5-2022

Lessons from an Exemplar Elementary Robotics Program: Implications for Learning and Life

Paige Price
DePauw University

Recommended Citation

Price, Paige, "Lessons from an Exemplar Elementary Robotics Program: Implications for Learning and Life" (2022). *Honor Scholar Theses*. 206.
https://scholarship.depauw.edu/studentresearch/206

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Paige Price

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DePauw University

April, 2022

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Abstract

As robotics is becoming more popular across the United States, there is little research to show the long term effects of robotics participation on students both within and outside of school. Through examining literature surrounding robotics, known themes of collaboration, problem solving, and an obvious growth in areas surrounding STEM have been identified. This qualitative study took the general information provided by literature and focused on a specific case study of two fifth grade elementary teams from Woodview Elementary School in Nappanee, Indiana. Using a technique called methods triangulation, new emerging themes were found between obtaining eight of the students' engineering notebooks from four previous academic years, observing a competition in December of 2021, and analyzing a newly produced interview of robotics judges from the Eaglebots competition. The themes showed students developments of their social skills, character development, and new learning goals that centered an ongoing process involving failure. These findings point towards the benefits of robotics being far reaching and lasting.

Ch 1: Introduction

Prior to discussing literature pertaining to elementary robotics and my own findings within a case study it is important to identify my own positionality and motives. I enter this space a white, cisgender female who grew up in a household that was supportive and financially stable. I was blessed in receiving a rigorous education and was involved in afterschool programs for which my parents were able to pay and provide transportation. I was successful in traditional schooling settings, where some students struggle more than others. From a robotics perspective, programs can function in both traditional and nontraditional settings, which may allow for more students to be successful. Due to my own pleasant experiences in classrooms as well as those not so pleasant I have always wanted to be an educator, with a specific passion for working with the elementary age student.

At DePauw University I am an education studies major, with an emphasis in rhetoric and interpersonal communications. I am also a member of the Honors Scholar program and DePauw softball team. Prior to this research my only involvement related to robotics has been observing my cousin competing throughout middle school and high school and sitting in on a small business class about coding. What I drew from those experiences was regret in my own lack of knowledge in the field and a desire to implement robotics in my own school's curriculum one day with the aim of increasing themes like the ones I drew from existing literature and conducting my own document analysis. As I begin my own career as a teacher, I aim to create a classroom that inspires students to learn and teaches them that failure is a part of the process of growing and learning and therefore, should not be a reason to avoid trying something new.

Statement of Purpose of Research Study

The basis of my research at this point is centered around the definition of robotics, what robotics looks like on the elementary level, and how participation in robotics at the elementary level affects students both short-term and long-term. As described in the literature review, there are currently many known themes of learning that have been a result of students' participation in robotics programs, however, because robotics is new in the broad timeline of education, there is still much to be discovered. After compiling information on these recurring themes, I turn my focus towards a specific robotics program consisting of fifth grade students from Woodview Elementary School in Nappanee, Indiana. The students call themselves the Eaglebots and have two teams, the red team and the blue team. The purpose of this research project is to (a) analyze students' engineering notebooks, complete observation notes from the Dec. 4, 2021 competition, and evaluate “Judges Perspective” video (Jan. 15, 2022) to determine if their experiences yield the same effects that literature has found, and (b) to find new unknown effects that the students denote in their notebooks, competitions, and “Judges” video.

Statement of the Research Questions

The questions listed here are aimed to create a thoughtful analysis of how known themes can be applied to Woodview Elementary School’s fifth grade robotics program. By using triangulation to analyze the students’ notebooks, observation of their competition, and evaluation of a “Judges Perspective” video, I intend to show how the impact of robotics participation can produce the themes already discussed in literature and discover unknown themes to introduce to the robotics community. My research questions are as follows:

(1) Are elementary students at Woodview Elementary School experiencing the same effects on their long-term education as those that already have been studied?

(2) What new themes can the students at Woodview Elementary school contribute to the existing literature relevant to robotic program participation?

Limitations of the Proposed Research

One of the larger limitations of this research is the applicability of my findings on other schools and afterschool programs. Due to Woodview being only one small sample from an entire community of students involved in robotics across the nation my findings cannot be considered universal. Woodview is located in a small town in northern Indiana and home to less than 500 students, which makes its resources different from schools across the nation. However, their size does not limit them to receiving lower experienced teachers. Jake Simons, the head robotics coach at Woodview is extremely bright, talented, and passionate about his work with the kids. Much of their credit is due to his teaching. Still, many schools across the US are just now being introduced to robotics education and lack the funds and expertise needed to have a program either intertwined with day-to-day classes or afterschool programs. In the schools who are able to introduce robotics it may look different than Woodview and therefore yield different results in the long term. Regardless of these limitations it is important to note that while they are not universally applicable, they do shed light on many of the benefits that robotics can have on young students and provide a starting point for the creation of their programs.

Chapter 2: Literature Review

As previously mentioned, robotics is considered to be a new branch of education in the grand scheme of things. For that reason, literature surrounding robotics is freshly written or still currently taking place. There is little existing information about the long-term effects of elementary robotics due to the genesis of their programs being within the last decade for most schools and programs. However, this introduces an exciting possibility for new discoveries to be made from firsthand experiences of students similar to the Eaglebots who are able to be analyzed based on existing literature and examined for new information. The students are existing in the exciting stages of the development of elementary robotics and making history both in their personal lives and for the education field. What we must examine is the historical implications and how it is shaping learning education for the future.

What is Robotics?

Firstly, it is necessary to address that robotics functions and exists differently based on age, access to resources, location, and many other factors. Generally speaking, robotics is a way for students to strengthen their learning in areas of science, technology, engineering, and math by means of using online programs, robots, and simulations to conduct experiments and compete against other teams (Curto, 2016). Students may use legos, online simulations, or premade kits to create their projects (Chaudhary, n.d.). VEX robotics, which is the program the Eaglebots compete in, has become a popular and easy route for students to get involved in STEM and can be accessed online to purchase kits and get information on annual competitions (VEX robotics, 2021). Each year in VEX robotics the competitions change and students must relearn and rebuild their skills to fit whatever challenge they face.

Differentiating Educational Settings

Today there are a plethora of different settings in which students are learning. In fact, young children are learning more than ever with technology at their fingertips so often. Throughout this paper it is important to know that robotics can take place in many different forms and settings. In “traditional” learning settings the word “traditional” is meant to refer to classes that happen in real time with an instructor, a physical classroom, and are face to face (Simmons, 2013). This is what setting comes to mind when students have robotics in their day-to-day classes that is included in their curriculum. However, some classes may be offered in a blended setting where online and traditional methods are both being used (Meyer, 2008). These settings are more common in extracurricular settings such as clubs where students meet in person for lessons and practice and offer online access and practice for work at home. Distance learning is what many elementary school students experienced during COVID19 when they could not go to in person class. Distance learning consists of an online learning community that consists of internet-based lessons (Farajollahi, Zare, & Hormozi, 2010). Many graduate programs and higher education learning or training programs are being offered as distance learning today.

Fear of Failure

Failure is frightening both in the academic world and in everyday life. The reasoning behind this fear is the connotation the word failure holds and the association we place with failure and being unsuccessful. Within any school students take failure as something that means low grades and therefore eventual long term negative impacts (Ramirez, n.d.). In robotics failure means there needs to be change to the plan of attack. While change can also be scary, it does not have the same fear associated with it as failure does. In robotics, rather than being seen as an end point, failure is used as a scaffolding technique that pushes students to rework their ideas and find out what is not working on their road to success (Yang, 2020). For students to be successful in robotics they must learn to be unafraid of failure and conversely accept failure as a stepping stone (Ramirez, n.d.). Part of what makes failure function uniquely in robotics is due to many programs still being offered as after school programs functioning in nontraditional classrooms that do not require grades.

Grades hold a certain gravity that extracurriculars often do not. The gravity that these instances of failure hold mean that some students can afford them while others cannot (Schiering, 2014). While we transition into adding robotics into traditional education settings, we cannot make a perfect parallel of failure in traditional classrooms to failure in robotics. Therefore, failure exists in robotics as a broader idea of being unsuccessful at attaining a goal in a singular moment. Because failure in these settings result so differently, they cannot be perfectly compared. However, if a student's relationship with failure becomes more amicable then their likelihood to work harder to overcome failure is significantly higher (Ramirez, n.d.). Authors Ramirez (n.d.), Schiering (2014), and Yang (2002) argue that robotics participation creates a shift in students' relationship with failure, along with many other themes of learning, that result in students' decreased fear of failure and increased grit to overcome their own momentary blunder.

Creative Thinking and Problem Solving

Robotics also has shown increased creativity and problem solving in students that have participated. Part of the goals of VEX robotics is to provide students with the tools to learn robotics and STEM, yet it was found that students took far more out of their experiences. For example, when learning about robots and competing at both friendly competitions and high stakes levels students showed their ability to collaborate with teammates and opponents (Chaudhary, n.d). During their time collaborating students show increased problem solving and ability to think proactively with friends and strangers alike (Chaudhary, n.d.; Kucuk and Sisman, 2017; Ohnishi et al., 2017). In order for students to be successful and create a product that functions correctly they must be able to accept momentary failure as a clue towards what went wrong. By doing so students are learning that failure is a necessary part of creating a perfect product and their attitudes shift for the better (Ohnishi et al., 2017).

When competing against students from other states or even countries the stress of time becomes something that students must overcome in order to be successful. In some competitions teams must learn to collaborate on the spot and in order to win they must be able to participate in coopetition against the clock. This leads us to the next impact robotics has on many of its competitors, which is increased creativity. For students to be able to think of new ideas and produce them in a tangible way with new people their creativity levels must expand (Noh and Lee, 2020). With this creativity comes the skill of computational thinking that can immediately translate to ideas becoming a project in action (Microsoft Research, 2016; Chaudhary, n.d.; Noh and Lee, 2020). In a study conducted by Noh and Lee (2020) they found that in their own programming education course in a Korean elementary school the students showed significantly better levels of computational thinking and creativity after just 11 weeks of participation. Needless to say, there would likely be more of these impacts in a longer term study. Kucuk and Sisman (2017) found that students at the elementary level showed more creative thinking and social skills after their robotics instruction and an ability to make quicker decisions with their teams in order to be successful. The key to linking failure and creativity is that robotics gives the ability of "scaffolding students to cope with and benefit from errors and failures and respecting students' ideas" which is argued to be "crucial for students' development of creativity" (Yang et al., 2020, p. 1827). By developing these skills students are also learning how important failure is to growth and rethinking their perspectives on it.

Proactive Learning Attitudes and Motivation

When students participate in robotics, they are having to make alterations to their projects at the moment they occur in order to adjust to many of the things that could go wrong (Schiering et al., 2014). While these adjustments do not come without stress or frustration, they become part of the process and impact the way students think about getting things wrong. In Japan there has been a push over the last decade to implement robotics programming in elementary and middle schools as an attempt to get students involved earlier in STEM (Ohnishi et al., 2017). What the experiments in Japan showed was that students gained inspiration for careers in STEM while also “inspiring a proactive learning attitude” (Ohnishi et al., 2017). What this learning attitude means is that students became more motivated to participate in their studies in general because of their interest in the robotics in which they participated. By learning STEM while students are still young, they develop a confidence in their abilities that inspires them to stay involved and develop their skills in a way many other children are unable to until much later in their education (Romero et al., 2012). By developing a skill base in the beginning, students are motivated to be involved in project-based learning like those that VEX and other robotics programs use to simulate real world robots (Schiering and Gerndt, 2014). Students commit to the project at hand and know that during the process they must put trust in their teams and be able to make changes along the way (Lopez et al., 2021). While these definitions and impacts of motivation may look different, they all have strong implications for a student both within school and robotics programs.

When students fail in front of their classmates and peers, especially at a young age, they take their failure to heart and are fearful of what the repercussions may be either socially or academically (Ramirez, n.d.). Unfortunately, failure is not an option for everyone. Some individuals can afford to fail more than others, depending on the resources and the support they have in any given setting. By reducing children's fear of failure, we have the opportunity to show children that failure is “a part of growth and learning rather than an indication of inability” (Ramirez, n.d., p. 8). Robotics is teaching children just that; needing to restart or try again does not mean you are unable. Students started to realize that their failure in one project did not equate to their failure in the long term, and their failure actually gave them even more lessons than they could have learned if they succeeded on the first attempt (Ramirez, n.d.). Every failure is a new step towards success. When these students learn this lesson, they no longer fear failing in front of their peers and instead they start reaching out for more help and collaborating in ways that help them build social skills (Kucuk and Sisman, 2017). Without fear, students feel they are able to act unapologetically like themselves and make mistakes in the classroom while still having support. All of these impacts are created and enhanced by students becoming a part of robotics programs and likely to have even further effects in the long term.

Why is Robotics Sparse?

A rather ignored aspect of robotics is the lack thereof. Since robotics programs are new in the timeline of formal education, there is a problem with the lack of access for funding and experienced teachers that can lead new programs. However, something that is necessary to shed light on is the lack of teacher training and experience that is prominent within the field of robotics. For example, Uğur Erdoğmuş (2021) identified during a qualitative study that teachers are in need of more training in order to know their approach is effective. Teachers in this study saw that their students were enjoying their time while participating in robotics programs, but they were unsure if their work was teaching what it was intended. Students are much more likely to receive information and be more motivated by teachers who exude confidence and are excited to teach their material to students (Cejka et al., n.d.). Being confident and excited to teach is difficult, however, when teachers do not have access to effective ways to begin their programs and material to teach themselves prior to teaching their students. The head of the Eaglebots team, Jake Simons, attempted to give teachers access to a program where they are able to take a 22 week long course on robotics instruction as a way to offset the observations he made on the scarcity of teacher training (personal communication, Dec 4, 2021). Simons identified that within the robotics community coaches of the programs were typically engineers with no teaching background or teachers with no robotics experience and there needed to be programs that are easily accessible for teachers to learn about what they are teaching and how to relay these experiences to students.

What is Literature Missing?

While many of the aforementioned articles can point towards these effects already, there is little literature existing on the long-term effects robotics participation has on students. Over the next decade there will be more and more information to report on the way students carry their participation in programs like VEX into their futures. We will be able to discover more about a student's motivation, creativity, collaboration, etc all inspired by their beginning days of programming in elementary school. There is another missing piece of the literature on robotics when it comes to studying the effects of gender on students. Kucuk and Sisman (2017) and Noh and Lee (2020) both found differences in students participating in robotics based on their gender, however little work has been done to question the cause of these differences. It is clear that across the world younger girls and boys have different expectations to which they are held, but until more work is done to establish the reasoning for the discrepancy in students' takeaway after participating in robotics, we cannot assume it is solely based on gender. This review of the literature and subsequent qualitative study is only the beginning of the possible research related to understanding robotics programs as they relate to children. From here we must continue to ask questions so that we may discover if the students in the small town of Nappanee are experiencing the same effects as literature would suggest based on their involvement in robotics.

Statement of the Research Hypothesis

At this point in my research, I expect to uncover evidence upon my analysis of the students notebooks and my own observation notes that supports the literature that I have already obtained. In addition to these known themes that I am looking to find, I predict that the students' work and interactions will reveal less explicit effects of students' participation in robotics. Within my analysis I foresee evidence supporting the themes of motivation, creativity, problem solving and growth through decreased fear of failure while also discovering new understandings that the Eaglebots have experienced on personal levels.

Chapter 3: Methods

Subjects & Techniques

At this point in my research, I have used triangulation techniques to study emerging themes of a fifth grade elementary robotics program at Woodview Elementary School in Nappanee, IN. Throughout my research I used three different sources from which to draw findings: student engineering robotics notebooks, observations if an elementary-aged robotics meet, and a video of judges' perspectives documented after an elementary school and middle school robotics meet.

Student Engineering Notebooks

The Woodview Elementary student's engineering books were the main source of my analysis in the genesis of my project, but slowly my sources grew as I was able to apply for grants and be given opportunities to see the team in action. After receiving the Hallward-Driemeier Honors Scholar grant I was able to use a section of the funds towards the printing cost that came along with printing nearly 1,000 pages of engineering notebooks which were created by the two Woodview Elementary teams (Red and Blue). In order to save costs, the books were printed in black and white, however, the attached images in the appendix have been saved in color to highlight the students' attention to detail in their images, coding, and models.

Table 3.1 VEX IQ Challenges

Academic Year (Hereafter AY)	VEX IQ Challenge
2016-2017 AY	VEX IQ CHALLENGE CROSSOVER
2017-2018 AY	VEX IQ CHALLENGE RINGMASTER
2018-2019 AY	VEX IQ CHALLENGE NEXT LEVEL
2019-2020 AY	VEX IQ CHALLENGE SQUARED AWAY
2020-2021 AY	VEX IQ CHALLENGE RISE ABOVE

2021-2022 AY	VEX IQ COMPETITION PITCHING IN

Note. Table 3.1 shows all of the academic years the Woodview Eaglebots competed in VEX robotics and the challenge for that year. It is important to recognize that during both the 2016-2017 AY and the 2017-2018 AY the Eaglebots team did not have robotics engineering notebooks.

Robotics Meet Observations (Dec. 4, 2021)

On December 4, 2021 I was able to go watch the Eaglebots compete and sit in on their interviews and lunch. The competition I observed included 28 teams from across the state of Indiana and varied from students who were competing their first time to students who were more experienced. The VEX challenge for this AY is called “Pitching In” and includes a target students can throw balls into to score higher points. Attending this robotics meet was an opportunity only possible to me because of the Hallward-Driemeier Honors Scholar grant I received that covered travel expenses.

Judges’ Perspective Video (Jan. 15, 2022)

This video was released mid January to the public as a newly produced interview of judges who had observed, worked with, and interviewed the students competing at Napanee. The judges were asked three questions about the Wa-Nee students specifically and their answers were compiled into a short video to spread awareness of the Wa-Nee robotics team in general and Woodview teams specifically. Since the video was applicable to my own work, I was able to obtain a transcript of the video audio to analyze.

Procedure

My research was conducted as predominantly qualitative, with my focus being student's personal experiences. As stated earlier, I was able to use methods triangulation to see how the students' engineering notebooks, observation of the Eaglebots at a competition, and an interview of the judges correlate to the already existing literature on the effects of robotics involvement. Thus, I was in pursuit of both themes already known from my search of the robotics literature, as well as identifying new themes from common features found in these three sources.

Student Engineering Notebooks

The base of my research surrounds students from the 2018-2019 team who placed in Worlds and were the first AY who utilized engineering robotics notebooks for the rest of the years of students on which to reflect on. However it also includes comparison from more recent years to provide more long term effects and observations. The student's engineering books were the main source of my analysis in the genesis of my project, but slowly my sources grew as I was able to apply for grants and be given opportunities to see the Woodview teams in action. The Woodview Eaglebots have both a blue and red team that compete at the same level and each team has its own engineering notebook. The journals span from the 2018-2019 academic year until their current unfinished season for the 2021-2022 academic year. As previously mentioned, no engineering notebooks were kept during the Eaglebots first two AY's of competition.

Throughout reading the students engineering robotics notebooks, I read and highlighted the student's work and looked for content with similarities of ideas that were known in robotics literature. While reading through the student's different strategies, practice plans, models, and reflections I denoted ideas that would fit into known categories from my review of existing literature then analyzed the information regarding new themes of learning. I was able to use a color coded sticky note tabs system to create new themes where I found similarities in ideas, sections and content. Table 3.1below provides a visual representation of the ideas and themes I noted throughout my reading of the student engineering robotics notebooks.

Table 3.2 Example of Notebook Themes

Competition Year	Characteristics	Visuals	Known/Found Themes of Growth
2018-2019	Red: 156 pages Blue:156 pages	Heavy on meeting notes (Fig 3.2), strategies are present but not very descriptive (Fig 3.2), photographs of robots and model drawings included (Fig 3.4)	Growth in handwriting and organization, accountability, learning STEM (Fig 3.4), collaboration (Fig 3.2 and 3.3), failure based learning, character growth (fig 3.3)
2019-2020	Red: 151 pages Blue: 150 pages	Hand drawn models with pictures included (Fig 3.6 and 3.7), attention to detail in directions (Fig 3.7), continued strategy work and meeting notes	Problem solving skills (Fig 3.8), social skills with adults (Fig 3.7), organization, accountability, and collaboration (Fig 3.7)
2020-2021	Red: 119 pages Blue: 109 pages	Programing explanation (Fig 3.8), attention to fine details (Fig 3.10), higher number of pictures, heavier amount of coding and sketch ideas (Fig 3.9), and meeting notes (Fig 3.12),	Goal orientation shifts to learning as an ongoing process (3.10), failure as an aspect of learning (Fig 3.12), creativity (Fig 3.9), collaboration (Fig 3.9), communication skills (Fig 3.8)
2021-2022	Current season is unfinished	Pages showing the process and creation of robots (Fig 3.13 and 3.16), higher attention to proving the work is done by students (Fig 3.14), meeting notes (Fig 3.14), hand drawn models and pictures (Fig 3.16 and 3.14), assigning scores and goals to members of the team (Fig 3.17)	Attention to detail (Fig 3.13), problem solving skills (Fig 3.15), goal oriented plans (Fig 3.18 and 3.17), collaboration (Fig 3.14 and 3.19), trial and error failure based learning (Figure 3.18 and 3.19), creativity in construction and design (Fig 3.14)

Note. Table 3.2 examines the three past seasons of engineering notebooks and the current academic year (2021-2022) in relation to each other for their contents and the learning themes exemplified by the students' work. All of the figures can be found in Appendix B.

Robotics Meet Observation (Dec. 4, 2021)

During my observation the Eaglebots were randomly paired for their first competition of the day and matched against each other again for the final round due to the red and blue teams scoring in the first and second at the end of the initial eight rounds of competition. I was able to watch the blue and red Eaglebots teams finish in first and second place, securing their place at state. Throughout my observation, I took notes of the encounters I watched, discussions the Eaglebots were having, and discussions I had with both the parents of the students and Coach Simon.

Judges' Perspective Video (Jan. 15, 2022)

There were three questions in which eight judges who participated in a robotics competition on Jan. 15, 2022 at Wa-Nee schools were asked before being interviewed for the video in January, 2022. The questions that were used as the foundation of the video are listed below.

3 main Questions posed to judges:

(1) What impressed you?
(2) How did the judging process change your perspective of robotics?
(3) How did our kids [Wa-Nee] stand out?

Chapter 4: Results/Findings

Throughout the next chapter I will be stating my preliminary findings from using a methods triangulation technique as the means for uncovering both known and unknown themes of learning in student engineering robotics notebooks, observation notes from the Dec. 4th, 2021 elementary robotics competition, and a video made of Judges' perspectives from the Jan. 15, 2022, robotics competition..

Student Engineering Notebooks

Throughout reading and studying eight different engineering notebooks from the years 2018-2019 to the current 2021-2022 AY the students show many areas of growth and learning, displaying new effects of robotics participation that are not limited to those described below. While the list is not exhaustive, those listed highlight both known themes depicted in a review of the literature, as well as, major new themes which I found via the methods mentioned in chapter three.

Failure Based Learning

In the genesis of my research something I heard from many professors, coaches, and mentors was that failure is a part of learning that is necessary to succeed. However, failure in classes and traditional school settings is not something many students can afford on a grander scale. While studying the engineering notebooks from Woodview's robotics teams I recognized that students kept referring to their learning as "for now" or noting the strategies they tried (Fig 3.5, 3.11) whether they were successful or not, as a system to track their progress. Even in the final steps of their creations students still developed multiple strategies as you can see in figures 3.2 and 3.12. By creating multiple methods for success students were able to all participate in learning an effective way to create their robot and take away a lesson about trial and error being an effective source of learning for similar situations.

Throughout the process of trying new ideas and failing to create the wanted outcome students show resilience in their unwavering faith in themselves and their teammates. Rather than slow their progress or question their capabilities, the team noted their problems and quoted their direct cause and how they could be fixed for the future (Fig 3.17). The reason that the students recorded all of these problems was not only to cover their trails in order to prove their work was their own when questioned by a competition judge, but also to record their obstacles in the moment so that they could prevent any recurrent mistakes and maximize their points in future competitions. In figure 3.19 the students recorded the timing and points received by the different drivers on their team, which was a common practice used to note their best drivers in order to track their practices. Students also used these scores to predict how they would compete and how their opponents could affect their scores, both positively and negatively. All of these tactics were used to show the successes and failures of the students' practices and process of learning so that they could eventually peak when it counts most – Worlds.

Creativity and Problem Solving

Two of the largest points of learning for those who participate in robotics are creativity and problem solving. It is impossible to talk about one without referring to the other, which is why here they will be analyzed together. Even before opening the notebooks for analysis it is important to note that they are bound, colored pieces of graphing paper that typically take the students a long time to work on. During their competition I was told that a singular page of notes with drawings, pictures, or a model takes around two hours to complete. Two hour for each page in journals that range from 109-156 pages, that is a lot of work. In order to create ideas like those mentioned in figure 3.18, 3.14, and 3.17 takes immense amounts of creative thinking skills and unique ways of looking at the world. The students take the ideas they have in their minds, put them on paper, then have to translate them to physical objects that are capable of being transported.

Although the names, ideas and drawings may not seem like the most important outcome of participating in robotics it is vital to notice that these skills, creativity and problem solving, are applicable to daily life and can be extremely handy in the workplace. The ability to envision something and then create it is a skill many individuals do not have, however, these students are all showing signs of learning to do just this. In pages of their journals, like figure 3.17, students are able to determine a flaw in their work, creatively think about a solution, and then problem solve to avoid the same hiccup later on in their season. In situations more dramatic than the pivot point in figure 3.17, students referred to robots breaking or malfunctioning during competitions as a crisis that was averted because of the students ability to know the exact composition of the robot. By knowing the makeup of each component of the robot any team member is able to fix the problem at hand without a major setback. To the students at Woodview flaws in their robots were an inevitable part of the process. The way students responded to these flaws was the most important thing to note.

Collaboration and Goal Orientation

In order for the Eaglebots to be successful they must collaborate as a larger unit and use coopetition to maximize points with their opponents. As a program the Eaglebots have two different teams, blue and red. The two different teams have their own journals and compete on their own, but they practice together and strategize with each other to be more successful. The reason they do so is to reach their ultimate goal of competing at Worlds together. As one can see in meeting notes like figures 3.1and 3.16, both the red and blue team divide their tasks by different subteams like design and build, supply manager, documentation, and the awards team to all ensure their best collective effort. While the journals cannot showcase the way students on the red and blue team both work together, my observation (note appendix A) of the competition did just that.

Since robotics is based on maximizing points, there are a multitude of different ways to build a robot and drive in each competition leading to different outcomes. This unpredictability creates a new type of competition that allows students to be competitive but does not peak like many physical sports do. There can always be a different way to build or a different path to drive during a competition that could result in different standings. This creates a type of learning and competition that is unique to robotics and inspires a new generation of thinkers that cannot settle for success because perfection is unattainable. Therefore students write, think, and act, as figure 3.3 indicates, where even after the conclusion of competitions or seasons students look for areas of improvement and aspire to be better next time. The students all are able to add their input and see their peers and a community of understanding is created where students are satisfied with their effort but hungry for higher scores and more awards.

One way that these students work for higher levels of success is special awards. The team assigns specific students in their meeting notes and day-to-day tasks to do research on awards at each competition with notes on how applicable and attainable they are for the teams to achieve (Fig 3.2, 3.12, 3.16). These research teams are what makes receiving awards like the Team Excellence award feasible for a small school from Indiana. The awards subteam takes the lead in scouting other schools' teams to perfect their own plans and ensure that their points will place them high enough to progress in the competition. These characteristics, along with the ability to transcribe them on paper and discuss them with a team are valuable traits in a leader in life. Students are working towards achieving goals together that are clearly measured and attainable, and by doing so students are learning how to create goals in other aspects of their life and make a habit out of striving to be better.

STEM Experience

A more obvious learning area that students gained experience in was STEM. Looking through Table 3.2, each year the students included coding and strategic plans to make their robot more successful, but in the later years their plans became even more thorough and their programming became longer and more complex. Figure 3.11 shows an example of the programming being explained in paragraph form for the way that their coding intended to have the robot function. The writing not only shows how thoroughly the students thought through the way the robot needed to move in order to be successful, but also shows the language students use to communicate their ideas, and how they can then translate their work from programming jargon to something that a spectator can understand. The students became familiar with the software and programs that VEX used and were able to then build on their work every year as new faces joined the teams and grew as a program both in size and in talent. These experiences created new passions for students, which will be analyzed later.

Learning is Ongoing

A quality of learning that was previously mentioned in multiple sections of findings is the students ability to think retrospectively and proactively to recognize their larger goals and that in order to achieve them there must be a collective mindset of learning being a never ending process. Across every year of journals, the students used language referring to their robots as trials, prototypes, and the ideas “for now”. This language was a testament to their coaching and the students' drive for progress and being successful at their competitions. Even at the end stages of a season the team got together to pick apart the ways they could be better and wrote down their own perspectives on the largest issues they came across after competitions. These students' recordings (fig 3.3, 3.8) were evidence of their ability to learn larger lessons about life in their participation. Whether or not they were winning competitions, they were leaving with new knowledge about robotics, their teammates, and themselves.

Character

One of the arguably most important outcomes students exemplified after their participation in robotics competitions was their growth in character. Students learned social skills that would help them tremendously later on in life and also learned how to represent themselves and their team in a way that would represent their schools in a positive light. For example, in Figure 3.3 a student mentioned that other coaches were accusing the team of their coach making their robots instead of the students. The student's response to this accusation coming from coaches and parents was to prove the coaches wrong in their interviews with judges. The ability for these students at the fifth grade level to not only take the higher road, but also to be unmoved by an adult's accusation of a serious offense showed their maturity.

The judges interviewing the students also provided a way for young boys and girls to learn important social skills that would take them far in life. As the student mentioned in Figure 3.3, the judges' interviews are a way to provide proof of their academic honesty, and this is undoubtedly an intimidating task for elementary aged students. In order to convey their ideas, students cannot be afraid of the adults posing questions and they must be aware of every step of their building process in order to answer adequately.

Student competitions also show signs of good sportsmanship that are vital to many relationships later in life for both work and play. In Figure 3.5 the students show their utmost respect for their coach, who is the common denominator in all of their successes. It cannot be misunderstood that their work is a reflection of his leadership and guidance. Similarly the language the children use to create solutions for obstacles they discover within their team and opponents shows their mutual respect for their teammates and opponents. While they may be competing against each other the students from Woodview also work towards being respected.

They write about ignoring the hate they receive from other teams that stems in jealousy, and the team never complains about an alliance that holds them back from scoring higher. These qualities all have little to do with the robotics that we are studying, but the effects of their actions are what makes the team known by judges like those in the interview for their character.

Robotic Meet Observation (Dec. 4, 2021)

On December 4th I was able to attend and observe a robotics competition because of funds I received from the Hallward-Dremier grant. During my visit I recognized many of the themes I had recorded in both my reading of literature and the students' engineering notebooks. The sections below refer to my outcomes from that observation. Notes from that day can be found in appendix A.

Failure Based Learning and Social Skills

Throughout my time observing the red and blue Eaglebots compete in Dec., of particular note was their interaction with judges during the interview portion of the day. Students were faced with question after question about their robots, how they were created and what their individual roles were in the process. What was most impressive to me about the students' responses was the balance in which they answered allowing each member to contribute what they did and the reasoning behind their ideas. The way students spoke eloquently and with clear intent was astounding to a bystander who did not know the students personally nor the practice that was likely behind the interview portion.

While being asked about the way the students created their robots they went through a linear explanation of how the students started with an original idea and had to create smaller tests and models to discover what worked and did not in order to find a successful solution. This process is the one I referred to earlier in my findings as trial and error, which is failure based learning that inspires students to think boldly and take risks in their work. The students looked at each other when a question was asked that they knew someone else would be more fit to answer, and the maturity that these social cues hinted towards was something that I don't often see even at the collegiate level.

Creativity and Collaboration

Another lesson that students exhibited during their interviews was the ability to collaborate on the spot when they were asked questions they were not expecting. The answers the team provided showed their creative thinking process and how their minds all worked differently. The difference that these students exhibited was their strength in the creative process, where countless different prototypes and ideas could be continually shared and discussed with each other. When the students talked about the problems they encountered throughout their design process they lit up with excitement about telling how they overcame the obstacle.

As I sat eating lunch at the kids table the young boys and girls were all excited to tell me about how much they loved being on the robotics team. The documenting subteam made it very clear that they loved creating new notebooks pages and that their handwriting had gotten exponentially better since starting their journals. The students' pages needed to be clear and legible so that judges could understand what was being written, and the students worked hard to create work of which they were proud, and by doing so they improved their handwriting and spelling in the process. One student told me that being one of the main creators of the engineering notebooks created a passion for any types of arts and craft she could get her hands on, specifically scrapbooking. The reason she attributed her work on the team to creating a love for scrapbooking was because she saw creating the models and putting pictures with explanations as the same thing as creating a page of the engineering notebook.

Goal Orientation and Learning as Ongoing

Let me be frank, the Eaglebots were far better than any other team I observed at the competition. The reasoning behind this is not anything other than hard work behind the scenes guided by their coach and an unquenching desire to do and be better. While some of the students at the competition were competing for their first time ever and driving simple robots, the Eaglebots were not. What this allowed me to recognize was just how good they are. When some of the higher level teams were hanging their robots from objects and receiving points for pushing balls into a designated area, the Eaglebots were catapulting balls into a raised platform and completing their drive with a high pull once they were out of balls. The students did this to maximize their points with the robot they had created, but in interviews the students talked about other models they had tried or could have tried to achieve more points. The language they were using, just like in their journals, referred to their works as it was at that point, hinting at more work to come and possible ways they could improve. Having a mindset of growth was something that the team clearly all wanted to work towards.Their aspirations and goals were all to do better, and as a team wanting to win worlds one day, setting the bar high is the only way to do so.

