From Birds to Gliders

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Aspire to the highest level of technical proficiency as it relates to flight operations and engineering practices. (EU5)

ESSENTIAL QUESTIONS

1. What is the difference between an animal that glides and an animal that flies?
2. What are the roles of lift, thrust, drag, and weight in flight?

LEARNING GOALS

Students Will Know

- Various characteristics of animals that help them fly or glide
- How opposing forces work on an object in flight

Students Will Be Able To

- *Differentiate* between animals that glide and animals that fly (DOK-L2)
- *Identify* adaptations that enable birds to fly (DOK-L1)
- *Explain* flight in a variety of situations, including as it relates to animals (DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
Students will determine whether animals with “flying” in their name, actually fly or glide.

Formative Assessment
Students will complete a Venn diagram to compare the characteristics of flying and gliding animals.

Summative Assessment
Students create an illustration that explains the concepts of lift, thrust, drag, and weight in flight.

LESSON PREPARATION

MATERIALS/RESOURCES

- From Birds to Gliders Presentation

- From Birds to Gliders Student Activity
- From Birds to Gliders Student Notes
- From Birds to Gliders Teacher Notes

LESSON SUMMARY

Lesson 1: From Birds to Gliders

Lesson 2: Glider Flight and Early Innovations

This lesson consists of one session. First, students will determine if two animals with “flying” in their names, actually fly. Students will begin to understand that not all things that travel through the air fly, and some animals that have “flying” in their names actually glide through the air. In a class discussion, students will explore the difference between flying and gliding. They will learn about the four forces of flight and how the four forces relate to one another. Next, students will read an article and answer questions that explain how birds achieve flight. Finally, students will create illustrations that explain the concepts of lift, thrust, drag, and weight in flight.

BACKGROUND

Not all things that travel by air fly, and some animals that have “flying” in their names actually glide through the air. In this lesson, it is important that students understand that animals that fly create thrust through their own motion/power (birds typically flap their wings to gain enough speed to generate sufficient lift.) Animals that glide can’t create thrust through their own motion. As they fall toward the ground, they use their bodies to generate lift as they gain speed. Gliders include various animals, including fish, squirrels, squids, lemurs, and reptiles.

There are four forces that act on an airplane in flight. These four forces are lift, weight, thrust, and drag. In steady flight, lift, weight, thrust, and drag all balance each other.

Lift is produced by the wings and acts in an upward direction. Wings are able to create lift by accelerating air over their top surfaces, which are curved expressly for that purpose.

Weight acts against lift and works in a downward direction. To stay in level flight, you have to keep enough air moving over the wings to exactly match the weight you're lifting—the airplane itself, plus its occupants, fuel, and any baggage.

Thrust is created by the propeller or, in the case of a jet, the outflow of a turbine engine. In the case of a bird, thrust is produced by flapping wings.

Drag opposes thrust. Drag comes in many forms, and it can add up quickly. The more drag that exists, the more thrust will be required to overcome it.

Each force has an opposing force: lift opposes weight and thrust opposes drag. When applied in flight, a plane or bird will go up or accelerate if the forces of thrust and lift are greater than drag and weight. If drag and weight are greater than thrust and lift, the bird or plane will decelerate or go down.

DIFFERENTIATION

To promote reflective thinking and guided inquiry in the **EXPLAIN** section of the lesson plan, circulate around the classroom and assist students who might have trouble coming up with ideas for their Venn diagrams. Ask questions that provoke their own ideas for possible answers.

LEARNING PLAN

ENGAGE

Teacher Material: From Birds to Gliders Presentation

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

Slide 4-6: Conduct the **Warm-Up.**

Explain to students that not all things that travel by air fly, and some animals that have "flying" in their names actually glide through the air. In this lesson, it is important that students understand that animals that fly create thrust through their own motion/power (birds typically flap their wings to gain enough speed to generate sufficient lift in order to fly.) Take no more than 5 minutes of class time to complete the warm-up. [DOK 2; Categorize, Separate]

> **Warm-Up**
>
> Show students the list of animals on slide 5 and ask them whether each animal is a glider or a flyer. Record the majority vote for each animal and reveal the answers on slides 6 and 7.

EXPLORE

Teacher Material: From Birds to Gliders Presentation

Slide 7: Introduce students to the concept of gliding.

Animals that glide can't create thrust through their own motion. As they fall toward the ground, they use their bodies to generate lift as they gain speed. Gliders include various animals, including fish, squirrels, squids, lemurs, and reptiles.

Slide 8: Show students the video of a sugar glider (an animal very similar to a flying squirrel). For the sake of time, the video can be stopped after the 2:49 mark.

