to improve these areas for future flights

Situational Awareness

It is the *accurate perception and understanding* of *all* the factors and conditions (inside and outside) within the four fundamental risk elements (**P**ilot, **A**ircraft, en**V**ironment, **E**xternal pressures) *that affect safety* before, during, and after the flight.

Things that reduce your situational awareness are things like:

- Fatigue
- Distractions and Unsterile Cockpits
- Unusual or unexpected events
- Complacency
- High workloads
- Unfamiliar situations
- Inoperative Equipment
- Unmanaged Automation in technically advanced aircraft

Recommendations for better SA

- Perform verification checks on all programming while on the **GROUND**.
- Check flight routing that all routing matches planned route.
- Verify waypoints
- Make sure to make use of ALL onboard navigation equipment (i.e. use VOR to back up GPS)
- Match use of automated systems with pilot proficiency (don’t learn as you go, know before you go!)
- Be ready to verify computer data entries for incorrect keystroke that could lead to loss of SA.

CFIT

Failure to **C**ontrol **F**light **I**nto **T**errain is a situation in which an airworthy aircraft is flown, under the control of a qualified pilot, into terrain with inadequate awareness on the part of the pilot of the impending collision.

Major causes include…

- ✓ Lack of pilot currency
- ✓ Loss of SA
- ✓ Pilot distraction or breakdown of risk management
- ✓ Failure to comply with minimum safe altitudes
- ✓ Breakdown in effective ADM
- ✓ Insufficient planning especially in the descent and arrival segments.

CFIT

Techniques that will assist in avoidance of CFIT accidents

- Maintain situational awareness at all times.
- Adhere to safe takeoff and departure procedures.
- Familiarize yourself with surrounding *terrain features* and obstacles.
- Adhere to published routes and minimum altitudes.
- Fly a stabilized approach.
- Understand ATC clearances and instructions.
- Don’t become complacent.
- “SLOWER” AIRCRAFT ALLOW A SHORTER TURNING RADIUS IF 180 TURN IS REQUIRED!

ATTITUDE AND ETHICAL BEHAVIOR

In aviation, dense regulations, technical skill and knowledge are insufficient to ensure safe flying. **Ethical behavior**, **constructive attitudes**, **and a *positive culture*** add to safety for individual pilots and foster a healthy aviation community.

Flying is not about ME, it is about **WE**. Your actions as a pilot have **significant effects and implications on OTHERS** on the ground, in the sky, and at your side in the cockpit. You mess up and EVERYBODY in the community pays. You should not consider being a pilot if you are only thinking of yourself.

Next: DANGEROUS ATTITUDES and ANTIDOTES

DANGEROUS ATTITUDE – “There are old pilots and bold pilots
There are NO old bold pilots because of bad attitudes and risks.”

Macho — Steve often brags to his friends about his skills as a pilot and how close to the ground he flies. During a local pleasure flight in his single-engine airplane, he decides to buzz some friends barbecuing at a nearby park.

Taking chances is foolish.

Anti-Authority — Although he knows that flying so low to the ground is prohibited by the regulations, Steve feels that the FARs are too restrictive in some circumstances.

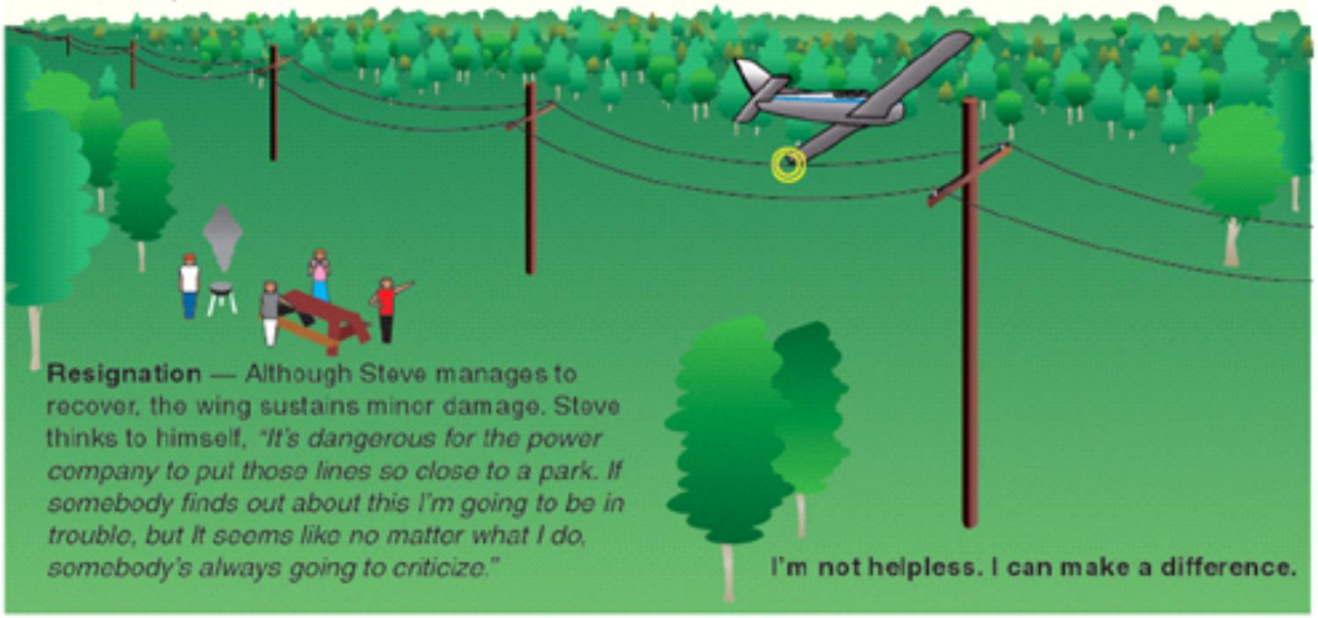
Follow the rules. They are usually right.

Invulnerability — Steve is not worried about an accident since he has flown this low many times before and he has not had any problems.

It could happen to me.

Impulsivity — As he is buzzing the park, the airplane does not climb as well as Steve had anticipated and without thinking, Steve pulls back hard on the yoke. The airspeed drops and the airplane is close to a stalling attitude as the wing brushes a power line.

Not so fast. Think first.



Resignation — Although Steve manages to recover, the wing sustains minor damage. Steve thinks to himself, *“It’s dangerous for the power company to put those lines so close to a park. If somebody finds out about this I’m going to be in trouble, but it seems like no matter what I do, somebody’s always going to criticize.”*

I’m not helpless. I can make a difference.

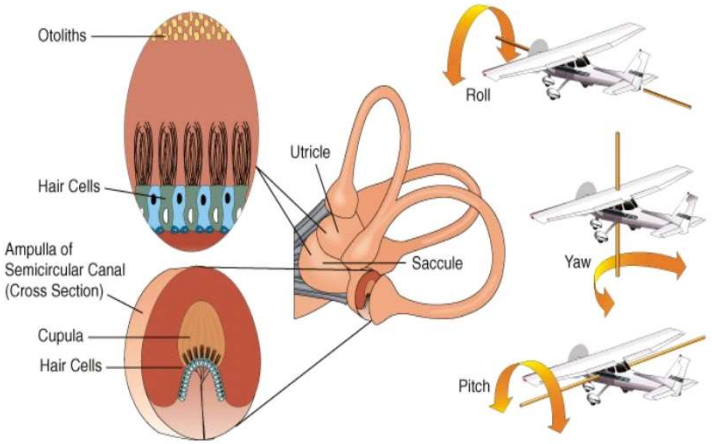
Aviation Physiology

Created by Steve Reisser

Aviation Physiology

- Disorientation
  - Brain receives conflicting messages from our senses
  - Spatial disorientation
    - Central vision differs from peripheral vision
    - Example: Car in spot adjacent to you begins to move
    - **To overcome spatial disorientation, you must rely on, and properly interpret, your flight instruments**
    - **Using your body to interpret flight attitude makes you more susceptible to disorientation**