Character and Community

A characteristic of the way students acted that impressed me was the maturity they all exhibited when talking to the judges, their parents, and their teammates. I have been around a fair share of students at the elementary age as a substitute teacher and nanny, but watching these students talk to adults and their own team showed their respect for others and the program they were representing. The social skills that the students were learning while being questioned by judges no doubt will prepare them for the future during interviews and interpersonal relationships with partners, coworkers, and superiors. While watching the parents and coaches interact I noticed that there was a sense of community even within that room that was different from many competitive settings I have witnessed before. Coach Simons and the parents had built a community for the adults and students alike and the interactions I saw were all reflections of the respect they had for the students' competition and the work they had all contributed.

When I was leaving the competition I was astounded by the way competition could look so amicable and draw so many strengths out of the students that were not necessarily exclusive to robotics. As I said my goodbyes, one encounter especially moved me. I spoke to a father who told me that his son had been struggling in school prior to his trying robotics. The student had not particularly liked school and was struggling to make friends. The dad concluded that now his son has been participating in robotics at Woodview he is excited to go to school, has made friends, and even wants to be an engineer one day when he grows up. The father credited all of those changes to being an Eaglebot and competing in robotics.

Judges’ Perspective Video Transcript (Jan. 15, 2022)

Wa-Nee Sponsored VEX Robotics ES/MS Event

January 15, 2022

“Judging Perspective” Video

transcription

Judge 1 (girl black shirt): Over the weekend, I had the opportunity to be a judge for the Wa-Nee Robotics Competition

Judge 2 (guy green shirt): I had the privilege to be a judge this year’s Wa-Nee Robotics Competition at Northwood Middle School

Judge 3 (guy red shirt): And what I saw from Wa-Nee Robotics was just fantastic.

Judge 4 (guy blue shirt): The whole process of walking through the rubric for scoring the teams and all the interviewing and then the scoring teams on their design, just the whole process was really eye-opening

Judge 1: I was really able to gain a better understanding of everything that goes into it and how hard these kids are really working

Judge 2 (guy green shirt): I was just completely blown away. I'd never been to a robotics competition before. I've heard some great things about it

Judge 5 (guy gray shirt): It really helped my understanding of what type of teams we want to shape and I think you guys really exemplify that.

Judge 6 (guy red tank): Being a judge, it opens your eyes a little bit. You hear about robotics, and you kind of get an idea that these kids take these robots, they build them, they toss balls around, they lift squares and cubes and stack them, but all the preparation behind the scenes is what you don't get to see

Judge 4: I've been in manufacturing for years, and I've worked in the design process and many different elements of that, and as we scored, it was evident that we needed to get into fine details of who's got the design process recorded in their notebook.

Judge 7 (guy white shirt): They were able to document, to record, graphically and verbally

Judge 2: When we were in the cafeteria, just doing basic interviews, asking the kids to show us their robots and just explain their process and thinking, just blown away, from fourth graders on up

Judge 8 (girl blue shirt): After interviewing you guys, I have some tips to take back to my own team

Judge 1: Their notebooks were just above and beyond unbelievable.

Judge 6: All the notebooks, all the engineering stuff they go through

Judge 4: All the fine details, the parts listing

Judge 6: From testing, to building, to testing, to rebuilding

Judge 1: Their attention to detail was just unbelievable.

Judge 2: Wow!

Judge 3: They did a great job at collaborating

Judge 4: Teamwork

Judge 3: Worked well with others

Judge 6: The whole process is nothing different than what I do daily as an engineer

Judge 3: One of the things that stood out most to me was the students were just so professional

Judge 6: These kids are second to none

Judge 2: It's just amazing just how personable they were

Judge 5: Well-prepared

Judge 1: They're all so super passionate

Judge 2: Locked in (?)

Judge 4: Organization

Judge 5: Confident

Judge 3: Super respectful

Judge 2: Respectful

Judge 5: Well-poised

Judge 1: How well they work together, how they all have a role, how they all know how they contribute

Judge 3: Every single student had a role on the team, and every single student knew what their role was

Judge 5: Everybody talked, everybody shared in the responsibilities that they had to do; even though each one of you has your own unique responsibilities

Judge 2: Just how responsible they were all day long

Judge 7: They gained an understanding of this design process through the coaches and trained adults

Judge 4: It was evident that the coaches are invested

Judge 6: The coaches are beyond involved in what they're doing; they're leading them the right way

Judge 7: But these kids made the process their own

Judge 6: It was beyond impressive on what our community is doing with our kids

Judge 1: I'm just glad that the kids in the community have an opportunity to be involved in such a great program.

Judge 4: It's exciting to see what we're doing through this robotics program in Wa-Nee

Judge 2: If you are considering joining a robotics club for next year, do it!

Judge 6: Don't take for granted what's going on right now.

Judge 7: These students can take this new-found knowledge and this new-found skill that they have and use this later in life in both interpersonal relationships and in their vocation

Judge 6: This world needs problem solvers.

Judge 1: I can't say enough about how much this program means to all these kids and what a difference it's making for them

Judge 3: It was awesome! The whole program was just fantastic!

Judge 4: These teams have really done some remarkable work to set themselves apart.

Judge 1: I was incredibly impressed, especially with the Wa-Nee teams

Judge 6: I really enjoyed Saturday. I've talked to numerous people since then about this process and what went on and was beyond proud to be able to volunteer.

Judge 3: It was just a delight to work with them.

Judge 2: Thank you, thank you, thank you for letting me be a part of your day

Judge 8: Keep up the great work! We'll see you at state! Go Wa-Nee Robotics!

Judge 7: Well done, Wa-Nee students.

Judges' Perspective Video Summary

Throughout the interviews included in the video, it is clear that the judges hold a high amount of respect for the Eaglebots team and the community supporting them. All eight of the judges being asked the three questions located in the methods answered them in a positive light. The judges admired the investment the team made, their ability to problem solve, and the way the team functioned as a unit. While it is difficult to read tone on paper, when I watched the video clip multiple times, all of the judges spoke with excitement and joy in their voices when referring to the Eaglebots and the way the team acted both on and off their course. The judges used words like prepared, poised, organized, confident, respectful, and responsible to describe the way the team worked together. These words correlate to the character I referred to previously and an improvement in social skills that the students exhibited during their interviews with the judges. All of these words were also points of emphasis that were found in both the engineering notebooks and in the observation of their competition, which supports the relevance of their themes of learning in all environments.

Ch 5: Discussion

Throughout my research I was able to analyze engineering notebooks, observation notes, and interviews of the competition judges for known themes of learning that have been identified in literature, while also discovering new themes of learning and growth. Current known themes that were found in literature include but were not limited to increased creative thinking, problem solving, proactive learning attitudes, and motivation, which all lead to a decreased fear of failing both in and out of the classroom. Starting from these themes I analyzed the students' robotic engineering notebooks, observation notes I took while attending their 2021 December competition, and “Judges Perspective” video compiled from interviews to identify parallels between the students' words and actions and themes already discovered in literature. The additional themes I found from studying and analyzing student robotics engineering notebooks included organization and social skills, character lessons, and increased passion for non STEM related subjects.

Limitations and Future Research

While investing nine months total on this research paper, It is important to state that four months of research came nowhere near exhausting all the findings I could have potentially uncovered from a more in depth analysis of the student robotics engineering notebooks alone. An obvious limitation of my work is that my case study looked at one individual robotics team. This specificity allowed me to dive deeply into the work of the students and be able to see their program at work, but it can be assumed that if there was a larger pool of robotics teams that was researched the findings may have looked different based of the way a school runs their program and sets up their engineering notebooks. Nonetheless, this case-study revealed important themes from a multi-year, world-level, elementary robotics team; so it was a relevant and informative research project that has potential to benefit others in traditional and alternative educational spaces. I can attest that the findings will continue to be ongoing throughout my career, and I would hope that future researchers would be able to personally interact and interview students that are both currently participating and having completed their robotics journey to ask how they have been affected. As a program that is still relatively new in relation to the inaugural year of VEX robotics, the Eaglebots have already made leaps and bounds in their competitions and skill sets. However, studying the team long-term would likely uncover more themes of learning.

Now that this information has been analyzed and documented, it is important to use it to spread awareness about robotics programs and get students started at a young age. As I mentioned early on, there is a small pool of teachers who are trained in both robotics and teaching, but with coaches like Coach Simon who offers tools for teachers to learn about robotics and how to teach within such programs, there is less reason for schools to delay initiating robotics programs and work their way towards becoming equipt with both the tools and means it takes for students to discover a new passion. My hope is that this research teaches something new about the effects of robotics participation on students and that with that information we can learn from the fifth grade Eaglebots at Woodview Elementary in Napanee and inspire a new wave of robotics enthusiasts.

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791-8036, Japan, Hiura Elementary School 79-2 Kawanaka-cho, Matsuyama, Ehime 791-0132, Japan, and Hiroshima University 1-1-1 Kagamiyama, Higashihiroshima, Hiroshima 739-8524, Japan. (2017) “Robotics Programming Learning for Elementary and Junior High School Students.” *Journal of Robotics and Mechatronics* 29, no. 6: 992–98. https://doi.org/10.20965/jrm.2017.p0992.

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Appendix A

Robotic Meet Observation Notes (Dec. 4, 2021)

