Airport Lighting

Session Time: Two, 50-minute session(s)

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

For ease and safety of operations at unfamiliar airports, signage, markings, and lighting are standardized.

An airport's rules and procedures are published and readily available to pilots.

ESSENTIAL QUESTIONS

1. How does airport lighting help pilots safely and efficiently navigate in and around the airport environment?

LEARNING GOALS

Students Will Know

- The names of different lighting systems used at and in the vicinity of airports.
- The purpose of lighting systems used at and in the vicinity of airports.
- The meaning of each type of lighting system used at and in the vicinity of airports.

Students Will Be Able To

- *Recognize* the various forms of airport lighting systems (DOK-L1)
- *Interpret* the intention of airport lighting systems (DOK-L2)
- *Construct* a simple approach path indicator (DOK-L3)
- *Design* an airport lighting plan (DOK-L4)

ASSESSMENT EVIDENCE

Warm-up
In groups, students will take a collection of images of airport lighting and place them in the order pilots would see them as they approached the airport, landed, and taxied to park. One group will then brief their plan to the rest of the class, with other groups discussing differences in their decisions.

Formative Assessment
In pairs, students will identify the lighting system information available to pilots on a VFR sectional chart and in the Chart Supplement U.S., and will explain the purposes of those lights and their use to pilots. Students will then discuss aeronautical decision making and risk management with respect to a pilot experiencing radio failure at night when approaching a nontowered airport.

Summative Assessment
Individually, students will evaluate the airport lighting requirements for a proposed airport and provide a recommended lighting plan suitable to the intended use and meeting the requirements of lighting discussed in this lesson. Students will also provide an explanation justifying the purpose of the proposed lighting system.

LESSON PREPARATION

MATERIALS/RESOURCES

- Airport Lighting Presentation
- Airport Lighting Student Activity 1
- Airport Lighting Student Activity 2
- Airport Lighting Student Activity 3
- Airport Lighting Student Activity 4
- Airport Lighting Student Activity 5
- Airport Lighting Teacher Notes 1
- Airport Lighting Teacher Notes 2
- Airport Lighting Teacher Notes 3
- Airport Lighting Teacher Notes 4
- Airport Lighting Teacher Notes 5
- Airport Lighting Teaching Aid
- **For each student, printed or digital access to the FAA Chart Supplement Legend**
- **For each student, printed or digital access to the FAA VFR Sectional Chart Legend**

Finding Airport Lighting Activity (per group)

- Colored adhesive dots (red, green, white, blue, amber/yellow)
- Airport model built in Lesson 3.A.2

Build a Glide Slope Indicator Activity (per group)

- Sheet of paper
- 8 sticky note pads
- Protractor
- 24 inches of string
- Black marker

LESSON SUMMARY

Lesson 1: Introduction to Airports and Airport Data
Lesson 2: Airport Markings and Signs
Lesson 3: Airport Lighting

The lesson will begin with students attempting to organize airport lighting systems in the order in which they would be used by a pilot flying at night. This exercise will then segue into a discussion of each of those systems, detailing their description, application, and purpose for pilots.

During the next part of the lesson, students will discuss a pilot's ability (or inability) to control airport lighting and see an example of airport lighting specific to radio failure. Students will then examine the information about airport lighting that is available to pilots during flight planning on the VFR sectional chart and Chart Supplement U.S.

Finally, students will divide into three groups and complete three workstations in which they will determine the airport lighting at proposed destination airports, identify the types and locations of lighting on their previously built airport model, and build a visual glide slope indicator. Students will then apply their knowledge to a proposed airport scenario.

BACKGROUND

Airport lighting differs from off-airport lighting in that airports generally cannot erect tall light poles to provide broad area lighting, as the tall structure would be unsafe for flight operations. As a result, airport lighting tends to be ground-based and narrowly focused: for example, an airport will have lights marking only the edge of a taxiway, while a road for cars might have tall street lights illuminating the entire street. The color and location of all airport lighting has a very specific message, as opposed to the broad area lights of non-airport areas. Just as consistent traffic signage makes it easier to travel safely from one town to another, consistent airport lighting helps pilots understand how to operate at an airport under night or poor visibility conditions, even if they've never been there to that specific airport before.

MISCONCEPTIONS

Airport lighting is not limited to night operations. Almost all lighting systems are also used during periods of low visibility (fog, haze, rain, etc.) to improve the safety of airport operations. A few lighting systems are used continuously, day or night, poor weather or good weather, because of their influence on flight safety.

