SOLIDWORKS

DESIGN PROJECTS

TEACHER GUIDE

3DEXPERIENCE



FLYING GLIDER

DASSAULT SYSTEMES

INTRODUCTION/GENERAL GUIDELINES

Welcome to the Design Projects Teacher Guide for the Flying Glider project. This activity presents a wide range of possibilities for the instructor. The individual components are simple enough for beginners to learn the basics of designing with CAD. This project is suitable for individuals and teams to design and build their own Flying Glider.

It is recommended that you have a completed model to pass around the class during the presentation. As an instructor, you have several resources at your disposal:

1. **Overview PDF**
    - The initial document that introduces the project providing a brief overview.
2. **Teacher Guide**
    - This document contains information that corresponds to the sections of the Presentation PowerPoint (see below). Each section discussed in this guide provides further details on how you can use the PowerPoint.
    - Also included are additional ideas you may want to use to enhance the activity in the classroom or adjust it for different skill levels.
3. **Student Guide**
    - This document is intended for students and provides basic guidelines for the activity such as deliverables, tips for creating the individual components and laser cutting guidelines.
4. **Presentation PowerPoint**
    - The PowerPoint is used to introduce the project to the class.
    - Feel free to customize any part of the presentation such as history, design concepts or any STEM related materials.
5. **Video**
    - The video is located on YouTube, and is intended to provide an overall approach to how the model could be created in CAD.
    - You may want to watch it together with the students in class.
    - LINK TO YOUTUBE VIDEO
6. **Step-by-Step Course**
    - This is where every step of the design process is demonstrated with short easy to follow procedures and video clips as well as overall videos showing the entire process.
    - LINK TO STEP-BY-STEP

BACKGROUND

This sections provides a brief introduction to the history of flight, and how the design process of this flying glider project connects to the rich and fascinating history of flight. Many designs are possible for producing a small glider that successfully flies in the air, not just the one shown in this project documentation. Encourage your students to research aircraft and find designs that they are interested in. Inspiration can come from military aircraft, birds, UFOs, and so on.

Throughout this project engineering terms will be used in explaining certain concepts. It is important to introduce these terms to students before the project starts to alleviate any potential confusion. These terms include:

Center of mass:

- The spot on an object where its weight is evenly balanced.
- If you were to try balancing an object on your finger, the center of mass is where it would be perfectly balanced.

Design intent:

- The purpose behind how something is designed

Design for manufacturing:

- The design intent for easy, cost-effective, and environmentally friendly production

Flat pack design:

- Design for a product to be packed and shipped in a flat box.

Tolerance:

- Additional space in holes for parts to fit together easier.

COMPONENT DESIGN

This section contains slides for each of the components. The purpose of this section is to discuss how Design Intent and DFM is to be applied to each part.

For detailed dimensions and step by step instructions for the parts, refer to the **ADDITIONAL RESOURCES** section below.

LASER CUTTING

This section outlines the steps for laser cutting the pieces of the glider. As each laser cutter has its own unique software and workflow, it's important to understand the specifics of your laser cutting machine before use. This section can also include your specific laser cutter's safety protocols, and links to your shop's safety training and rules.

MATERIAL CHOICE

Information on this slide is purposefully left blank. It is a template to introduce the material(s) your students will be using for this project.

This section allows you to introduce the materials used for the glider. It is necessary to share with your students the material thickness. Optional material parameters are also included and can open up a discussion on material sustainability and supply chain considerations.

Many different material are good options for this project, including balsa wood and foam board, as long as the thickness is around $1/16^{th}$ of an inch.

CLASS DISCUSSION QUESTIONS

This section provides a space to have an open, engaging discussion about many of the design decisions behind the flying glider. These questions allow students to think critically about the design intent and DFM for the glider.

PROJECT TASKS

Depending on the goals of the class, at a minimum students should be able to accomplish the following tasks:

1. Create all of the components of the glider.
    a) Wing
    b) Stabilizer
    c) Fuselage
    d) Ballasts
2. Create an assembly of the plane in CAD for design analysis
3. Manufacture the components from your design.
4. Assemble and test fly the glider.

ADDITIONAL RESOURCES

LINK TO DOCUMENTS

LINK YOUTUBE

LINK TO STEP-BY-STEP

The following sections do not correspond to the PowerPoint, and are included here for added benefit.

ASSESSMENT CRITERIA

Some other possibilities for assessment may be in the following categories:

SUSTAINABILITY – How was environmental impact minimized in production?

ASSEMBLY AND MANUFACTURABILITY – How easy was it to cut out and assemble the pieces? Were there any difficult features to make in the material?

PERFORMANCE – Does the plane fly as intended?

ADVANCED OPTIONS

For more experienced students, you can challenge them with advanced concepts and tasks that encourage creativity, engineering principles, and real-world application. Below are some ideas that could be suitable for this level:

Rubber-band powered propellor

- Have students design a propellor that attaches to the glider's nose. Encourage students to explore 3D printing for this component.
- Key concepts: energy transfer, friction, and design for additive manufacturing

Glider design competition

- Create a design competition for students to participate in. Provide the dimensions and the weight of a payload for the student's gliders to carry with the goal of flying the farthest. Encourage students to work together in teams.
- Key concepts: Teamwork in CAD, assembly analysis, and engineering design cycle.

Electronic wing control

- Have students use a sensor, actuator, and microprocessor to control the tilt of the wings of the plane.
- Key concepts: control loops, coding for embedded systems, and actuator control.

By including these advanced design elements, students will be pushed to develop critical thinking skills and a deeper understanding of engineering concepts.

EDUCATIONAL CONCEPTS

- This project offers valuable opportunities for educators to introduce or connect to many common STEM curriculum points, including:
- **SCIENCE**
    - Explore kinetics: teach students about velocity, trajectory, angles, and gravity.
    - Discuss conservation of energy, including potential and kinetic energy.
    - Explain the flight of the glider using the concept of forces and torques.
- **TECHNOLOGY**
    - Teach students to use 3D modeling for creating their glider designs.
    - Emphasize the importance of Designing for Manufacturing (DFM) by considering manufacturability and minimizing waste through smart design decisions.
- **ENGINEERING**
    - Introduce the engineering design cycle and the importance of design considerations throughout all steps of the project cycle.
    - Discuss structural stability and how to prevent the glider from breaking on impact.
    - Introduce failure analysis and iteration to identify and fix weak points in the design.
- **MATHEMATICS**
    - Analyze the angles involved in flight, from the angle of the wing to the launch angle of the glider.
    - Utilize formula driven, parametric design in software.
    - Solve for unknown variables such as total flight length or initial velocity.
    - Explore how material density and distribution contribute to calculating the center of mass of an object.
    - Calculate environmental and monetary impact of making a glider. Considerations can include product supply chain, material biodegradability, and waste material generated.