LIFTOFF
NATURE INSPIRED DESIGNS FOR FLIGHT

Subject: Biomimicry

Grade Level: *3-5*

Topic: Engineering Design Process

Time: *30-45* minutes

Learning Objectives

Students will:

- describe the stages of the engineering design process.
- explain why engineers look to nature for inspiration in their designs.
- look to nature for engineering ideas and imagine, design, create, and test their own flight craft in a wind tunnel or with a fan.

Materials

EiE Design Process Poster, *Behavior of the Natural World Info Sheet*, drawing paper, marker or colored pencils, paper cone water cups, scissors, tape, card stock, coffee filters, pipe cleaners, mylar ribbons, fan or wind tunnel optional: other recyclables to extend the exploration

Procedure

Engage: To promote student curiosity, introduce the engineering design process using the EiE poster graphic and share specific examples of flight in the natural world aeronautic. Be sure to include both birds and insects as example of natural flight.

Explore: Help students build an understanding by sharing specific examples of biomimicry in flight and aeronautics, using the links below, including the design of airplanes and military jets, NASA's Armstrong Flight Research Center's design and testing of Unmanned Aerial Vehicles (UAVs) and the insect-sized Micro Aerial Vehicles (MAVs).

Biological Strategy:
"Wingtip Feathers Increase Aerodynamic Efficiency — Biological Strategy — AskNature" (*Asknature.org*)

Biological Strategy: "Wing Flexibility Generates Lift — Biological Strategy — AskNature" (*Asknature.org*)

Article: "IS IT A BIRD?IS IT A PLANE? BIOMIMICRY IN AIRPLANES" (*Medium, 2018*)

Article: "How Did We Learn to Fly Like Birds?" (*NASA*)

Research Paper: "Flexible-Wing-Based Micro Air Vehicles" (*American Institute of Aeronautics and Astronautics, 2022*)

Explain: Have students begin to show what they have learned by having each student share about learner's personal experience with flight. *Ask: "Have you ever traveled in an airplane? What was it like? How could they make flight more comfortable for passengers? What if you were flying all the way to the Moon? What other ways can we imagine using or needed insect sized flying technology? Here on Earth? Exploring distant planets?"*

Elaborate: Have students use their new knowledge by working in groups using material provided to imagine, plan, and create their own model space craft. Encourage engineering language. Ask open-ended questions about the design and how they think it will work. Encourage learners to talk about what parts of the design were inspired by nature. Participants can test their flight craft with the fan or in the wind tunnel. *Ask: "Did it fly the way you expected? What improvements do you want to make?"*

Assessment

Evaluate: Evaluate student learning by having each group evaluate their creation. A*sk: Referencing the Behavior of the Natural World info sheet, how would you change your design or the materials you used to be more in line with natural systems?*

Extension Activities

- Give learners the opportunity to circle back to their design and make adjustments and changes based on testing and on thinking about the NASA-related examples of flight technology. Students can retest their builds in the wind tunnel. Again, encourage engineering talk. Have students reflect on the original designs. *Ask: "What did you learn from any failures they experienced? Did you need other materials or resources?"*
- Encourage learners to modify their designs to create a craft that hovers. *Ask: "Can you make your design go higher in the tunnel? Can you make a craft that moves up and down in the wind tunnel? "*

NGSS Alignment

3–5-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3–5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints.

3–5-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

LS1: From Molecules to Organisms—Structures and Processes

4-LS1-1 - Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

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