Finally, airport lighting is not "passive." Some airport lighting is directive, requiring action on the part of the pilot. When pilots see lights of certain colors or in certain locations, they are required to react to those lights in a specific way to ensure safe flight operations. Airport lighting itself could require pilot action: At some airports, if pilots want the runway lit so they can land, they are the ones responsible for turning the lights on.

DIFFERENTIATION

To support student retention of concepts during the **EXPLAIN** section of the lesson plan, make flashcards with different types of lighting systems. A Quizlet could be created as well (https://quizlet.com/138041952/chapter-4-section-b-flash-cards/), which students could review while in their groups during the **EXTEND** section of the lesson plan.

LEARNING PLAN

ENGAGE

Teacher Materials: Airport Lighting Presentation, Airport Lighting Teaching Aid

Session 1

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

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

Warm-Up

Divide the class into groups of three to five students and give each group an envelope containing a full set of the cards from the **Airport Lighting Teaching Aid**. The cards contain images of the following airport lighting systems:

- airport beacon
- red obstruction lights
- lighted windsock or wind tee
- runway with green threshold lights, white edge lights, and red end lights
- VASI or PAPI
- blue taxiway lights

Tell the students they are on a flight approaching an airport after sunset. They are about 15 miles out from the airport. Have groups arrange the cards depicting the airport lighting aids in the sequence they would most likely see each lighting aid as they approach the airport, land, and taxi to the ramp.

The objective of this warm-up is to promote thought and discussion that will lead into the EXPLORE section next. Thus, a "correct" solution is not required. However, the most probable solution is:

1. *airport beacon*
2. *lighted windsock or wind tee*
3. *runway with green threshold lights, white edge lights, and red end lights*
4. *VASI or PAPI*
5. *blue taxiway lights*

Red obstruction lights could be in almost any location to note a potential hazard.

This presumes that a pilot is visually searching for the airport and first sees the beacon, then flies toward the beacon and sees the windsock to determine landing direction, then flies a pattern and landing in relation to the runway (seen next) with reference to the visual glideslope indicator (VASI/PAPI).

Variations: It may be possible to see the runway lights not long after the airport beacon, though they would only be "used" once flying the traffic pattern. While it is possible to see the VASI/PAPI before the runway lights, the VASI/PAPIs are very directional, and will likely not be visible until the aircraft is aligned on the final approach to the runway.

[DOK-L1; *recognize*]

EXPLORE

Teacher Material: Airport Lighting Presentation

Slide 5: Evaluate the results from the Warm-Up and have one group explain their reasoning for the order of the lighting systems they chose. Then ask the other groups who may have placed lights in a different order to explain their reasoning.

Questions

What is the purpose of airport lighting?

Airport lighting complements other airport markings and signs. Markings and signs help pilots maintain situational awareness as they approach and move about an airport—primarily during the day and in good weather. Airport lighting primarily enhances airport safety by helping pilots maintain situational awareness at night and in reduced visibility. It can also be used to direct or guide pilots. In some cases, such as following a radio failure, airport lighting can also be used to convey instructions and/or clearances to pilots.

EXPLAIN

Teacher Materials: Airport Lighting Presentation, Airport Lighting Teacher Notes 1
Student Materials: Airport Lighting Student Activity 1, **FAA Chart Supplement Legend, FAA VFR Sectional Legend**

Slide 6: Locating an airport at night can be challenging due to darkness obscuring most of the normal visual cues pilots recognize. Cultural lighting plays a part in this as well, because it could be difficult to find airport lights if there are a lot of other lights around (from a nearby city or development, for example). That's one reason airport lighting is designed to be unique, so that it stands out from other lighting.

One light that stands out from cultural lighting is the primary light that helps pilots visually acquire the airport at night: the airport beacon. Rather than being a steady or even flashing red or white light, the **airport beacon** uses a rotating light (much like a lighthouse) that alternates in color based on the type of airport. The beacon alternates:

- white/green for a civilian airport (land)
- white/yellow for a water airport (seaplane base)
- white/yellow/green for a heliport
- white/white/green for a military airport

The airport beacon normally operates from dusk to dawn or when weather is below VFR minimums.

The slide contains an image of an example airport beacon, in this case placed on a tower, though at some airports it may be placed on the control tower or even on the terminal building.

