AOPA'S HIGH SCHOOL

AVIATION STEM CURRICULUM

Cindy Hasselbring, Sr. Director, High School

Aviation Initiative, AOPA

AOPA HIGH SCHOOL AVIATION INITIATIVE

Increase student awareness of and engagement in career opportunities in aviation and aerospace.

1. **High School Aviation STEM Curriculum**
2. **Annual High School Aviation STEM Symposium**
3. **High School Flight Training Scholarship Program**

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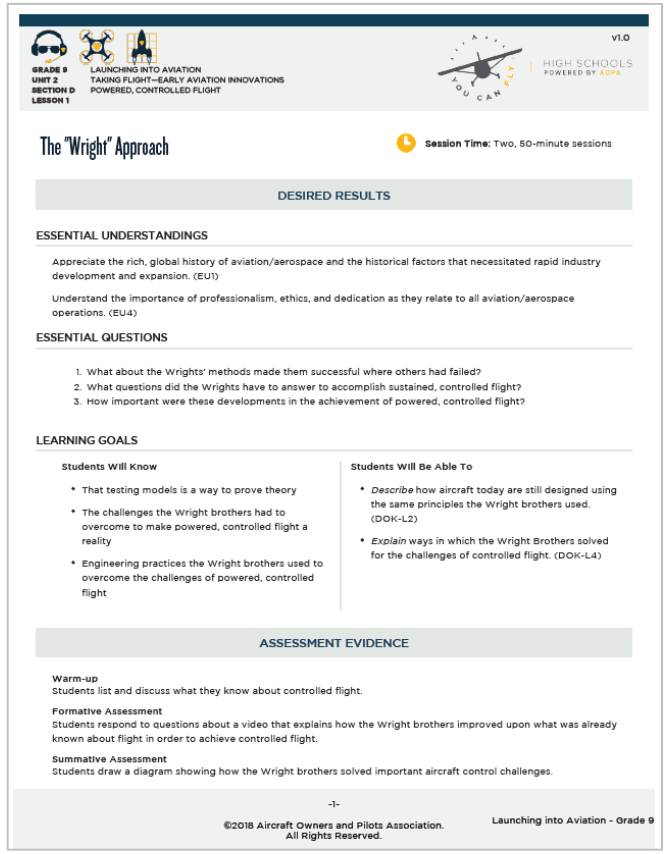
HIGH SCHOOL AVIATION STEM CURRICULUM

- **2 career pathways – Pilot, UAS**
- **Offering four years of curriculum – schools can decide how many courses to implement**
- **To be used as a credit-bearing course during the school day**
- **Prepare students for FAA written tests**
  - Private pilot
  - Part 107 remote pilot
- **Thanks to donations to the AOPA Foundation, this curriculum is offered at no charge to high schools.**

WHAT'S INCLUDED?

- **Lesson plans**
- **Presentations**
- **Student activities**
- **Student projects**
- **Student assessments**
- **Teacher notes**
- **Teaching aids**



GRADE 9
UNIT 2
SECTION D
LESSON 1

LAUNCHING INTO AVIATION
TAKING FLIGHT—EARLY AVIATION INNOVATIONS
POWERED, CONTROLLED FLIGHT

v1.0

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The "Wright" Approach

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)

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

ESSENTIAL QUESTIONS

1. What about the Wrights' methods made them successful where others had failed?
2. What questions did the Wrights have to answer to accomplish sustained, controlled flight?
3. How important were these developments in the achievement of powered, controlled flight?

LEARNING GOALS

Students Will Know

- That testing models is a way to prove theory
- The challenges the Wright brothers had to overcome to make powered, controlled flight a reality
- Engineering practices the Wright brothers used to overcome the challenges of powered, controlled flight

Students Will Be Able To

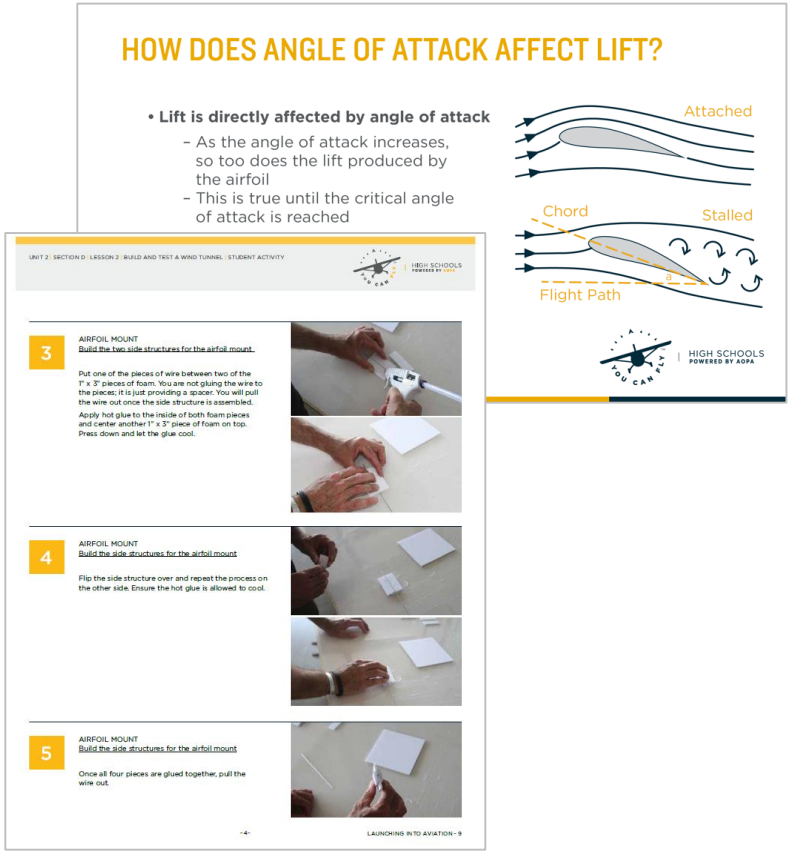
- *Describe* how aircraft today are still designed using the same principles the Wright brothers used. (DOK-L2)
- *Explain* ways in which the Wright Brothers solved for the challenges of controlled flight. (DOK-L4)

ASSESSMENT EVIDENCE

Warm-up
Students list and discuss what they know about controlled flight.

Formative Assessment
Students respond to questions about a video that explains how the Wright brothers improved upon what was already known about flight in order to achieve controlled flight.

Summative Assessment
Students draw a diagram showing how the Wright brothers solved important aircraft control challenges.



HOW DOES ANGLE OF ATTACK AFFECT LIFT?

- **Lift is directly affected by angle of attack**
  - As the angle of attack increases, so too does the lift produced by the airfoil
  - This is true until the critical angle of attack is reached

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3 AIRFOIL MOUNT
Build the two side structures for the airfoil mount.

Put one of the pieces of wire between two of the 1" x 3" pieces of foam. You are not gluing the wire to the pieces; it is just providing a spacer. You will pull the wire out once the side structure is assembled.

Apply hot glue to the inside of both foam pieces and center another 1" x 3" piece of foam on top. Press down and let the glue cool.

4 AIRFOIL MOUNT
Build the side structures for the airfoil mount

Flip the side structure over and repeat the process on the other side. Ensure the hot glue is allowed to cool.

5 AIRFOIL MOUNT
Build the side structures for the airfoil mount

Once all four pieces are glued together, pull the wire out.

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AOPA CURRICULUM PATHWAYS

	GRADE 9		GRADE 10		GRADE 11		GRADE 12	
	SEMESTER 1	SEMESTER 2	SEMESTER 1	SEMESTER 2	SEMESTER 1	SEMESTER 2	SEMESTER 1	SEMESTER 2
PILOT	LAUNCHING INTO AVIATION	EXPLORING AVIATION & AEROSPACE	INTRODUCTION TO FLIGHT	AIRCRAFT SYSTEMS	PRIVATE PILOT FUNDAMENTALS I	PRIVATE PILOT FUNDAMENTALS II	AVIATION SAFETY	PILOT CAPSTONE
UNMANNED AIRCRAFT SYSTEMS	LAUNCHING INTO AVIATION	EXPLORING AVIATION & AEROSPACE	INTRODUCTION TO FLIGHT	AIRCRAFT SYSTEMS	UAS OPERATIONS I	UAS OPERATIONS II	UAS DESIGN & APPLICATIONS	UAS CAPSTONE

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AOPA CURRICULUM DEVELOPMENT TIMELINE

