What Is A Capstone?

Session Time: Two, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

A capstone project allows students to showcase their accumulated knowledge and experience through independent research into the topic of their choosing.

Organizing coursework, experiences, credentials, and achievements within a field of study articulates the full breadth of one's knowledge and accomplishments within that field.

ESSENTIAL QUESTIONS

1. How do students' experiences in the AOPA High School Aviation STEM Curriculum prepare them for a capstone project?
2. What accomplishments throughout a student's high school experience are relevant to their future plans?
3. How can students effectively organize their academic achievements?

LEARNING GOALS

Students Will Know

- How to draw on diverse concepts, skills, knowledge, and experiences to develop and complete a capstone project.
- How academic, professional, and volunteer accomplishments are relevant to achieving their career goals.
- How to evaluate and organize their experiences, skills, and accomplishments into a comprehensive, stackable credential portfolio.

Students Will Be Able To

- *Match* personal interests with their aviation career goals. [DOK-L1]
- *Identify* possible capstone projects. [DOK-L1]
- *Assess* prior course content, their skills, and their knowledge to develop a capstone project. [DOK-L3]
- *Organize* personal and course experiences and accomplishments for inclusion in a stackable credential portfolio. [DOK-L3]

ASSESSMENT EVIDENCE

Warm-up
Students watch a video about three people who were able to blend their interests with aviation careers. The students then discuss how they might weave their interests into aviation careers they would like to pursue.

Formative Assessment
Students write a few paragraphs explaining how they might develop one idea or topic into a capstone project that aligns with their career goals.

Summative Assessment
Students use a checklist to evaluate three to five credentials they have earned and assess how those credentials may assist them in reaching their goals in aviation.

LESSON PREPARATION

MATERIALS/RESOURCES

- What Is a Capstone? Presentation
- What is a Capstone? Student Activity 1
- What Is a Capstone? Student Activity 2
- What Is a Capstone? Student Activity 3
- What Is a Capstone? Teacher Notes 2
- What Is a Capstone? Rubric

Students will also need to obtain a ruled, bound composition book by Lesson 5.B.1: The Research Notebook.

LESSON SUMMARY

Lesson 1: What is a Capstone?
Lesson 2: Managing the Capstone

The lesson will begin with a warm-up in which students watch a video about three people who were able to blend their interests with aviation careers. The students then discuss how they might weave their interests into aviation careers they would like to pursue.

During the next part of the lesson, students are introduced to the culminating experience for the course: the capstone project. Students will also be introduced to the research notebook, which they will begin in a future lesson. Students will then begin to explore possible capstone topics relevant to their individual experiences and career goals, and they will consider the qualifications and requirements necessary to achieve these goals.

In the final part of the lesson, students will learn about stackable credentials. For the **Summative Assessment**, students will use a checklist to evaluate several credentials they have earned in the past.

BACKGROUND

Over the course of many semesters, students enrolled in the AOPA High School Aviation STEM curriculum have examined the fundamentals of aviation in detail. During this time, students have completed a wide variety of activities—including training in flight simulators, preparing for the FAA Private Pilot Knowledge Test, exploring careers and business opportunities, and developing interpersonal, presentation, and professional skills—all designed to prepare students for this culminating experience.

The United States Department of Education has created a Stackable Credentials Tool Kit (available here: https://cte.ed.gov/initiatives/stackable-credentials-tool-kit), which describes stackable credentials as "part of a sequence of credentials accumulated over time to build up an individual's qualification to help them move along a career pathway or up a career ladder to potentially different and higher paying jobs." Students enrolled in and completing the AOPA High School Aviation STEM curriculum may already have nationally-recognized, stackable credentials such as a passing grade on the FAA Private Pilot Knowledge Test, a Part 107 remote pilot certificate, or a student pilot certificate.

MISCONCEPTIONS

Students often misconstrue the term *research*. Particularly in English Language Arts classes, research typically requires students to select a topic, draft a thesis statement, and search publications for evidence that supports their thesis, whereas scientific research commonly involves the collection and analysis of data through observation and

experimentation. In this course, however, *research* is interpreted much more broadly. Students who apply the engineering design process, compile a case study, explore return on investment in the context of a new business, investigate new or innovative aviation designs (e.g., wings, hull, cabin seats, microbe barriers), teach or present aviation topics to other students, start an aviation-centric club or event in their school or community, or record the story or life history of a local aviator are considered to be conducting research.

The term *credentials* is often confused with *certification* or *accreditation*. Credentials may range from documenting one's experience to passing an exam or test (e.g, Microsoft certification) to obtaining a degree. *Certifications* are designated credentials earned by an individual to verify their legitimacy and competence to perform a job. *Accreditation* entails an outside, legitimate authority verifying that an institution meets certain educational standards.

DIFFERENTIATION

To support student success in the capstone project, provide opportunities for students to meet with the instructor to discuss their ideas. Use this time to conduct check-ins, provide constructive feedback, and foster a growth mindset.

LEARNING PLAN

ENGAGE

Teacher Material: What Is a Capstone? Presentation

Session 1

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

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

Warm-Up

Have students watch the following video about different aviation careers. As they watch, students should think about how their interests may fit within the world of aviation.

- "Aviation Careers: Full Series" (Length 10:07)
  https://video.link/w/jrEwb
  For teachers unable to access VideoLink links, the video is also available here: https://www.youtube.com/watch?v=Zkf6VAZs6vY&feature=youtu.be

Following the video, discuss the following questions as a class:

1. The video showed three very different pathways within aviation. Thinking of the various careers you have learned about so far in AOPA's curriculum, which do you find the most interesting? Why?

Student answers will vary.

1. In the video, there were examples of people finding ways to integrate their interest in aviation with other pursuits (e.g. law enforcement, photography). What are some ways you can think of that you could pursue your hobbies or personal interests within the aviation industry?

Student answers will vary.

[DOK-L1, *match*]

EXPLORE

Teacher Material: What Is a Capstone? Presentation

Slides 6-7: Explain that this semester's "capstone" is a multifaceted culminating experience that represents students' growth and acquisition of skills, knowledge, and experiences throughout their high school career and time in the AOPA High School Aviation STEM curriculum. It is an opportunity for students to reflect on their experiences and engage in a deep dive into an aspect of aviation that inspires or intrigues them. This semester does contain some direct instruction and instructor-led lessons, but overall the expectation is that students will be self-directed and the teacher will be a facilitator, supporting students' endeavors.

As they complete their capstone project, students will complete the following steps (in roughly this order):

1. Decide on an idea for a project.
2. Draft and defend a project proposal.
3. Find a mentor.
4. Define research questions and conduct research.
5. Maintain a research notebook.
6. Write a research paper.
7. Give a formal presentation.

Slides 8-9: Students need to consider all of the possibilities available for developing a capstone project. To help them get started, show the following video of high school seniors at a school in Maine talking about their own capstone experience. As students watch the video, direct them to take note of the variety of projects displayed.

- "Bringing it all together: The senior capstone project" (Length 2:45)
  https://video.link/wQv8tb/
  For teachers unable to access VideoLink links, the video is also available here: https://www.youtube.com/watch?v=7CM8AYjj1Ss

Then, use the following questions to conduct a class discussion. Encourage students to use examples from the video they just watched to support their responses.

Questions

Think about the capstone projects that were highlighted in the video. Was there one example that stood out to you?

Responses will vary.

What were some of your favorite lessons or experiences in the aviation classes you've taken so far?

Responses will vary.

What are you curious to learn more about?

Responses will vary.

EXPLAIN

Teacher Materials: What Is a Capstone? Presentation, What Is a Capstone? Teacher Notes 2
Student Materials: What Is a Capstone? Student Activity 1, What Is a Capstone? Student Activity 2

Slide 10: Explain that students will need to keep a research notebook as they work on their project throughout the semester. In this notebook, students will document all aspects of their project, from start to finish, including (but not limited to) notes, sketches, surveys, proposals, data, questions to investigate, and answers to questions, as well as reflections on results, successes, setbacks, and even failures. The notebook should have lined paper and a sewn binding (a ruled composition or memo book is fine), and students will follow a specific protocol for setting up and maintaining their notebook. This protocol will be taught in Lesson 1.B.1: The Research Notebook. Following this protocol will legally protect the information contained in the notebook as the student's intellectual property—a necessary step when applying for a patent for example.