Slide 7: The following video gives an example of what a standard civilian land airport beacon looks like. Don't identify this for students, however; after they watch the video, poll the class to see how many students can correctly identify the type of beacon.

- "Airport Vintage Rotating Beacon" (Length 0:13)
  https://video.link/w/k8Lq

For teachers who do not have access to Safe YouTube links, the video can also be found here: https://www.youtube.com/watch?v=v9Bk4BXZsEE

The slide contains another image of an example airport beacon.

Slide 8: Red or white **obstruction lights** are required on all towers, buildings, and other structures above certain heights during both day and night to make them visible to aircraft and increase safety. In addition to these obstacles, pilots approaching an airport will often see steady red lights closer to the ground marking buildings or other lower obstructions. These lights help pilots identify the locations of objects (buildings, towers, cranes, antennae, etc.) which may be hazardous to their flight path.

The slide contains an image of a building rooftop that has a red obstruction light installed.

Slide 9: An airport's **wind tee**, **tetrahedron**, or **windsock** may also be illuminated with internal or external lighting so pilots flying overhead can not only see the wind indicator but also determine the wind direction in preparation for landing. The airport diagram on the airport's Chart Supplement page will show the location of the wind indicators and whether they are lit.

The slide contains an image of a windsock illuminated internally at night.

Slide 10: Approach light systems support two basic types of runways: runways with precision instrument approaches, and those without. As a general rule, non-instrument approach runways will have only basic edge and runway lighting, while runways with precision approaches can have fairly complex lighting systems that "lead" a pilot to the runway touchdown zone.

Approach light systems generally help pilots transition from instrument flight to visual flight; however, they are also useful for finding the runway when flying VFR at night.

The slide contains an image of the approach lighting system into London Gatwick Airport.

Slides 11-12: Once the airport is identified, the pilot has assessed the winds, and the aircraft is aligned for the final approach, the next system available at many airports is a **visual glide path indicator**. These systems—which can be lights or simple panels—give pilots visual feedback about their glide path. There are two primary types of visual glide path indicators:

- Visual Approach Slope Indicator (VASI)
- Precision Approach Path Indicator (PAPI)

Both systems use variations of red and white lights. The VASI uses two or more rows of lights, while the PAPI uses a single row of four lights.

Teaching Tips

To remember the difference between the two types of approach path systems, remember that VASI lights are stacked vertically from the perspective of the pilot.

A typical VASI appears as one bar or light over the other. The system can display the following indications on the final approach glide path (usually three degrees):

- White over white: Above glidepath
- Red over white: On glidepath
- Red over red: Below glidepath

A typical PAPI uses the same concept but displays the red/white in four horizontally aligned lights to more precisely indicate how far above or below a three-degree glidepath an aircraft is. "On glidepath" for a PAPI is 2 red/2 white lights, with slightly above glide slope being 3 white and slightly below-glide slope being 3 red.

Here are memory aids for these lighting configurations for VASI:

- White over white, too much height (above glidepath)
- Red over white, doing alright (on glidepath)
- Red over red, end up dead (below glidepath)

The memory aids are essentially the same for PAPI:

- Four white, too much height (Above glidepath)
- Two red, two white, doing alright (On glidepath)
- Four red, end up dead (Below glidepath)

Other variations, somewhat less common in the United States, are a single-light pulsating VASI (pulses red or white when the aircraft is well above or well below glide path) and tri-color VASIs, which use amber, green, and red lights to indicate position above, on, or below the glidepath.

Slide 12 contains two images. The one on the left is a VASI on the right side of the runway showing "on glideslope" with red over white. The image on the right is a PAPI on the left of the runway indicating "on glideslope" with two red/two white.

Slide 13: The following video explains how PAPIs and VASIs work and shows examples of what they look like:

- "Airport Lighting" (Length 1:30)
  https://video.link/w/SgMq

For teachers who do not have access to Safe YouTube links, the video can also be found here: https://www.youtube.com/embed/FSl8ilpeHEk?start=160. Please end the video at 4:10.

Teaching Tips

Astute students may ask a key question about VASIs and PAPIs: "They show the glidepath to what?" Both VASIs and PAPIs steer a pilot to an approximately 3-degree glidepath to the runway's touchdown zone. Normally, this is approximately 1,000 feet from the runway threshold, or the location of the runway aiming point marking discussed in the previous lesson. Most larger aircraft will follow the VASI/PAPI to the point of the flare, then transition to land. This could result in an actual touchdown point anywhere from 500 feet short of the aimpoint to 1,000 feet beyond the aimpoint. Smaller aircraft and those with shorter landing distances will often land short of those points.

