

Engineering Design Worksheets

Western U.P. STEM Fair & Festival

2023-2024

This document includes a series of 5 worksheets that guide students through the engineering process.

These completed worksheets (collected in a 3-ring binder) may be used as the required progress log for engineering project submissions.

Western U.P. STEM Fair & Festival
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Memorial Union Building (MUB) @ Michigan Technological University

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If any support is needed from a teacher, student, or parent please do not hesitate to reach out to Emily Geiger, Western U.P. MiSTEM Network Director, at egeiger@copperisd.org or (906)482-4250 ext. 188

Overview of Student Worksheets

Worksheet 1: Identifying and Understanding

Uncover a problem that needs to be solved and research how that problem might impact others. Learn what existing solutions to the problem already exist and identify the shortcomings of current solutions to the problem.

Worksheet 2: Ideating

Ideating refers to the brainstorming or imagination stage inventors go through to generate a variety of original ideas. Ideation includes developing specific criteria for a successful solution.

Note: An inventor's idea(s) may be updated at any time throughout the invention process.

Worksheet 3: Designing & Building

Designing an invention or a prototype requires critical-thinking skills; inventors are expected to articulate how they intend the invention to work and why they chose the materials they did for executing their invention.

Worksheet 4: Testing & Refining

The keys to this step are iterations, improvements, and perseverance. The best inventors know the first build is often not the best and seek feedback through testing and refining their design accordingly.

Worksheet 5: Communicating

Once an invention is created, identifying the target market it will benefit and letting them know about the invention is and how it will solve their problem takes time and thoughtfulness.

Worksheet 1: Identifying and Understanding

Explanation

Identifying occurs when inventors seek problems they want to solve. This stage involves how inventors uncover problems and discover who else might experience the same problem.

Understanding a problem requires research to identify existing solutions that solve the identified problem and the shortcomings of those solutions. Understanding also includes researching the impact the problem may have on others.

Your Turn

Begin brainstorming possible problems or needs that you might be interested in solving. What are some common problems you encounter throughout your day? What are some common problems your family and friends encounter throughout their day? Is there something in your neighborhood or community that could be made better?

What problem are you trying to solve? The more specific you are in describing the problem, the better your solution will be. How did you come up with the problem?

To gain understanding and perspective, research the problem you are trying to solve. Example questions: What are the causes of this problem? Who and what is impacted by the problem? When did people begin to discover that this is a problem? Has anyone tried to fix it?

Interview at least three people to gain understanding of the problem. Ask them to share their experiences with this problem. How have they tried to fix it themselves? What might help improve this problem for them, specifically?

After completing your research, clarify the problem you are trying to solve and restate it.

What is the result you are trying to achieve? The more specific you are in describing the result you want, the better your solution will be.

Worksheet 2: Ideating

Make a List:

What are some possible solutions? Brainstorm as many as you can. Don't stop to think whether it is possible (you'll do that later). For now, let your imagination run. Even silly ideas can inspire real solutions.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

Which one did you choose to pursue? How did you decide which solution to try?

Has this solution been done before? If it exists, how is your approach different and better? What research did you do to see if this invention had been done before? Who did you talk to? Where did you look? What website did you search? You should show four pieces of evidence of different types of research — talking with experts, searching the internet, interviewing friends and family as to how useful this would be, etc.

Where I looked to see if my idea is new:

A: _____

B: _____

C: _____

D: _____

Document any similar inventions you find. Include how yours is different.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Worksheet 3: Designing & Building

Draw a model (sketch or drawing) of the invention you are thinking about building. Label all of the important parts and features. Explain how the invention will work. (If you need more space, use more blank pages.)

What problems or issues might you encounter with this design? Who did you talk to about this design (another student, parent, teacher, etc.)? What were their comments about your design?

How can you fix those problems or address those issues?

Revise your design and draw a new model that you think will work. (Use additional blank pages if necessary)

What parts, materials and tools will you need to make the invention, and how much will they cost?

Where will you get those parts and materials?

What additional skills or abilities will you need to make the invention?

Who can help you build the invention?

Considering the materials and skills you need; do you need to revise your design? Draw a new model.

[illegible]

Worksheet 4: Testing & Refining

Create a testing plan to collect observations and data on your prototype. How will you know if your invention works?

Test and evaluate the invention. How did you test the invention?

Identify any problems with the invention. What will you change to make it better?

Repeat

Invention Step: Designing & Building (Worksheet 3) to fix any problems. Add additional sheets of paper as needed.

Repeat

Invention Step: Testing & Refining. (Worksheet 4)

Continue **DESIGNING** and **TESTING** until you have reached your goal. Add additional sheets of paper as needed.

Worksheet 5: Communicating

Naming your invention is important. What words describe your invention?

What is the function of your invention? How will it solve the problem? How will it help others?
(This might be referred to as marketing.)

How is your invention different from others that may already be on the market? If it is similar, what did you do to make it better? How is it different?

Who is your target audience? Who would use your invention?

Some creative, attention-getting techniques you can use:

- Alliteration (using the same first letters or sounds): *Kit Kat*
- Rhyming: *Light Bright*
- Alternative spelling: *Sno Bal*
- Using numbers in the name: *Super Clean 3000*
- Describing the function of the invention: *Hydro-Blast*

Based on this analysis, what are some good names for your invention?

Which name do you like best and why?

Prototype/Model

1. Students should create a model that demonstrates the key characteristics that make the invention valuable, usable and unique.
2. The prototype need not be a working model but should communicate how the invention would work were it real.
3. Following the guidance provided in Worksheet 3 (Designing & Building) and Worksheet 4 (Testing & Refining) will result in a suitable prototype/model

Display Board

Students will need to create a visual display (tri-fold poster board) to compete. The display should communicate significant aspects of the invention process.

1. **Display board:** This forms the background for the project. A standard-size display board is 36" (height) by 48" (width). It is usually three-sided and sturdy enough to stand on its own for several days.
2. **Information from the Engineering Design Process:** This information should be on the display unit in a NEAT, CONCISE, and EASY TO READ manner. You should include the following:
 4. *Name of the Invention*
 5. **First name (only)** of student(s) and their grade
 6. **Identifying the Problem:** Describe how the idea for this invention came about, the problem that was encountered which needed a solution, what solutions previously existed (if any) and what their short-comings are which led to this invention.
 7. **Ideating:** Provide examples of possible solutions that were explored, including those that were not pursued as a way to show how the ideas led to the development of the final invention
 8. **Designing:** Describe the process of designing the invention and how it evolved during the process.
 9. **Testing:** Describe how the invention was tested, what aspects of the invention did not work and needed to be changed during the process, and what parameters were used to determine the invention solved the initially identified problem.

Pitch Video

*Only for projects which advance to the Invention Convention State and National competitions (details will be provided to groups advancing to Invention Convention Michigan)

Invention Convention Michigan and U.S. Nationals require students to record and submit an unedited and continuous video (4 to 6 minutes) of student(s) pitching their invention.

Judging Criteria and Student Checklist

The Judging Criteria will follow the requirements set forth by Invention Convention and can be found in the document *2023-2024 Project Toolkit* provided by Invention Convention.

Included with the *2023-2024 Project Toolkit* is a checklist and scoring rubric for students to follow when preparing their project for the competition.