ACCIDENT CASE STUDY

UNIT 6
Aviation Safety and Oversight

SECTION B
Accident Investigation

TIME OF LESSON
Three, 50-minute periods

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Historically, aviation and aerospace technology have evolved as concerns about efficiency and safety have been addressed. (EU1)

Innovators in the world of aviation used combinations of engineering design and the scientific process to advance aviation technology, procedures and, ultimately, make aviation safe. (EU2)

Government agencies work to make aviation and aerospace safer and more efficient. (EU4)

ESSENTIAL QUESTIONS

1. Can we really know what went wrong in an aviation accident?
2. Why is the NTSB an independent government entity?

Students Will Know

- How to apply the aircraft accident investigation process to actual aircraft accidents
- Various limitations or challenges to conducting an effective investigation of this accident
- What kind of safety recommendations might result from accident investigations

Students Will Be Able To

- *Define* an aircraft accident. (DOK-L1)
- *Describe* the role of the NTSB during an aircraft accident investigation. (DOK-L2)
- *List and describe* the general elements related to the aircraft accident investigation process. (DOK-L2)
- *Formulate* various safety recommendations that might result from accident case studies. (DOK-L3)

ASSESSMENT EVIDENCE

Pre-Assessment Students will review the parts and functions of the NTSB "Go Team," along with the general investigative process, in order to support the simulated aircraft accident investigation within this lesson.

Formative Assessment Students will conduct a mock investigation as a member of an NTSB "Go Team." Each student will be assigned to a specific area of the investigation.

Post-Assessment Each "Go Team" will present its list of contributing factors and recommendations to the class.

INSTRUCTION AND FORMATIVE ASSESSMENT PLAN

Materials/Resources Needed

Lesson Resources

- 6.B.Day 4-6 POWERPOINT 1
- 6.B.Day 4-6 STUDENT ACTIVITY 1
- 6.B.Day 4-6 STUDENT ACTIVITY 2
- 6.B.Day 4-6 TEACHING NOTES 1

Lesson Summary

This lesson covers the last three days of Unit 6, Section B. Section B comprises six days.

Day 1-3: The Investigative Process
Day 4-5: Accident Case Studies

This section will promote the practice of conducting an aircraft accident investigation. To assess what knowledge students have retained since the previous lesson, group students in teams of 3-4 and ask them to work together to recall and list the seven different elements of a "Go Team" and the four major stages of an accident investigation.

In a class discussion, students will debate whether an aircraft accident investigation will always result in knowing what caused the accident.

Students will join their own "Go Team" and have an opportunity to evaluate an accident case study. The third day of this lesson will be devoted to groups planning five-minute presentations in which they will share their "findings" and "recommendations" upon completing the activity.

Background

If necessary, review the parts of an NTSB "Go Team" and an aircraft investigation using **6.B.Day 1-3 TEACHING NOTES 1**.

Please refer to **6.B.Day 4-6 TEACHING NOTES 1** for sample findings, sample recommendations and other answers to the questions students will be discovering throughout their own case study. It also includes an executive summary of the accident case study that is being used in this lesson.

Learning Activity	Assessment
Engage To assess what knowledge students have retained since the previous lesson, group students in teams of 3-4 and ask them to work together to recall and list: 1. *The seven different elements of a "Go Team"* 2. *The four major stages of an accident investigation* Refer to **6.B.Day 4-6 POWERPOINT 1** to review the key elements of these topics from the previous lesson. Inform the class that during this lesson, they will be studying real aircraft accidents and simulating the roles and the process used by the NTSB.	**Pre-Assessment** Students will review the parts and functions of the NTSB "Go Team," along with the general investigative process, in order to support the simulated aircraft accident investigation within this lesson.

Explore

Refer to **6.B.Day 4-6 POWERPOINT 1**. Ask the class: *Will an aircraft accident investigation always result in us knowing what really caused the accident?*

Allow students to briefly think about this question and explain their reasoning. Teachers may supplement their answers with the following:

> *Accident investigations are designed to find "probable cause," which does not necessarily mean that the actual or all causes will be determined due to the many factors the investigation may not be able to uncover. However, the investigation does provide a fairly accurate account of factual data, which can be used to improve safety and thus prevent similar accidents in the future. This is the theme of this lesson and the upcoming accident investigation exercises.*

Explain

Students will join their own "Go Teams" and have an opportunity to evaluate an accident case study. Each team will present its "findings" and "recommendations" upon completing the activity.

Split the students into teams of seven. Each student will be assigned a "Go Team" responsibility. If a team has less than seven members, some students will need to accept more than one responsibility.

Give each student the activity sheet (**6.B.Day 4-6 STUDENT ACTIVITY 1**) and provide each "Go Team" an accident information packet (**6.B.Day 4-6 STUDENT ACTIVITY 2**).

Refer to **6.B.Day 4-6 POWERPOINT 1** to set up the activity. Show the students a video animation of the accident flight after they review the accident information packet, which includes a timeline of the flight and important terms and definitions.

"Colgan 3407 NTSB Animation" (Length 3:38)

https://www.youtube.com/watch?v=vMy8kZ2_TMs

Extend

Students should take the following steps to complete the activity. The activity and presentations will extend into the second and third day of the lesson.

Ask students who they believe has a role in safety in this scenario? Possible answers include:

1. Using the reanimation video and the information provided in the accident packets, each team member should evaluate their areas of responsibility.
2. Teams then will regroup and compile the information below. Teachers should review these items before students move to the next step. Refer to **6.B.Day 4-6 TEACHING NOTES 1**.

Formative Assessments

Students will conduct a mock investigation as a member of an NTSB "Go Team." Each student will be assigned to a specific area of the investigation.

Identify at least three factors that may have contributed to the accident:

- *Pilot failure to monitor flight instruments properly*
- *Pilot's inappropriate response to the activation of the stick shaker, indicating that the airplane was stalling from too slow of an airspeed*
- *Lack of training involving the stick shaker and how to respond to low airspeed ques*
- *Icing conditions that cause the airplane to stall at a higher than normal airspeed*
- *Pilots being distracted by conversation not pertinent to the flight, lack of pilot professionalism*
- *Pilot fatigue (due to commuting from Seattle), late-night flying and possible illness*

List the limitations or challenges that would have been factors in conducting an effective investigation of this accident:

- *Location is a rural area of residential homes*
- *Severity of the wreckage and post-crash fire*

Based on what you learned about the party system in the last lesson, name at least three other parties that might be brought into this investigation.

- *Colgan Air*
- *Bombardier*
- *Engine, propeller manufacturers*
- *Air traffic controllers*
- *Other system and component manufacturers -- avionics, deicing systems*
- *Airline pilot union*

3. Students then will identify several safety recommendations that their "Go Team" creates as a result of their investigation:
    - *Improved training on proper aircraft control during low-speed flight and proper monitoring of flight instruments*
    - *Improved training on stick-pusher operations and pilot response*
    - *Improved training and adherence to sterile cockpit rules*
    - *Improved leadership training for captains, including professional standards and codes of conduct*
    - *Airline to address fatigue risks brought about by commuting, illness and late flights*

Evaluate

Each team will prepare a five-minute presentation to share its findings. This should include what they believe the contributing factors are and recommendations to the class. Each member of the "Go Team" should play a part in the presentation.

Post-Assessment

Each "Go Team" will present its list of contributing factors and recommendations to the class.

Differentiation

The collaborative-group learning activity should give students the opportunity to capitalize on their strengths in the amount they contribute to the group's work while also allowing the group to delegate tasks based on these strengths.

Going Further

Encourage students to explore other aircraft accidents and compare their own assessments of probable cause and safety recommendations to that of what is reported by the NTSB. One example is the "Miracle on the Hudson". https://www.ntsb.gov/investigations/AccidentReports/Pages/AAR1005.aspx

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-ETS1-2 -** 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 a 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
    - Influence of Science, Engineering, and Technology on Society and the Natural World

- **HS-ETS1-4 -** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
  - Science and Engineering Practices
    - Using Mathematics and Computational Thinking
  - Disciplinary Core Ideas
    - ETS1.B: Developing Possible Solutions
  - Crosscutting Concepts
    - Systems and System Models

COMMON CORE STANDARDS

- **RST.9-10.2 -** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.4 -** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- **WHST.9-10.2 -** 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

https://www.ntsb.gov/Pages/default.aspx

https://www.ntsb.gov/investigations/process/Documents/MajorInvestigationsManual.pdf

https://www.ntsb.gov/investigations/process/Documents/MajorInvestigationsManualApp.pdf

https://www.ntsb.gov/investigations/AccidentReports/Pages/AAR1005.aspx

https://www.ntsb.gov/investigations/AccidentReports/Pages/AAR1001.aspx