

References: FAA-H-8083-3, FAA-H-8083-25,
FAA-S-8081-12, FAA-S-ACS-6

Objectives	<ul style="list-style-type: none"> The student will understand the elements related to night operations
Elements	<ul style="list-style-type: none"> How the eyes work Disorientation & Night Optical Illusions Pilot Equipment Preflight Inspection Engine Starting Taxiing, Airport Orientation, & the Run-Up Takeoff & Climb In-Flight Orientation Traffic Patterns Approach & Landing Go Around Night Emergencies
Schedule	<ul style="list-style-type: none"> Review lesson objectives Review lesson material Conclusion & Review
Equipment	<ul style="list-style-type: none"> White Board / Markers References
CFI Actions	<ul style="list-style-type: none"> Present lesson Use teaching aids Ask/ answer questions
Student Actions	<ul style="list-style-type: none"> Participate in discussion Take notes Ask / answer questions
Completion Standards	<ul style="list-style-type: none"> The student will understand how the principles of flight are at play while the airplane is flying.

Additional Notes: _____

CE = Common Error

Introduction

Overview

Review objectives / Elements

What

Night operations are the factors dealing with and the operation of the airplane at night.

Why

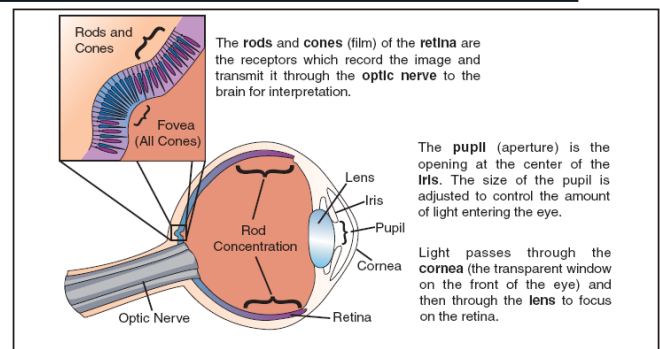
Flying at night presents many unique situations which, if ignored, can result in dangerous situations. If you learn to use your eyes correctly and know your limitations, night vision can be used more effectively.

How

How the Eyes Work

Rods & Cones

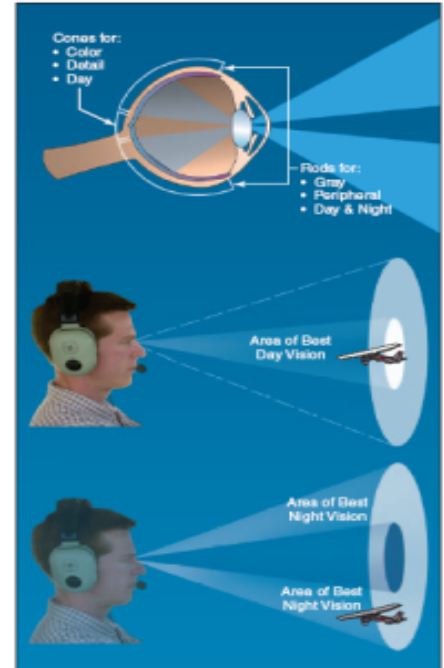
- **Two types of light sensitive nerve endings which transmit messages to the brain via the optic nerve**
 - **Cones** - Responsible for color, detail, and far away objects
 - The cones are located in the center of the retina
 - **Rods** – Function when something is seen in the peripherals and provide vision in dim light
 - The rods are in a ring around the cones (peripherals)
- **Both the cones and rods are used for vision in the day**
 - However, without normal light, the process of night vision is placed almost entirely on the rods



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Rods, Cones, & Night Vision

- **Cones** are located in the center of the retina (the layer upon which all images are focused)
 - There is a small pit called the fovea where almost all the light sensing cells are cones
 - This is the area where most looking occurs (your center of vision)
- **The Rods**
- **Make night vision possible**
 - During daylight, objects can be seen by looking directly at them, using the fovea, but at night a scanning procedure to permit off center viewing is more effective
 - The cones need light to function, without sufficient light (at night, for example) the cones are effectively a blind spot
 - ❖ Rods are concentrated around the cones and are used to see in dim light
 - Since cones are only useful with sufficient light and the rods lie outside the fovea (outside the center of vision), off-center viewing is used for night flight
 - When attempting to find traffic do not stare directly at it, look slightly off to the left or right to allow the rods to see the aircraft
 - The problem with rods is that a large amount of light overwhelms them, and they take a long time to reset and adapt to the dark again
 - The rods can take approximately 30 minutes to fully adapt to the dark
 - ❖ Once fully adapted the Rods are about 100,000X more sensitive to light
 - After the rods have adapted to the dark, the process is reversed when exposed to light
 - The eyes adjust to the light in a matter of seconds
 - Therefore, it is important to avoid bright lights before and during a flight
 - **This is why red flashlights are recommended during flight, they do not disrupt the rods dark adaptation**



