



Accident Case Study



Session Time: Three, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Understand the operational differences between general, commercial, and military aviation as well as how these differences influence the modern aviation/aerospace industry. (EU2)

Understand the importance of professionalism, ethics, and dedication as they related to all aviation/aerospace operations. (EU4)

Develop an uncompromising safety mindset, understanding that growth and development in the aviation/aerospace industry must always be accompanied by responsive safety initiatives. (EU6)

ESSENTIAL QUESTIONS

1. Can we really know what went wrong in an aviation accident?
2. Why investigate aircraft accidents?

LEARNING GOALS

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
- Kinds of safety recommendations might result from accident investigations

Students Will Be Able To

- *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

Warm-up

Students review the roles and functions of an NTSB “Go Team,” along with the general investigative process, in order to support the simulated aircraft accident investigation within this lesson.

Formative Assessment

Students discuss if aircraft accident investigation will always result in knowing what caused the accident.

Students identify at least three factors that may have contributed to the accident, list the limitations or challenges that would have been factors in conducting an effective investigation of this accident, name at least three other parties that

might be brought into this investigation, and identify three safety recommendations that have come as a result of their investigation.

Summative Assessment

Each “Go Team” will present their accident investigation findings and recommendations to a “review board” who will ask probing and clarifying questions.

LESSON PREPARATION

MATERIALS/RESOURCES

- [Accident Case Study Presentation](#)
- [Accident Case Study Student Activity](#)
- [Accident Case Study Teacher Notes](#)

LESSON SUMMARY

Lesson 1: The Investigative Process

Lesson 2: Accident Case Study

This lesson 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 three to four 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 dive deeper into the process of aircraft accident investigations in the remainder of the lesson by studying a real accident and simulating the roles and the investigation process used by the NTSB. Each student will be part of their own “Go Team.”

In the final session of this lesson, each “Go Team” will present their accident investigation findings and recommendations to a “review board” who will ask probing and clarifying questions.

BACKGROUND

Students will study Colgan Air Flight 3407 in this accident case study.

On Feb. 12, 2009, about 10:17 p.m. Eastern Standard Time, a Colgan Air Bombardier DHC-8-400, N200WQ, operating as Continental Connection Flight 3407, was on an instrument approach to Buffalo-Niagara International Airport in New York when it crashed into a residence in Clarence Center, N.Y., about 5 nautical miles northeast of the airport. The two pilots, two flight attendants and 45 passengers aboard the airplane died, one person on the ground died, and the airplane was destroyed by impact and fire.

If necessary, review the parts of an NTSB “Go Team” and an aircraft investigation using **Accident Case Study Teacher Notes**.

Refer to the teacher notes for sample findings, sample recommendations, and other answers to the questions students will be discovering throughout their own case study. It also included an executive summary of the accident case study that is being used in this lesson.

DIFFERENTIATION

To support guided inquiry in the **EXTEND** section of this lesson plan, circulate around the classroom while students are working in their “Go Team” to ask questions that provoke deeper thinking that fosters a growth mindset.

LEARNING PLAN

ENGAGE

Teacher Material: [Accident Case Study Presentation](#)

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

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

Warm-Up

Group students in teams of 3-4. Using what students learned in the previous lesson, ask them to work together to recall and list the seven different elements of an NTSB "Go Team" and the four major stages of an NTSB accident investigation.

Inform students that during this lesson, they will be studying real aircraft accidents and simulating the roles and the process used by the NTSB. As a class, review students' answers. Record the correct components and stages on the board and ask students to briefly define or describe each one.

This warm-up is worth 5 points.

[DOK-L1; *recall*]

Slides 5-6: Use these slides to review the answers to the Warm-Up.

Answers:

"Go Team" components:

- *Operations: The history of the accident flight and crewmembers' duties for as many days prior to the crash as appears relevant.*
- *Structures: Documentation of the airframe wreckage and the accident scene, including calculation of impact angles to help determine the airplane's pre-impact course and attitude.*
- *Powerplants: Examination of engines (and propellers) and engine accessories.*
- *Systems: Study of components of the airplane's hydraulic, electrical, pneumatic and associated systems, together with instruments and elements of the flight control system.*
- *Air traffic control: Reconstruction of the air traffic services provided to the pilot, including acquisition of ATC radar data and transcripts of controller-pilot radio transmissions.*
- *Weather: Gathering of all pertinent weather data from the National Weather Service, and sometimes from local TV stations, for a broad area around the accident scene.*
- *Human performance: Study of crew performance and all before-the-accident factors that might be involved in human error, including fatigue, medication, alcohol, drugs, medical histories, training, workload, equipment design, and work environment.*

Four Major components of an NTSB accident investigation:

- *Notification and initial response: the NTSB Go Team is formed*
- *On-scene activities: preserve, collect, record, and report*
- *Post on-scene activities: analyze, prepare, present, and publish*
- *Safety recommendation: research, test, develop, and publish*

EXPLORE

Teacher Material: [Accident Case Study Presentation](#)

Slide 7: Show students the first four to five minutes of NTSB Board Member Bella Dihn-Zarr's media briefing on the crash of a private charter helicopter hired for a photoshoot over New York City in March 2018. The helicopter crashed into New York City's East River and flipped upside down in the water, killing all five passengers aboard. The pilot freed himself and was rescued.

- NTSB Member Dinh-Zarr's Media Briefing on the East River, NYC (Length 16:03, play the first 4-5 mins)
<http://video.link/w/kqLd>

Formative Assessment

After watching the video, ask students to write a paragraph in response to the following question. Ask students to be prepared to share their answers and reasoning.

