Get Yo Wiggle On - Design Report

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Client:
High Tech Elementary
Samantha Lee, 4th Grade Teacher

University of California, San Diego
Global TIES

Course: ENG 100D, Fall 2020
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Executive Summary

Our partner organization is High Tech Elementary whose goal is to educate students through a hands-on learning experience in STEAM. High Tech Schools aim to teach students about the design principles of equity, personalization, authentic work and collaboration to create a strong foundation for learning and setting aspirational goals. Their mission is to create an environment that allows students to achieve beyond the traditional elementary school curriculum and become active contributors to building a better world. We are specifically working with Samantha Lee and her fourth grade classroom at High Tech Elementary Chula Vista.

The core of HTe mission statement is learning through a project oriented classroom environment. Due to the recent pandemic, students have been forced to learn remotely at home. Samantha and her colleagues were expecting to be physically back in class this year, but they had to continue remote learning. Some students are having difficulty staying engaged with the remote classroom format. We observed on multiple remote classroom sit-ins that at least half of the students don't have their webcams on and those that do have difficulty staying engaged.

Our approach is to supplement a hands-on project that can be safely delivered due to the pandemic but proctored remotely. We want her students to engage in this activity away from the computer as much as possible since Samantha has stated that her students are experiencing "Zoom fatigue" from spending so much time on the computer. We decided upon a project called the Wiggle Bot which is a simple robot that spins on marker legs and can draw fun and random circular designs. The Wigge Bot lines up with the STEAM core values and engages students to test and troubleshoot various aspects of the design as well as produce something with an artistic value. To maximize the impact of our approach, the project will be broken down inside of a teacher's manual so that it can be replicated in the future, whether that be remote or in person. The manual also includes a reference video to maximize student success since we won't be there for extra assistance.

By proctoring the students' vote, which also includes a hydroponic project and circuit building exercise, we found that the majority of her students were excited about the Wiggle Bot Project. The final design handed to Samantha includes 24 Wiggle Bot kits, the student manual, the teacher reference video, and finally the teacher's manual if she or anyone wants to replicate the project in the future.

Project Management

1.1 Goals & Objectives

High Tech Elementary is a project-based elementary school that focuses on the design principles of equity and creating a safe environment for students to collaborate and personalize their creative works. Our goal for this partnership is to deliver High Tech Elementary's mission of developing emotional intelligence and identity with a STEAM-based technical project for their students during the COVID-19 pandemic. The outcomes that we strive to achieve include reducing online learning fatigue, encouraging hands-on experiments/projects, and improving innovative and technical skills that can be applied towards future projects.

In an effort to accomplish these goals, we will create a project called the Wiggle Bot which serves as a robot for students to build and design. This will allow the students to take a break from online learning and work on a hands-on project outside of their lesson plan. Our objective is to establish a strong relationship with our stakeholders, utilize our creativity and knowledge to construct a project, and deliver a fun and educational experience for HTe students.

1.2 Approach

Based on our human-centered design approach, we plan to get to know our stakeholders and empathize to understand their wants and needs. Prior to our meetings with Samantha and her students, our team compiled a list of interview questions, as shown in ***Figure 1.1*** in the Appendix, that would allow us to gain more insight and information about our stakeholders. We first communicated with our main client, Samantha Lee, through emails and Zoom meetings. As we established rapport and mutual goals with Samantha, we then proceeded to interact with her students while making observations of their daily Zoom environment. To keep our documents organized, our team created a shared Google Drive to store and access our files and notes. Our main source of communication was through Discord and Zoom to have team meetings and discussion sessions.

Through our observations with Samantha and her students, our team created a mind map, as shown in ***Figure 1.2***, to visually represent the issues we had noted from the interview with Samantha and from our interactions with the students over Zoom. This brainstorming phase of our project gives us the opportunity to organize encountered problems into different sections for our team to easily refer back to when going through the ideation phase.

Once we completed our mind map, we started to brainstorm several project ideas such as coding a game, hydroponics, LED lights, and the Wiggle Bot. In the process of ideating, we realized that coding a game would not fit the solution to mitigating online learning fatigue, so we collectively agreed to eliminating that idea. We finally concluded that hydroponics, LED lights, and the Wiggle Bot were the project ideas we wanted Samantha's students to choose from. We made a Project Choice Survey to receive feedback on which project the students were most interested in based on a majority vote in order to help guide our design process.

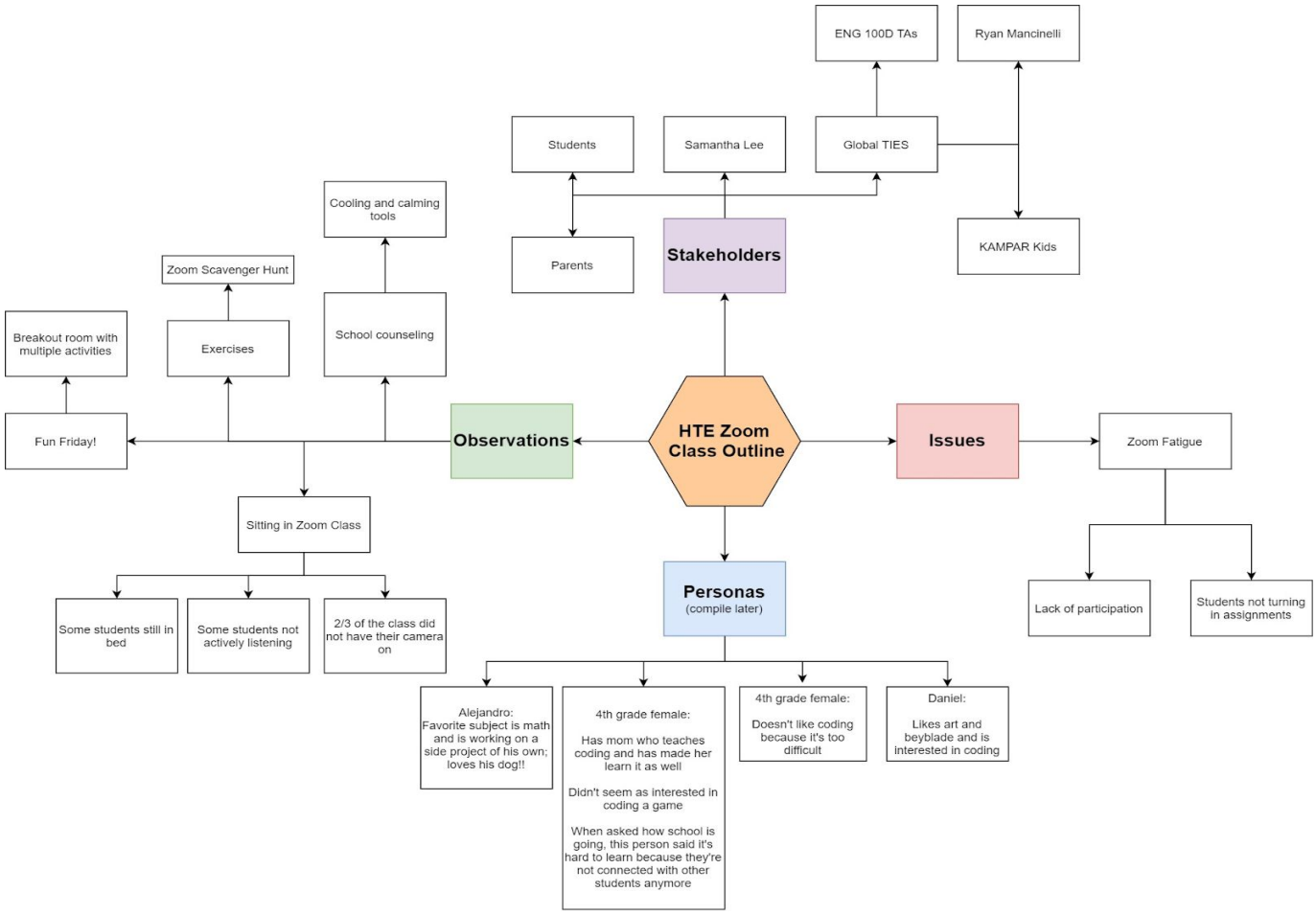


Figure 1.2 shows a mind map of the observations we made during our Zoom class sit-in

1.3 Schedule

To effectively keep track of our progress, we created a Gantt chart, as seen in ***Figure 1.3*** in the Appendix, to get a visual timeline of our deadlines and project phases. We divided the work into tasks and assigned task owners to each team member in efforts to create a more efficient work flow. As designers, our human-centered design approach requires organization and project management in order for our project to be executed properly within the deliverable deadline. This is also emphasized in our team meetings and referred back to multiple times throughout the course of this project in order to manage our workload.

1.4 Team Bios

Alex Tanzer - Team Leader
atanzer@ucsd.edu
Third Year
Major: Electrical Engineering
As the team leader Alex delegated tasks to team members as well as led team and Samantha check-in meetings. Alex directly oversaw the testing and packaging of the Wiggle Bot kits and safe hand off to Samantha Lee due to SARS-CoV-2. He has past experience running a small business specializing in household repair and remodeling and returned to UCSD to broaden his professional scope as an electrical engineer.

Michelle Tran - Facilitator mtt033@ucsd.edu
Fourth Year
Major: Cognitive Psychology, Minor:Design
As the team facilitator, Michelle initiates discussion about the project's objective and provides suggestions/feedback during group meetings. She is also responsible for ensuring that the team is moving in the right direction and encourages team members to speak up on any ideas that would be a good addition to the project.

Rachael Hall - Secretary
rahall@ucsd.edu
Fourth Year
Major: General Biology, Minor: Design
As the team secretary, Rachael is in charge of note taking and attendance at all meetings, organizing all documents, and maintaining project records. She has worked on illustrations for this project.

Phing Taing - Prioritizer
cptaing@ucsd.edu
Fourth Year
Major: Computer Engineering
As the team's prioritizer, Phing determines the priority of each task and assigns due dates for the project's milestones. She is responsible for keeping the team on track for due dates and establishing a team schedule so that everyone will be progressing at the same rate.

Ky Dang - Designer akdang@ucsd.edu
Third Year
Major: Computer Science
As a designer and researcher, Ky is responsible for helping design project materials, preparing presentations, and researching on the topic at hand.

Ahmad Milad - Partner Liaison amilad@ucsd.edu
Third Year
Major: Computer Science
As the team's partner liaison, Ahmad is responsible for handling communications between KAMPAR Kids and HTe, coordinating their activities, and resolving conflicts.

1.5 Stakeholder Analysis

Our stakeholder analysis, shown in ***Figure 1.4***, is determined by power on the y-axis and interest on the x-axis. These two factors were chosen in consideration to where we would place the stakeholder on our matrix based on their influence on our project.

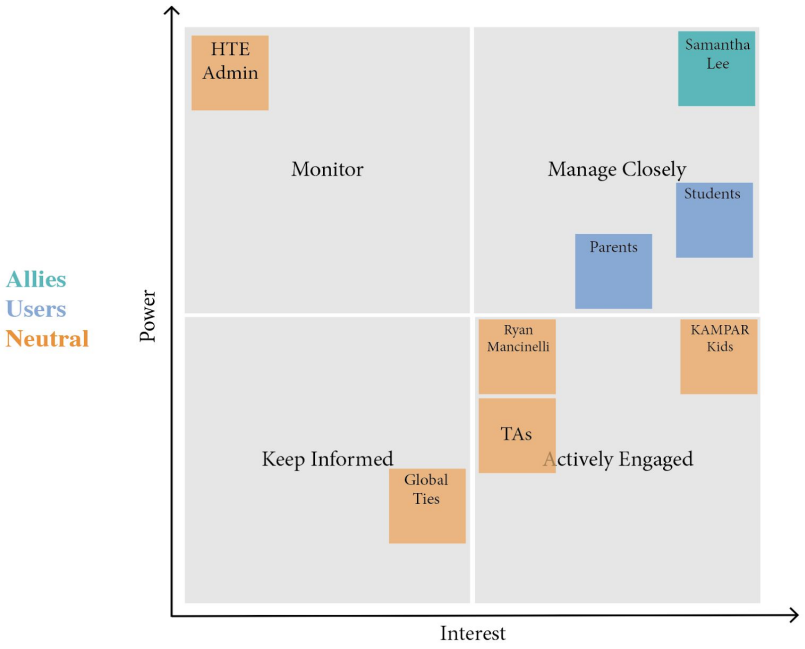


Figure 1.4 *Stakeholder Matrix*

Samantha Lee (Ally): Samantha Lee is a fourth grade teacher at High Tech Elementary Chula Vista. As our go-to contact and client for this project she is placed at the top right of the stakeholder matrix. Overall project direction and all concepts were run through Samantha for her approval.

Fourth Grade Students (User): Samantha's fourth grade students are our target users. The project is designed for them and since they had direct power over which concept they chose through voting, they are placed moderately high on the power matrix but below Samantha. Their interest is maxed on the map.

Parents (Neutral): Parents are undoubtedly concerned with their child's education. They will hold a similar place on the map as students but with less power as they didn't vote on the presented projects. Due to the nature of the pandemic, they will be in close proximity to their child during class time and may or may not assist with the Wigge Bot Project.

Ryan Mancinelli, TAs, and Global Ties (Neutral): Global Ties, including our instructor Ryan and his teaching assistants will hold a neutral position on our map. They serve as a counseling resource if we run into issues during the project and our instructors of the human-centered design process. They will ultimately be grading our progress and final project based on completion and content. Ryan and the TAs will hold similar interest but Ryan has higher power as he is the ENG 100D instructor.

KAMPAR Kids: We, KAMPAR Kids, are actively engaged in designing a solution for Samantha and her students. We have similar power compared to our instructor and TAs in the context of the project as we are the main designers of our solution. Since we are supporting Samantha and her students, we have placed ourselves slightly below them in power because we are designing for them, but also within the same plainfield because we want to contribute our ideas to create a sustainable solution that works best for our client.

HTe Administration (Neutral): Samantha answers to the HTe Chula Vista administration and must design her curriculum within the administration's parameters. We considered pivoting the project in the direction of redesigning the classroom's remote schedule in an effort to maximize student learning and participation, but was informed by Samantha that this would not be possible. We decided to stay on course with the Wiggle Bot project. Within the scope of the project they have high power but low specific interest.

Project Definition

2.1 Problem Statement

Samantha Lee's 4th grade students at High Tech Elementary need an interactive and engaging remote hands-on project that will mimic their in-person learning experience to improve and practice their innovative and technical skills that they can apply to future projects.

2.2 Background & Context

COVID-19 has caused people to deviate from their daily routine and for students, it has affected their academic and social development. Due to these sudden changes, students are not given enough time to adapt to their new learning environment. Online learning resources are assumed to enhance and expand learning; however, students are still missing out on physical and social interaction with the teacher and their peers. Even though projects can act as a relief to constant screen time, the problem will still exist in the future as remote learning is the "new normal." We also had to consider each student's different home environments or learning styles, all of which could affect how they perform academically. Parental support can also be different with the students, as some parents may be available to help their child through online learning, while others may have other obligations.

Based on our interviews, observations, and survey responses from the students, the common problem that we had finalized with our partner organization is remote learning. The students are seen unmotivated to learn which has resulted in a decrease in class participation and assignment submissions compared to the beginning of the semester. While remote learning is a new concept for students who are used to in-person learning, learning online seems to yield lower grades and student participation. As remote learning continues to persist, so will the issues that come along with it.

High Tech Elementary gives Samantha a classroom budget of $500 and Samantha Lee has decided to allocate $200 of that $500 in order to help fund our project solution. A request for a higher budget is possible, but this would require fundraising which is something KAMPAR Kids and Samantha collectively decided not to do.

2.3 User Profiles

	**4th Grade Female Student** **Biography:** Enjoys drawing and playing video games. She wants to try new and exciting activities during school hours. **Difficulties:** She struggles with remote learning because it is difficult to connect with other students over Zoom. **Need:** Something new and exciting, different from the video lessons

	**4th Grade Male Student** **Biography:** Enjoys playing video games, space, and beyblades. **Difficulties:** Does not like video lessons and misses in-person school **Need:** Something new and exciting, different from the video lessons
	**Samantha Lee** **Biography:** 2nd year teaching at High Tech Elementary among two other 4th grade teachers **Goal:** construct an engaging environment for her students to participate in hands-on activities **Difficulty:** faces zoom fatigue, students lack of participation, and assignment submission **Need:** an innovative hands-on project for students to have the same experience at home

2.4 Design Requirements

Criterion	Requirements
Type of project	The project should be interactive and hands-on so it would reduce Zoom fatigue and encourage more participation.
Time frame	Due to a restricted time frame of 4 weeks, the project should be simple yet have depth to it in order for students to grasp the main takeaway from what they are doing. We would also be creating a detailed gantt chart for the students to follow along.
Project budget	The project must be within our budget due to the limited school budget $200 to spend on materials.
Group activities	It must encourage collaboration and to think collectively in a remote learning environment.
Feasibility and technical difficulty	The team must design a project that is easy to follow along through remote instruction. We must also adapt to the different learning environment and consider how students will retain information best.
Project preference	Ideally students will be excited about working on the project designed by the team and of their preferred interest based on majority votes.

Concepts

3.1 Analogous Solutions Analysis

Educational organizations and school systems have taken other approaches to make remote learning engaging. Some of these approaches include virtual tours of museums and other sites of interest. The pros with virtual tours are that they can be engaging but part of the fun of a field trip is actually going to someplace new and having all the senses engaged. Just seeing a place via virtual tour seems hollow.

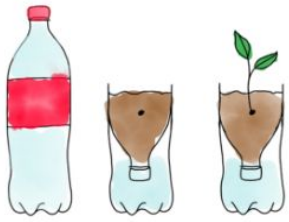
Organization	Problem/Solution	Pros/Cons
Cottage Health	**Problem:** Need resources and support from online educational system due to quarantine **Solution:** Cottage Health combined the free online educational resources that they could find into a PDF file and distributed them to families who need it.	**Pros:** The resources are free to use and students can use it at their own pace. The activities are interactive and students get instant feedback for their work. **Cons:** The resources are all online and can sometimes be hard without a secure connection to the internet. Much of the learning is not hands-on and eventually causes computer vision syndrome.
Ocean Beach Elementary	**Problem:** Due to the coronavirus outbreak, all classes have been moved online. It is hard to hold students accountable for being late to class or not showing up because of technology issues. **Solution:** Made a webpage on the school website to instruct and inform students and parents how to use technologies such as Chromebook, internet, and troubleshooting.	**Pros:** Students can still participate in study sessions on time. Students don't have to worry about being on time when they're setting up their remote learning environment. Parents will be able to find all the necessary information in a single resource. **Cons:** Problems can be subjective and still require additional help that can't be solved from the resource. Some students don't have internet access.
Funbrain	**Problem:** Some students find learning very tiresome and boring. They often lose focus or have a short attention span where they cannot sit still and	**Pros:** These websites have an easy and interactive interface. They include education games full of content that students can learn from.

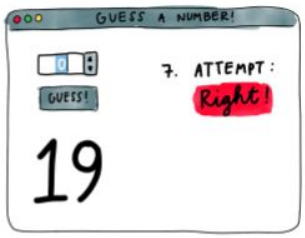
FUNBRAIN	listen to the teachers lecture for hours. **Solution:** Create a colorful and interactive platform where students can learn and is not boring to them.	**Cons:** Looking at the screen for too long eventually causes computer vision syndrome. Students can become addicted to games and instead begin to learn nothing from other resources. Also requires the internet and a computer.

