Commercial Air Travel

Session Time: Two, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Appreciate the rich, global history of aviation/aerospace and the historical factors that necessitated rapid industry development and expansion. (EU1)

Aspire to the highest level of technical proficiency as it relates to flight operations and engineering practices. (EU5)

ESSENTIAL QUESTIONS

1. What social changes did the development of commercial jet aircraft foster?
2. How do technological advancements in commercial jet travel affect humankind?

LEARNING GOALS

Students Will Know

- The factors involved in the growth of commercial air travel
- Major innovations in commercial air travel and the benefits and impacts they had on the airlines, passengers and society in general

Students Will Be Able To

- *Explain* how and why jet engine use for military purposes led to civilian applications. (DOK-L2)
- *Summarize* the impact of advancements made in commercial air travel. (DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
Students discuss their current understanding of the impact that commercial air travel has had on society.

Formative Assessment
Students consider how modern air travel would be different if key events in the history of commercial aviation had not occurred.

Summative Assessment
Students weigh the costs and benefits of large commercial aircraft and consider where limitations on air travel exist.

LESSON PREPARATION

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MATERIALS/RESOURCES

- Commercial Air Travel Presentation
- Commercial Air Travel Student Activity 1
- Commercial Air Travel Student Activity 2

Timeline Activity

- Rolled paper
- Markers

LESSON SUMMARY

Lesson 1: Development of the Jet Engine

Lesson 2: Commercial Air Travel

The first session will begin by asking students informal questions about the impact that commercial air travel has had on society.

As a way to explore commercial air travel's beginnings, they will learn about the changes in aircraft design as a response to the development of the jet engine. Students will research innovations that define the growth of commercial air travel and will explain how those innovations benefited airlines, passengers, or society in general.

In session two, students will work together as a class to build a comprehensive commercial aviation timeline by adding the innovations they identified to a large timeline on the wall. At the end of the activity, the students will have developed a comprehensive view of the growth of commercial air travel.

Finally, the teacher will ask students to answer questions about the future of commercial air travel and what, if any, limitations exist in its development.

BACKGROUND

The exponential growth of commercial air travel has profoundly changed society. It has made travel safer. In fact, commercial air travel has the best safety record of any transportation type. It has also made travel quicker and easier. Millions of people now move around the globe each year on airlines, compared with just one passenger on the first commercial airline flight, between the Florida cities of St. Petersburg and Tampa in 1914.

As a result, the world economy has grown exponentially. Commercial air travel brings people together from around the world, and it has facilitated faster and less expensive trade. In addition, the industry employs millions of people and drives immense economic benefit. According to the trade association Airlines for America, the U.S. airline industry employs more than 10 million people and is responsible for creating $1.5 trillion in economic activity each year.

It has taken a little more than 100 years to get here. When students understand the innovations and technologies built into commercial air travel, they will be able to better appreciate the impact that reliable, safe air travel has had on the world.

DIFFERENTIATION

To support verbal reasoning in the class discussion in the **EXPLORE** section of the lesson plan, organize the class into groups for Think-Pair-Share instead of a whole group discussion. This allows learners to think about the question, discuss their thoughts with a partner before sharing with the larger group. It encourages all students to participate and practice skills, including metacognition.

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To promote reflective thinking and guided inquiry in the **EXPLAIN** section of the lesson plan, circulate around the classroom and assist students who might have trouble coming up with ideas for the activity. Ask questions that provoke their own ideas for possible answers.

LEARNING PLAN

ENGAGE

Teacher Material: Commercial Air Travel Presentation

Slides 1-3: Introduce the topic and learning objectives for today's lesson.

Slide 4: Conduct the **Warm-Up.** Allow up to five minutes for the warm-up and grade according to completeness and participation. [DOK 1; recall]

Questions

What factors had the greatest impact on commercial air travel?

Improvements in safety, efficiency, speed, and power have allowed the development of modern commercial airliners, which can transport hundreds of people thousands of miles in just a few hours.

How were industries impacted by the growth of commercial air travel?

Airplanes make transporting supplies and products to remote places much easier. The ability of people to travel long distances quickly enabled improved collaboration and international cooperation.

There are no further advancements needed in commercial air travel. True or false?

Even though airlines are the safest form of mass transit, there are always safety improvements to make. Opportunities for improvement also exist in fuel efficiency, environmental impact, and passenger comfort.

Warm-Up

Ask the class each of the following questions. Have students suggest and discuss their answers. Probe students for explanations or reasoning when they provide an answer or challenge another student's answer.

- What factors had the greatest impact on commercial air travel?
- How were industries impacted by the growth of commercial air travel?
- No further advancements are needed in commercial air travel. True or False?

EXPLORE

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Teacher Material: Commercial Air Travel Presentation
Student Material: Commercial Air Travel Student Activity 1

Slide 5: Show the video "Engineering the Jet Age," which connects the use of military jet aircraft to the commercial jet age. Boeing's president at the time, Bill Allen, had a vision for commercial airline travel and took on immense risk to fulfill it. Have students complete the video guide **(Commercial Air Travel Student Activity 1),** and discuss and share their answers with the class.

- "Engineering the Jet Age" (Length 5:25)
  https://florida.pbslearningmedia.org/resource/aeroeng-sci-eng-jetage/engineering-the-jet-age/#.WRSCo-XyteV

Questions

Which airplane took the Air Force into the jet age?

The B-47 bomber.

Why was redesigning the B-47 jet into a passenger airplane a risky idea?

Bill Allen took on immense financial risk in designing and manufacturing an airplane that Boeing didn't know whether airlines wanted to buy. The general population still feared jet travel, and airlines weren't ready to give up their propeller- driven airplanes.

What industry was most impacted by the development of the Boeing 707?

Commercial air travel.

In your opinion, how has the Boeing 707 impacted society?

The B-707 launched the world into the commercial jet age, and we became a much more global society. Commercial jets made travel safer; they made travel quicker and easier; they expanded the economy by bringing people and cultures together and allowing for faster trade.

EXPLAIN

Teacher Material: Commercial Air Travel Presentation
Student Material: Commercial Air Travel Student Activity 2

Slides 6-7: Explain to students that innovations were not just limited to advancements in the jet engine itself but also included all of the related components, such as the avionics and airframes.

The largest hurdle in the beginning of the jet age was that there were no aircraft designs that could structurally take full advantage of the power and performance that jet engines offered. The Germans were the first to realize this, and developed the swept wing design. Before the German swept wing designs, aircraft wings were perpendicular and straight out from the fuselage.

This was okay until aircraft speed approached the speed of sound. As the airspeed over the top of the wing reached these high speeds, it would cause vibrations due to shock waves, rendering the aircraft almost uncontrollable. The swept wing design delayed the impact of the shock waves at higher speeds and allowed aircraft to take advantage of the power and performance of the evolution of jet engines.

Show students a video that synthesizes the origination of the swept wing design.

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- "Design Innovation for Jet-Powered Flight: The Swept Wing" (Length 5:44) https://florida.pbslearningmedia.org/resource/aeroeng-sci-eng-sweptwing/design-innovation-for-jet-powered-flight-the-swept-wing/?#.WxFxPUgvyUk

Slide 8: Swept wings were just one of the advancements that came about with the jet engine. Provides students with Commercial Air Travel Student Activity 2 where they will work individually to research innovations and milestones that define the growth of commercial air travel throughout history.

In this activity, have students discover at least one innovation for each defined time period. In addition to identifying and describing the innovations they select, they will write brief explanations of what benefit they brought to airlines, passengers or society, in general.

Encourage your students to think outside the box! The innovations that students identify can be anything from specific new technologies incorporated into airplanes that made flying safer or more efficient to new airplane types or even technologies that improved the passenger experience.

