# In-flight Weather and Tactical Weather Decision Making

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

## DESIRED RESULTS

### ESSENTIAL UNDERSTANDINGS

Safe and efficient aviation operations require pilots use math, science, and technology.

Pilots must know how to use the weather services that are available to help form an understanding of the weather situation and make better flying decisions.

### ESSENTIAL QUESTIONS

1. What weather resources are available to pilots in the air, and how can pilots effectively use these resources to make tactical weather decisions en route?

### LEARNING GOALS

**Students Will Know**

- The following types of in-flight weather services: Flight Service Stations (FSS), Hazardous In-flight Weather Advisory Service (HIWAS), Air Traffic Control (ATC), Automatic Terminal Information Service (ATIS), Automated Weather/Surface Observing System (AWOS/ASOS), Flight Information Services-Broadcast (FIS-B), commercial satellite weather, and the Next Generation Weather Radar System (NEXRAD)
- The limitations of different in-flight tools and services, such as ATC and NEXRAD
- The Perceive—Process—Perform risk management framework as a guide for in-flight weather decision making

**Students Will Be Able To**

- *List* different in-flight weather services a pilot may use and actions a pilot may take to ensure weather does not adversely affect the flight. (DOK-L1)
- *Use concepts to solve non-routine problems* pilots may be confronted with en route. (DOK-L3)
- *Analyze* weather decision making using the Perceive—Process—Perform risk-management framework. (DOK-L4)

## ASSESSMENT EVIDENCE

**Warm-up**

Students will come up with reasons a pilot may use the listed in-flight weather sources on the "What's the weather out there?" slides. They will also consider what a pilot might do if it is inadvisable to continue the flight, and how to use those same resources in determining an appropriate Plan B.

**Formative Assessment**
Students will view a video overlaying air traffic and weather radar; they will answer questions that require them to consider what weather sources were likely used by the pilots in the video and how the available weather data likely affected the decisions the pilots made.

**Summative Assessment**
Students will watch a video describing an aircraft accident for which weather decision making was a contributing factor. Students will apply the 3P process, first as a group, to evaluate the pilots' decision making, and then individually, to identify key details of available in-flight weather products and their influence on in-flight decision making.

## LESSON PREPARATION

### MATERIALS/RESOURCES

- In-flight Weather and Tactical Weather Decision Making Presentation
- In-flight Weather and Tactical Weather Decision Making Student Activity 1
- In-flight Weather and Tactical Weather Decision Making Student Activity 2
- In-flight Weather and Tactical Weather Decision Making Teacher Notes 1
- In-flight Weather and Tactical Weather Decision Making Teacher Notes 2
- **Internet-capable device for each student, or a classroom overhead display with internet access**

### LESSON SUMMARY

Lesson 1: Preflight Weather Planning
**Lesson 2: In-flight Weather and Tactical Weather Decision Making**

The lesson will begin with students attempting to estimate the weather and evaluating their estimates by referencing reported data. This will lead to a discussion about the importance of in-flight weather analysis on decision making.

During the next part of the lesson, students will learn the capabilities and limitations of FSS, ATC, NEXRAD, and in-cockpit displays with regard to informing the pilot about changing in-flight weather.

Finally, students will apply the 3P model introduced in the previous lesson to the in-flight weather and tactical weather decision-making processes, using the 3P model to evaluate the decision making during a real-world accident caused by weather.

### BACKGROUND

Previous lessons discussed how pilots use available weather information in their preflight planning, which generally focuses on helping the pilot decide whether or not to fly (a "go/no go" decision). Even so, sometimes a pilot may make a "go" decision based on the best available information only to discover, once airborne, that the weather is different or changing. The purpose of this lesson is to describe how to monitor and respond to changing weather conditions during flight, using both pilot observation and in-flight weather resources.

Most importantly, pilots must be proactive as they fly, looking for updated information rather than assuming that everything will be as forecast. They must understand where they can obtain new information, as well as what limitations that information has. Finally, they need to be able to make a reasonable decision with that information, understanding that the pilot-in-command is ultimately responsible for the decision.

