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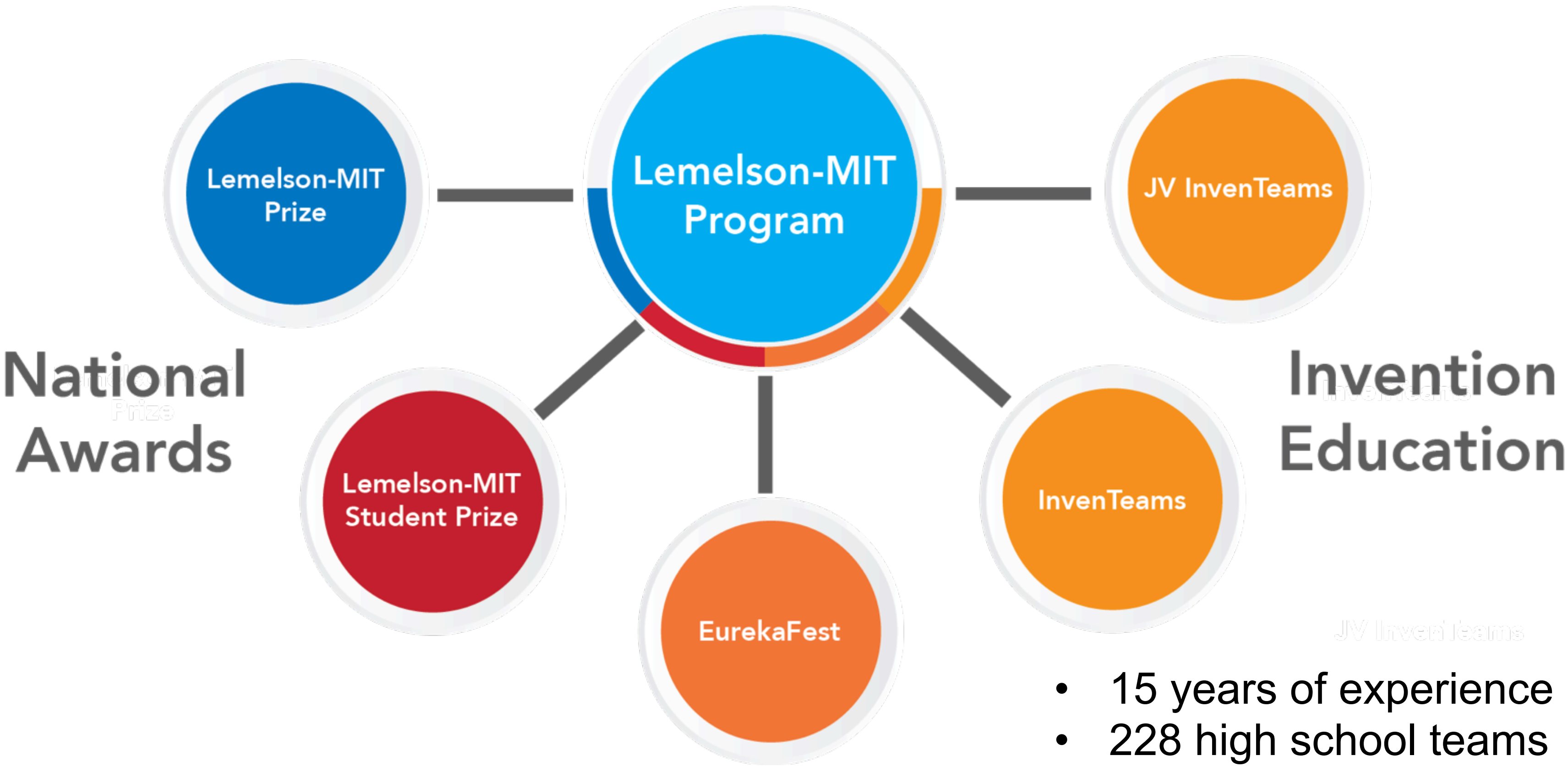
Models, Molds, and Casts

Invention Education Webinar Series

Thursday, January 25, 2018
6:30 – 7:00 p.m. ET

Lemelson-MIT Program Overview



- 15 years of experience
- 228 high school teams
- 7 U.S. patents

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Presenter Mike Gallagher

- Technology Education department chairperson at Saratoga Springs High School, NY
- Master teacher PLTW
- Leader for Educating Young Engineers Program

Lemelson-MIT InvenTeam Experience

Saratoga High School InvenTeam 2008: The Garden Consultant

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Models, Molds, and Casts

Model: An original design or pattern made out of materials like clay, wax, sand, concrete, stone, metal, and foam with all the detail, texture, and dimensions that you want to reproduce.

