II.A. Aeromedical Factors

References: Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25); Airplane Flying Handbook (FAA-H-8083-3), AIM

Objectives	The student should exhibit knowledge regarding aeromedical factors as required in the PTS/ACS.
Key Elements	1. IM SAFE – Self Checklist 2. Trust the instruments 3. Carbon Monoxide is 200x more likely to bond with blood than oxygen 4. Drugs / Alcohol + Flying = Very Bad
Elements	1. Obtaining a Medical Certificate 2. Hypoxia 3. Hyperventilation 4. Middle Ear and Sinus Problems 5. Spatial Disorientation 6. Motion Sickness 7. Carbon Monoxide Poisoning 8. Fatigue and Stress 9. Dehydration 10. Alcohol and Other Drugs 11. Nitrogen and Scuba Diving 12. IM SAFE
Schedule	1. Discuss Objectives 2. Review material 3. Development 4. Conclusion
Equipment	1. White board and markers 2. References
IP's Actions	1. Discuss lesson objectives 2. Present Lecture 3. Ask and Answer Questions 4. Assign homework
SP's Actions	1. Participate in discussion 2. Take notes 3. Ask and respond to questions
Completion Standards	The student has the ability to explain different aeromedical factors, and their importance to flying and possible effects during flight.

Instructor Notes:

Introduction:

Attention

Interesting fact or attention-grabbing story

Safety in the aircraft requires knowledge of the factors that can lead to negative consequences if we were unaware or unable to treat them. Hypoxia, for example, can result in symptoms of euphoria and the inability to make any sort of rational decision, which is obviously not a good thing while you're trying to fly a plane. (There are many good hyperbaric chamber/hypoxia videos on you tube)

Overview

Review Objectives and Elements/Key ideas

What

Aeromedical factors involve a number of health and physiological factors that can influence a pilot and his or her ability to fly safely. Some are minor, while others require special attention to ensure safety and survival.

Why

Many of these factors not only affect the health and well-being of the pilot, but can quickly lead to in-flight emergencies.

How:

1. Obtaining a Medical Certificate

A. Medical Certificate

i. What is it?

a. A routine medical exam from an FAA authorized Aviation Medical Examiner (AME)

b. 3 different classes depending on what you intend to fly – 1st, 2nd, 3rd class

- Exam requirements increase with increased responsibilities

ii. Who Needs it? (more details / requirements in FAR 61.23)

a. 1st Class: Generally required when exercising PIC privileges of an ATP

b. 2nd Class: Generally required when SIC at an airline (SIC privileges of an ATP)

c. 3rd Class: Required when

- Exercising the privileges of a Private, Recreational, or Student pilot certificate
- Exercising the privileges of CFI certificate as PIC or required crewmember
- Taking a practical test for recreational, private, commercial, ATP, CFI certificates

iii. How to find an AME

a. FAA Directory of AMEs can be found at:

- FSDOs, FSSs, FAA Offices
- Online: FAA.gov Find an AME

iv. Once you have a medical, how is it regulated?

a. FAR 61.53 (Prohibition on operations during medical deficiency) prohibits flying if you:

- Know of any medical condition that would prevent you from obtaining a medical
- Are taking medication/receiving treatment that would prevent you from obtaining a medical

b. Once a medical is obtained, it is self-regulating

- Can you fly with an injury, possible sickness?
  - a It's the pilot's judgment (be safe, and conservative)

v. Medical Certificate with a Possible Medical Deficiency

a. Even with a medical deficiency, a medical certificate may be able to be issued
   - Students with physical limitations may be issued a "student privileges only" certificate
     a Special equipment may need to be installed in the airplane
     b Some disabilities require limitations on the certificate
   - When all the knowledge, experience, and proficiency requirements have been met, and the student can demonstrate the ability to operate with the normal level of safety, a "statement of demonstrated ability" (SODA) will be issued
     a Remains valid as long as the impairment doesn't worsen
   - Obtain assistance from the local FSDO as well as an AME

b. The FAA specifies 15 medical conditions that are disqualifying (listed here)
   - If ever diagnosed with one of these conditions, the only way to receive a medical certificate is through a Special Issuance Authorization (FAR 67.401)

c. With few exceptions, all disqualifying medical conditions may be considered for special issuance
   - Chances are good if you can present satisfactory documentation that the condition is stable