Aviation Physiology



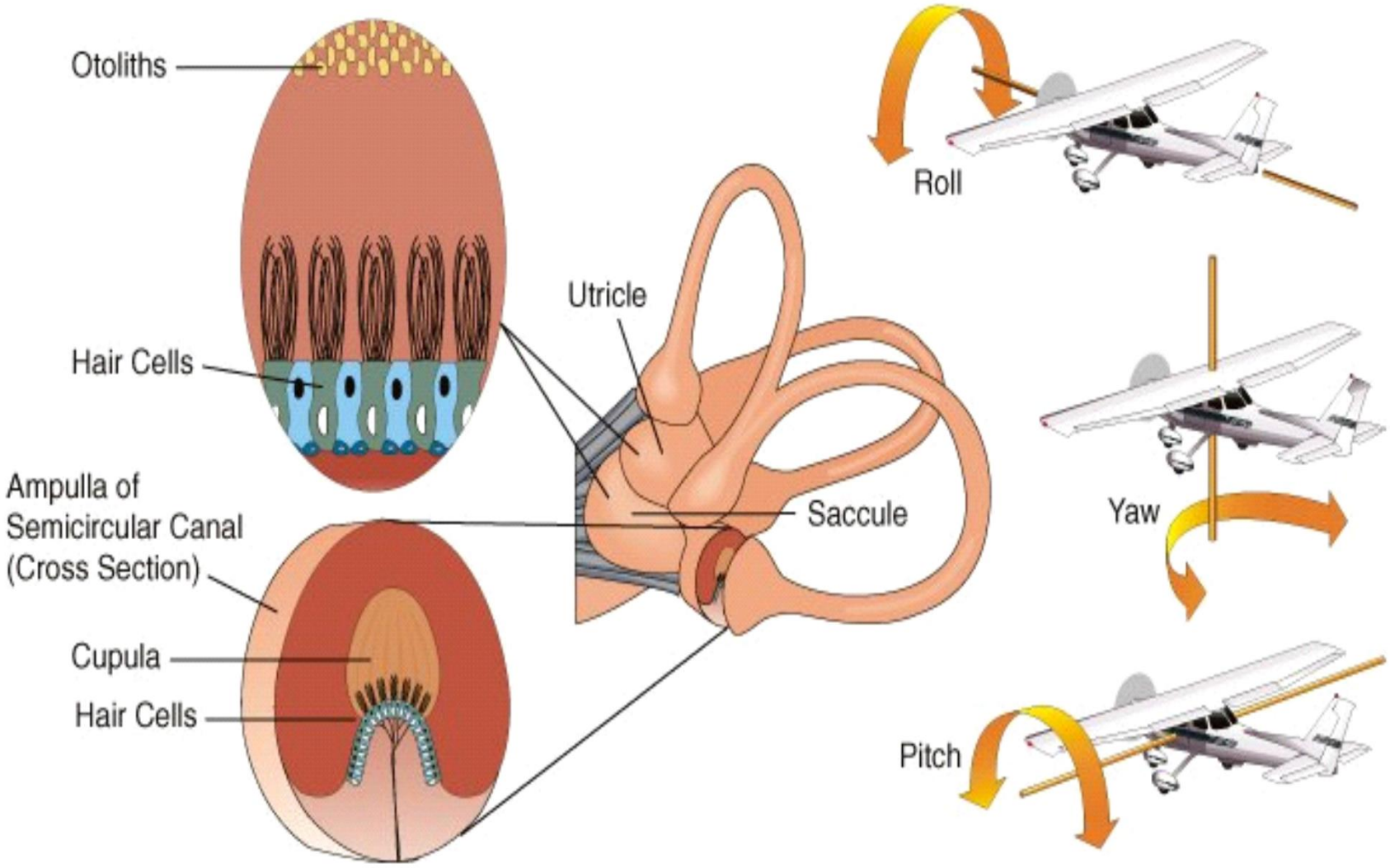
- Disorientation (cont'd)
  - Vestibular disorientation
    - Fluid in bony canals of inner ear is set in motion (acceleration)
    - Interpreted as movement by the brain
    - Since bony canals are oriented in three axes, fluid movement in any canal is interpreted as movement in that direction
    - Constant movement (no *acceleration*) is interpreted as no movement, i.e., no acceleration -> no movement

Vertigo

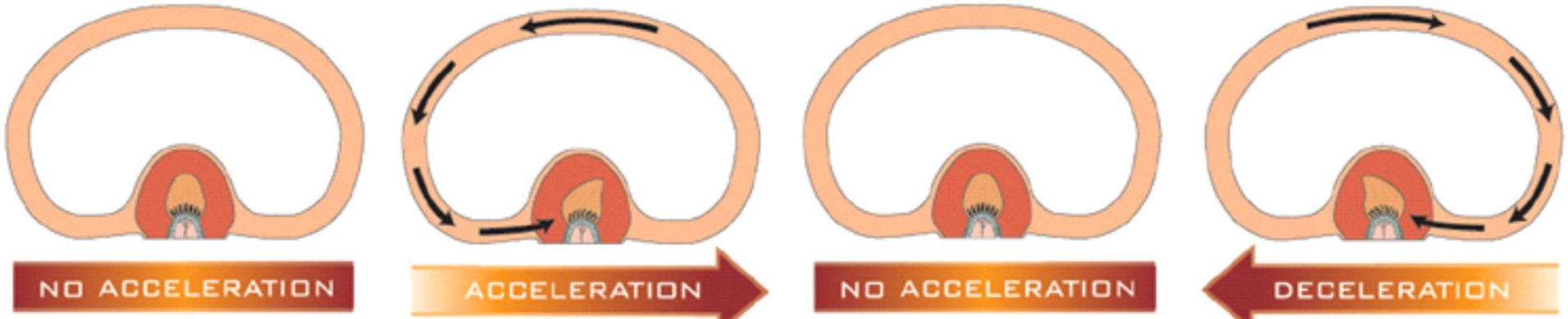
What do you think you should do if you get vertigo ….

- On the ground before a flight?
- In the air as pilot-in-command?

Aviation Physiology - Equilibrium



Aviation Physiology - Equilibrium



NO TURN

If no acceleration is taking place, the cupula is stationary and the hair cells are not deflected. No sensation of a turn is felt.

INITIATING A CLOCKWISE TURN

A clockwise turn deflects the hair cells in the direction opposite of the acceleration. You experience an accurate sensation of the turn direction.

PROLONGED CONSTANT-RATE TURN

During a prolonged constant rate turn, you may not sense any motion since the fluid in the canals eventually reaches equilibrium and the hair cells are no longer deflected.

DECREASE IN RATE OF TURN

If you decrease the rate of turn, the deflection of the hair cells may produce a false sensation of a turn in the opposite direction. In this example, you experience the sensation of a counterclockwise turn.

Created by Steve Reisser

Aviation Physiology

*Rapid acceleration during takeoff will be interpreted as ?

