Event Specifications
Additive Manufactured Manipulative
MESA Day 2019

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:	Studies have shown that people learn better through demonstrations than through lecture. Teachers are always trying to demonstrate new concepts with toys but the manipulatives can be boring. It is important to keep everyone engaged. Students will design a toy that demonstrates a math and/or science concept. 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. Any design that is utilized on other MESA Day competitions will receive bonus points.
MATERIALS:	3D printed object(s) must be made of ABS or PLA plastic.

BACKSTORY:

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. Demonstrate a mathematical or scientific concept,
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 is usable in the classroom.

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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 beings, 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 (40 points max)
    b. Pitch of the Accessory (40 points max)
    c. Engineering Notebook (20 points max)
2. The design will be judged on:
    a. Accuracy of the demonstration of the math/science concept
    b. Usability of the design
    c. Ease of use
    d. Originality of design
3. Teams will be judged on their pitch of their design, see score sheet for details.
4. Teams will be judged on their Engineering Design Notebook, see score sheet for details

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School:_____

Student Names:_____

_____

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Specification Check (circle one):	**Pass**	**Fail**
Team has submitted an Engineering Design Notebook?	Yes	No
Design is a maximum of 150 x 150 x 150 mm?	Yes	No

Final Score:

Presentation (40 points)	
Design (40 points)	
Engineering Design Notebook (20 points)	
Total (100 points)	

Lead Judge Signature:_____

Student Signature:_____

Comments:

Presentation:

Category	**Exceptional** **(5 points)**	**Excellent** **(4 points)**	**Good** **(3 points)**	**Fair** **(2 points)**
Description of the design	A clear and complete description is provided, and thoroughly reviews design features	A clear and almost complete description is provided, and reviews design features well.	An adequate description is provided, and adequately reviews design features	A inadequate description is provided, and inadequately reviews design features
Need for the design	A clear and complete description of the need is provided	A clear and almost complete description is provided	An adequate description is provided	A inadequate description is provided
Math & Science Concept	Students thoroughly explain the concept and a create a clear link to the design	Students clearly explain the concept and a create a good link to the design	Students describe the concept and a create an adequate link to the design	Students mention the concept but the link to the design is unclear
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	

Design:

Category	**Exceptional (5 points)**	**Excellent (4 points)**	**Good (3 points)**	**Fair (2 points)**
Accuracy of Concept	The simulation of the concept constructs new knowledge of the concept for intended audience	The design presents the concept in an interesting way for the intended audience.	The design summarizes the concept for the intended audience	The design identifies the concept.
Ease of Use	The design is easy to use. A teacher could use without any training.	The design is easy to use. A teacher can use with minimal training.	The design is difficult for a teacher to use.	The design is challenging for a teacher to use.
Usability of Design	The design is an effective model of a concept that can easily translate to learning.	The design is a model of a concept that can easily translate to learning.	The design has minor flaws that would make learning difficult	The design has major flaws that could possibly prevent learning.
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.
			Total x 2	

Rubric for Engineering Design Notebooks (EDN).

EDN Goals	3	2	1	0
1. Explore				
1.1 Problem Statement. Accurately describes, in your words, the design objective (includes success criteria, constraints constants and variables)	**Specific** description of problem, success criteria, constraints, variables and constants	Basic...	Weak...	No...
1.2 Depth of Free exploration. Prior knowledge, brainstorming & hands-on exploration documented.	**Numerous** examples of brainstorming and hands-on exploration observations.	Regular...	Few...	No...
1.3 Research in Design: Research ideas about your design that might be useful. Record information using different sources (e.g. books, websites, interviews from experts).	**Clear** analysis of other design pros/cons.	Basic...	Scant...	No...
2. Design				
2.1 Design Plan. Includes reasoning on your design choices (materials used, modifications, etc.). Use data from past trials, research and design considerations.	**Clear** reasons given (based on data or research) for each design choice.	Basic...	Scant...	No...
2.3 Design sketching and/or photos. Prior & during build, team sketches, 2-D or 3-D perspective drawings.	**Numerous** representations of each design iteration.	Regular...	Scant...	No...
3. Test				
3.1 Observation. Data & written observations (tables, graphs, labeled drawings, etc.).	**Numerous** presentation of quantitative & qualitative data, graphs & charts follow design progression.	Regular...	Scant...	No...
3.2 Reflection/Analysis. Assesses pros and cons of design/materials, testing procedure, etc. Apply test results and analysis to pose a theory, recommend and argue for a next step, or draw an insightful conclusion. Restate the purpose in your conclusion.	**Detailed** reflection shows how design considerations and logic flowing from research, test analysis, etc.	Basic...	Scant...	No...
4. EDN Organization				
4.1 Structured. Includes Table of Contents with key elements. Elements of EDN can be used to answer judges questions easily	**Clear** organization utilizes defined sections.	Basic...	Minimal...	No...
4.2 Labeled. Clearly labeled with School and Team Members names.			Yes	No
Column Totals (for selected categories)				
		Subtotal (out of 25)		
		Modifier	(S ÷ 25) x 20	
		Score (out of 20)		

Comments/Suggestions: