SOLIDWORKS

DESIGN PROJECTS

TEACHER GUIDE

3DEXPERIENCE



SPINNING TOPS

DASSAULT SYSTEMES

INTRODUCTION/GENERAL GUIDELINES

Welcome to the Design Projects Teacher Guide for Spinning Tops. 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 and the result is a model that can be used to explore the aspects of the design. This project is suitable for individuals and teams to eventually design and build their own Spinning Top.

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 3D printing 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 PHASE 2 (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 PHASE 3 (RISE CONTENT)

BACKGROUND

This section provides students with an introduction to the history of spinning tops, and a few examples of different top designs.

Since this project focuses on creating one or more tops, a slide with several examples is included. Use these examples as a starting point for discussing the advantages and disadvantages of each style.

Also included in this section is a slide for the discussion of key design terms.

- **Design Intent** – In the context of CAD modeling, Design Intent refers to how a model adapts when dimensions are changed. For example, it describes how a hole is created and dimensioned in a block. In product design, Design Intent encompasses how a product is intended to look, function, and feel from the user's perspective.

- **Additive Manufacturing** – This refers to the process of creating a 3D object by adding material layer by layer. 3D printing is a specific form of additive manufacturing.

- **DFM/DFAM** – These acronyms stand for Design for Manufacturing and Design for Additive Manufacturing, respectively. In these contexts, it is essential to consider both the materials used and the capabilities of the 3D printer to achieve a functional design while minimizing waste.

- **Nesting** – In manufacturing, nesting involves arranging cutting patterns on raw material to reduce waste during processes such as laser cutting. In 3D printing, nesting refers to the arrangement of parts on the printer's bed to optimize space and allow for the simultaneous printing of multiple components.

COMPONENT DESIGN

This section contains a slide to discuss applying Design Intent and DFAM to each part.

For detailed dimensions and step by step instructions for the parts, refer to LINK TO PHASE 3 (RISE CONTENT), in the **ADDITIONAL RESOURCES** section below.

3D PRINTING

This section provides an opportunity to discuss how the individual components will be oriented and prepared for 3D printing on the available machines in the classroom.

You may want to develop classroom procedures for using the machines and a method for keeping account of the materials used cost of each project. The way the components are designed and oriented on the 3D printer will have an impact on this. Here is also an opportunity to discuss sustainability, being mindful of our environmental impact when designing and making things.

PROJECT TASKS (ASSESSMENT CRITERIA)

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

1. Create one or more tops in CAD.
2. Print one or more tops on a 3D printer.
3. Test the balance and spin time of the top.
4. Compete against other students for longest spin time.

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

- SUSTAINABILITY – Minimize support material by changing the orientation.
- MANUFACTURABILITY – How many tops can fit within the parameters of the 3D printer?
- PERFORMANCE – Predetermine how much the top design affects the balance or spin time.

CLASS DISCUSSION

This section includes a couple of questions to start the conversation. The intent is to tailor the discussion to your course goals and the student's needs. Some additional questions may include:

- Why did some tops spin longer than others?
- Did any tops fail to spin? If so, what were the reasons?
- How do small changes in the design affect stability?
- What are the physics that explain how a top balances while spinning?
- What modifications could allow a top to spin longer or enhance its stability?
- How could the 3D printer affect the spin performance?

ADDITIONAL RESOURCES

LINK TO DOCUMENTS
LINK TO YOUTUBE VIDEO
LINK TO STEP-BY-STEP

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

ADVANCED OPTIONS

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

Advanced Spinning Tops

- Reversable: Have students design a top that spins oriented up or down.
- Crazy design: Create a top that looks like it shouldn't spin, but does.
- Add a knurled texture to the stem for improved grip.
- Design an adapter that allows spinning by pulling.

Material Efficiency

- Reduce weight: Create a top that uses less material than the initial design, but still spins as long.

Collaboration

- Team-based Competition: Have students work in teams to design different top styles, then compete against each other to see who has the longest spin time, the most balanced top, etc.

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

Crazy design inspiration:



