

LEVEL:	Middle School/High School
NUMBER OF TEAMS:	One (1) team per school can participate at the MESA Day state competition. Three (3) teams can participate at MESA regional events.
TEAM MEMBERS:	Two (2) to Four (4) Students per team
OBJECTIVE:	Students will use the Human Centered Design model to design a 3D printed solution to meet a need of a member of their community. Students will give a 5-8 minute pitch to a panel of judges that will include a question and answer period to discuss their design process and testing.
MATERIALS:	3D printed object(s) must be made of ABS or PLA plastic.

BACKSTORY:

Human-Centered Design is an approach in engineering that focuses on people and their specific needs. According to IDEO.org (<http://www.designkit.org/human-centered-design>), “**Human-centered design is all about building deep empathy with the people you're designing for...**” IDEO further suggests that Human-Centered Design consists of three phases.

1. Inspiration - Engineers learn directly from their client in order to deeply understand their needs.
2. Ideation - Analysis of what is learned from the client leads to design ideas and possible prototypes.
3. Implementation - building of the final proposed solution knowing that it meets the needs of your client.

Additive Manufacturing (AM) is an appropriate name to describe the technologies that build 3D objects by adding layer-upon-layer of material, whether the material is plastic, metal, concrete or one day....human tissue. Common to AM technologies is the use of a computer, 3D modeling software (Computer Aided Design or CAD), machine equipment and layering material....

The term AM encompasses many technologies including subsets like 3D Printing, Rapid Prototyping (RP), Direct Digital Manufacturing (DDM), layered manufacturing and additive fabrication. AM application is limitless. Early use of AM in the form of Rapid Prototyping focused on preproduction visualization models. More recently, AM is being used to fabricate end-use products in aircraft, dental restorations, medical implants, automobiles, and even fashion products.

- <http://additivemanufacturing.com/basics/>

DESIGN PARAMETERS

1. Designs will be:
 - a. Designed using a CAD program.
 - b. Designed by students
 - c. Designed to meet the need of a community member.
2. All dimensions must be in millimeters (mm) in the design.
3. The maximum size of the design is 150 x 150 x 150 mm total.
4. The design must be of student design.
5. Teams will prepare a “sales” pitch to demonstrate their design and convince a panel of judges that their design meets the needs of their client.

SPECIFICATION CHECK:

1. Immediately upon submission for competition, designs will receive a specification check to determine whether it conforms to material and design parameters. Any design which fails the specification check will be given a performance score of zero. Designs may not be modified for competition.
2. Designs must be ready for presentation prior to inspection. If designs are disqualified during inspection check, design changes will not be allowed. Only designs passing inspection will be allowed to participate in the presentation.
3. During specification check, teams will check in to the competition area and submit their design and Engineering Design notebook for impounding.
 - a. Essential components or scored components of the Engineering Design Notebook will be listed and included in a rubric on the reverse side of the score sheet.

TESTING PARAMETERS:

1. At least two (2) team members are required to be present during the pitch.
2. Teams should arrive at least 10 minutes before their pitch time to retrieve their designs from impound and prepare for their pitch. Designs must be present during the pitch.
3. When the judges are ready, they will ask the teams to begin.
4. When the pitch begins, judges will start the timer and notify teams when there is one (1) minute remaining and thirty (30) seconds remaining.
5. Teams that go beyond the 8 minute time will receive a 5 point deduction.
6. Judges will have the option of asking questions for clarification to assist with scoring.

SCORING CRITERIA:

1. Teams will be judged on:
 - a. Designed Accessory (50 points max)
 - i. Demonstration
 - ii. Product look, feel, and functionality
 - iii. Advantages of Solution
 - iv. Originality of the Design
 - v. Challenges and Solutions
 - b. Pitch of the Accessory (50 points max)
 - i. Client and Problem Description
 - ii. Proposed Solution
 - iii. Human Centered Design
 - iv. Advantages of Solution

v. Presentation

c. Engineering Notebook (Multiplier)

2. Teams will be judged on their pitch of their design, see score sheet for details.
3. The Final Score will be determined by multiplying the Performance Score by the Notebook Multiplier (N).
4. The Performance Score will be determined by adding together the points received for the Design and Pitch.
5. The Notebook Multiplier will be determined by dividing the notebook score by the maximum points. (25 point maximum) If team does not submit a notebook their notebook multiplier will be .10. For example, if a notebook receives 20 points. The notebook multiplier will be .80 (20/25).



Student Names: _____

Specification Check (circle one):

Design is a maximum of 150 x 150 x 150 mm? Yes No

If team fails size requirement, they are disqualified (except during regional events)	Pass	Fail
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Presentation (50 points)	+
Design (50 points)	*
Engineering Design Notebook *(If no notebook, multiply by .1)	=
Total (100 points)	

Student Signature: _____

Comments:

Design:

Category	Exceptional (5 points)	Excellent (4 points)	Good (3 points)	Fair (2 points)
Demonstration	The team expertly explains key features and functions of the prototype. Team provided specific evidence that the client(s) was able to use it with no assistance from team.	The team explains key features and functions of the prototype well. Team provided good evidence that the client(s) was able to use it with no assistance from team.	The team sufficiently explains key features and functions of the prototype. Team provided adequate evidence that the client(s) was able to use it with no assistance from team.	The team insufficiently explains features and functions of the prototype. Team provided inadequate evidence that the client(s) was able to use it with no assistance from team.
Product look, feel, and functionality	Excellent explanation and specific examples of how client(s) criteria for functionality, elegance, aesthetics, and cost effectiveness were met	Good explanation of how design met the client(s) criteria for functionality, elegance, aesthetics, and cost effectiveness	Adequate explanation of how design met the client(s) criteria for functionality, elegance, aesthetics, and cost effectiveness	Inadequate explanation of how design met the client(s) criteria for functionality, elegance, aesthetics, and cost effectiveness
Advantages of Solution	The team clearly and completely describes why their design is better than current solutions on the market	The team clearly describes why their design is better than current solutions on the market	The team describes why their design is better than current solutions on the market	The team mentions other design available on the market.
Originality of the Design	The design is 100% the students' design. There is only one other at max for sale	The design is 100% the students' design. There are 4 or fewer designs for sale.	The design is a modification of a product on the market. There are many choices available for purchase.	The design is a copy of a product on the market.
Challenges and Solutions	The team clearly describes challenges they encountered and how they overcame them, Research helps inform their decisions	The team clearly describes challenges they encountered and how they overcame them.	The team describes some of the challenges they encountered and how they overcame them.	The team mentions challenges and solutions but does not elaborate on them.
Total x 2				

Presentation:

Category	Exceptional (5 points)	Excellent (4 points)	Good (3 points)	Fair (2 points)
Client and Problem Description	Client base is thoroughly defined and the problem the team is addressing clearly and specifically meets their needs	Client base is defined and the problem the team is addressing meets their needs	Client base is loosely defined and the problem the team is addressing broadly meets their needs.	The client base is abstract and the problem being addressed is loosely defined
Proposed Solution	A clear and complete description of the solution is provided	A clear and almost complete description of the solution is provided	An adequate description of the solution is provided	A inadequate description of the solution is provided
Human Centered Design	Team explains the design requirements and all requirements are directly linked to client input and feedback	Team explains the design requirements and there is a clear link to client input and feedback	Team explains the design requirements and they are mostly linked to client input and feedback	Team inadequately explains design requirements and lacks connection to client input and feedback
Potential of Design	Team provides an excellent description of next steps they need to undertake to bring prototype to the client	Team provides a good description of next steps they need to undertake to bring prototype to the client	Team sufficiently describes the next steps they need to undertake to bring prototype to the client	Team insufficiently describes the next steps they need to undertake to bring prototype to the client
Presentation	ALL students share equally in presentation. ALL voices heard & understood. Eye contact is distributed across the audience. Engineering Design Notebook well used as a visual aid.	All students share in presentation. Most voices heard & understood. Eye contact is mostly distributed across the audience. Engineering Design Notebook used as a visual aid.	Most students share in presentation. Some voices heard & understood. Eye contact is distributed across the audience. Engineering Design Notebook inadequately used as a visual aid.	Some students share in presentation. Some voices heard & understood. Eye contact is not distributed across the audience. Engineering Design Notebook not used as a visual aid.
Total x 2				

Rubric for Engineering Design Notebooks (EDN).

EDN Goals	3	2	1	0
1. Explore				
☐ Described Design Objective ☐ Described Success Criteria ☐ Described Constraints ☐ Described Variables and Constants	All	Most	Some	None
☐ Described Prior Knowledge ☐ Described Brainstorming ☐ Described Exploration (testing materials, modelling, etc.)	All	Most	Some	None
☐ Has Research documented with at least 5 sources (website, book, video, article, interviews, etc.) ☐ Research is reliable (i.e. experts, researched websites, etc.)	All	Most	Some	None
2. Design				
☐ Describes materials used ☐ Documents data from previous trials ☐ Documents modifications	All	Most	Some	None
☐ Includes sketch/photo of initial prototype ☐ Includes sketch/photo of final prototype	All	Most	Some	None
3. Test				
☐ Has data in graphical form ☐ Has written description of data ☐ Multiple iterations	All	Most	Some	None
☐ Describes pros and cons of data results ☐ Discusses next steps ☐ Tests are well designed	All	Most	Some	None
4. EDN Organization				
☐ Has Table of Contents or clearly labelled sections ☐ Notebook is organized	All	Most	Some	None
4.2 Labeled. Clearly labeled with School and Team Members names.			Yes	No
Column Totals (for selected categories)				
Total (out of 25)				

Comments/Suggestions: