



National 3D Printing Challenge Rules
22 August 2023

Contents

Section 1 3D Printing Skills Challenge	3
1.1 Overview	3
1.2 Schedule	3
1.3 Rules.....	3
1.4 Printing Options	4
1.5 Deliverables.....	4
1.6 Evaluation	5
1.7 Awards	5

Section 1 3D Printing Skills Challenge

1.1 Overview

3D printing, known also as additive manufacturing, has become one of the most important methods of rapid prototyping today. The ability to model a product and manufacture that model in 3 dimensions aids education and industry manufacturing through rapid deployment of solutions. As 3D printing materials improve, so does our ability to create useful and reliable products with this process. As with the example in this challenge.

Every year, nearly 4000 people in the US alone receive heart transplants with a greater than 80% success rate. The success of heart transplantation, however, has reinvigorated the search for the total artificial heart, with the more achievable goal of keeping the patient alive until a donor is found, or a “bridge to transplant” as it is called.¹

The 3D Printing Skills Challenge gives BEST students an opportunity to develop solutions using 3D printing technologies for the “bridge to transplant” goal.

Our patient has been on the heart transplant waiting list for some time, but their heart is failing rapidly and may not last another 2 days until the scheduled transplant. Your challenge is to design and manufacture a temporary artificial heart using your 3D printing capabilities to allow the patient to survive until the transplant can take place.

1.2 Schedule

1. This is a national level challenge that complements your BEST Robotics competition participation. You may begin development immediately following your hub kickoff.
2. The deadline for completing your modeling and submitting your deliverables will be November 18, 2023, 11:59PM Central Time.

1.3 Rules

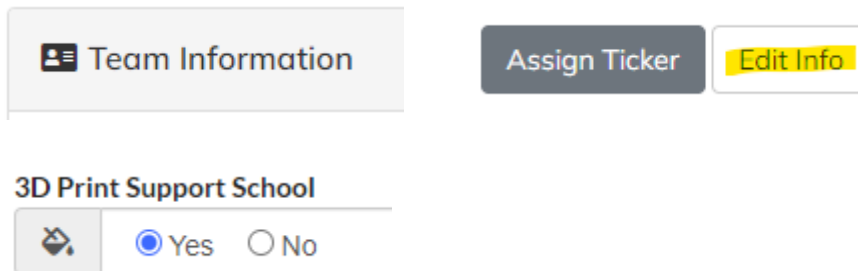
1. The 3D Printing Skills Challenge is an optional activity, open to any team participating in the BEST Robotics competition. All teams are encouraged to participate regardless of your current 3D printing capabilities. In this challenge, more emphasis is placed on the process than the final product. Having an existing 3D printing capability is not a requirement of the challenge.
2. The goal is to design and print a temporary artificial heart for Patient X.
3. Points are awarded for your process, your design, and the product’s manufacturability using 3D printing technology.
4. The design and functionality of the artificial heart are left up to the team.

¹ *In Search of the Impossible Machine, the Artificial Heart, The MIT Press Reader,*
<https://thereader.mitpress.mit.edu/in-search-of-the-impossible-machine-the-artificial-heart/>

5. Any available CAD tool(s) and 3D printer(s) may be used in the design and manufacturing.
6. The team must submit all deliverables to the [Prusa Printables 3D model library](#) in the **Healthcare: Medical Tools** category and with the tag **BESTRobotics2023**.
7. As with all BEST activities, the student(s) should be the primary developer(s) of the model and manage all printing of the parts.
8. Teams will have until **November 18, 2023, 11:59PM Central Time** to complete the 3D printing AND submission of all deliverables.

1.4 Printing Options

1. The final product must be 3D printed by the student(s).
2. Teams (schools) that do not have an existing 3D printing capability, may use one of the following alternatives to print their design:
 - a. Use a print company with 3D print capabilities (shapeways.com, staples, Fedex, etc.)¹
 - i. The print company shall not change any print parameters on their own.
 - b. Use a makerspace near you ([Find a makerspace](#)) or a local library.
 - c. Find a nearby school with 3D print capabilities who is volunteering to support your printing efforts ([See a list of BEST 3DP volunteer schools](#)).
3. If you are a school with 3D printing capabilities and wish to volunteer to support schools in your area that do not currently have 3D printing capabilities, please indicate your desire by selecting the checkbox in the Team Information panel of your Team Workflow.



1.5 Deliverables

All deliverables must be uploaded to the [Prusa Printables 3D model library](#) with the tag **BESTRobotics2023**. Select the **Healthcare: Medical Tools** category when uploading your model. If the model does not contain the **BESTRobotics2023** tag, it will not be visible for judging.

The following deliverables must be included:

1. CAD model in STL file format (for sharing purposes)
2. Images (all 3 types must be provided)

- a. CAD rendering(s)
- b. Slicer image(s)
- c. Photo of the final printed product.
3. Model Description containing the following information (what, why, how)
 - a. Contact Name, School, and BEST Hub²
 - b. Description of your process
 - c. Design summary
 - d. Print parameters

What printer did you use? _____

Infill % _____

Brim YES NO

SUPPORTS YES NO

Type of Filament: PLA ABS PETG Other _____

1.6 Evaluation

1. At least 2 judges will take part in the evaluation of the team's artificial heart.
2. The 3D Print Challenge score sheet will be used in the evaluation of the team's efforts.

Table 1. Evaluation Criteria

Category	Criteria
Process	Was the process well thought out and conceived? Was it appropriate for the rapid-prototyping task?
Design	Does the design solve or relieve the problem. Does it support the 'bridge to transplant' goal?
3D Print Manufacturability	Is the design manufacturable using 3d print technology?
Quality	Quality of the design and the final product.

1.7 Awards

1. The BEST 3D Printing Challenge Award will be presented to the team that accumulates the highest score in each BEST region (Texas, Denver, Souths).
2. The winning team in each region (Texas, Denver, Souths) will be awarded a Prusa Mark 3S+ printer.

² Must be a 2023 registered student, teacher, or mentor. All information must be correct. If the school cannot be located in the BEST National Registry, the submission will not be eligible for judging.