Helpful Documents

Session Time: Two, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Comprehensive preflight planning is an integral (and regulatory) component of safety for all flights.

Recording navigation details for reference during a flight allows pilots to monitor their progress effectively.

Pilots rely upon a wide range of printed and electronic resources for flight planning.

ESSENTIAL QUESTIONS

What documentation helps a pilot organize information for a cross-country flight?

LEARNING GOALS

Students Will Know

- How to fill out a VFR navigation log.
- Where to find airport information in the Chart Supplement.
- How to fill out a flight plan form.

Students Will Be Able To

- *Describe* the information a pilot needs to know to fly safely, legally, and efficiently. [DOK-L1]
- *Synthesize* information from aeronautical charts, weather reports, and mathematical calculations to plot and plan a cross-country flight in visual flight conditions. [DOK-L4]
- *Organize* data from flight planning calculations on a navigation log. [DOK-L2]

ASSESSMENT EVIDENCE

Warm-up
Individually, students will collect the necessary information from the VFR sectional chart and Chart Supplement to safely conduct a flight; they will then divide into pairs to compare their responses to see if either missed any important information.

Formative Assessment
In small groups students will brainstorm and recall sources of flight planning information, how the information can be accessed, and how to analyze a flight plan for potential issues discovered in flight.

Summative Assessment
Individually, students will recall key pieces of information about flight planning and the navigation log then apply changes to update a previously planned route.

LESSON PREPARATION

MATERIALS/RESOURCES

- Helpful Documents Presentation
- Helpful Documents Student Activity 1
- Helpful Documents Student Activity 2
- Helpful Documents Student Activity 3
- Helpful Documents Student Activity 4
- Helpful Documents Teacher Notes 1
- Helpful Documents Teacher Notes 2
- Helpful Documents Teacher Notes 3
- Helpful Documents Teacher Notes 4
- VFR Navigation Log
- **E6-B Flight Computer (manual or electronic)**
- **VFR sectional charts for local area (digital or paper)**
- **Chart Supplement for local area (digital or paper)**
- **Plotter**

LESSON SUMMARY

Lesson 1: Plotting Your Course
Lesson 2: Helpful Documents
Lesson 3: VOR and GPS Navigation

The lesson will begin with a warm-up in which students recall and research the information a pilot needs to properly plan for a cross-country flight. The teacher will then lead a class discussion reviewing the students' findings and relevant Federal Aviation Regulations (FARs).

During the next part of the lesson, students will review some key aspects of navigation logs and how to use them during both preflight planning and in flight. The Formative Assessment offers students the ability to demonstrate their knowledge about flight planning resources, in flight information sources, and responses to differences in the actual flight compared to what was planned.

Finally, students will complete a navigation log, account for inflight changes, and then demonstrate in a summative assessment the ability to make estimates and decisions based on changing conditions.

BACKGROUND

A significant amount of information goes into planning even a relatively short flight. Planning involves looking at a variety of factors including aircraft performance, airport information, and en route conditions. Proper planning and cockpit organization ensures the flight can be accomplished as safely, legally, and effectively as possible.

Some information is best when it is immediately available on a sheet of paper. Navigation logs are a good example. As a planning tool, they help pilots organize navigation information culled from a variety of sources including sectional aeronautical charts and Chart Supplements. As an inflight tool, the log is an important reference for the pilot, allowing them to compare the planned flight to the actual flight in real time.

MISCONCEPTIONS

The idea of pilots strolling directly to their aircraft, taking off, and then deciding on their flight route and destination as they fly into the sunset may make a good story, but it is far from reality. As previous lessons have discussed, preflight planning is critical to safe and efficient flying. It is so critical, in fact, that it's actually written into the FARs. FAR 91.103

covers “Preflight Action” and says pilots must be familiar with “all available information” regarding their flight. Thus, when pilots collect and organize that information, they’re not only creating a useful inflight reference for their flight, they’re also creating a record of their compliance with the regulations.

DIFFERENTIATION

To support student comprehension of the use of navigation logs in the **EXTEND** and **EVALUATE** sections of the course, demonstrate several navigational log scenarios for students. Demonstrations should include pre-flight planning documentation, in-flight data collection, and changes to the plan. Prepare several copies of a navigation log for students to complete during demonstrations and/or practice opportunities.

LEARNING PLAN

ENGAGE

Teacher Materials: Helpful Documents Presentation, Helpful Documents Teacher Notes 1
Student Materials: Helpful Documents Student Activity 1, **VFR Sectional Chart, Chart Supplement**

Session 1

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

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

Warm-Up

The objective of this Warm-Up is to get students in a “data gathering” mindset and help them begin to understand the quantity of information needed to adequately conduct proper preflight planning.

Provide individual students with **Helpful Documents Student Activity 1**. When individual students are finished, have the students divide into pairs and compare their answers. Sample responses are available in **Helpful Documents Teacher Notes 1**.

EXPLORE

Teacher Material: Helpful Documents Presentation

Slide 5: The information the students collected is the beginning of a pilot’s responsibility to comply with 14 CFR 91.103. Note that 91.103 specifically calls out weather, fuel calculations, alternate flight plans, traffic delays, runway lengths, and takeoff and landing distance information. However, the first sentence says:

“Each pilot in command shall, before beginning a flight, **become familiar with all available information** concerning that flight.”

It is the pilot’s responsibility to know everything they can in preparation for the flight.

Slide 6: The data collected in the Warm-Up activity is similar to what pilots would collect for each origin and destination airport; however, additional information is needed between those two points.

Questions

Not including airport data, what other data does a pilot need to fly a route on a cross-country trip? Recall previous cross-country trips you've planned.

Poll the class and collect the responses on a classroom display (bulletin board, whiteboard, or screen). Once again, have the students brainstorm and discuss to see if anything is missing.

Possible responses include:

1. *Checkpoints along the route*
2. *Altitude*
3. *Airspeed*
4. *Winds*
5. *Distance*
6. *TC, WCA, TH, MV, MH, Dev, CH, and GS*
7. *Fuel onboard*
8. *Fuel usage rate*
9. *Hazards (terrain, special use airspace, etc.)*

Slide 7: What is the purpose of all of this information? It provides pilots with the data they need to safely and effectively accomplish the flight. This data collection also meets the requirements of 91.103.

EXPLAIN

Teacher Materials: Helpful Documents Presentation, Helpful Documents Teacher Notes 2
Student Materials: Helpful Documents Student Activity 2, VFR Navigation Log

Slide 8: The airport data and cross-country data is a lot of information, particularly if there are several legs on the flight plan or multiple airports along the route. What can pilots do to keep track of all that information and ensure they haven't missed anything?

Navigation logs, introduced in the last lesson, can help organize the information a pilot collects in preparation for a flight. In addition, most navigation logs are formatted to help pilots step through the required flight planning calculations. When a pilot is planning, any empty blocks on the logs serve as a stark reminder that the pilot needs to obtain that information, helping to avoid forgetting important data. The information organized in a navigation log can also be used as the source for filing a flight plan, if the pilot desires to do so. Finally, should it be necessary, the navigation log can also serve as documentation that the pilot accomplished the preflight planning required by FAR 91.103.

Teaching Tips

Slides 8–12 show a section of the blank navigation log from the previous lesson (6.C.1: Plotting Your Course). Students may find it helpful to reference a copy of the complete navigation log as they study these slides.

Slide 9: Referencing the example navigation log excerpt on the slide, after inputting route and altitude, the next piece of information required is wind. Where does the pilot obtain this information? The wind data should come from the winds aloft forecast for the planned altitude of the route.

Slide 10: Recall how to read the winds aloft forecast from previous lessons. Present this example forecast, which students shall reference in the scenario that follows. The winds aloft forecast represents winds at Charles B. Wheeler Downtown Airport in Kansas City (KMKC) and Eppley Airfield in Omaha (KOMA).

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
MKC	3623	3327-01	3045-02	2946-08	2763-20	2781-30	761344	773352	765063
OMA	3632	3232-04	3046-08	2960-13	2882-22	2795-32	770747	762056	764662

Note that the winds at KMKC at 3,000 feet MSL are 360° at 23 knots, while at 6,000 feet MSL they are 330° at 27 knots. Similarly, at KOMA they are 360° at 32 knots at 3,000 feet MSL and 320° at 32 knots at 6,000 feet MSL.

Questions

If the pilots in this scenario are planning to fly from Kansas City (KMKC) to Omaha (KOMA) at 4,500 feet, what wind and temperature data should they put in their navigation log?

Different pilots may arrive at slightly different responses to this question.

Winds at altitude: Since winds at 3,000 feet and 6,000 feet are available, pilots can interpolate between the two to determine the winds at 4,500 feet MSL.

Winds at location: Pilots could choose to use the winds at KMKC for the first half of route and KOMA for the second half, or they could attempt to average the winds along the route, or they could use some combination of the two.

Flight planning software programs and apps generally use these same techniques, interpolating the winds for altitude and breaking the route into segments, then applying winds to each segment based on the closest reported wind information.

For this scenario, one potential solution is to use winds of 340° and 25 knots at 4500 feet for the first half of the route, and winds of 340° and 32 knots for the second. These winds will be used on the wind side of the E6-B to compute the wind correction angle (WCA), which is a significant column in the navigation log because it will affect the compass heading, groundspeed, time en route, and even the amount of fuel used. The instructions for calculating the WCA are printed on the E6-B itself as well as in the lesson materials for 6.B.3: Flight Computers.

Slide 11: The temperature data can also be obtained from the winds aloft chart. Recall from previous lessons that there is no forecast temperature for 3,000 feet MSL or within 2,500 feet of the ground. Estimates can be determined by using the standard lapse rate or the actual lapse rate between the surface and 6,000 feet. In this example at KMKC (–1° C at 6,000 feet), using a standard lapse rate of 2° C per 1,000 ft gives a 3° change from 6,000 to 4,500 for a temperature of 2° C at 4,500 feet. Similarly, at KOMA the 3° temperature change from 6,000 feet would result in a temperature of –1° C at 4,500 feet. Though not used in any of the calculations in the cross-country route planning thus far, temperature data is often used in completing aircraft performance calculations.

Slide 12: Navigation logs are intended to be used during flight. They are generally formatted so that navigation information is easily read, and blank spaces are available for the pilot to update elements such as groundspeed and actual time en route. Comparing in-flight data and preflight data allows the pilot to correct any values for upcoming legs of the flight.

Slide 13: Consider what utensil a pilot should use to fill out the navigation log—pencil or pen? What should they use to write while flying? What about electronic means?

These may seem like silly questions, but pilots need to consider the logistics of each of the options. In preflight planning, pencils might be preferred because they can be erased if a mistake is made while filling out the navigation log. However, for night operations, some aircraft use night vision-friendly lighting like dim lighting or red-colored lighting. Pencil lead is more difficult to read than ink under those conditions. When preparing for night flying, filling in the navigation log with pen may be preferable.

During flight, the choice of writing implement comes down to pilot preference. The one that is easiest to operate while simultaneously operating the aircraft is generally preferred. Wood pencils are reliable, but if the lead breaks, re-sharpening in flight is inconvenient. They generally also lack "clips" to attach them to something and keep them within reach.

Mechanical pencils don't require sharpening and have clips, but they tend to use relatively thin leads that may break. Retractable ink pens (as opposed to pens with caps) can be operated with one-click and are reliable—at least, not until they run out of ink. Often, having two writing utensils at hand is a good plan, and many pilots fly with one pen and one pencil—one the backup to the other.

Finally, consider that some planning and even inflight note taking can be done electronically, for those who have access to electronic devices and comfort with using them.

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

Formative Assessment

Divide the class into groups of 3 or 4 and distribute **Helpful Documents Student Activity 2**. Students will recall the various sources of flight planning information and brainstorm possible ways to recognize and address inflight changes. Sample responses are available in **Helpful Documents Teacher Notes 2.**

EXTEND

Teacher Materials: Helpful Documents Presentation, Helpful Documents Teacher Notes 3
Student Materials: Helpful Documents Student Activity 3, **VFR Sectional Chart, Chart Supplement, Plotter, E6-B Flight Computer,** VFR Navigation Log

Session 2

Slide 15: Divide the class into pairs and distribute **Helpful Documents Student Activity 3**. Students will complete a navigation log for a long flight between two airports of their choice and update it with in-flight data. Sample responses are available in **Helpful Documents Teacher Notes 3**.

EVALUATE

Teacher Materials: Helpful Documents Presentation, Helpful Documents Teacher Notes 4
Student Materials: Helpful Documents Student Activity 4, **VFR Sectional Chart, Chart Supplement,** VFR Navigation Log **(Completed)**

Slide 16: Conduct the **Summative Assessment**.

Summative Assessment

Distribute **Helpful Documents Student Activity 4**. In this summative assessment, students will analyze navigation logs, adapt to changes, and synthesize class discussions on the navigation logs application to pilots. Sample responses are available in **Helpful Documents Teacher Notes 4**.

[DOK-L4; *synthesize*]

Summative Assessment Scoring Rubric

- Follows assignment instructions
- Postings show evidence of one or more of the following:
    - Correct recall of data sources, calculations, and purposes for navigation logs
    - Reasonable application of navigation logs to scenarios
    - Evidence and explanation of the above that demonstrate understanding of the material
- Contributions show understanding 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 all data sources, calculations, and purposes for navigation logs, and uses a reasonable application and analysis to scenarios, with appropriate explanations.
7-8	Correctly understands most data sources, calculations, and purposes for navigation logs, with some errors, and makes generally reasonable application and analysis to scenarios, with some incomplete analysis or errors.
5-6	Understands some data sources, calculations, and purposes for navigation logs, with errors, or makes generally reasonable application and analysis to scenarios but lacks adequate explanation.
0-4	Provides few, if any, correct ideas about data sources, calculations, and purposes for navigation logs, and/or makes poor application and analysis to scenarios with inadequate explanation.

GOING FURTHER

Teacher Material: Helpful Documents Presentation

Slide 17: A navigation log can serve as a source of information to file a VFR flight plan. The purpose of a VFR flight plan is to let the FAA know the pilot's intended destination and arrival time. If the arrival time passes, and the pilot does not show up (and the flight plan is still open) the FAA will initiate search and rescue operations using the information on the flight plan to locate the aircraft.

Most people probably hear about flight plans after an aircraft accident, when the local news reports that the "plane was not on a flight plan." While this sounds serious, it is actually common for VFR flights to fly without flight plans.

Flight plans for VFR flights are not required in most cases. In some special use airspace, all aircraft are required to be on a flight plan. Even if not required, flight plans are recommended, particularly for cross-country flights, night flights, and

flights over water or mountainous terrain. VFR flight plans are a safety net or “insurance policy" in the unlikely event that an aircraft does not arrive at its destination when expected. Without a flight plan, no one knows for certain where a missing aircraft may be.

VFR flight plans can be filed several ways: by telephone, via computer, through an app, or by radio.

Slides 18-19: The flight plan document on these slides is actually an FAA Form (FAA Form 7233-4), and the same one is used whether the pilot is flying within the US, internationally, under IFR, or under VFR.

Much of the information determined in flight planning and recorded on the navigation log can be placed directly on the flight plan. Some blocks on the form use special codes. Instructions for completing the form, and the possible codes to put in each block, are available in the Aeronautical Information Manual (AIM) section 5-1-9.

Slide 20: Once filed, the flight plan must be opened to initiate it. This is generally done after takeoff by calling Flight Service on the radio, though sometimes a control tower will open the flight plan if asked. Pilots simply ask Flight Service to open the flight plan and inform them of the actual takeoff time.

If pilots want to change their route or arrival time, their flight plan can be updated in flight by calling Flight Service.

After landing, pilots must close their flight plans with Flight Service, which is normally done by telephone but can now be done with some apps. In some cases, control towers will close VFR flight plans if they're asked.

Slide 21: Because the purpose of a VFR flight plan is to ensure an aircraft has arrived at its destination, failure to close the flight plan could flag the aircraft as overdue. This initiates a search and rescue sequence of events.

