Introduction to Aviation

8th grade science and technology/engineering

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Curriculum Overview

<table>
<tr><th colspan="2">Stage 1: Desired Results</th></tr>
<tr>
<td rowspan="3">6.MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution.

7.MS-ETS3-3(MA). Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle, including structural, propulsion, guidance, suspension, and control subsystems.

7.MS-ETS3-5(MA). Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system.

8.MS-PS2-2. Provide evidence that the change in an object’s speed depends on the sum of the forces on the object (the net force) and the mass of the object.

CCSS.ELA-LITERACY.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).</td>
<td>Essential Questions

How do the four fundamental forces of flight—lift, weight, thrust, and drag—interact to enable an aircraft to take off, fly, and land?

How does the structure of an airplane compare to animals that can fly?

What role do different transportation subsystems play in aviation?

How does the understanding of Bernoulli's principle and Newton's laws of motion contribute to the design and operation of airplanes?</td>
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<td>Enduring Understandings

Flight involves a delicate balance between the forces of lift, weight, thrust, and drag, which interact to enable controlled movement in the air.

Advances in aviation technology are influenced by historical innovations, societal needs, and environmental concerns, shaping the trajectory of air travel.

Safety is paramount in aviation, and engineers continually innovate to enhance aircraft design, navigation systems, and emergency procedures.</td>
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<td>Transfer

At the end of this unit, students will be able to describe the physics of flight, identify the four main forces of flight, and design and test a glider that gains the maximum amount of lift possible while carrying a payload</td>
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Stage 2: Evidence
Formative Assessment ideas: Bird wing and plane design warm up, plane diagram labeling, Bernoulli's principle stations, Transportation systems check-in
Summative Assessment ideas: Transportation systems research, Glider wind tunnel project

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Stage 3: Learning Plan				
Lesson Number	**Lesson Name**	**Brief Description**	**Standards (number)**	**Time (assuming 60 minute class periods)**
1	Biomimicry	Students will be introduced to flight by comparing different flight patterns in birds to different types of airplanes and aerodynamics	7.MS-ETS3-3(MA)	1 day
2	Physics of flight	Students will receive direct instruction on the forces that affect the flight of an object (thrust, lift, drag, and weight). Bernoulli's principle/air pressure	8.MS-PS-2-2	2 days
3	Transportation systems	Introduction to transportation system components, including structural, propulsion, guidance, suspension, and control systems	7.MS-ETS3-3(MA)	2 days
4	Glider design	Culminating project in which students will use their knowledge to design, build, and test a glider that can achieve maximum lift while carrying a payload	7.MS-ETS3-3(MA) 8.MS-PS2-2 6.MS-ETS2-2(MA)	10-15 days

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Lesson 1: Biomimicry

Lesson 1: Overview	
Lesson Overview: Lesson 1 serves as an introduction to flight, using birds as an anchoring concept. Students will analyze pictures of different types of birds to categorize different flight patterns	Lesson Objectives: Students will be able to describe how bird wings affect their flight patterns. Students will compare and contrast bird wing types to airplane types
Standards: 7.MS-ETS3-3(MA)	Timing: • *Total time: 1 day*
Materials: Warm up - google slides matching activity Laminated photos of birds Video: From Birds to Brothers: The Evolution of Flight Video question sheet or edpuzzle	Assessment: *Matching activity will act as a pre-assessment to give an idea of what students may already know about flight*

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Lesson 1: Activities			
Activity	**Teacher is…**	**Students are…**	**Materials**
Warm up	Checking in, taking attendance	Independently completing activity	Google slides, projector, google classroom
Class discussion	Facilitating discussion, asking students what they already know about flight, what allows birds to fly, different styles of flight, and comparing to different planes	Participating and sharing in discussion	None
Video and questions	Monitoring work completion	Watching video with a partner and answering questions	Student chromebooks, internet access, video question sheets (or edpuzzle)

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Lesson 1: Tips, Strategies, and Suggestions
As a possible extension, have diagrams available of the inner framework of an airplane wing compared to the structure of a bird's bone to add to the idea of biomimicry *Some students may already have extensive knowledge about different types of planes and/or flight, these students can be invited to lead the class discussion and share what they know*

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Lesson 2: Physics of Flight

Lesson 2: Overview	
Lesson Overview: Students will receive direct instruction on the physics of flight, including the forces of thrust, lift, drag, and weight. Students will experiment with Bernoulli's principle in three different hands-on stations	Lesson Objectives: Students will be able to describe and model the four main forces of flight Students will be able to apply Bernoulli's principle to the flight of an object
Standards: 8.MS-PS2-2.	Timing: ● *Total time: 2 days* ● *Day 1: Aviation notes and vocabulary review* ● *Day 2: Bernoulli's principle stations and Bernoulli's principle slides*
Materials: Aviation Notes slides, printed notes pages, vocabulary review, Hair dryer, ping pong balls, paper or note cards, straws, empty soda cans, Bernoulli's Principle Slides	Assessment: Vocabulary review will be assessed for a classwork grade

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Lesson 2: Activities			
Activity	**Teacher is…**	**Students are…**	**Materials**
Notes	Direct instruction, circulating to make sure all students are completing notes	Completing fill-in-the-blank style doodle notes	Slides, notes, projector or smartboard
Aviation vocabulary review	Monitoring student work, assisting students with vocabulary terms as needed	Working in pairs or small groups to study vocabulary terms and complete review game	Printed vocabulary cards, quizlet set, student worksheet
Bernoulli's principle activities	Review each station and expectations at start of class, monitor time and let students know when to change stations, monitor for behavior and work completion	Rotating through stations in small groups, reading instructions and completing each activity	Hair dryer, ping pong balls, paper or note cards, straws, empty soda cans

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Lesson 2: Tips, Strategies, and Suggestions
Notes pages can be pre-filled for students who need extra support The vocabulary review can be turned into a competition to see who can recall the most terms after reviewing them If time constraints are limiting, the Bernoulli's principle activities could be done as teacher demonstrations or with one or two student helpers

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Lesson 3: Transportation Systems

Lesson 3: Overview	
Lesson Overview: Introduction to transportation system components, including structural, propulsion, guidance, suspension, and control systems	Lesson Objectives: Students will be able to categorize components of a transportation system. Students will compare and contrast the components of two transportation systems
Standards: 7.MS-ETS3-3(MA).	Timing: ● *Total time: 2 days*
Materials: ● Notes slides, notes pages, research sheets	Assessment: Transportation systems research and rubric will be used to assess student understanding. Students should be able to clearly distinguish between different transportation systems, their uses, and the subsystems that make up each one

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Lesson 3: Activities			
Activity	**Teacher is…**	**Students are…**	**Materials**
Warm up: What are some forms of transportation people can use to travel locally or far away?	Taking attendance, monitoring student work completion	Brainstorming and answering question	Question in google classroom
Class discussion	Facilitating discussion, asking leading questions	Discussing various types of transportation and their pros/cons	
Transportation Subsystem notes	Reviewing information with students	Completing fill-in-the-blank style notes	Notes pages, slides, projector
Group activity - Transportation system research	Assigning groups, checking in for work completion	Working with a partner or small group to research two specific transportation systems and compare their subsystems, pros, and cons (example: car versus plane, ferry versus bus)	Student chromebooks, internet access, research sheets

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Lesson 3: Tips, Strategies, and Suggestions
Some students might already have a lot of knowledge about how different vehicles work - use them to your advantage and pair them up with students with limited knowledge about the topic *There might be some confusion about the terminology "transportation system", explain that it's just a way of describing different vehicle types and that we call them a system because there are many different components that work together to help them function* *Students who are struggling may benefit from some scaffolding in the form of assigning specific transportation systems for them to research, instead of having them come up with two on their own*

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Lesson 4: Glider Design

Lesson 4: Overview	
Lesson Overview: This lesson is the students' culminating project in which students will use their knowledge to design, build, and test a glider that can achieve maximum lift while carrying a payload. The project will show understanding of the forces of flight and how the structural system relates to successful flight	Lesson Objectives: Students will be able to design and create a glider that can achieve maximum lift while carrying as much payload as possible in a wind tunnel
Standards: 8.MS-ETS2-5(MA). 7.MS-ETS3-3(MA). 6.MS-ETS2-2(MA).	Timing: ● *Total time: 5 - 10 days*
Materials: Glider materials can include popsicle sticks, cardboard, hot glue, foam board, tape, 3d printed components, and any other materials the teacher may have access to	Assessment: Students will be evaluated used a standardized rubric to account for both success of the glider design, as well as the appropriate use of the engineering design process

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Lesson 4: Activities			
Activity	**Teacher is…**	**Students are…**	**Materials**
Glider design	Explaining project, completing individual group check-ins, helping with appropriate tool use where necessary, monitoring student budgets, facilitating testing once gliders have been completed	Working with a small group to follow the engineering design process while researching, designing, building, testing, and revising a glider	Glider materials can include popsicle sticks, cardboard, hot glue, foam board, tape, 3d printed components, and any other materials the teacher may have access to Each student will need a copy of the packet (either electronically or on paper) and access to technology to complete research

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Lesson 4: Tips, Strategies, and Suggestions
This design challenge will take one to two weeks of class time, depending on timing and student engagement. Students will need varying levels of support. Be prepared with some helpful links and youtube videos that can be provided via google classroom to students who are having a hard time finding possible design ideas online. Review all safety rules before allowing students to start building. It is helpful to have an example glider available for students to see at the beginning of the project to give them an idea of what is expected.

Resources

Resources to support teacher learning - *help teachers to develop background content knowledge for this unit.*
NASA is an amazing resource for background information and supplemental activities: Beginner's Guide to Aeronautics Aeronautics Educator's Guide Guide to Aerodynamics Aviation Terminology National Air and Space Museum: How things fly

Additional resources
Youtube: Smithsonian National Air and Space Museum

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