B. BasicMed
   i. As of May 2017, pilots can take advantage of the regulatory relief in the new BasicMed rule and operate without an FAA medical certificate, or opt to continue to use their FAA medical certificate
      a. Under BasicMed, a pilot is required to complete a medical education course, undergo a medical examination every four years, and comply with aircraft and operating restrictions
      b. More info in III.A. Certificates and Documents

C. Driver's License
   i. A driver's license can also be used in place of a medical in certain situations
   ii. More info in III.A. Certificates and Documents

2. Hypoxia

A. Hypoxia means "reduced oxygen" or "not enough oxygen"
   i. The greatest concern is with getting enough oxygen to the brain, since it is particularly vulnerable to oxygen deprivation
   ii. Hypoxia can be caused by several factors including:
      a. An insufficient supply of oxygen
      b. Inadequate transportation of oxygen
      c. Inability of the body tissues to use oxygen

B. Hypoxic Hypoxia
   i. A result of insufficient oxygen available to the lungs
   ii. A blocked airway or drowning are examples of how the lungs can be deprived of oxygen
   iii. For Pilots: The reduction in partial pressure of oxygen at high altitude is a common example
      a. Partial Pressure is the amount of pressure that a single gas (out of a mixture) contributes to the total pressure
   iv. Although the percentage of oxygen in the atmosphere is constant with changes in altitude, the partial pressure decreases as altitude increases
      a. As you ascend, the percentage of each gas remains the same, but the molecules no longer have the pressure required to drive oxygen into the respiratory system
      b. The decrease of oxygen molecules at sufficient pressure leads to hypoxic hypoxia

C. Hypemic Hypoxia
   i. Occurs when the blood is not able to take up and transport sufficient oxygen to the cells in the body
   ii. Hypemic means "not enough blood"
   iii. This type of hypoxia is a result of oxygen deficiency in the blood
   iv. Possible Causes:
      a. Not enough blood volume

- Can be caused by severe bleed or blood donation

b. Certain blood diseases, such as anemia
c. Hemoglobin, the molecule that transports oxygen, is unable to bind oxygen molecules
d. Carbon monoxide poisoning

D. Stagnant Hypoxia
   i. Stagnant means "not flowing;" stagnant hypoxia results when the oxygen rich blood in the lungs isn't moving to the tissues that need it
      a. Ex. An arm or leg "falling asleep" because the blood flow has been restricted
   ii. This type of hypoxia can result from:
      a. Shock
      b. The heart failing to pump blood effectively
      c. A constricted artery
   iii. During flight, stagnant hypoxia can occur when pulling excessive positive G's
   iv. Cold temperatures can also decrease the blood supplied to extremities
E. Histotoxic Hypoxia
   i. The inability of the cells to effectively use oxygen
      a. "Histo" refers to tissues or cells, and "Toxic" means poison
   ii. In this case, oxygen is being transported to the cells, but they are unable to use it
   iii. Causes:
      a. Alcohol and other drugs, such as narcotics and poison
      b. Drinking an ounce of alcohol is equivalent to an additional 2,000' of altitude
F. Symptoms of Hypoxia
   i. The first symptoms are euphoria and a carefree feeling. With increased oxygen starvation, the extremities become less responsive and flying becomes less coordinated.
   ii. As it worsens, vision narrows, concentration and instrument interpretation become difficult
   iii. Common symptoms include:
      a. Cyanosis (blue fingernails and lips)
      b. Headache
      c. Decreased reaction time
      d. Impaired judgment
      e. Euphoria
      f. Visual Impairment
      g. Drowsiness
      h. Lightheaded or dizzy sensation
      i. Tingling in fingers or toes
      j. Numbness
   iv. Even with all of these symptoms, the effects of hypoxia can cause a pilot to have a false sense of security and be deceived into believing that everything is normal (euphoria)
G. Useful Consciousness
   i. Describes the maximum time the pilot has to make rational, lifesaving decisions and carry them out at a given altitude without supplemental oxygen
   ii. As altitude increases above 10,000 ft., the symptoms of hypoxia increase in severity, and the time of useful consciousness rapidly decreases

Altitude	Time of Useful Consciousness
45,000 ft. MSL	9 to 15 seconds
40,000 ft. MSL	15 to 20 seconds
35,000 ft. MSL	30 to 60 seconds
30,000 ft. MSL	1 to 2 minutes
28,000 ft. MSL	2 ½ minutes to 3 minutes
25,000 ft. MSL	3 to 5 minutes
22,000 ft. MSL	5 to 10 minutes
20,000 ft. MSL	30 minutes or more

H. Treatment
   i. Flying at lower altitudes
      a. Emergency Descent
   ii. Use supplemental oxygen immediately

I. FAA Physiology Training – One day course in OK. Altitude chamber and vertigo demonstrations
   i. Experiencing and witnessing the effects of hypoxia can be very helpful to recognizing its onset

3. Hyperventilation

A. Occurs when an individual is experiencing emotional stress, fright, or pain, and the breathing rate and depth increase
   i. The result is an excessive loss of carbon dioxide from the body, which can lead to unconsciousness while the respiratory system attempts to override your actions and regain control of breathing

B. Pilots encountering a stressful situation may unconsciously increase their breathing rate
   i. If flying at higher altitudes, with or without oxygen, a pilot may have a tendency to breathe more rapidly than normal, which can lead to hyperventilation

C. Since many symptoms of hyperventilation are similar to those of hypoxia, it is important to correctly diagnose and treat the proper condition.

D. Common Symptoms:
   i. Visual Impairment
   ii. Unconsciousness
   iii. Lightheaded or dizzy sensation
   iv. Tingling sensations
   v. Hot and cold sensations
   vi. Muscle spasms

E. Treatment
   i. Involves restoring the proper carbon dioxide level in the body
   ii. If using supplemental oxygen, check the equipment and flow rate to ensure the symptoms are not hypoxia related
   iii. Breathing normally is both the best prevention and the best cure for hyperventilation
   iv. Breathing into a paper bag or talking aloud helps to overcome hyperventilation
   v. Recovery is usually rapid once the breathing rate is returned to normal
   vi. Because hyperventilation and hypoxia symptoms are so similar, if unsure, it is best to treat the hypoxia as it the more threatening situation

4. Middle Ear and Sinus Problems

A. Middle Ear Problems
   i. Explanation
      a. There is a difference between the pressure of the air outside the body and the air inside the middle ear and nasal sinuses
      b. The middle ear is a small cavity located in the bone of the skull
         - Normally, the pressure difference between the middle ear and the outside world are equalized by the Eustachian Tube
            a A tube leading from inside each ear to the back of the throat on each side
            b These tubes are usually closed, but open during chewing, yawning or swallowing to equalize pressure
   ii. Symptoms
      a. Pain is the primary indicator
         - The pain can be excessive and damage can be done to the eardrums if the pressure differential is too great

b. Temporary reduction in hearing sensitivity

iii. Relation to flying
a. During a climb, if the air pressure in the Eustachian tube cannot equalize (remains at ground level), while the pressure on the outside of the eardrum decreases the eardrum will bulge outward resulting in discomfort
b. During a descent, the reverse happens: as the aircraft descends, the pressure on the outside of the eardrum increases while the pressure in the Eustachian tube remains at altitude, resulting in the eardrum bulging inward causing discomfort
c. Excessive pressure in either situation can result in pain and a ruptured ear drum

