



TeachEngineering

Machine-Free Manufacturing



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Pre-Activity Questions:

- What is easier to melt: plastic or metal? Explain your answer in one sentence.
- What materials are used to make wire? List all materials you think go in a wire in bullet point form.
- Can you name a manufacturing process? If so, what does that process make?

Materials Research

Choose a metal, plastic, or composite material to research. Research your chosen material and answer the following questions.

What is your material?

Which countries produce your chosen material?

Where does your material come from, or how is it made?

List at least five properties of this material.

What is your material used for?

Why did you pick this material to research?

What is manufacturing?

- Manufacturing is the process of turning raw materials or parts into finished goods by using tools, human labor, machinery, and chemical processing.

Why is manufacturing important?

- Manufacturing is a skill that a computer cannot learn how to do. It is a task that contributes to the economy by having people make things with their hands.
- Manufacturing is involved in every industry.

Manufacturing Research

Pick a local manufacturer and research the following:

1. What do they manufacture?
2. How do they manufacture their product?
3. What is their product used for?
4. What other businesses use the same manufacturing process?

Today we are going to talk about four manufacturing processes.

- Mixer milling
- Extrusion
- Injection molding
- Forging

What is a mixer milling machine?

- Used in materials science for sample creation.
- Mixes materials together with stainless steel components for cleanliness due to purity of the steel.
- Homogenizes materials and creates accurate and consistent samples every time due to the timing ability.
- Examples would be in making composite materials that have both properties of the materials included, such as a popsicle stick that has wood and plastic mixed in.

Mixer Milling Video (4:48)



Mixer Milling Questions



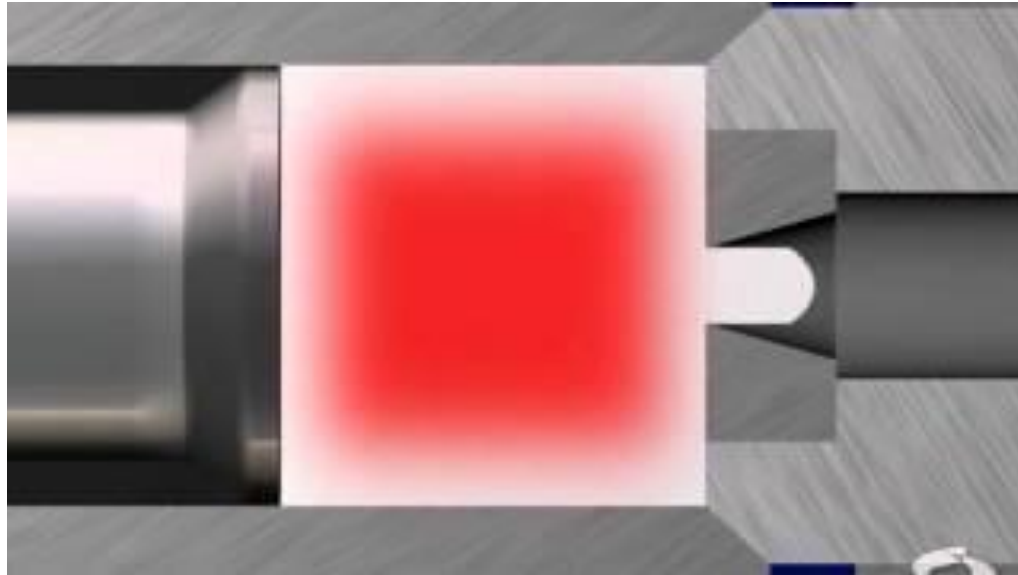
Answer the following on your Manufacturing Research Worksheet:

- What is the importance of milling?
- How does this process change the chemical and physical properties of the material?

What is an extrusion machine?

- Can be used in plastic and metal production.
- Forces a block of material through a mold.
- Forces required to push the material through the mold can be found through mathematical equations that require the area divided by the area of the mold.
- Can use hot or cold materials.
- Examples include wire, PVC pipes, and ceiling beams used to hold Styrofoam squares in place.