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
GRADE 9	DEVELOP COURSES	FIELD TEST	IMPLEMENT			
GRADE 10		DEVELOP COURSES	FIELD TEST	IMPLEMENT		
GRADE 11			DEVELOP COURSES	FIELD TEST	IMPLEMENT	
GRADE 12				DEVELOP COURSES	FIELD TEST	IMPLEMENT

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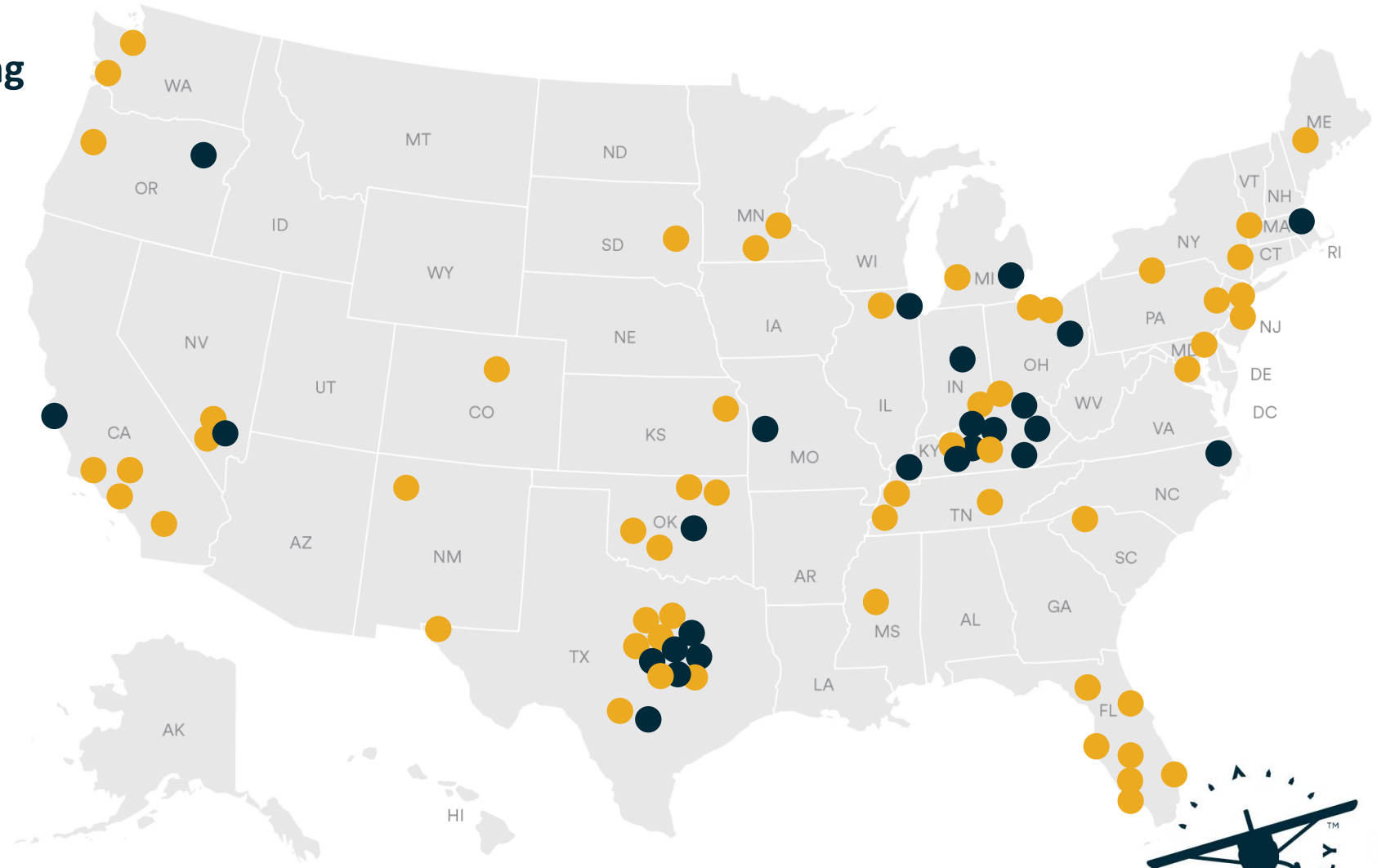
GRADES 9 AND 10 PARTICIPATION, 2018-19

80 schools using ninth grade curriculum



● = **GRADE 9** PARTICIPATION 2018-19

● = **GRADE 10** PARTICIPATION 2018-19

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AOPA HIGH SCHOOL CURRICULUM METRICS