Mold: A *negative impression* that captures all the detail, texture, and dimensions of the original model so that you can reproduce it over and over. *We focus on one-piece molding.*

Cast: A *positive impression* or reproduction of the original model

One Piece Block Mold

To make the mold reusable, the open part of the mold needs to be larger than the closed part.

Inventing with One-piece Molding

Students use clay to create shoe sole models, and VytaFlex® 30 to create one-piece molds and casts.

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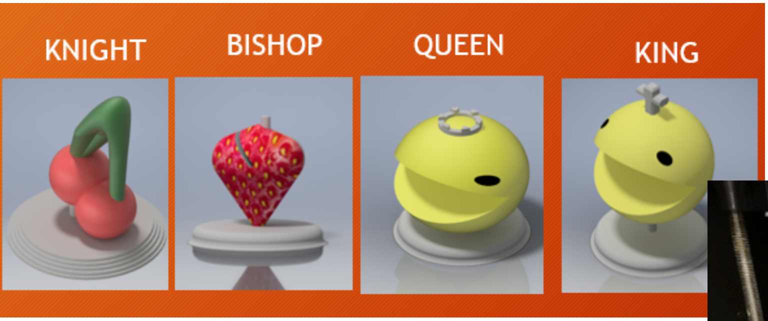
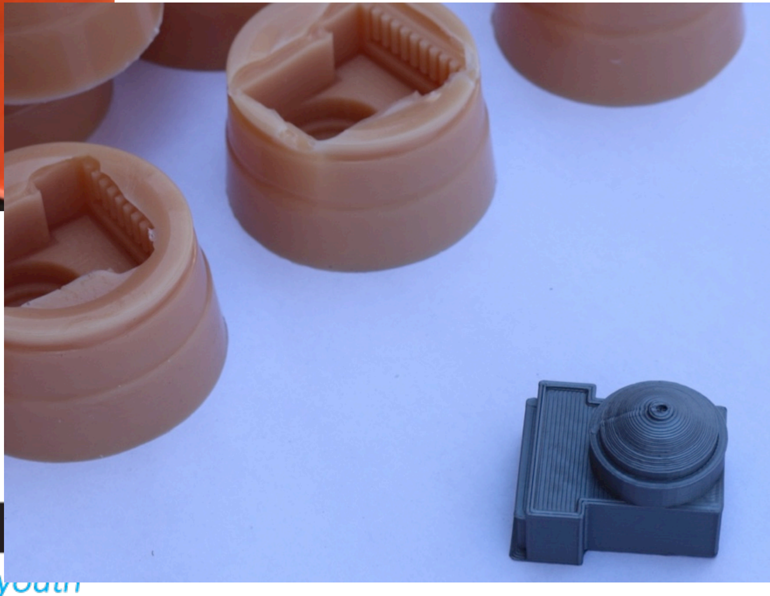
One-Piece Molding + 3D printing

3-D printed figures are ideal models for molding.





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Basic Safety Rules

Wear safety glasses.

If you are in doubt about how to use a tool, ask!

Have a plan for what you are going to do with the tool.

Be mindful of others who might enter into your workspace accidentally.

Secure the workpiece.

Have a balanced stance while using a tool.

Remove all jewelry, watches, and loose clothing before working with machinery.

Pin up long hair and wear closed-toe footwear.

Never work when you are tired or unfocused.

Leave the workspace cleaner than you found it.