iv. Treatment
a. If minor, chew gum or stretch the jaw to attempt to equalize pressure
b. Pinch the nostrils, close the mouth, and blow slowly and gently in the mouth and nose
- This forces air into the Eustachian tube allowing the pressure to equalize
- It may not be possible to equalize the pressure in the ears if a pilot has a cold, an ear infection, or sore throat
- This treatment is more helpful in a descent
  a Be cautious in a climb, forcing air into the Eustachian tube may add more pressure and force the eardrum farther outward leading to increased pain

c. If experiencing minor congestion, nose drops or nasal sprays may reduce painful ear blockage

B. Sinus Problems

i. Explanation
a. Air pressure in the sinuses equalizes with the pressure in the cockpit through small openings that connect the sinuses to the nasal passages
b. An upper respiratory infection (cold or sinusitis) or a nasal allergic condition can produce enough congestion around an opening to slow equalization

ii. Symptoms
a. Pain over the sinus area (pain can become excessive)
b. Some sinus blocks can make the upper teeth ache
c. Bloody mucus may discharge from the nasal passages

iii. Relation to flying
a. As the difference in pressure between the sinus and the cockpit increases, congestion may plug the sinus' openings
b. The "sinus block" occurs most frequently during descents

iv. Treatment
a. Slow descent rates can reduce the associated pain
b. Do not fly with sinus problems (avoid the situation entirely)

5. Spatial Disorientation

A. Explanation

i. Orientation is the awareness of the position of the aircraft and of oneself in relation to a specific reference point

ii. Disorientation is the lack of orientation

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

iv. The body uses three systems to ascertain orientation and movement in space
a. Visual: The eye, by far the largest source of information
b. Somatosensory: Nerves in the skin, muscles, and joints that, along with hearing, sense position based on gravity, feeling, and sound

c. Vestibular System: A very sensitive motion sensing system located in the inner ears. It reports head position, orientation, and movement in three-dimensional space

v. All of this info comes together in the brain, and most of the time, the three streams of information agree, giving a clear idea of where and how the body is moving

B. Relation to flight

i. Flying can result in conflicting information being sent to the brain, leading to disorientation

ii. Visual System (eyes)

a. Flight in VMC

- The eyes are the major orientation system and usually prevail over false sensations from the other systems when outside references are available

b. Flight in IMC

- When visual cues are taken away, the eyes cannot correct for the false sensations causing the pilot to quickly become disoriented

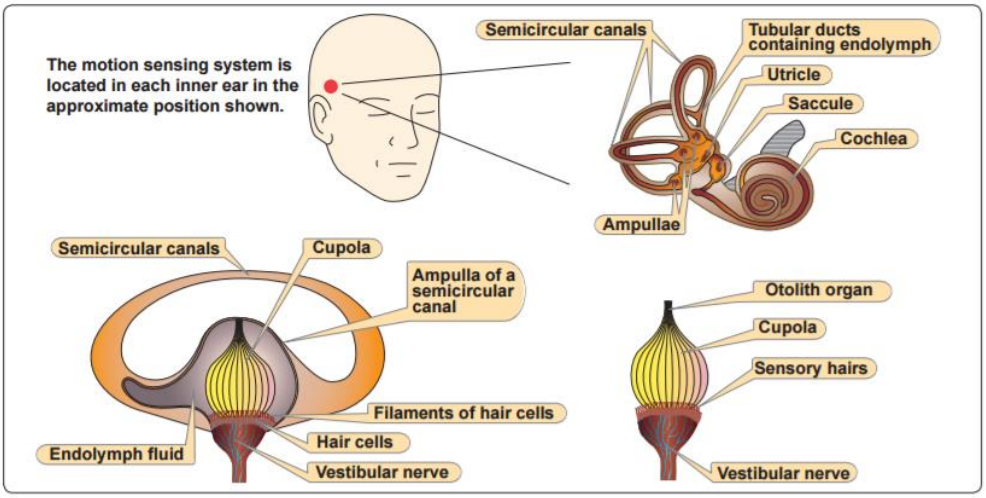
iii. Vestibular System (ears)