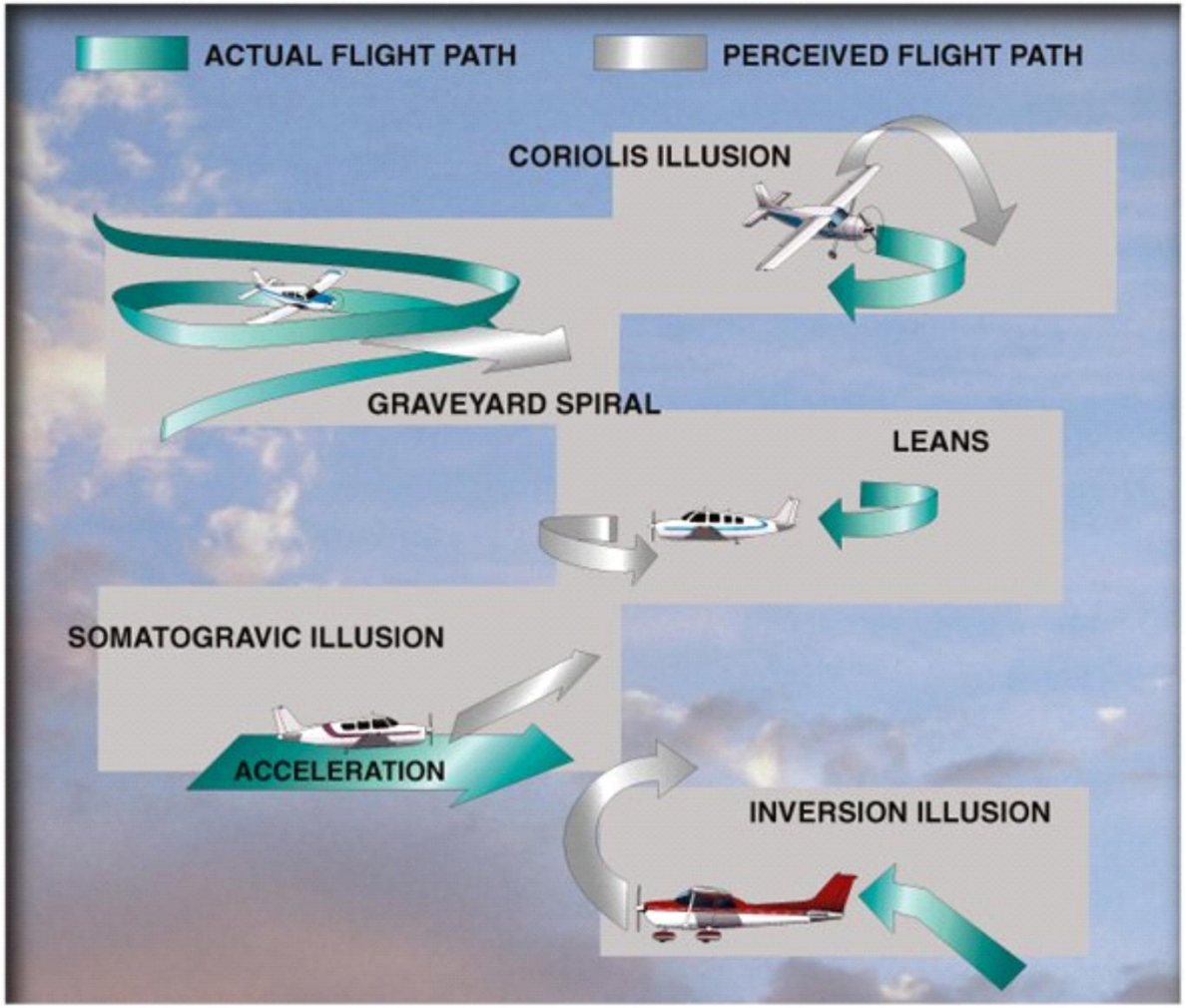
Being in a nose-up attitude

*Abrupt change from a climb to straight and level will be interpreted as ?

Tumbling backwards

*Abrupt movement of your head during a constant rate turn will produce ?

Coriolis illusion



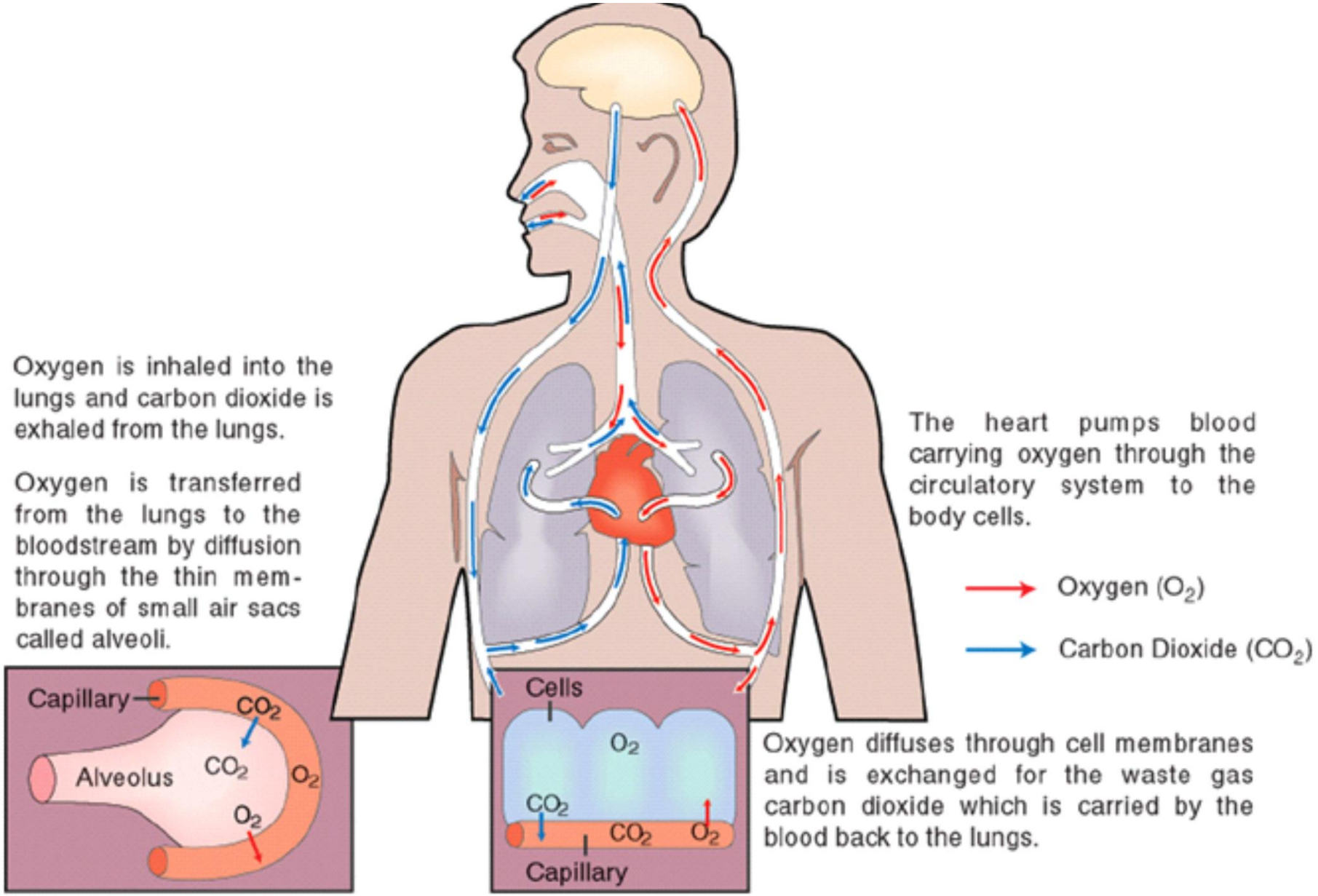
Vertigo frequently leads to “Air Sickness”

- Physical symptoms include loss of appetite, saliva collecting in the mouth, nausea, nausea, vomiting.
- Actions a pilot might take if the passenger is suffering air sickness might include open air vents, loosen clothing, use supplemental oxygen and keep the eyes on a point outside the airplane. Avoid unnecessary head movement. Get the passenger down on the ground as soon as possible.

Ear Blockage

- Infections, colds, allergic reactions prevent equalization of external pressure to internal pressure in the Eustachian tube between throat and inner ear causing sever pain and loss of hearing. Duration hours to days.
- Possible relief by yawning, swallowing, tensing muscles in throat, pinching nostrils and exerting pressure (“Valsalva Maneuver”)

Aviation Physiology



Aviation Physiology

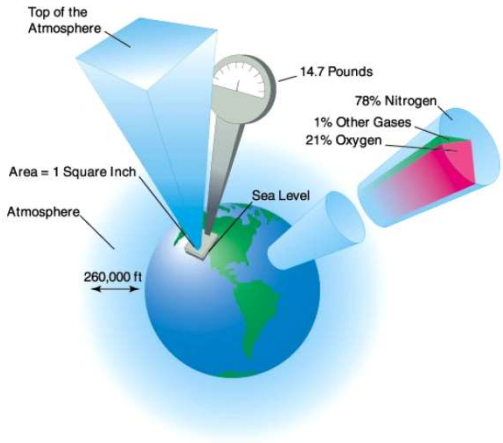
Altitude	Time of Useful Consciousness
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2 1/2 to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

Aviation Physiology

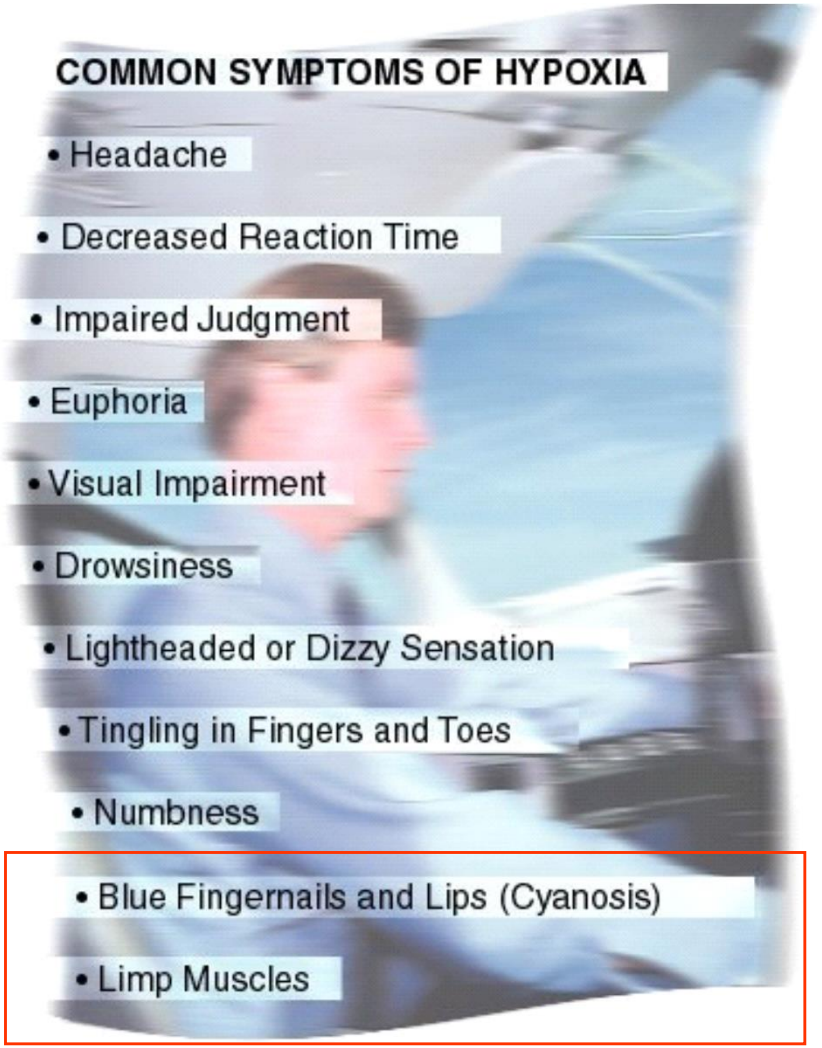
- Hypoxia
  - Tissues, e.g, the brain, the eyes, in the body do not receive enough oxygen (hypo -> below, ox -> oxygen, -ia -> condition of)
  - * Insidious because the symptoms are difficult to recognize before your reactions are affected!
  - Hypoxic hypoxia is due