## MISCONCEPTIONS

Today, pilots have more weather information immediately available to them than ever before, including in-cockpit displays that show weather in real time. Pilots need to remember, however, that not all the data is live, up-to-date information. Some systems receive weather data after it has been observed, analyzed, and compiled by ground stations—a process that takes time and means the "real time" data is actually delayed. For this reason, unless systems are specifically certified as displaying "live" weather information, in-cockpit information is typically not suited for immediate decision making about hazardous weather (for example, negotiating a path through a line of thunderstorms).

## DIFFERENTIATION

To promote collaboration and engagement in the **EXPLORE** section of the lesson plan, have students complete a Think-Pair-Share when discussing the challenges associated with making a decision to continue a flight after taking off.

To support struggling learners in the **EXPLAIN** section of the lesson plan, have students fold a piece of paper vertically and horizontally, then unfold it, thus making four sections for which they can take notes on the four methods to update weather in flight. Have students note what these four methods are and how they are used. Having these notes can help students feel more confident as they complete the Formative Assessment.

# LEARNING PLAN

## ENGAGE

**Teacher Material:** In-flight Weather and Tactical Weather Decision Making Presentation

**Session 1**

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

**Slides 4-5:** Conduct the **Warm-Up**.

**Warm-Up**

After completing their weather diaries, have students make a list of weather sources a pilot can access in flight to make sure conditions are favorable for continuing the flight. Then have students make a list of the actions they could take to alter a planned flight to reflect changing weather conditions.

The students have been introduced to Flight Service Stations (FSS), Automatic Terminal Information Service (ATIS), Automated Weather/Surface Observing System (AWOS/ASOS), air traffic control (ATC), and electronic flight displays (EFDs), so they may recall these terms to add to their lists.

Additionally, students may offer generic statements such as:
"The pilot could ask the controller about the weather."
"The pilot could use an app."
"They could look at the radar."
"The pilot could land somewhere else where the weather was better."
"The pilot could turn around and go back home."

The video on the following slide will review the names of the weather resources before the students begin to answer the Explore questions.

[DOK-L1; *list*]

## EXPLORE

**Teacher Material:** In-flight Weather and Tactical Weather Decision Making Presentation

**Slide 6:** Remind students that the last lesson focused on preflight weather planning, which is largely concerned with making a "go or no go" decision based on available information. Many times, however, decisions are not clear cut; also, the weather can change in unexpected ways in the time it takes a pilot to reach a destination. This lesson will focus on how pilots monitor and respond to weather changes while in the air, using both observation and in-flight weather sources.

Have the students watch the Air Safety Institute video discussing the importance of in-flight weather awareness:

- "Weather Wise: Awareness Aloft" (Plan to stop the video at 5:14.) https://video.link/w/DVBq

For teachers who are unable access Safe YouTube links, the video can also be found here: https://youtu.be/TMw_K3lYrts (Plan to stop the video at 5:14.)

**Questions**

What are the challenges associated with making a decision to continue or discontinue a flight after you have taken off? What kinds of information would you like to have to help make that decision?

*Answers will vary. The primary challenge might be difficulty in obtaining accurate weather information both for the en route and landing phases of the flight. In most airplanes, the pilot has technological limitations in his ability to access that information directly. Further, it is a challenge for a pilot to obtain the information in a timely manner, since he may not realize he needs new information until he sees an unforecast change in the weather, at which point he is already behind in his now-in-flight planning.*

*Also, the airborne pilot has to fly at the same time he carefully analyzes the changing weather information. The challenge of safely aviating, navigating, and making changes to a planned flight is why some teach that the best decisions are made at "zero knots and zero feet above the ground," in other words, sitting in an airport lounge instead of in a flying cockpit. Even after takeoff, a pilot almost always has the option to land and then reconsider alternative plans for continuing the flight.*

*Information that might help a pilot modify a flight plan includes the most current ceiling, weather, and visibility, the trends in that weather data, and the experiences of other aircraft that have recently flown through the weather on a similar route.*

**Teaching Tips**

Though not directly related to this lesson, other challenges to the decision to continue or discontinue a flight include human factors. For example, a pilot may face "external pressures" like the desire to attend a friend's wedding at the destination—a wedding he may miss if he chooses to divert due to weather. This could potentially influence a pilot to continue a flight that he might have otherwise discontinued.

Other factors may be a bias toward the original weather data and decision ("continuation bias"), overconfidence in the pilot's ability to handle the changing weather, or minimization of the seriousness of the changing weather. These and related factors are discussed in the Pilot's

Handbook of Aeronautical Knowledge, in the context of the FAA's recommended "PAVE" checklist for assessing personal risk. (See the section "E = External Pressures," beginning on page 2-9.) The PAVE checklist will be covered in detail in an upcoming lesson.

## EXPLAIN

**Teacher Materials:** In-flight Weather and Tactical Weather Decision Making Presentation, In-flight Weather and Tactical Weather Decision Making Teacher Notes 1
**Student Material:** In-flight Weather and Tactical Weather Decision Making Student Activity 1

**Slide 7:** This lesson will discuss four methods to update weather in-flight:

- Flight Service Stations (FSS)
- Radio Broadcasts
- Air Traffic Control
- In-Cockpit Displays

Each of these will be covered in more detail in later slides.

**Slide 8:** Flight Service Stations (FSS) can be used for preflight planning, but they are also useful for obtaining updates to weather information during a flight. Pilots can call either the universal Flight Service frequency of 122.2 MHz or a local frequency; local frequencies are printed along the top line of VOR boxes on aeronautical charts and they are listed in the Chart Supplement. FSS can provide airborne pilots with up-to-date versions of the same information they used in preflight planning, as well as any additional weather data or warnings. Flight Service technicians need to know a pilot's type of aircraft, location, altitude, and direction of flight; they can then provide the most current weather and forecasts relevant to the route of flight. FSS can also provide any pilot reports (PIREPs) that have been reported along the route of flight. In addition to asking for information, pilots can also pass their own PIREP to Flight Service, as discussed in previous lessons.

The slide contains an image of a Flight Service Station technician's desk.

**Slide 9:** Pilots may tune their communication (or sometimes VHF navigation) radio to an ATIS, AWOS/ASOS frequency listed in an airport's data block on a sectional chart. These frequencies are also in the Chart Supplement. Listening to the automated weather broadcasts of airports along the route of flight while in the air is a good practice for keeping abreast of potentially changing weather conditions along the route. Monitoring the weather conditions at airports along the route also allows the pilot to know if an airport's weather is suitable for landing if the pilot needs to land somewhere other than the destination airport.

**Slide 10:** Flight Information Services-Broadcast (FIS-B) is a service provided by the FAA. Weather and alerts are broadcast using radio frequencies (978 MHz and 1090 MHz) so reception in properly equipped aircraft is based on line-of-sight principles like communication and navigation radio signals. This means that it may be difficult to receive the data in some circumstances (high terrain for example). Additionally, because of the time required to collect, compile, format, and transmit the data, pilots may be receiving information that is up to 20 minutes old. Some data, such as NEXRAD displays may not be as detailed as those provided by commercial providers. https://www.faa.gov/nextgen/programs/adsb/pilot/#fisb

**Slide 11:** The primary function of Air Traffic Control (ATC) is the safe separation of aircraft. However, when possible, ATC will also provide hazardous weather information and help pilots avoid areas with hazardous weather.

ATC uses radar to track aircraft; these radar systems sometimes have the side effect of displaying weather phenomena like precipitation—some systems can even determine the relative intensity of precipitation. However, controllers cannot tell the type or nature of the precipitation (i.e., snow vs. rain), so it reports all weather returns as "precipitation." The ATC radar also cannot detect other forms of weather like clouds or turbulence, though turbulence is likely to increase with increasing precipitation.

Air Route Traffic Control Centers (ARTCC), otherwise known as Centers, typically use a Weather and Radar Processor (WARP) to display data from Next Generation Weather Radar (NEXRAD) sites.

**Slide 12:** Have the students watch this 2009 video by NOAA, which offers an overview of NEXRAD:

- "NEXRAD: Eye to the Sky" (Length 3:10)
  https://video.link/w/seBq

For teachers who are unable access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=KdKouCnhvPs Plan to stop the playback at 3:10.

NEXRAD is a joint venture between the Department of Commerce, the Department of Defense, and the Department of Transportation. The National Weather Service, Air Force Weather Agency, and the FAA are the controlling agencies.

**Slide 13:** NEXRAD can determine precipitation location and intensity (light, moderate, heavy, and extreme), as well as wind velocity. NEXRAD data can be displayed for up to a 2,000-mile range.

NEXRAD radar can be displayed on some aircraft in-cockpit electronic displays. However, this is not "real-time" data. Besides the initial delay in physical detection, the weather must be processed, compiled, transmitted to central locations, and retransmitted before it can be displayed on a pilot's cockpit screen. Latency—or the delay in the data—is typically around 6 minutes; in extreme cases, however, the data could be up to 20 minutes older than the pilots realize. For this reason, NEXRAD data is considered a "reference only" to what the weather was a few minutes ago. It provides the pilot with awareness, but it does not show what the weather is now. Because the weather may be different now than what a NEXRAD display shows, pilots should not use NEXRAD as a primary means to navigate through severe weather. Similarly, when the Air Route Traffic Control Center (ARTCC) Weather and Radar Processor (WARP) displays NEXRAD data, the data displayed to the controller could be delayed up to 6 minutes.

When WARP is unavailable, another system called the Air Route Surveillance Radar (ARSR) can display "moderate" or "heavy to extreme" precipitation. If ATC is unable to describe the precipitation intensity, controllers will tell pilots "intensity unknown."

**Slide 14:** In addition to providing weather information from radar, when time is available ATC will also pass on the weather reports (PIREPs) from pilots of aircraft that have followed the same route of flight or flown in the vicinity of the route. In this way, controllers have the ability to help pilots understand where clouds and turbulence might be even if they cannot directly detect these weather phenomena.

**Teaching Tips**

Just as ATC radar has the "unintended" capability to detect precipitation, NEXRAD can not only detect weather but also flocks of birds; indeed, NEXRAD's data on birds contains enough detail that scientists can use it to document and monitor migratory patterns. Some air traffic facilities and organizations (like the U.S. military) use NEXRAD data on birds to assess the risk of a bird strike in a particular area, and they broadcast that assessment over ATIS or other ATC frequencies to controllers in the area to help them avoid the hazards associated with a bird strike.

**Slides 15-17:** Many aircraft manufacturers now include the capability to display weather products on Electronic Flight Displays (EFD) and Multi-Function Displays (MFD). These displays give an airborne pilot access to many of the same weather services available while on the ground, including a wide variety of graphical and textual weather data:

- NEXRAD
- METARs
- TAFs
- Surface analyses
- Wind and lightning strikes
- Storm tops and movement
- SIGMETs/AIRMETs
- Freezing levels

EFDs and MFDs put more weather information at the fingertips of pilots than ever before, but access to this information requires pilots to be able to efficiently navigate the technology. Furthermore, because of the inherent delay associated with the in-cockpit display of ground-based weather data, pilots should not rely on them as "real time" information. The weather products shown on the displays are either classified as "current" and tagged with an age (referenced from Zulu and based on how old the information is) or "forecast" and tagged with an expiration time.

**Teaching Tips**

This course does not cover aircraft with onboard weather radar, which is carried by most airlines. Onboard radar is not carried on most small aircraft due to its cost and complexity, though it is available on some advanced aircraft. While pilots should still understand their systems and the limitations of their onboard radar, this type of weather radar does provide near-instantaneous information on the intensity of weather directly off the nose of the aircraft; this data can sometimes be used for weather avoidance and navigation.

**Session 2**

**Slide 18:** Complete the **Formative Assessment**.

**Formative Assessment**

Divide the class into pairs and distribute the worksheet for **In-flight Weather and Tactical Weather Decision Making Student Activity 1**. Have students watch this video of a severe thunderstorm hitting the Memphis, TN, hub of FedEx operations, in 2003, and then answer the questions on the worksheet. Sample answers are provided in **In-flight Weather and Tactical Weather Decision Making Teacher Notes 1**.

- "FedEx Weather Divert" (Plan to stop the playback at 0:49.) https://video.link/w/2wBq

For teachers who are unable to access Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=gIz-9pdzeTs (Plan to stop the playback at 0:49.)

[DOK-L2; *explain, observe*]

## EXTEND

**Teacher Material:** [In-flight Weather and Tactical Weather Decision Making Presentation]

**Slide 19:** The 3P model introduced in the last lesson can be applied to in-flight decision making: pilots should be prepared to **perceive**, **process**, and **perform**.

**Slide 20:** In order to properly perceive the situation pilots must understand the weather circumstances that are impacting their flight. Even with thorough preflight planning, the weather along a route of flight is not always certain. For example, a 300-mile flight could have a two- to three-hour gap between the preflight review of weather for an area and the time when the airplane actually flies through that area. To stay informed about their environment and the potential risks to their flight, pilots must proactively seek updates to weather while airborne. Pilots can update their weather knowledge visually; they can also obtain the in-flight weather products discussed in prior lessons.

The most obvious way for a pilot to stay up-to-date on the current weather is to look outside. The pilot knows what the weather was forecast to be, so observing any unexpected changes should prompt a need to seek more information. Sometimes, isolated storm cells or other localized events can occur without appearing on weather products. Since weather changes rapidly, a pilot must always compare what she sees outside with what other weather products are telling her. Additionally, a pilot may be able to see horizontally that weather is clear at the current altitude and above, but it is often not possible to visually see weather conditions at lower altitudes far away.

Pilots should also continue to monitor in-flight weather sources to stay alert to possible weather changes. Sources discussed earlier in the lesson include Flight Service Stations and Air Traffic Control. In the case of FSS, pilots will need to monitor their location on a navigation chart not only so they can tell FSS their location, but also so they can understand the reference locations (for example, local towns) about which FSS informs them. Pilots can directly contact ATC to ask about weather along their route of flight, or they can simply listen as ATC discusses weather with other pilots in the area. In addition, pilots can reference Electronic Flight Displays if their aircraft is equipped with this technology. Finally, pilots can listen to the current weather broadcasts (e.g., from ATIS/ASOS/AWOS) at the airports along the route of flight to monitor for potential shifts in weather that deviate from the original forecast.

**Slide 21:** In order to process the information, pilots must have the skills to evaluate the impact of weather updates on the safety of their flight. Weather information is only as useful as a pilot's ability to interpret it.

It is not necessarily easy to accurately evaluate weather conditions even when you can see them, but it is a skill that can be developed and improved. Pilots can become more accurate at evaluating the weather by practicing: first by visually interpreting the weather, then by checking their interpretations against actual weather reports. Similarly, it is also useful to note the TAF in the morning and then observe how accurate that TAF was throughout the day. All of these actions will develop a pilot's skills at interpreting weather and understanding weather products.

Weather displays in the cockpit also require interpretation. Pilots can improve their skills in interpreting their in-cockpit displays by having a full understanding of the display system's operations (reading the operations manuals) and using the system often—and, again, comparing it to known data.

**Slide 22:** Pilots must remember that all these weather sources have limitations, including the technology that makes the observations, the time it takes to interpret and report the observations, and the fidelity of the observations to the actual weather. Pilots need to consider:

- Indications of system failure
- Data integrity, or reliability of the information displayed
- The time when the data was published and when it will be updated

- The content and format of the information provided
- The coverage areas of the weather sources

In fact, misinterpreting aircraft systems can be hazardous, particularly if they are used without regard to their limitations. For example, trying to use NEXRAD to fly through a "hole" in a line of thunderstorms may result in the aircraft flying directly through a thunderstorm; because NEXRAD does not update quickly enough, it may not be showing the most up-to-date location of the thunderstorms. Learning to properly operate aircraft systems—including a full understanding of their limitations—is imperative to safe flying.

Learning to properly process audio data is also an important skill. Understanding how weather trends may affect the outcome of a flight is an important part of the Process step. For example, if AWOS/ASOS reports from airports progressively closer to the destination show lower and lower ceilings and visibilities, but the pilot is unable to hear the ATIS at the destination airport, it would be prudent to consult another source such as FSS or ATC and formulate a Plan B in case the deteriorating weather means a safe landing at the original destination is not assured. In another example, without any graphical depictions of weather, a pilot must rely on visualization skills to imagine how movement of a thunderstorm in the vicinity of the destination airport might impact the decision to continue or divert.

**Slide 23:** In the preflight planning process, pilots use weather data and analysis to develop a strategic, "big picture" flying plan. "Strategic" refers to the long-term and overall game plan for performing the flight. While airborne, pilots then use the available weather sources and their own analysis to make tactical weather decisions. "Tactical" refers to very specific, short-term execution. Safe, tactical flying requires pilots to perceive the weather, process the weather's impact on the flight, and then perform the best course of action based on that impact.

Continuously throughout a flight, pilots should:

- Reassess the weather, using both personal observations and available in-flight resources described to get updated information.
- Take action if possibly deteriorating weather is observed; appropriate actions might include contacting Flight Service for more information or diverting to another airport.
- Use ATC to obtain or react to the weather. Ask for help sooner rather than later.
- Never hesitate to ask questions of either Flight Service or ATC if more clarity is required.

Should weather become a factor during the flight, a pilot should be prepared to execute an alternative plan, which might include entering a holding pattern or diverting to another airport with better weather to make a safe landing and let the weather pass. The FAA summarizes this succinctly by saying "If in doubt, wait it out." (See the .pdf How to Obtain a Good Weather Briefing.) Around the hangar, pilots may be heard saying, "It's better to be on the ground wishing you were in the air than in the air wishing you were on the ground."

Remember, the safe operation of the aircraft is ultimately the responsibility of the pilot-in-command, not ATC, FSS, or anyone else.

## EVALUATE

**Teacher Materials:** In-flight Weather and Tactical Weather Decision Making Presentation, In-flight Weather and Tactical Weather Decision Making Teacher Notes 2
**Student Material:** In-flight Weather and Tactical Weather Decision Making Student Activity 2

**Session 3**

**Slides 24-29:** Quiz students on the Private Pilot Knowledge Test questions.

**Slide 30:** Conduct the **Summative Assessment**.

**Summative Assessment**

Distribute **In-flight Weather and Tactical Weather Decision Making Student Activity 2**.

In this summative assessment, students will watch a video re-creating an aircraft accident in which weather was a contributing cause and the pilot failed to adequately perceive, process, and perform to ensure his safety.

Any class discussion of this incident should include the fact that the pilot appears to have known about and used the information sources at his disposal, but his processing and performance did not allow for the safe completion of the flight. The 3P model is important in that even if a pilot perceives and processes the fact that the safe completion of the flight is in jeopardy, the pilot must then perform an action that ensures the safe completion of the flight.

Discussion along those lines may include theorizing whether or not the pilot would have made the same decisions if he had advanced technology such as FIS-B or other EFD weather depictions in the cockpit. Is an accident like this a result of the available technology or pilot actions?

**Resources**

- AOPA Air Safety Institute video titled Accident Case Study: VFR into IMC https://video.link/w/7HLq
  For teachers who are unable access Safe YouTube links, the video can also be found here: https://youtu.be/bLmzy8ZPgtc
- Student response sheets for "Student Activity 2: In-flight Weather Decisions and Impacts"

In small groups, students will apply the 3P model and identify opportunities for the pilot to have used each component of the 3P model.

Individually, students will identify key details about in-flight weather sources used by the pilot and attempt to identify lessons learned.

Sample answers are provided in **In-flight Weather and Tactical Weather Decision Making Teacher Notes 2**.

[DOK-L2; *make observations*, DOK-L3; *investigate,* DOK-L4; *critique*]

**Summative Assessment Scoring Rubric**

- Follows assignment instructions
- Responses show evidence of one or more of the following:
  - Correct application of the 3P model
  - Correct identification of key details of in-flight weather services and their impact on the safety of the flight.
  - Evidence and explanation of the above that demonstrate understanding of the material
- 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 | Correctly understands the 3P model and all or almost all applications of the model to in-flight |

weather analysis and tactical weather decision making. Makes a reasonable application of the model to the mishap, with explanation.
7-8 Correctly understands the 3P model and most of the applications of the model to in-flight weather analysis and tactical weather decision making, with some errors. Makes generally reasonable applications of that information to the mishap flight, with some incomplete analysis or errors.
5-6 Correctly understands the 3P model, with some errors, and makes a reasonable application of the model to in-flight weather analysis and tactical weather decision making, with some errors. Makes generally reasonable applications to the mishap flight, but lacks adequate explanation.
0-4 Provides few, if any, correct interpretations of either the 3P model or the application to in-flight weather analysis and tactical weather decision making, and/or makes poor application of the model to the mishap with inadequate explanation.

## STANDARDS ALIGNMENT

### NGSS STANDARDS

**Three-Dimensional Learning**

- **HS-ETS1-3** - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - None

### COMMON CORE STATE STANDARDS

- **RST.9-10.2** - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.4** - 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 9-10 texts and topics.
- **WHST.9-10.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- **WHST.9-10.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9** - Draw evidence from informational texts to support analysis, reflection, and research.

## FAA AIRMAN CERTIFICATION STANDARDS

### PRIVATE PILOT

The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:

- **PA.I.C.R1** Factors involved in making the go/no-go and continue/divert decisions, to include:
  - **PA.I.C.R1a** Circumstances that would make diversion prudent
  - **PA.I.C.R1b** Personal weather minimums
  - **PA.I.C.R1c** Hazardous weather conditions to include known or forecast icing or turbulence aloft
- **PA.I.C.R2** Limitations of:
  - **PA.I.C.R2a** Onboard weather equipment
  - **PA.I.C.R2b** Aviation weather reports and forecasts
  - **PA.I.C.R2c** In-flight weather resources

**REMOTE PILOT** The applicant demonstrates understanding of:

- **UA.III.A.K1** Internet weather briefing and sources of weather available for flight planning purposes.
- **UA.III.A.K2** Aviation routine weather reports (METAR).
- **UA.III.A.K3** Terminal aerodrome forecasts (TAF).
- **UA.III.A.K4** Weather charts.
- **UA.III.A.K5** Automated surface observing systems (ASOS) and automated weather observing systems (AWOS).

## REFERENCES


Advisory Circular (AC) 00-45J Change 1, “Aviation Weather Services”
Pilot’s Handbook of Aeronautical Knowledge
Aeronautical Information Manual, 10 December 2015.
How to Obtain a Good Weather Briefing (FAA-P-8740-30), available at:
https://www.faasafety.gov/files/gslac/library/documents/2011/Aug/56400/FAA%20P-8740-30%20GoodWeatherBriefing%5Bhi-res%5D%20branded.pdf
“Weather Wise: Awareness Aloft” (Length 5:14), https://video.link/w/DVBq
“NEXRAD: Eye to the Sky” (Length 3:10), https://video.link/w/seBq
“FedEx Weather Divert” (Length 0:49), https://video.link/w/2wBq
FAAST Blast, Week of May 19, 2019 – May 25, 2019, "Hazardous in-flight Weather Advisory Service Sunsets"