a. The vestibular system in the inner ear allows the pilot to sense movement and determine orientation in the surrounding environment

b. Two major parts: Semicircular Canals and Otolith Organs

c. Semicircular Canals

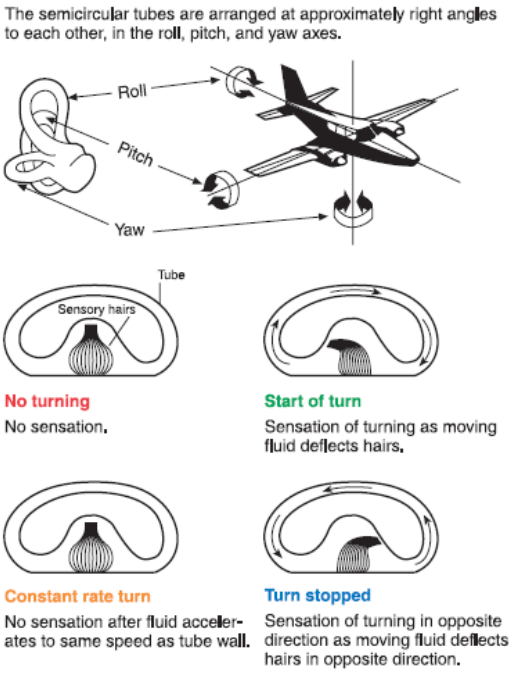
- Explanation
  - a Detect angular acceleration
  - b Three tubes at right angles to each other
    1. One on each of the three axes; pitch, roll, and yaw
  - c Each canal is filled with a fluid, called Endolymph Fluid
  - d In the center of the canal is the cupola, a gelatinous structure that rests upon sensory hairs located at the end of the vestibular nerves



- How they work: In a Turn
  - a Turn Detection
    1. In straight and level flight, with no acceleration, the hair cells are upright, and the brain does not sense a turn
    2. Placing the aircraft into a turn puts the semicircular canal and its fluid into motion, with the fluid within the semicircular canal lagging behind the accelerated canal walls

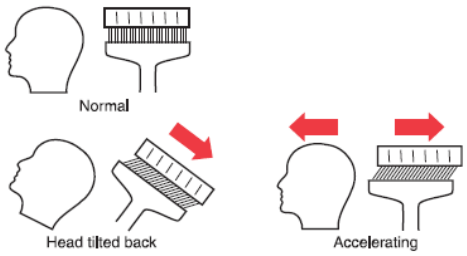
a. This lag creates a relative movement of the fluid within the canal. The canal wall and the cupola move in the opposite direction from the motion of the fluid
3. The brain interprets the movement of the hairs to be a turn in the same direction as the canal wall

b The ear only detects turns of a short duration
1. After approximately 20 seconds, the motion of the fluid in the canals catches up with the canal walls and the hairs are no longer bent
2. At the same speed, the hairs detect no relative movement and the sensation of turning ceases (it feels like straight and level flight)
a. With the hair cells upright, the brain receives the false impression that the turning has stopped
3. When the aircraft rolls back to straight-and-level flight, the fluid in the canal moves briefly in the opposite direction. This sends a signal to the brain that is falsely interpreted as a turn in the opposite direction
a. In an attempt to correct the falsely perceived turn, the pilot may reenter the original turn



c This can be demonstrated: Establish a 30° bank turn, tell the student to close their eyes and let you know when the aircraft is flying straight. Maintain the turn, after about 20 seconds the student should feel as though the aircraft is out of the turn, have them open their eyes. Try it again, but this time once they believe the aircraft is straight, roll out of the bank. The student will feel like the aircraft is turning in the opposite direction.

