Project Overview

Your names and grades:	
Your project's title:	
Your teacher's name:	**Your school:**
Your project summary: *(A short, ~5 sentence overview. To be completed AFTER you complete your project.)*	

Define the Problem

Guide

Before you even begin to work on your project, it's important to first ask a few questions to guide your work. On the next page, you'll answer the following questions in order to develop a problem statement.

1. First, think about why there is a **need** for your project's solution. What would happen if the problem wasn't addressed? What is the impact of the problem?

2. Second, think about the **audience** affected by the problem and your solution. Are there any particular traits of your audience you should consider? Can your project's solution be more inclusive by considering other audiences with different abilities or challenges?

3. Third, think about if there are any particular **constraints or specifications** your solution must adhere to. These can be things like size, timing, cost, or any other factor that puts a limit on possible solutions. Your constraints or specifications may be given to you in a prompt, or they may be considerations or goals in your design that you want to follow yourself.

Finally, use your thoughts on all of the above to create a **problem statement**. A problem statement is a short (one to a few sentences) description of the problem which includes the need, audience, and any constraints or specifications. **A problem statement is specific.** For instance:

- "*Build a better mousetrap"* is not a sufficient problem statement. It addresses a challenge, but none of the items above.
- "*John's house is infested with mice that only eat oranges. Design a mousetrap that can trap mice with oranges using only supplies from John's house before his friends arrive this weekend."* is a much better problem statement as it addresses the need, audience, and design constraints such as supplies and timing.

Define the Problem

Need:
Audience:
Constraints or Specifications: *(Number each below)*
Problem Statement:

Brainstorm & Evaluate Solutions

Guide

Before you get too committed to one way of solving a problem, it's important to **consider alternatives and get feedback**. In fields like robotics, this may help you consider ways to reduce time and material costs. Even in computer science design, you might find that one way of approaching the problem gets you the same result for less code!

Many designers review their brainstormed solutions by placing them on **a chart to compare their pros and cons**. These charts often compare things like:

- Time and material costs
- How well the solution meets the problem's constraints/specifications
- If there are any major unknowns or difficulties with this approach
- Safety
- If there is any particular skill required
- ...and any other items relevant to the project.

To make comparing these different concerns easier, often a "**decision matrix"** is used. A decision matrix is a chart in which each approach is scored by how well the approach meets those concerns. The scores can then be tallied to see which approach won the most points.

On the next page, you'll be asked to make your own decision matrix. For each row, write a short description of each of your brainstormed approaches and then put a score in each column using the following metric:

1 = Poor, 2 = Fair, 3 = Excellent

Tally up the scores in the last column to help you pick your approach (the higher the number the better). **Duplicate the page as needed if you have more ideas.** Finally, use the "Get Feedback" page to share your best approach with others and note the results!

Brainstorm & Evaluate Solutions

Decision Matrix

Short description of approach	Quick to make	Little Resource Cost	Meets problem constraints	Little Technical Difficulty	Total Score (higher is better)
Example: Plexiglass city model that uses pressure sensors to detect "pedestrians" (marbles) that move through its streets and use LED lights to direct walking traffic flow	2	1	3	2	**8**
1)					
2)					
3)					

Brainstorm & Evaluate Solutions

Get Feedback

Suggestions made:	New ideas given:
Concerns raised:	Things others liked:

Prototype

Guide

Before creating the final product, many designers (especially in engineering) build what is called a "**prototype**." A prototype is an early sample or model of the final product used to test or learn from before making the final product. Prototypes are used to help test a solution before committing the time and materials needed for the final product. Prototypes often have the following characteristics compared to the final product:

- Are simpler
- Made of cheaper materials
- Not decorated or as well-polished
- Easier to work with
- Sometimes smaller or reduced in capacity

For instance, in computer science this may be a simplified, shorthand version of a particular program that accomplishes most of the program's goals, but to a lesser extent. In engineering, this might be a smaller, more cheaply built version of a robot.

Now that you've decided on the intended solution to your problem, it's time to make a prototype. **Your prototype should help you learn about the characteristics of your design solution and be testable.**

On the next two pages, briefly describe the approach or solution you chose from the previous brainstorming steps and why you chose it. Answer the planning questions about your prototype and then, in the "diagram/explanation" section, draw and label the main components and capabilities of the prototype you will create. If your project consists mostly of code, you can draw a flow-chart of the code's logic. **Be sure to write some short explanations of anything not obvious from the drawing!**

Additional resource: [Prototyping Toolkit]
Attach an additional page if you need more space.

Prototype

(Remember: The total cost for all prototyping AND your final design should not exceed $30. Plan ahead!)

Chosen solution/approach and reasoning:
What inputs/sensors are there?
What outputs are there?
What processing will your project do?
Will it store any data, and if so, what?
Will the data be transmitted to another device, and if so, how?

Prototype (continued)

Diagram/picture/explanation of your prototype:

Testing & Redesign

Guide

Designing a solution is almost always an "**iterative**" process. An iterative process is one that repeats itself, ideally improving each time, until reaching the desired goal. An important part of such a process is **testing** at each stage of the process to assess your solution in relation to the goal. A product may be tested and **redesigned** many times before reaching its final version.

In robotics design, this might look something like:

1. Build a prototype
2. Test the prototype
3. Evaluate the data from the test to see if it meets the desired solution and constraints
4. Redesign an improved prototype
5. Repeat

In a pure programming project, the iterative process might be different versions of your program. Your first prototype program might not be able to accomplish all of the design specifications, but after testing to verify working portions, you might create new versions with further capabilities.

This process would continue until the prototype is ready to be considered the final product, either by tweaking the prototype or by completing new builds.

So now that you have a prototype, it's time to test it! Determine the best way to test your prototype against your problem's intended solution and constraints and fill out the next page with what you've learned. You can then duplicate the next page for any major additional tests and redesigns. Ideally, all data and multiple trials should be recorded, but it's up to you on how many iterations you will go through here.

Testing & Redesign

Duplicate this page for any additional major tests & redesigns

How did you test your prototype?	
What were the results? *(Report your actual data as possible. Attach additional pages if needed.)*	
How well did your prototype meet the needed specifications/constraints?	
Things my design is doing well:	**Changes I need to make:**

Final Product

Guide

Now that you've built your prototype, tested it, and redesigned it as needed, it's time to **communicate** the solution you've made! On the next two pages, first briefly describe how your final design meets the initial constraints or specifications set in the Define the Problem step. Answer the questions about your final design and then use the next page to diagram and explain your project. If your project is mostly coding, you can draw a flow chart of the code's main logical components. Be sure to explain any items that are not clear from the drawing.

Attach an additional page if you need more space.

There are a couple of remaining things to think of:

- **You'll need to list out your materials and supplies.** With the exception of non-consumable items that your teacher lets you use (such as robotics or electronics kits), your total supply cost must not exceed $30. Use the "Materials and Supplies" page to list out what materials you had to buy, how much they cost, and attach pictures of your receipts.
- **Did you use any code that you didn't write yourself (such as code found online)?** If so, use the "References" page to list which parts of your code you found elsewhere and where you found them. The majority of your project should be original work by your team.
- **Did you use supplies or equipment from an industry, laboratory, or individual outside of your class?** If so, use the "References" page to note those supplies, where they came from, and provide some contact information for the individual who worked with you on those items.
- **Don't forget to work on your video presentation for the Student STEM Challenge Competition!**
- **Additional resource:** Storytelling Guide

Final Product

(Remember: The total cost for all prototyping AND your final design should not exceed $30!)

How does your final design meet your constraints/specifications? *(If you run out of space, describe on your diagram below.)*
What inputs/sensors are there?
What outputs are there?
What processing does your design do?
Does it store any data, and if so, what?
Is the data be transmitted to another device, and if so, how?

Final Product (continued)

Diagram/picture/explanation of your final product:

Materials & Supplies

You'll need to list your materials and their cost. Don't forget to attach receipts! With the exception of non-consumable items that your teacher lets you use (such as robotics or electronics kits), your total supply cost must not exceed $30. Use this page to list out what materials you had to buy, their total cost, and to attach pictures of your receipts as evidence. Feel free to add additional pages as needed.

Total Supply Cost:	

References

Did you use any code that you didn't write yourself (such as code found online)? If so, use this box to list which parts of your code you found elsewhere and where you found them. The majority of your project should be original work by your team. Use whichever format your teacher requires.
Did you use supplies or equipment from an industry, laboratory, or individual outside of your class? If so, use this box to note those supplies, where they came from, and provide some contact information for the individual who worked with you on those items.

Team Member Contributions

Please explain the different roles and divisions of tasks amongst your team members here.