



# “Making” Fun with 3-D Printing

3-D Printing Project #1 for 4-H Makerspace Clubs  
Age: Junior 4-H’ers (8–13 years old)

A makerspace club is a group of 4-H’ers who create, invent, tinker with various tools, and explore new technologies together. These clubs access community resources, such as libraries with 3-D printers and the local Extension office with robots, Arduinos, and Snap Circuits. It is a place for creative brains to come together and make something new. Often, young people who are interested in this type of activity will meet together at their Extension office or local library.

Some local libraries have 3-D printers from the Mississippi Library Commission. This makes a great field trip for 4-H clubs. However, you should contact your local library at least 1 month before your desired field trip time so that your librarian has time to coordinate with the Library Commission to have the printer available.

Your local librarian may have some fun tips and ideas for projects, but, if you run out of ideas, a group of Mississippi State University mechanical engineering students has a unique challenge for you! James Shaffer, Adam Nguyen, Ethan Watts, and Ben Harned completed an Introduction to Mechanical Engineering service-learning class at Mississippi State University. Service-learning allows students to take what they are learning in the classroom and apply it to real-world issues. This process helps shape the students’ learning experience while they give back to the community. These students developed a 3-D lesson plan using Shel Silverstein’s book *The Giving Tree*.

For this project, you will need a copy of *The Giving Tree*, access to a 3-D printer, hot glue, green tissue paper, craft paint, and loads of imagination. Before you begin, be sure to download the .gcode or .stl file to your computer. Remember, it will take several hours (think overnight) for the tree to print. Consider using some of the Extra Ideas at the end of this lesson plan to keep 4-H’ers engaged with hands-on learning.

## LESSON PLAN: ***THE GIVING TREE***

### ■ OBJECTIVES

- The learner will define 3-D printing.
- The learner will sketch a 3-D model.
- The learner will demonstrate safe practices while using the 3-D printer.

### ■ SAFETY TIPS

- Always use the 3-D printer in a well-ventilated area.
- Always use safety glasses when working with the build plate.
- Be aware that filament is extremely hot when printing; always wait for the filament to cool before handling.
- Always have an adult present when working with the 3-D printer.

### ■ MATERIALS

- 3-D printer
- Filament
- Craft paint
- Paint brushes
- Green and red tissue paper
- Projector, laptop, and Internet connection

### ■ KEYWORDS

- 3-D printing
- filament
- layer
- build plate
- rendering

### ■ INTRODUCTION (15 minutes)

Read *The Giving Tree* to students or have them read it on their own. Discuss the major characters in the story and their roles. Show participants a slice of a tree trunk, and ask them to count the rings to determine the age of the tree. Just as each ring represents growth for the tree, a 3-D printer lays down “rings” or layers for each object it creates. Tell students they will now see the story come to life using a 3-D printer.

## ■ DISCUSSION (5 minutes)

Ask the students if they have ever seen or heard of a 3-D printer. Show one of the following movies to help students think about the possibilities of 3-D printing:

- **What Is 3-D Printing and How Does it Work?**  
<https://www.youtube.com/watch?v=Vx0Z6LplaMU>
- **Will 3-D Printing Change the World?**  
<https://www.youtube.com/watch?v=X5AZzOw7FwA>
- **Kids Can Easily Make Their Own Toys with 3-D Printing**  
<http://www.cnet.com/videos/kids-can-easily-make-their-own-toys-with-3d-printing/>
- **An Affordable 3-D-Printed Arm**  
<https://www.youtube.com/watch?v=AcLh-aSUdx0>
- **Kids Learn 3-D Design and Printing**  
<http://www.cnn.com/videos/tech/2015/04/03/pkg-mueller-children-3d-printing.cnn>

## ■ EXPERIENCE (20 minutes)

3-D printing can make what you imagine or dream become a physical reality. When you give commands to the printer through 3-D software, you can create an object that previously only existed in your imagination. When a 3-D printer prints, it prints in layers. Demonstrate this concept with a hot-glue gun. Create a rectangle with the hot glue. Once it is cooled, add another layer on top of it to model how 3-D printing works. The 3-D printer uses filament (which functions like ink in a normal laser printer) to create objects. Filament is usually colored plastic, but it also can be made of wood, bronze, or other materials. Pass around objects made from filament for participants to see and touch.

In order for the computer to communicate with the printer, a special 3-D modeling software must be used. There are several free options available, such as Tinkercad or SketchUp, which can be downloaded to use at home or at the library. Show participants the software package you have chosen. Point out key features and perhaps create a small object using the software.

Open the .gcode or .stl file for *The Giving Tree* (<http://extension.msstate.edu/content/3-d-files>). Take participants to the 3-D printer and have them put on their safety glasses. Remind participants that it is important to wear safety glasses when working with a 3-D printer. Also make sure participants know not to open the door to the build plate or touch the build plate once printing has begun.

Explain what an extruder is and how the filament is loaded. Point out the build plate and any other interesting features of your particular 3-D printer. Begin the print. Allow 4-H'ers to observe the printing process for a few minutes. Explain that it will take the printer all day (or overnight) to complete the print job.

## ■ EXTRA EXPERIENTIAL ACTIVITY (20 minutes)

Pick one of the hands-on activities in the Extra Ideas section below for participants to create together. Encourage them to check back periodically on the progress of the print.

## ■ SHARE (25 minutes)

Once the tree and boy are finished printing, encourage 4-H'ers to compare how the objects printed to how they thought they would, based on how the rendering looked in the software. Did it turn out how they expected? Why or why not?

Give each participant a piece to decorate (trunk, branch, boy). You will need craft paint, paint brushes, tissue paper, and other craft supplies. Once they are done and the pieces are dry, ask students to work together to assemble their tree.

## ■ PROCESS (10 minutes)

Discuss any problems the participants had and how they could be resolved in the future. Ask which part of the process they liked most or least.

## ■ GENERALIZE (10 minutes)

Ask participants what possibilities they see for 3-D printing in the future. How could you use 3-D printing in your daily life? Give participants graph paper to sketch a design they would like to create. They can use the 3-D software to make their objects.

## ■ EXTRA IDEAS

- Put 4-H'ers in groups of two. Give one person a container of modeling clay and the other an image from *The Giving Tree*. The person with the image must be the computer software and communicate to the other person (who is the 3-D printer) how to build the drawing one layer at a time. The "software" may not touch the "printer" or the modeling clay.
- Using twine, create an XYZ plane. Ask participants to build a structure or object out of drinking straws. Each layer of straws represents a layer of filament.
- Let students create their own movie based on the 3-D printed tree and character they created.
- Let students research the history of 3-D printing and create a timeline to display at the library.
- Working in groups of three to four, create a 3-D tree that stands at least 1 foot tall using nothing but toothpicks, a piece of cardboard, 10 mailing labels, one pair of scissors, two pieces of construction paper, two markers, and one piece of string measuring 12 inches. Take pictures of the process and create a storybook or presentation to share with others in the community.

**Reference:** Silverstein, S. (1964). *The Giving Tree*. Harper & Row, New York.

**Publication 3027** (POD-03-17) • By Dr. Mariah Smith Morgan, Assistant Extension Professor, Extension Center for Technology Outreach; and James Shaffer, Adam Nguyen, Ethan Watts, and Ben Harned, MSU mechanical engineering students.

Copyright 2017 by Mississippi State University. All rights reserved. This publication may be copied and distributed without alteration for nonprofit educational purposes provided that credit is given to the Mississippi State University Extension Service.

Produced by Agricultural Communications. We are an equal opportunity employer, and all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director