MESA Spec Scan. Part I.

A Problem Well-Stated is Half-Solved.

Student Design Team: _____

Team Members:_____

WHAT'S IT ALL ABOUT? When you begin a MESA design challenge, there is a lot of exploring to do. The best place to start is by understanding your design problem. As the inventor Charles Kettering said, "A problem well-stated is half-solved."

Design Problem (In your own words)

Success Criteria. *What are the main performance objectives for your design (e.g. outcomes like height, speed, etc.)?*	**Constraints:** *What might be disallowed – or ineffective – based on the specs? (e.g. materials, weight, size, costs, impacts).*

Design Variables Brainstorm. *Great designs require making good choices - on every last detail.*

A. Building Choices. *What choices do you have (e.g. materials, adhesives, structures, etc.)?*

1.	2.	3.
4.	5.	6.

B. Optimization Choices. *What qualities do you need to maximize or minimize (e.g. weight, strength, cost, durability, flexibility, functionality, energy)?*

1.	2.	3.
4.	5.	6.

C. External Factors. *What external factors might effect your design (e.g. wind, heat, safety, friction, transportability)*

1.	2.	3.
4.	5.	6.

Research Hint: *Some competitions involve math/physics concepts like weight distribution, friction, mechanical advantage (e.g. gear ratios or belts), energy transfer or the conservation of energy. Learning about these may help you make better choices.*

Optimization Hint: *One Variable At a Time. To help you make choices, compare/test models with only 1 key difference (e.g. material, glue, angle, etc.).*

UP NEXT: *"MESA Spec Scan. Part II." Know the Problem. Own Every Detail.*

MESA Spec Scan. Part II.

Know the Problem. Own every detail.

Student Design Team: _____

Team Members:_____

Be Spec-tacular! Scanning the Specs.

Guidelines: *Print a hard copy of the design specifications Highlight key aspects, underline new vocabulary, and use the margins to write questions and comments. In your team's design notebook, paste this sheet inside – or write your responses/checklists.*

Vocab. *See any new terms? Or any old ones that seem important? Write those here. Then, look up their definitions. If desired, create a glossary in your notebook.*

Page & Section	☑	Key Points.	Page & Section	☑	Questions We Have.
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	

Reflection Challenge. *Imagine a cool design that would … fail in **3** ways. Describe it here.*

Your Cool Design Idea *(describe)*	***Why would it fail?*** *(or be unlikely to succeed). Give 3 reasons.*	***Page*** *from specs*
	1.	
	2.	
	3.	

UP NEXT: *"MESA Storm #1." Imagine the Coolest Designs. Build on what you already know.*

MESA Storm #1: Ideate

Imagine Some Cool Designs. Build on What You Know.

Student Design Team: _____

Team Members:_____

Five-minute Brainstorms: Question Everything. Find Better Answers.

***Guidelines**: Let the wild ideas fly – as a team, in pairs, or separately. As you do, jot these in your team notebook (or on a paper you can fold into your notebook). Sketch your ideas if it helps. Regardless of your topic, try to generate new ideas or questions. Creativity theorist Alex F Osborn recommends four goals: 1) focus on quantity; 2) withhold criticism; 3) welcome unusual ideas; and 4) combine best ideas and improve quality. But if your group feels comfortable debating, studies suggest you should reverse the second rule – and actually challenge ideas (Nemeth, 2003)! Perhaps, as The New Yorker magazine suggested in 2012, "the most creative spaces are those which hurl us together. It is the human friction that makes the sparks." Snacks also help.*

EXPLORE. *Before looking below, make your own list of topics to brainstorm. If you need more, here's a few:*