- Cute Sugar Glider In Slow Motion (Length 4:49)
  http://video.link/w/BJJd

After they watch the video, ask students explain why a sugar glider isn't a flyer? Remind them that as far as animals are concerned, a glider is one that can't create thrust through its own motion. In other words, it doesn't use muscular power to generate aerodynamic forces (such as flapping its wings to create thrust and lift).

EXPLAIN

Teacher Material: From Birds to Gliders Presentation
Student Material: From Birds to Gliders Student Activity

Slide 9: Explain to students there are four forces that act on an object in flight - lift, weight, thrust and drag.

Lift - holds an object up
Weight - pushes an object down
Thrust - pushes an object forward
Drag - slows an object down

Ask students which force do animals that only glide (like a flying squirrel) not create through its own motion? Students should recall that an object that glides does not produce THRUST through its own motion.

Slide 10: Explain to students the definition of thrust, which is a force that moves a bird (or aircraft) in the direction of the motion. Animals that glide can't create thrust through their own motion. Aircraft create thrust through their engine.

Slide 11: Explain to students the definition of lift. Birds typically flap their wings to gain enough speed to generate sufficient lift.) As they fall towards the ground, they are able to use their body to generate lift as they gain speed.

Slide 12: Explain to students the definition of weight, which is the force caused by gravity.

Slide 13: Explain to students the definition of drag which is the force that restricts the movement of an object through the air.

Slide 14: Explain that each force has an opposing force: lift opposes weight, and thrust opposes drag. When applied in flight, a plane or bird will go up or accelerate if the forces of thrust and lift are greater than the drag and weight. If the drag and weight are greater than thrust and lift, the bird or plane will decelerate or go down.

Maintaining a steady flight requires a balance, often described as an *equilibrium* of all the forces acting upon an airplane. Weight, lift, thrust and drag are the acting forces on an airplane. Assuming a straight and level flight, lift must be equal to weight and drag must be equal to thrust.

Slide 15: Conduct the **Formative Assessment.**

Take no more than 10 minutes of class time to complete the assessment. [DOK 2; Distinguish, Categorize]

Formative Assessment

Ask students to complete a Venn diagram using From **Birds to Gliders Student Activity**.They should write characteristics of flying animals in the circle on the left (leave overlapping space blank), characteristics of gliding animals in the circle on the right (leave overlapping space blank) and characteristics the two types of animals have in common in the overlapping space.

EXTEND

Teacher Material: From Birds to Gliders Presentation, From Birds to Gliders Teacher Notes
Student Material: From Birds to Gliders Student Notes

Slide 16: Provide students a copy of the article or the link to "How Do Birds Fly?" https://files.dnr.state.mn.us/mcvmagazine/young_naturalists/young-naturalists-article/bird_flight/bird_flight.pdf

Ask students to read the article individually or in small groups. While students are reading the article, they should answer the questions on the activity **From Birds to Gliders Student Notes**. The answers for the student note sheet are provided in **From Birds to Gliders Teacher Notes.**

EVALUATE

Teacher Material: From Birds to Gliders Presentation

Slide 11: Conduct the **Summative Assessment.**

They should take no more than 10 minutes of class time to complete the assessment. [DOK 4; Create, Design]

Summative Assessment

In groups of 3 to 4 students, students will create an illustration that explains the concepts of lift, thrust, drag, and weight in flight. They might want to consider explaining these concepts in relation to differences between gliders and airplanes, or animals that glide and animals that fly. Invite students to brainstorm ideas first.

Summative Assessment Scoring Rubric

- Follows assignment instructions
- Illustration shows evidence of one or more of the following:
    - Knowledge of the difference between flying and gliding
    - Understand the concepts of lift, thrust, drag, and weight as related to flight
- Shows understanding of concepts covered in the lesson.

Points	Performance Levels
9-10	Consistently demonstrates criteria
7-8	Usually demonstrates criteria
5-6	Sometimes demonstrates criteria
0-4	Rarely to never demonstrates criteria

GOING FURTHER

Ask students to create an airplane using a tissue box to illustrate the four forces of flight. The “airplane” should have wings, a tail, and a nose, at a minimum. They may write directly on the box or cover the sides in construction paper or other material. Encourage the students to be as creative as possible. They should label and describe one force per side to cover all sides of the box. Their design should allow for the removal of tissues without destroying the educational content.

STANDARDS ALIGNMENT

NGSS STANDARDS

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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

COMMON CORE STATE STANDARDS

- **RST.9-10.1** - Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- **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** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **RST.9-10.5** - Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
- **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.
- **RST.9-10.8** - Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- **WHST.9-10.1** - Write arguments focused on discipline-specific content.
- **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

The "Explain" section is from an article from the teacher's guide for young naturalists, "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*.

http://files.dnr.state.mn.us/mcvmagazine/young_naturalists/young-naturalists-article/bird_flight/bird_flight.pdf

https://www.aopa.org/training-and-safety/students/presolo/topics/the-four-forces

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