The main gap in the landscape of the current solutions is that students are placed in a position where they will spend more time on online learning and will have less time to interact with other students or to work on a hands-on project. The best opportunity for the current solutions to increase their positive impact is to include assignments or activities that encourage students to work in pairs or think collectively.

The gaps within the existing solutions would be that some solutions are interactive while others are not. However, all the solutions deal with online materials such as accessing something through the web or interacting with something on the web. The unaddressed obstacles are how it could be tiresome for students to be behind a computer all day and the health risks involved which include damage to vision, lack of exercise, and fatigue. While these projects provide relief from the typical schedule of lecture videos and Zoom meetings, it does not provide a long-term solution. Additionally, all the above solutions assume that students have an environment suitable.

3.2 Concept Generation

	**LED Lamp** A simple circuit that drives an LED with a battery and resistor to create a lamp.The LED circuit is an easy technical project for fourth graders to follow along with and possibly customize in the future. For students interested in circuit design turning on an LED can be a fun and rewarding experience. The project is very easy to do and can be completed in minutes. And as such, the weakness of this project would be that it would not effectively engage the students in a fun and interactive learning environment. The cost of materials might not justify the time spent building the circuit. To bolster the project a teaching lesson on the components involved, how they work, what other circuits could be built, and the basics of Ohm's Law might be a good idea.
	**Hydroponics** The cultivation of plants using a self-watering hydroponics system. The design itself is simple yet effective, self-sustaining, and is able to be done with household materials. This project would fulfill the needs of the students by allowing them to design and customize their very own garden which would help alleviate some of the fatigue they may accumulate from remote learning. The strengths of this project would be that many of the kids could customize the project to their liking and expand further on it. The weaknesses of this project is that it is not within our time constraints. Ideally we would like to prototype and make possible

	improvements in each iteration, but due the nature of, well nature, growing a plant could take up more time than we would like.
	**Coding a game** This project would have given the students a chance to use basic coding techniques to write code for a simple guessing game using Python, C, Java or C++. We designed this project to give Samantha's students an opportunity to see the bright side of programming. It was also designed to encourage collective thinking and would give students a chance to collaborate and improve their code. In other words, this project was designed to promote student socialization. The drawback of this project was the fact that the coding part was very challenging for Samantha's 4th grade students as many of them do not have prior exposure to what coding even is. Alongside that, this wouldn't align with our objective to reduce the fatigue caused by remote learning because they would have even more on screen time.
	**Wiggle Bot** A robot that would draw random and interesting designs with its legs as it wiggles around. The wiggleness part comes from the spinning motor and a weight attached to it. Since the weight of the object is not enough to make it fall over, it will continuously draw until it is turned off. This project was designed to allow the students to engage them in an innovative learning environment where they can put their skills and knowledge they've attained to the use. The only required materials they need to utilize are the battery, motor, and some sort of weight by either a clothespin or gear. Everything else is up to them to decide. The strengths of this project is that this would highly encourage collaboration between the students in the process of sharing their design and their end artwork. The weakness of this project is that the materials could be possibly more expensive in comparison to other projects especially when sustainability is taken into consideration. Alongside that, there are also logistical problems of distributing and maybe returning the materials back to the school.

3.3 Concept Evaluation and Selection

Before developing a final concept, we had a set of criteria and requirements, shown in ***Table 3.1***, as a basic foundation to what our design should include. As our team was able to observe the 4th grade class and collect more data through interacting with the students and receiving survey responses, we were able to finalize our main problem statement to be the lack of interaction and participation when learning through Zoom. Comparing our initial assumptions to our current findings, we can see that our design requirements align with our final concept, which is to create a project that encourages students to collaborate with one another and work on something fun that is outside of their daily class routine. Based on our current thinking, we think that our design requirements translate over to what our concept goal is and fully revolves around mitigating the problem that Samantha and her students consistently encounter through remote learning.

Table 3.1 Design Criteria and Requirement

Criterion	**Requirements**
Type of project	The project should be interactive and hands-on so it would reduce Zoom fatigue and encourage more participation.
Time frame	Due to a restricted time frame of 4 weeks, the project should be simple yet have depth to it in order for students to grasp the main takeaway from what they are doing. We would also be creating a detailed gantt chart for the students to follow along.
Project budget	The project must be within our budget due to the limited school budget of $200 to spend on materials.
Group activities	It must encourage collaboration and to think collectively in a remote learning environment.
Feasibility and technical difficulty	The team must design a project that is easy to follow along through remote instruction. We must also adapt to the different learning environment and consider how students will retain information best.
Project preference	Ideally students will be excited about working on the project designed by the team and of their preferred interest based on majority votes.

Table 3.2 Decision Matrix

Criteria	**Weight**	**Coding Game (Baseline)**	**Hydroponics**	**LED circuit**	**Wiggle Bot**
Time Frame	2	0	-2	-2	+2
Budget	2	0	+2	-2	-2
Collaboration	3	0	-3	+2	+3
Feasibility	1	0	+1	-1	0
Technicality	1	0	-1	-1	0
Preference	3	0	-3	+3	+3
	Weighted Total	0	-6	-1	6

Analysis & Testing

4.1 Overview

The project preferred by our group, Samantha, and had a majority vote in Samantha's classroom poll was the Wiggle Bot. The concepts were evaluated based on being able to be completed in one or two weeks given our own time constraints (10 weeks in the quarter), staying inside a budget given to us by Samantha, something that could inspire and encourage collaboration amongst Samantha's students, and actual ability to implement the project, if the project was technical and desirable enough.

Table 4.1 Design Criteria Analysis and Testing Overview

Criteria	**Definition**	**Measurement Metrics**
Time Frame	A lesson plan that can be completed over a week, in half hour blocks during class time. The first iteration of the project to be completed by HTe students during the Fall 2020 UCSD quarter.	Testing the time a user thinks it would take them to build the robot from a given demo video and manual.
Budget	The cost of supplying 24 students with materials to build a Wiggle Bot.	Staying inside the budget constraints of $200.
Collaboration	After building their own bot, encourage students to engage in discussion about customizing their own robots, troubleshooting issues, working on the supplied lesson plan worksheets.	To be seen and tested later after seeing how the project progresses in Samantha's class.
Feasibility	The ability to implement the project remotely and also be done for future classes if Samantha wants to .	Testing if a user could build the bot from a given instructional manual.
Technicality	STEAM educational values covered during the duration of the project.	Implementing the design process, introduction to the scientific method, introduction to some electrical components, and ending with an art project.
Desirability	The overall stakeholder interest in the project.	Samantha's preferred project from the concepts presented to her. Students preferred the project after voting on the given concepts presented to them.

4.2 Desirability & Usability

Our project aims to deliver a fun and exciting hands-on experience that teaches children about science and engineering, and allows them to explore their creativity, especially during a pandemic when learning is mainly virtual. For this project, we are targeting Samantha Lee's 4th graders at High Tech Elementary (HTe). As we performed our user testing, we realized that many people and Samantha found our solution desirable and useful in many ways. Samantha found the project exciting and appropriate because she wanted her students to gain more knowledge by performing a hands-on project during this pandemic as a break from learning virtually. Furthermore, other user testers found that our Wiggle Bot project is easy to follow and can be replicated for future use, which made it more desirable. Our project addresses the design challenge, because it fulfills Samantha's needs for producing a hands-on project where her students can enjoy creating and learning from while taking a break from virtual school. Our solution is simple and replicable, because we made the direction easy to follow for the recreation of this project for future uses. The replication of this project can also teach other students about the basic fundamentals of science and engineering and allow them to explore their creativity and inspiration.

Figure 4.1 Proof of Concept, Wiggle Bot

The first iteration of the Wiggle Bot, as seen in ***Figure 4.1***, was a proof of concept to see if the project was feasible. It was crudely taped together with blue painter's tape. Painter's tape makes for a great prototyping adhesive as it comes in a number of different widths, very sticky, easy to remove, easy to tear, and doesn't leave residue. Future iterations would utilize scotch tape. The proof of concept also sported two batteries in series to test the speed of the motor. From this first prototype we learned that only one battery was necessary, the increased voltage flings off the clothespin. We learned that the motors we were going to distribute have a portion of the spinning rod sticking out of the bottom of the motor housing. This made it difficult to just stick the motor to the top of the cup, the motor bottom has to float (the motor can't touch anything or the friction will slow the rod).

Figure 4.2 Second Iteration, Wiggle Bot

The second iteration, as seen in ***Figure 4.2***, takes into account the motor issue where it was stuck to the side of the cup instead, rather than the top. Battery cases had not been purchased yet, to improvise, wire leads were soldered to poles of the battery for testing purposes. Scotch tape was used this time to make sure it would work as the standard adhesive for the project (in the instructional manual, to increase overall inclusivity, it is mentioned that any tape on hand is fine).

We have also created a prototype user manual, shown in ***Figure 4.3***, for the students that is written in simple and clear language. We used the second iteration of the Wiggle Bot to create the initial steps and pictures for this manual. The manual will be used to test our users and get a feel for the difficulty and fun factor of the project.

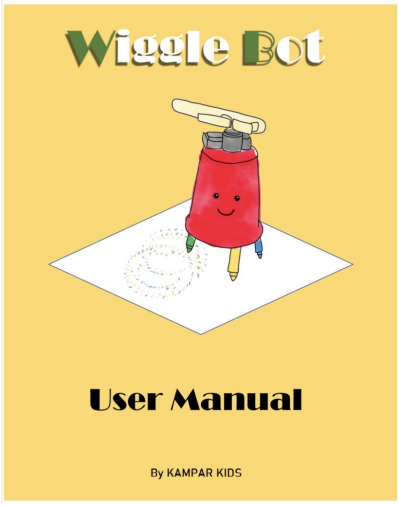


Figure 4.3 Instruction Manual Cover

Overall, we have three prototypes that we displayed to our user including the 4th grader student manual, the demo video, and an instructional reference video. During our user testing phase, observations will be made alongside with an interview at the end. Users will be asked to rate how difficult the manual is to understand based on a Likert scale ranging from 1-10, with 1 being easy to understand and 10 being too difficult to understand on ***Figure 4.4*** found in the Appendix.

