ENGINEERING DESIGN NOTEBOOK TEMPLATE

NAME: _____

SCHOOL: _____

Engineering Design Notebook Template Overview

The purpose of this notebook is to provide a structure for all MESA students to fully document their work as they build their individual prototypes. The following notebook has a template for each step of the engineering design process. Each group should reference the templates as they begin to document their findings throughout the MESA program.

Each template can be used as a guide for students to not only build their prototype, but also document the needed information to fully compete in the MESA State Competition.

Instruction for Teachers

- Make sure each student has a blank notebook. Either college rule or composition is acceptable.
- Have students set up their MESA Notebook. Display the individual templates on a document camera so all students will copy down the structure of each template in their notebook. You can do this all at once or over time.
- Be aware that Steps 4, 5 and 7 might require students to make multiple copies of the template in their journal. Thus, leave enough room in their journal to allow space.
- After students have set-up their notebook, each student will use their notebook along with the MESA curriculum.

Questions or Concerns

If you have any questions or concerns, please contact Leon Haskins at haskinlj@plu.edu or 253-535-8879.

OVERVIEW OF THE ENGINEERING DESIGN PROCESS

Engineering Design Process

The engineering design process (EDP) is a cyclical model that is designed to help scientists and engineers build up ideas to turn them into real world projects. "*Cyclical" means that you will evaluate and repeat many of these steps as you develop your ideas and prototypes.* Complete the engineering design process for every MESA engineering project.

Step 1- **Define the Problem**: Carefully read the MESA Contest Specifications. Take notes and summarize the details of the specifications by listing criteria to solving the problem, constraints, and outcomes.

Step 2 - **Research**: Gather background information about this problem. Have other people experience the same problem? Look for research on products or solutions that have been developed or used to solve the problem.

Step 3 - **Brainstorm:** As a team, brainstorm different ideas that could solve the problem based on research and group ideas. Use the SCAMPER technique to help you with brainstorming.

Step 4 - **Create a Design Brief:** Plan and outline the process of building your prototype. The design brief defines materials needed, a sketch of the prototype, and a description how the prototype will function.

Step 5. **Review Design Brief**: Ask your teachers, parents, experts and your peers to review your design brief. Eliminate and/or add ideas to your design brief. Analyze your solution for safety and practicality.

Step 6 - **Build**: Analyze the project design for its systems, components, and parts. Consider appropriate materials, tools and methods for constructing a model. Now build a model of the entire design and/or it systems.

Step 7 - **Test, Evaluate and Revise**: Run an experiment by testing your prototype according to the MESA conditions and specifications. Evaluate your prototype: Is it functional and safe? How can you improve it? Modify and then retest your prototype. After each time your team tests your prototype, make sure you are documenting your findings.

Step 8 - **Reflection**: Once you no longer have time to modify your prototype, document your findings, recommendations and conclusions. This will allow your team to effectively communicate your results and as well as have recommendations to use the following year.

Engineering Design Process Templates

Step 1. **Define the Problem**: Carefully read the MESA Contest Specifications. Take notes and summarize the details of the specifications by listing criteria to solving the problem, constraints, and outcomes.

Directions: Use the following template to complete Step 1 of the Engineering Design Process in your MESA Engineering Notebook.

Read the rules to the MESA contest and fill out the information below.

MESA Engineering Project: _____

Make a list of the competition tasks. (What does your prototype have to complete?)	**Make a list of possible constraints. Be specific!** ***(Possible constraints can include time, materials, skills, information, and/or budget)***
Make a list of the main points from the MESA Contest Specifications.	

Problem Summary

Use the information above and summarize the main problem of this engineering project.

_____

_____

Step 2. **Research**: Gather background information about this problem. Have other people experience the same problem? Look for research on products or solutions that have been developed or used to solve the problem.

Directions: Use the following template to complete Step 2 of the Engineering Design Process in your MESA Engineering Notebook.

Answer the following questions by researching online, researching through books, or talking to professionals. Make sure you include your references. Complete all (4) parts of this section. NOTE: Students will have to refer back to their answers in Engineering Step 1 to complete this section.

Part 1: How does a _____ work? ***(Fill in the blank with the project you are currently working on.)***
References:
Part 2: Look at your problem summary that you filled out during Step 1 of the Engineering Design Process. How does your problem summary to a real world problem? What are some real-world solutions to your MESA project problem?
References:

Step 2. **Research**: Gather background information about this problem. Have other people experience the same problem? Look for research on products or solutions that have been developed or used to solve the problem.

Part 3: Look at your answer to the previous question (Part 2), what materials and tools did engineers/ use to solve that the real-world problem?
References:
Part 4: Choose a design that you like to model your prototype after and describe it! Include a picture if possible. *(You will use this information to complete Engineering Process Step 3).*
References:

Step 3 - **Brainstorm:** As a team, brainstorm different ideas that could solve the problem based on research and group ideas. Use the SCAMPER technique to help you with brainstorming.

Directions: Use the following template to complete Step 3 of the Engineering Design Process in your MESA Engineering Notebook.

Pick a pre-existing design of your current project. Use the SCAMPER technique to brainstorm different ways to modify the pre-existing design. NOTE: Students will have to refer back to their answers in Engineering Step 2 to complete this section.

