

Name:

Date:

Class:

Lab Worksheet **Answer Key**

Material Mixer Milling Station Instructions and Questions:

1. Take one piece of paper and cut it into 12 strips.
2. Place the paper strips into the blender.
3. Add in optional colored paper strips or food coloring.
4. Blend the paper for 3 seconds. Record observations of the blended paper below.
Answers will vary.
5. Close the lid and blend the paper for 3 more seconds. Record your observations of the blended paper below.
Answers will vary.
6. Close the lid and blend the paper for a final 4 seconds.
7. Record your observations of the blended paper below. *What does your paper look like? Is there a temperature difference? What does the paper feel like?*
Answers will vary.
8. Add enough water to just cover the paper. Don't add too much or you will create paper soup instead of paper pulp!
9. Blend the paper mixture until smooth.
10. Place the grate or screen over a bucket. Put the paper pulp on the screen and press the paper pulp flat, draining the excess water (into the bucket below).
11. Use paper towels to absorb the extra moisture.
12. Leave the paper pulp on the screen to dry (approximately 1 to 2 days.)
13. Clean up the station and materials.

Material Mixer Milling Reflection Questions:

1. What properties are you trying to give this paper? Is there a certain strength/texture you are looking for?
Can be whatever they want!
2. Write a hypothesis about how the materials you added will make the paper better than it was before:
Can be whatever they want!

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Extrusion Station Instructions and Questions:

(Note: Engineering Design Process Worksheet MUST be completed before doing this station!)

1. Place parchment paper or a tablecloth on the table or lab station countertop.
2. Put Play-Doh into the piping bag.
3. Starting from the back of the dough ball, gently squeeze the Play-Doh into a shape.
4. Repeat Step 3 and gently squeeze the Play-Doh into a line.
5. Have each person in the group extrude a shape and a line.
6. Clean the station by making sure all extruded Play-Doh is put back into the PlayDoh container.

Extrusion Reflection Questions:

1. Which process took more force? The first one (shape), or the second (line)? Why?
The first process took more force because the material needed to be warmed up first. The second time, the material was softer because it had already been extruded once and warmed up.
2. If the material were less dense, would it be easier to extrude, and if so, why?
If the material was less dense then yes, because there are not as many particles or material parts that have to be forced through the extruder, making the process easier.
3. When would you need to extrude materials into strands like this? Provide three examples.
You would need to extrude material like this when you create wire. Extrusion is also a process that a 3D printer uses to create new things. Straws and other long-shaped items are extruded as well.
4. What material(s) goes through the extrusion process: plastic, metal, or composites? Why?
Extrusion could apply to a wide variety of materials, the most popular being thermoplastics, Additionally, 3D printing could extrude paste-like materials such as ceramics, concrete, and chocolate.

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Injection Molding Station Instructions and Questions:

(Note: Engineering Design Process Worksheet MUST be completed before doing this station!)

1. Make sure the mold is lying flat on the table/desktop.
2. Put Play-Doh in the piping bag.
3. Place the tip of the piping bag into the mold.
4. Squeeze enough material to fill up the mold, and remove the tip of the piping bag from the mold.
5. Let everyone in the group repeat this process, and if more Play-Doh is needed, use enough for everyone to fill one mold.
6. After everyone has taken a turn, take a piece of parchment paper and lay it over the top of the filled molds.
7. Smooth the tops of the molds to flatten out the undersides of the items molded.
8. Carefully pop out the new items molded onto the parchment paper.
9. Clean up the station before moving on to the next.

Injection Molding Reflection Questions:

1. What is the difference between injection molding and forging?

Injection takes material and forces it into a mold, while forging creates the shape using different tools and not molds.

2. What is the difference between injection molding and extrusion?

Extrusion pushed material through a hose-like object and then the material cools into the long shape, while injection can produce more shapes.

3. What applications and items would you use an injection molding process for? Provide multiple examples.

Ice cube trays, jewelry, computer parts, etc.

4. What material goes through the injection process: plastic, metal, or composites? Why?

Injection molding materials include metals, glass, elastomers, and confectionery, although it is most used with thermoplastic and thermoset polymers.

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Forging Station Instructions and Questions:

(Note: Engineering Design Process Worksheet MUST be completed before doing this station!)

1. Each student gets only a one-foot piece of aluminum foil. BE CAREFUL! THIS IS THE ONLY PIECE OF FOIL YOU GET!
2. Create your creature, its habitat or its food with the foil using ONLY your hands or small hand tools—no other materials.
3. Forge any part of your creature, habitat, or food for the creature.

Forging Reflection Questions:

1. What material(s) goes through the forging process: plastic, metal, or composites? Why?
Carbon, alloy, and stainless steel are frequently used in forging. Aluminum, brass, and copper, which are very soft metals, can also be forged. The method can produce parts in large quantities and can be used to induce desired mechanical properties for the finished product.
2. What application would you use forging for?
Large boat parts, large car parts, swords, and plated armor
3. What was difficult about this part of the station? What went well with this station?
Can be whatever; they just must answer!