Results:

From our user testing, as seen in ***Table 4.5*** in the Appendix, the results show that in terms of difficulty of our manual based on a Likert scale ranging from 1-10, the average is 5.0833. Alongside that, many of the comments and observations we saw were very similar to saying that there were not enough pictures and the descriptions were too hard to understand.

Discussion:

Our findings conclude that there can be changes made to the Wiggle Bot prototype to improve clarity, but overall, we have a solid solution to our problem statement. Our solution fulfills a meaningful need, albeit a temporary solution. It will give the students a change of pace from their usual Zoom meetings and asynchronous video lessons with a hands-on project. Aside from a few hazards listed with the materials used for the Wiggle Bot, it should be relatively safe, easy to access and intuitive to use.

The limitations of our solution is that is which we cannot resolve completely, but rather resolve some of the symptoms for. Alongside that, we do not have the necessary tools or permission from Samantha to provide another solution because much of the ways teachers teach and students learn are being resolved by High Tech Elementary Chula Vista themselves.

4.3 Feasibility & Suitability

The resources required to create and then deliver the solution are well within the projected budget as well as in the time frame of Ms. Lee's class. We have the people, tools, technology, and resources available to make this project successful. However, there are the risks that we have to consider such as ensuring that all the equipment provided works when they need to, the logistics of distribution, and making sure that every student within Ms. Lee's class gets the materials.

The team will create user and teaching manuals so that when the project is replicated in future classes or by other teachers, consultation with group members will not be needed. In the teacher's manual, instructions, materials, and lesson planning will be provided to ensure teachers

can easily follow through with the project without any troubles. In the user manual, students in this case will easily follow the steps provided to create the Wiggle Bot and if they were to have any questions, they can consult the teacher which they can provide the answer from the teacher's manual. The cost of doing this part will be close to none other than the willpower and time from the team, however, once implemented, these parts will not have a cost.

To deliver the solution, this would require students to have the required materials as listed on the teacher's manual. The materials come out to around $160 which is well within the budget of $200 we were given. Since much of learning is now remote because of COVID-19, distribution of the materials will be done by Ms. Lee herself at High Tech Elementary, but before that one of our team members will have the role in packaging and sanitizing it before going to Ms. Lee. When everyone has the materials, delivering the solution will be a matter of Ms. Lee executing the lesson and having each student follow the instructions from the user manual. We expect the time for the child to assemble the Wiggle Bot and complete the necessary papers to vary from child to child. As such, we expect giving them 1 week to do so will be enough so that many of the students can customize it and show it off in the end.

The project is suitable for our design challenges of High Tech Elementary where their mission is to teach every student about principles of equity, personalization, authentic work, and collaboration as well as in the scope of our problem statement. Since we have concluded the problem statement is that which we cannot solve the root cause for, we have opted for a solution that will hopefully alleviate some of the symptoms that the root is causing. The root cause as discussed is that of remote learning and because we are not equipped with the necessary tools or permission from Ms. Lee, we cannot work on solving the problem of remote learning from her end. Much of the way the teacher and the learning environment provided by High Tech Elementary is up to them to decide and we do not have the power to change that.

4.4 Sustainability

The ecological sustainability of our project is guaranteed with the usage of material that is easily recyclable. The DC motor for this project includes the following parts: the shaft built out of steel, the copper windings built out of copper, the armature of the motor built with permanent magnets, and the motor casing. All of the following parts can be recycled as described in the recycling process. Next, the AA batteries are built out of hazardous material but it is also a valuable source of recyclable metal and can be recycled up to 90%, for more information refer to CalRecycle. Similarly, the battery holder, the cups, the tape, and the markers are built out of recyclable materials such as plastic and PVC. Although these materials are not eco friendly, however, if recycled appropriately the ecological footprint will be reduced significantly.

On the other hand, the economic sustainability of our project is guaranteed by coordinating the project costs with Samantha, and considering the average budget of a classroom at HTe. Furthermore, to have a backup plan for a future shortage of project budget, we have decided to categorize the project materials into two parts: Required and optional. The required materials are the parts that are necessary for building our project. The optional materials are the parts that will make the project even more attractive for students. The cost of required materials is well below the initial budget that was offered to us by Samantha (Samantha's budget: $200; our final project cost: $151.57) which is a great success for our team. Thus, giving our stakeholder a flexible project cost guarantees the sustainability of our project in the long run.

Finally, we guaranteed the socio-cultural sustainability of our project by considering the age, culture, and social background of our stakeholders. In our first meeting with Samantha we

have collected information about her students to understand their social and economic background. Based on the collected information, we initially designed multiple project solutions that were age appropriate for 4th grade students. To find the most attractive project for the students, we have listed all the project solutions in a survey to collect their feedback:

Alongside the plain text instructions, we have included detailed, step by step, images in our project assembly manual in consideration of students who might have difficulty in reading the manual. By doing this we made sure that our project is culturally appropriate. Finally, to make our project replicable, we have designed two manuals: one for students and one for teachers, and a detailed project materials and cost worksheet. The combination of these documents creates a detailed road map for the future users. It will enable them to replicate our project without a need for our presence.

Design

5.1 Overview

The Wiggle Bot is an activity that diverts students from their typical remote learning environment to something that involves creativity and learning new concepts. Due to COVID-19, learning is mostly asynchronous while instructions are synchronous over Zoom. Not only does the Wiggle Bot allow the students to take a break, it also teaches the basics of engineering and design by encouraging them to customize and utilize their knowledge at a 4th grade level. Since High Tech Elementary School also prioritizes the idea of project-based learning, we designed a project that aligns with their vision to create a hands-on learning experience for the students.

Within our design implementation, the class is presented with a student manual and Samantha Lee with a teacher manual. The student manual provides step-by-step directions with images that will guide the students in putting together the Wiggle Bot. Once they have completed the project, students are prompted to do the challenge activities at the end. The challenge activities encourage the students to customize their robots in the way they look and behave. The teacher manual is divided into different sections in preparation for the project. This manual consists of the objectives and concepts for the project, required materials, packaging, a test guideline, and a link to an instructional video on how to set up the Wiggle Bot. We have done this for the teacher manual as our long-term plan so that Samantha and other teachers can utilize the manual and replicate the same project.

5.2 Detailed Design

The Wiggle Bot is a simple oscillating device powered by a DC (direct current) motor. Markers are taped to the inside of a cup to act as legs. A battery case housing one AA battery is taped to the top of the cup. A motor is taped to the end of the battery case. The wires are connected via prototyping jumper wires that easily connect together. A clothespin is pinned to the rod of the motor and when activated, the cup will spin. The major overarching consideration was to keep the project feasible for a 4th grader. Secondary design considerations include keeping the material list short, using an easy-to-use adhesive-like scotch tape, and including a comprehensive instructional manual with clear images to visually aid students and the teacher during each step.

The final iteration of our design, shown in ***Figure 5.1***, is very similar to the third prototype, but includes a customization design to inspire the students to do something creative with their robots. The first prototype of the manual was a way to get a feel for how each step should flow and what pictures would be necessary. The pictures in the first prototype included the second iteration of the robot and acted as placeholders for the final version. Tips on how to recycle the materials used in the project were also added to the final version of the student instructional manual. ***Figure 5.2*** shows an example of customization to inspire the students.

Wiggle Bot Lesson Plan Final Design

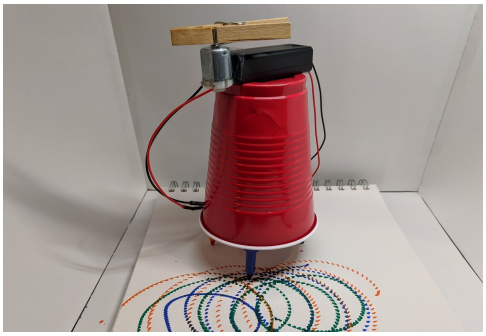


Figure 5.1 shows the third iteration of our prototype

Figure 5.2 shows our final design

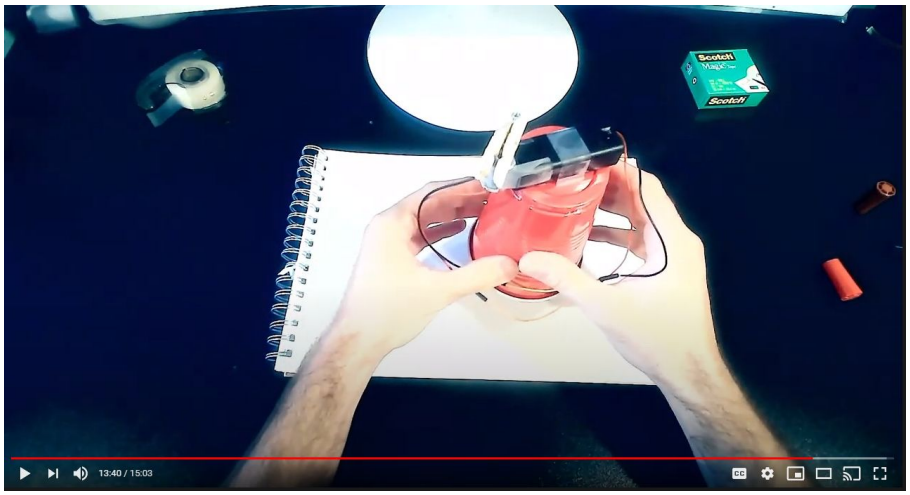


Figure 5.3 Screenshot from the teacher reference video

In the appendix is the final version of the student manual, teacher manual, and the teacher reference video, sample screenshot seen in ***Figure 5.3***, Samantha can use to familiarize herself with building a Wiggle Bot so that she can help her students if necessary.

