# Airport Safety and Pilot Considerations

**Session Time:** Two, 50-minute sessions

## DESIRED RESULTS

### ESSENTIAL UNDERSTANDINGS

Pilots are always required to maintain vigilance outside the aircraft to maintain safe flight.

The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft (FAR 91.3(a)).

### ESSENTIAL QUESTIONS

1. What factors influence flight safety when aircraft are operating near each other?

### LEARNING GOALS

**Students Will Know**

- What wake turbulence is, how it affects flight safety, and avoidance procedures
- Methods for avoiding aircraft collisions

**Students Will Be Able To**

- *Identify* the *causes* and *effects* of wake turbulence. [DOK-L1]
- *Identify* ways aircraft can avoid collisions. [DOK-L1]
- *Explain* how to scan for traffic. [DOK-L2]

## ASSESSMENT EVIDENCE

**Warm-up**
Students practice giving a clock, distance, and altitude reference for several objects arrayed throughout the classroom.

**Formative Assessment**
Students work in groups with model airplanes to determine how closely aircraft can follow each other and explain possible limitations on aircraft proximity.

**Summative Assessment**
Students individually answer questions on all major topics presented in this lesson. Questions are provided on a student activity worksheet.

## LESSON PREPARATION

### MATERIALS/RESOURCES

- Airport Safety and Pilot Considerations Presentation
- Airport Safety and Pilot Considerations Student Activity 1
- Airport Safety and Pilot Considerations Student Activity 2
- Airport Safety and Pilot Considerations Student Activity 3
- Airport Safety and Pilot Considerations Student Activity 4
- Airport Safety and Pilot Considerations Teacher Notes 1
- Airport Safety and Pilot Considerations Teacher Notes 2
- Airport Safety and Pilot Considerations Teacher Notes 3
- Airport Safety and Pilot Considerations Teacher Notes 4

**Warm-Up (per class)**

- Table
- Large piece of white paper
- Model airplane
- Classroom props (to be used as "targets" in students identifying traffic)

**How Close Can They Follow?: Student Activity 2 (per class)**

- Table
- 4 model airplanes, ranging in size

**Create Your Own Vortices: Student Activity 3 (per group)**

- 1 roll of aluminum foil
- 1 meter stick
- 2 cones (any sturdy material), one 6" tall and the other 12" tall
- 2 model airplanes of different size
- 1 roll of Scotch tape

## LESSON SUMMARY



**Session 1** of the lesson begins with a brief review and warm-up where students identify the location of specified objects around the classroom relative to a central reference point. Students provide clock position, location, and altitude information in relation to the reference point.

In Part 1 of Student Activity 1, the teacher and students go outside and scan the sky for air traffic. Students will call out any aircraft they see, using the clock, distance, and altitude system to report traffic. Back in the classroom, students will discuss the system or technique they used to scan the sky.

Part 2 of Student Activity 1 will immediately follow. In this activity, students will examine an image from the *Where's Waldo?* series of books and try to find Waldo. After a few minutes, the teacher will lead a classroom discussion on what techniques the students used to locate Waldo. Did they skim? Scan? Look for patterns? Randomly search? Did they use a system?

Students will then explore a series of slides detailing the FAA-recommended method for searching for air traffic in flight. Students will view a video by AOPA and will discuss why the method the FAA suggests is better than a random search technique.

The session will continue with a discussion of midair collisions, including where they are most likely to occur and what environmental, aeronautical, and aircraft design factors can increase the risk. Techniques and practices for minimizing the chance of a collision between aircraft, both on the ground and in flight, will be discussed.

Session 1 will end with a brief activity in which students will speculate about the amount of separation between aircraft that is necessary for safety.

**Session 2** begins with a brief review of the material covered in Session 1. Several slides and two videos introducing the concept of wake turbulence will then be presented, detailing its causes and the effects aircraft experience when exposed to another aircraft's wake. The emphasis will be on the potential dangers of wake turbulence, where and under what circumstances wake turbulence can be most hazardous, and strategies for wake avoidance.

Student Activity 3 calls for students to create simulated wingtip vortices using aluminum foil. They will create vortices of various sizes, simulating the various levels of turbulence produced by aircraft of different weights and sizes. The teacher will present a series of scenarios involving wake turbulence, as described in the Student Activity 3 worksheet, and lead a classroom discussion on the effects of wake turbulence and avoidance strategies for pilots.

Finally, students will answer questions drawn from the FAA Private Pilot Knowledge Exam and complete a **Summative Assessment** to demonstrate their knowledge of the material presented in this lesson.

## BACKGROUND

The sky is big. Aircraft are small. That aircraft might collide with one another in a big sky seems unlikely, yet it can still happen—particularly in busy airspace where numerous aircraft converge. Pilots and ATC alike bear responsibility for preventing midair collisions, and both have strategies and technologies to help them.

For pilots, the principle underlying midair collision prevention is "see and avoid." When flying in good weather known as visual meteorological conditions (VMC) under visual flight rules (VFR), it is the pilot's responsibility to spend the majority of his or her time looking out the window and scanning for traffic. The FAA has researched the best way to scan the sky for other aircraft and has developed a technique to maximize the efficiency of this search. Pilots are trained to use this technique when searching for traffic. Although radar and ADS-B technology can also provide important information to pilots, the principle of "see and avoid" remains the primary doctrine in collision avoidance.

Midair collisions aren't the only risk to pilots operating in close proximity to other aircraft. The disturbance of the air as an airplane passes through it can also create a danger. If a pilot passes through the "wake" of another aircraft, the turbulence experienced could make it difficult or, in some cases, impossible to control one's aircraft. These turbulent wakes are invisible, but pilots are trained to anticipate their strength and location and to take steps to avoid coming into contact with them. For example, pilots learn that heavy aircraft create the largest wakes and that the most dangerous location to encounter a wake is when a following an aircraft is low to the ground, such as during takeoff or landing. As a risk management tactic, pilots are trained to delay their takeoff or landing if a significant wake is possible, or to maneuver their aircraft in a manner that avoids the risk of a wake turbulence encounter. Although pilots are primarily responsible for the safety of their flight, ATC is charged with advising pilots of the possibility of significant wake turbulence if heavy aircraft are operating in the vicinity.

## MISCONCEPTIONS

Many people believe that airplanes can fly near each other without consequences. In this lesson, students learn how much aircraft disturb the air behind them (their wake), and how invisible eddies called wingtip vortices can endanger nearby aircraft.

In addition, many people think that because the sky is so large, there is plenty of room for all aircraft and little danger of collisions. Although the “big sky theory” holds in many cases, it breaks down in areas where aircraft congregate, such as airports, navaids, and waypoints. Additionally, the precision of GPS and autopilot technology means that aircraft are more likely to be flying very close to the center of established routes in the sky. Earlier forms of navigation along these “airways” were not as precise, so aircraft were less likely to be near each other along a particular route.

Another misconception is that ATC, with its radar and ADS-B capability, maintains primary responsibility for collision prevention by vectoring aircraft around one another or, at a minimum, by calling out traffic to pilots so they may narrow their visual search field. This is not the case. When the weather is good and pilots can see out the window, primary responsibility rests with the pilot, not with ATC. ATC can assist pilots, but “see and avoid” remains the basic principle behind collision avoidance.

## DIFFERENTIATION

To engage struggling learners during the **EXPLAIN** section of the lesson plan, have students take notes after watching the videos, with emphasis on capturing information about wake turbulence and vortices.

So that students can continue to check their understanding, increase their engagement, and build confidence before getting to the EVALUATE section of the lesson plan, have students conduct a Think-Pair-Share after completing **Airport Safety and Pilot Considerations Student Activity 3** at the end of the **EXTEND** section of the lesson plan instead of just a class-wide discussion.

# LEARNING PLAN

## ENGAGE

**Teacher Material:** [Airport Safety and Pilot Considerations Presentation]

**Session 1**

**Slides 1–3:** Introduce the topic and learning objectives of the lesson.

**Slide 4:** Conduct the **Warm-Up**.

**Warm-Up**

Set up a table in the middle of the room with a 4  3 sheet of white paper on top. Place one model airplane in the center of the table to serve as a focal point to simulate a pilot seated in a cockpit. Write the four directions of the compass on the paper around the airplane (N-E-S-W) and place various objects on the table and at different distances and heights above the table and around the room. Present a list of these objects to students on the board (or on a sheet of paper). The goal is for the students to give a clock, distance, and altitude reference for the objects in relation to the model airplane on the table.

