Proposed Design Concept for a Magnetic Maze Table to be used in the Discovery Space Museum

Hannah Miller, Jack Sisco, Owen Warner, and Isabel Zimeri
Team 1.5, ME 340, Mechanical Engineering Department, Pennsylvania State University

Summary

This report centers on the development of an interactive STEM exhibit for children, focusing on science, technology, engineering, and mathematics (STEM) concepts. It underscores the significance of early exposure to STEM fields and highlights the effectiveness of hands-on learning in nurturing children's interest in these subjects. The project, assigned by the Design Methodology course (ME 340) at Pennsylvania State University, aims to create a compelling and educational exhibit for the Discovery Space Museum in State College, Pennsylvania. The museum serves as a valuable resource for young learners to engage with STEM principles through more than 45 interactive exhibits.

The primary objective is to inspire the next generation of scientists and engineers by offering a safe, engaging, educational, and durable STEM exhibit. To meet these goals, the project should fit within a 2-foot cube and stay within a budget of $50. The chosen concept for the exhibit is a magnetic maze table, allowing children to explore the principles of magnetism while enhancing their fine motor skills. The report delves into various design aspects, including the function structure and system decomposition, prototype needs and specifications, concept generation, concept screening, and concept selection. It also provides detailed CAD drawings of the selected design concept.

Additionally, the report outlines a management plan that includes a Gantt chart for task scheduling and cost considerations. The project's success relies on the diverse skill sets of the team members, comprising three juniors and one senior in mechanical engineering, who bring a range of skills and experiences to the table.

Statement of Problem

According to the U.S. Bureau of Labor Statistics, careers in science, technology, engineering, and mathematics (STEM) fields account for 6.2% of all employment in the U.S. [1]. Additionally, children exposed to STEM concepts early on, such as in elementary school, are more likely to pursue STEM-related careers [1]. To effectively teach children these STEM concepts at a young age, a hands-on approach has been found to be most successful [1]. When the children can physically perform a task and see how a scientific principal functions, it will make more sense to them. It is important to give children this interactive STEM experience to pique their interest in the science field and increase their curiosity of the world around them.

To provide this hands-on learning experience, the Design Methodology course (ME 340) in the mechanical engineering department at Pennsylvania State University has asked our team to design an interactive STEM exhibit. The exhibit that our team creates will be placed in the Discovery Space Museum, located in State College, Pennsylvania. Discovery Space is a resource for children to learn about science and technology, containing over 45 exhibits that are designed to teach children STEM principles [2]. The goal for our team is to inspire the next generation of scientists and engineers through engagement with our exhibit at the Discovery Space. Utilizing the woodshop, CAD capabilities, and the assistance of the teaching staff of the course, our team plans to create an exhibit that is safe, educational, engaging, and durable.

The exhibit is required to be a hands-on experience as opposed to a visual exhibit because children learn best through hands-on learning [3]. The exhibit should also be intuitive, so the children should be able to use the exhibit with few written instructions. The exhibit should also be safe, so it cannot have any sharp edges or pinch points. The exhibit should have signage that shows how to use the exhibit and is visually appealing. The exhibit should fit within a 2-foot cube and should have colors and look well made. In addition, no logos can be included that would be copyrighted so that the exhibit can be displayed in the Discovery Space.

After creating multiple different general concepts of a potential exhibit, our team has decided to move forward with creating a magnetic maze table. A general sketch of the magnetic maze table can be seen in Figure 1. The table will teach the children magnetism and help them with their fine motor skills through the use of a wand that will move a magnetic ball within the maze.

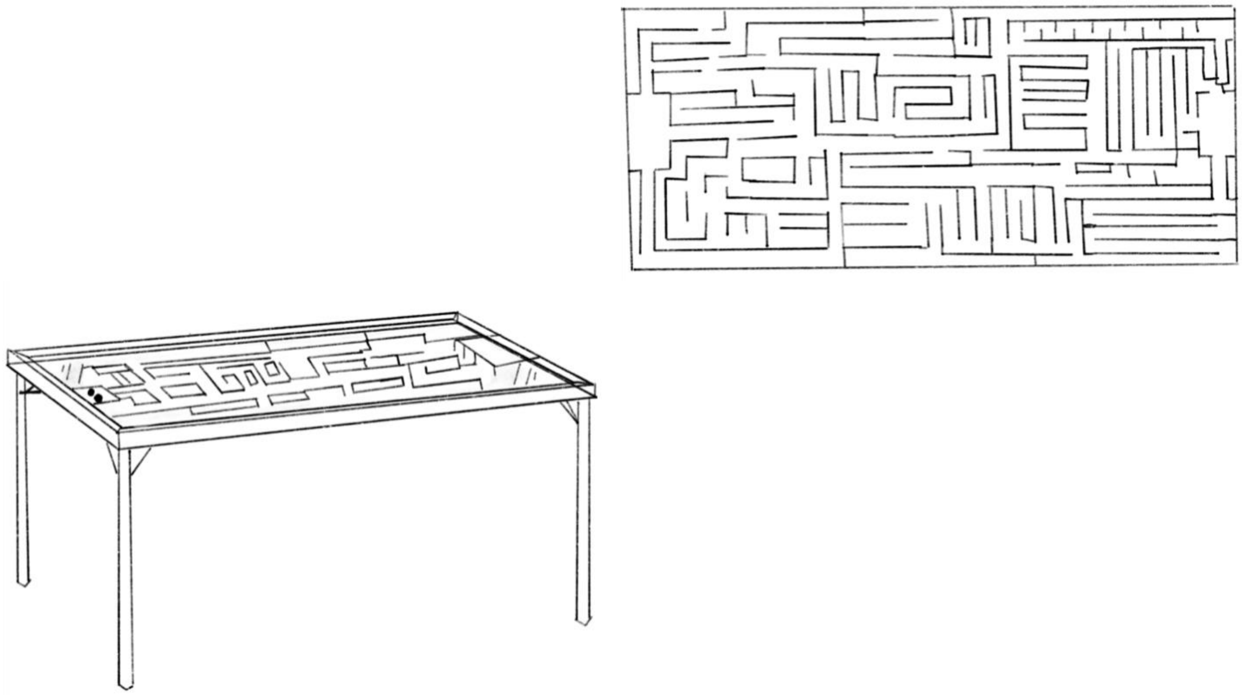


Figure 1. Magnetic Maze table. The magnetic maze table is a two-foot-tall table maze that has a magnetic ball and handle for kids to practice fine motor skills.