Table 5.1 Wiggle Bot Cost Table

Required Materials	**Price**
DC Motor (low voltage/rpm)	6 for $9.78 24 motors = $39.12
AA Battery	24 pack (1 battery per student) $14.57
AA Battery Holder with switch	Single AA case with switch pack of 5 costs $8.48. 5 packs = $42.40
Cups Any disposable plastic cup (i.e. solo cups)	30 pack for $1.97 need 1 pack = $1.97
Tape Alternatives: Painters tape, scotch tape, duct tape	12 pack $15.35 24 tape dispensers =$30.70
Markers	12 pack $4.98 24 markers = $9.96
Clothespins	$5.87 for 36 pins
Jumper Wires Female to Female	$6.98 120 pieces, Each student needs two 40 in a pack Need 48 (2 packs)
<u>Total:</u> $151.57	

Implementation and Impact

6.1 Implementation

Our implementation plan involves close contact with Samantha while communicating with her about the mutual expectations of the project guidelines and how it will be executed to the students. This plan has been confirmed by Samantha and thoroughly explained on how the project will enhance the students' learning experience. After confirming our plan with Samantha, our team received, tested and packaged materials, then delivered them to Samantha. Our main contact throughout implementation is Samantha because our project will be worked into her existing class schedule. The project itself is estimated to take at least an hour, but times may vary depending on the customization of the Wiggle Bot and the use of the instructional video. If Samantha wants to have her students explore testing and modifying their own designs, the project could take multiple hours. So far, Samantha has received the materials and is working with her fourth grade team and parents to get as many robot kits delivered as possible.

A perfect scenario, successful implementation would be getting every student a robot kit, observing what they built, getting feedback on the project, then tweaking the teacher and student manuals so that impact in the following years could be maximized. If we aren't able to see the students build their robots we want to at least prepare Samantha to support them when they are able to finish the project.

Strategy for Engaging Stakeholders

Engaging our stakeholders is a multifaceted challenge. The most prominent stakeholders we aim to engage are the students, their parents, and Samantha Lee. Parents enrolled their children into High Tech Elementary Chula Vista because the High Tech organization offers a unique learning experience through a project based curriculum. Due to the pandemic and remote learning, a project based curriculum has been harder to achieve and by implementing a hands on project at home we can mitigate some of the frustration parents might be feeling towards their child's education. The Wiggle Bot is essentially an exploration into simple circuits and learning how a motor works. To make it more approachable and fun the robot spins and draws interesting patterns. The customization aspect allows for students to take ownership and incorporate their identity into the project. By designing and including the teacher's manual Samantha could proctor the project again and even give it to other teachers to use as well.

Table 6.1 Resource Assessment

Distribution	**Activity**	**Capabilities**	**Responsibilities**				**Still Needed**
			Design Team	Organization	Funder	External	
	Student outreach	Polling	X				Student Feedback
		Wellness survey		X			
		Project feedback	X	X			

		Student performance		X			
	Staff outreach	Teacher Guidance	X				Class Curriculum Teacher Background Knowledge
		Project feedback (teacher pov)		X			
	Inventory and Curriculum Management	Project Materials	X		X		
		Technological materials			X	X	
		Package delivery to teacher	X	X			
		Package delivery to students		X			
	Informational Material	Teacher Manual	X				
		Student Manual	X				
		Safety Measures	X	X			
		Recycling Instructions	X				

6.2 Failure Analysis

For our failure analysis, seen in ***Table 6.2***,we have shown the overall risk score based on the calculation of their severity, occurrence, and detection probability. For categories severity and occurrence, their ratings start from (1) no effect to (10) very high. For the category of detection, their ratings start from (1) almost certain to (10) absolute uncertainty. For the actions column, these actions would be the possible strategies in order to mitigate these failures. The one failure type that we have yet to mitigate fully is that students don't like the activity. This failure type is different from the rest because the observer has to see it in order to try and do the action.

Table 6.2 Failure Analysis

Failure Type	**Effect(s)**	**Severity (1-10)**	**Occurrence (1-10)**	**Detection (1-10)**	**Risk Score (S*O*D)**	**Action(s)**

Material distribution doesn't get to every student	Activity cannot be done by every student	8	3	1	24	Samantha Lee will hold a day for parents to pick up robot kits from school. If parents cannot pick up materials on that day, Samantha will mail it to those students.
Materials failure	Activity cannot be done by some of the students	7	2	2	28	Samantha could provide material replacement if any of the batteries or motors are bad. Extra materials could be worked into the budget to account for failures.
Student manual too hard to follow / Wiggle Bot too hard to build	Activity cannot be done by some of the students	6	3	3	54	Samantha is available to help students over Zoom if need be during class synchronous hours.
Students are even less motivated to learn	Students are less interactive than before	8	3	4	96	The user manual could be made easier to understand using student feedback
Students don't like the activity	Students aren't motivated to complete the build of a Wiggle Bot	8	5	3	120	Create more varieties of activities that can be done with the Wiggle Bot

Material and distribution failure have been mitigated to a relatively low level. One of our team members tested all of the components involved with the project to make sure that they were working properly. Samantha will hand off materials to students and if any families feel uncomfortable driving to school for a curbside pick up she can just send the materials in the mail. As far as the student manual being too difficult to follow for some students, this has been mitigated by preparing Samantha with a reference video so that she can help those specific students personally.

6.3 Monitoring & Evaluation Plan

Through our implementation of the Wiggle Bot into the classroom, we hope to see that the students within Samantha's fourth grade class are motivated to learn and discover how to

build robots. By introducing a step-by-step manual for students to follow, we also hope to see that students are able to build this Wiggle Bot and then attempt to challenge their abilities through various activities with the bot. For our outcome of the project, shown in ***Figure 6.1*** and ***Table 6.2***, our goal was to help alleviate symptoms of remote learning so that students can get a refresher and start being motivated to learn again. For the depth of impact, our goal is to show the bright side of engineering and design so that they can pursue education into these fields and ultimately think about a career that involves such. These instructional manuals were created in response to remote learning, but seeing how remote learning is not going to be permanent, both of these manuals can be adapted to be used in conjunction with in-person learning as well.

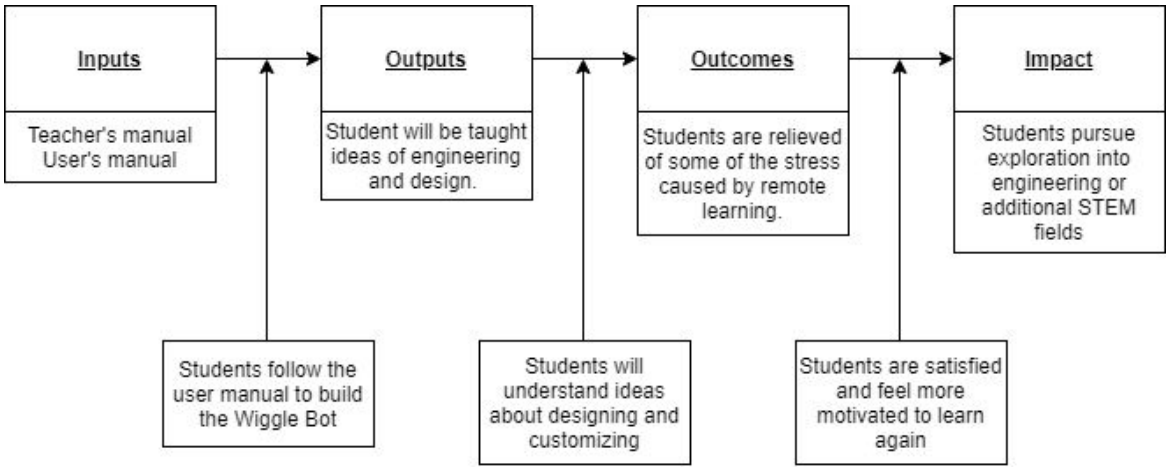


Figure 6.1 Theory of Change Diagram

Table 6.3 Evaluation Plan

	Objectives	**Indicators**	**Baseline**	**Target**	**Mode & Timeline of Verification**
Input	Teacher(s) and students complete manuals provided	Build completion of the Wiggle Bot	60% (Follows steps and finishes building)	80% (Baseline + doing some challenge activities)	Once through Google survey polling
Output	Students taught ideas within engineering and design	Challenge activities attempted + customization of the Wiggle Bot	25%	75%	Once through live synchronous class observations
Outcomes	Students are satisfied/relieved and are ready to go back to remote learning	Amount of students who share/show off their Wiggle Bot + amount of students with their cameras	25%	75%	Every school day available during live synchronous class observations

		back on			
Impacts	Students think about engineering and design related careers	Percent of students who do engineering/design related passion projects	0%	50%	Once a school year done by Samantha's observations

6.4 Ethical Analysis

The main goal for the Wiggle Bot Project is to benefit HTe students, especially Samantha's 4th graders. Not only will this project provide her students with hands-on experience to explore their creativity and their interest in science and engineering field related projects in the future, but it also alleviates the stress and zoom fatigue from online learning during this pandemic. Our project also includes two manuals, one for the students and one for the teacher. In doing so, her 4th graders will be able to learn how to do independent work. However, in the case that they need more assistance with the project, they can refer to Samantha for help where she can follow our manual and assist her students.

Our other benefactors are elementary schools teachers and students. We understand that it is a difficult time and online learning could be a new step to most people. It is important to alleviate stress and adapt to the new system. Therefore, we made the Wiggle Bot Project replicable and easy to understand even when our team won't be there to provide additional aid. Even when the pandemic is over, the Wiggle Bot Project can serve as a regular science or in class project. This enriching experience will create a fun and educational environment for many teachers and students.

The Wiggle Bot aims to introduce a different educational experience from online learning. With this new experience, comes challenges. Some of the challenges that teachers will face in an attempt to deliver this project to their students includes financial difficulties and interest preferences. Teachers might face financial difficulties due to the budget constraints they have from the school. We understand that not every school will be able to provide classroom funds for teachers to purchase the materials necessary for the Wiggle Bot. Our team mitigated this issue by assembling our material list to include everyday items like cups and tapes. However, there are still some items that would need to be purchased like the motors and the battery cases.