Students will need to obtain a research notebook prior to Lesson 1.B.1: The Research Notebook. If the school does not provide the books for students, inform students to procure one independently prior to Lesson 1.B.1.

Slide 11: Distribute **What Is a Capstone? Student Activity 1**, and either assign each student a partner or give them a few minutes to choose a partner. Partners should complete the activity by brainstorming and then ranking ideas for possible capstone projects.

When students finish, ask for volunteers to share their ideas with the class and explain why certain ideas interest them. Encourage students to add their classmates' ideas to their individual lists, as appropriate.

Teaching Tips

Some students may wish to complete their capstone project using their topic and research from Unit 4 in the previous semester. Students are welcome to choose this option, but all students should still take part in this lesson's brainstorming activities. Explain that it can't hurt to consider alternative ideas, and even students who are absolutely certain of their topic can help generate ideas for their classmates.

Slide 12: Students complete the **Formative Assessment**.

Formative Assessment

Have students respond to the following prompt:

Consider the ideas that you and your partner brainstormed, as well as the topic that you researched in Unit 4 last semester. Choose one of these ideas or topics and write a paragraph or two about how you might develop it into a capstone project. Be sure to explain how this project would relate to your career goals.

[DOK-L1, *match*]
[DOK-L1, *identify*]

Session 2

Slides 13-14: Complete the **Warm-Up** for Session 2.

Warm-Up

Show students the following video, which highlights careers in aviation. As they watch, students should note what training and education might be necessary for these careers.

- "Careers in Aviation" (Length 3:30)
  https://video.link/w/6m9ub
  For teachers unable to access VideoLink links, the video is also available here: https://www.youtube.com/watch?v=AQ75DC4WcS8

Following the video, use the following questions to support a class discussion:

1. What training and education might be necessary for the careers in the two aviation career videos you've seen in this lesson?

Student answers will vary. Below are possible responses for each of the careers mentioned in the video.

Pilot: flight training, college degree, flight experience (a certain number of flight hours), an instrument rating, commercial pilot certificate, Airline Transport Pilot certificate (for airline operations)

Air traffic controller: passing grade on ATC pre-employment test, specific FAA training

Airport operations: airport management college degree, work experience in a range of airport support jobs like like line operations (fueling, baggage handling) may be helpful, project management certificate

Airfield maintenance: Apprenticeship in a trade such as electrician, construction experience, OSHA (Occupational Safety and Health Association) training certificate, construction trades certifications (general contractor, plumbing contractor, etc.), ASE (Automotive Service Excellence) certifications, and related work experience are possible responses.

Aircraft rescue and fire fighting: fire science degree, fire fighting experience, EMT training and certification, paramedic training, heavy vehicle or commercial driver license

Law enforcement and security: law enforcement college degree, law enforcement training, specialized training such as use of sniffer dogs or Homeland Security training

Project management: project management college degree, project management certification(s) (e.g. Project Management Professional (PMP))

1. Do you already possess any of this training or education?

Answers may vary, but regardless of the career students in high school will likely require additional training and education. However, many students may already have met certain requirements: e.g., by passing tests such as the FAA Private Pilot Knowledge Test, apprenticing or interning with a professional, or gaining hours in aircraft or flight simulators.

[DOK-L3; *assess*]

Slide 15: The students have just finished brainstorming possible training and certification requirements for certain jobs. The next step is for them to see precisely what employers are looking for in job candidates. The next activity allows students to peruse job search sites and select a job that is of interest to them. The goal is to determine the exact

employment requirements for that job. They are also asked to assess their own education and experience to see how qualified they already may be for the selected job. Students then map out a path to obtaining the required education, certification, and experience they would need to apply for the job.

Distribute **What Is a Capstone? Student Activity 2**. Students should follow the instructions to complete the activity. Sample responses and additional support are found in **What Is a Capstone? Teacher Notes 2**.

Teaching Tips

This activity is intended as an exercise in career research, and is meant to help students understand the various levels of education, certification, training, and experience that might be required for a job they find interesting. Students should not worry that the career or the job posting that they choose in this exercise will necessarily steer the direction of their capstone project, however. They will not be obligated to research this career beyond this activity.

EXTEND

Teacher Material: What Is a Capstone? Presentation
Student Material: What Is a Capstone? Student Activity 3

Slide 16: In the previous activity, students considered qualifications and requirements to obtain a specific job. Students will now approach this topic from a slightly different perspective: credentials. Understanding how to obtain—and, over time, "stack"—credentials is an element of the capstone experience. Students may very well obtain an industry-recognized certificate or credential during their capstone project, and they should understand that it is part of the foundation they are building to support their career goals.

Credentials are achievements or qualifications that give someone the ability or authority to complete a task or pursue a goal. *Stackable credentials*, according to the U.S. Department of Labor, are "part of a sequence of credentials accumulated over time to build up an individual's qualification to help them move along a career pathway or up a career ladder to potentially different and higher paying jobs."

Questions

Why does the U.S. Department of Labor describe certain credentials as "stackable"? What does *stackable* mean in this context?

"Stackable" describes things that are stacked or layered on top of each other. Describing credentials as "stackable" should help students understand how credentials build up over time: broader credentials earned earlier in one's career provide a foundation for and support more-targeted credentials earned later.

For example, a student whose career goal is to become an airline pilot may earn their FAA Basic Ground Instructor certificate (BGI) as part of their capstone project. How does this "stack" toward the credentials required to meet that goal?

With a BGI, a student may be able to run an evening or weekend ground school class at a nearby flight school. This allows the student to build important relationships within the flight school. It may be possible for the student to exchange their work as a ground instructor for flight training time, and this would aid the student's effort to earn the next certification: a private pilot certificate. Beyond the private pilot certificate, the student is likely to train to be a flight instructor, and the

knowledge and experience gained by working as a ground instructor will be invaluable when working toward that goal. The BGI is again "stackable" in conjunction with the flight instructor certificate.

Slide 17: An important concept to recognize is that not all credentials contain equal weight. For example, a credential that is issued by a nationally-recognized certifying organization is likely to be viewed more favorably by employers than a credential that is exclusive to your school. In **What Is a Capstone? Student Activity 3**, students will recall various credentials that they have earned, and evaluate them using a credentials checklist. The checklist will help them to understand the value of these different credentials.

Distribute **What Is a Capstone? Student Activity 3**. As a class, read through the Credentials Checklist on the final page of the activity. Emphasize that not every criteria in the checklist is likely to apply to every credential. However, a quality credential will likely meet multiple criteria in the checklist.

To help students understand each criterion in the checklist, apply it to a commercial pilot certificate as an example. Ask students whether this certificate meets any of the criteria, and discuss why or why not. The purpose of using the commercial pilot certificate is to elicit a "yes" for each of the criteria. This highlights the valuable nature of that certificate; however, what happens when a student evaluates a credential, and only some of the boxes are marked "yes"? A credential may still be valuable, or stackable, when pursuing a particular career even if it does not "check all the boxes." In general, the more boxes that are checked, the more valuable the credential may be in the pursuit of a particular career.

EVALUATE

Teacher Materials: What Is a Capstone? Presentation, What Is a Capstone? Rubric
Student Material: What Is a Capstone? Student Activity 3

Slide 18: Conduct the **Summative Assessment**.

Summative Assessment

Students should complete **What Is a Capstone? Student Activity 3**. Students will identify various credentials they have earned thus far and use the Credentials Checklist to evaluate them. Use the **What Is a Capstone? Rubric** to evaluate students' work.

[DOK L-3; *organize*]

STANDARDS ALIGNMENT

COMMON CORE STATE STANDARDS

- **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*.
- **RST.11-12.7** - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

- **RST.11-12.9** - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- **WHST.11-12.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **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.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research.
- **WHST.11-12.10** - Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

REFERENCES

- https://cte.ed.gov/initiatives/stackable-credentials-tool-kit
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- http://otc.umd.edu/inventors/lab-notebooks
- https://www.edglossary.org/capstone-project/
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- https://www.indeed.com/jobs?q=Pilot%20on%20C-130%20Hercules%20aircraft%20Full%20Job%20Description%20Pilot%20on%20Lockheed%20C-130%20Hercules%20aircraft%20based%20at%20Phoenix-Mesa%20Gateway%20Airport%20in%20Mesa%2C%20Arizona%20USA&l&vjk=2bbe7e8a07bcaa08
- https://www.credentialingexcellence.org/blog/5-things-you-should-know-about-stackable-credentials
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