  to insufficient partial pressure

  of oxygen in the atmosphere
  - **What are the symptoms**?



Aviation Physiology - Hypoxia



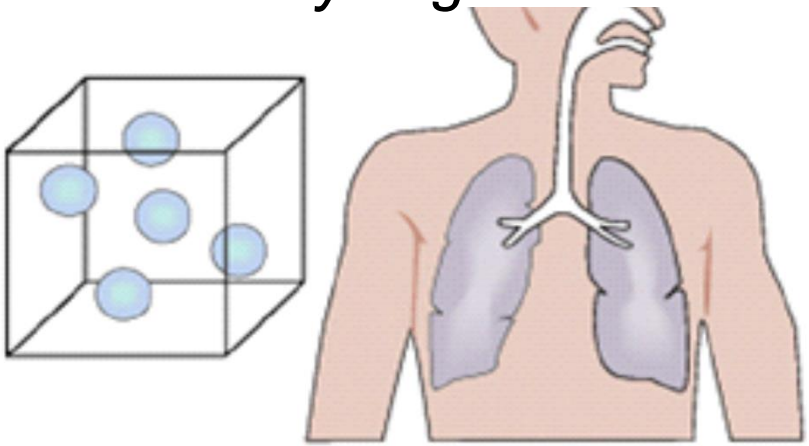
What's the remedy for hypoxia?

Oxygen (O_2)

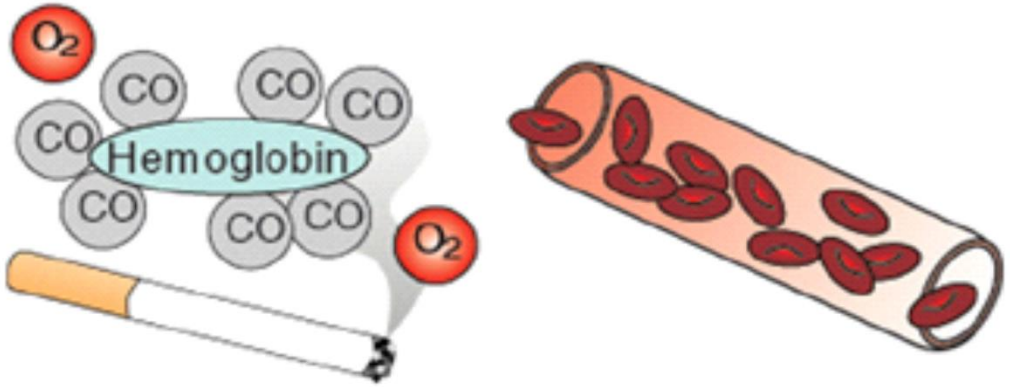
Either use O_2 or descend to lower altitude.

Aviation Physiology

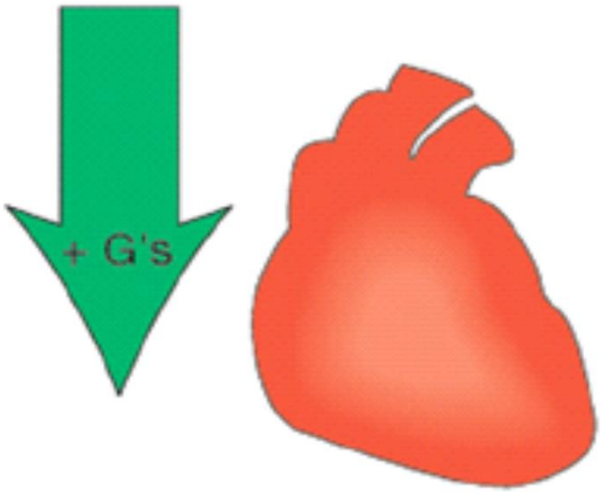
Why might sufficient oxygen not get into your body?



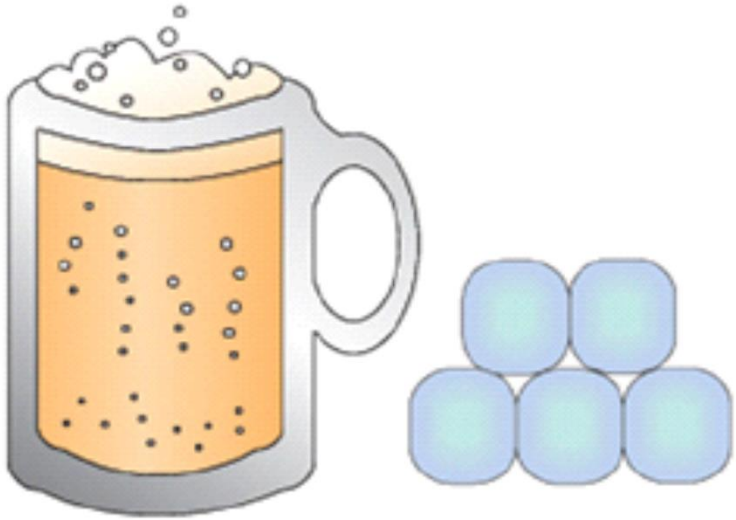
Hypoxic Hypoxia – Inadequate Supply of Oxygen



Hypemic Hypoxia – Inability of the Blood to Carry Oxygen

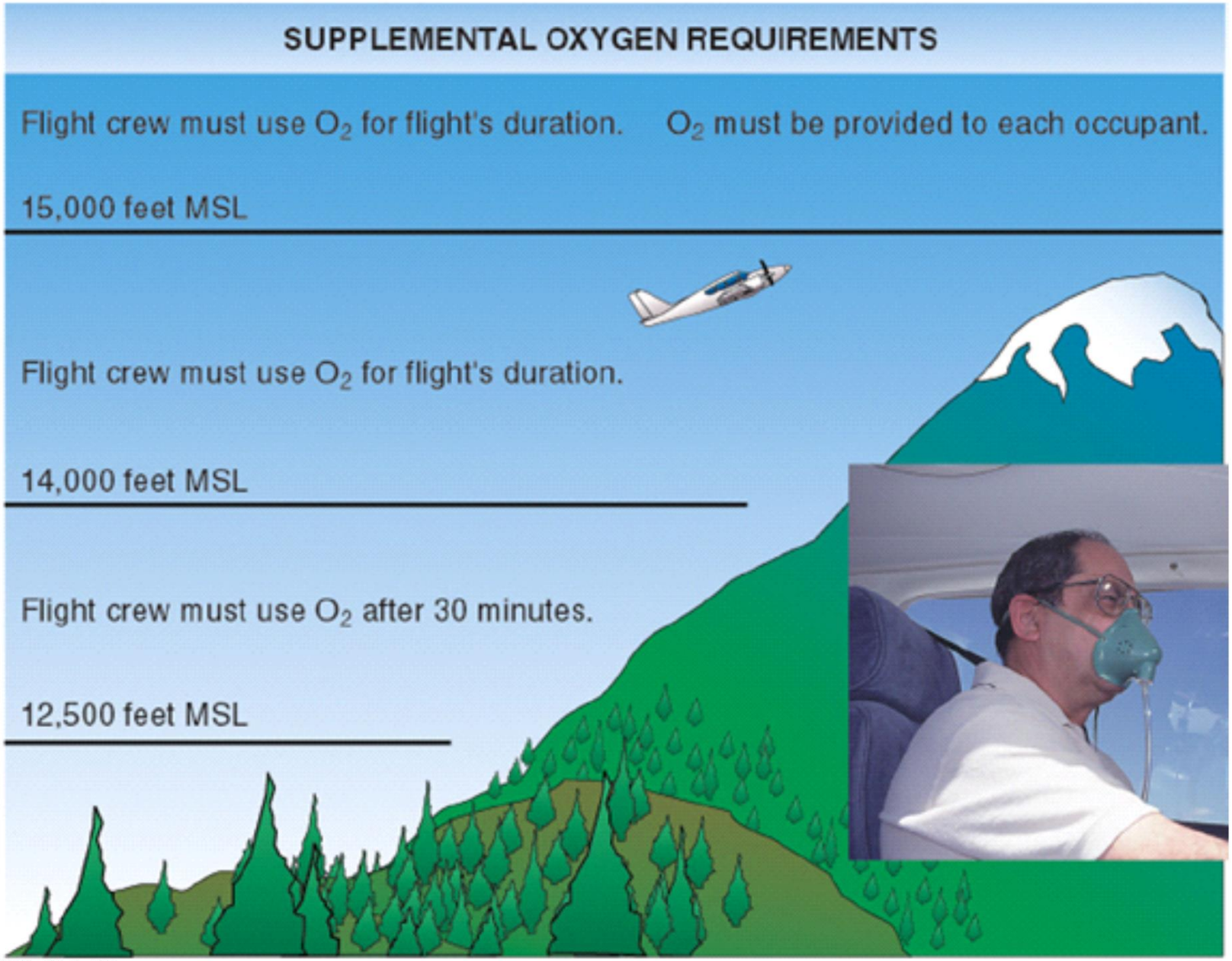


Stagnant Hypoxia – Inadequate Circulation of Oxygen



Histotoxic Hypoxia – Inability of the Cells to Effectively Use Oxygen

Aviation Physiology



Aviation Physiology

- Carbon monoxide, CO, can cause hypemic hypoxia
  - CO is found in cigarette smoke
    - 3 cigarettes ⟶ equivalent of 8,000 feet!
    - *If you are around smokers, you are being exposed to CO*!
  - CO is found in internal combustion engine exhaust
    - Cabin heat is provided by a shroud around exhaust pipe
    - Hole in exhaust pipe will cause CO to enter cabin
    - *If you smell exhaust, you are being exposed to CO*!

How can hypoxia be avoided?

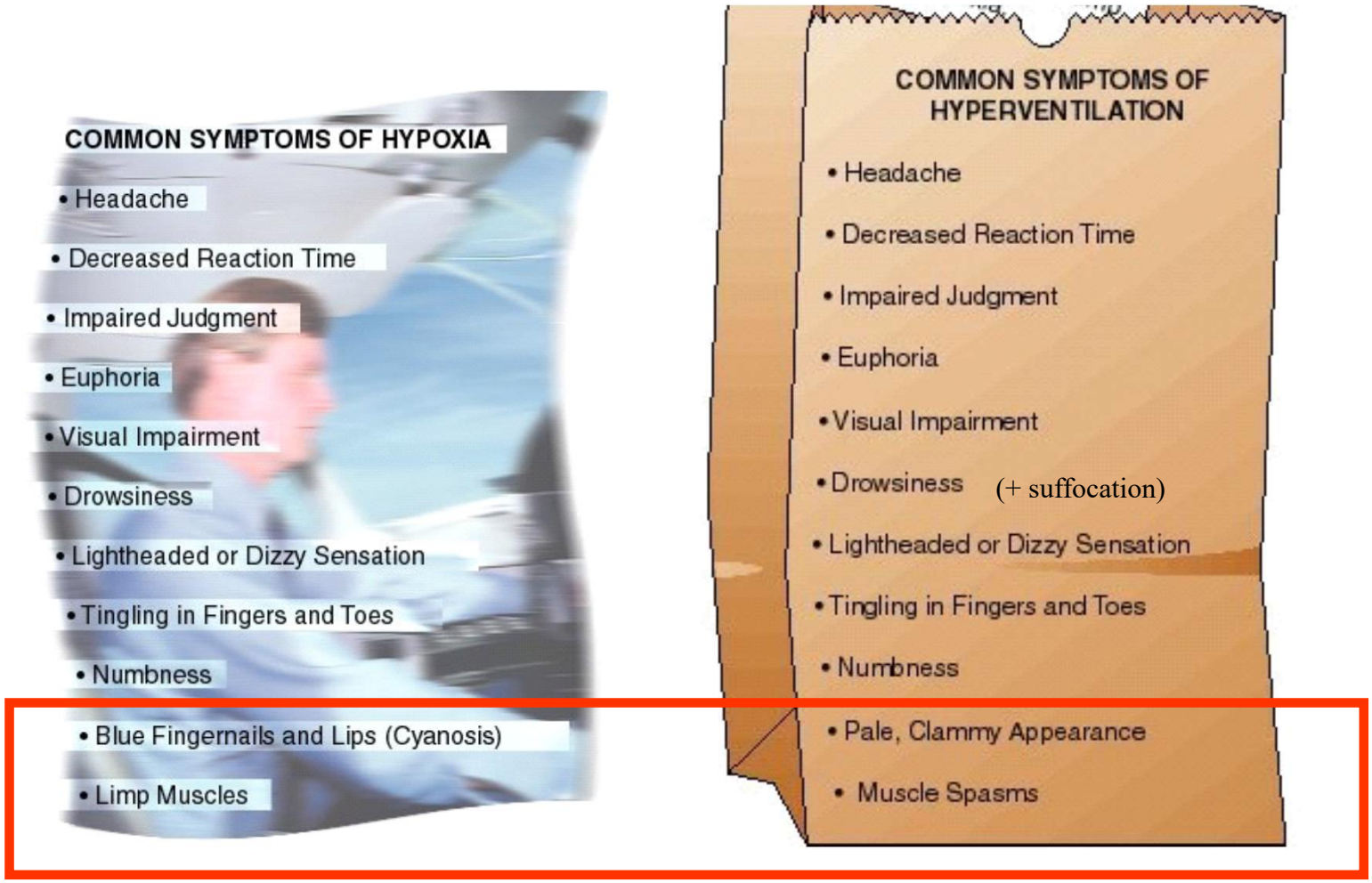
- Maintain a safe, comfortable, oxygen rich pressure cabin level
- Although not required by FAA regulation, it is wise to use supplemental oxygen above 10,000 MSL during the **day**.
- Although not required by FAA regulation, it is wise to use supplemental oxygen above 5,000 MSL during the **night**.

Aviation Physiology

- Hyperventilation
  - Breathing too rapidly (hyper -> above, ventilation -> breathing) - **Why**?
  - Causes too much carbon dioxide, CO_2, to be lost
  - The remedy is simple - *slow your breathing down*!
    - Conscious effort to slow breathing
    - Breathing into a paper bag
  - **What are the symptoms**?
  - **How can these symptoms be distinguished from hypoxia**?

Aviation Physiology - Hyperventilation

Hypoxia or Hyperventilation?



Aviation Physiology – IMPAIRMENT

- FATIGUE – You must be SHARP, ALERT, and IN CONTROL. Fatigue jeopardizes.
- NOISE – Causes fatigue and problems with communications – use headphones.
- MEDICATION, DRUGS, ALCOHOL – Impair response and judgment.
- ATTITUDES (Anti-authority, “Beat the Clock”, Ego Trips, etc.)