Another problem that our Wiggle Bot Project created is regarding the conflict of interest. Since our team brainstormed the Wiggle Bot Project by focusing on the issues that Samantha and her students are facing, it is tailored to solve their problems. Other teachers and students might not find it as an interesting or captivating project to do. Our team considered this issue and came up with a challenge part for the project where students are able to modify the project based on their liking and creativity in hopes to solve this problem.

Conclusion and Recommendations

KAMPAR Kid's main objective was to help Samantha Lee's classroom return to HTe's mission of project based learning in hopes to alleviate negative symptoms of remote learning. The stakeholders we identified were Samantha Lee, her students, student parents, Ryan Mancinelli (course instructor), his TAs, the Global Ties NGO, the HTe Chula Vista administration, and ourselves KAMPAR Kids. The main stakeholders we engaged were Samantha and her students as our solution is specifically geared towards them. After interviewing Samantha and sitting in on some classroom sessions the problem statement we formulated was: Samantha Lee's 4th grade students at High Tech Elementary need an interactive and engaging remote hands-on project that will mimic their in person learning experience to improve and practice their innovative and technical skills that they can apply to future projects. The solution we decided to implement, after surveying the classroom with some options including a simple hydroponics build, coding a game, and building an LED lamp, was a project lesson plan revolving around building a Wiggle Bot. The lesson plan includes a teachers manual for future implementation, a comprehensive and easy to follow instruction manual, and materials for all of Samantha's students to build their own robot. The project is designed to pique student interest in engineering and design as well as to bolster skills such as following written instructions closely which will be critical for STEAM courses in the future. All the materials were sourced from Amazon and the materials were packaged and sanitized (due to SARS-CoV-2) by a team member. That team member then delivered the kits to Samantha so she could distribute them to her students. Unfortunately, starting in December 2020, COVID cases were increasing at an alarming rate in San Diego, so distribution was postponed until January 2021.

With the teacher's manual (appendix, ***Figure A.1:*** Teacher's Manual), student manual (appendix, ***Figure A.2:*** Student User's Manual), and reference video we created we hope that our solution can be implemented in the future by Samantha and possibly her fellow teachers at HTe. It can be utilized again in a remote format or back in class where Samantha could keep the materials and use them again year after year keeping the cost of the project down. We hope that this is an experience that leaves a lasting impression on her students with the possibility that some of them are inspired to pursue careers in STEAM related fields. Recommendations for the future would be to expand on the manuals to include more robot designs for the students to explore with materials they might possibly have at home, as well as the materials we provided them. More background information about circuits, batteries, DC motors given at the fourth grade level could be incorporated and an entire electronics lesson plan could be built around the Wiggle Bot.

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    d. 11/19/2020 - Wiggle bot logistics
2. Samantha Lee's classroom - October - November. Class sit-in observation and survey.
    a. 11/06/2020 - Introduction and observation
    b. 11/10/2020 - Survey and observation
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    a.
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Appendix

Interview Questions:
1. How was your experience with the last UCSD group you worked with, what did you develop together? What do you want to develop next? 2. What type of difficulties have you or that you know your students have faced as a result of this new learning situation? 3. Would it be okay to sit in during class time to observe classroom flow? Do we need parent consent? 4. What kind of projects are assigned to your students? 5. What is the most important goal of your organization? 6. What are you looking forward to most this school year? 7. What's it like teaching at high tech elementary? Especially now, remotely, during the pandemic? 8. Compared to previous years, have you noticed anything different? (motivation, academic scores) 9. What are the most significant challenges you're facing right now? 10. How is your organization funded? 11. What do you find most frustrating about teaching? 12. Are students adapting to learning remotely? 13. How is your class structured? 14. Are there certain activities or subjects that your students prefer? 15. What's your format for testing/quizzing students? 16. How has the school district helped teachers 17. What type of lesson plans have you designed for students to receive the same hands-on learning they would get in person? 18. How have you implemented the lessons considering each student might have a different learning style?

Figure 1.1 shows a list of interview questions for Samantha Lee

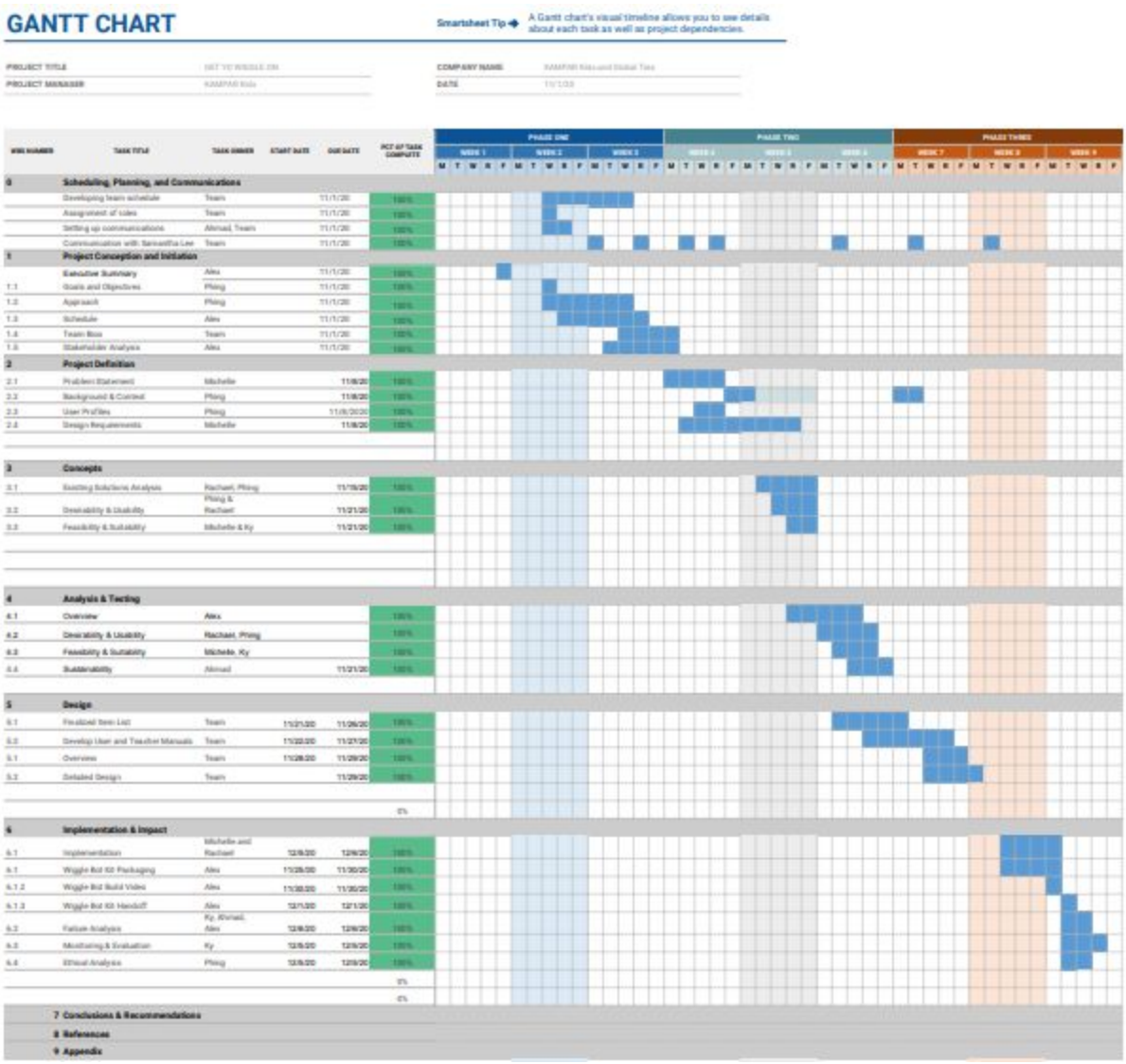

Figure 1.3 Gantt Chart

Questions to be asked afterwards:

- Rate 1-10, how difficult is it to understand. 1 being extremely easy and 10 being not understandable
    - At what points do you think were the most confusing?
        - Words - descriptions
        - Pictures - do the images give enough information
- Are there any suggestions to improve this?
- If you were a 4th grader, would you want to do this type of project?
- How long do you think it would take you to build this?

Figure 4.4 shows the user testing questions we asked after the user completed the interview

Table 4.5: User Testing Data Collection of Student Manual

Participant Information	**Rate**	**Estimated build time**	**Comment(s)**
Cuong Dang	4	~1 hour	Needs to be more clear about steps #7 and #8. Was confused about how the wires should be connected.
Bao Dang	7	~24 hours	Steps #6 - #9 makes no sense.
Amy Taing	4	~1 hour	Add more pictures and says to add to step #6 to turn off the switch
James Pun	3	~1 hour	Suggests more picture and better videos
Sally Hall	2	~30 min	Says the project seems boring and messy
Jolie Nguyen	5	~2 hours	More pictures are needed for clarity. Not something they would make but is interesting
Tracey Tanzer	6	~1 hour	More and better pictures
Paloma Fernandez	4	~1.5 hours	Better pictures and simpler descriptions to help understand
Vivian Tran	5	~1 hour	Pictures should be labeled
Felicia Liang	6	~1 hour	Thought it was cool and liked the wrapup questions at the end
Mariam Hakimi	8	~2 hours	Project seems easy and clear to follow.

Abigayle Gonzaga	7	~1 hour	Easy to understand however could be hard for 4th graders
Average Difficulty Rating	5.0833		

Wiggle Bot

Teacher's Manual

Table of Contents

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Introduction

The wiggle bot draws random and interesting designs with its marker-legs as it spins around. The wiggling comes from the spinning motor and with a clothespin attached to it. The robot will continuously draw until it is turned off. This project is designed to engage students in an innovative learning environment where they can put their skills and knowledge they've obtained to use. The only required materials they need to use are a battery, motor, and some sort of weight which could either be a clothespin or gear. Everything else is up to them to decide.

The purpose of this project is to encourage collaboration between students by sharing their design and their end artwork. It also teaches students about the basic fundamentals of science and engineering. This project is designed to spread the impact and importance of a hands-on experiment, especially during a time when everything, including school, is online. It allows students to remove themselves from the online world and engage in real life activities while still learning

Hazards and Safety Information

Choking Hazard - small parts may be swallowed.

If a battery is ingested: Don't induce vomiting, don't eat or drink anything. Go to the hospital immediately. Call the national battery ingestion hotline (800-498-8666) for additional treatment information.

Be careful when the clothespin is spinning, it might fall off while the motor is turning if it is not secured very well.

Information

Why does the Wiggle Bot spin?

The off centered rotating clothespin is producing a force (centrifugal inertial force) in the direction of its rotation, and since the cup is not attached to a fixed position, the rotation force generated by the clothespin forces the cup to spin.

What happens if we swap the wires that connect the battery to the motor?

Swapping the wires will change the direction of how the motor spins, which will change the rotating direction of the Wiggle Bot.

What will happen if we increase the number of batteries?

Increasing the number of batteries in a row, or also known as "in series," can increase the voltage of the DC motor. This will cause the motor to spin faster.

How can we make the wiggle bot spin faster?

We can increase the rotation speed of the Wiggle Bot by increasing the voltage to the motor. Like adding two batteries in a row so the voltage adds up, or using a 9 volt battery instead. Make sure your motor is rated for the voltage you are using.

How can we make the wiggle bot spin slower?

We could weigh down the robot with more stuff! You could try taping coins around the cup.

Material Content

Item	Image	Description
Motor		The motor will provide a way for the bot to wiggle. Depending on what is attached to the rotating part of the motor a clothespin or gear will affect how much it wiggles. This could teach them about design to show how much they want the bot to wiggle?
AA Battery		Batteries to power the motor
AA Battery Holder with Switch		Battery case so that the motor/ LED can be turned on or off

5

Plastic Cup		Cups will act as the body of the Wiggle Bot but anything can work. Cups are lightweight and cost effective.
Tape		Tape will provide a way to put things together. Other options are glue or hot glue but tape is much more adaptable to all sorts of surfaces, and kid-friendly.
Markers		Markers will be the legs of the robot. As the bot wiggles and slowly moves, designs from the markers will be made onto the paper below it.

6

Clothespin		The clothespins will act as a weight attached to the spinning part of the motor. This part is effectively what makes the bot wiggle. Other options are gears.
Female to Female Wires		Wires to connect the motor to the battery pack. Easy to use, just push together.
Paper		The piece of paper goes under the Wiggle Bot so the markers can draw shapes as they wiggle around.
Optional Materials		For design purposes. May include: Glitter Googly eyes Stickers Sharpies Construction Paper Pipe Cleaners Any other decorative materials

Material Content Checklist

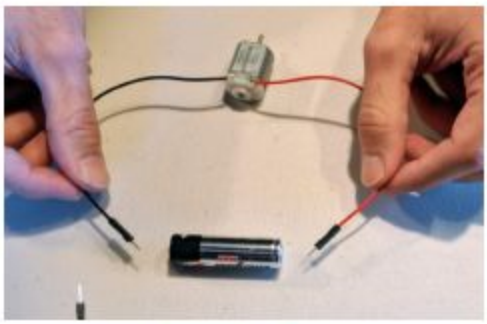
1 Battery case
1 AA 1.5 V Battery
1 Roll of Tape
1 Motor
2 Female-Female Wires
1 Clothespin
3 Markers
1 Cup
Paper

Suggested Materials

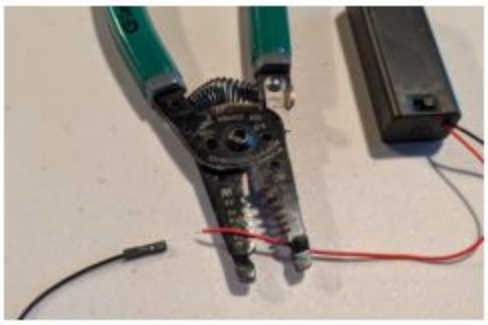
Arts and crafts (pipe cleaners, googly eyes, glitter, stickers, etc.)

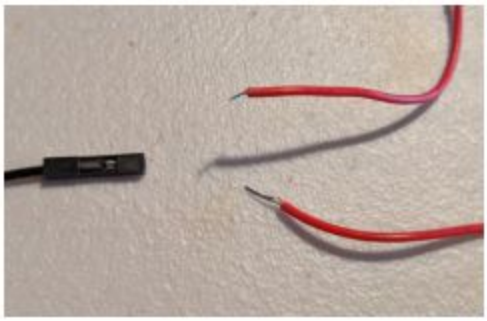
Material Preparation

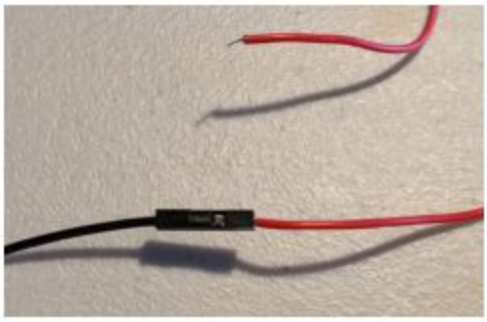
Testing the Motors
Make sure to test all motors to ensure they are working before distribution.
To test the motors, touch the pins from the motor to the ends of a battery. If the motor spins up (you can usually hear a faint whining noise), it's good to go!



Tip for Wires
The pins on the wires from the battery case sometimes come very short and will be hard to insert into the jumper wires. You may need to strip some insulation off of the wires. This can be easily done with a pair of wire strippers or scissors. If you're using scissors don't cut all the way through. Gently grip some insulation with the scissors then pull away revealing more wire).





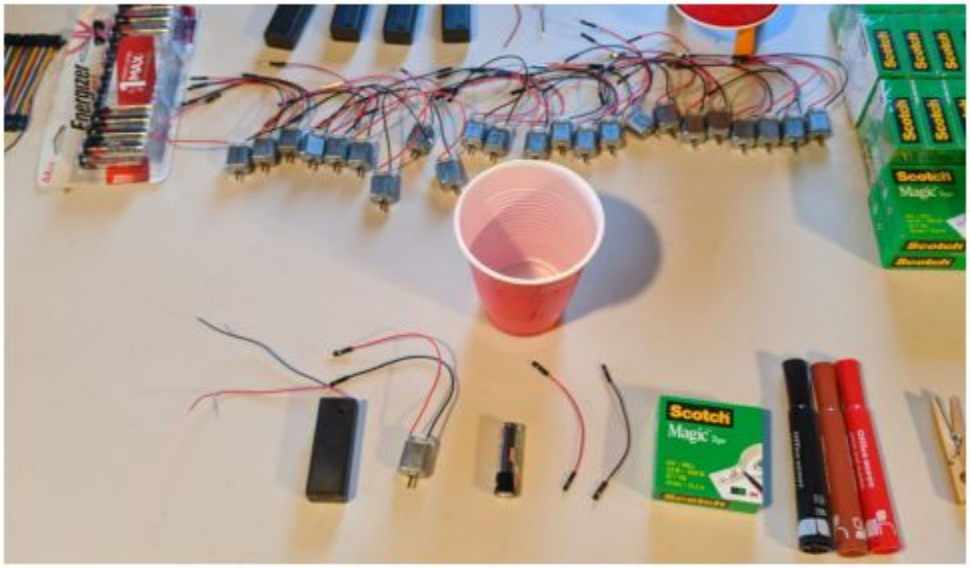


9

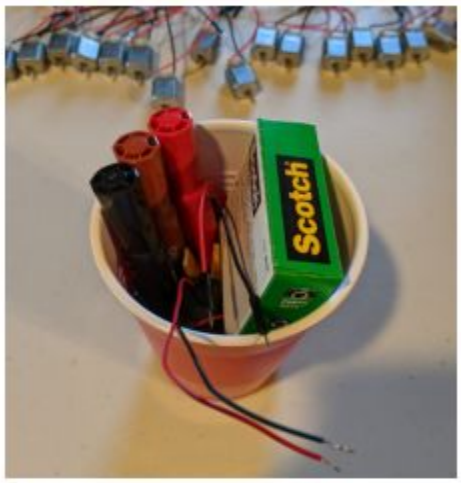
Packaging & Distribution

All the required materials (listed in Material Content Checklist) have to be included in the package unless students have access to them elsewhere. The optional materials list is provided as a suggestion to what teachers can provide students with to decorate and design their individual Wiggle Bot.

Lay out your materials. Each kit can be packaged into a cup for easy transportation and distribution. In each cup put a battery case, motor, battery, two jumper wires, tape, markers, and a clothespin



Finished packaged cup



10

Figure A.1: Teacher's Manual

Wiggle Bot

Student User Manual

KAMPAR Kids

global TIES

TEAMS IN ENGINEERING SERVICE

UNIVERSITY OF CALIFORNIA · SAN DIEGO · LET THERE BE LIGHT

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Introduction

The Wiggle Bot is a self-spinning robot that is powered by a 1.5V battery and a motor. The robot spins, because the off centered rotating clothespin is producing a force (centrifugal inertial force) in the direction of its rotation. Since the cup is not attached to a fixed position, the rotation force generated by the clothespin forces the cup to spin.

Hazards and Safety Information

Choking Hazard - small parts may be swallowed.
If a battery is ingested: Don't induce vomiting, don't eat or drink anything. Go to the hospital immediately. Call the national battery ingestion hotline (800-498-8666) for additional treatment information.
Be careful when the clothespin is spinning, it might fall off while the motor is turning if it is not secured very well.

