



Governor's Summer STEM Challenge 2021

Week 1: July 5 - July 9

Prosthetic Hand Challenge: Team/Individual

Background Information

In the United States, there are over forty thousand hand or arm amputees. However, traditional functional prosthetics are often very expensive and heavy. Yale e-NABLE is an organization that 3D prints prosthetics as a lightweight and inexpensive alternative.

Challenge Objective

We challenge you to design a prosthetic hand/ grasper/ or pincher out of household materials. The objective is to be able to pick up an empty water bottle with this prosthetic hand. The more water in the bottle your prosthetic hand can hold, the stronger your design.

Materials Allowed

- Any materials available to you (cardboard, string, straws, tape, motors, etc.). Use no more than \$20 worth of supplies.
- 3D printed materials are NOT allowed. We want to see your creativity with what you have!

Rules

- The prosthetic hand can be actuated by one's own body part such as arm, wrist, or fingers. It may also be actuated by an electronic device such as with motors.
- You may NOT use any adhesive or tape as the mechanism to pick up and hold the water bottle.
- For the video recording, the prosthetic hand may pick up a plastic water bottle from any angle.
- The strength of the design will be determined by 1) the amount of water in the water bottle that the prosthetic hand can hold and 2) whether the prosthetic hand holds on to the water bottle for at least 3 seconds.

Design Tips

- Designing a prosthetic device is no easy task, so simple is OK!
- Using the materials you have, determine what you will use to create the pinching/grasping mechanism.
- Determine ways you can get a better grip (i.e. better contact, friction, angle of approach, etc).
- Decorate your creation!

Content Required for Submissions

- Required – Documentation of the design process.
 - Describe in detail the final prosthetic design, the approach you took to come up with ideas, any prototype designs, and what you would have done differently with more time.
 - Documentation should be in English or in your native language with an English translation.
- Required – Describe your final prosthetic design and if you succeeded in picking up an empty water bottle. If successful, estimate how much water in the bottle your prosthetic hand was able to hold (i.e. one-fourth of the bottle)
- Required – A bill of materials and their costs for final design
 - Should not exceed \$20
- Required – Photo of the final prosthetic hand/grasper/pincher (aerial view).
- Required – Video of picking up an empty plastic water bottle
 - Hold water bottle for at least 3 seconds if possible.
 - In the same or separate video, demonstrate picking up the water bottle with as much water in it as your prosthetic hand can hold.
- Optional – Photos or videos of the design and build process.
- Optional – Photos or videos of your prosthetic hand picking up any other objects (ex. pencil).

Prosthetic Hand Challenge Rubric

| Score Value | Follows the Rules | Testing Hand Strength | Design Process | Creativity | Final Design Review |
|-------------|--|--|---|--|---|
| 4 | The challenge is completed with only allowed materials, all outlined rules are followed, and required materials are submitted. | Prosthetic hand can pick up a full water bottle. | Design process and thinking is documented in full detail, with descriptions of adjustments made throughout the process. | Creativity is demonstrated in the design of the hand/grasper/pincher, materials or technology used, and in final presentation | Documents the strengths and weakness of final design, explains how this design could benefit a potential patient, and where improvements could be made. |
| 3 | The challenge is completed with only allowed materials, all outlined rules are followed, and not all required materials are submitted. | Prosthetic hand can pick up a water bottle that approximately half full. | Design process and thinking is documented in some detail. | Some creativity is demonstrated in the design of the hand/grasper/pincher, materials or technology used, and in final presentation | Documents the strengths and weakness of final design and explains how this design could benefit a potential patient. |
| 2 | | Prosthetic hand can pick up a water bottle that approximately one fourth full. | Design process and thinking is documented in little detail. | Little creativity is demonstrated in the design of the hand/grasper/pincher, materials or technology used, and in final presentation | Documents the strength and weaknesses of final hand design. |
| 1 | The challenge is completed with more materials than allowed or some of the design rules are not followed. | Prosthetic hand cannot pick up empty water bottle. | Design process and thinking is not documented. | No creativity is demonstrated in the design of the hand/grasper/pincher, materials or technology used, and in final presentation | No documentation on how the final prosthetic design was created or how applicable the prosthetic is to real life. |

TOTAL: _____