d. Otolith Organs
- Explanation
  - a Detect linear acceleration/gravity
  - b A gelatinous membrane containing chalk like crystals covers the sensory hairs
  - c When you tilt your head, the weight of the crystals causes the membrane to shift due to gravity and the sensory hairs detect the shift
- Acceleration
  - a Forward acceleration gives the illusion of the head tilting backward and deceleration gives the illusion of the head tilting forward



iv. Somatosensory System (nerves)
a. Nerves in the body's skin, muscles, and joints constantly send signals to the brain, which signals the body's relation to gravity
b. Acceleration will be felt as the pilot is pushed back into the seat
c. False Sensations
- Forces created in turns can lead to false sensations of the direction of gravity, and may give the pilot a false sense of which way is up

        a. The brain has no way of differentiating between the forces of a turn (coordinated or uncoordinated) and the force of gravity
      - Turbulence can create motions that confuse the brain
      - Fatigue or illness can exacerbate these sensations
  C. Countering the sensations
    i. Recognize the problem, disregard the false sensations, and rely totally on the flight instruments
    ii. The pilot must have an understanding of the problem and the self-confidence to control the aircraft using only instrument indications (do not trust the feelings, trust the instruments)

6. Motion Sickness

  A. Cause
    i. Caused by the brain receiving conflicting messages about the state of the body
    ii. Anxiety and stress also affect motion sickness
  B. Symptoms
    i. General discomfort
    ii. Nausea
    iii. Dizziness
    iv. Paleness
    v. Sweating
    vi. Vomiting
  C. Treatment
    i. Open fresh air vents
    ii. Focus on objects outside the airplane
    iii. Avoid unnecessary head movement
    iv. Take control of the aircraft and fly smooth, straight and level
      a. Letting someone else fly can make the situation worse
    v. Usually goes away after a few flight lessons
      a. After more used to flying and stress/anxiety are reduced

7. Carbon Monoxide Poisoning

  A. How it Happens – In the Plane
    i. Carbon Monoxide (CO) is a colorless, odorless gas produced by all internal combustion engines
    ii. Aircraft heater vents and defrost vents provide CO a passageway into the cabin if the engine exhaust system has a leak or is damaged
  B. How it Happens – In the Body
    i. CO attaches itself to the hemoglobin in the blood
      a. It does this about 200 times easier than oxygen
      b. CO prevents the hemoglobin from carrying oxygen to the cells resulting in Hypemic Hypoxia
    ii. It can take up to 48 hours for the body to dispose of CO
    iii. If severe enough, CO poisoning can result in death
  C. Effects of CO poisoning
    i. Headache
    ii. Blurred vision
    iii. Dizziness
    iv. Drowsiness
    v. Loss of muscle power
  D. Detecting and Correction
    i. Disposable, inexpensive CO detectors are widely available
    ii. If a strong odor of exhaust gases is detected, assume CO is present
      a. CO may be present in dangerous amounts even if no exhaust odor is detected

iii. If exhaust odor is noticed or symptoms are experienced immediate actions should be taken
   a. Turn off the heater
   b. Open fresh air vents and windows
   c. Use supplemental oxygen, if available
   d. Land

8. Fatigue and Stress

A. Fatigue

i. Effects
   a. Degradation of attention and concentration
   b. Impaired coordination
   c. Decreased ability to communicate

ii. Causes
   a. Sleep loss
   b. Exercise
   c. Physical work
   d. Stress and prolonged performance of cognitive work can result in mental fatigue