SCAMPER	Questions to ask about your pre-existing design	What is your proposed modification?	How does the modification improve the pre-existing design?
Substitute	What kind of alternate materials can I use?		
Combine	What could be added? How can I combine materials or components?		
Adapt	How can it be adjusted to fit another purpose?		
Magnify or **M**inimize	What happens if I exaggerate a component? How can it be made smaller or shorter?		
Put to other uses	Can you change a component to be used for another purpose?		
Eliminate or **E**laborate	What can be removed or taken away from it? What can be expanded or developed more?		
Reverse or **R**earrange	Can I interchange any components? What can be turned around or placed in an opposite direction?		

Step 4 - **Create a Design Brief:** Plan and outline the process of building your prototype. The design brief defines materials needed, a sketch of the prototype, and a description how the prototype will function.

Directions: Use the following template to complete Step 4 of the Engineering Design Process in your MESA Engineering Notebook.

Based on your brainstorming activity, create a design brief. Each student should plan how he or she will build their design BEFORE they start building. Be as detailed as possible. Complete all (3) parts of this section.

Part 1: Sketch **Directions: Sketch what your prototype will look like. Include three different views of the prototype as well as approximate dimensions.**	
Front View	**Side View**
Top View	

Step 4 - **Create a Design Brief:** Plan and outline the process of building your prototype. The design brief defines materials needed, a sketch of the prototype, and a description how the prototype will function.

Part 2: Materials, Tools and Budget

Based on the results of your brainstorm activity and your sketch, fill out the following information about your prototype.

	Items	Quantity	Cost
Material List			
Total Cost of Prototype			
Tool List			

Step 4 - **Create a Design Brief:** Plan and outline the process of building your prototype. The design brief defines materials needed, a sketch of the prototype, and a description how the prototype will function.

Part 3: Procedures for Building Prototype **Directions: Summarize how you will you use tools and materials to build your prototype. Additionally, summarize how your prototype will function and complete the MESA competition tasks.**	
Estimated Amount of Building Time	

Step 5. **Review Design Brief**: Ask your teachers, parents, experts and your peers to review your design brief. Based on the each reviewer's notes, eliminate and/or add ideas to your design brief. Analyze your solution for safety and practicality.

Directions: Use the following template to complete Step 5 of the Engineering Design Process in your MESA Engineering Notebook.

Print out or show your design brief to your teacher, parents, peers, or experts. Show as many people as you can! Have each person (reviewer) fill out the following checklist to review your design brief.

Team Name: _____

Student Name(s): _____

Reviewer Statements	Circle One	
1. The sketch directly reflects the procedure of the building prototype.	Y	N
2. The material list contains all the materials needed to completely build the prototype.	Y	N
3. The tool list contains all the tools needed to completely build the prototype.	Y	N
4. There are not any missing steps in the procedure of building the prototype.	Y	N
5. The prototype will be functional and safe.	Y	N
6. The estimated amount of time to build the prototype is realistic.	Y	N

Reviewer Notes

_____

_____

_____

_____

Reviewer Name: _____

Review Signature: _____

Step 6 - **Build**: Analyze the project design for its systems, components, and parts. Consider appropriate materials, tools and methods for constructing a model. Now build a model of the entire design and/or it systems.

Directions: Use the following information to complete Step 6 of the Engineering Design Process.

Tips for Building a Successful Prototype

- **Keep a clean workstation**; be aware of the location of all materials and tools.
- **Read the MESA Contest Specifications** carefully before starting the competition. Make sure you are building a prototype that will successfully complete each MESA competition task.
- **Plan before you build**. It is better to plan out your ideas before acting upon them. This allows you not to waste material or time.
- **Write everything down.** These projects take a long time to build so if you write everything on paper (i.e. data, future plans, procedure), you don't have to try to remember things over a long period of time.
- **Tools are not toys.** Use tools properly and be careful with any tool in the classroom. If you don't know how to use a tool, ask your teacher of an adult for assistance.
- **"Measure twice, cut once."** When cutting any material, it is best to measure multiple times for accuracy before permanently altering the material.
- **Manage your time well.** One main constraint for all engineers is time. You will not get an unlimited amount of time to build your prototype. So make sure your team is managing your time well.
- **Have fun and be safe!** Most students do not get a chance to build their own designs. So be as creative as you can and have fun.

Step 7 - **Test, Evaluate and Revise**: Run an experiment by testing your prototype according to the MESA conditions and specifications. Evaluate your prototype: Is it functional and safe? How can you improve it? Modify and then retest your prototype. After each time your team tests your prototype, make sure you are documenting your findings.

Directions: Use the following template to complete Step 7 of the Engineering Design Process in your MESA Engineering Notebook.

In the classroom, run an experiment according to the MESA conditions outlined in the specifications. Test your prototype and document your findings. Be prepared to use this template multiple times for each prototype you build.

MESA Contest:	
Individual Competition Task (if any):	

Prototype Results without any modification			
Trial	**Observations**	**Dependent Variable 1**	**Dependent Variable 2**
1			
2			
3			

Prototype Results with modification			
Name the proposed modification:			
Trial	**Observations**	**Dependent Variable 1**	**Dependent Variable 2**
1			
2			
3			

Did the modification improve your prototype? Yes No

Step 8 - **Reflection**: Once you no longer have time to modify your prototype, document your findings, recommendations and conclusions. This will allow your team to effectively communicate your results and as well as have recommendations to use the following year.

Directions: Use the following template to complete Step 8 of the Engineering Design Process in your MESA Engineering Notebook.

Summary of Results
Write a summary of how modifying your prototype either improved or worsen your original design.

Summary of Recommendations
Answer the following question: If you had more time and possibly more resources, how would you design your prototype different?