1. **Start with What You Know.** Brainstorm a list of what you bring to the table. What knowledge, skills or interests do you bring to this challenge? Do you know of any animals, plants or machines that accomplish similar tasks?
2. **Build on Your Funds of Knowledge:** Think about family, friends and community members that fix or make things (e.g. a mechanic, plumber, cook, homemaker, construction worker) or work in other STEM fields (engineers, urban planners, prosthetists). Who might share ideas, tools or materials?
3. **Reach Out.** Who DON'T you know that you might call to seek their advice or support? What kinds of STEM professionals could you email or call to seek feedback on your ideas? Which community organizations or members might provide you feedback as a possible design's client or end-user?
4. **Brainstorm & Sketch Ideas/Features.** If possible, take 8 minutes to watch the design process video, "ABC Nightline – IDEO Shopping Cart." It asks designers to focus on one conversation at a time, to "encourage wild ideas, defer judgment, [and] build on the ideas of others." It asks designers to get comfortable with failure. "Fail often to succeed sooner," is the motto of IDEO. With this in mind, imagine three to five VERY different types of design attributes/features/solutions for your problem that might fail, but might be worth trying.

DESIGN *(Topics you may want to brainstorm during this phase of your design process).*

1. **Materials and Structures.** What materials/adhesives might you try – and where might you get them? What kinds of structures might work best?
2. **Tools and Resources.** What tools might help (e.g. hardware, measuring equipment, cameras) – and who might help you get or pay for them?
3. **Prototyping: Make Your Ideas Tangible**. IDEO defines prototypes as "disposable tools" for idea generation and validation. You are "building to think." They recommend prototypes be done "Rapid, Rough and Right," meaning cheaply and quickly, so each prototype can rightly assess your big ideas. What questions must your prototype answer? Return to your design variable brainstorm. Which ideas/variables could your test 1st, 2nd, 3rd?
4. **Human-Centered Design.** If your design involves an end-user/client, IDEO suggests beginning with: 1) what's desirable; then, 2) what feasible technologically (or organizationally); and, 3) what is financially viable. Brainstorm all to find ideas that meet all criteria.
5. **Research.** What might you research in STEM to help you make design choices? Some competitions involve math/physics concepts like weight distribution, friction, mechanical advantage (e.g. gear ratios or belts), energy transfer or the conservation of energy. What might you research?

***TEST** (Topics you may want to brainstorm during this phase of your design process).*

1. **Performance Choices.** If any variables can be controlled or changed on the morning of your event (e.g. angles, drop heights, goals), what are they?
2. **What to Observe.** What might you observe or measure before, during or after testing (with which tools)? Who will watch/become experts at what?
3. **What Can't Be Observed** through your testing procedure (e.g. durability, transportability, safety, long-term impact). How can you assess these?
4. **What Data Already Exists?** *Geospatial*: what kinds of public data/GPS maps might already exist and where might you find it online? *Design Comparison*: If you'd like to compare your data or drawings to other designs, what kinds of designs might exist online?
5. **After Testing.** What might have impacted the performance that you never thought of before?

***UP NEXT:** "MESA Storm #2." Brainstorm what a perfect design process looks like - and decide what matters. (if desired).*

MESA Storm #2: Plan

Imagine the Best Process.

Student Design Team: _____

Team Members:_____

Team Brainstorm: Design Process & Research Goals.

Guidelines: *Imagine the ideal design. Then, imagine the perfect PROCESS leading up to it. Think broadly. List any goal that comes to mind. How many designs could be tested? How many variables could be considered? What kind of research could you do? Who might you call to seek their ideas – or their support? List your ideas and rank according to what you think matters most.*

Rank	☑	Team Brainstorm	Rank	☑	Team Brainstorm
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	
	☐			☐	

Common MESA Design Process Goals. *Choose any additional goals that apply. Rank what matters most.*

