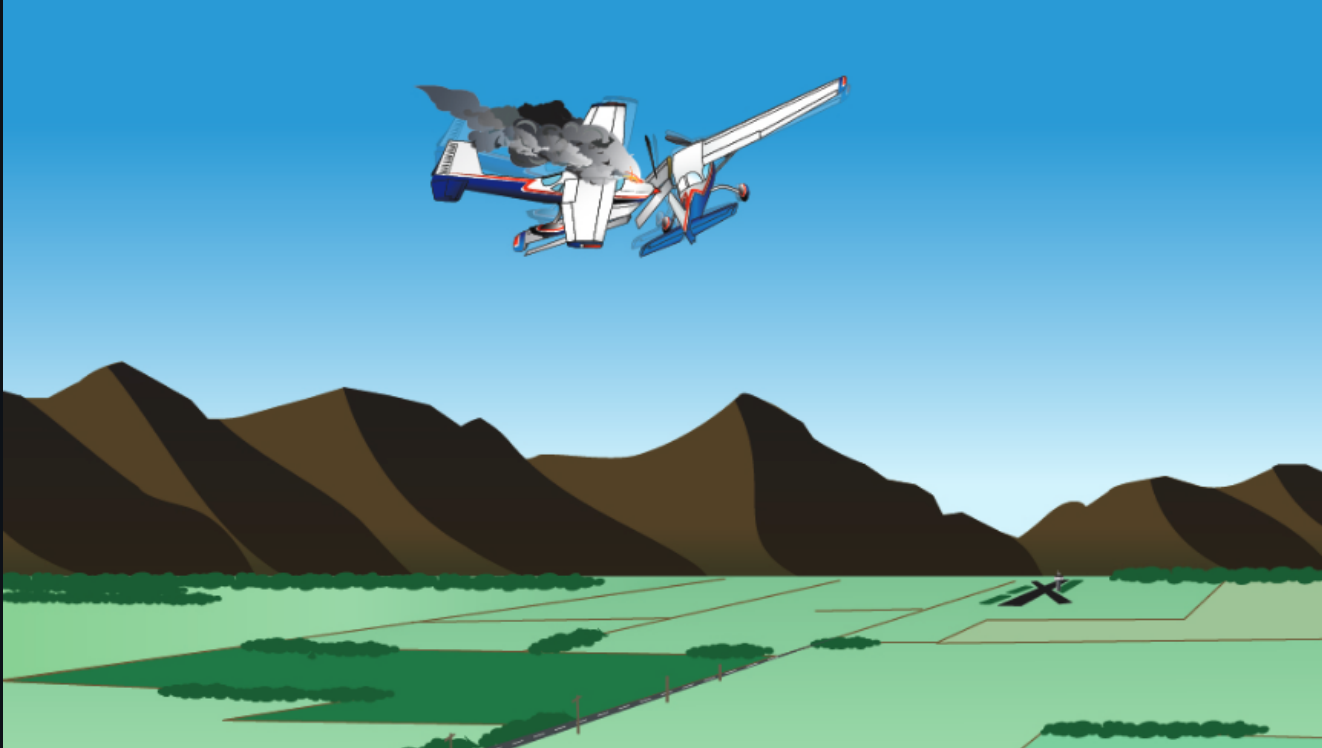


Visual Scanning and Collision Avoidance

Objective / Motivation



We want a *systematic* approach to visual scanning and collision avoidance.

"See-and-avoid" is the primary method by which VFR pilots will maintain separation from other aircraft, so we want effective habits when scanning for other aircraft.

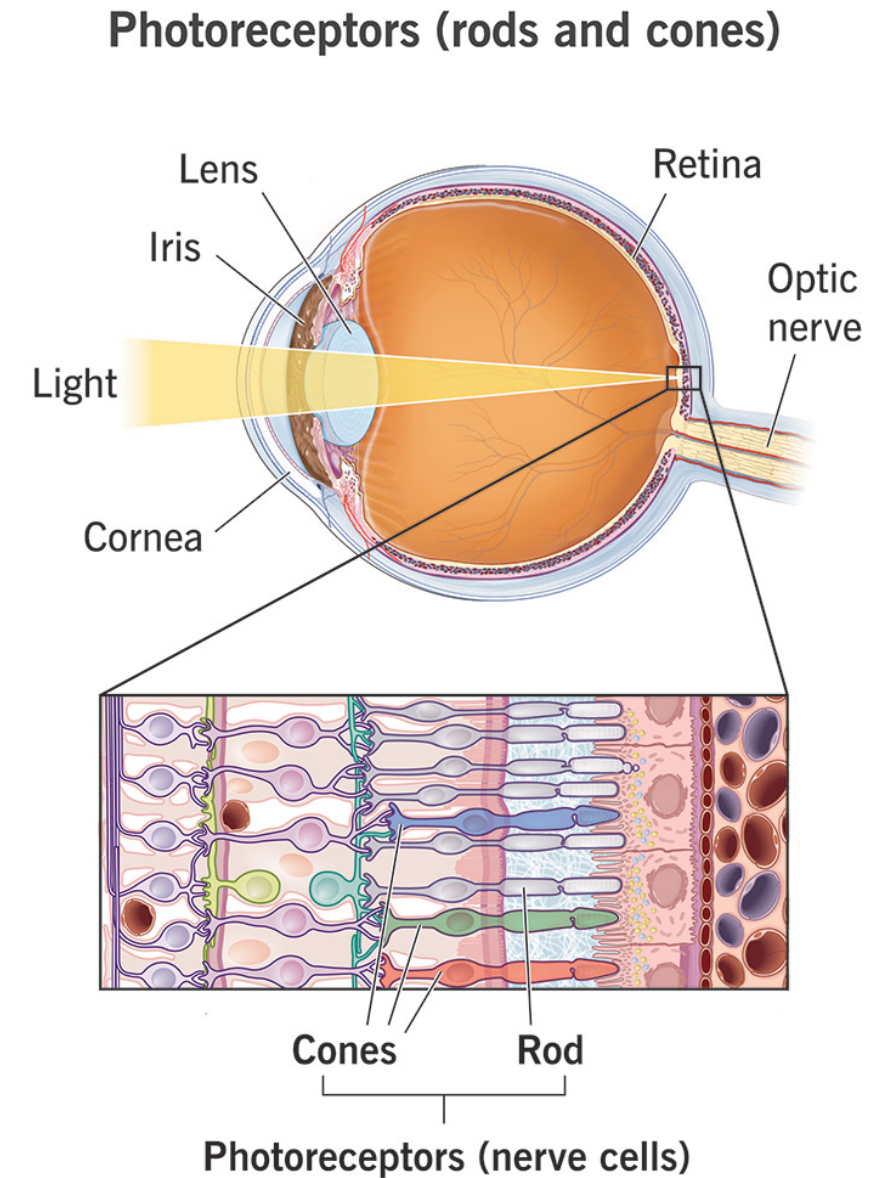
Overview

- Vision system and its limitations
- "See and avoid"
- Scanning techniques
- Collision-course aircraft
- Clearing procedures
- Aircraft blind spots
- Situations with the greatest collision risk
- TIS-B and ADS-B
- Tools for collision avoidance

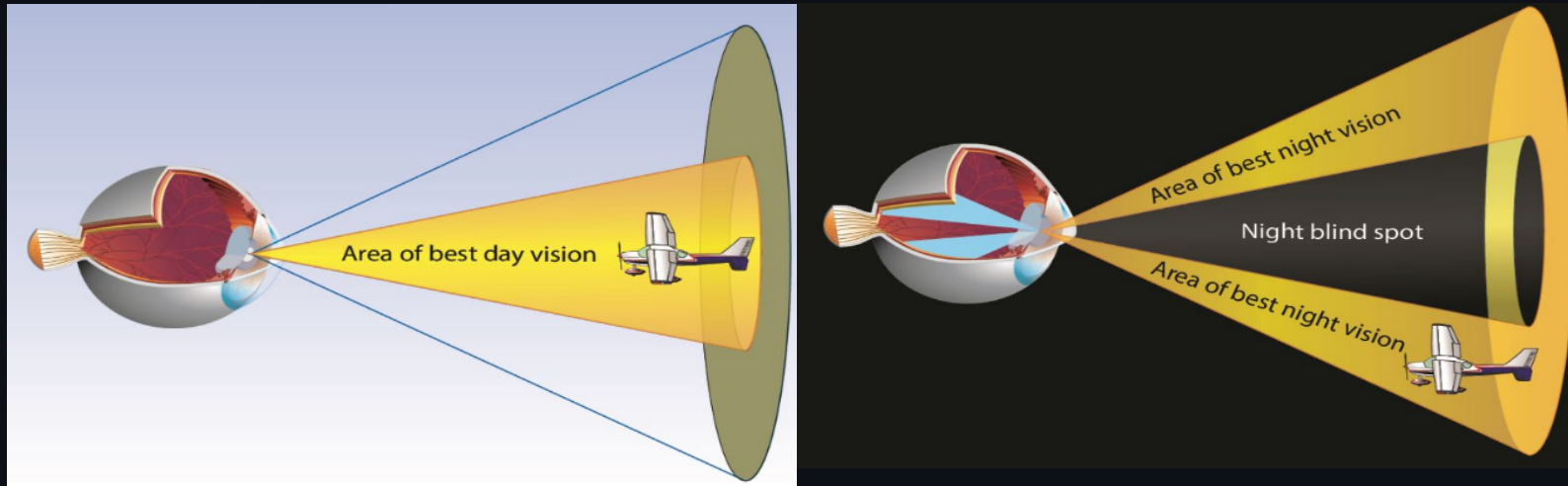
Vision System

Visual receptors in our eyes:

- Cones: Very acute, color, detail, daytime
- Rods: Very sensitive, gray, peripheral, day and night
 - Become deficient with even mild hypoxia



Vision Types



Vision types:

- Photopic vision: Primary central vision - cones
- Mesopic vision: Fading light vision - mix of cones and rods
- Scotopic vision: Dark conditions - rods

Vision System Health

- Good eyesight depends on good health
 - Fatigue, illness, smoking, drugs, alcohol, oxygen deprivation, diet
- Dark adaptation
 - Allow for 30 minutes for eyes to adjust
 - Avoid bright lights
 - Impaired by cabin altitude above 5,000' - Oxygen use recommended at night



Environmental Factors Affecting Vision

- Atmospheric conditions: Fog, haze, clouds
- Glare: Reflection off water or the aircraft
- Lighting: Sun angle
- Windshield deterioration and distortion
- Aircraft design
- Cabin temperature
- Oxygen supply (particularly at night)

Limitations of the Human Eye

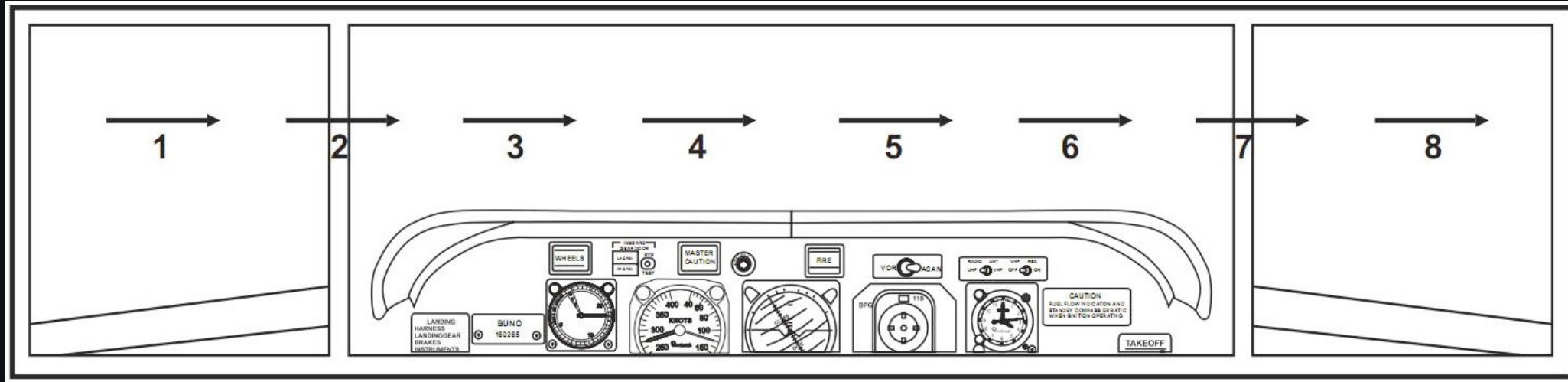
- Accommodation and Refocusing
 - It can take 1-2 seconds for you eye to refocus
- Empty-Field Myopia
 - Eyes tend to not focus when there is nothing to focus on
 - Common on hazy days
- Narrow Field of Vision/Tunnel Vision
 - Our eye can only focus in a narrow center range
 - Particular dangerous when focused on a task
- Binocular Vision
 - Something seen by one eye but not the other
 - Move your head and your eyes

See and Avoid



- "See and avoid" is the main method in which we maintain separation from other aircraft, terrain, and obstacles
- This applies to all aircraft: big and small, slow and fast, VFR or IFR

Scanning Technique



- Pilot should shift glances and refocus at intervals
- Each movement should not exceed **10°** and should last for **1 second**
- Spend 3/4 of of the time with eyes outside the aircraft

Collision-Course Aircraft (The Blossom Effect)



Approximate Distance	View	Approximate Time to Impact
1NM		14 sec.
1/2 NM		7 sec.
1/4 NM		4 sec.
1/8 NM		2 sec.
1/16 NM		1 sec.

Measurements are approximate, based on Transport Canada's *Human Factors for Aviation—Basic Handbook*, P. 79.

- An aircraft on a collision course will appear stationary in the wind screen
- Object will appear approximately on the horizon

Reaction Time

Table 1. Aircraft Identification and Reaction Time Chart

Event	Seconds
See Object	0.1
Recognize Aircraft	1.0
Become Aware of Collision Course	5.0
Decision to Turn Left or Right	4.0
Muscular Reaction	0.4
Aircraft Lag Time	2.0
TOTAL Time Before Aircraft Begins to Move	12.5

- Take action early!
- Even if you're unsure about the collision risk

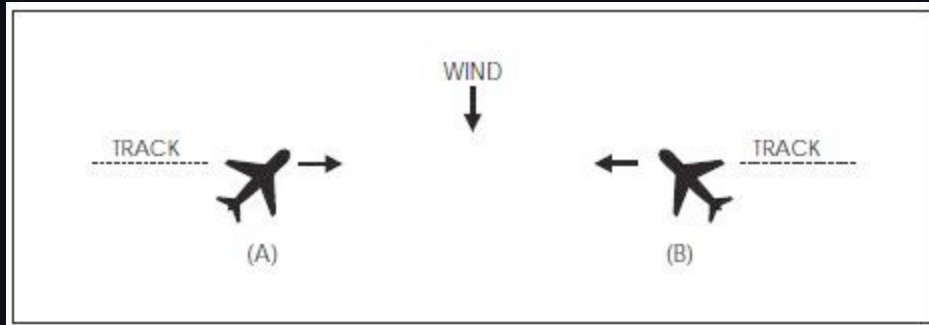


Closure Rate

- Aircraft above the horizon: Probably above you
- Aircraft below the horizon: Probably below you
- Aircraft may not be pointed toward you
- The faster the aircraft the faster the closure rate
 - Why we have bigger weather minimums at higher altitudes

Wind and Closure Rate

Aircraft may not be pointed at each other if on a collision course, due to wind correction angle



Clearing Procedures for Maneuvers

- Clear the area that the airplane is going to maneuver in
- Clearing turns help eliminate blind spots
- Verbalize where you're looking
- Back-up visual scanning with radio calls and ADS-B traffic data (if available)

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Other Scenarios

- Taking a runway: Always check base, final, and the runway
- Climbs and descents: Gentle banks for continuous scanning
- Straight and level flight: Periodically perform clearing turns
- Traffic patterns: Avoid entering while descending
- VOR intersections: Be extra vigilant for other traffic

Preferred Mid-Field Traffic Pattern Entry

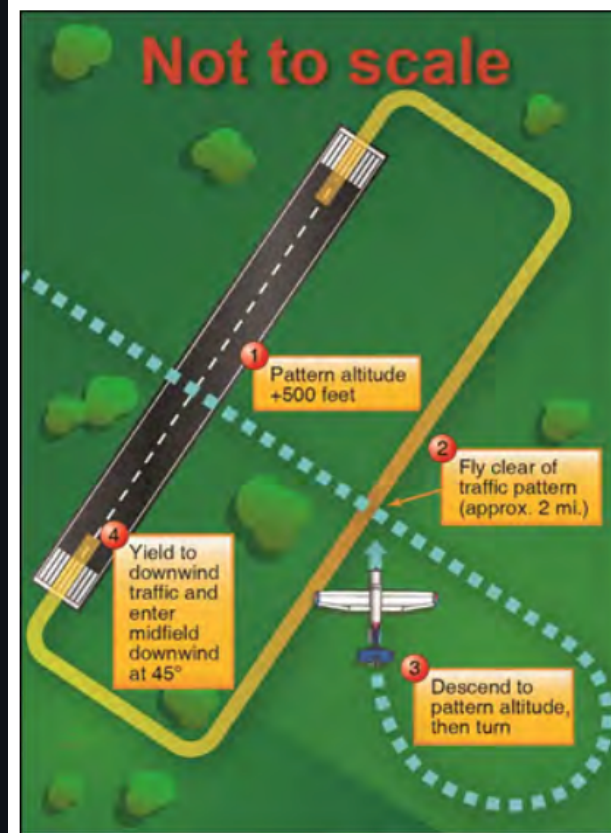


Figure 14-2. Preferred Entry-Crossing Midfield.

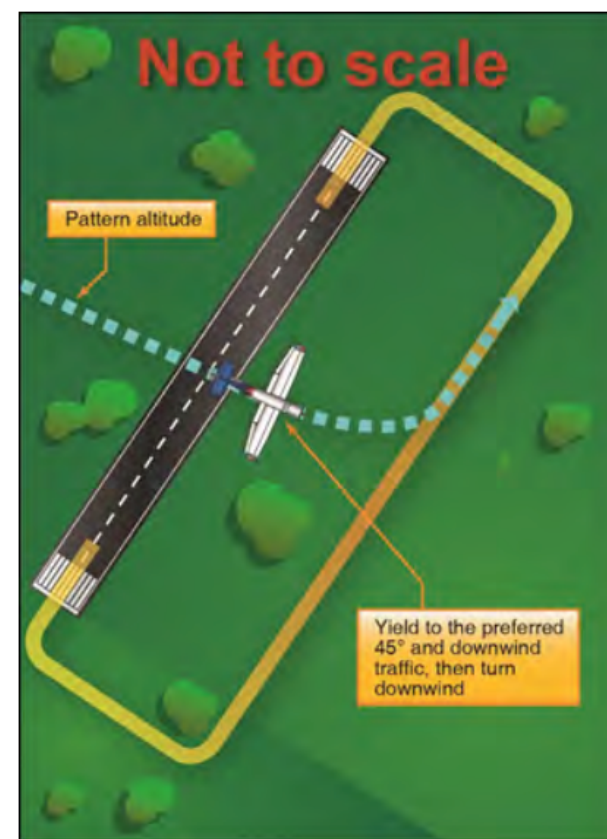
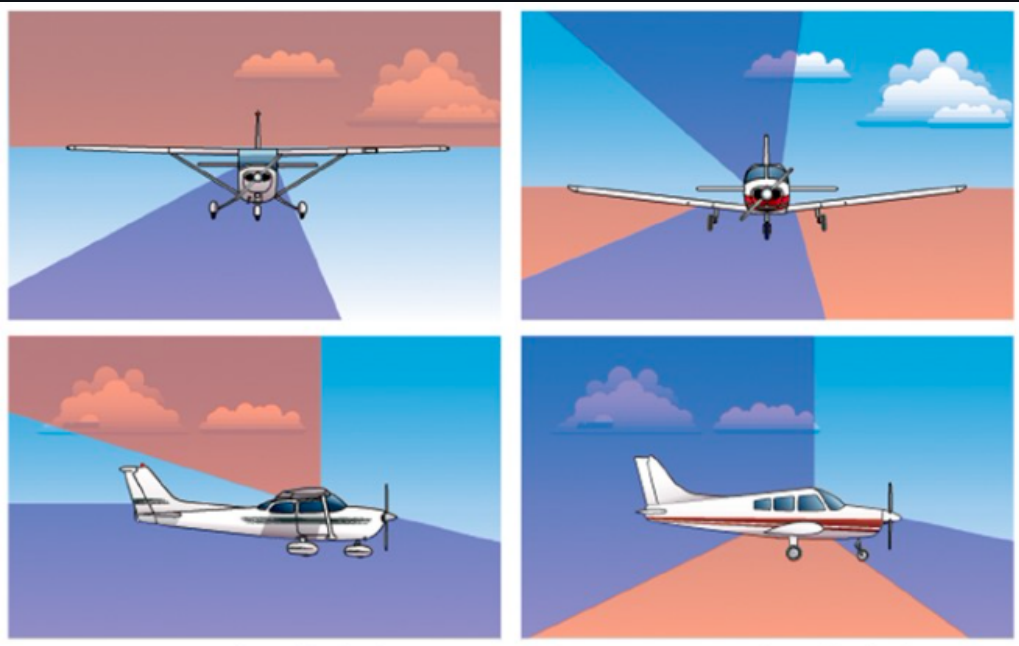


Figure 14-3. Alternate Midfield Entry.



Blind Spots

- High wing airplanes tend to have large spots above the wing
 - A clearing turn should raise the wing
- Low wing airplanes tend to have blind spots below the wing
 - A clearing turn should lower the wing

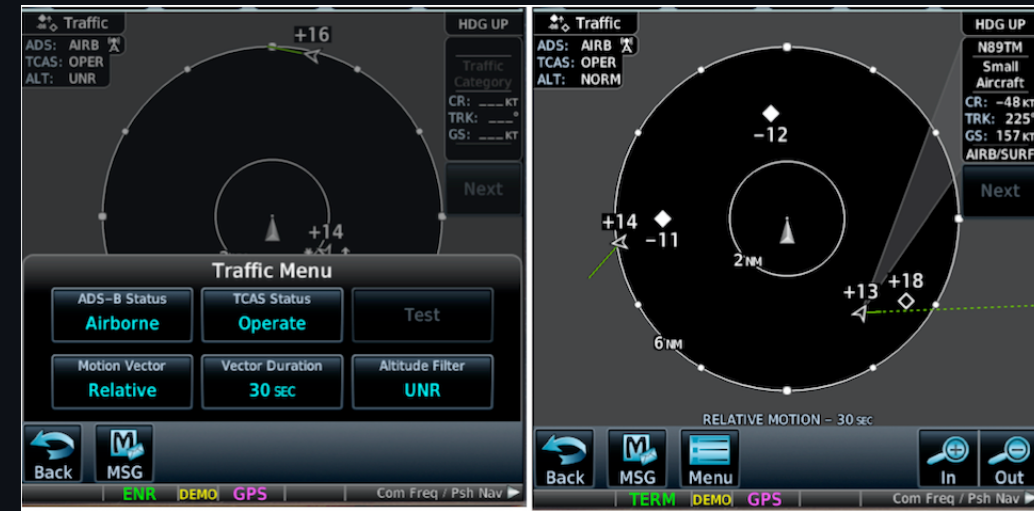
Situations with the Greatest Risk

The NTSB provides statistics on midair collisions:

- VFR, daylight, weekend
- Below 3,000' AGL at uncontrolled airports within 10nm, 8,000' AGL within 25nm
- Great weather
- All pilot skill levels
- Pleasure flight, no flight plan
- Within 5 miles of towered and 10 miles of non-tower airports
- Transitioning to/from the traffic pattern (crossing or overtaking maneuvers)
- Primarily in the traffic pattern

TIS-B and ADS-B

- Traffic Information Service - Broadcast
- Provided by ADS-B uplink
- Some systems provide traffic alerts
- Not all aircraft are equipped with ADS-B
- Traffic information may be old



Operation Lights On

- Pilots are encouraged to turn on their landing lights during takeoff
- Keep your lights on when operating below 10,000 feet, day or night
- Especially within 10sm of an airport

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Summary

- Vision system and its limitations: Night vision, peripheral vision
- "See and avoid": Everyone's responsibility
- Scanning techniques: Small chunks of sky at time
- Collision-course aircraft: Stationary in the windscreen
- Clearing procedures: Clearing turns
- Aircraft blind spots: High-wing vs low wing
- Situations with the greatest collision risk: Day VFR, uncontrolled airports
- TIS-B and ADS-B: Not a replacement for scanning
- Tools for collision avoidance

Knowledge Check

Where should you look when pulling out onto a runway?

Knowledge Check



You're all set to fly on a beautiful sunny day in a low-wing aircraft with a bubble canopy. You get to the airport and realize you've forgotten your sunglasses. What do you do?

Knowledge Check

What are some reasons why an aircraft would not appear on a ADS-B In display?

Knowledge Check

What is the preferred entry for crossing mid-field and entering the downwind?