Alcohol Impairs Judgment

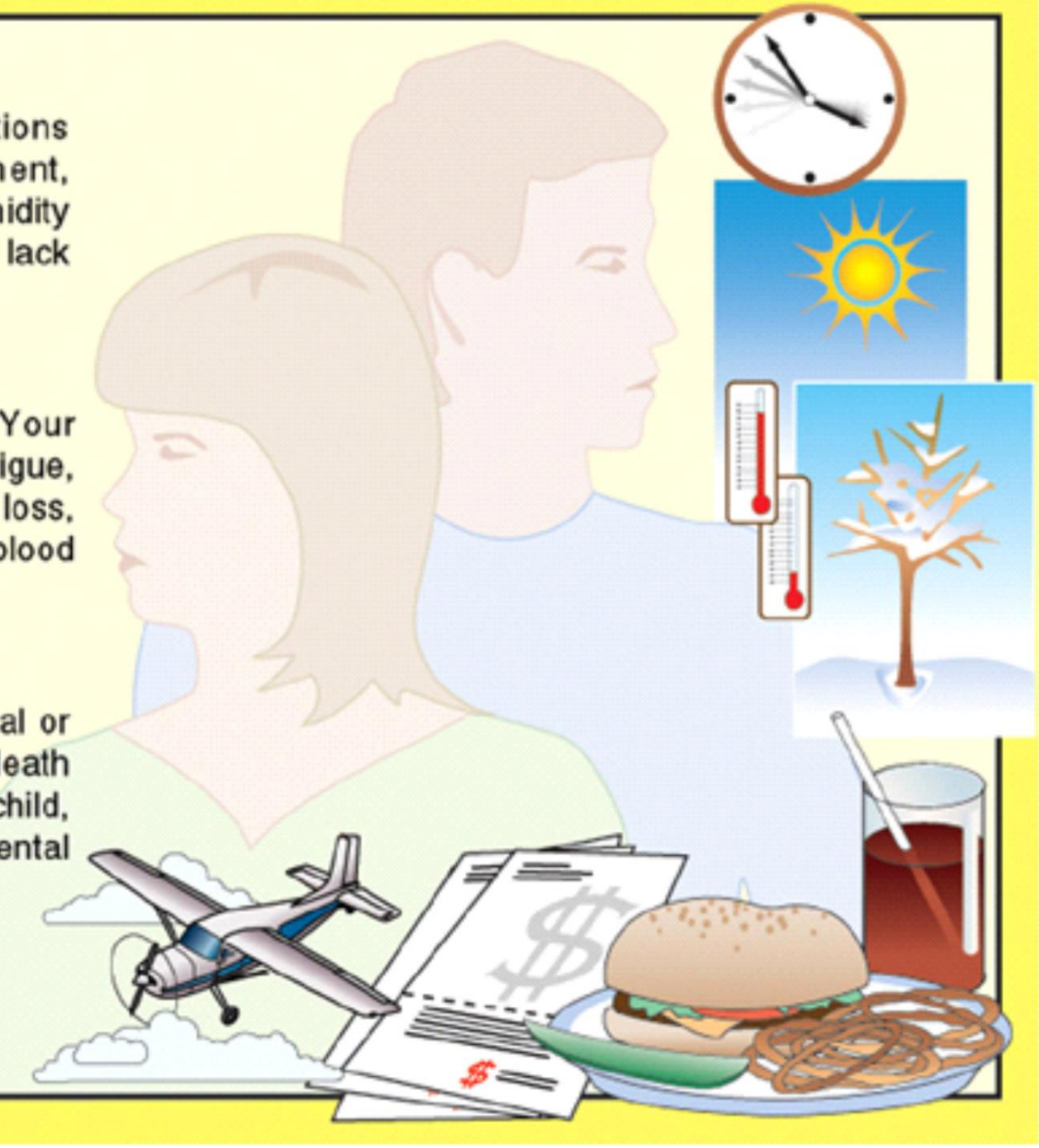
- **NEVER DRINK AND FLY - P E R I O D**
- FAA says 8 hours, less than .04% percent
- Wiser judgment says no less than 12 hours, better 24 hours bottle to throttle!!

Aviation Physiology – IMPAIRMENT

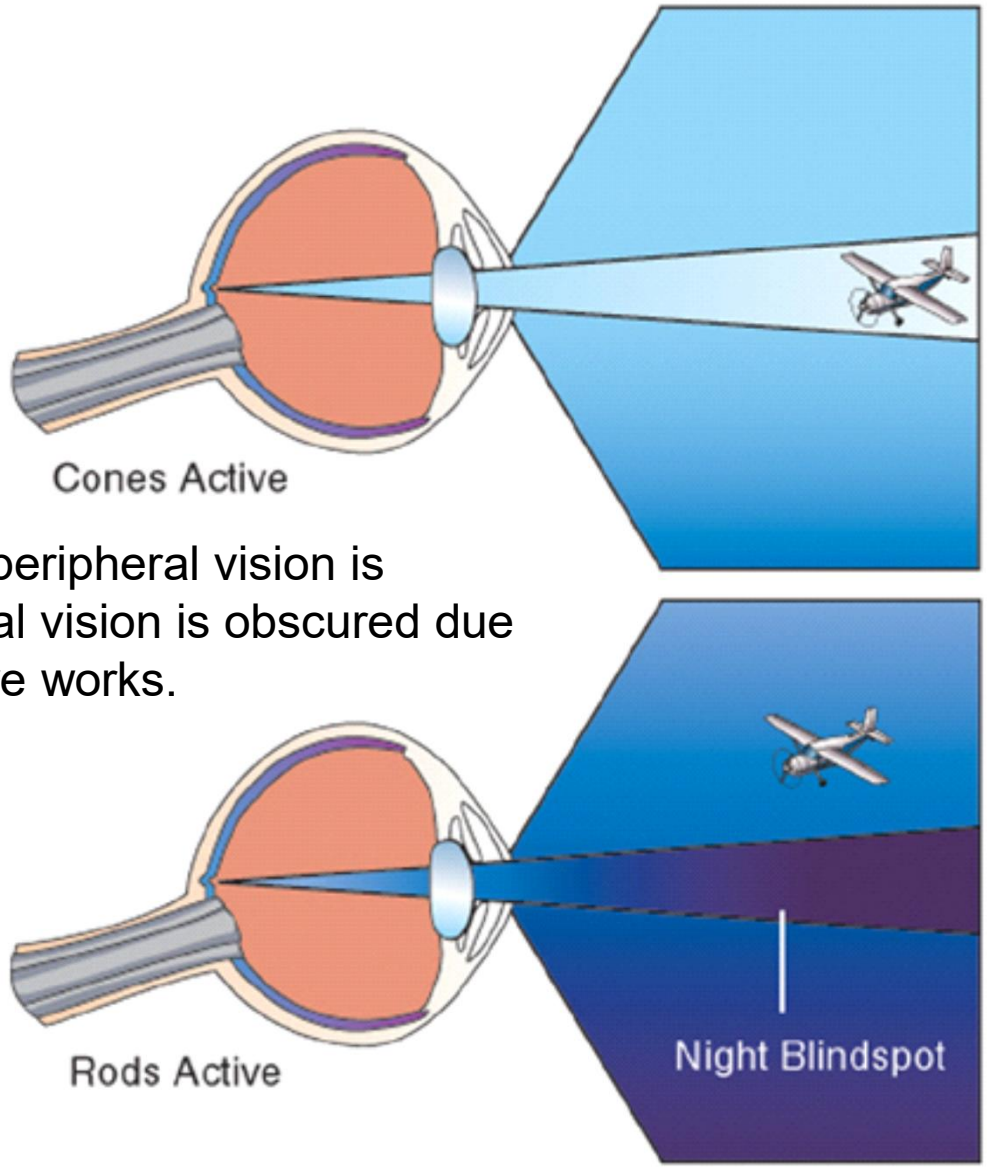
Physical Stress — Conditions associated with the environment, such as temperature and humidity extremes, noise, vibration, and lack of oxygen

Physiological Stress — Your physical condition, such as fatigue, lack of physical fitness, sleep loss, missed meals (leading to low blood sugar levels), and illness

Psychological Stress — Social or emotional factors, such as a death in the family, a divorce, a sick child, a demotion at work, or the mental workload of in-flight situations