Slide 14: Review the lighting systems covered to this point and address the three questions on the slide.

Questions

What rotating light helps pilots locate airports at night?

The airport beacon. The first image is of a green/white airport beacon, which would designate a civilian land airport.

How would you know ahead of time if an airport had a lit windsock?

Students should draw on what they have learned in prior lessons about flight planning information for airports. As mentioned in prior lessons, during flight planning the pilot should review the Chart Supplement for that airport. The Chart Supplement contains information about airport lighting, including whether wind indicators are lit. The information about airport lighting available in the Chart Supplement will be discussed in greater detail later in this lesson. The middle image on the slide is an excerpt from a Chart Supplement airport diagram which indicates a lit wind tee on the east side of the runway.

While on final approach you look at the PAPI and see three red and one white light. What does that mean?

You are slightly below a 3-degree glideslope. You should reduce your descent rate so you can increase your approach angle if you intend to fly a 3-degree glide path to the runway aimpoint. The far-right image contains a graphic of a runway with 3 red/1 white PAPI.

Slide 15: Once inside the airport environment, the lighting of the runway itself is important. **Runway lighting** is not just for ground operations but also for helping pilots locate the airport while airborne and then land on the runway. Runway lighting defines the edges of the runway surface. As pilots approach a lit runway on final approach, the first runway edge lights they will see are the **green threshold lights** showing the beginning of the landing surface. The lights along the **left and right edges** of the runway are **white**, though for an instrument runway the final 2,000 feet may have amber lights, which warn pilots of their runway remaining. The **far end** of the runway has **red lights** across the runway edge.

These runway lights are directional. The green threshold lights viewed from the other direction are red runway end lights. The amber edge lights on the last 2,000 feet of runway appear white to an aircraft landing in the opposite direction. Thus, the colors, location, and even the direction of the lights are designed to enhance the pilot's situational awareness on the runway.

On either side of the green threshold lights may be **Runway End Identifier Lights (REIL)**, which are composed of a flashing strobe indicating the corners of the threshold.

More complex and busier airports may have even more lighting systems, including **runway centerline lighting**, **touchdown zone lights (TDZL)**, and **lead-off lights**.

As pilots exit the runway after landing, they will transition from seeing white runway edge lights to **blue taxiway edge lights**. The taxiway lights are omnidirectional, which can aid in locating taxiways without being lined up with them. Larger airports may have **green taxiway centerline lights** that are directional, making them visible only to the pilot taxiing on the taxiway. All these lights are generally used for area orientation at night or during periods of low visibility.

Slide 16: The slide contains an image of a runway at night with the lighting systems from the previous slides annotated.

Questions

What other light systems are visible in the photo?

Approach lighting system (white lights leading to runway), two red obstruction lights, PAPIs

At larger, more complex airports, additional ground lighting may include:

- Clearance Bar Lights: Three recessed yellow lights typically installed prior to hold lines
- Stop Bar Lights: Red recessed lights across the hold line
- Runway Guard Lights: Elevated (on the side of the taxiway) or recessed along a hold line
- Runway Entrance Lights: Red recessed lights along the taxi centerline to the runway indicating there is conflicting traffic on the runway
- Takeoff Hold Lights: Red recessed lights near the runway numbers and aligned on either side of the runway centerline; used to indicate that an aircraft should not take off

Runway guard lights, runway entrance lights, and takeoff hold lights may be used under any weather or lighting conditions.

Slide 17: The following video explains surface lighting for the previously discussed airport. Before playing the video, tell the students to watch for the primary differences between edge lighting and centerline lighting (besides color) that the video describes:

- "Airport Lighting" (Length 1:34)
  https://video.link/w/fhMq

For teachers who do not have access to Safe YouTube links, the video can also be found here: https://www.youtube.com/embed/FSI8iIpeHEk?start=250

Questions

What differences are there between edge and centerline lighting? Why do you think that is?

Edge lights are elevated on posts, while centerline lighting is recessed into the concrete surface. The posts allow for the greatest visibility, but airplane tires need to taxi over the centerlines, so lights on those surfaces must be recessed and reinforced so they can be run over by heavy aircraft.