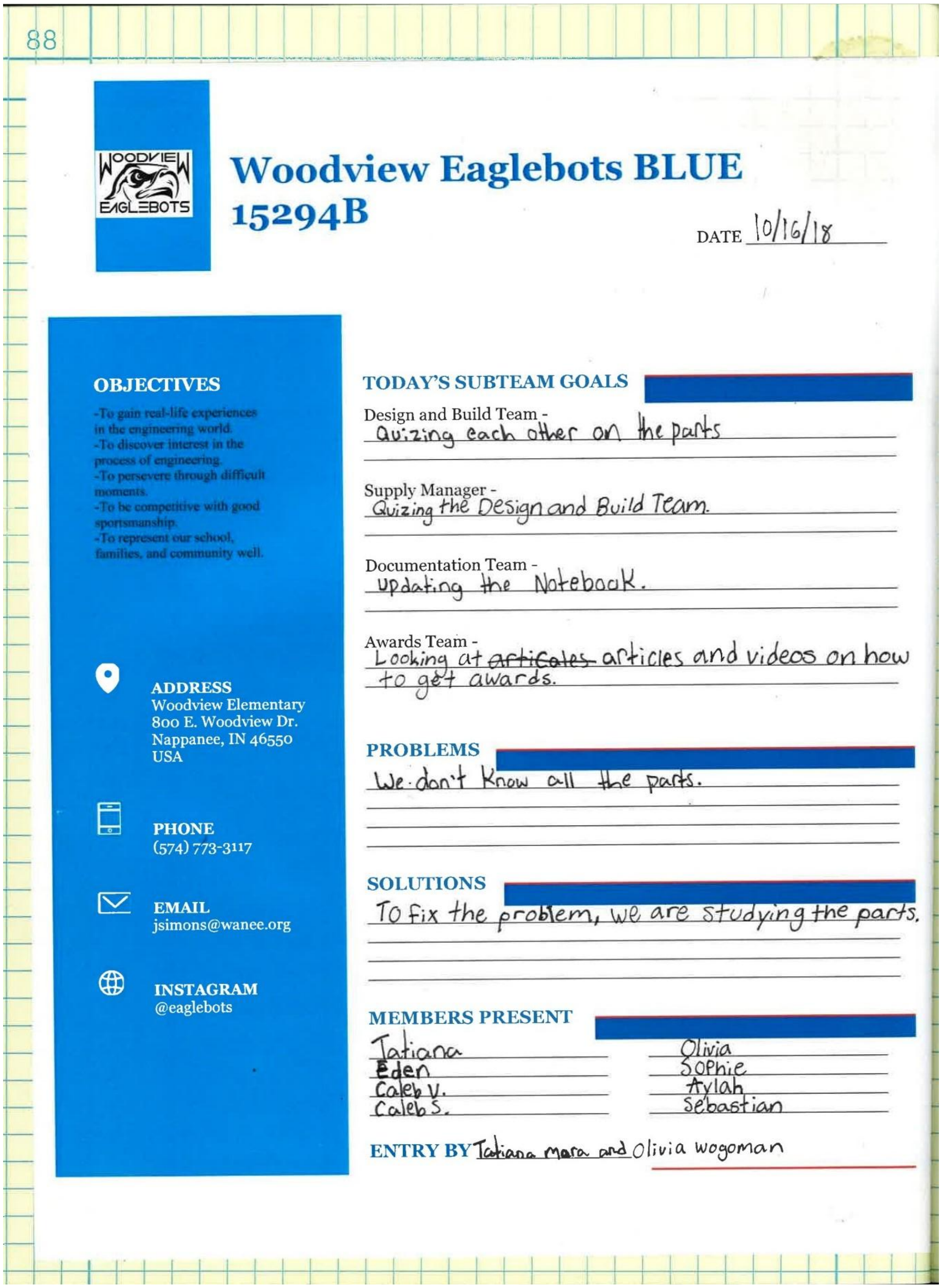
- Judges walk through rubric for scoring and interview the students to ask the way they designed their project and how they overcame obstacles
  - The purpose of these questions is to determine if the students made their robots or received outside help, which is grounds of disqualification
- Score from judges is based on design and the fine details of who is behind the process in the notebooks
- The preparation behind the scenes is what you don't get to see… students spend roughly two hours on each page of their engineering notebooks
- Blown away by kids from interviews, they act with class and are good speakers. The students are not intimidated by being questioned by adults and learning social skills while practicing STEM
- Notebooks were above and beyond, with attention fine details, drawings, graphs, coding, etc
- Coach Simon mentions the collaboration and teamwork that is necessary for students to be successful. Most often the students must maximize their points by working with the team they are competing against
- Students were so professional, personable, prepared, respectful, poised, serving their role, responsible
- Coaches (some volunteers) are invested and involved, leading the right way…but the kids are doing it all

- Community!!! The parents all mentioned the community that robotics has created for the school, the parents, and the kids.
- Students want to use their skills later in their personal life and vocationally. Two students who previously hated any subject in STEM now want to be an engineer and work at NASA as their dream jobs.
- Coach Simon argues that robotics is creating problem solvers who have to think on their feet during competitions and this translates to daily life.
- Before leaving, a parent pulled me aside to ask about my thesis and said his son hated school before starting robotics and begged not to go every day, but after becoming involved made friends, wants to read, and loves school. He credits it all to VEX.

Appendix B

2018-2019 Notebooks

Figure 3.1



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Woodview Eaglebots BLUE 15294B

DATE 10/16/18

OBJECTIVES

-To gain real-life experiences in the engineering world.
-To discover interest in the process of engineering.
-To persevere through difficult moments.
-To be competitive with good sportsmanship.
-To represent our school, families, and community well.

ADDRESS
Woodview Elementary
800 E. Woodview Dr.
Nappanee, IN 46550
USA

PHONE
(574) 773-3117

EMAIL
jsimons@wanee.org

INSTAGRAM
@eaglebots

TODAY'S SUBTEAM GOALS

Design and Build Team - Quizing each other on the parts

Supply Manager - Quizing the Design and Build Team.

Documentation Team - updating the Notebook.

Awards Team - Looking at ~~articales~~ articles and videos on how to get awards.

PROBLEMS

We don't know all the parts.

SOLUTIONS

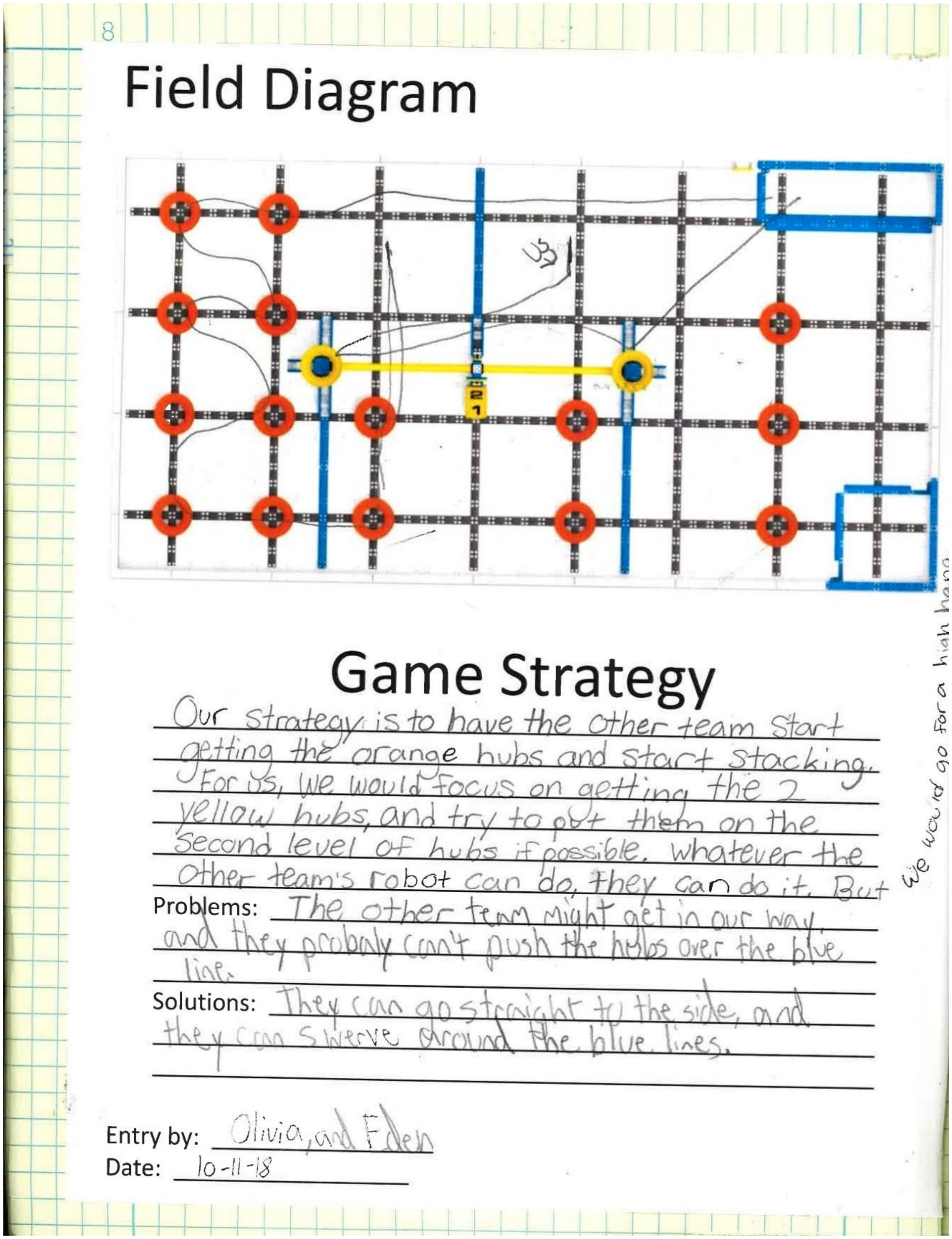
To fix the problem, we are studying the parts.

MEMBERS PRESENT

Tatiana
Eden
Caleb V.
Caleb S.
Olivia
Sophie
Aylah
Sebastian

ENTRY BY Tatiana Mara and Olivia Wogoman

Figure 3.2



Field Diagram

Game Strategy

Our strategy is to have the other team start getting the orange hubs and start stacking. For us, we would focus on getting the 2 yellow hubs, and try to put them on the second level of hubs if possible. whatever the other team's robot can do, they can do it. But

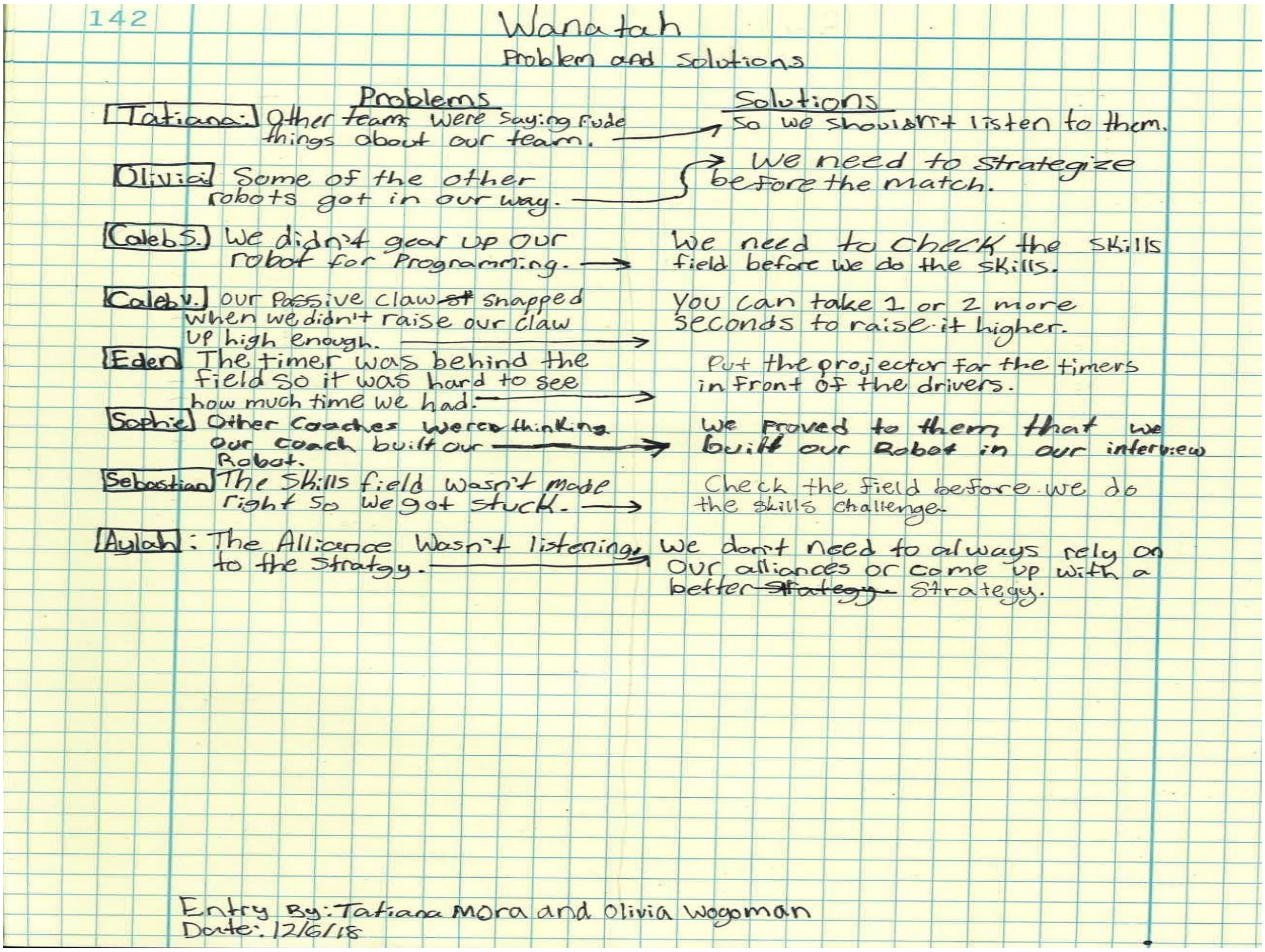
We would go for a high hang

Problems: The other team might get in our way, and they probaly can't push the hubs over the blue line.

Solutions: They can go straight to the side, and they can swerve around the blue lines.

Entry by: Olivia, and Eden
Date: 10-11-18

Figure 3.3



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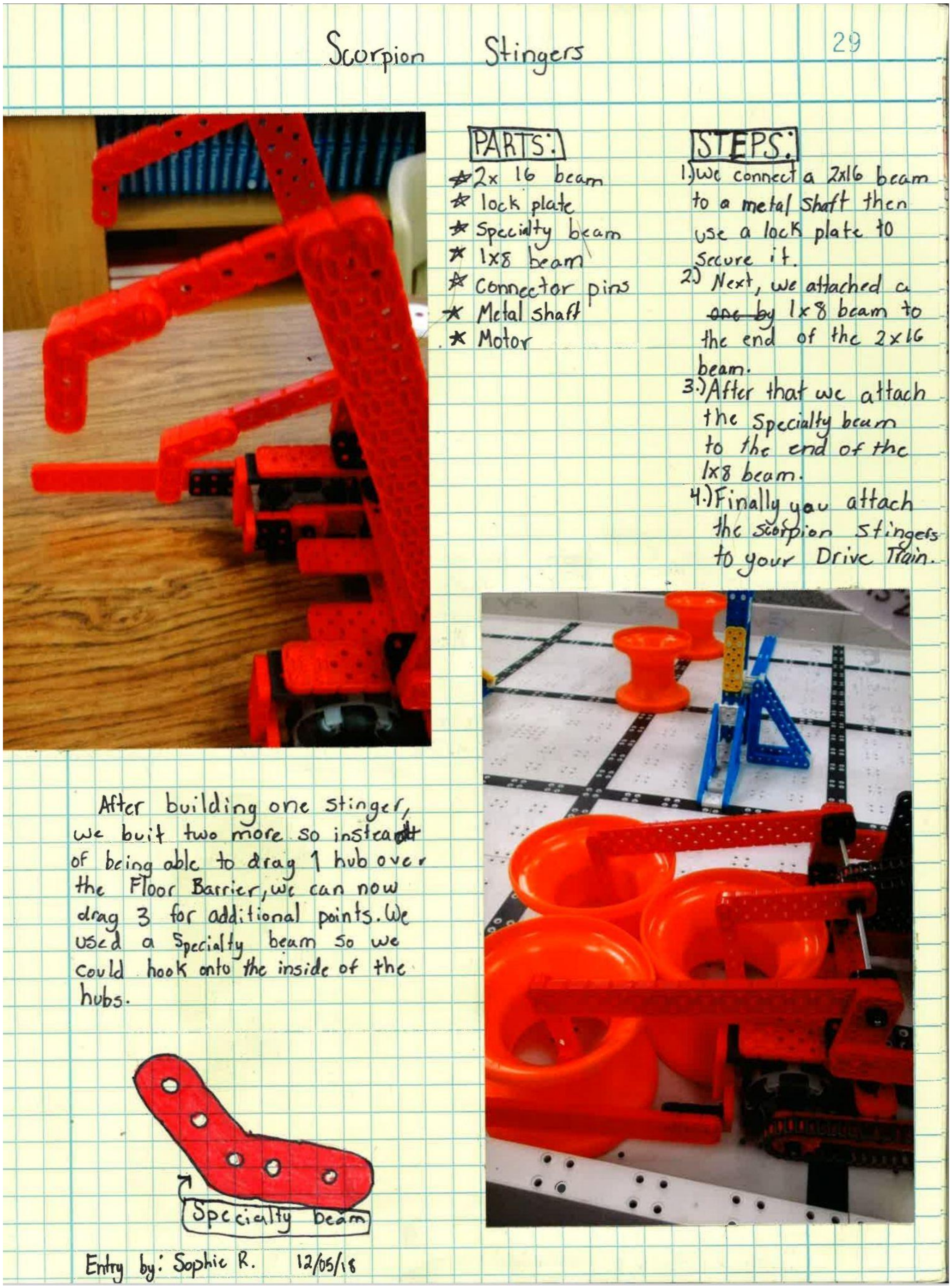
Wanatah

Problem and Solutions

	Problems	Solutions
Tatiana:	Other teams were saying rude things about our team.	So we shouldn't listen to them.
Olivia	Some of the other robots got in our way.	We need to strategize before the match.
Caleb S.	We didn't gear up our robot for Programming.	We need to check the skills field before we do the skills.
Caleb V.	our Passive claw ~~st~~ snapped when we didn't raise our claw up high enough.	You can take 1 or 2 more seconds to raise it higher.
Eden	The timer was behind the field so it was hard to see how much time we had.	Put the projector for the timers in front of the drivers.
Sophie	Other Coaches were thinking our coach built our Robot.	We proved to them that we built our Robot in our interview
Sebastian	The Skills field wasn't made right so we got stuck.	Check the field before we do the skills challenge
Aylah:	The Alliance wasn't listening to the Stratgy.	We don't need to always rely on our alliances or come up with a better ~~Strategy~~ Strategy.

Entry By: Tatiana Mora and Olivia Wogoman
Date: 12/6/18

Figure 3.4



Scorpion Stingers

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PARTS:

★ 2x 16 beam
★ lock plate
★ Specialty beam
★ 1x8 beam
★ Connector pins
★ Metal shaft
★ Motor

STEPS:

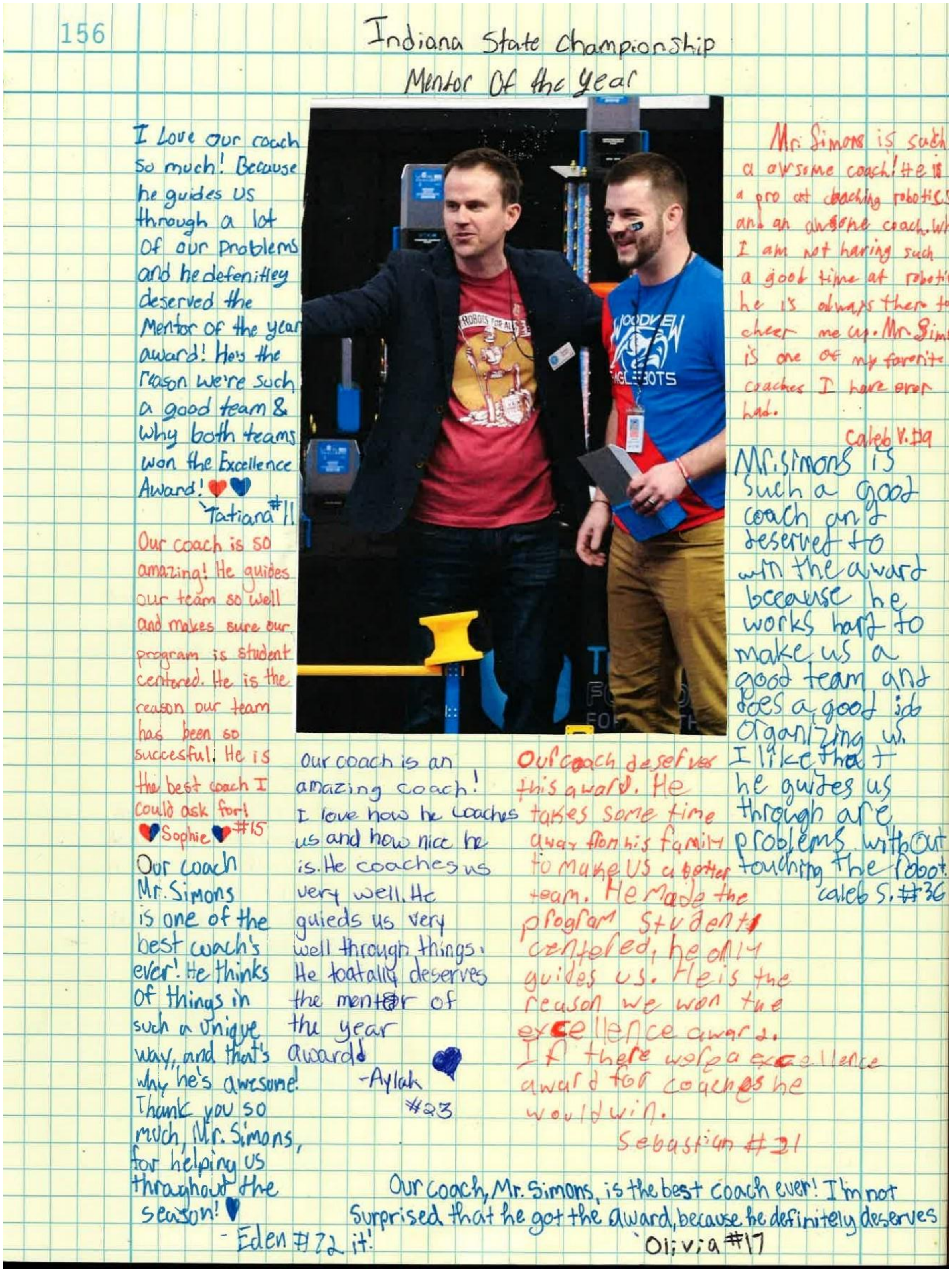
1.) We connect a 2x16 beam to a metal Shaft then use a lock plate to secure it.
2.) Next, we attached a ~~one by~~ 1x8 beam to the end of the 2x16 beam.
3.) After that we attach the Specialty beam to the end of the 1x8 beam.
4.) Finally you attach the Scorpion Stingers to your Drive Train.

After building one stinger, we buit two more so instead of being able to drag 1 hub over the Floor Barrier, we can now drag 3 for additional points. We used a Specialty beam so we could hook onto the inside of the hubs.

Specialty beam

Entry by: Sophie R. 12/05/18

Figure 3.5



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Indiana State Championship
Mentor Of the year

I Love our coach so much! Because he guides us through a lot of our problems and he defenitley deserved the Mentor of the year award! He's the reason we're such a good team & why both teams won the Excellence Award! ♥♥

Tatiana #11

Our coach is so amazing! He guides our team so well and makes sure our program is student centered. He is the reason our team has been so succesful. He is the best coach I could ask for!