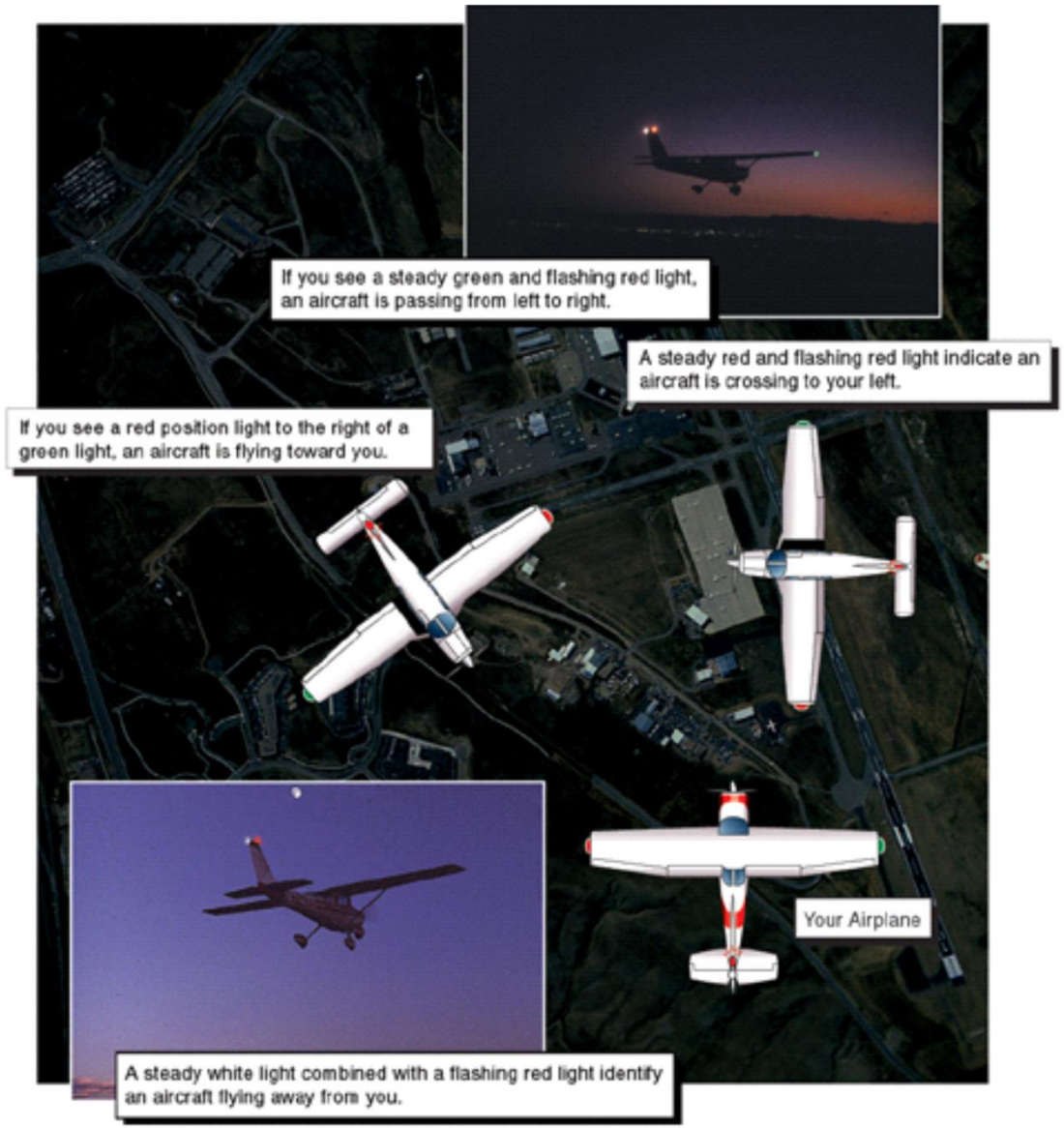
Aviation Physiology – Vision



At night, the your peripheral vision is effective but central vision is obscured due to the way your eye works.

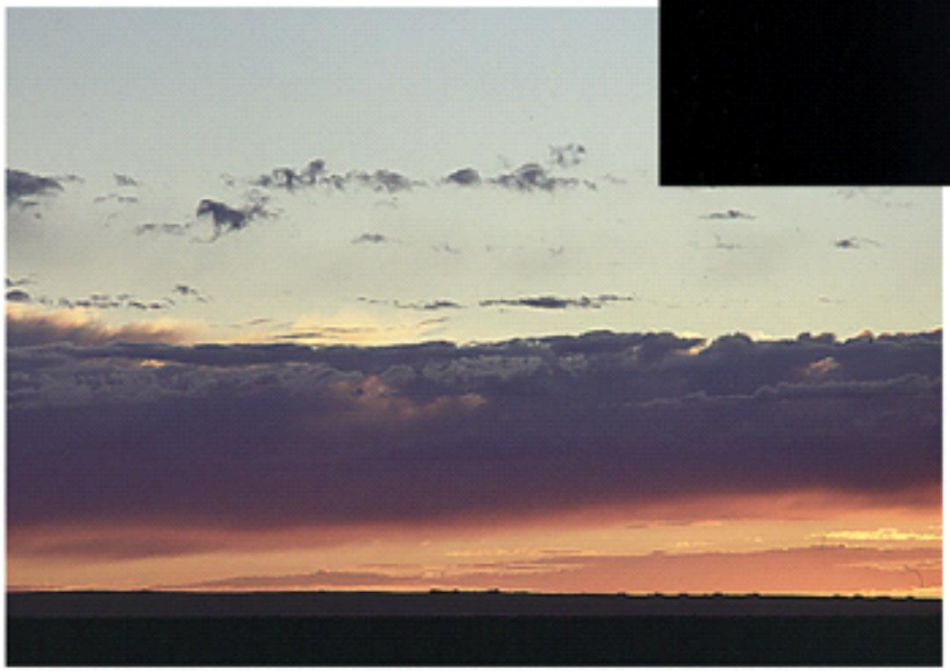
Aviation Physiology – Vision

At night you must see lighting to determine movement of other aircraft.



Aviation Physiology – Vision

CAUTION
Twilight can cause you to misinterpret the horizon. Cloud banks are sometimes mistaken for the horizon

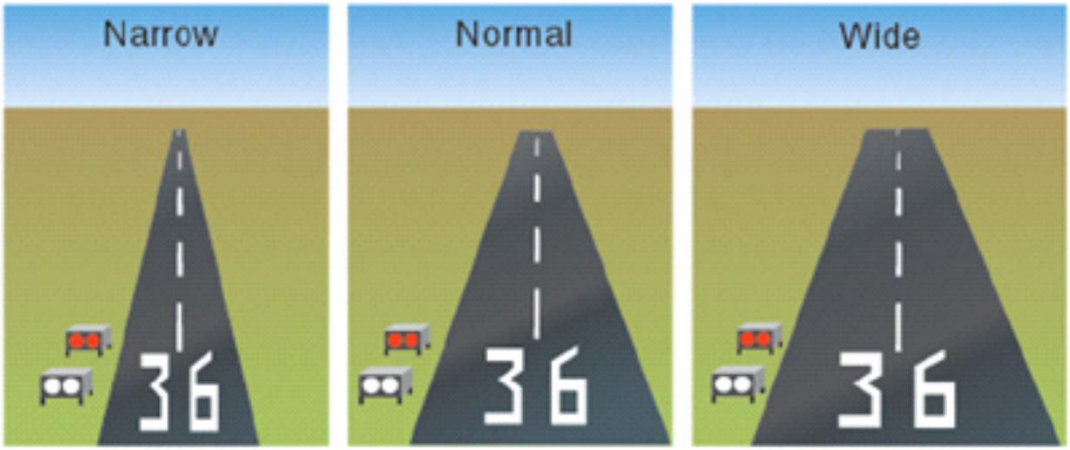


Aviation Physiology – Vision

Elements that create any type of visual obstruction, such as rain or haze, can cause you to fly a low approach.

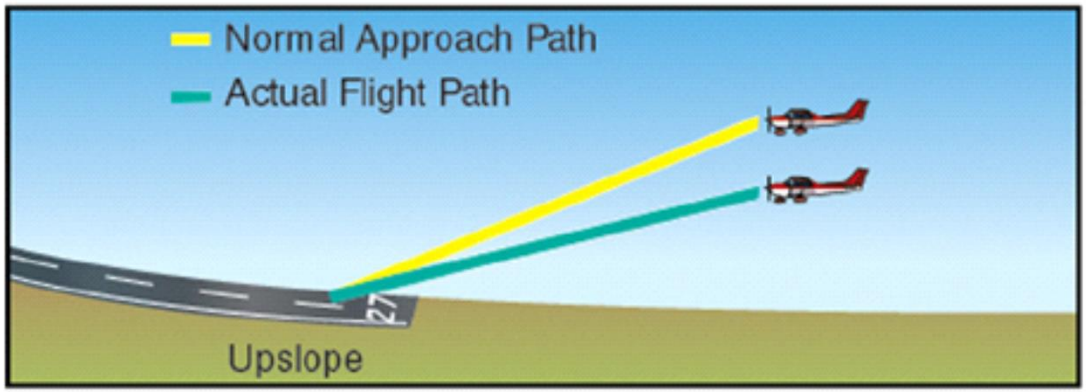
Over water, at night, or over featureless terrain, such as snow-covered ground, there is a natural tendency to fly a lower-than-normal approach.

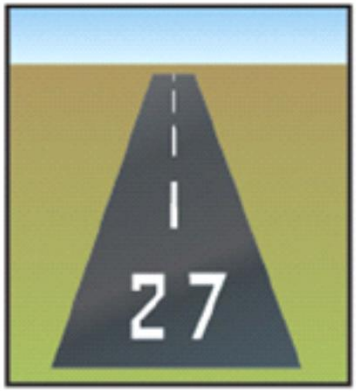
Penetration of fog can create the illusion of pitching up which can cause you to steepen your approach.