Materials You Will Need to Cast Shoe Soles

- Safety glasses
- Gloves
- Table/workspace protection
- Knife or clay sculpting tools
- Soft, sulfur-free clay
- Stirring sticks
- Molding rubber
- Release agent

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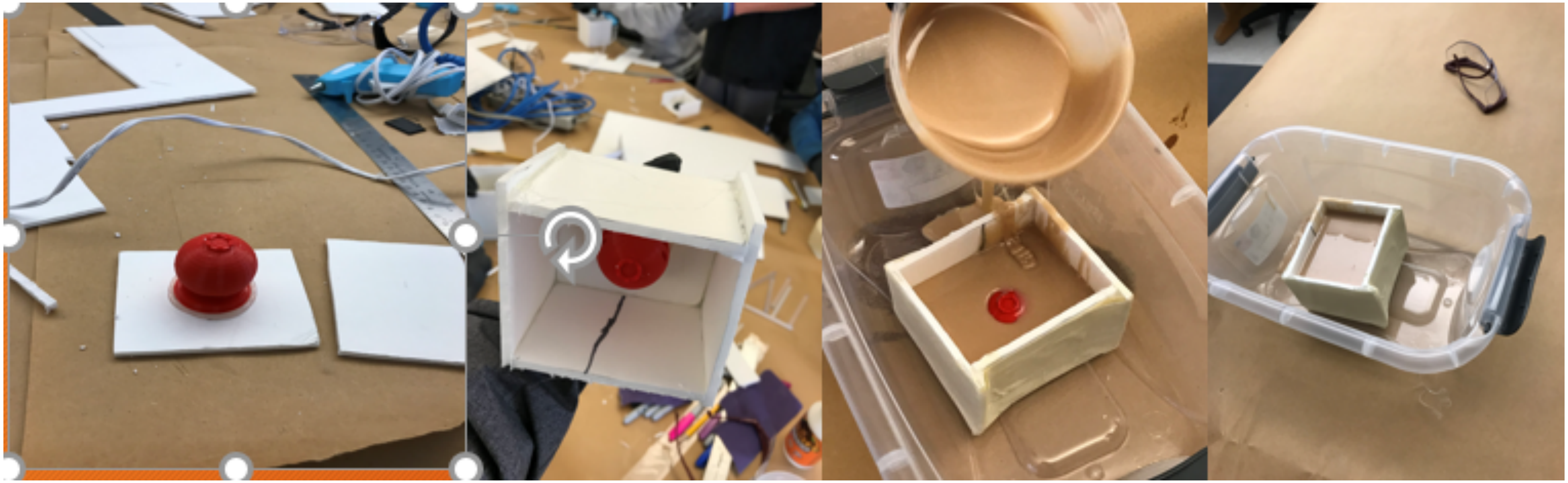
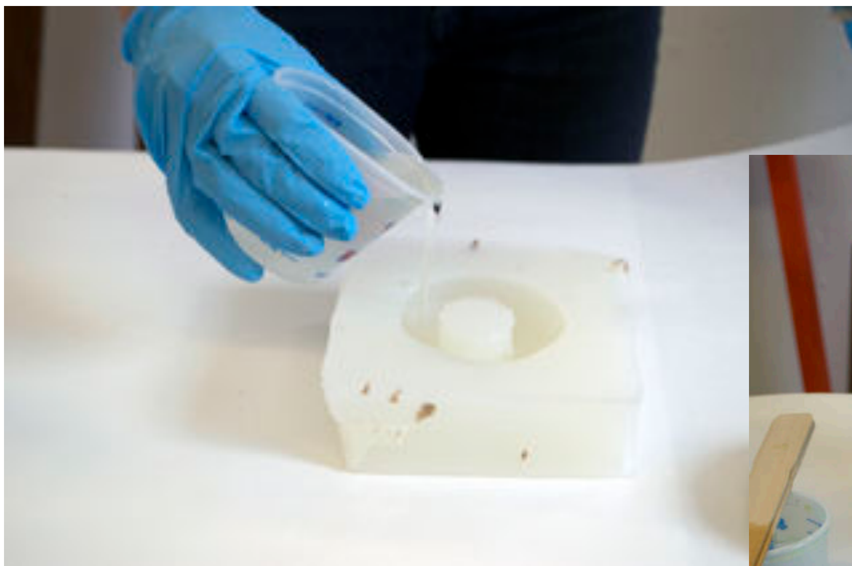
Another One-Piece Molding Processes

Step 1: Create a mold box for molding rubber
Step 2: Prepare the molding material following the mixing instruction
Step 3: Spray the release agent on the model
Step 4: Pour the mixture into the mold box
Step 5: Cure and remove the model