iii. Categories of Fatigue (Acute and Chronic)
   a. Acute Fatigue (short term)
      - Definition
         a Short term, and a normal occurrence in everyday life
         b Tiredness felt after a period of strenuous effort, excitement, or lack of sleep
      - Skill Fatigue – A special type of acute fatigue affecting piloting skill. Effects include:
         a Timing Disruption
            1. Appearing to perform a normal task, but the timing of each component is slightly off
            2. Pattern of operation is less smooth as each component is performed as a separate part instead of part of a single, integrated activity
         b Disruption of the perceptual field
            1. Concentrating attention upon movements or objects in the center of vision and neglecting those in the periphery
            2. May be accompanied by a loss of accuracy/smoothness in control movements
      - Causes
         a Mild hypoxia
         b Physical stress
         c Psychological stress
         d Depletion of physical energy resulting from psychological stress
         e Sustained psychological stress
      - Prevention
         a Proper diet
            1. Prevents the body from having to consume its own tissues as an energy source
         b Adequate rest and sleep
            1. Maintains the body's store of vital energy
            2. The difference between flying fatigued and rested can be night and day,
   b. Chronic Fatigue
      - Definition
         a Fatigue extending over a long period of time
         b Usually has psychological roots, an underlying disease is sometimes responsible
      - Causes

        a. Continuous high-stress levels produce chronic fatigue
    - Symptoms
        a. Weakness
        b. Tiredness
        c. Palpitations of the heart
        d. Breathlessness
        e. Headaches
        f. Irritability
        g. Stomach or intestinal problems (rare)
        h. Generalized aches and pains throughout the body
        i. Emotional Illness (when conditions become serious enough)
    - Prevention
        a. Usually requires treatment by a physician
iv. Prevention
    a. If suffering from acute fatigue, stay on the ground
    b. Fatigue in the cockpit cannot be overcome through training or experience
    c. Getting adequate rest is the only way to prevent fatigue
        - Avoid flying without:
            a. A full night's rest
            b. After working excessive hours
            c. After an especially exhausting or stressful day
    d. Suspected chronic fatigue should be treated by a physician

B. Stress
i. The body's response to physical and psychological demands placed upon it
ii. Body's Reaction
    a. Releasing chemical hormones (such as adrenaline) into the blood
    b. Increasing metabolism to provide more energy to the muscles
    c. Blood sugar, heart rate, respiration, blood pressure, and perspiration all increase
iii. Stressors (elements that cause an individual to experience stress)
    a. Physical stress (noise or vibration)
    b. Physiological stress (fatigue)
    c. Psychological stress (difficult work or personal situations)
iv. Categories of Stress (Acute and Chronic)
    a. Acute Stress (short term)
        - Involves an immediate threat that is perceived as danger
        - The type of stress that triggers a "fight or flight" response in an individual
        - Normally, a healthy person can cope with acute stress and prevent stress overload
        - On-going acute stress can develop into chronic stress
v. Chronic Stress (long term)
    a. A level of stress that presents an intolerable burden, exceeds the ability of an individual to cope, and causes individual performance to fall sharply
    b. Causes
        - Unrelenting psychological pressures such as loneliness, financial worries, and relationship or work problems
    c. Pilots experiencing this level of stress are not safe and should not fly. Consult a physician

9. Dehydration

A. Definition

i. Critical loss of water from the body

B. Causes
   i. Hot flight decks/flight lines, wind, humidity, diuretic drinks (coffee, tea, alcohol, caffeinated soda)
C. Effects
   i. First noticeable effect is fatigue
      a. Top physical and mental performance is difficult, if not impossible
   ii. Headache, cramps, tingling, sleepiness, and dizziness
D. How it affects flying
   i. Flying for long periods of time in hot temperatures or at high altitudes increases the susceptibility of dehydration since the dry air at altitude increases the rate of water loss from the body
   ii. If the fluid is not replaced, fatigue progresses to dizziness, weakness, nausea, tingling of the hands and feet, abdominal cramps, and extreme thirst
   iii. Attention is taken from flying and skills diminish
E. Prevention
   i. Carry an ample supply of water on any flight (recommended to drink 2 quarts of water per day)
      a. Carry a container to measure daily water intake
      b. Stay ahead – don't wait until you're thirsty to drink
   ii. If the airplane has a canopy or roof window, wearing light colored, porous clothing and a hat will provide protection
   iii. Keep the cockpit well ventilated
   iv. Limit daily caffeine and alcohol intake

10. Alcohol and Other Drugs

A. DON'T drink and fly
   i. Even in small amounts, alcohol can impair judgement, decrease sense of responsibility, affect coordination, constrict visual field, diminish memory, reduce reasoning ability, lower attention span
      a. Altitude multiplies the effects of alcohol on the brain
      b. Alcohol interferes with the brains ability to utilize oxygen (form of histotoxic hypoxia)
   ii. A hangover can impair anyone attempting to fly
   iii. FAR 91.17 – 8 hrs. 'from bottle to throttle' (8 hrs. and not feeling the effects of alcohol is better)
      a. Considerable amounts of alcohol can remain in the body for over 16 hours – be cautious
B. Medications
   i. FAR 61.53 (Prohibition on operations during medical deficiency) prohibits flying if you:
      a. Are taking medication/receiving treatment that would prevent you from obtaining a medical
   ii. FAR 91.17 prohibits use of drugs affecting a person's faculties in any way contrary to safety
   iii. Medication can absolutely affect pilot performance
      a. Side effects of medicines can impair judgment, memory, alertness, coordination, vision, can cause confusion, dizziness, headaches, nausea, mood swings, anxiety, balance problems, hearing problems, etc.
      b. Drugs that cause no apparent side effects on the ground can create serious problems airborne
   iv. Basically: Do not fly while taking any medication(s), unless approved by the FAA

11. Nitrogen and Scuba Diving

A. Why it's a Danger
   i. Scuba diving results in a significant increase in the amount of nitrogen dissolved in the body
      a. The deeper the dive, the greater the nitrogen
   ii. At sea level, the nitrogen inside the body and outside the body is in equilibrium
   iii. When atmospheric pressure is reduced, the equilibrium is upset and nitrogen leaves the body
   iv. If the nitrogen leaves too quickly, bubbles may form causing a variety of symptoms
      a. Bubbles can form in the bloodstream, spinal cord or brain as pressure decreases with altitude

   b. Symptoms include impairment or severe pain, but in extreme cases this can result in death
B. Scuba Diving and Flying
   i. Following scuba diving, if not enough time is allowed to eliminate the excess nitrogen, DCS can occur as low as 5,000' and create an in-flight emergency
      a. In normal conditions, most cases of DCS occur at altitudes of 25,000' or higher
   ii. Wait at least 12 hrs. after a dive not requiring a controlled ascent before flight up to 8,000' MSL
      a. 24 hrs. for flight above 8,000'
   iii. Wait at least 24 hrs. after a dive that requires a controlled ascent before flight up to 8,000' MSL
   iv. If a decompression occurs (especially a rapid decompression) symptoms can be brought on quickly

12. IM SAFE

A. Always perform your own preflight
   i. Illness
   ii. Medication
   iii. Stress
   iv. Alcohol
   v. Fatigue
   vi. Emotion

Conclusion:

Brief review of the main points

There are many factors a pilot needs to be aware of in order to ensure a safe flight and to understand the medical risks involved with flying.

PTS Requirements:

To determine that the applicant exhibits knowledge of the elements related to aeromedical factors by explaining:

1. How to obtain an appropriate medical certificate.
2. How to obtain a medical certificate in the event of a possible medical deficiency.
3. The causes, symptoms, effects, and corrective action of the following medical factors:
   a. hypoxia.
   b. hyperventilation.
   c. middle ear and sinus problems.
   d. spatial disorientation.
   e. motion sickness.
   f. carbon monoxide poisoning.
   g. fatigue and stress.
   h. dehydration.
4. The effects of alcohol and drugs, and their relationship to flight safety.
5. The effect of nitrogen excesses during scuba dives and how this affects pilots and passengers during flight.