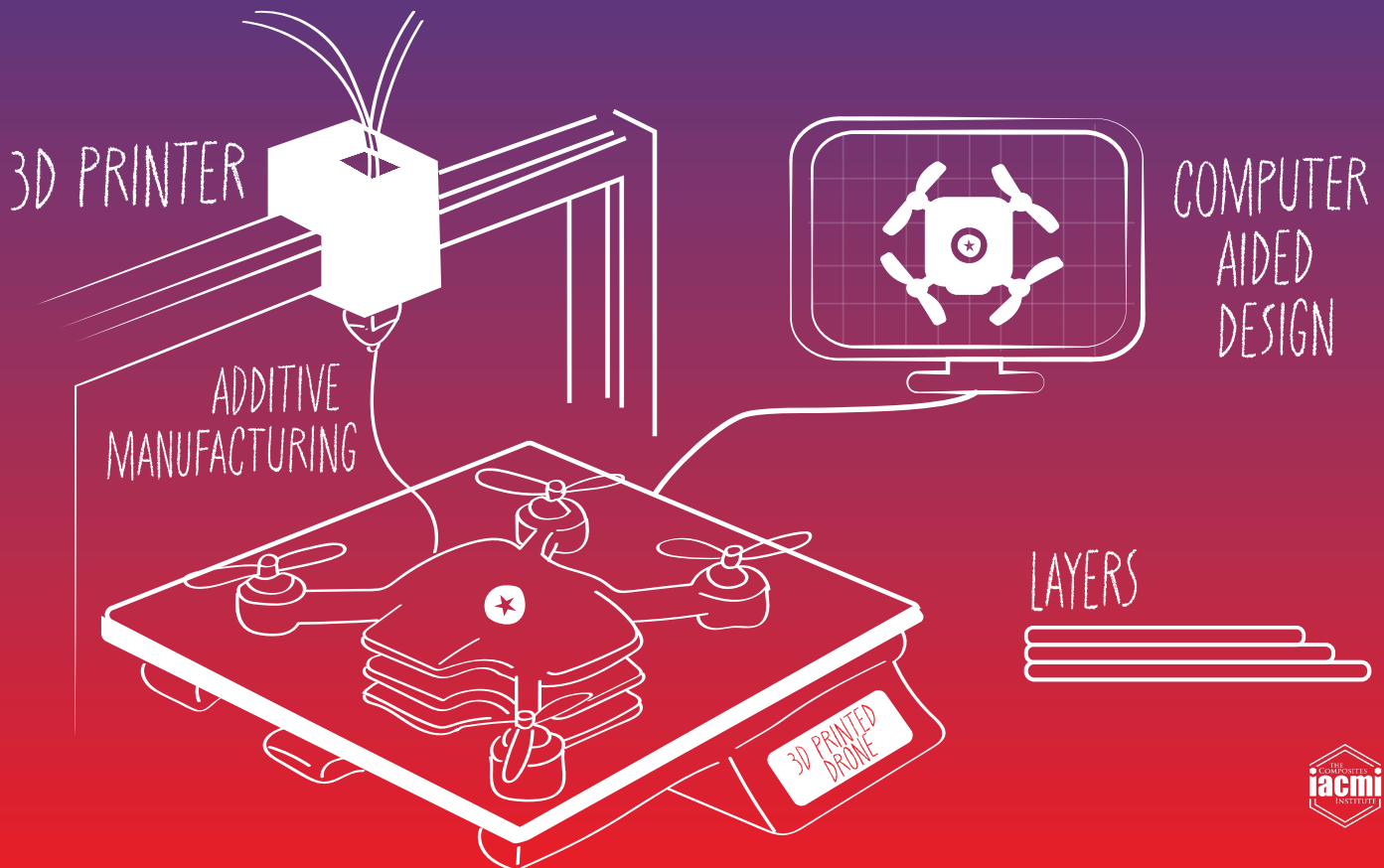


DREAM. BUILD. BECOME.

ACE METAL FOUNDATIONS

By IACMI

Additive Adventures



Additive Adventures



Prior Knowledge

This activity requires little prior knowledge. Students should have a basic understanding of three-dimensional shapes, and how to work within a specified sequence.