Extrusion Video (2:16)



Extrusion Questions



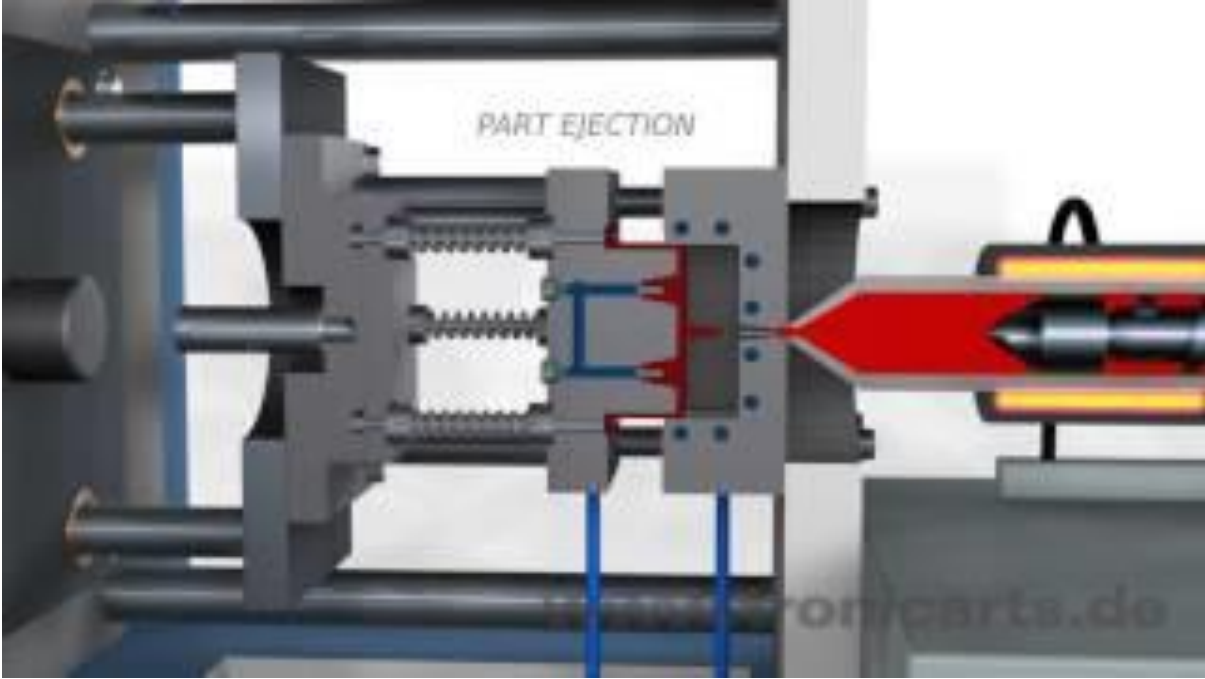
Answer the following on your Manufacturing Research Worksheet:

- Is 3D printing an object the same as or different from extrusion? Please explain in three sentences with your own example.

What is an injection molding machine?

- Used only for plastic materials.
- Creates complex shapes using a mold.
- Very quick at producing multiple items and is popular in manufacturing due the reproducibility of it.
- Takes plastic pellets and melts them to create a liquid that then cures in the mold.
- Examples include Tupperware, ice cube trays, and coffee cup lids.

Injection Molding (2:58)



Injection Molding Questions



- List as many examples as you can: What items at your home are made using injection molding?

What is forging?

- Used for metal only.
- Can make large pieces of metal that need a specific thickness and uniformity.
- Only heated metal can be forged, due to the malleability needed to form the metal into what it needs to be. Cold forging is like forging, but without the heat.
- Examples include shields, armor, swords, and wheels.

Forging Video (1:50)