♥Sophie♥ #15

Our coach Mr. Simons is one of the best coach's ever! He thinks of things in such a unique way, and that's why he's awesome! Thank you so much, Mr. Simons, for helping us throughout the season! ♥

- Eden #22

Our coach is an amazing coach! I love how he coaches us and how nice he is. He coaches us very well. He guieds us very well through things. He toatally deserves the mentor of the year award

-Aylah ♥
#23

Our coach deserves this award. He takes some time away from his family to make us a better team. He made the program student centered, he only guides us. He is the reason we won the excellence award. If there were a excellence award for coaches he would win.

Sebastian #21

Mr. Simons is such a awsome coach! He is a pro at coaching robotics and an awsome coach. Wh I am not having such a good time at roboti he is always ther to cheer me up. Mr. Sim is one of my favorite coaches I have ever had.

Caleb V. #9

Mr. simons is such a good coach and deserved to win the award because he works hard to make us a good team and does a good job organizing us. I like that he guides us through are problems without touching the robot.

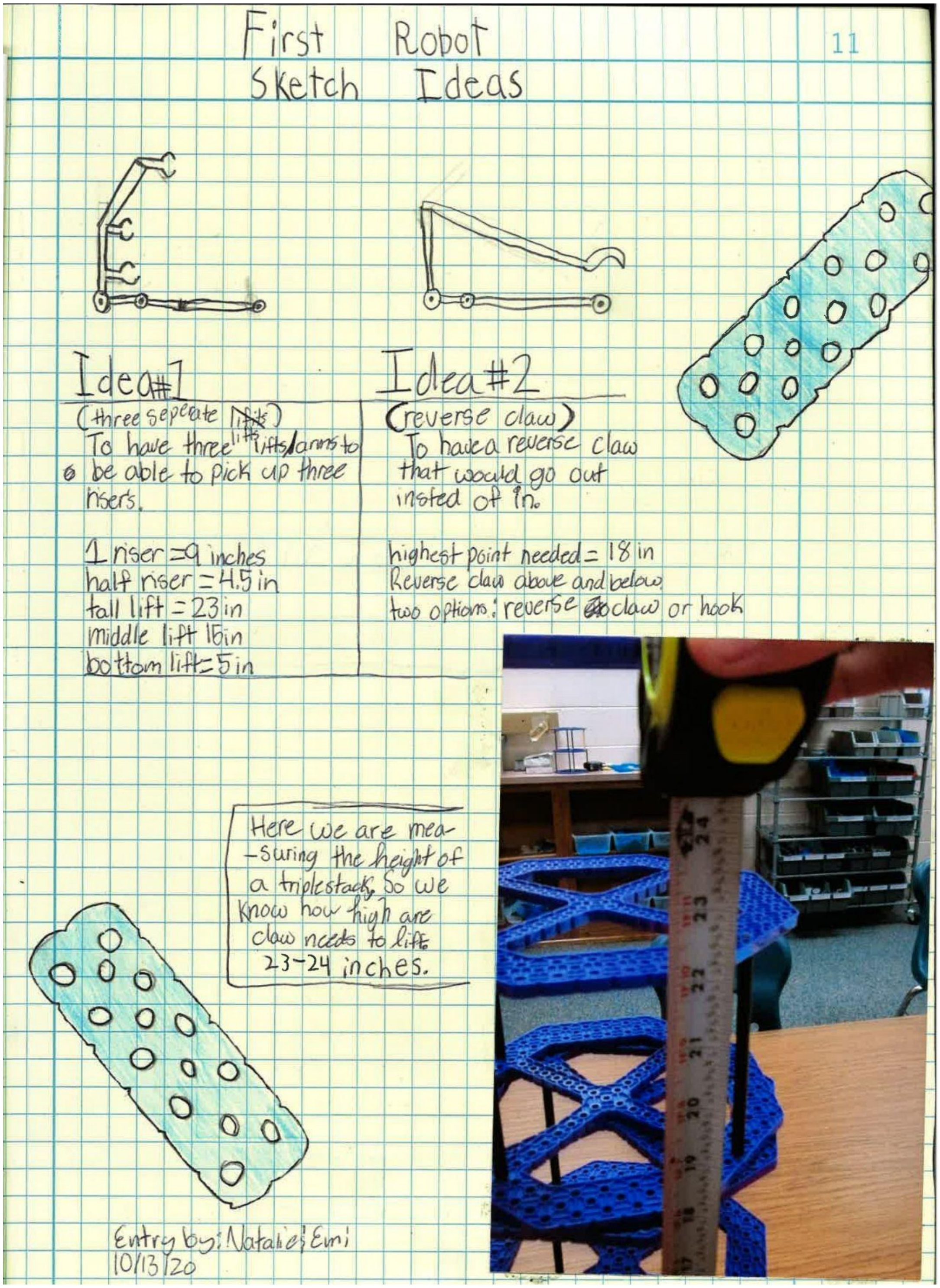
caleb S. #36

Our coach, Mr. Simons, is the best coach ever! I'm not surprised that he got the award, because he definitely deserves it!

`Olivia #17

2019-2020 Notebooks

Figure 3.6



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First Robot Sketch Ideas

Idea#1

(three seperate ~~lifts~~)
To have three lifts ~~lifts~~/arms to be able to pick up three risers.

1 riser =9 inches
half riser =4.5 in
tall lift =23 in
middle lift 15in
bottom lift=5 in

Idea#2

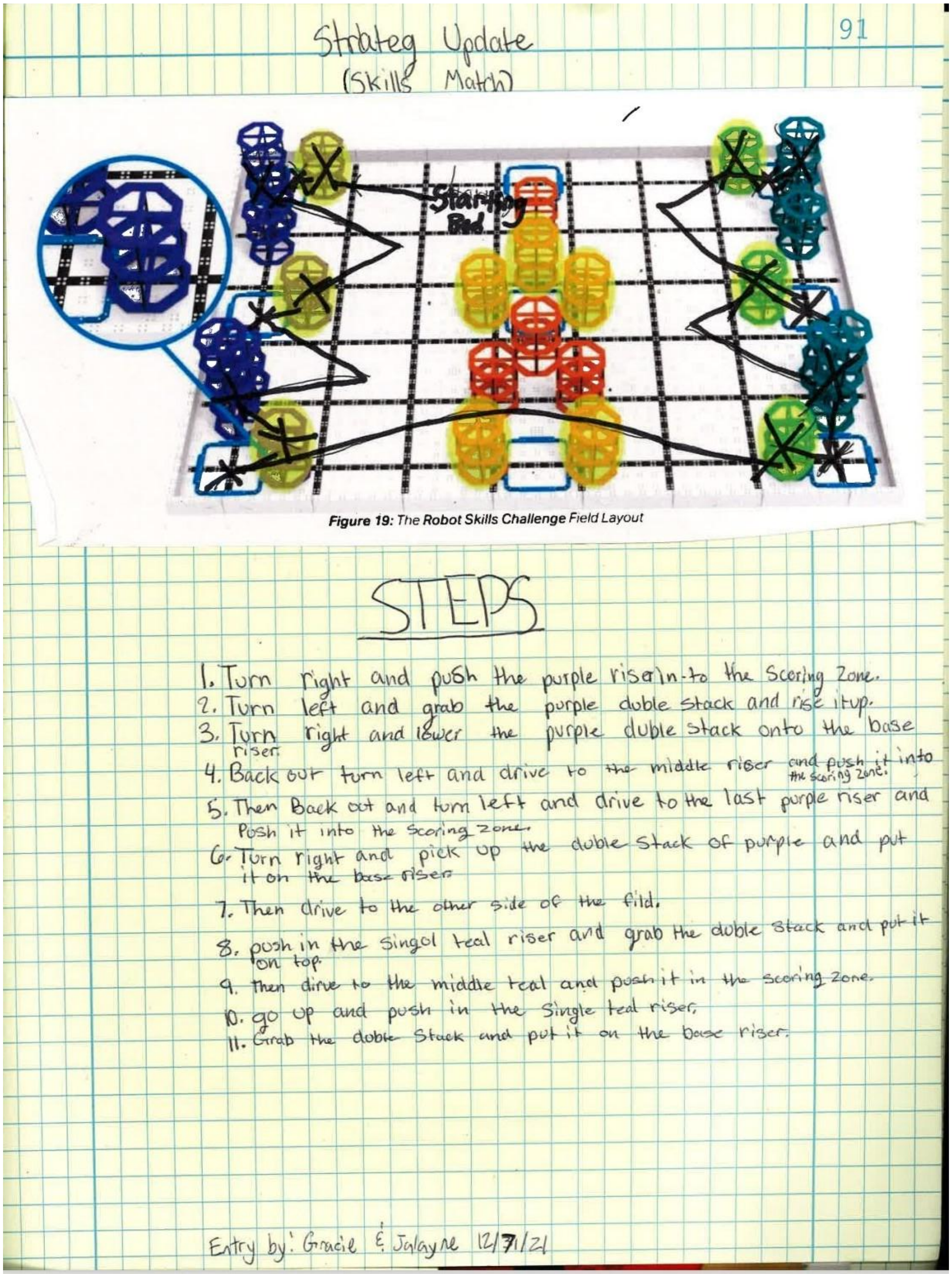
(reverse claw)
To have a reverse claw that would go out insted of in.

highest point needed = 18 in
Reverse claw above and below
two options: reverse claw or hook

Here we are mea-suring the height of a triplestack, So we know how high are claw needs to lift 23-24 inches.

Entry by: Natalie & Emi
10/13/20

Figure 3.7



Strateg Update
(Skills Match)

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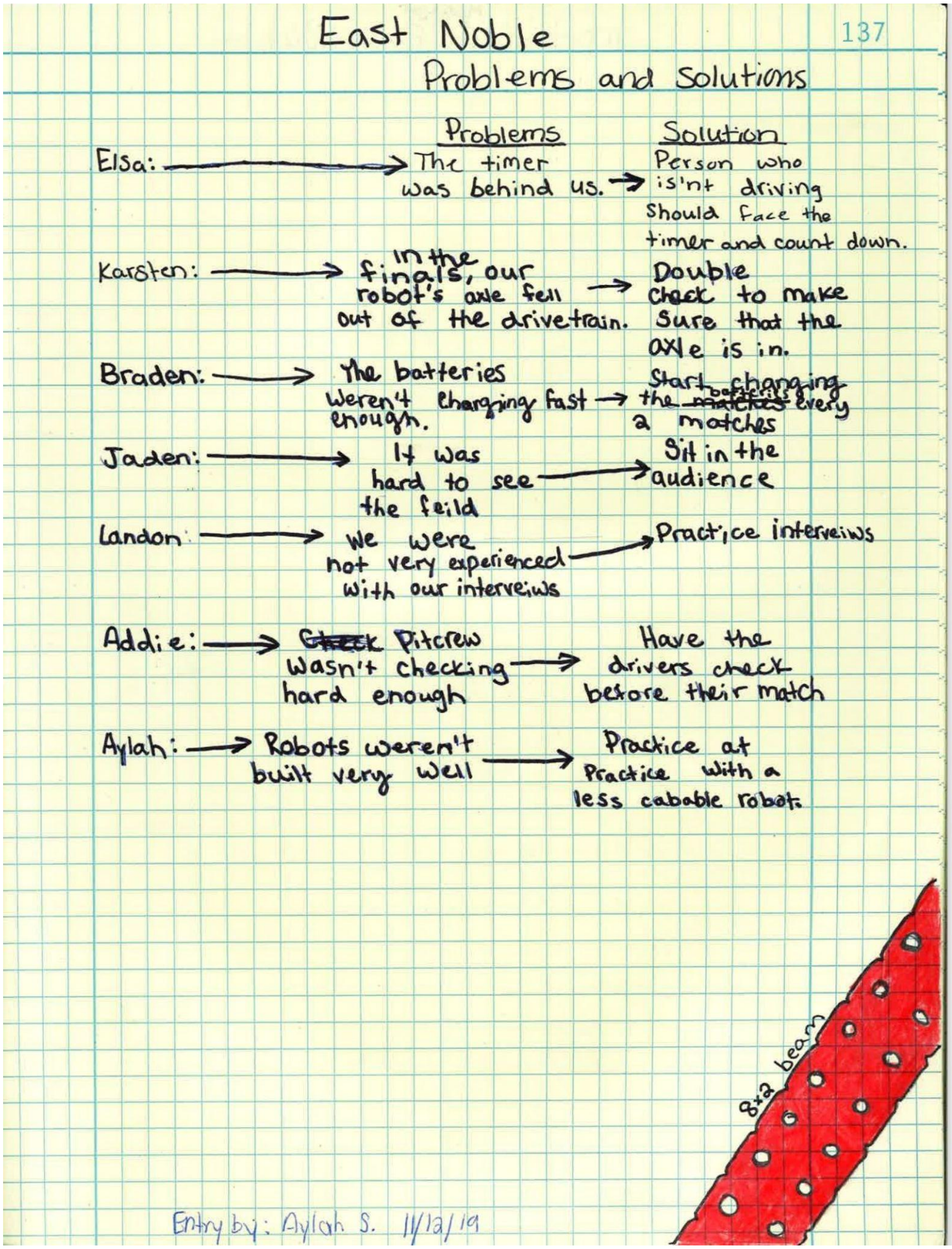
Figure 19: **The Robot Skills Challenge** *Field Layout*

