

Teacher Tool 44: The Science Behind Aviation

Study Guide

Study Guide for Aviation 2: The Science Behind Aviation

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The Science Behind Aviation

Original Air Date: April 20, 2017

Grade Levels: 8-12

Program Description:

From the Wright Brothers successes at Kitty Hawk to the supersonic jets of today, aviation has completely changed the way we live, work, and play. Interact with engineers, pilots, and other aviation specialists to investigate the scientific principles, engineering design, and construction processes that make successful flight possible. More details on the topics explored in the program, the order they will be explored, and the expert guests that students will interact with during that exploration is included in the Program Format section of this document.

Guests for the program include:

Patrick McAlee--air show aerobatic pilot and commercial airline pilot

Learn more about Mr. McAlee at <http://www.patrickmcaleearshows.com>

See a previous interview with Mr. McAlee from our "Explore! Flying" program at

<http://www.hectv.org/watch/hectv-live/explore-flying-october-8-2014/15465>. The interview runs from the 44:44 mark to the 59:37 mark.

Steve Debronski--USAF Veteran Lt. Colonel, Instructor Pilot with ratings in the F-15 and T-38 aircraft

Military Duty Title: Inspector General of the Wing at Columbus AFB, Mississippi

Current Occupation: Integrated Product Team Lead over F-15 Joint Mission Planning System, Foreign Military Sales,

Robert Dowgillo--Technical Lead Engineer, Aerodynamic Analysis and Testing

Aeromechanics/Boeing Research and Technology

Mr. Dowgillo has worked widely in the development of tactical aircraft. His experience includes advanced design, analysis tool development, production program engineering, wind tunnel testing, flight testing, and aerodynamic design.

Ken Blackburn--aeronautical engineer for the Air Force and Guinness world record holder for time aloft for a paper airplane

You can learn more about Mr. Blackburn, the art and science of creating paper airplanes, and find more educational materials about the science of aviation at his website, <http://paperplane.org>.

Major Mallory Nordquist--USAF AMC 458 AS/ADO

Major Nordquist is currently stationed at Scott Air Force Base and will share her expertise on military airlift and aviation.

Program Objectives:

1. The participant will interact with engineers, designers, scientists, and mechanics working in the field of aviation.
2. The participant will gain a greater understanding of the nature of flight and aircraft and the design and function of aircraft.
3. The participant will explore methods to design, build and program aircraft.
4. The participant will engage in critical thinking and creative thinking.

Program Format:

Time codes are provided in blue to help find specific segments in a program.

I. Welcome and Introduction—Student groups and experts are introduced and welcomed to the program. (00:00 to 01:05)

II. Interaction with Robert Dowgwillo—For this segment of the program, students interact with Robert Dowgwillo—American Institute of Aeronautics and Astronautics and Technical Lead Engineer, Aerodynamic Analysis and Testing for Aeromechanics/Boeing Research and Technology.

Major Focus for this Segment: Mr. Dowgwillo shares information on the design process used to create an airplane. To bring this to life, we look at a specific example, the F-15 fighter jet. (01:06 to 11:20)

Video Segment: The Use of Drones in Television
(11:21 to 15:23)

III. Interaction with Patrick McAlee—For this segment of the program, students interact with Patrick McAlee—Aerobatic Stunt Pilot and Commercial Airline Pilot.

Major Focus for this Segment: We apply the ideas of aerodynamic design we learned about with Mr. Dowgwillo to Patrick McAlee and his stunt plane as we look at still images and video of his plane in the air. We also learn about the effect of G forces on his body while flying. (15:24 to 24:21)

IV. Interaction with Steve Dobronski, USAF Ret. Lt. Col.—For this segment of the program, students interact with Steve Dobronski—Instructor Pilot, former Inspector General of the Wing at Columbus AFB Mississippi, and currently Integrated Project Team Lead over the F-15 Joint Mission Planning System.

Major Focus for this Segment: We continue discussion of G forces, this time as they are experienced in a supersonic fighter jet and also discuss the impact of flight conditions (weather, temperature, etc.) and flight purpose on operation of a plane and the experience of the pilot. (24:22 to 33:45)

V. Interaction with Major Mallory Nordquist, USAF AMC 458 AS/ADO—For this segment of the program, students interact with Major Mallory Nordquist who is currently stationed at Scott Air Force Base in Illinois.

Major Focus for this Segment: We discuss a very different plane with Major Nordquist, the C5 convoy plane that she has flown in to provide operational and logistical support to troops around the world and to convey troops in deployment worldwide.