Additive Adventures

Lesson Overview

In this activity, students learn how **additive manufacturing**, the process used in 3D printing, builds objects one thin layer at a time. Instead of using an actual 3D printer, students will model the process using play dough by rolling out thin “layers” and stacking them to create a small creature or object.

Students will get a hands-on understanding of how 3D printers form shapes with precision, and repetition as they explore how:

- 1) Layers combine to make 3D shapes,
- 2) Shape accuracy depends on consistent layers
- 3) Design choice affects how easily an object can be “printed.”

Students will also learn how to **plan a design, follow a build sequence, understand constraints, and iterate to improve results** in a fun and creative format.

Vocabulary

Additive manufacturing: Building something one layer at a time

Layer: A thin, flat piece of material added to the top of another to create a 3D shape

Design: A plan or drawing that shows how something will look before it is built

Precision: Making something carefully so it matches the intended shape

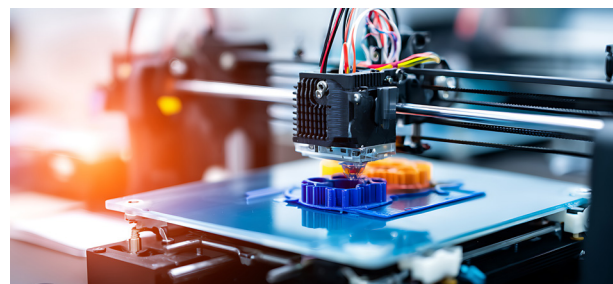


Figure 1: 3D printer in operation creating plastic objects on build platform

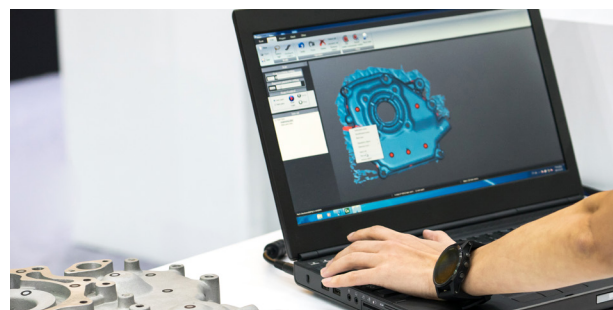


Figure 2: 3D design software of an engine part.

Additive Adventures

The Foundations of 3D Printing

Have you ever stacked blocks to build something tall? That's how many modern products are made today. Instead of carving something from a large piece, some builders use a process called additive manufacturing. This means building something by adding one thin layer at a time. 3D printers work this way. They follow a design and place tiny layers of material on top of each other until the object is complete.

Today, you will become a 3D printer. You will roll out thin layers and stack them to build your own object. Just like real builders, you'll follow a plan, build step-by-step, and see how your design comes together.

Why do we use additive manufacturing?

People use additive manufacturing to create shapes that are hard, or even impossible to make with traditional tools. With additive manufacturing, you can build:

- Toys and figures
- Phone stands, and tools
- Machine parts
- Medical devices
- Full-sized houses and bridges



Figure 3: 3D printed toy inside of a 3D printer.

The importance of layers

Layers are the “building blocks” of any 3D printed object. Some 3D printers can even make composite parts. A composite is made when two or more materials work together to make something stronger, lighter, or more useful than one material by itself. In composite 3D printing, tiny fibers can be added to a plastic-like material to help make the finished part stronger without making it too heavy.

If layers are too thick, it makes the object look rough. If layers are uneven, the design may not fit together. When layers are accurate and smooth, the final shape looks clean and works well. Understanding layers helps you plan ahead, follow a pattern and design something that can actually be built.

By building with layers, students get a real sense of how modern manufacturing works, and why so many industries use 3D printing to solve problems, make new products, and to create the impossible.

Additive Adventures

Materials

Materials Supplied in Kit

Per Student

- 1 container of play dough



Activity Directions

This activity looks easy but can be a little tricky. Below are instructions for a simple starter project to help students understand how layers stack, connect, and support each other. Let students try this starter project first and then use any observations or takeaways to inform their own creations.

Students will make a simple snake using layer lines.