Rank	☑	General Design Goals	Rank	☑	Advanced Design Goals
	☐	Read specs (highlighted key parts, vocab)		☐	Outlined monthly timeline/goals for EDP (# of prototypes, etc).
	☐	Jotted down questions about specs in Notebook.		☐	Research STEM (how 6-8 math/science/engineering concepts inform
	☐	Summarized design problem in your own words.		☐	Research in Design. Explore features of related designs to utilize/modify.
	☐	Made list of success criteria, constraints.		☐	Drew Orthographic (2D) and Isometric (3D) models of drawings.
	☐	Made list of all possible design variables.		☐	Presented to STEM experts or design clients, sought feedback.
	☐	Explored team's prior knowledge related to the design problem.		☐	Used Web Tools to build Animations (SketchUp) or Project Maps (ESRI).
	☐	Considered choices for materials and costs.		☐	Impact Analysis (social/environmental impact, durability, etc.)
	☐	Research Related Designs (Online or in Library)		☐	Presented Designs to School Staff, Local Businesses, Service Clubs,
	☐	EDN Includes Table of Contents & Appendix (including what was		☐	Discussion of Which Variables Aren't Addressed and Why.
	☐	Created glossary of related STEM concepts.		☐	Final Reflection (address same topics req'd for MESA USA poster).
	☐	Sketched/Took Photos of Each Design (to scale, features labeled).		☐	
	☐	Final Reflection on Design Strengths/Shortcomings		☐	

UP NEXT: *"MESA Lead Roles." Every MESA student is a leader. How will you lead? Use to decide on lead roles (if desired).*

MESA Lead Roles.

Step Up. Be Counted. Make it Happen.

Student Design Team: _____

Team Members:_____

Guidelines: *Teams often work better when each member can take the lead and be responsible for their her/his part of the project. Review the lead roles below (and in the footer). Which roles look fun or challenging? Which roles match which the skills or interests of your teammates? Which would you like to include on your resume? Choose the lead roles that interest each of you – or create your own below.*

Design Team Lead Roles *(with related goals)*	**Team Members Responsible**
Explore	
• **Specification Reviewer(s):** Make checklist of key design goals based on specs and score sheet.	
• **Lead Researcher(s)**: Research at least ___ Math/Sci/Physics or Engineering/Tech concepts that might inform your design.	
• **Team Leader:** Help team commit to at least ___ goals. Help team set and meet ____ deadlines.	
Design	
• **Lead Illustrator:** Create _____ illustrations (drawings/photos) of past/future designs/modifications.	
• **Prototype Developer:** Build at least ___ prototypes informed by research, testing data, team reflection.	
• **Design Archivist:** Over your entire design process, document of at least _____ key factors (testing data, research) informing your design choices.	
Test	
• **Testing Engineer:** Design and document a high-quality testing procedure. Test & record data for at least ___ prototypes/modifications.	
• **Data Analysis Lead:** Analyze testing data to propose next design modifications & research needed to achieve ___ key design features.	
What Other Lead Roles Do You Want On Your Team?	
1.	
2.	
3.	

NOTE: If you prefer taking on specific roles, here are just a few to consider: *project lead (logistics, etc), lead researcher (into STEM concepts, etc.), prototype developer(s), quality control engineer, cost researcher/purchaser/accountant, test engineer, data analyst, chart/graph creator, design illustrator, design photographer, video director, poster designer, technical writer, copy editor, notebook archivist, team reflection lead, cartographer, community mapper, communications lead, community partner liaison, social/environmental impact analyst, sustainability analyst, tool inventory captain, media outreach lead, universal design investigator, community liaison, local expert liaison (esp. for Prosthetic Arm design), teacher liaison (if seeking support form the English teacher, for example, on your paper/poster), simulation developer (esp. for Water Wheel).*

UP NEXT: *"MESA Road Map". Estimate how much time you need to accomplish your goals (if desired).*

MESA Road Map

Plan Ahead to Stay On Track.

Student Design Team: _____

Team Members:_____

Guidelines: *<u>After</u> brainstorming your goals and ranking them according to your priorities, take some time to plan out your design work. Begin with the end in mind – MESA Day – and work backwards. Use this planner below to create a road map for your team's success.*

team goals (see common design goals – and list your <u>own</u>)	**time needed** (# of hours or weeks?)	**time span**		**name(s) of lead(s)**
		start by	**finish by**	

** ASIDE: If you need to get inspired, visit TED's video series, "Design that Matters," at http://www.ted.com/topics/design.*

Our MESA Regional Design Day is _____ and Arizona's MESA Day State Competition is _____.

UP NEXT: *"MESA Planning Calendar." Countdown to MESA Day.*