**Variation:**

Act as ATC and call out objects on the table or around the room as “traffic” using the clock, distance, altitude system of reporting; for example: “Scissors at 10 o’clock, five inches, same altitude.” Students should respond by looking in the correct direction, identifying the object, and saying, “scissors in sight.” You can also call out an object that is not in the room, in which case the students would respond with, “Looking.” You can repeat this procedure for other objects on the table or around the classroom (for example, flag, object on the blackboard, door handle, student wearing blue sweater).

## EXPLORE

**Teacher Materials:** Airport Safety and Pilot Considerations Presentation, Airport Safety and Pilot Consideration Teacher Notes 1
**Student Material:** Airport Safety and Pilot Considerations Student Activity 1

**Slide 5:** Inform students that they will be shown an image with many objects in it. You will tell them to find a particular object in the image. Advance to the next slide for a full-size version of the image. Tell the students they will have 60 seconds to find an object you name. You may choose to amend the time as you see fit. Give a "Ready, set, go!" and proceed to Slide 6.

**Slide 6:** Full size version of image to search. Advance to Slide 7 when time is up.

**Slide 7:** Ask students to share with the person next to them their answers to the questions on screen. Ask students to record their answers on the **Airport Safety and Pilot Considerations Student Activity 1** paper. Select a few students to share their responses with the class. You may choose to select a new object and return to the image so students may try a new technique. This is a great option after Slide 9 where a segmented scanning technique is presented. Possible answers can be found in **Airport Safety and Pilot Consideration Teacher Notes 1**.

**Note:** If you are in an area where students are likely to see aircraft in the sky, consider going outside or looking out the window and doing the **GOING FURTHER** section of the activity, which is optional.

## EXPLAIN

**Teacher Materials:** Airport Safety and Pilot Considerations Presentation, Airport Safety and Pilot Considerations Teacher Notes 2
**Student Material:** Airport Safety and Pilot Considerations Student Activity 2

**Slide 8:** Pilots following visual flight rules (VFR) are always responsible for seeing and avoiding other traffic in the air. Although ATC can alert pilots to potential traffic conflicts, it remains the pilot's primary responsibility to see and avoid other aircraft.

This can be difficult, even for the most experienced pilots. Keeping a sharp and attentive eye out for other traffic is critical to minimize the risk of midair collisions, and most pilots take advantage of the flight following services available from ATC in many areas. Avoiding complacency requires constant vigilance and a professional attitude in the cockpit.

- "Collision Avoidance: See, Sense, Separate" (Length 2:33
  https://video.link/w/oq1v

  For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/embed/NQrzrNkmUzs?start=180&end=333

**Slide 9:** In the past, pilots developed their own methods for scanning the skies for other aircraft. Most of these methods were disorganized, haphazard, and often ineffective.

The FAA and other organizations have done extensive research into the most effective methods for scanning the sky and have determined that the best way to look for traffic is to concentrate on small segments of the sky and to focus intensely on each segment for at least 1 second before moving on to the next segment. The eye is very sensitive to movement, and this technique provides the best opportunity for detecting aircraft that may be maneuvering nearby.

The FAA recommends scanning from the 10 o'clock position to the 2 o'clock position because aircraft operating in these areas present the greatest collision threat. Focusing on the 10 o'clock area for 1–3 seconds, moving to the right in 10-degree steps until reaching the 2 o'clock position, and then starting over has been shown to be the most effective technique in finding potentially conflicting traffic.

**Slides 10-11:** Tell students that most midair collisions occur during the day in good weather. Discuss possible reasons for this as a class.

**Questions**

Why do most midair collisions occur during the day in good weather?

*Possible answers: There are more planes flying during these conditions, pilots feel safer because of good weather and may not be as vigilant, pilots may be looking at instruments rather than out the window for traffic, sun glare may affect a pilot's ability to see other aircraft, or many more aircraft are out on good weather days increasing the risk of a collision—especially around airports.*

What factors can affect pilots' ability to see other aircraft?

*Possible answers: Failure to look outside, poor visibility due to haze, smoke, glare, dirty windows, bugs on windshield, and so on.*

How can aircraft design affect pilots' ability to see other aircraft?

*Low wing aircraft have a blind spot below the wings, while high wing aircraft have a similar blind spot above the wings. When a low wing aircraft descends into a high wing aircraft, neither pilot can see the other aircraft due to these blind spots.*

**Slide 12:** There are several things pilots can do to reduce the risk of a midair collision. First, pilots should scan the airport area and traffic pattern prior to takeoff to make sure no other aircraft are crossing the runway on the ground, are on the base leg, or are on final approach to land.

When climbing and descending, pilots should make gentle turns left and right to increase their field of view and to make sure no other aircraft is above or below them. They should also scan the sky in 10-degree segments during climbs, descents, and straight-and-level flight, and always be on the lookout for slower traffic ahead.

**Slide 13:** Complying with conventional and published traffic pattern procedures can also reduce collision risk. Watch for traffic on the 45-degree entry to downwind, as well as on all legs in the pattern. Keep an eye out for pilots who may not be flying proper patterns, may be flying on the wrong side of the runway, or may be setting up to land on the wrong runway. All of these things happen, and all contribute to midair collision risk.

When maneuvering, it's always a good idea to do clearing turns. Always clear in all directions, not just the direction of turn.

Pilots should be especially vigilant when operating in areas where aircraft congregate, such as airports, VORs, and waypoints. These are locations where aircraft come together to take off, land, or navigate, and the concentration of air traffic can be much greater in these areas than anywhere else. Pilots should "keep their head on a swivel" when operating in these high-traffic areas.

**Slide 14:** Complete the **Formative Assessment**.

**Formative Assessment**

Provide students with **Airport Safety and Pilot Considerations Student Activity 2**. Students will use what they have learned thus far in the lesson to complete the activity. Correct answers are provided in the **Airport Safety and Pilot Considerations Teacher Notes 2** document. After students complete the activity, moderate a class discussion of students' answers.

[DOK-L2; *explain*]

**Session 2**

**Slide 15:** Lead a brief class discussion, posing this thought exercise for students:

*Imagine for a moment that you realized that you were directly behind a large aircraft, like a passenger jet. Does it matter? Should you move out of the way? Why or why not?*

*Possible student responses: The jet blast would slow us down; the jet blast would bounce us around; it would be smoother since the bigger plane pushed away air; it would be turbulent because when something big moves through the air it disturbs the air. Some students may relate this scenario to being passed by a large truck on a highway. Sometimes, one's car is buffeted by the air pushed aside by the large truck.*

**Slide 16:** Objects passing through fluids, such as air or water, create a disturbance behind their direction of travel. This disturbance is called a wake, and it can have serious implications for flight.

Boats create a wake in the water as they move forward. Large boats create bigger wakes because they are heavier and displace more water as they travel. Boats designed to create large wakes, such as those used in wakeboarding, are designed with ballast in the back to push the stern down and create a large displacement, especially when moving relatively slowly.

Because air is fluid, airplanes also create a wake as they fly. Like boats, heavier aircraft create bigger wakes than lighter aircraft, and aircraft generate the largest wakes when they are slow and at high angles of attack. The wakes from aircraft are created by a circular rotation of air as it trails off the wingtips, similar to the ribbons in this video. These are called wingtip vortices.

- https://drive.google.com/open?id=17obyU2pxyrce3Uhmqm7PSDWqMn1iSwS8

**Teaching Tips**

In addition to showing the video, you can demonstrate the appearance of wingtip vortices with long, light Caution tape or fabric.

**Slide 17:** Strong wakes can be very dangerous to aircraft following behind because the circular rotation of air can impact an aircraft that is following too closely and turn it over, or cause its pilot to lose control. To prevent a dangerous wake encounter, pilots are trained to visualize where a strong wake could be so that they can maneuver their aircraft to avoid vortices.

Wingtip vortices are generated whenever an airplane is creating lift. They present as tornado-like currents of air that move in a circular motion directly behind each wingtip. Small, light aircraft generate relatively minor vortices that are not dangerous to other aircraft. Larger, heavier aircraft, however, can create dangerously powerful wingtip vortices, and pilots must be extremely careful to avoid flying too closely to these aircraft.

**Slide 18:** Recall that there is a high-pressure area beneath the wing and low pressure above the wing during lift creation. At the wingtip, where the two pressure areas come together, air flows from the high pressure (below the wing) to the low pressure above the wing, forming a circular flow of air. This circular flow generates the vortices. These vortices can be very weak, as with small, lightweight airplanes, or extremely strong, as with large transport category aircraft.

Several factors influence the strength of the wingtip vortices. For example, the heavier the airplane, the stronger the wake. Additionally, slow-moving airplanes create stronger wakes than airplanes at cruise speed. This is because higher angles of attack result in stronger vortices (there is a stronger difference between low and high pressure around the wing with high angles of attack), and flying slowly typically requires a higher angle of attack. Similarly, because flying slowly without flaps typically requires a higher angle of attack, clean aircraft configurations (no flaps) tend to create greater vortices. So, the strongest wakes are produced by airplanes flying heavy, slow, and clean (flaps up).

**Slide 19:** Whenever air passes over an object, swirling masses of air form at the tips or ends. All surfaces that generate lift also generate these vortices behind the surface.

Aerodynamically engineered wings are obvious producers of vortices, but even simple flat objects, such as a piece of flat metal, will generate tornado-like currents at their tips. In the following video, a professor demonstrates this:

- "Wingtip Vortices" (Length 1:01)
  https://video.link/w/5Ofr
  For teachers who are unable to access Safe YouTube links, the video can also be found here:

https://www.youtube.com/watch?v=id_DUwH6Zag

In this example, note how the air passing over the metal strip causes the small propeller blades to turn *only at the tips*, not in the center. This is because the swirling air at the tips of the "wing" rotates the propeller. Because there are no vortices in the center of the strip, no force acts on the propeller to cause it to rotate. Note: Watch the propeller rotation carefully. Do they rotate as expected?

**Slides 20-21:** Vortices can be dangerous to other aircraft, but they behave in predictable ways. Pilots can anticipate their location and take steps to avoid them. For instance, vortices always form behind large aircraft and spread outward and downward, away from the wings or other lift-producing surfaces. Vortices also get deflected by the wind, so pilots need to understand both how vortices behave and the current conditions to avoid contact with another aircraft's vortices. As a rule, pilots fly at the same altitude, or higher, and upwind from the vortices-generating aircraft to ensure they avoid the turbulence-inducing vortices.

- "All You Need to Know About Wake Turbulence" (Length 6:34)
  https://video.link/w/uMfr

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=qMpNThOKTuE

**Slide 22:** Wingtip vortices and the turbulence they create are most hazardous in the terminal area—that is, where aircraft are operating near each other and close to the ground, as during takeoff and landing. Large, heavy transport airplanes produce the most powerful wakes, so it is vital that pilots operating in these terminal areas maintain a keen awareness of the wakes nearby aircraft are producing and take steps to avoid the turbulence those wakes cause.

As students view the following video, you can highlight these segments:

1:15–1:51: Vortices seem tiny, but wait!
3:13–3:33: Excellent view of the size and flow pattern of passenger jet vortices.

3:40-4:29: Flaps are lift-producing surfaces also. Watch the vortex off of this plane's left flap.

5:12–5:25: Propellers are just small wings, and they make interesting vortex patterns.

5:34–6:00: A classic and clear visualization of what wingtip vortices' size and what they can do. If you only show one segment, show this one.

- "Planes, Clouds, and Vortices" (Length 6:39)
  https://video.link/w/hbgr

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=dfY5ZQDzC5s

**Slide 23:** Although the most powerful wake turbulence is caused by heavy airplanes flying slowly, large aircraft traveling at cruise speed—several hundred miles per hour—continue to generate significant wingtip vortices and turbulence. Pilots of aircraft in cruise at altitude must maintain a strong awareness of possible wake turbulence, especially when flying behind a large aircraft or along heavily travelled airways and routes.

**Slide 24:** Avoiding wake turbulence is a primary responsibility of both ATC and pilots. Both share the obligation to take the necessary steps to remain clear of any wingtip vortices larger aircraft produce. For example, ATC will advise pilots of aircraft flying behind larger airplanes by saying, “Citation 2341 Echo, runway three-two right, cleared to land, CAUTION WAKE TURBULENCE, Boeing 737 short final.” The phrase “Caution wake turbulence” can be used in advisories or clearances during takeoff, during landing, and en route.

During takeoffs behind large airplanes, pilots are trained to wait at least two minutes before departing. Once the decision to takeoff is made, pilots observe the point on the runway at which the leading aircraft gets airborne. The wingtip vortices begin at the point where the weight of the airplane is shifted from the wheels to the wings—that is, the point of takeoff. Pilots are cautioned to make sure their point of takeoff is *before* the heavy airplane’s point of takeoff so they do not fly through a wake. They may also turn soon after takeoff to avoid the leading airplane’s vortices during climbout.

Pilots should be especially aware if there is a light quartering tailwind because this condition can cause one of the wingtip vortices to remain near the runway for longer than normal. In these cases, pilots should add another two minutes to their wait time before starting their takeoff roll.

When landing, pilots should observe where a large airplane in front of them touches down on the runway. Once the weight of the airplane is shifted back to the wheels, the wake turbulence will stop, so pilots will remain on a higher glidepath when approaching the runway and will land *beyond* the large aircraft’s point of landing. All this is done to prevent flying through the glidepath of a large airplane.

Pilots must develop a mental “picture” of where a large airplane’s wake begins and ends, and must also keep in mind that the wake is spreading outward from the wingtips and descending. Avoiding strong wakes is a skill developed early in pilot training.

**Slide 25:** Wake turbulence is not only a danger during takeoff and landing, but can also create hazards in the en route segment of flight. Although wakes are not as powerful during cruise flight as they are during takeoff and landing, pilots are encouraged to take precautionary steps to avoid wake encounters, even when cruising at altitude.

For example, remaining at least five miles behind large aircraft is a good safety measure. Pilots should stay mindful that vortices travel with the wind and descend, so maintaining awareness of where and how fast a wake is sinking can help keep aircraft safe. Where it is impractical to maintain five miles of separation, flying slightly above a leading airplane or slightly upwind of its flightpath can also provide good separation from vortices.

**Slide 26:** There are other considerations in avoiding wake turbulence. For instance, wakes drift with the wind, and at airports with multiple runways, the wake can move outward and affect takeoffs and landings on nearby parallel runways. Similarly, wakes can linger over crossing runways and affect traffic, often to the surprise of unsuspecting pilots whose focus was on departing and arriving traffic on their runway. Pilots must have a broad situational awareness when operating at airports that serve large airplanes.

Pilots landing can often lose sight of traffic they’re following and often can’t tell where the touchdown point was. In these situations, it may be best to go-around or to request an extended downwind to give the wake more time to dissipate.

Most of all, pilots must not get impatient when taking off or landing. Waiting an extra minute or two to take off or land will not put the flight significantly behind schedule, but it can avoid an unpleasant encounter with a strong wake and improve flight safety.

## EXTEND

**Teacher Materials:** Airport Safety and Pilot Considerations Presentation, Airport Safety and Pilot Considerations Teacher Notes 3
**Student Material:** Airport Safety and Pilot Considerations Student Activity 3

**Slide 27:** Provide students with **Airport Safety and Pilot Considerations Student Activity 3**. Students will use what they have learned about wingtip vortices to model vortices on aircraft of various sizes and use their models to draw conclusions about the characteristics of vortices and safety measures to avoid them. Correct answers are provided in the **Airport Safety and Pilot Considerations Teacher Notes 3** document. After students complete the activity, moderate a class discussion of students' answers.

## EVALUATE

**Teacher Materials:** Airport Safety and Pilot Considerations Presentation, Airport Safety and Pilot Considerations Teacher Notes 4
**Student Material:** Airport Safety and Pilot Considerations Student Activity 4

**Slides 28–41:** Sample Private Pilot Knowledge Exam questions.

**Slide 42:** Conduct the **Summative Assessment**.

**Summative Assessment**

Provide students with **Airport Safety and Pilot Considerations Student Activity 4**. In this activity, students will demonstrate their retention of the material presented in this lesson by answering a series of written questions in multiple choice, short answer, and long answer forms. Correct answers are provided in the **Airport Safety and Pilot Considerations Teacher Notes 4** document. After students complete the activity, moderate a class discussion of students' answers.

[DOK-L2; *explain*, DOK-L1; *identify*]

**Summative Assessment Scoring Rubric**

- Follows assignment instructions
- Postings show evidence of one or more of the following:
  - Understanding of collision avoidance principles
  - Knowledge of recommended scanning technique for searching the sky for traffic
  - Knowledge of locations, conditions, and scenarios where collision risk is the highest
  - Understanding of wake turbulence, its causes and impacts, and pilot techniques for avoiding wingtip vortices from other aircraft.
  - Knowledge of locations and scenarios where wake turbulence could be most dangerous
  - Understanding of relationship between weight, speed and aircraft configuration in estimating the strength of wingtip vortices/wake turbulence
- Contributions show understanding of course of the concepts covered in the lesson
- Contributions show in-depth thinking including analysis or synthesis of lesson objectives

| Points | Performance Levels |
|---|---|
| 9-10 | Demonstrates full understanding of wake turbulence, how it affects flight safety, and collision avoidance procedures. Answers 9-10 questions correctly. |
| 7-8 | Demonstrates sufficient understanding of wake turbulence, how it affects flight safety, and collision avoidance procedures. Answers 7-8 questions correctly. |
| 5-6 | Demonstrates a limited understanding of wake turbulence, how it affects flight safety, and collision avoidance procedures. Answers 5-6 questions correctly. |
| 0-4 | Demonstrates little or no understanding of the lesson objectives. Answers 0-4 questions correctly. |

## STANDARDS ALIGNMENT

### COMMON CORE STATE STANDARDS

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research

### FAA AIRMAN CERTIFICATION STANDARDS

**PRIVATE PILOT**

**IV. Takeoffs, Landings, and Go-Arounds**
**Task A. Normal Takeoff and Climb**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
  - **PA.IV.A.R2d** Wake turbulence
- Skills - The applicant demonstrates the ability to:
  - **PA.IV.A.S6** Clear the area; taxi into the takeoff position and align the airplane on the runway centerline

**Task B. Normal Approach and Landing**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
  - **PA.IV.B.R2d** Wake turbulence

**Task C. Soft-Field Takeoff and Climb Approach and Landing**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
    - **PA.IV.C.R2d** Wake turbulence

**Task D. Soft-Field Approach and Landing**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
    - **PA.IV.D.R2d** Wake turbulence

**Task E. Short-Field Takeoff and Maximum Performance Climb (ASEL, AMEL)**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
    - **PA.IV.E.R2d** Wake turbulence

**Task F. Short-Field Approach and Landing (ASEL, AMEL)**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
    - **PA.IV.F.R2d** Wake turbulence

**Task M. Forward Slip to a Landing (ASEL, ASES)**

- Risk Management - The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
    - **PA.IV.M.R2d** Wake turbulence

REMOTE PILOT

**II. Airspace Classification and Operating Requirements**

**Task B. Airspace Operational Requirements**

- Knowledge - The applicant demonstrates understanding of:
    - **UA.II.B.K1** Basic weather minimums.
    - **UA.II.B.K2** ATC authorizations and related operating limitations.
    - **UA.II.B.K3** Operations near airports.
    - **UA.II.B.K4** Potential flight hazards.
        - **UA.II.B.K4a** Common aircraft accident causal factors

**V. Operations**

**Task A. Radio Communications Procedures**

- Knowledge - The applicant demonstrates understanding of:
    - **UA.V.A.K1** Airport operations with and without an operating control tower.
    - **UA.V.A.K2** The description and use of a Common Traffic Advisory Frequency (CTAF) to monitor manned aircraft communications.

- **UA.V.A.K3** Recommended traffic advisory procedures used by manned aircraft pilots, such as self-announcing of position and intentions.
- **UA.V.A.K4** Aeronautical advisory communications station (UNICOM) and associated communication procedures used by manned aircraft pilots.
- **UA.V.A.K6** Aircraft call signs and registration numbers.
- **UA.V.A.K8** Phraseology: altitudes, directions, speed, and time.

## REFERENCES


FAA Advisory Circular AC90-23G: Aircraft Wake Turbulence
https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_90-23G.pdf

FAA: How to Avoid a Midair Collision
https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6851

AOPA Safety Advisor: Collision Avoidance
https://www.aopa.org/training-and-safety/online-learning/safety-advisors-and-safety-briefs/collision-avoidance

https://www.aopa.org/training-and-safety/air-safety-institute/accident-analysis/featured-accidents/epilot-asf-accident-reports-midair-collision

FAA Advisory Circular AC-90-48D: Pilots Role in Collision Avoidance