Slide 18: Airports that are active throughout the night may leave their lights on throughout the nighttime hours. Airports with reduced traffic at night, particularly small airports or those not controlled by a tower, may have lights that are only turned on when required. An airport's lighting system availability can be determined by reviewing the relevant Chart Supplement.

At a towered airport, pilots can ask air traffic control to turn on the lights as well as adjust their brightness. Sometimes, brighter lights will make it easier to find an airport or to see during poor visibility conditions. Generally, however, dimmer lights make landing easier, as the pilot's vision isn't impacted as it is when the lights are bright.

At a nontowered airport, lights may sometimes be placed on a timer or a photocell so they come on automatically as the sunlight fades. In some cases, pilots may have to call ahead and have the lights turned on, or, more often than not, they may control the lighting on their own. Pilot-controlled lighting (PCL) is listed in an airport's Chart Supplement along with the radio frequency used to turn the lights on. When desired, a pilot selects the appropriate frequency and then keys the radio an appropriate number of times to turn on the lights and set their brightness. On adjustable systems, pilots can select the intensity by keying their radio 3 (low), 5 (medium), or 7 (high) times. After the lights are on, they can adjust the brightness simply by keying their radio again, the appropriate number of times. A good practice is to key the radio 7 times, and once the airport is acquired visually, lower the lighting to the desired intensity.

Slide 19: While not strictly "airport lighting," there is one other lighting system with which pilots should be familiar. If a pilot loses his or her radio (or if a pilot flies an aircraft that does not have a radio), he or she can still obtain instructions and landing clearance from a control tower by observing the tower's **light gun**, which is essentially a giant, directional flashlight that can be pointed at an aircraft and show red, green, or white lights—steady or flashing. Controllers can send pilots specific signals based on the color and state (flashing or steady) of the light.

The slide contains an image of an Air Force air traffic controller using a light gun. You can see the legend for the signals on a sticker on the side of the gun.

The slide also contains a table of light gun signals and their meaning.

Slide 20: The following video shows what a tower's light gun looks like from a ground vehicle. Have the students identify each signal as the tower transmits it.

- "FAA Tower Vehicle Light Gun Signals" (Length 1:08) (no sound) https://video.link/w/MhMq

For teachers who do not have access to Safe YouTube links, this video is also available here: https://www.youtube.com/watch?v=U7sVkPnCB3Y

Slide 21: During flight planning, pilots should determine what type of lighting they can expect at their destination airport. Some information is available on a VFR sectional aeronautical chart, with symbols near the airport that can be interpreted using the **FAA VFR sectional legend**. For example, a hollow star at the top of the airport symbol indicates the airport has a beacon that operates from dusk to dawn. (If there is a star but not on the actual symbol, it indicates the relative position of the beacon to the airport.) An "L" indicates the airport runway lights are on from sunset to sunrise. An asterisk L (*L) indicates "lighting limitations exist" and the Chart Supplement must be referenced for more information, which could detail that lighting is available on request (phone or radio), that there is part-time lighting, or that the airport's lighting is pilot-controlled. These symbols can be found in the sectional's legend, and are explained more fully in the FAA's Aeronautical Chart User's Guide.

The slide contains an excerpt from a VFR sectional with the lighting symbol ("L") and beacon annotated at two different airports.

Slides 22-23: More detailed lighting information, including the specific approach lighting systems used at airports with instrument approaches, can be found in the Chart Supplement. Acronyms and abbreviations on an airport's Chart Supplement page are explained in the Chart Supplement legend. The slides contain an excerpt from the Chart Supplement for Seward Municipal Airport (KSWT), in Omaha, Nebraska.

Questions

While showing **Slide 22**, ask students: According to the provided Chart Supplement, what lighting is available at Seward Municipal Airport? Use the Chart Supplement legend to help identify lighting terms.

*After giving the students an opportunity to answer, advance to **Slide 23** to display highlighted areas with lighting information on the airport's Chart Supplement page.*

The "B" in the second line of the Chart Supplement indicates a rotating beacon is available. (This is explained in the legend.) The RWY lines indicate the presence of medium intensity runway lights (MIRL) and PAPIs. The SERVICE line indicates that lighting for the MIRL, PAPI, and windsock is activated by using the CTAF frequency.

The miniature airport sketch shows a graphic depiction of the PAPIs and airport beacon.

What frequency is used to activate the pilot-controlled lighting?

The COMMUNICATIONS line shows the CTAF/UNICOM as 122.8.