Proposed Design Concept

This document proposes a specific design concept for a magnetic maze table. The proposed magnetic maze table will be a fully enclosed maze system where children can explore the properties of magnetism and challenge their critical thinking skills. One assumption for our maze is that it will be used frequently by children. Because of this frequent use, abrasion and fatigue of the materials used to build the maze is expected and will be taken into consideration in our concepts. In addition, our primary supply of building material will consist of plywood, so plywood will be the main material used for construction of the exhibit. Another assumption for the design of our exhibit is that it will always be indoors. With the exhibit indoors, there is no need to account for harsh weather conditions such as rain or wind.

The final design of the maze will have limitations because of the constraints given to us by the Discovery Space and Penn States design course. As stated in the proposed design concept section, one limitation is that the maze should fit within a 2-foot cube. Additionally, the maze will be made for the use of children ages 2-12, so a child of this age should be able to solve it. Lastly, the maze should be built with a budget of $50.

The next five subsections of this proposal present the system decomposition, prototype needs and specifications, concept generation, concept screening and selection, and CAD drawing of selected design concept. Firstly, the function structure covers the overall function, the supporting functions, and auxiliary functions of our proposed design concept. The prototype needs and specifications compare different concepts based on their adherence to the customer needs and developed metrics. The concept generation section contains drawings of each selected concept in a table. In these drawings, key differences are labeled to contrast each of their unique properties. The concept screening and selection section includes a comparison to each concept using metrics and specifications. A chart has been made to rank each concept, with each ranking derived from how well they fulfill each metric. Finally, a detailed CAD drawing of the selected concept is provided. The CAD drawing provides a perspective on what the final project will look like in its physical form.

Function Structure and System Decomposition

This sub-section discusses the functional decomposition for our general design concept. Shown in Figure 2 is a structure outlining the operation of the maze and how a child will interact with it. This structure includes the overall function, supporting sub-functions, and auxiliary functions of the maze. Through the connecting arrows, the relationships between each of the three functions are shown.

The maze will allow a child to be challenged by an engaging game while learning scientific principles. The overall function of the system is to solve the maze, which is done with user input in the supporting sub-functions. The first task is to maneuver the ball through the maze with the magnetic wand. Using problem solving skills, the user will navigate the ball to the designated finish area to solve the maze. Once they reach this part of the maze, they will feel a sense of accomplishment for solving the puzzle. Additionally, there will be a passageway from this finish area back to the designated start area of the maze. The passage will have a one-way gate to ensure the user only begins from the start area. Once the user gets back to the start area, they can play again or pass it on to one of their friends to attempt to solve the maze.

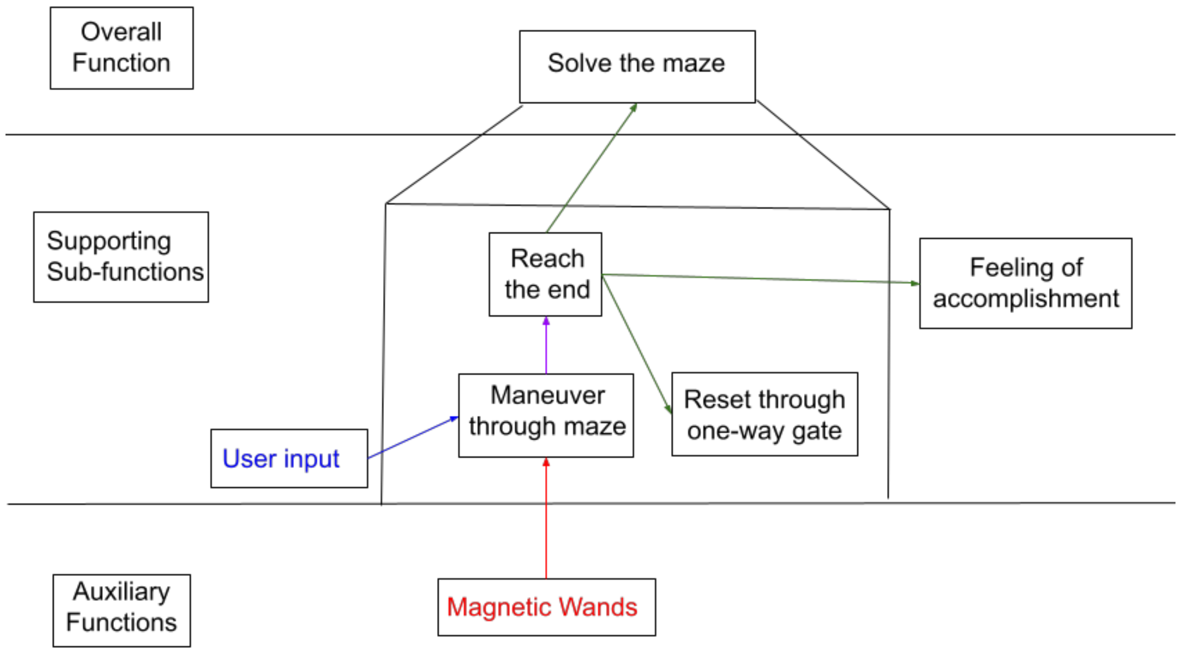


Figure 2. System decomposition of a magnetic maze. Examination of the overall function, supporting sub-function, and auxiliary functions shows how the user interacts with the system. The child uses the magnetic wand to maneuver through the maze, with the end goal reaching the end and solving the maze. Once they reach the end, they have the option to reset to the beginning thought a one-way gate to try again.