2018-19 school year

- First year available
- 80 high schools
- 26 states
- 2,223 students
- 25% females
- 52% students in underrepresented groups

2019-20 school year

- 93 high schools on board for 2019-20 school year (48 more have started process)
- 31 new aviation programs
- 32 states
- Deadline is February 28, 2019

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GRADE 9 CURRICULUM

- Foundation for exploration of flying and unmanned aircraft systems
- Incorporate engineering practices throughout ninth grade
- Engages students with hands-on activities and projects
- Career planning embedded throughout four years

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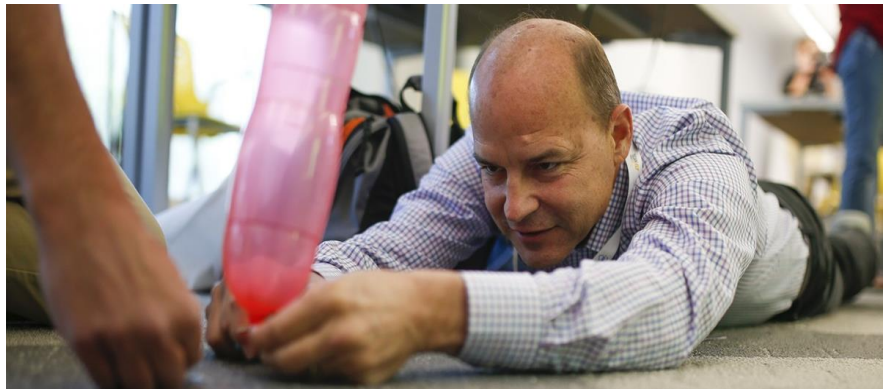
GRADE 9 HIGHLIGHTS

TISSUE PAPER
HOT AIR
BALLOONS



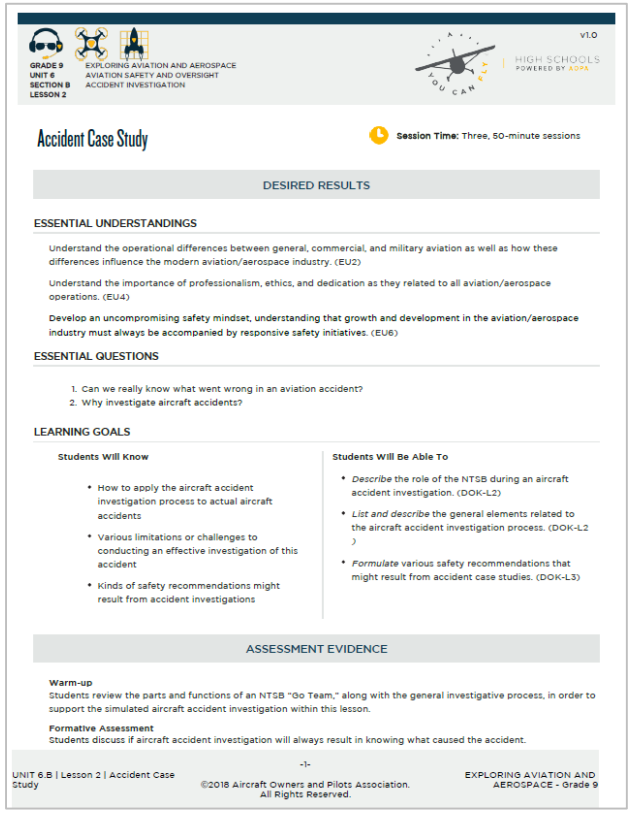
HEAVY BALLOON ROCKET
LAUNCH

CARDBOARD
WIND TUNNELS AND AIR
FOILS

INNOVATION CHALLENGE

CAREER
PLANNING
PROJECT

GRADE 9 “ACCIDENT CASE STUDY” LESSON



GRADE 9
UNIT 6
SECTION B
LESSON 2

EXPLORING AVIATION AND AEROSPACE
AVIATION SAFETY AND OVERSIGHT
ACCIDENT INVESTIGATION

v1.0

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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