Casting Processes

Step 1: Mix the casting material
Step 2: Spray the release agent on the mold (especially the inside)
Step 3: Pour the mixture into the mold
Step 4: Cure and pop the casting out of the mold



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Tips

- Mix the molding and casting mixture well, but carefully.
  - Use the paint stirrer.
  - Always wear gloves and safety glasses and try not to get it on you.
- Seal off the mold box so that the molding rubber doesn't escape.
  - Use aluminum foil pans (with flat bottoms) if the model is not too high.
  - Be conservative with the expensive molding and casting material and size the mold box to just accommodate the model with ½" – ¾" of border.
- Spray release agent on the inside and outside of the mold.
  - Spray the release agent outdoors or under a chemical hood.
- Try to use soft molds so that it's easier to pop out the cast.
- Be prepared to fail! Have fun!

Other Types of Molding: Vacuum Forming

<u>Vacuum forming</u> to create candy molds

Plastic sheet are heated to a forming temperature, stretched onto and forced against a mold by a vacuum, and trimmed to create a usable product.

Injection Molding

Injection molding using CNC machines

Melting plastic is injected into a tightly closed, chilled mold. The plastic quickly takes the shape of the surrounding mold. Finally, the mold is opened and the plastic object is released.

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Lemelson-MIT Resources

- Lemelson-MIT Program
http://lemelson.mit.edu/

- InvenTeams National Grants Initiative
http://lemelson.mit.edu/inventeams

- JV InvenTeams Curriculum Materials
http://lemelson.mit.edu/jv-inventeams

- Inventor Archive
http://lemelson.mit.edu/search-inventors

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Other Resources

- Smooth-On Tutorials on Molding and Casting

- Reyonlds Materials Advanced
Basics of Molding and Casting

- Instructables Molding Making and Casting Class

Q & A

Q: What is the appropriate investment cost for start-up?

The cost depends on the molding and casting materials used in the project. For the Shoe Soles JV InvenTeam guide, a kit with materials enough for 20 students costs $470 (including the clay, VytaFlex® 30, release agent, the printed student and educator guides, etc.). More information on what is included in the kit and how to order it can be found at http://lemelson.mit.edu/resources/jv-inventeams-shoe-soles.

You can also order the molding and casting materials directly from Smooth-on.com. A gallon sized of VytaFlex® 30 costs approximately $110, and a trial unit costs around $25.

Q: How is the smell? What are your ventilation/mask needs?

The VytaFlex® 30 does not have a strong smell. Students could work in a well-ventilated classroom.

However, the release agent has a strong smell, and we recommend spraying the release agent outdoors or under a chemical hood. In our previous implementations of the Shoe Sole project, teachers typically spray the release agent for students.

As with all chemicals, teachers should read and follow instructions for handling and use on the Safety Data Sheets and the packaging labels for VytaFlex and the spray release agent.

Q & A

Q: Just a quick recap: students can make a 3D prototype and then create a mold of it and then use that to reproduce multiple pieces quickly?

Yes, students can 3D-print the prototype, create a mold of it using the molding materials, and then use the mold to reproduce the casts over and over. We actually use a 3-D print of the MIT dome for training purposes. Please advise your students to:

- ✓ create a model for one-piece molding so that they do not need to cut the mold to get the cast. They can use the mold multiple times.
- ✓ hot glue the 3D printed prototypes to the mold box before pouring the molding materials, otherwise they will float. The molding materials are denser than the 3D printed figures.

Q: Can the materials be repurposed (melted down)?

No, VytaFlex® 30 is a type of urethane rubber and the chemical reaction that occurs during mixing part A and B is not reversible.

Q & A

Q: What was the youngest age you tried this with?

The Shoe Sole JV InvenTeam guide has been implemented among 6th to 12th graders. For educators working with students younger than 12 years old, we recommend asking students to create the models using the clay, and make the mold box using aluminum foil covered cardboard. The teacher mixes and pours the molding and casting materials, and then asks students to work on the post-finishing of the molds and casts.

Q: When will these slides be up on the site so that we can download to print?

The slides of all previous webinars can be downloaded at http://lemelson.mit.edu/resources/invention-education-webinar-series-0.

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THANK YOU!

Contact Us at PD-lemelson@mit.edu

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