- Will an aircraft accident investigation always result in us knowing what really caused the accident?

Supplement student answers as needed 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.

[DOK-L3; summarize, draw conclusions]



Teaching Tips

Optional Approach: Instead of working independently, ask students to work in pairs or small groups to compile and present their answers.

EXPLAIN

Teacher Materials: [Accident Case Study Presentation](#), [Accident Case Study Teacher Notes](#)

Student Material: [Accident Case Study Student Activity](#)

Slide 8: Throughout the rest of this lesson, students will join their own "Go Teams" and have an opportunity to evaluate Colgan Air Flight 3407. 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.

- Operations
- Structures
- Powerplants
- Systems
- Air traffic control
- Weather
- Human performance

Provide each student with **Accident Case Study Student Activity**.

Slide 9: Review the accident scenario with the students. Students can also refer to **Accident Case Study Student Activity**.

Slide 10: Show students an NYTB video with a reanimation of the accident and a recording of the air traffic control communications.. Tell students to listen for “Colgan 3407.”

- Colgan 3407 NTSB Animation (Length 3:38)
<http://video.link/w/esLd>

EXTEND

Teacher Materials: [Accident Case Study Presentation](#), [Accident Case Study Teacher Notes](#)

Student Material: [Accident Case Study Student Activity](#)

Slide 11-12: Students should use the following steps and record their responses in the **Accident Case Study Student Activity**. The activity and presentations will extend into the second and third sessions of the lesson.

Step 1: Each member of your team will choose one element of the “Go Team.” If you have less than seven members, some students will need to accept more than one “Go Team” responsibility.

Step 2: Using the reanimation video and the information provided in the accident packets, each team member should evaluate their own areas of responsibility. If desired, students may use the internet to complete additional research.

Steps 3 and 4: Students will complete steps 3 and 4 as the **Formative Assessment**. This formative assessment is worth 10 points.

[DOK-L3; *construct, draw conclusions*]

Possible answers include:

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*
- *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*

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*
- *Accident occurred at night. NTSB investigators and first responders would have arrived at the scene and completed its first hours of work in the dark.*

Other parties that might be brought into this investigation.

- *Colgan Air (airline)*
- *Bombardier (aircraft manufacturer)*
- *Engine, propeller manufacturers*
- *Air traffic controllers*
- *Other system and component manufacturers – avionics, deicing systems*
- *Airline pilot*

Likely safety recommendations:

- *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*

Formative Assessment

Step 3: After students complete their own individual research, each “Go Team” should regroup and identify at least three factors that may have contributed to the accident, list the limitations or challenges that would have been factors in conducting an effective investigation of this accident, and name at least three other parties that might be brought into this investigation. Ask students to review these items with their teacher before moving on to step 4.

Step 4: Each “Go Team” should identify three safety recommendations that have come as a result of their investigation.

EVALUATE

Teacher Materials: [Accident Case Study Presentation](#), [Accident Case Study Teacher Notes](#)

Student Material: [Accident Case Study Student Activity](#)

As step 5 of the accident case study, each “Go Team” will present their accident investigation findings and recommendations to a “review board” who will ask probing and clarifying questions. Allow 5 minutes for each team to present and 5 minutes for the review board to ask questions. This final step is the summative assessment for this lesson.

Slide 13: Conduct the **Summative Assessment**.

Summative Assessment

Each “Go Team” presentation should include the group’s conclusions regarding the following:

- An assessment of the factors that contributed to the accident
- Uncertainties or unanswered questions that remain regarding accident
- At least two recommendations for preventing similar accidents

Presentations should be no more than 5 minutes long. The class will listen to each presentation and then ask questions of the presenter(s). Questions should be respectful and constructive and should focus on clarifying and critiquing the content of the presentation. Each question and answer session should take no more than 5 minutes.

[DOK-L3; *critique, assess*]

Use the 10-Point Scoring Rubric for grading.

10-Point Scoring Rubric for Presenters:

- Presentation identifies factors that contributed to the accident. (2 points)
- Presentation identifies uncertainties and unanswered questions about the accident. (2 points)
- Presentation includes two or more recommendations for preventing similar accidents. (1 point per recommendation, maximum of 2 points total)
- Presentation is no more than 5 minutes long. (1 point)
- Presenter(s) answers questions appropriately, demonstrating understanding of the group’s findings. (3 points)

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.nts.gov/investigations/AccidentReports/Pages/AAR1005.aspx>

For an NTSB presentation about Colgan Air 3407, use <https://www.nts.gov/news/speeches/RSumwalt/Documents/SCAA-100212.pdf>

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 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
 - 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 realworld problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
 - Science and Engineering Practices
 - Using Mathematical and Computational Thinking
 - Disciplinary Core Ideas
 - ETS1.B: Developing Possible Solutions
 - Crosscutting Concepts
 - Systems and System Models

COMMON CORE STATE 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.
- **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.
- **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.nts.gov/Pages/default.aspx>

<https://www.nts.gov/investigations/process/Documents/MajorInvestigationsManual.pdf>

<https://www.nts.gov/investigations/process/Documents/MajorInvestigationsManualApp.pdf>

<https://www.nts.gov/investigations/AccidentReports/Pages/AAR1005.aspx>

<https://www.nts.gov/investigations/AccidentReports/Pages/AAR1001.aspx>