Step 1: Build the Coiled Body

- Roll a long, thin line of play dough



Additive Adventures

Activity Directions Continued

Step 1: Build the Coiled Body Continued

- Coil it into a shape on the table. Slowly curve it around into a shape that looks like the number 9 or the letter P
- Roll another thin line and place it on top. Press lightly to make sure that the layers stitch together
- Continue stacking letters to build height. Repeat step 3 as many times as desired to build a taller, thicker snake body



Step 2: Make the Snake's Head



- Form the head shape by rolling out another short layer line. Coil it into a tight spiral, like a cinnamon roll. This should be a little smaller than the body.
- Continue adding layers to the head. Repeat step 5 a couple more times with slightly shorter layer lines so that you end up with a small half-dome shape for the head. This is how 3D printers build round shapes: lots of small, shrinking layers
- Add the eyes and tongue. Roll two tiny balls of a different color and press them onto the head. Roll out a tiny layer line and flatten it to create a tongue, then press it into the snake's head
- Attach the head. Press the bottom of the head onto the coiled body. Your snake is now complete and built much like a 3D printer would do it – **layer by layer!**

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Activity Directions Continued

General tips for free creation:

- Layers can't float on air: Every new layer has to sit on top of the layer below it. If nothing is underneath, the layer will fall or stretch out, just like a real 3D printer.
- Use shapes that get smaller as they get taller
- Cones, pyramids, hills, towers, volcanoes, and animals with wide bases all work best
- Keep layers thin and even
- Thick layers are harder to shape, control, and stack
- Uneven layers are wobbly or lopsided prints
- Gently press down each layer to help them stick
- A little pressure keeps things stable
- Too much pressure squishes the whole shape

Discussion Prompts or Reflection

- What decisions did you make before you started building?
- If you were to redesign your object, what would you change about the shape or layers?
- What challenges did you run into while building your layers?
- Did any part collapse, warp, or stretch? What might have caused that?

Variations and Enrichment

- Once students have a foundational understanding of how building structures with layer lines will work, they can build almost anything.
- Students who are struggling to build figures with layer lines may be encouraged to make their name or experiment with different layer patterns.
- Divide the class into two groups. Give half of the class 5 minutes to build something with thick layers, and the other half 10 minutes to build with thin, careful layers. At the end, compare strength, neatness, and accuracy.

Additive Adventures

Foundation Exploration

- **Engineers** use additive manufacturing to design tools, machine parts, airplanes, cars, and robots. They must carefully plan the shape, size, and structure of every layer so the finished product is strong and accurate.
- **Doctors and medical engineers** use 3D printing to make custom casts, prosthetic limbs, braces, and models of organs. These can help patients heal faster and give surgeons a chance to practice before an operation. Precision and careful layer design are extremely important for safety.
- Some **construction workers and architects** use 3D printing to build walls, homes, and bridges. Just like in this activity, these men and women print layer on top of layer, but with concrete instead of clay.
- **Toy and product designers** use 3D printing to make new toys, action figured, board game pieces, phone accessories, and prototypes of products before they are mass-produced.

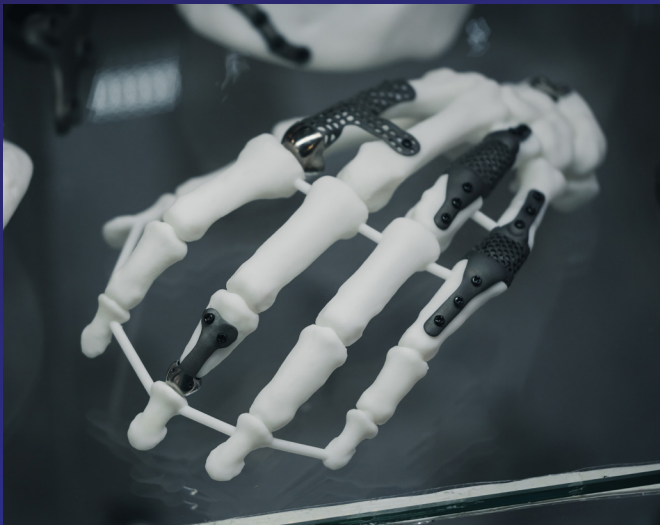


Figure 4: 3D printed prosthetic hand



Figure 5: 3D printed cement walls