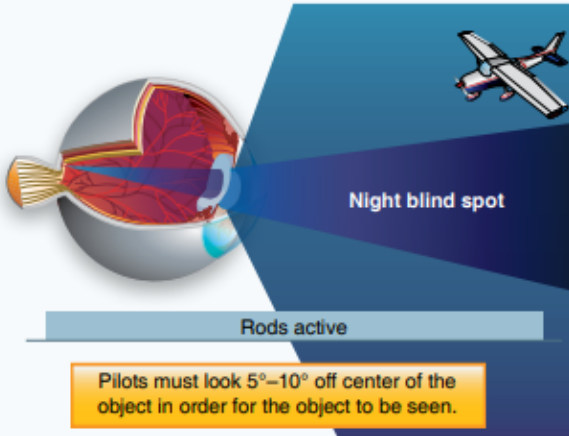


Night Operations

Objective	 <p>The diagram illustrates the human eye's visual field at night. A central beam of light is labeled 'Rods active'. A dark blue area to the right is labeled 'Night blind spot'. A yellow box at the bottom states: 'Pilots must look 5°–10° off center of the object in order for the object to be seen.' An airplane is shown in the upper right corner of the visual field.</p>
<p>To ensure the applicant learns the elements that affect night vision and the procedures for operating safely at night.</p>	
Purpose	
<p>While not all pilots fly at night, night flying can provide a great deal of utility and enjoyment. Weather is often quite favorable at night, with smooth air and good visibility. However, night flight is associated with certain hazards, and requires pilots to use proper procedures to ensure safe operations. This lesson introduces pilots to the potential hazards of night flying, as well as how to perform the proper procedures for safe night flying.</p>	
Schedule	Equipment
<ul style="list-style-type: none"> ● Ground Lesson: 15 minutes ● Student Q&A: 10 minutes 	<ul style="list-style-type: none"> ● Whiteboard / Markers (optional)
Student Actions	Instructor Actions
<ul style="list-style-type: none"> ● Ask any questions, receive study material for the next lesson. ● Watch linked video. ● Review listed references. 	<ul style="list-style-type: none"> ● Deliver the ground lesson (below). ● Answer student questions.
Completion Standards	
<ul style="list-style-type: none"> ● Student can explain the following concepts: <ul style="list-style-type: none"> ● Factors that relate to night vision, night blind spot, the function of rods and cones ● How to preserve night vision, how to adjust cockpit lighting ● Night optical and spatial illusions ● Procedures for night operations <ul style="list-style-type: none"> ○ Preflight, taxi, takeoff, climb, enroute, go-arounds ○ Traffic pattern operations, Pilot Controlled Lighting ○ “Black Hole” Approaches, Use of Landing Lights ○ Importance of increased reliance on flight instruments ○ Procedures for handling night emergencies 	

References

- MZeroA Flight Training - "Hazards When Flying At Night - Day 18 #31DaySPC"
 - YouTube - <https://www.youtube.com/watch?v=DN7qO7q-ieg>
- FAA-H-8083-3B (Airplane Flying Handbook) - Chapter 10 [Night Operations]
- FAA-H-8083-25B (Pilot's Handbook of Aeronautical Knowledge) - Chapter 17, Page 6-12 [Spatial Disorientation and Illusions], Chapter 17, Page 19-25 [Vision in Flight]
- AIM (Aeronautical Information Manual) - Chapter 8, Section 1-6 [Vision in Flight]
- FAA-S-ACS-6B (Private Pilot ACS) - Area XI Task A
- FAA-S-8081-6D (CFI PTS) - Area II Task H

Ground Lesson Outline

- Factors Related to Night Vision
 - Function of Rods and Cones
 - Night Blind Spot
 - Effects of Hypoxia, Fatigue
- Disorientation and Night Optical Illusions
 - False Horizon
 - Autokinesis
- Preserving Night Vision
 - Dark Adaptation
 - Close one eye near bright lights
 - Don't wear sunglasses after dark
 - Move eyes slowly
 - Blink if eyes become blurry
 - Concentrate on seeing objects
 - Use off-center viewing
 - Maintain good physical condition
 - Avoid drinking/smoking/drugs
 - Cockpit Lighting - Adjustment of interior lighting, Importance of a red lens
 - Aircraft Lighting
- Night Operating Procedures
 - Equipment Required - Keep essentials within easy reach. White flashlight, red flashlight
 - Night Preflight Inspection - Importance of using a white light
 - Engine starting procedures, Use of position and anti-collision lights prior to start - § 91.209
 - Taxiing and Orientation on an Airport - Use of airport diagrams, taxiway signs, lighting, and markings
 - In Flight - Importance of increased reliance on instruments, lack of outside references
 - Takeoff and Climb-out - Dangers of loss of horizon in a climb attitude
 - In-flight orientation - Awareness of night optical illusions
 - Traffic Pattern Procedures
 - Spotting Airport Beacons
 - Pilot Controlled Lighting
 - "Black Hole" Approaches
 - Landing with and without landing lights
 - Dangers of night go-arounds
 - In-flight Emergencies - Aim for dark areas if not within gliding distance of an airport

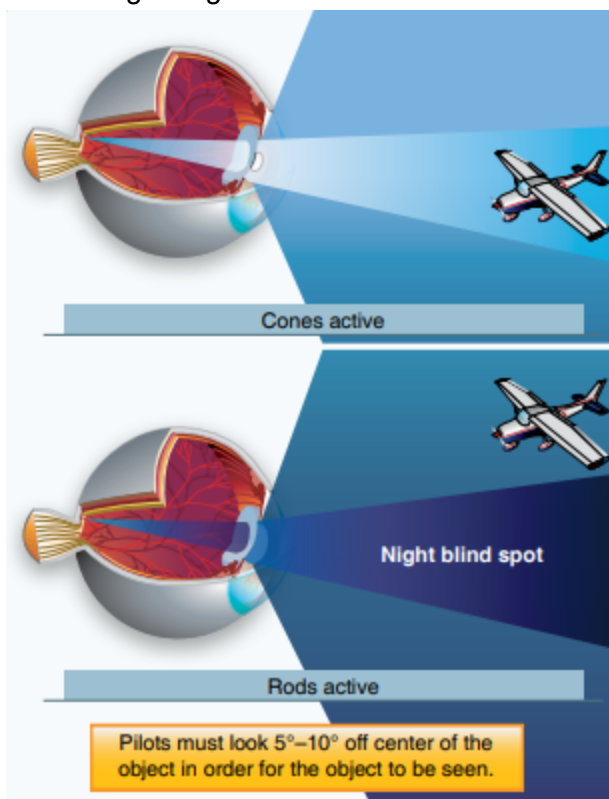
Common Errors

- **Failure to protect night vision during taxi or other operations.**

Ground Lesson Content

- **Factors Related to Night Vision**

- **Function of Rods and Cones** - Two types of cells in the retina
 - **Rods** - Evenly distributed around the retina *except* the fovea, extremely sensitive to low levels of light but do not provide any color vision.
 - **Cones** - Provide color vision, but not effective at night. Mostly concentrated in the fovea.
- **Night Blind Spot** - The *fovea*, near the center of vision, consists mostly of cones with very few rods. Therefore at night, there is a *night blind spot*, due to the lack of rods in the fovea. Pilots must use off-center viewing at night to scan for traffic or obstacles.



- **Effects of Hypoxia** - Hypoxia significantly decreases night vision as rods have reduced functionality in low oxygen environments. **Pilots should use supplemental oxygen when over 5,000 feet at night.**
 - **Fatigue** - Fatigue also reduces night vision.
- **Disorientation and Night Optical Illusions** - Night flying produces a number of optical illusions which can lead to spatial disorientation. In particular, night flying provides less outside visual references, which increases the difficulty of flying by visual references only.
 - **False Horizon** - Pilots can confuse ground lighting, stars, or angled clouds with the true horizon.
 - **Autokinesis** - Staring at a bright light in a dark area for a long time can cause an appearance of spontaneous movement when none exists.
- **Preserving Night Vision** - Rods, while extremely sensitive in low light, are slow to adapt. It can take 30 minutes for eyes to adapt to very low light conditions. Once eyes are adapted to low light, it is important to protect them from viewing bright lights, which will overwhelm the rods and degrade night vision. It may take several minutes (even up to 30 minutes again) to regain the lost night vision.

- **Dark Adaptation**
 - **Close one eye near bright lights** - When expecting to view a bright light source, close one eye to preserve dark adaptation in the other.
 - **Don't wear sunglasses after dark** - Sunglasses significantly impair the dark adaptation process.
 - **Move eyes slowly** - It takes more time for eyes to adjust in low light.
 - **Blink if eyes become blurry**
 - **Concentrate on seeing objects** - Focusing on objects may require time and deliberate effort.
 - **Use off-center viewing** - Avoid looking directly at things, to avoid the night blind spot.
 - **Maintain good physical condition** - Fatigue can impair night vision.
 - **Avoid drinking/smoking/drugs** - Smoking or drugs/alcohol can cause hypemic or histoxic hypoxia, which impairs night vision significantly.
- **Cockpit Lighting** - It is important to keep cockpit lighting dim, using only red light, as red light does not create harmful glare. Keep a red flashlight available and in easy reach at all times.



- **Aircraft Lighting** - At all times, pilots should use an anti-collision light or beacon when the airplane is operating. The use of navigation lights is required at night (after the end of civil twilight), but it is best to use them from sunset to sunrise. **Avoid use of strobes or bright landing lights when in the proximity of other airplanes and not on the runway!** This helps other pilots protect their own night vision.
- **Night Operating Procedures**
 - **Equipment Required** - Keep essentials within easy reach. A red flashlight should be within easy reach at all times. A headlamp with a red lens is also a good idea, in case of an in-flight electrical failure.



- **Night Preflight Inspection** - Because red light distorts details, pilots should use a white light for

- performing external preflight operations.
- **Engine Starting Procedures** - Pilots should always use position and anti-collision lights prior to start when operating at night - § 91.209
 - **Taxiing and Orientation on an Airport** - Taxiing on an airport at night is extremely confusing because taxiway markings may be difficult to use. It is important to use airport diagrams to track the progress of the airplane on the airport. Keep a careful watch for taxiway signs, lighting, and markings
 - **In Flight** - During night operations, outside visual references are frequently unavailable, for example just after takeoff, particularly on moonless or overcast nights. **Pilots must scan their flight instruments more frequently at night, especially when outside visual references are less available!**
 - **Takeoff and Climb-out** - During a pitch up on takeoff or during climbout on moonless or overcast nights, no ground lighting is visible over the nose and it is easy to lose reference to the horizon.
 - **In-flight orientation** - Be vigilant for night optical illusions, such as false horizons caused by ground lighting.
 - **Traffic Pattern Procedures** - Following proper nighttime traffic pattern procedures is important:
 - **Spotting Airport Beacons** - Look for the green-white flashing airport beacons to find airports at night. Airports often appear as inky black areas when the runway lights are not illuminated.
 - **Pilot Controlled Lighting** - Most uncontrolled airports have pilot-controlled lighting, where pilots have to activate the runway lighting for 15 minutes at a time using 3, 5, or 7 clicks within 5 seconds of the push-to-talk switch on the CTAF frequency. (For low, medium, and high intensity)
 - **“Black Hole” Approaches** - Descending to a runway at night where there are no other outside visual references can create the feeling of descending into a black hole, and pilots can inadvertently end up far too low. **Always be aware of the field altitude and check instruments carefully!**
 - **Landing with and without landing lights** - Landing without a landing light is extremely difficult, especially on moonless nights or without proper dark adaptation. Pilots should practice this skill occasionally, should the need arise.
 - **Dangers of night go-arounds** - Go-arounds at night are exceptionally dangerous for the same reasons as night takeoffs.
 - **In-flight Emergencies** - Aim for dark areas if not within gliding distance of an airport. Roads are generally surrounded by power lines or other hazards. Options during night emergencies are very limited, and dark areas are more likely to be unpopulated and free from such hazards.