The supporting sub functions and auxiliary functions work together to achieve the overall function of solving the maze. This system repeats itself as there will be more than one solution to the maze. Through iterations, the children can enhance their problem-solving skills and learn the effects of magnetism while navigating through the maze.

Prototype Needs and Accompanying Metrics and Specifications

This subsection discusses the prototype needs and accompanying metrics and specifications that will be fulfilled by the final prototype. These needs, as outlined in our initial design report [3], include that the exhibit should be safe, educational, durable, engaging, attractive, lightweight, and easy to fix. Additionally, our team assigned metrics to each customer need to ensure that they were being accommodated. The metrics listed are measurable parameters used to measure the success of the design at meeting the customers' needs. In addition, maximum and minimum specifications are assigned to provide a target value for each metric. Shown in Table 1 is a Quality Functional Deployment (QFD) chart, which shows the relationship between the customer needs, metrics, and target specifications.

Table 1. Quality Functional Deployment chart illustrating metrics and associated specifications.

		Metrics					
		Total weight of maze	Weight supported	Customer height accommodated	Volume of maze structure	Number of maze solutions	Number of users accommodated
Customer Needs	Safe		x				
	Educational					x	
	Durable		x				
	Engaging					x	
	Attractive			x	x		
	Lightweight	x			x		
	Easy to Fix		x			x	x
	Minimum	--	150lbs	35in	--	2	2
	Maximum	50lbs	--	60in	8 cubic ft	4	3
		Target Values					

Using the QFD chart, our team was able to assign metrics and specifications for our prototype to ensure that the customer needs are met. The first and most important customer need is safety. The metric used to verify a safe exhibit is the weight supported by the maze. The target specification for this metric requires the maze to support at least 150lbs, which is greater than the average weight of a 4-year-old child [5]. With this specification met, it will prevent the maze from collapsing if a child puts their full weight on the maze. The maze should also be educational and engaging, with the metrics for these customer needs being the number of maze solutions. This metric has a minimum and maximum specification of two to four maze solutions, respectively. With at least two maze solutions, it allows the child to use more critical thinking skills to find more paths through the maze. This critical thinking will help them to learn more while interacting with the exhibit, as well as keep them engaged. Additionally, it is important for the maze to be durable, so that it can withstand use from young children. Similar to safety, the measurement of the ability of the maze to be durable is weight supported. If the maze can support large amounts of weight, it is indicative of a strong structure that can withstand abuse.

When considering the physical appearance of our maze, it is important for it to be visually appealing to the children. The main metric dictating compliance of this prototype need is the customer height accommodated. With a minimum and maximum height of 35 in and 45 in respectively, the maze will be inviting to the average height of children that will be using the exhibit. Our group is also targeting to have a lightweight design, with a maximum weight of 50lbs. This maximum wight will ensure that the maze can be easily transported to new locations, while also decreasing risk of injury is the maze was to tip over. The final customer need that will be considered is how easily the maze can be fixed. The main associated metric for this customer's need is the number of users accommodated, with a maximum of three users. With more users accommodated, it brings more complexity into the design of the maze. Limiting the number is users to three, ensures a simple design and will make the maze easier to fix if it breaks.

Concept Generation

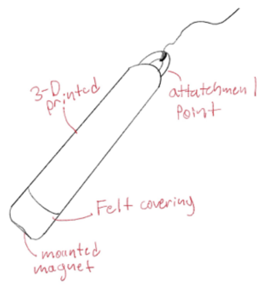
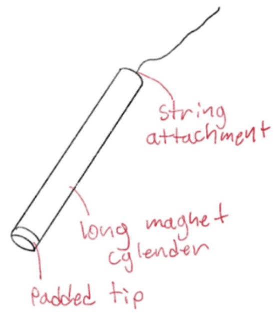
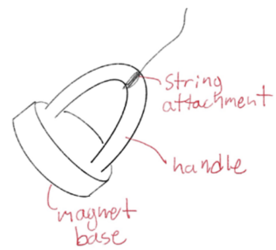
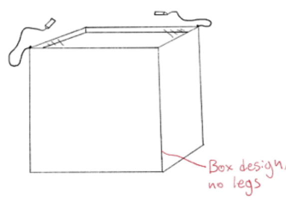
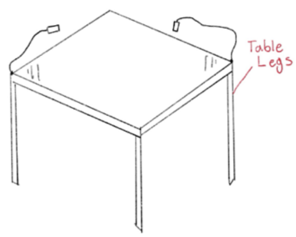
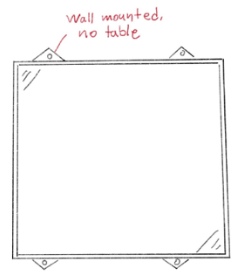
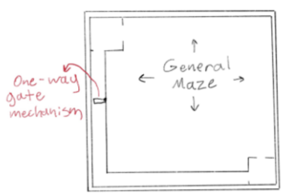
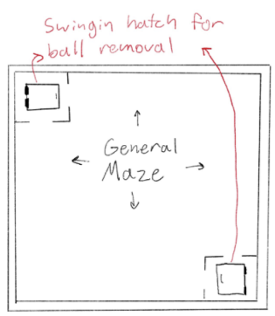
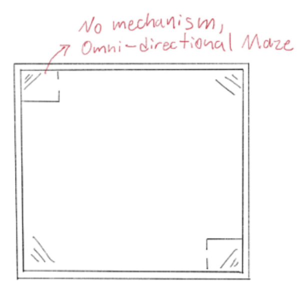
This subsection presents the design concepts for our maze exhibit as well as the methods that our team used to generate these concepts. The brainstorming process that we used to generate design concepts consisted of the 6-5-3 method. The goal of this method is to create a multi-step process to write down ideas as a team. We first identified three necessary sub-functions of our maze, which consist of the magnet attachment, table style, and ball retrieval system. Then, each member wrote one concept for each sub-function on a piece of paper. The concepts for each sub-function in turn combined to create one design concept. We then rotated the papers every few minutes. This rotation allowed each team member to critique and improve upon each other's design concepts. Once the papers were rotated to each team member twice, we stopped and discussed the concepts that were generated. During this discussion, an emphasis was placed on each of the concepts' conformity to our customer needs. The concepts that we thought did not meet our customer needs were rejected, and the concepts that remained were modified and combined until we narrowed down to three final concept selections.

Shown in Table 2 are the three design concepts that we generated and their accompanying subfunctions. The first sub-function, the magnet attachment, is the piece that will house the magnet that will be used to move the ball through the maze. This part will be held by the children as they are interacting with the maze. Two of the concepts utilize a longer design, making it easier to hold in the children's hand. One of the concepts is smaller, making it lightweight but also causing it to be harder to hold and as a result decreasing its usability. Additionally, all of these concepts include a string to keep the magnet with the table to prevent lost parts.

The second sub-function includes the style of table that will support the maze. The first concept for this sub-function shows a table with four separate legs, one on each corner. This concept makes the table lightweight, but also decreases its durability by making the table weaker with less support. The second concept resembles the structure of a box. This box design allows the table to be stronger and simpler, making it more durable. The third concept is not a table, but instead a wall mounted design. This wall mounted design makes the maze lighter, but also increases complexity with the need for fasteners to hold it to the wall. Additionally, with the wall mounted design it will cause the magnetic ball to be pulled against the force of gravity, making the maze harder to use.

The third and final sub-function consists of the ball retrieval system. This sub-function consists of the method that will be used to place the ball back in the starting position after the maze is solved. The first concept for this sub-function is an opening hatch, where the children can open the maze cover and take the ball out to place it back where it started. Some disadvantages of the hatch system are the possibility of the ball being lost, as well as the choking hazard that it would create. The second system is a path leading from the end to the start of the maze with a one-way gate. This pathway allows the ball to always stay inside the maze, increasing its safety. The third and simplest system consists of no ball retrieval system. Instead, the children will go in reverse once they reach the end, and in the process try to find new ways through the maze.

Table 2. Concepts generated for our maze design [12].

Subfunction	Design 1	Design 2	Design 3
Magnet Attachment			
Table Style			
Ball Retrieval System			

Concept Screening and Selection

This subsection presents the concept screening and selection process used to determine the concepts that best match our customer needs. The purpose of concept screening and selection is to choose one concept from each sub-function to incorporate into our prototypes. To make these selections, we first created an Analytic Hierarchy Process (AHP) matrix to weigh the importance of each customer need. By comparing the different customer needs, our team generated relative weights that would help to numerically score our concepts. Our AHP matrix, along with more details of the weighting process, can be found in Appendix A.

After the relative weights of each customer need were established, we generated a table for each subfunction and their accompanying concepts. Each concept was given a score of one to five for each customer need. Each score was then multiplied by the weight for that customer need. The weighted scores were then totaled, and the highest scoring concept is the one that we chose to move forward with.

Shown in Table 3, Table 4, and Table 5 are the concept screening matrices for each sub-function. For the magnet attachment, the 3D printed wand was the selected concept, largely because of its aesthetically pleasing design. Additionally, the box structure was selected because of its simplicity and strength. Lastly, the one-way gate was chosen because of its safe design. In addition to these attributes, these concepts scored the highest by at least 0.75 points in their respective sub-function.

Table 3. Concept Screening for Magnetic Attachment

		Magnet Attachment					
		Concept 1: Handle		**Concept 2: 3D Printed Wand**		**Concept 3: Magnet Wand**	
	AHP Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Aesthetically Pleasing	0.05	3	0.14	5	0.24	1	0.05
Safety	0.28	2	0.55	3	0.83	1	0.28
Durability	0.22	4	0.89	3	0.66	3	0.66
Engaging	0.16	1	0.16	4	0.63	3	0.47
Educational	0.15	2	0.30	4	0.60	4	0.60
Lightweight	0.02	3	0.05	2	0.03	2	0.03
Easy to Fix	0.13	2	0.27	2	0.26	2	0.27
		Total Score:	2.35	Total Score:	3.25	Total Score:	2.4
		Rank:	3	Rank:	1	Rank:	2

Table 4. Concept Screening for Table Style

		Table Style					
		Concept 1: Standard Table		Concept 2: Box		Concept 3: Wall Mounted	
	AHP Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Aesthetically Pleasing	0.05	4	0.19	5	0.24	3	0.14
Safety	0.28	4	1.10	5	1.37	5	1.38
Durability	0.22	2	0.44	5	1.11	3	0.66
Engaging	0.16	3	0.47	3	0.47	3	0.47
Educational	0.15	3	0.45	3	0.45	3	0.45
Lightweight	0.02	4	0.06	3	0.05	4	0.06
Easy to Fix	0.13	4	0.53	4	0.05	2	0.27
		Total Score:	3.25	Total Score:	0.53	Total Score:	3.43
		Rank:	3	Rank:	1	Rank:	2

Table 5. Concept Screening for Ball Retrieval System

		Ball Retrieval System					
		Concept 1: Swinging Hatch		Concept 2: One-Way Gate		Concept 3: Omni-Directional Maze	
	AHP Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Aesthetically Pleasing	0.05	4	0.19	3	0.14	4	0.18
Safety	0.28	2	0.55	4	1.10	5	1.38
Durability	0.22	2	0.44	3	0.6	5	1.11
Engaging	0.16	4	0.63	4	0.63	3	0.47
Educational	0.15	3	0.45	3	0.45	3	0.45
Lightweight	0.02	3	0.05	3	0.05	3	0.05
Easy to Fix	0.13	2	0.27	3	0.40	5	0.66
		Total Score:	2.58	Total Score:	3.43	Total Score:	4.31
		Rank:	3	Rank:	2	Rank:	1

CAD Drawing of Selected Design Concept

This subsection presents our team's final design concept chosen to proceed into the prototyping phase. Shown in Figure 3 is the CAD design for the magnetic maze table. Included in this drawing are the various sub-systems chosen in the sections above. Firstly, the ball retrieval system includes a one-way gate with a passage running through the left side of the maze. This system was chosen because we believe the increased engagement outweighs the simplicity of the omni-directional system. Alongside the gate, the general body of the maze was decided to be the box design. The box design was chosen because it is more durable, manufacturable, and safer. Children also like to push and climb objects; therefore, a box design will be less likely to tip because of its lower center of gravity. The box design will be 8 cubic feet in volume, as described in appendix B, Figure B-1. Finally, the magnet holder was decided to be a 3D-printed wand with commercially available magnets attached to the end. Shown in Figure 4, this design features a groove to increase comfort and grip, as well as a loop at the top to attach it to the table. The detailed dimensions for this wand are specified in appendix B, Figure B-2.

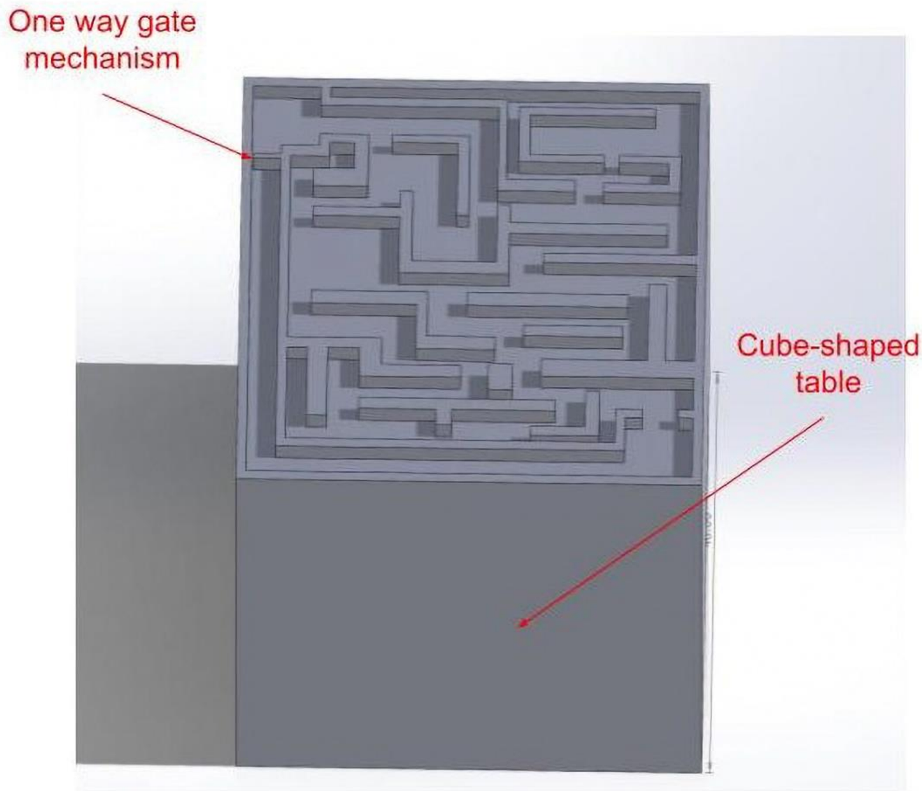


Figure 3. Top view of magnetic maze table featuring a one-way gate mechanism and a legless box design.

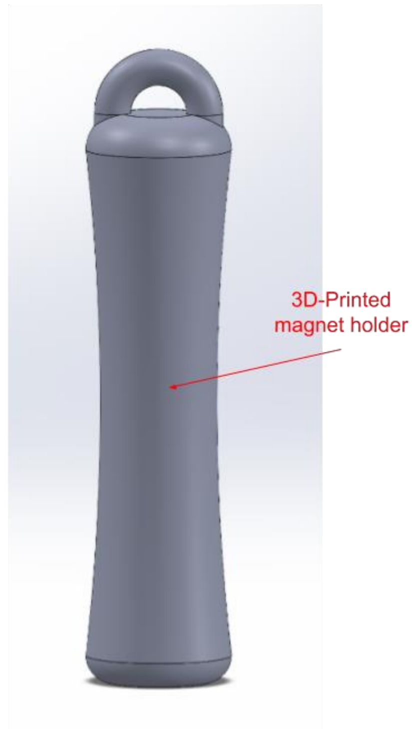


Figure 4. Side view of the 3D-printed magnetic wand featuring comfortable grip and attachment loop.

Management Plan

To create the magnetic maze exhibit, the foreseeable tasks and costs of producing the project have been considered. The schedule for the project and the leadership of each task are shown in the Gantt chart in Figure 4. The chart is used to outline the plan for due dates and designates the responsibilities to each team member. These responsibilities are distributed based on the strengths and weaknesses of each team member based on previous experience, which can be seen in more detail in Appendix C. Creating a schedule allows the team and management to see a clear timeline to ensure the project is completed on time.

WEEKLY GANTT CHART

Discovery Space Exhibit	Owen Warner	8/21/2023	12/10/2023
PROJECT NAME	OWNER	START DATE	END DATE

Task ID	Task Name	Start Week	End Week	Resources	WK01	WK02	WK03	WK04	WK05	WK06	WK07	WK08	WK09	WK10	WK11	WK12	WK13	WK14	WK15	WK16	WK17
01	Initial Design Report	WK01	WK04																		
01.01	Proposal Presentaion	WK04	WK05																		
01.02	Written Proposal	WK05	WK08																		
01.03	0th Prototype	WK06	WK07																		
02	Concept Selection	WK07	WK07																		
02.01	Alpha 1 Prototype	WK08	WK09																		
02.02	3D prototype	WK09	WK09																		
02.03	Peer Evaluation	WK11	WK11																		
02.04	Manufacture Alpha 1	WK11	WK12																		
	Design/Sketch Alpha 2	WK09	WK11																		
03	3D model	WK12	WK13																		
03.01	Manufacture Alpha 2	WK12	WK14																		
03.02	Final video	WK13	WK14																		
03.03	Final Presentation	WK12	WK14																		
03.04	Peer Evaluation	WK14	WK14																		
03.04	Peer Evaluation	WK14	WK15																		

Figure 4. Gantt chart showing the remaining assignments for the rest of the semester. The Gantt chart includes the project tasks, the dates and duration of each task. Green indicates the tasks we have already completed, yellow indicates the tasks we are currently working on, and red specifies the tasks we have not yet begun.

The chart has four major sections which are Alpha 0 Prototype, Alpha 1 Prototype, Alpha 2 Prototype, and Final Presentation. Each of these sections have more specific tasks to guide the team. The chart includes tasks, progress, start date, and time duration for each task. The chart also includes a color-coded schedule which gives a visual of which tasks have been started or completed. The color-coded schedule emphasizes which tasks are important to focus on each week and team meeting.

In designing and planning the exhibit, several costs were considered for the management plan. Costs include the $50 budget the team was given for the project, along with the time it will take to ship and build the exhibit. Throughout the project, Hannah will be responsible for leading the team in drafting the written components of the project. Isabel will be responsible for leading the team in the preparation of presentations of the project. Jack will be responsible for all the 3D modeling, and Owen will be responsible for leading the group in designing and building the prototypes. Appendix B shows the drawings of each part, which are used in the 3D modeling and final construction of the exhibit.

Our team is composed of three juniors and one senior in mechanical engineering. Being in higher level engineering courses has allowed our team to experience different components of the design process and engineering projects through classes, internships, and research. Our team consists of engineers with different skill sets and experiences that can all be utilized to ensure a successful project. Team members have skills such as CAD, project management, and understanding of the design and assembly process is important because these skills are all required to ensure the project is finished well and on schedule. The skills our team members have qualifies the team to create a safe, engaging, and educating science exhibit for children.

Appendix A: AHP Matrix

This appendix contains a description of the analytic hierarchy process (AHP) and how our team utilized this method in concept selection and scoring. An AHP is a method for organizing criteria using psychology and math. For the magnetic maze table exhibit, our team used the AHP matrix, shown in Table A-1, to determine which criteria holds higher importance over other criteria. The specific criteria compared were safety, durability, engagement, education, lightweight, easy to fix, and aesthetically pleasing. One example is when comparing aesthetically pleasing to safety, our team decided that safety is much more important, so the AHP weight was higher for safety. In addition, our team concluded that it is more important for the exhibit to be durable, engaging, and educational than it is for the exhibit to be easy to fix.

Table A-1. Analytical Hierarchy Process (AHP) Matrix

Selection Criteria	Aesthetically Pleasing	Safety	Durability	Engagement	Educational	Lightweight	Easy to Fix	Row Total	AHP Weight
Aesthetically Pleasing	**1**	0.25	0.2	0.25	0.2	3	0.2	4.1	0.04704586
Safety	4	**1**	3	2	4	6	5	24	0.27539042
Durability	5	0.333	**1**	4	3	5	2	19.333	0.22183846
Engagement	4	0.5	0.25	**1**	2	4	3	13.75	0.15777576
Educational	5	0.25	0.333	0.5	**1**	5	2	13.083	0.1501222
Lightweight	0.333333333	0.166666667	0.2	0.25	0.2	**1**	0.2	1.35	0.01549071
Easy to Fix	5	0.2	0.5	0.333	0.5	5	**1**	11.533	0.13233657
				Column Sum				87.149	1

After our team determined the AHP weights for each of the prototype needs, each of the subfunctions were given a weighted score. The weighted comparison is referred to as the AHP scoring matrix. For our three concept variants, we created separate scoring matrices for their developed components, which can be seen in Tables 3,4, and 5. These concept scoring matrices were then used to determine which design of the subfunctions would work best for the magnetic maze exhibit. The weights from the AHP matrix were carried over to the tables, then scores were set based on how well each of the designs fulfills the prototype needs. Next, the AHP weight was multiplied across the table, creating a weighted score. The sum of the weighted scores gives a total score, and the design concept with the highest score is what our group is moving forward with.