Overview

- Night vision is based on the rods and off-center viewing
- Staring directly at an object at night could result in not seeing the object at all since the cones in the center of your vision are considerably less effective without sufficient light
- Avoid bright lights before and during a flight to maintain adequate night vision
 - **Cockpit Lighting**
- Cockpit lighting should set to a minimum brightness that will allow reading of the instruments and switches without hindering outside vision

Disorientation & Optical Illusions

- Night illusions can cause confusion

Autokinesis

- Caused by staring at a single point of light against a dark background for over a few seconds
- The light appears to move on its own
- Prevent this by focusing the eyes on objects at varying distances and avoid fixating
 - Keep the eyes moving and offset/use peripherals

False Horizon

- Caused when the natural horizon is obscured/not readily apparent
 - Generated by confusing bright stars and city lights
- Use and trust your instruments to maintain orientation

Featureless Terrain

- An absence of ground features can create the illusion that the aircraft is higher than it actually is
 - This results in a tendency to fly a lower than normal approach

Runway Slopes

- An up-sloping runway/terrain can create the illusion that the aircraft is higher than it actually is
 - The pilot who does not recognize this will fly a lower approach
- Down slope – The opposite applies
 - Be prepared - use the Chart Supplement to know what runway slope to expect

Ground Lighting

- Regularly spaced lights along a road/highway/etc. can appear to be runway lights
- Lights on moving trains have been mistaken for runway/approach lights
- Bright runway or approach lights can create the illusion the airplane is closer to the runway
- Lessen this as much as possible by maintaining situational awareness
 - Know what to expect to see (type of airport/runway lighting), where you expect to see it and know where you are (use nav aids, GPS, landmarks, etc.)
- Verify Attitude by Reference to the Flight Instruments
 - Reference to the flight instruments is the best way to cope with disorientation/optical illusions
 - If making an approach and an ILS or VASI is available, make use of it
 - Use vertical guidance as much as possible, especially at night
- Visual references are limited – incorporate the instruments in your scan more often than normal
- If at any time the pilot is unsure of their position, a go around should be executed

Pilot Equipment

Flashlight

- **Red or white light**
 - White light is used to preflight the aircraft
- **Red light** is used when performing cockpit operations as it will not impair night vision
 - Be cautious, when using a red light on an aeronautical chart, the red colors will wash out

Aeronautical Charts

- **If the intended course of flight is near the edge of a chart, the adjacent chart should be available**
 - City lights can be seen at far distances and confusion can result without the necessary charts

Preflight Inspection & 14CFR 91.205

Required equipment for VFR flight at night

- **TOMATO FLAMES and FLAPS**
 - **F**uses (if applicable)
 - **L**anding Light
 - **A**nti-Collision Lights
 - **P**osition Lights
 - **S**ource of Power

Walk Around

- The preflight inspection is still necessary
- White light flashlight is good for the inspection (red light inside the cockpit)
- Check all aircraft lights
- Check the ramp for obstructions

Engine Starting

- Be sure the propeller area is clear
 - Turn on position and anti-collision lights *prior* to start
- Announce “Clear Prop”
- Keep all unnecessary electrical equipment off to avoid draining the battery

Taxiing, Airport Orientation & Run-up

Taxiing

- Due to restricted vision, taxi speeds should be reduced
 - Don't taxi faster than a speed that will allow a stop within the distance you can clearly see
- Use the landing/taxi lights as necessary
 - Do not use strobes or landing lights in vicinity of other aircraft
 - This can be distracting and blinding to other pilots. Plus, it's just rude.

Orientation

- Airport Diagram (always have one out)
- Understand taxiway markings, lights, and signs

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FAA-S-8081-12, FAA-S-ACS-6

Run-up

- **The before taxi run-up should be performed with the checklist as usual**
 - Forward movement of the airplane may not be easy to detect
 - Hold/lock the brakes and be alert that the airplane could creep forward without being noticed
- **Be extra cautious**

Takeoff & Climb

Takeoff

- **Clear the area for approaching traffic – Final Approach**
 - Uncontrolled airports: Make a 360° turn in the direction of air traffic to clear the local area
 - Radios are not required, however, just because you don't hear anyone doesn't mean they aren't there
- **After receiving clearance, align the airplane with the centerline**
 - Check to ensure the magnetic compass and heading indicator match the runway intended
- **Perform a normal takeoff depending more on the instruments as many visual cues are not available**
 - Perception of runway width, airplane speed, and flight attitude will vary at night
 - The flight instruments should be checked frequently
- **As the airspeed reaches V_R , the pitch attitude should be adjusted to establish a normal climb**
 - Refer to outside visual references (such as lights) as well as the flight instruments

Climb

- **To ensure the airplane is climbing check the airspeed indicator, the VSI and the altimeter; the darkness makes it hard to judge your rate of climb**
- **Necessary adjustments should be made by referencing the attitude and heading indicators**
- **Turns should not be made until reaching a safe maneuvering altitude**

In-Flight Orientation

Checkpoints

- **Although there are less of them, it should not be a problem**
 - Light patterns of towns are easily identified
 - Rotating beacons are useful
 - Highways with cars on them are usually easy to see (headlights/brake lights are visible)
 - Ensure you maintain orientation as it is easier to become disoriented and confused about location
 - Continuously monitor position, time estimates, and fuel consumed
- **NAVAIDS/GPS should be used whenever possible**
- **Clouds / Restricted Visibility**
 - It is difficult to see clouds at night – be cautious to avoid flying into MVFR/IFR weather conditions
 - 1st indication - Gradual disappearance of the ground and glowing around lights

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- Be conservative, don't expect to pop out the other side, take action as necessary to avoid flying in the clouds
- **Nav Lights**
 - Red Light on Left Wing, Green Light on Right Wing and White Light on the Tail
 - Used to orient another aircraft direction in relation to your own

Traffic Pattern

Identify runway / airport lights as soon as possible

- **It may be difficult to find the airport or runways (especially if they're buried within a city)**
 - Fly towards the beacon until you identify runway lights
 - Compare the runway lights with heading indicator to ensure you are in the right place
 - If possible, tune the localizer for course guidance to the runway and/or use the OBS function of a GPS to view an extended runway centerline
 - Use any additional means available to help orient yourself and maintain situational awareness

Distance may be deceptive at night

- **A lack of references on the ground and the inability to compare their location and size causes this**
- **More trust must be put on the instruments (particularly the altimeter and airspeed indicator)**
- **Landing light should be on for collision avoidance**

Fly a normal traffic pattern

- **Know the location of the runway/threshold lights at all times**
- **When entering, allow for plenty of time to complete the before landing checklist**
- **Execute the approach in the same manner as during the day**

Approach & Landing

- **A stabilized approach should be made in the same manner as during the day**
- **Use flight instruments more often (especially altimeter/airspeed indicator)**
 - Distance, height, etc. may be deceptive
 - Maintain specified airspeeds on each leg and watch the VSI to keep the approach under control

Final Approach

- **If there are no centerline lights, align the airplane between the edge lights**
- **Apply power and pitch corrections to maintain a stabilized approach**
 - Use approach lights (VASI, PAPI, etc.) to maintain glideslope
 - Tune the glideslope if available for additional guidance

Round-out / Touchdown

- **A smooth, controlled round-out and touchdown should be made in the same manner as in the day**
 - Judgment of height, speed, and sink rate may be impaired
 - There is often a tendency to round out too high
- **A good rule is to start the round-out when the landing lights reflect on the tire marks on the runway**
 - In the case you have no landing light/can't see tire marks start the round-out when the runway lights at the far end appear to be rising higher than the airplane

Go Around

- **A prompt decision is even more necessary at night due to the restricted visibility**
- Be prepared in case the maneuver is necessary
- **Fly the go around as normal, with a greater emphasis on the instrument cross check if outside references are lacking**

Night Emergencies

Electrical

- **The greatest electrical load is placed on the system at night = the greatest chance of failure**
- **In the case of a suspected problem**
 - Reduce load as much as feasible
 - If total failure is expected, land at the nearest airport immediately

Engine

- **Don't Panic - Establish a normal glide and turn toward an airport or away from congested areas**
- **Check to determine the cause and correct immediately if possible (Engine restart checklist)**
 - If no restart – Maintain positive control of the airplane at all times!
 - Maintain orientation with the wind – don't land downwind unless there is no other choice
 - Check the landing lights and use them on landing if they work
- **Announce the emergency to ATC, UNICOM, and/or guard (If on a frequency, don't change unless instructed to)**
- **Consider an emergency landing area close to public access (don't land where no one can get to you)**
 - Before landing checklist
 - Touchdown at the slowest possible airspeed
- **After landing, turn off all switches and evacuate as quickly as possible**

Conclusion & Review

Review the Main Lesson Points

Night operations present unique situations to a pilot and require vigilance to maintain orientation and safety. Night flying is not inherently dangerous, but it can require more effort.

Review

1. Factors related to night vision.
2. Disorientation and night optical illusions.
3. Proper adjustment of interior lights.
4. Importance of having a flashlight with a red lens.
5. Night preflight inspection.
6. Engine starting procedures, including use of position and anti-collision lights prior to start.
7. Taxiing and orientation on an airport.
8. Takeoff and climb-out.
9. In-flight orientation.
10. Importance of verifying the airplane's attitude by reference to flight instruments.
11. Night emergencies procedures.
12. Traffic patterns.
13. Approaches and landings with and without landing lights.
14. Go-around