(33:46 to 40:45)

Video Segment: Building Your Own Plane

(40:46 to 43:32)

VI. Interaction with Ken Blackburn—For this segment of the program, students interact with Ken Blackburn—Former McDonnell Douglas engineer, former world record holder for longest time aloft for a paper airplane, and author of “The World Record Paper Airplane Book.”

Major Focus for this Segment: We put the principles of flight and design in to action as Mr. Blackburn instructs us building a paper airplane.

(43:33 to 55:32)

VII. Summary and Closing—We fly the paper airplanes we have just built, summarize the major concepts learned, and say goodbye.

(55:33 to 59:47)

Featured National Standards:

The following **Common Core Standards for English/Language Arts and Literacy in History/Social Studies, Science and Technical Subjects** are referenced in this program:

College and Career Readiness Anchor Standards for Reading

7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

College and Career Readiness Anchor Standards for Writing

6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

College and Career Readiness Anchor Standards for Speaking and Listening

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

College and Career Readiness Anchor Standards for Language

6. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

Featured National Standards: (Science)

Unifying Concepts and Processes - Unifying concepts and processes help students think about and integrate a range of basic ideas which builds an understanding of the natural world

1. Systems, order, and organization
2. Evidence, models, and explanation

Science as Inquiry - Science as inquiry requires students to combine processes and scientific knowledge with scientific reasoning and critical thinking to develop their understanding of science.

1. Abilities necessary to do scientific inquiry
2. Understandings about scientific inquiry

Featured State Standards (Missouri):

Schools from across the country are invited to join in the program. Missouri state standards are provided for Missouri schools since partial funding for this program comes from various Missouri

organizations.

Missouri Grade Level Expectations

Strand 7: Scientific Inquiry

Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking

Program-Related Activity Suggestions:

1. Extend Your Study of the Topic— Utilize any or all of the additional Educate.Today video resources listed below to give students the opportunity to learn more about the topics explored in this program.

Aviation 3 “Explore! Flying”

Aviation 4 “The Science Behind Flight: Soaring the Sky 1

Aviation 5 “The Science Behind Flight: Soaring the Sky 2

2. Learn More About the Principles of Flight and the Use of Unmanned Drones

Additional Educate.Today videos related to these topics are listed below:

Aviation 6 “How Does That Work? Bernoulli’s Principle”

Aviation 7 “Gary Liming Experimental Plane Builder”

Aviation 8 “TV Drones”

Aviation 9 “Propulsion”

Aviation 10 “How Does That Work? Flight Control Surfaces of an Airplane”

Aviation 11 “How Does That Work? Helicopters”

Aviation 12 “Drones Safety and Usage”

Aviation 13 “Four Forces that Affect Flight”

3. Send a Thank You or Insight—Have students write a letter to one of our guests detailing an insight the student gained from hearing his story, an appreciation for her participation, and/or another focus area of their choice. E-mail the letter to us at live@hectv.org or mail the letter to us at Live@HEC-TV 3221 McKelvey Rd #106, Bridgeton, MO 63044.

4. Bring in a Guest Speaker—Have students contact individuals in your own area who are involved in the field of aviation and see if they can locate a guest speaker to come to your class and share their story.

Vocabulary Words Related to the Program:

Drag
Fluid Mechanics
Gravity
Lift
Pitch
Roll
Thrust
Weight
Yaw

Supplemental Resources:

Learn more about our guest Patrick McAlee at his website,
<http://www.patrickmcaleearshows.com/>.

Learn more about our guest Ken Blackburn at his website, www.paperplane.org.

Explain That Stuff, “Airplanes”
<http://www.explainthatstuff.com/howplaneswork.html>

NASA, “Dynamics of Flight”
<https://www.grc.nasa.gov/www/k-12/UEET/StudentSite/dynamicsofflight.html>

Science Learning, “Principles of Flight”
<http://sciencelearn.org.nz/Contexts/Flight/Science-Ideas-and-Concepts/Principles-of-flight>

How Stuff Works, “How Airplanes Work”
<http://science.howstuffworks.com/transport/flight/modern/airplanes.htm>

Airbus, “How is an Aircraft Built”
<http://www.airbus.com/company/aircraft-manufacture/how-is-an-aircraft-built/>

RobotShop, “How to Make a Drone”
<http://www.robotshop.com/blog/en/make-uav-lesson-2-platform-14448>

Air and Space Smithsonian, “Build Your Own Drone”
<http://www.airspacemag.com/flight-today/build-your-own-drone-180951417/?no-ist>