Appendix B: Detailed Part Drawings

This section presents detailed drawings for our teams' maze and magnetic wand concepts. The maze structure, shown in Figure B-1, will be made of plywood. Additionally, a plexiglass cover will be used to contain the ball inside the maze. The magnetic wand, shown in Figure B-2, will be 3D-printed with a magnet attached at one end. A loop on the wand is provided to tie a string to secure the wand to the maze. With the ability to 3D-print, it allows the wand to be ergonomically designed to fit into the user's hand.

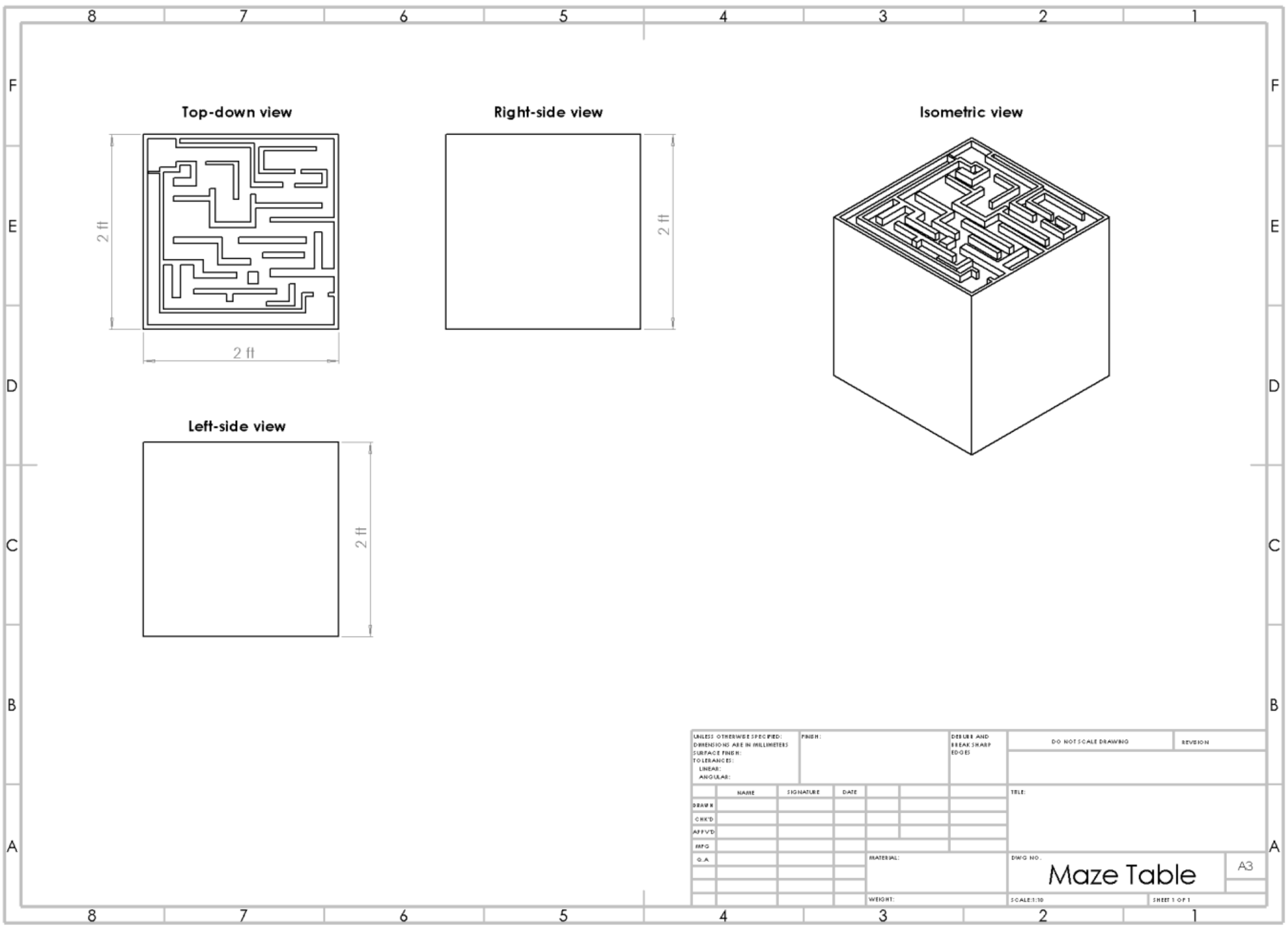


Figure B-1. Defined and dimensioned drawing of magnetic maze table.

