



# “Making” Fun with 3-D Printing

3-D Printing Project #2 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! Kevin Trinh, Stephen Moffett, Barrett Schock, and Siji Osinowo 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 the Golden Classics Book *Little Boy with a Big Horn*.

For this project, you will need a copy of *Little Boy with a Big Horn*, access to a 3-D printer, 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 objects 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: *LITTLE BOY WITH A BIG HORN*

### ■ OBJECTIVES

- The learner will define 3-D printing.
- The learner will identify supports.
- The learner will demonstrate safe practices while using the 3-D printer.

### ■ MATERIALS

- 3-D printer      Filament      Craft paint      Paint brushes
- Projector, laptop, and Internet connection

### ■ 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.

### ■ KEYWORDS

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

### ■ INTRODUCTION (15 minutes)

Read *Little Boy with a Big Horn* to students or have them read it on their own. Discuss the major characters in the story and their roles. 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 videos to help students think about the possibilities of 3-D printing, or choose one of your own:

- **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 *Little Boy with a Big Horn* (<http://extension.msstate.edu/content/3-d-files>). Three objects can be printed: the boy, the horn, and the dog. Choose which one to print first. Next, 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.

Talk about the concept of supports. In 3-D printing, if a rendering does not have the correct supports drawn, it will droop or collapse. Look around the room and identify objects that support other objects (for example, legs on a table). Often, supports have to be added to a drawing so that the object will print correctly. Show an example of an object that did not have supports (if one is available) and one that did have supports.

The horn, boy, and house 3-D prints will require supports to print properly. Encourage participants to look for the supports being printed as the object is printing. Are there any differences between where the support is printed and where the actual object is printed? Does it look different? Remind participants that it will take many hours for the pieces to print.

## ■ 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 objects are finished printing, encourage 4-H'ers to compare how the object printed to how they thought it would, based on how the rendering looked in the software. Did it turn out how they expected? Why or why not? Point out the supports and ask participants how they can be removed. Generally speaking, you should use a craft knife and sand paper to remove the supports. Once most of the supports have been removed, allow participants to gently rub the remainder off with sandpaper. Use craft paint to decorate the pieces.

## ■ 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

1. Invite a musician who plays the horn to talk about the instrument and how to play it.
2. Create an air horn using this handout: <https://www.childrensmuseum.org/blog/saturday-science3a-handmade-horn> or by watching this video: <https://www.youtube.com/watch?v=nyGvBQCWzuw>
3. Give each participant a chocolate chip cookie and a toothpick. Ask them to remove the "object" (in this case, chocolate chips) from the "support" (the cookie). Adapted from: [http://naturalsciences.org/docs/exploring-nc/TH\\_Chipping\\_Away\\_at\\_Fossils.pdf](http://naturalsciences.org/docs/exploring-nc/TH_Chipping_Away_at_Fossils.pdf)
4. Show different grains of sandpaper and explain the difference between them. Give participants crayons and ask them to draw one of the images from the book on a piece of sandpaper. When everyone is finished, string the pieces of sandpaper together to form the story.
5. Visit <http://www.nskids.org> to "play" various instruments, including a tuba.
6. Make an oboe using this easy-to-follow guide: <http://www.exploratorium.edu/snacks/straw-oboe>. Hold a concert with the air horn and oboes.

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**Publication 3026** (POD-03-17) • By Dr. Mariah Smith Morgan, Assistant Extension Professor, Extension Center for Technology Outreach; and Kevin Trinh, Stephen Moffett, Barrett Schock, and Siji Osinowo, MSU mechanical engineering students.

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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