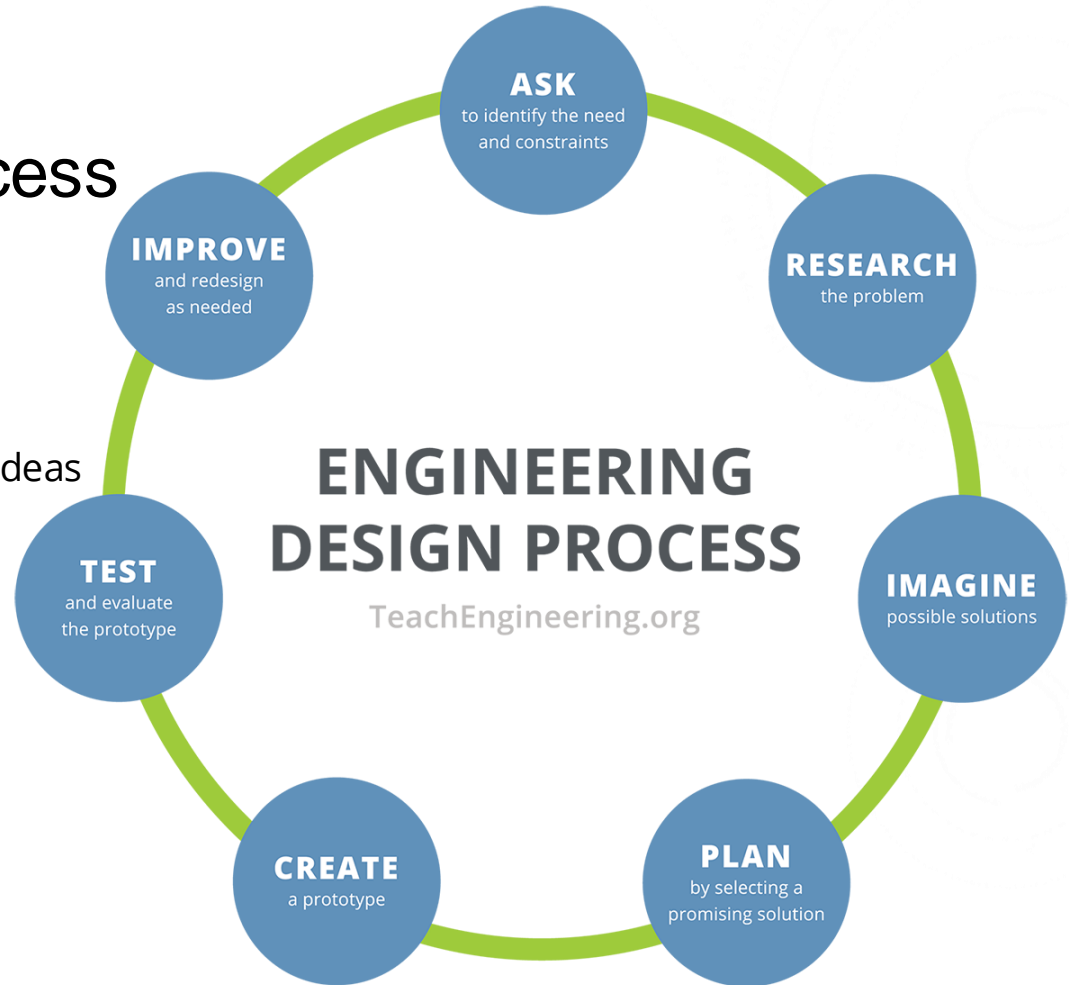
Forging Questions



1. Make a list of items that are forged.

Engineering Design Process

1. Ask: Identify the Need / Problem
2. Research the Problem
3. Imagine/Brainstorm: Develop Solution Ideas
4. Plan: Select a Promising Solution
5. Create: Build a Prototype
6. Test and Evaluate Prototype
7. Improve: Redesign as Needed



Creature creation time!

- You must use the Engineering Design Process to create a creature of your very own! The creature creation must have:
 - A habitat made from one of the four manufacturing processes.
 - A food made from one of the four manufacturing processes.

The creature, the habitat, and the food must be made from three out of the four manufacturing processes we learned about today. It can be small or large, flat or three dimensional, real or completely made up!

Lab Time!

To Demonstrate Material Mixer Milling: You will be creating your own paper by giving the paper pulp new colors and physical properties from cotton balls, plant material, and different types of paper.

To Demonstrate Extrusion: You will be asked to pipe Play-Doh from a piping bag to create shapes you might need for your creature.

To Demonstrate Injection Molding: You will be asked to pipe Play-Doh from a piping bag into a mold of your choosing.

To Demonstrate Forging: You will be given one piece (constraint) of aluminum foil to shape into whatever shape you need!

Group 1 will start at the material mixer mill, while everyone else will work on their Engineering Design Worksheet!

References

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Supporting Program was a Research Experience for Teachers (RET) through the NSF 1855147 at the University of Houston.
Special Thanks to Dr. Zhu and Dr Robles.

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