GLIDER DESIGN & BUILD

An Aerospace Lesson Plan by Richard Saldana

Summary

Grade Levels: 9-12
Duration: Multiple class periods (suggested: 3–5 sessions of 60 minutes each)
Lesson Overview: In this lesson, students will explore the history of aviation and the forces of flight by researching, designing, simulating, and ultimately building a model glider. Using online simulation tools and hands-on construction materials, students will learn about the principles of simple machines, basic aerodynamics, aircraft structures, and the theory of flight. Students will apply the engineering design process to plan, test, analyze, and refine their glider models.
Subject Areas: Engineering Design and Problem Solving, Aerospace Engineering, Introduction to UAV Flight, Aircraft Technology, Astronomy, Physics, Chemistry, Earth and Space Science, and Integrated Physics/Chemistry (IPC)

Learning Objectives

- **Research & Simulate:**
  - Complete online research to understand glider history and design.
  - Use an online simulation tool to design and test their glider models.
- **Understand Aerodynamics:**
  - Explain key aerodynamic forces and flight dynamics including lift, thrust, weight, and drag.
  - Describe how roll, pitch, and yaw affect glider stability and maneuverability.
- **Design & Build:**
  - Apply the engineering design process to plan and create a physical glider.
  - Use hands-on skills and materials (e.g., balsa wood sheets, balsa wood sticks, modeling clay) to build a model glider.
  - Evaluate and refine design choices based on testing results and predefined criteria.

Materials & Resources

Research and Simulation Tools:

- ☐ Computers or tablets with internet access (for online research and simulation software)

Construction Materials:

- ☐ Balsa wood sheets
- ☐ Balsa wood sticks
- ☐ Hot glue guns and glue sticks
- ☐ Exacto knives
- ☐ Modeling clay
- ☐ Coloring markers
- ☐ Sandpaper
- ☐ Cutting boards
- ☐ Rulers
- ☐ Pencils
- ☐ Rubber bands

Visual Aids & References:

- ☐ Videos demonstrating glider builds and historical developments in aviation
- ☐ Diagrams of aerodynamic forces and aircraft components

Vocabulary

- **Aerodynamic Forces:**
  - Lift, Thrust, Weight, Drag
- **Aircraft Components:**
  - Fuselage, Vertical & Horizontal Stabilizers
- **Flight Dynamics:**
  - Roll, Pitch, Yaw
- **Other Relevant Terms:**
  - Wind (as a force influencing flight)

Instructional Procedures

- **Engage (Session 1 – 10 minutes)**
  - *Demonstration & Discussion:*
    - Begin the lesson with a model glider demonstration or a video showing glider construction and flight.
    - Discuss the historical significance of gliders in the evolution of aviation.
    - Ask guiding questions:
      - "How do the forces of flight enable a glider to stay airborne?"
      - "What elements do you notice in the glider's construction that contribute to its stability?"
- **Explore (Sessions 1–2 – 20 minutes)**
  - *Online Research & Simulation:*

        - Students conduct online research on glider history and principles of flight using provided digital resources.
        - Introduce students to the online simulation tool for glider design. In small groups, have them simulate glider designs by adjusting parameters (e.g., wing shape, stabilizer configuration) and observing flight behavior.
        - Students record observations about lift, drag, roll, pitch, and yaw from their simulations.
- **Explain (Session 2 – 15 minutes)**
    - *Class Discussion & Reflection:*
        - Facilitate a discussion where students share their simulation findings.
        - Review and define key vocabulary (lift, thrust, weight, drag, fuselage, stabilizers, roll, pitch, yaw). Use diagrams to illustrate these concepts.
        - Ask students to explain how each aerodynamic force affects the glider's flight.
- **Elaborate (Sessions 2–3 – 30 minutes)**
    - *Design Challenge:*
        - Students use their research and simulation data to sketch a design plan for their glider.
        - In groups, they outline specifications regarding dimensions, material use, and aerodynamic features.
        - Students begin constructing their glider models using balsa wood, glue, and other provided tools. The teacher circulates to offer guidance on technique, safety (especially when using Exacto knives), and design choices.
- **Evaluate (Sessions 3–4 – 20 minutes)**
    - *Testing & Redesign:*
        - Groups test their built gliders in a designated open area or wind tunnel setup if available.
        - During flight tests, students record performance data such as flight duration, distance, and stability.
        - Class discussion follows testing where each group presents their findings.
        - Using criteria discussed earlier, students evaluate which aspects of their design worked well and which need improvement.
        - Optionally, students can revise their design with additional construction and re-test for improved performance.
- **Extension Activity (Session 4 or Later)**
    - *Reflective Writing & Presentation:*
        - Students write a reflection detailing the design process, testing outcomes, and how they applied engineering principles.
        - Host a mini "glider gallery" or presentation session where groups display their models, share performance data, and discuss redesign strategies.

Standards Alignment

- **NGSS Disciplinary Core Ideas:**
  - ETS-1 (Engineering Design and Problem Solving)
  - PS-2 (Forces and Motion)
- **NGSS Science and Engineering Practices:**
  - Asking questions and defining problems
  - Developing and using models
  - Planning and carrying out investigations
  - Analyzing and interpreting data
  - Constructing explanations and designing solutions
  - Engaging in argument from evidence
  - Obtaining, evaluating, and communicating information
- **NGSS Cross-Cutting Concepts:**
  - Patterns
  - Cause and Effect
  - Scale, Proportion, and Quantity
  - Systems and System Models
  - Energy and Matter
  - Structure and Function
  - Stability and Change
- **Common Core ELA:**
  - Reading technical texts and synthesizing information
- **Mathematics**:
  - Measurements, scaling, and proportional reasoning

Differentiation & Supports

- **For Advanced Learners:**
  - Encourage deeper analysis by having students incorporate more complex aerodynamic variables in their designs or perform detailed calculations regarding lift and drag.
- **For Students Requiring Additional Support:**
  - Provide step-by-step guidance during research and design phases.
  - Use additional visual aids and offer pre-drawn diagrams for reference.
  - Pair students strategically for peer support during construction and testing.
- **Language/ELD Supports:**
  - Supply vocabulary lists with definitions and visual illustrations.
  - Provide sentence frames for explanations and group discussions (e.g., “The purpose of the [component] is to…”).

Teacher Reflection

After the lesson, reflect on the following:

- Did students successfully integrate research, simulation, and hands-on construction to build a functioning glider?
- Were learners able to clearly articulate the connections between aerodynamic forces and glider performance?
- What modifications could further support students who struggled with the design process or the use of technical vocabulary?
- How effective were the group discussions and presentations in deepening student understanding of the engineering design process?

This lesson plan provides a comprehensive, hands-on approach to exploring aviation history and the forces of flight, blending online simulation with traditional model building. It encourages analytical thinking, collaboration, and the practical application of engineering concepts in a real-world context.