Slide 24: Complete the **Formative Assessment**. The slide contains questions that are broadly related to what is on the Student Activity sheet.

Formative Assessment

Divide the class into pairs and distribute **Airport Lighting Student Activity 1**, which asks students to identify the appropriate airport lighting systems during preflight planning and flying. Each pair of students should also have a copy of the **FAA Chart Supplement Legend**. Have the students answer the questions on the Activity Sheet. Sample responses are available on **Airport Lighting Teacher Notes 1**.

[DOK-L2; *interpret*]

EXTEND

Teacher Materials: Airport Lighting Presentation, Airport Lighting Teacher Notes 2, Airport Lighting Teacher Notes 3, Airport Lighting Teacher Notes 4
Student Materials: Airport Lighting Student Activity 2, Airport Lighting Student Activity 3, Airport Lighting Student Activity 4

Session 2

Slide 25: Divide the class into three groups. Each group will go to a separate station, as described in **Airport Lighting Student Activity 2** (planning for airport lighting, using the Chart Supplement), **Airport Lighting Student Activity 3** (finding airport lighting, using the model airport), and **Airport Lighting Student Activity 4** (build a glide slope indicator). Give the groups approximately 10 to 15 minutes at each station, and then have them cycle to the next station. All three groups can accomplish each station. Alternatively, if time is limited, have each group accomplish one station and then brief the rest of the class on what they accomplished.

Sample responses are available in **Airport Lighting Teacher Notes 2**, **Airport Lighting Teacher Notes 3**, and **Airport Lighting Teacher Notes 4**.

EVALUATE

Teacher Materials: Airport Lighting Presentation, Airport Lighting Teacher Notes 5
Student Material: Airport Lighting Student Activity 5

Slides 26-35: Review the Private Pilot Knowledge Test Questions.

Slide 36: Conduct the **Summative Assessment**.

Summative Assessment

Distribute **Airport Lighting Student Activity 5**. In this summative assessment, students are provided with a scenario in which their city is proposing to build a new airport, and the students have been asked to provide a plan for airport lighting. Students will assume the role of a subject matter expert on airport lighting and individually create a proposal for the necessary lighting.

Sample responses are available in **Airport Lighting Teacher Notes 5**.

[DOK-L5; *design*]

Summative Assessment Scoring Rubric

- Follows assignment instructions
- Responses show evidence of one or more of the following:

- Correct recall of the names, types, and purpose of specific airport lighting systems
- Reasonable application of the lighting systems to a notional airport scenario
- 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 all or almost all airport lighting systems and makes a reasonable application of those systems to a proposed airport scenario, with explanation.
7-8	Correctly understands most airport lighting systems, with some errors, and makes generally reasonable applications of those systems to a proposed airport scenario, with some incomplete analysis or errors.
5-6	Correctly understands some airport lighting systems, with errors, or makes generally reasonable applications of those systems but lacks adequate explanation.
0-4	Provides few, if any, correct ideas of airport lighting systems, and/or makes poor application of those systems with inadequate explanation.

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
    - Asking Questions and Defining Problems
    - Constructing Explanations and Designing Solutions
  - Disciplinary Core Ideas
    - ETS1.A: Defining and Delimiting Engineering Problems
  - Crosscutting Concepts
    - Systems and System Models
- **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
        - Influence of Science, Engineering, and Technology on Society and the Natural World

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

III. Airport and Seaplane Base Operations

Task A. Communications, Light Signals, and Runway Lighting Systems

- Knowledge - The applicant demonstrates understanding of:
    - **PA.III.A.K3** ATC light signal recognition.
    - **PA.III.A.K9** Runway Status Lighting Systems.

Task B. Traffic Patterns

- Skills - The applicant demonstrates the ability to:
    - **PA.III.B.S1** Identify and interpret airport/seaplane base runways, taxiways, markings, signs, and lighting.

REFERENCES

Aeronautical Chart User's Guide. FAA, 20 June 2019.
"Airport Vintage Rotating Beacon" (Length 0:13), https://video.link/w/k8Lq
"Airport Lighting" (Length 1:30), https://video.link/w/SgMq
"Airport Lighting" (Length 1:34), https://video.link/w/fhMq
"FAA Tower Vehicle Light Gun Signals" (Length 1:08), https://video.link/w/MhMq
Pilot's Handbook of Aeronautical Knowledge, 2016.