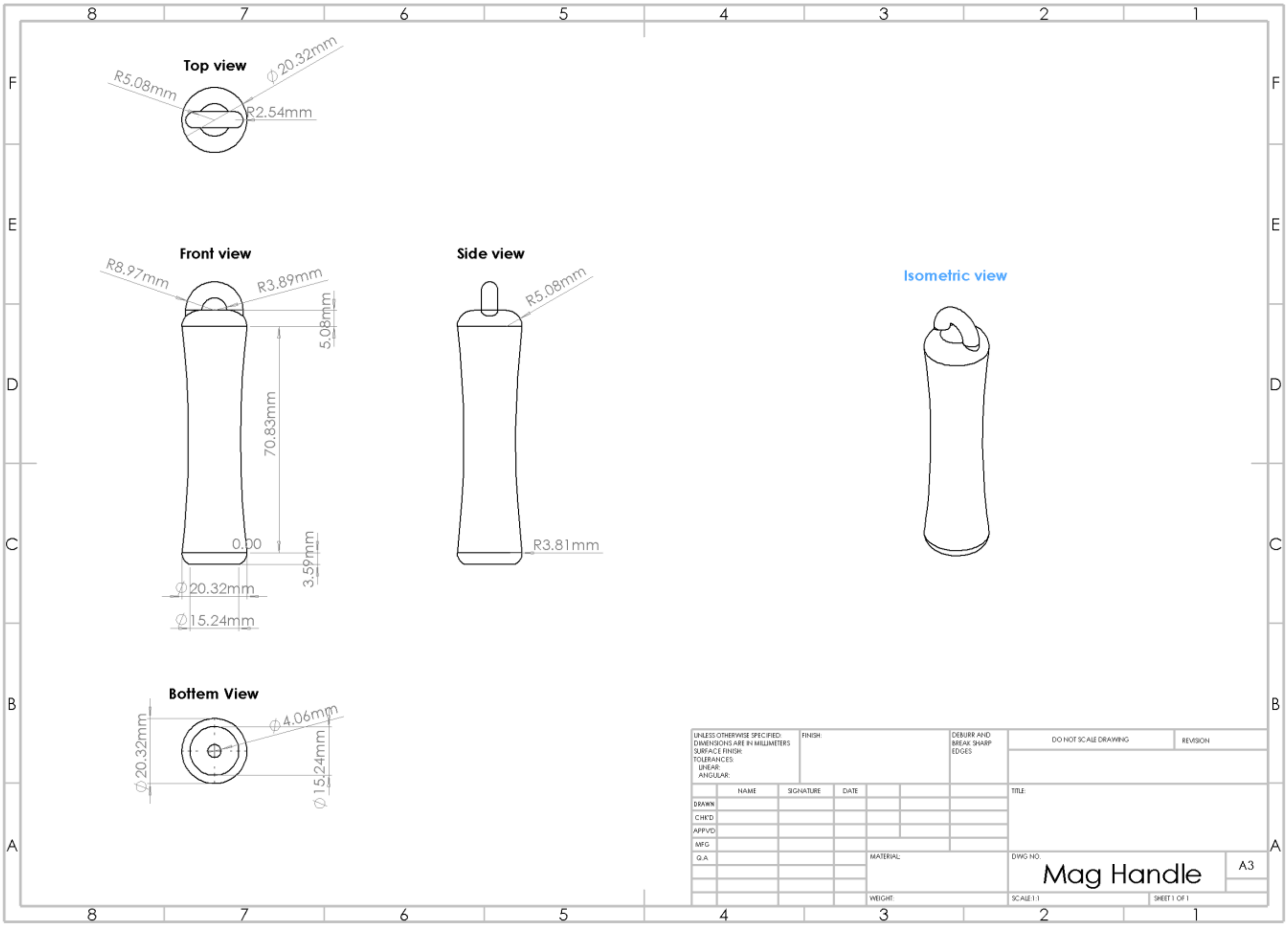


Figure B-2. Fully defined and dimensioned part drawing of 3D-printed magnet holder for magnetic wand.

Appendix C: Qualifications of Design Team

Figure C-1. Photo of each member of our design team. From left to right and top to bottom, the team members are Hannah Miller, Isabel Zimeri, Owen Warner, and Jack Cisco. All four are engineering students at Pennsylvania State University.

Owen is a junior in mechanical engineering at Pennsylvania State University. Originally from Montgomery County, Pennsylvania, he had an internship with the Penn State Applied Research Laboratory this past summer. He continued working there as a part-time research and development engineer, designing and testing a thermal management system for one of their underwater vehicles. Outside of work, he is also the Vice-President of SEDS at Penn State, which is a club that builds rockets. In addition to being Vice President, he is currently in the process of designing the fluid systems for a student built bi-propellant liquid rocket engine. He has an interest in thermodynamics, heat transfer and fluid systems and anticipates doing something in this field upon graduation. Outside of school, Owen likes to be outdoors, either hiking, snowboarding, or mountain biking. He also likes baseball and is an avid Phillies fan.

Hannah Miller is a senior year student pursuing a Bachelor of Science in Biomedical Engineering and Mechanical Engineering. She is interested in biomechanics and mechanical design, which is something she hopes to pursue upon graduation in May 2024. She is a member of the musculoskeletal regenerative engineering laboratory at Penn State. In the research laboratory, she led a project studying electrospinning with silk and other polymers to create tendon scaffolds. She also studies how cells react to different surfaces and the effects of the cells on the surface. In addition, Hannah has served as a mentor to incoming engineering students to help the students get adjusted and succeed in their classes. Throughout her years at Penn State, Hannah has been involved in numerous extracurricular activities. Most notable is her involvement in THON through both her sorority, Sigma Kappa, and on multiple committees. Hannah loves to read, cook, or ride her bike at the beach in her free time.

Jack is a third-year mechanical engineering student at Pennsylvania State University. Over this past summer he studied abroad in Japan to learn Japanese. As a result of this experience, he has since joined the Global Engineering Fellows program to promote studying abroad for fellow engineers. Because of his interest in language, he is an active member in the Japanese Student Association. He is also an officer in the ASME design team, leading a group to design the steering and suspension subsystems of a fully 3D printed open-source RC car. Jack has an interest in design processes and additive manufacturing which he hopes to integrate into his future career. While not at school he enjoys snowboarding, riding his bike, working on personal projects, and being with his family.

Isabel Zimeri is a junior in mechanical engineering at Pennsylvania State University, University Park. She is from Guatemala City, Guatemala and although it has been challenging, she's enjoying studying abroad. After graduation, she will continue her education with an MBA or a Graduate Program in Advanced Manufacturing and Design at Penn State. Her interests include aerodynamics, thermodynamics, design, and manufacturing. One of Isabel's hobbies is Formula 1. She hopes to one day be a part of the motorsport industry or work in the automotive industry. Isabel is currently a member of Society of Hispanic Professionals (SHPE) where she learns from engineers from different companies about the experiences and challenges as an international student. She recently joined the Tennis Club. So, if she is not studying, she is playing tennis or working out. She also enjoys spending time with her family when she goes back home, and her friends.