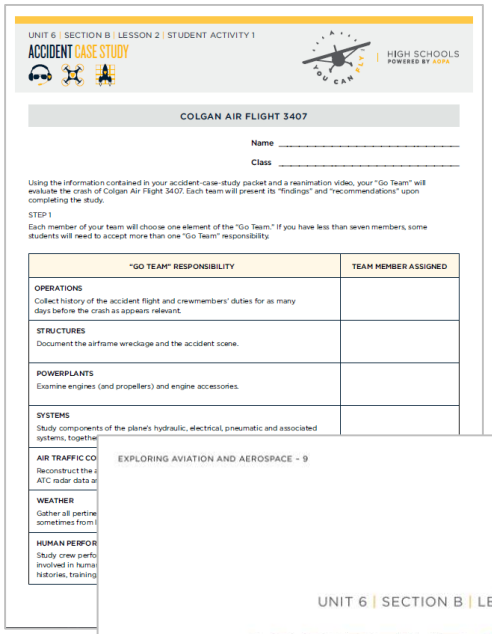
Students Will Be Able To

- *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 parts 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.



UNIT 6 | SECTION B | LESSON 2 | STUDENT ACTIVITY 1

ACCIDENT CASE STUDY

HIGH SCHOOLS POWERED BY AOPA

COLGAN AIR FLIGHT 3407

Name _____

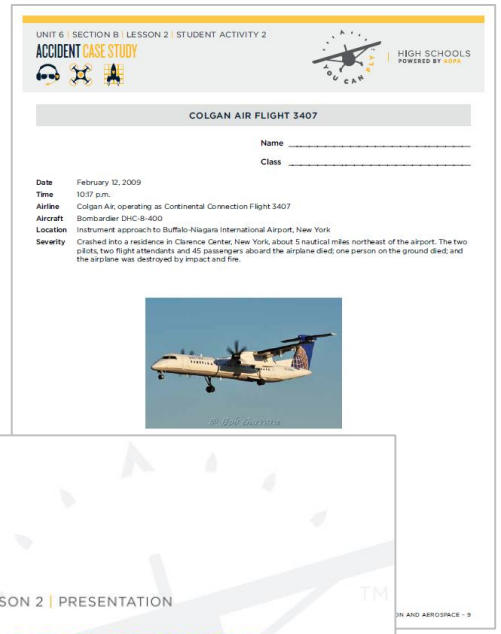
Class _____

Using the information contained in your accident-case-study packet and a reanimation video, your “Go Team” will evaluate the crash of Colgan Air Flight 3407. Each team will present its “findings” and “recommendations” upon completing the study.

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.

“GO TEAM” RESPONSIBILITY	TEAM MEMBER ASSIGNED
OPERATIONS Collect history of the accident flight and crewmembers’ duties for as many days before the crash as appears relevant.	
STRUCTURES Document the airframe wreckage and the accident scene.	
POWERPLANTS Examine engines (and propellers) and engine accessories.	
SYSTEMS Study components of the plane’s hydraulic, electrical, pneumatic and associated systems, togethe	
AIR TRAFFIC CO Reconstruct the a ATC radar data a	
WEATHER Gather all pertine sometimes from	
HUMAN PERFOR Study crew perfo involved in huma histories, training	