Hey Students!

Have you ever wanted to build your very own robot? Do you like art and drawing? Why not make a robot that can draw for you! Let's build a Wigglebot! Using stuff that you see everyday, like a plastic cup, markers and tape, combined with a battery and motor we can build a robot that draws fun patterns! Try and customize your design at the end.

Sincerely,
KAMPAR Kids

Dear Parents,

The wigglebot draws random and interesting designs with its marker-legs as it spins around. The wiggling comes from the spinning motor and with a clothespin attached to it. The robot will continuously draw until it is turned off. This project is designed to engage students in an innovative learning environment where they can put their skills and knowledge they've obtained to use. The only required materials they need to use are a battery, motor, and some sort of weight which could either be a clothespin or gear. Everything else is up to them to decide. The purpose of this project is to encourage collaboration between students by sharing their design and their end artwork. It also teaches students about the basic fundamentals of science and engineering. This project is designed to spread the impact and importance of a hands-on experiment, especially during a time when everything, including school, is online. It allows students to remove themselves from the online world and engage in real life activities while still learning.

Sincerely,
KAMPAR Kids

Material Content Checklist

Battery case
AA 1.5 V Battery
Double sided tape
Scissor
Motor
Switch
Clothespin
3 Markers
Cup

Suggested Materials

Arts and crafts (pipe cleaners, googly eyes, glitter, stickers, etc.)

Instructions

1.

Materials needed: cup, tape, markers

Apply tape to the sides of the markers so they will stick to the inside of the cup

Tip: *Roll up tape like in the picture to make it double sided*

2.

Line up 3 markers around the inside of the cup. Try to make them as even as possible. The markers will act as the Wigglebot's legs.

Tip: *Line up the line where the marker and cap meet with the rim of the cup*

Your markers might look different than what's in the picture. That's okay! If you are using skinny markers try adding four legs instead.

3.

Make sure the cup is able to stand upright by itself, on the markers, without anything holding it up

Tip: *If the cup can't stand on its own, readjust your markers*

4.

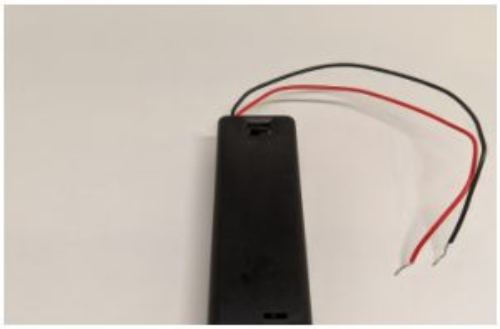
Materials Needed: Battery and battery case

Open up the battery case.
Put the battery in the case.

Line up the plus **+** and minus **−** that are on the battery with the **+** and **−** inside the case

Put the battery cover back on.

Check the switch on the battery case. Make sure the switch is in the **OFF** position.



5.

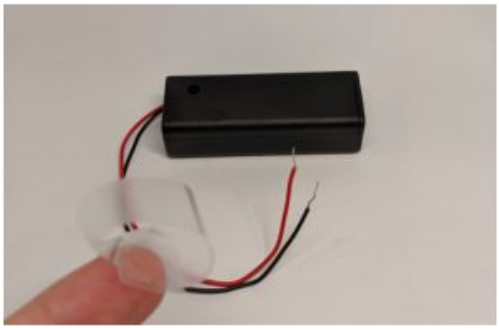
Materials needed: tape

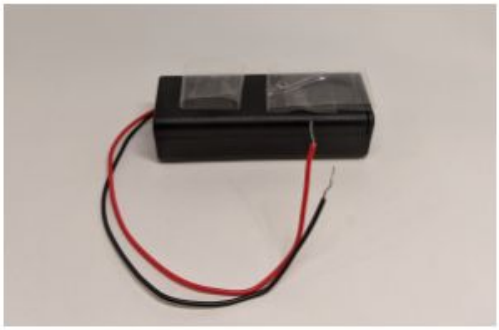
Flip over the battery case so that the switch is facing down.

Roll up two pieces of tape.

Stick the tape onto the battery case.

Remember: put the tape on the side WITHOUT the switch





6.

Materials needed: battery case, tape

Take the battery case and tape it to the top of the cup in the middle.

Tip: make sure the battery case is properly fixed on top of the cup and it's not moving.
To do this, add another strip of tape across the case and onto the top of the cup

7.

Materials needed: motor, tape

Tape the motor onto the end of the battery case. Tape down the side **WITHOUT** the switch

Tip: You can use a rolled up piece of tape to first stick the motor to the battery case.

8.

Secure your motor with another strip of tape. The tape should be long enough to go across the motor and stick to the battery case

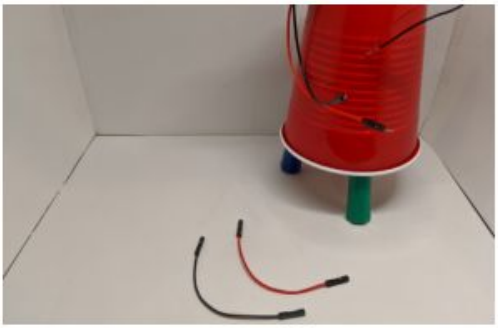
Tip: make sure the motor is properly fixed on the side of the battery case and it is not loose.

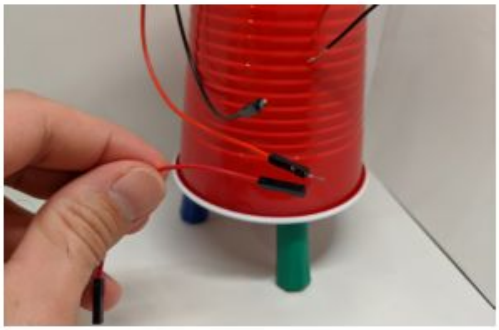
9.

Materials Needed: Two jumper wires

Your jumper wires might be different colors! That's okay! The color of the wire doesn't matter.

Use the jumper wires to connect the battery and motor wires together.



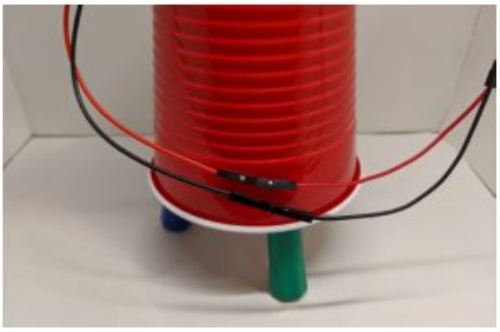


10.

The wires coming from the battery and motor have pins

The jumper wires have sockets

Gently push the wires with pins into the jumper wires that have sockets.

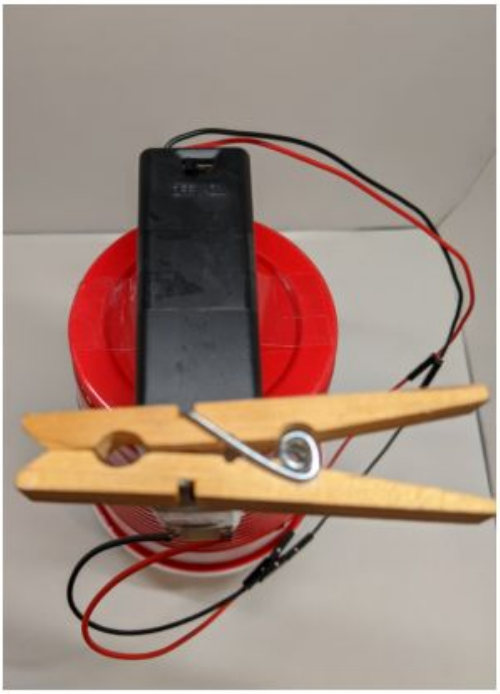


11.

Materials needed: clothespin

Attach the clothespin onto the rod of the motor.

Make sure the clothespin can spin all the way around, without hitting anything!



12.

Materials Needed: Paper

Time to test your robot! With the markers still on flip the switch to the ON position. The clothespin should start spinning and your robot should start moving in circles.

Once you're happy with how the robot is working, turn off the switch and take off the caps of the markers.

13.

With the caps off, stand your robot on top of some paper and turn it on! Have fun with your robot!

Optional:
Decorate your Wiggle Bot with eyes, arms, or anything else you want! (Make sure your Wiggle Bot is **OFF** when you decorate)

Try some of these activities with your Wiggle Bot!

1. Try reversing the wires. What do you notice different about your robot? Which direction does it spin in?
2. Try removing the clothespin from the top of the motor. What happens? Explain why this causes the robot to draw.
3. On different pieces of paper, leave your Wiggle Bot spinning for 10 seconds, what does it draw? 25 seconds? 1 minute? Are you able to see anything special in the artwork the Wigglebot made?
4. Try adding more markers inside the cup. What do you notice when you have 3 markers? 4 markers? 5 markers? How many markers can you add so that it stops wiggling?
5. Are you able to place the motor somewhere else on the cup but still keep it wiggling? Where?
6. Try removing the battery from the case. What happens to your Wiggle Bot?
7. Try adjusting the length of the markers within the cup so that it can still stand up on its own. How does this change how the Wiggle Bot wiggle?
8. Look into the future, what parts do you think the Wiggle Bot needs in order to keep wiggling?
9. How do you think a switch works?

How to Recycle your Wiggle Bot

Done playing with your Wiggle Bot? To recycle your Wiggle Bot, disassemble all parts any decorations you might have.

The pieces of tape can go in the regular trash.

The plastic cup, motor, and battery case can be put into the standard recycling bin.

The battery and wires should be recycled at a battery collection event or at an electronic waste collection event. Below are some resources to help you find a recycling center.
https://www.sandiego.gov/environmental-services/recycling/events/one-day
https://www.sandiego.gov/environmental-services/recycling/events/reselectronics

***Figure A.2*:** Student User Manual