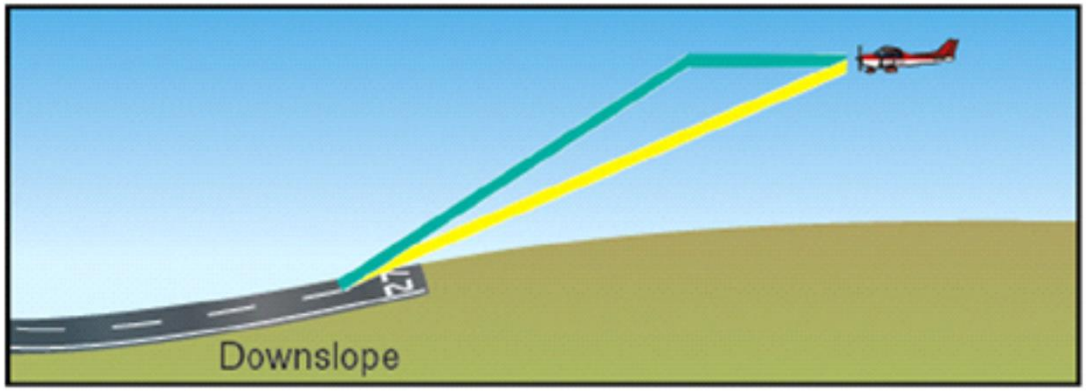


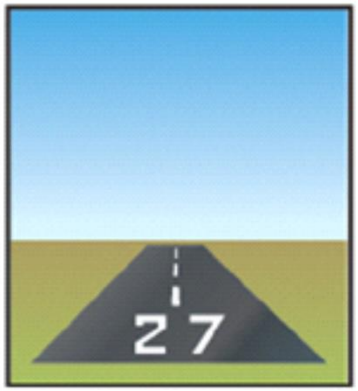
Due to the illusion of greater height, you may fly a lower approach than normal to a narrow runway. A wide runway can have the opposite effect and produce higher-than-normal approaches.

Aviation Physiology – Vision









These runway views illustrate how normal 3° approaches might look for upslope and downslope runways.

SLOPE can cause you to misjudge your approach. CHECK the AIRPORT FACILITIES DIRECTORY to know that slope could occur BEFORE you take-off.

DO YOU SCUBA DIVE?

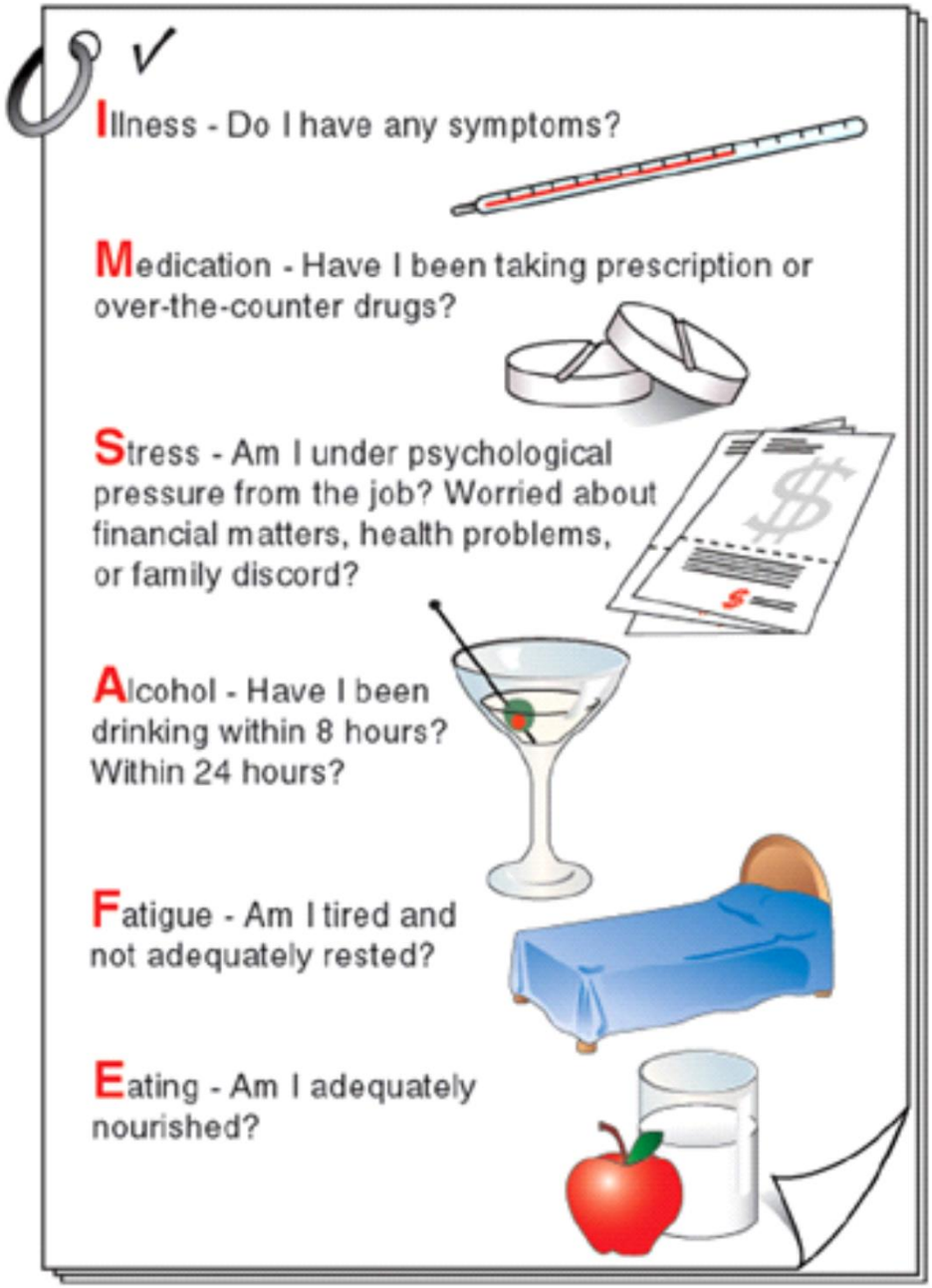
- If you or a passenger scuba dives be careful. The divers body must have sufficient time to expel and nitrogen build up from the dive before flying.

WAIT TIMES

Flight altitudes below 8,000 feet: Wait at least 12 hrs after dives not requiring controlled ascent. Wait at least 24 hrs after dives requiring controlled ascents.

Flight altitudes above 8,000 feet. Wait at least 24 hours after any scuba dive.

Aviation Physiology



Advanced Human Factors Checklist

• When subjected to various forces of flight, the vestibular system can send misleading signals to the brain resulting in vestibular disorientation.
• Hypoxia occurs when the tissues in the body do not receive enough oxygen.
• Hypoxic hypoxia occurs when there are not enough molecules of oxygen available at sufficient pressure to pass between the membranes in the respiratory system.
• Hyperemic hypoxia occurs when your blood is unable to carry sufficient oxygen.
• Carbon monoxide (CO) prevents the blood from carrying sufficient oxygen since it attaches itself to the hemoglobin about 200 times more easily than does oxygen.
• Stagnant hypoxia is an oxygen deficiency in the body due to poor circulation.
• Inability of cells to effectively use oxygen is defined as histotoxic hypoxia.
• If you are planning a flight with a cruise altitude over a cabin pressure of 12,500 MSL, you should know the FAR part 91 requirements at 12,500, 14,000, and 15,000 MSL.
• Prior to operating a pressurized aircraft with a service ceiling or maximum operating altitude higher than 25,000 MSL, you must complete high-altitude training.
• Hyperventilation develops when too much carbon dioxide (CO_2) has been eliminated from the body, usually caused by breathing too rapidly or deeply.
• Be aware of Decompression sickness (DCS) and the risk of flying after scuba diving.
• ALWAYS use the IMSAFE checklist in preflight !
• ALWAYS Preflight !
• ALWAYS use checklists !

Advanced Human Factors Checklist

• ADM is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances.
• Approximately 75% of all aviation accidents are attributed to human factors-related causes.
• The focus of CRM and SPRM is the effective use of all available resources: human, hardware, and information.
• When 2 pilots share the cockpit, each pilot's responsibility must be defined ***before*** the flight.
• Studies have identified that the 5 hazardous attitudes can interfere with the ability to make sound decisions and exercise authority properly.
• Readback of ATC clearances is crucial in the IFR environment. You should not assume controller silence after a readback is verification of your transmission.
• Cockpit resources will increase as you fly more complex aircraft with advanced systems and avionics. Your safety is compromised if you are not thoroughly familiar with equipment or you rely on it so much that you become complacent.
• Maintaining situational awareness is perhaps on of the largest challenges to an instrument pilot. It requires that you have a solid mental picture of the flight, from your own fitness and that of passengers to the operating conditions of the airplane, weather trends, and ATC instructions.
• Constantly assess PAVE (Pilot, Aircraft, eVironment, External Pressures) and consider risks to the 5 P's (Plan, Plane, Pilot, Passengers, Programming) to help further access risk and CARE (Consequence, Alternatives, Reality, External Pressure) and TEAM (Transfer, Eliminate, Accept, Mitigate) to manage that risk.
• When there is a conflict between the information relayed by your central and peripheral vision, you may suffer from spatial disorientation.