UNIT 6 | SECTION B | LESSON 2 | STUDENT ACTIVITY 2

ACCIDENT CASE STUDY

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COLGAN AIR FLIGHT 3407

Name _____

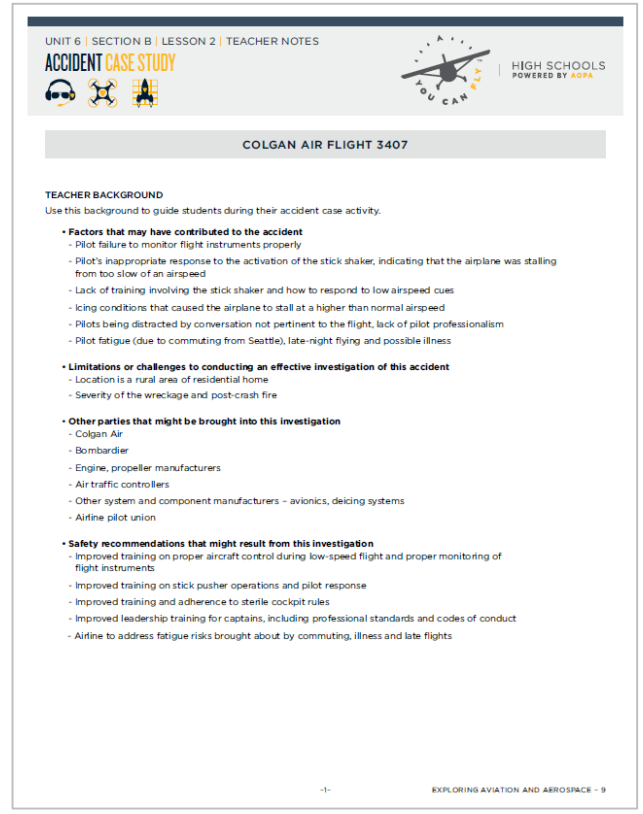
Class _____

Date February 12, 2009
Time 10:17 p.m.
Airline Colgan Air, operating as Continental Connection Flight 3407
Aircraft Bombardier DHC-8-400
Location Instrument approach to Buffalo-Niagara International Airport, New York
Severity Crashed into a residence in Clarence Center, New York, 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.

EXPLORING AVIATION AND AEROSPACE - 9

UNIT 6 | SECTION B | LESSON 2 | PRESENTATION

ACCIDENT CASE STUDY



UNIT 6 | SECTION B | LESSON 2 | TEACHER NOTES

ACCIDENT CASE STUDY

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COLGAN AIR FLIGHT 3407

TEACHER BACKGROUND

Use this background to guide students during their accident case activity.

- **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 cues
  - Icing conditions that caused 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 to conducting an effective investigation of this accident**
  - Location is a rural area of residential home
  - Severity of the wreckage and post-crash fire
- **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
- **Safety recommendations that might result from this 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

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GRADE 10 CURRICULUM

- Similar to the first half of ground school
- Teaches how an airplane is designed and constructed, how an airplane flies (four forces), and aircraft controls
- Simulation activities embedded
- Schools can use 10th grade courses without using 9th grade courses

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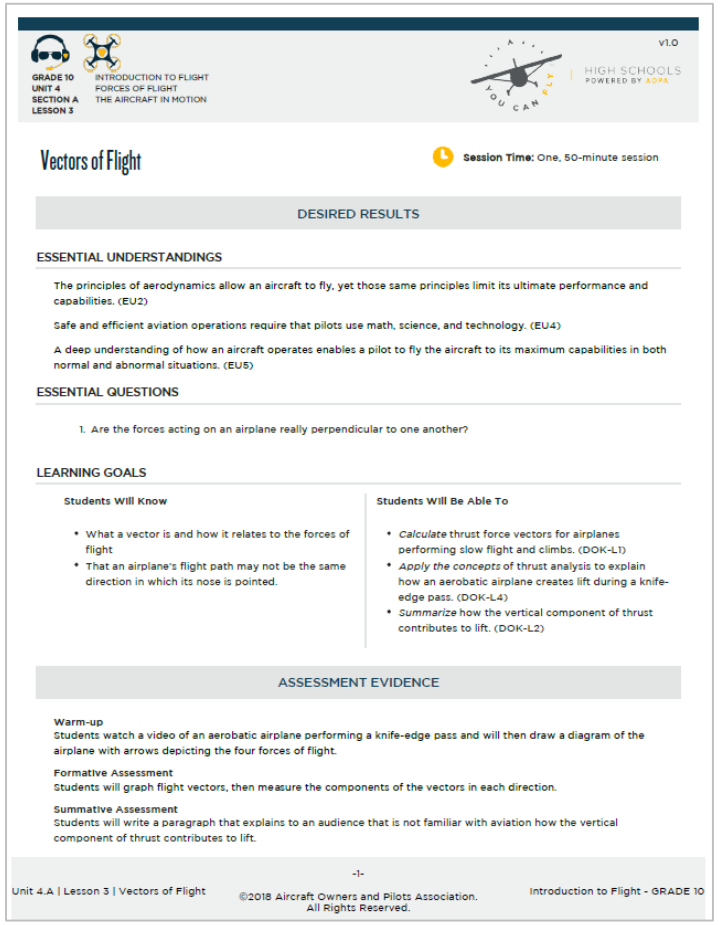
GRADE 10 "VECTORS OF FLIGHT" LESSON



GRADE 10
UNIT 4
SECTION A
LESSON 3

INTRODUCTION TO FLIGHT
FORCES OF FLIGHT
THE AIRCRAFT IN MOTION

v1.0

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Vectors of Flight

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

The principles of aerodynamics allow an aircraft to fly, yet those same principles limit its ultimate performance and capabilities. (EU2)

Safe and efficient aviation operations require that pilots use math, science, and technology. (EU4)

A deep understanding of how an aircraft operates enables a pilot to fly the aircraft to its maximum capabilities in both normal and abnormal situations. (EU5)

ESSENTIAL QUESTIONS

1. Are the forces acting on an airplane really perpendicular to one another?

LEARNING GOALS

Students Will Know

- What a vector is and how it relates to the forces of flight
- That an airplane's flight path may not be the same direction in which its nose is pointed.

