Aerodynamics - Teacher Guide

Anchoring Phenomenon - Plants and animals have specialized characteristics.

Investigative Phenomenon - Humans study and copy ideas found in nature to solve problems.

STEELS Standards

3.2.K.A Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

3.2.3.A Make and communicate observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3.5.K-2.X Develop a plan in order to complete a task.

3.5.K-2.W Apply concepts and skills from technology and engineering activities that reinforce concepts and skills across multiple areas.

NGSS

K-LS1-1 (Structure & Function): Observing how animals use their special parts to understand how structures help them survive.

1-LS1-1 (Biomimicry Design Solutions): Investigating how plant/animal structures inspire human inventions

PA Career Readiness Skills -

Career Awareness and Preparation: Recognize that individuals have unique interests.

Career Acquisition (Getting a Job): Discuss the importance of the essential workplace skills, such as, but not limited to: • Team building • Technology

Career Retention and Advancement : Identify attitudes and work habits that contribute to success at home & school

Materials
Biomimicry and Aerodynamics slideshow
Flying Squirrel video
Flying Squirrel Suit video

Enrichment Opportunities
The Genius of Bionic Morphing Wings: Future of Flight?
How have birds inspired technology? | Birds and biomimicry

Key Vocabulary (Do not front load these. If they come up in conversation help clarify and come to an understanding if students are ready for the vocab)
Adaptation - something special that helps a plant or animal live
Biomimicry - science of studying and imitating nature to solve human problems
Drag - resistance an object faces as it moves through air
Function - what something does
Gravity - pull of the Earth that brings all things to the ground
Lift - air below the wings that pushes it up or down
Observe - to look closely and notice details
Structure - the shape or parts of something
Thrust - forward movement of a flying object

Time Requirement - 20 to 30 minutes

Engage
1. Open the Biomimicry and Aerodynamics slideshow.

2. Show slide 2, which displays a picture of Leonardo da Vinci's Mona Lisa. Ask students to identify the painting's name and artist.

3. Show slide 3, which displays a picture of a kite (raptor) and Leonardo da Vinci's flying machine sketches. Explain to students that da Vinci was not only an artist, but also an inventor. He studied and sketched things found in nature and used them to create inventions. Have students look at the two images and ask whether this is an example of biomimicry. Focus only on asking questions and avoid providing any answers.

4. Review key vocabulary terms from the first lesson biomimicry. (Slide 4)
- **Adaptation** - Something special that helps a plant or animal live
- **Structure** - The shape or parts of something
- **Function** - What something does

5. Display slide 5, which shows pictures of the Wright brothers' first plane and a turkey vulture. Ask students if this is another example of biomimicry and, if so, how. Focus only on asking questions and avoid providing any answers.

6. Explain why the Wright Brothers studied turkey vultures.
Answer - While Turkey vultures have wide wings that help them glide smoothly through the air. The structure of their wings is long and spread out. The function is that the wings help the bird stay in the air without flapping a lot. The Wright brothers watched birds like turkey vultures fly and copied this idea when they built their first airplane. They made wide wings so the plane could glide and stay in the air, just like the bird.

7. Tell the students that they are going to watch a video about a unique little rodent. (Slide 6) Without telling them the creature's name, challenge students to think about what invention or creation could be made by studying this animal.
Play Flying Squirrel video.

Explore and Explain
8. Ask the students if flying squirrels really fly. Have them explain their answer.

9. Share slide 7 - Facts about Flying Squirrels
- Flying squirrels glide through the air
- Skin flaps (between their arms and legs) that help them glide
- Their wrists work like tiny wings to help them stay steady
- They move their bodies to turn and steer
- Air pushes on their bodies to help them glide

10. Explain that flying creatures and machines all follow the same aerodynamic principles. Show a picture of Sir George Cayley on slide 8. Explain that Sir George Cayley is often called the father of aerodynamics. He based much of his work on studying birds' physical features and how those features affect the ability to fly.

11. Share slide 9 - Key Principles of Aerodynamics.
- Drag - resistance an object faces as it moves through air
- Gravity - pull of the Earth that brings all things to the ground
- Thrust - forward movement of a flying object
- Lift - air below the wings that pushes it up or down

12. Ask students if flying squirrels use these principles when they fly (glide). Slide *Answer - A flying squirrel uses the air to help it glide from tree to tree. Gravity pulls the squirrel down when it jumps. As it spreads its skin flaps, the air pushes up to create lift, which helps it stay in the air longer. Drag slows the squirrel down so it does not fall too fast. The squirrel does not flap its wings, but it gets thrust from its jump and push-off from the tree. All of these forces work together to help the squirrel glide safely and land on another tree.*

13. Ask students if they know of any inventions based on flying squirrels. Explain that thrill seekers did invent speciality suits that turn humans into flying squirrels. Play the flying squirrel suit video. (Slide 11)

14. Tell students that they will be participating in a design challenge where they must build a gliding machine that uses drag, gravity, thrust, and lift to fly. Challenge them to create different versions of their glider to see if it can fly the farthest distance, stay in the air the longest, or glide accurately through a target. (Slide 12)

Evaluate

15. Restate the Investigative Phenomenon – Humans study and copy ideas found in nature to solve problems. (Slide 13)

16. Ask: “Do you think it’s important to be curious?” “Did curiosity inspire Leonardo da Vince, the Wright Brothers and Sir George Cayley?”, “Would humans be able to fly today without studying flying organisms?” (Slide 14)

17. Remind students that nature provides solutions to many real-world problems. By observing it closely, we can learn from it.

18. Ask students if they think it's important to protect places where living organisms are found. What impact could it have on our world if organisms become endangered or extinct because of the human footprint? (Slide 15)