Some ideas include: the first all-metal airplanes, the structure of airplanes, avionics, two-way radio communications, the use of flight simulators for pilot training, the introduction of air traffic control, the first jetliner, supersonic airplanes for passenger travel, low-cost airline business models, the addition of winglets, the swept wing, pressurized cabins, GPS navigation, all-composite airplanes, electronic ticketing, internet access on airplanes, passenger comfort, and many more!

Teaching Tips

You may ask students to work in pairs or small groups to compile their answers.

EXTEND

Teacher Material: Commercial Air Travel Presentation

Slide 9: At the beginning of the second session, students will work together as a class to build a comprehensive commercial aviation timeline.

Affix a long piece of rolled paper to a wall and draw a blank timeline on it. With markers, students will fill in the timeline with the innovations they identified in the "Commercial Aviation Grows!" activity. Some students will have identified the same innovations. If there are discrepancies in the years when students believe their milestones were achieved, have them "prove" their answers before marking the milestone on the paper.

As each innovation is added to the timeline, ensure that students discuss the impact and benefits that each advancement had on airlines, passengers and society, in general.

At the end of the activity, provide highlights for events on the timeline. Ask students what types of innovations they think may come 10 years from now and 20 years from now.

Slide 10: Conduct the Formative Assessment. Divide students into small groups. Assign each group one of the events on the aviation timeline and have them answer the question, "If your assigned event had not taken place, how would modern commercial air travel be different?" The groups should write a summary of their response along with justification for their prediction. Allow for a brief discussion.

Collect student and grade up to 10 points based on completeness and group participation, [DOK 3; hypothesize, cite evidence]

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Formative Assessment

In small groups, assign students one or more of the events on the timeline. They should answer the question, "If your assigned event had not taken place, how would modern commercial air travel be different?" Groups should discuss the hypothetical situation for five minutes and then write a short summary of their prediction.

EVALUATE

Teacher Material: Commercial Air Travel Presentation

Slide 11: Conduct the **Summative Assessment** to conclude the lesson. [DOK 2-3; summarize, predict, construct]

Summative Assessment Scoring Rubric

- Question 1 includes at least one benefit of large aircraft.
- Question 1 includes at least one example supporting the identified benefit of large aircraft.
- Question 2 includes at least one negative consequence of large aircraft.
- Question 2 includes at least one example supporting the identified negative consequence of large aircraft.
- Question 3 includes a clear statement of whether there is an upper limit on the size of commercial aircraft AND a logical justification for the statement.

Points	Performance Levels
9-10	Consistently demonstrates criteria
7-8	Usually demonstrates criteria
5-6	Sometimes demonstrates criteria
0-4	Rarely or never demonstrates criteria

Summative Assessment

Remind the class that the first commercial airline flight had room for only one passenger and that today, an Airbus A380--a double decker airliner--is certified to carry 853 passengers. Keeping this in mind, students should write two to three sentence responses to the following four questions.

- What benefits do large aircraft bring to society?
- What are some of the negative consequences of large aircraft?
- Do you think there is an upper limit on how big commercial aircraft can become and how many people they can carry?

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GOING FURTHER

Research why the Concorde is no longer flying. Ask students to develop an educated opinion on whether there will be supersonic passenger flight again in the future.

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-dimensional Learning

- **HS-ETS1-1** - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
    - 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
        - Influence of Science, Engineering, and Technology on Society and the Natural World
- **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.9-10.1** - Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- **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.
- **RST.9-10.7** - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

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- **WHST.9-10.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **WHST.9-10.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **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.9-10.7** - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **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.

REFERENCES

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http://www.airspacemag.com/flight-today/how-things-work-cabin-pressure-2870604/

http://www.airbus.com/aircraft/passenger-aircraft/a380-family/cabin.html

http://airlines.org/

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