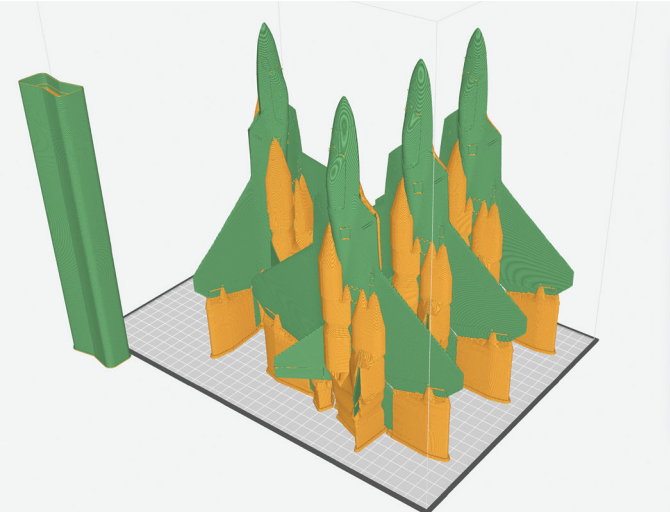
LESSON GUIDE

NESTING: ORIENTATION AND SUPPORT MATERIAL



Level	Intermediate
Academic Connections	Design for Manufacturability, Design Thinking
Core Concepts	Design Optimization, Print Optimization
Duration	1 week

Students will learn what nesting is and how it impacts the 3D printing process. Students will also learn 3D printing considerations for tolerances and support material removal.

LEARNING OBJECTIVES

By the end of this workshop, the student will be able to:

- Nest and orient 3D models on the build tray to conserve space and materials.
- Make more space- and cost-efficient use of 3D printing technology.

ESSENTIAL QUESTIONS

Use these questions to guide students' understanding:

- Why is material conservation important?
- Why is space conservation important?
- Why is nesting important?
- When should nesting be avoided?
- How to account for various materials?
- Is strength a consideration?

REQUIREMENTS

- Educator PC with access to:
  - Microsoft PowerPoint
  - QuickTime
- Internet connection
- Projector
- 3D printers
- CAD design tool

CLASSROOM

Lecture: Nesting

Learning Aids: PowerPoint with Lecture Notes

Case Study: Multiplier

Learning Aids: PowerPoint, Video

Download PPTs and Video from Lessons section at http://www.stratasysy.com/3DLC

COMPUTER LABS

Discussion: Material Behavior

Learning Aids: Material Spec Sheets

Preparation: Print spec sheets, available at: http://www.stratasys.com/materials (spec sheets are found on the individual material web pages)

Demonstration: Resolution, Tolerance, and Support Material

Learning Aids: 3D Printed Models

Preparation: 3D Print the models from STLs provided in Lessons section at http://www.stratasysy.com/3DLC.

ASSIGNMENT

Students will get hands-on experience with nesting their designs to conserve space and material inside the 3D printer.

3D Printed Airplane or Other Parts

1. Determine orientation

2. Support material

3. The piece must be produced in one print without assembly.

Preparation: Nesting Guide PowerPoint includes options. (Available in Lessons section at http://www.stratasysy.com/3DLC.)

DOCUMENTATION AND PRESENTATION OF ASSIGNMENT

Your presentation should demonstrate use of Design Thinking. As you work, be sure to address your problems, challenges and lessons learned. Include the following:

Material use:

- What design challenges have you encountered as a result of your chosen material?
- If you could have chosen another material, what would you have chosen? Why?

Technology:

- What design challenges have you encountered as a result of the 3D printing technology you used?
- If you had access to other fabrication technology, what would you have chosen? Why?

Wall thickness:

- Have you encountered problems with thin areas in your model?
- Were any supporting parts affected?
- How did you fix this?

Details:

- Does your design contain areas with small embossed or engraved features?
- Are they necessary for your design to function?
- Have you encountered issues with details getting lost?

Holes and Gaps:

- Have you encountered any tiny holes or gaps?
- How did you fix this?

Scaling:

- Have you been able to resolve some of your issues by increasing the scale of your model or did you have to significantly alter your design?

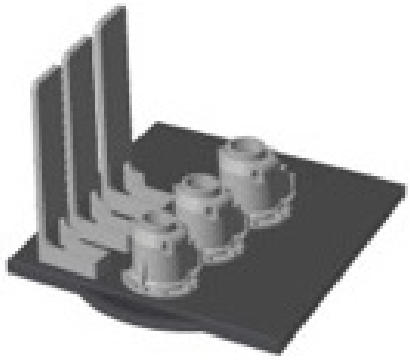
ASSESSMENT

ESSAY QUESTION

1. The image below shows three optional part orientations. Which orientation is most preferable in your opinion? Relate to printing speed, amount of support material needed and highest pack-density.

MULTIPLE-CHOICE QUESTIONS

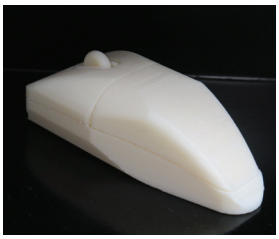
2. What does the term “tolerance” refer to when designing dynamic surfaces?
   a. Material durability
   b. The space between connected parts, designed for supported materials
   c. The friction and resistance between connected parts
   d. The dynamic surface design complexity
3. Which of the following are basic elements of 2D nesting? Select all correct answers.
   a. Part orientation
   b. Part combinations
   c. Spacing between parts
   d. Material selection
4. Which of the following are benefits of proper nesting and positioning? Select all correct answers.
   a. Reduced material waste
   b. Reduced energy usage due to shorter print-head travel
   c. Sharper details and smoother surface finish
   d. Increased yield of parts per print job
5. Part orientation can affect its strength. True or false?
   a. True
   b. False
6. Examine the image below. What would you do to improve the nesting layout and shorten print time?
   a. Print tall parts and short parts separately
   b. Rotate tall parts to shorten Z axis height and reduce height differences between two part types
   c. Align all 6 parts to one row to reduce print-head travel time
   d. Increase spacing between parts



SUGGESTED NEXT LESSONS

COMPUTER MOUSE

Keeping the users of your product in mind, design a wireless mouse that will provide optimum comfort and performance.



CHESS SET

Design a chess set that includes six unique game pieces: pawn, rook, knight, bishop, queen and king.

SOUND WAVES

Students will 3D print their voices and learn about sound waves using a sound wave generator.

To access additional 3D Learning Content and resources visit:

http:// www.stratasys.com/3DLC

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