Students Will Be Able To

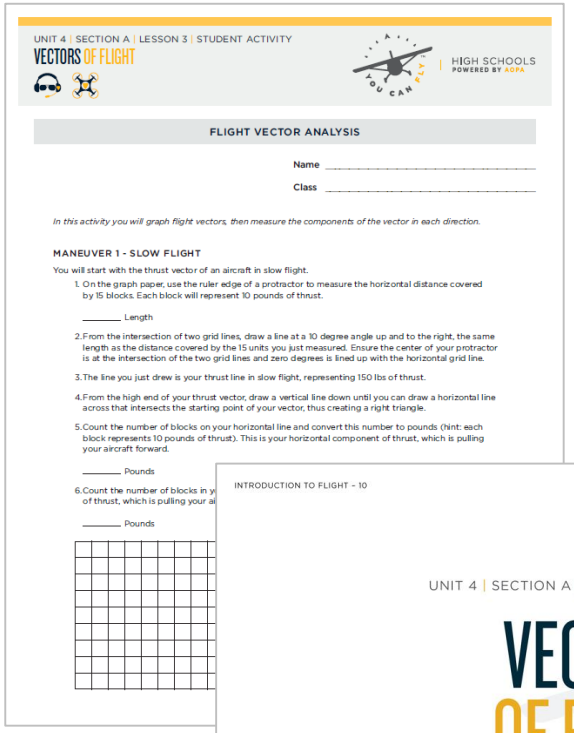
- *Calculate* thrust force vectors for airplanes performing slow flight and climbs. (DOK-L1)
- *Apply the concepts* of thrust analysis to explain how an aerobatic airplane creates lift during a knife-edge pass. (DOK-L4)
- *Summarize* how the vertical component of thrust contributes to lift. (DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
Students watch a video of an aerobatic airplane performing a knife-edge pass and will then draw a diagram of the airplane with arrows depicting the four forces of flight.

Formative Assessment
Students will graph flight vectors, then measure the components of the vectors in each direction.

Summative Assessment
Students will write a paragraph that explains to an audience that is not familiar with aviation how the vertical component of thrust contributes to lift.



UNIT 4 | SECTION A | LESSON 3 | STUDENT ACTIVITY

VECTORS OF FLIGHT

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FLIGHT VECTOR ANALYSIS

Name _____

Class _____

In this activity you will graph flight vectors, then measure the components of the vector in each direction.

MANEUVER 1 - SLOW FLIGHT

You will start with the thrust vector of an aircraft in slow flight.

1. On the graph paper, use the ruler edge of a protractor to measure the horizontal distance covered by 15 blocks. Each block will represent 10 pounds of thrust.

_____ Length

2. From the intersection of two grid lines, draw a line at a 10 degree angle up and to the right, the same length as the distance covered by the 15 units you just measured. Ensure the center of your protractor is at the intersection of the two grid lines and zero degrees is lined up with the horizontal grid line.

3. The line you just drew is your thrust line in slow flight, representing 150 lbs of thrust.

4. From the high end of your thrust vector, draw a vertical line down until you can draw a horizontal line across that intersects the starting point of your vector, thus creating a right triangle.

5. Count the number of blocks on your horizontal line and convert this number to pounds (hint: each block represents 10 pounds of thrust). This is your horizontal component of thrust, which is pulling your aircraft forward.

