Manufacturing Processes

**OBJECTIVE**
Students will simulate an assembly line and 3D printing as they explore, compare, and contrast the two manufacturing processes.

**MATERIALS**
- Modeling clay, one handful per student
- Manufacturing Images (cut out in advance), enough sets for half the class
- Trophy Manufacturing handout, enough for half the class
- Device to project video, one for the instructor
- 3D Printing in 30 Seconds video, to project

**ENGAGE**
Begin by helping students find a partner and distribute one set of Manufacturing Images to each pair. Then use the following prompts to guide the class in examining the images:

- First, spread the images out in front of you and observe each one.
- Now place similar images together and discuss the similarities with your partner. You may group and regroup the images a few times! What are some of the similarities?
- Which images look newer to you? Which look older? Separate the images into two categories and discuss their differences.
- Manufacturing is the process of making products or goods from simpler materials. Place images that show examples of manufacturing in front of you.
- The companies that make or manufacture products are called manufacturers. Many manufacturers today use machines (including robots!) to make their products. Place any images that show examples of machine manufacturing in front of you.
EXPLORE

- Tell students to imagine that they just got their first manufacturing job! They now work for a company that manufactures all kinds of trophies—for sports, contests, school events, competitions, and more.
- Explain that one way to manufacture trophies is to use an assembly line. Ask: Have you heard of an assembly line before? Explain that an assembly line is a way to create a lot of products quickly. In an assembly line, each person or each machine is responsible for creating one specific part of the product, and the product is built as it passes from one person or machine to the next.
- Distribute one Trophy Manufacturing handout to each pair. Ask students to think about a sport or competition that may need a trophy. Once they have one in mind, they should sketch a trophy for this competition in the top square. They should then divide the entire trophy into four simple parts and sketch each of these parts in the handout’s bottom four squares.
- Next, pair partners with each other and explain that each group of four will be responsible for forming an assembly line that manufactures models or prototypes of these trophies. Give each group more than enough playdough to accomplish this, and then lead them in forming an assembly line by instructing each group to:
  - Randomly select one of their trophy designs.
  - Decide which person will be responsible for creating each part.
  - Line up in the correct production order with the modeling clay in hand.
- Once all groups are ready, explain that each student will create their assigned part, add it to the part that the person before them created, and then pass the completed portion to the next person. Then instruct groups to begin and challenge them to see how many small prototypes they can create within a four- or five-minute window.
- When the time is up, debrief with the class by asking:
  - What are some of the benefits or positive aspects of assembly lines?
  - What seem to be some of the disadvantages or negative aspects of assembly lines?
APPLY

• Tell the class that they will now consider what they have learned about assembly lines as they investigate a type of advanced manufacturing called 3D printing.

• Play the 3D Printing in 30 Seconds video and ask students to think about how making a trophy this way may be different from creating one with an assembly line. When the video is complete, explain that 3D printers come in all different sizes and can be used to create everything from trophies and jewelry to rockets and homes. Rather than starting with larger pieces of material and cutting them down to make smaller pieces, 3D printing begins with nothing and adds material one layer at a time.

• Instruct student pairs to look again at the trophy they designed on the top of their Trophy Manufacturing handout. Explain that 3D printing always begins with a digital design and encourage students to spend a few minutes improving or personalizing their original trophy.

• Then give a handful of modeling clay to each student. This time, instruct students to create a prototype of their new trophy by modeling 3D printing. To achieve this, they should start with the very bottom of their design and add modeling clay layer by layer to build their trophy. Remind them to think of the video they just watched as they complete this process!

• When there are five minutes left in the session, wrap up with a discussion that compares 3D printing to assembly lines. Questions to probe student thinking include:
  - Which manufacturing process created trophies more quickly?
  - Which process may allow you to create more detailed or original trophies?
  - Can you think of any other pros or cons of assembly lines or 3D printing?

K–2 CONSIDERATIONS

• Keep the age level of the students in mind as you explain concepts and substitute simpler words as needed.

• Try to model sample responses to open-ended questions before you ask students to brainstorm or respond on their own.

• Select just a few questions to focus on during the picture sort. Be sure to keep the questions that specifically address manufacturing.

• Model how an assembly line works before allowing groups to create their own. In classes where this may be tricky for groups to complete independently, you may also guide all groups through forming an assembly line that creates the same trophy.
MANUFACTURING IMAGES

Instructor note: Cut out images in advance.
TROPHY MANUFACTURING

Trophy Design

Assembly Line: 1st Part

Assembly Line: 2nd Part

Assembly Line: 3rd Part

Assembly Line: 4th Part