At 30 minutes past the pilot's filed ETA, Flight Service will start making phone calls to try to determine the status of the aircraft. Normally, they will call the control tower at the destination first, if there is one, trying to see if the tower can confirm the aircraft has landed. In some cases, they may also call the fixed base operator (FBO) that rented the aircraft out or the aircraft owner. Eventually, they will call the phone number listed for the pilot who filed the flight plan. Ideally, pilots should list their cell phone number so they are always reachable by Flight Service in this kind of situation.

If Flight Service is able to confirm the aircraft has landed or is able to reach the pilot, the pilot is generally reminded to close the flight plan next time. If Flight Service can't confirm the status of the aircraft, however, the scope of the search will widen until eventually more extensive search and rescue resources are utilized. This may include police vehicles and aircraft.

Slide 22: While it is potentially embarrassing for pilots to get a call from Flight Service asking where they are, the FAA wants to encourage pilots to use flight plans because they are a valuable tool that increases flight safety. Historically, pilots have not been penalized for simply forgetting to close their flight plan.

Slide 23: When students select landmarks from a sectional chart, the landmark’s appearance in the real world can be quite different than what a pilot might expect. This video from AOPA gives pilots some tips and techniques when selecting visual checkpoints.

- “Tips and Techniques - Landmarks as visual checkpoints” (Length 2:46)
  Safe YouTube link: https://video.link/w/jzw0

For teachers unable to access Safe YouTube links, the video is also available here:

https://www.youtube.com/watch?v=wX8agIQUPGc

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-Dimensional Learning

- **HS-ETS1-2** - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.C: Optimizing the Design Solution
    - Crosscutting Concepts
        - None
- **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.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

I. Preflight Preparation

Task D. Cross-Country Flight Planning

- Knowledge - The applicant demonstrates understanding of:
    - **PA.I.D.K1** Route planning

- **PA.I.D.K2** Altitude selection accounting for terrain and obstacles, glide distance of the airplane, VFR cruising altitudes, and the effect of wind.
- **PA.I.D.K3** Calculating:
  - **PA.I.D.K3a** Time, climb and descent rates, course, distance, heading, true airspeed, and groundspeed
  - **PA.I.D.K3b** Estimated time of arrival to include conversion to universal coordinated time (UTC)
  - **PA.I.D.K3c** Fuel requirements, to include reserve

- Skills - The applicant demonstrates the ability to:
  - **PA.I.D.S1** Prepare, present, and explain a cross-country flight plan assigned by the evaluator including a risk analysis based on real-time weather, to the first fuel stop.
  - **PA.I.D.S2** Apply pertinent information from appropriate and current aeronautical charts, Chart Supplements; NOTAMs relative to airport, runway and taxiway closures; and other flight publications.
  - **PA.I.D.S3** Create a navigation plan and simulate filing a VFR flight plan

Task E. National Airspace System

- Knowledge - The applicant demonstrates understanding of:
  - **PA.I.E.K1** Types of airspace/airspace classes and associated requirements and limitations
  - **PA.I.E.K2** Charting symbiology
  - **PA.I.E.K3** Special use airspace (SUA), special flight rules areas (SFRA), temporary flight restrictions (TFR), and other airspace areas

VI. Navigation

Task A. Pilotage and Dead Reckoning

- Knowledge - The applicant demonstrates understanding of:
  - **PA.VI.A.K1** Pilotage and dead reckoning.
  - **PA.VI.A.K2** Magnetic compass errors.
  - **PA.VI.A.K3** Topography
  - **PA.VI.A.K4** Selection of appropriate
    - **PA.VI.A.K4a** Route
    - **PA.VI.A.K4b** Altitude(s)
    - **PA.VI.A.K4c** Checkpoints
  - **PA.VI.A.K5** Plotting a course, to include
    - **PA.VI.A.K5a** Determining heading, speed, and course
    - **PA.VI.A.K5c** Estimating time, speed, and distance
- Skills - The applicant demonstrates the ability to:
  - **PA.VI.A.S1** Prepare and use a flight log.

REFERENCES

https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=3efaad1b0a259d4e48f1150a34d1aa77&rgn=div5&view=text&node=14:2.0.1.3.10&idno=14

https://www.faa.gov/air_traffic/publications/media/AIM_Basic_dtd_10-12-17.pdf