_____ Pounds

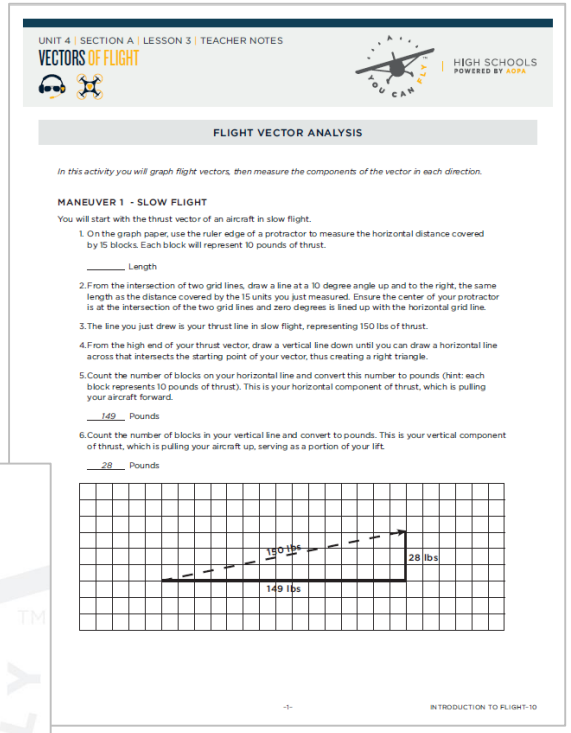
6. Count the number of blocks in y
of thrust, which is pulling your a

_____ Pounds

INTRODUCTION TO FLIGHT – 10

UNIT 4 | SECTION A | LESSON 3 | PRESENTATION

VECTORS
OF FLIGHT



UNIT 4 | SECTION A | LESSON 3 | TEACHER NOTES

VECTORS OF FLIGHT

HIGH SCHOOLS
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FLIGHT VECTOR ANALYSIS

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4. From the high end of your thrust vector, draw a vertical line down until you can draw a horizontal line across that intersects the starting point of your vector, thus creating a right triangle.

5. Count the number of blocks on your horizontal line and convert this number to pounds (hint: each block represents 10 pounds of thrust). This is your horizontal component of thrust, which is pulling your aircraft forward.

149 Pounds

6. Count the number of blocks in your vertical line and convert to pounds. This is your vertical component of thrust, which is pulling your aircraft up, serving as a portion of your lift.

28 Pounds

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HOW CAN HIGH SCHOOLS USE THE AOPA CURRICULUM?

- **Schools apply to use the curriculum on AOPA's website each year, deadline is February 28, 2019 for the 2019-20 school year.**
- **Teachers are required to attend 3-day professional development workshop – Frederick, MD (or can participate virtually).**
- **The course(s) is used as a full year, credit-bearing course, and submit data.**
- **Share AOPA high school curriculum website for more information: https://youcanfly.aopa.org/high-school/high-school-curriculum**
- **Contact hs@aopa.org for more information.**

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HIGH SCHOOL AVIATION STEM

WHEN & WHERE?

NOV. 10-12, 2019

United Airlines Flight
Training Center
7500 E. 35th Ave. | **Denver, CO 80238**

AND

Doubletree by Hilton Denver
3203 Quebec St. | **Denver, CO 80207**

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HIGH SCHOOL AVIATION STEM SYMPOSIUM

- **For high school educators and administrators to learn best practices from each other in aviation education.**
- **Build connections to industry and higher education**
- **Learning, networking, collaborating, sharing, building**
- **Teachers walk away with ideas they can use.**

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HIGHLIGHTS FROM THE 2018 SYMPOSIUM

- **Dynamic keynote speakers**

Houston Mills
UPS

Gwynne Shotwell *SpaceX*

- **UPS tours**
- **Expanded exhibit area**
- **Wide variety of breakout sessions**
- **Experts on panels**
- **Emphasis on diversity throughout the event**
- **Networking with likeminded, passionate educators**

2019 AOPA HIGH SCHOOL
FLIGHT TRAINING SCHOLARSHIP

Thanks to the generosity of the **Ray Foundation**, **80 exceptional high school students and 20 teachers** will be awarded scholarships of **up to $10,000 each** to pursue their primary pilot certificate.

- High school students must be 15 to 18 years old.
- Must be a U.S. citizen or permanent resident.
- Must be a current member of AOPA (can include free membership)
- Teachers must currently be instructing students or providing curriculum to teachers for students in preparation for a future in aviation.
- Check www.AOPA.org/Scholarships for more information.

Deadline April 2, 2019 11:59 pm EDT

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HOW CAN AABI SCHOOLS AND MEMBERS BE INVOLVED?

- Share AOPA curriculum and high school symposium with local high schools
- Invite local high schools using AOPA curriculum to visit campus/airport
- Help support teachers' understanding of aviation
- Provide dual credit for AOPA courses
- Other ways?


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