STEPS

1. Turn right and push the purple riserin-to the Scoring Zone.
2. Turn left and grab the purple duble stack and rise itup.
3. Turn right and lower the purple duble stack onto the base riser.
4. Back out turn left and drive to the middle riser and push it into the scoring zone.
5. Then Back out and turn left and drive to the last purple riser and Push it into the Scoring zone.
6. Turn right and pick up the duble stack of purple and put it on the base riser
7. Then drive to the other side of the fild.
8. push in the singol teal riser and grab the duble stack and put it on top.
9. Then dirve to the middle teal and push it in the scoring zone.
10. go up and push in the single teal riser.
11. Grab the doble stack and put it on the base riser.

Entry by: Gracie & Jalayne 12/71/21

Figure 3.8



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East Noble
Problems and Solutions

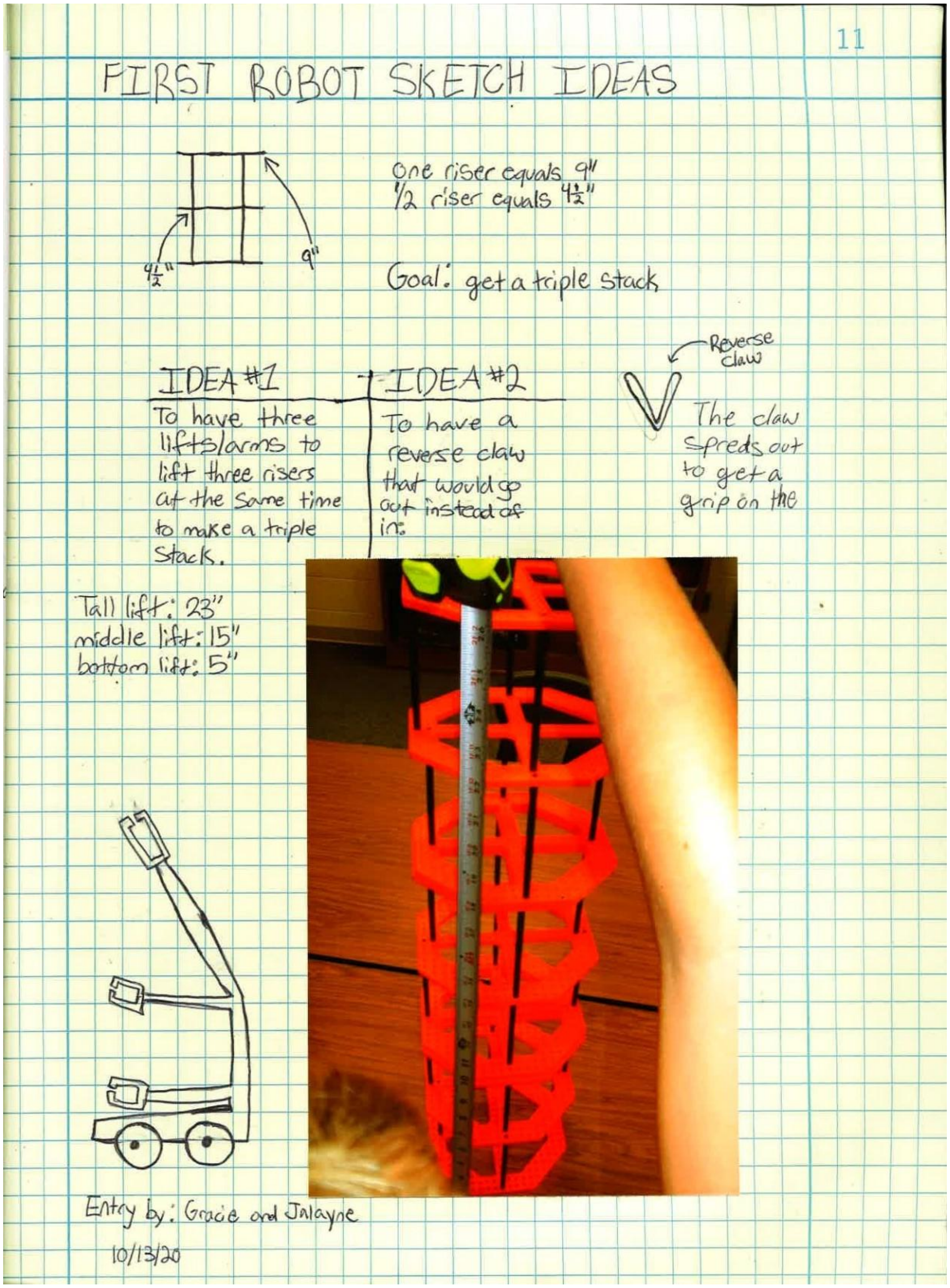
	Problems	Solution
Elsa:	The timer was behind us.	Person who is'nt driving Should face the timer and count down.
Karsten:	In the finals, our robot's axle fell out of the drivetrain.	Double Check to make Sure that the axle is in.
Braden:	The batteries weren't charging fast enough.	Start changing the ~~matches~~ batteries every 2 matches
Jaden:	It was hard to see the feild	Sit in the audience
Landon	We were not very experienced with our interveiws	Practice interveiws
Addie:	~~Check~~ Pitcrew wasn't checking hard enough	Have the drivers check before their match
Aylah:	Robots weren't built very well	Practice at Practice with a less cabable robot.

8x2 beam

Entry by: Aylah S. 11/12/19

2020-2021 Notebooks

Figure 3.9



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FIRST ROBOT SKETCH IDEAS

One riser equals 9"
½ riser equals 4½"

Goal: get a triple stack

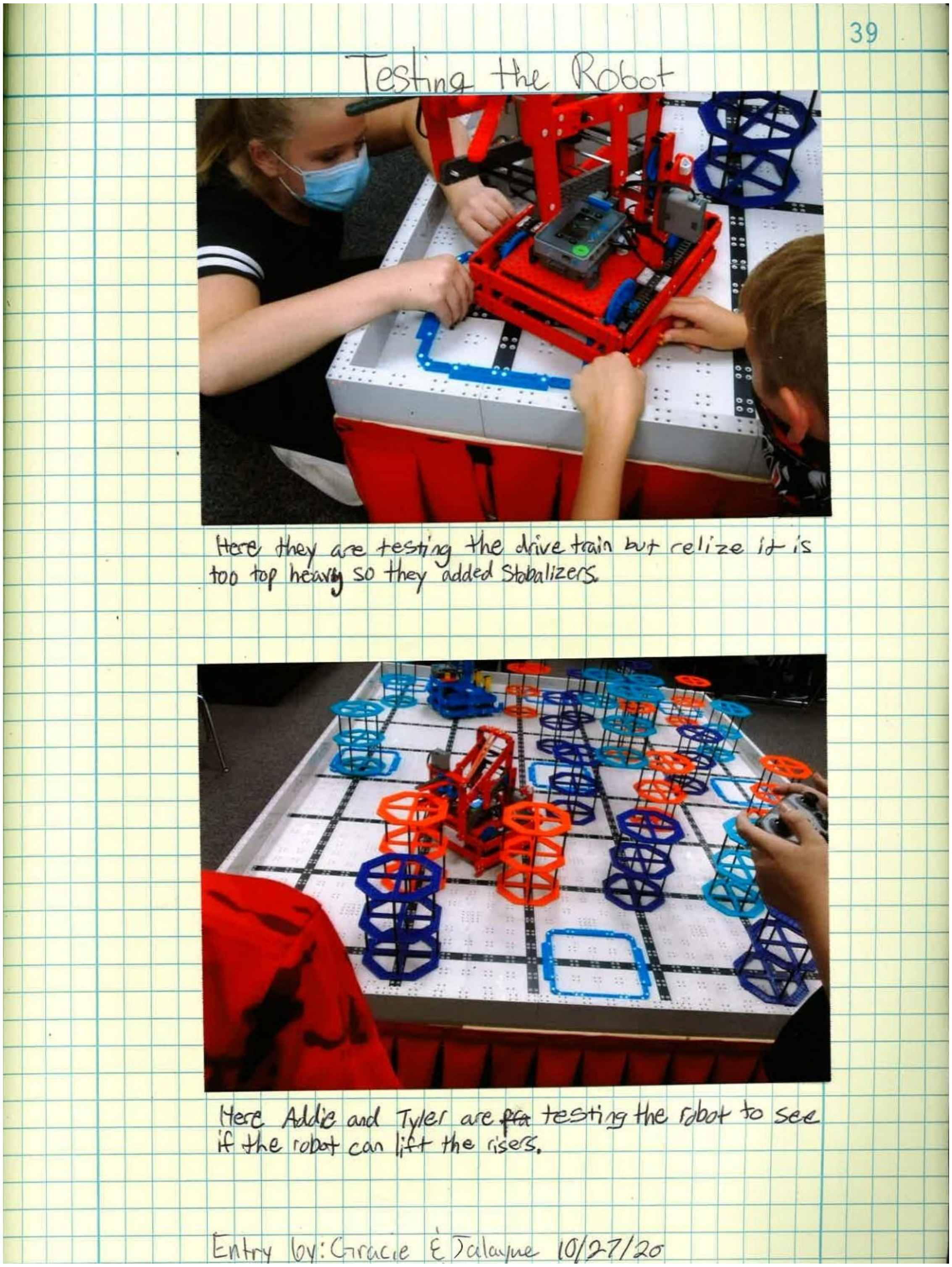
IDEA #1	IDEA #2
To have three lifts/arms to lift three risers at the same time to make a triple stack.	To have a reverse claw that would go out instead of in.

The claw spreds out to get a grip on the

Tall lift: 23"
middle lift: 15"
bottom lift: 5"

Entry by: Gracie and Jalayne
10/13/20

Figure 3.10



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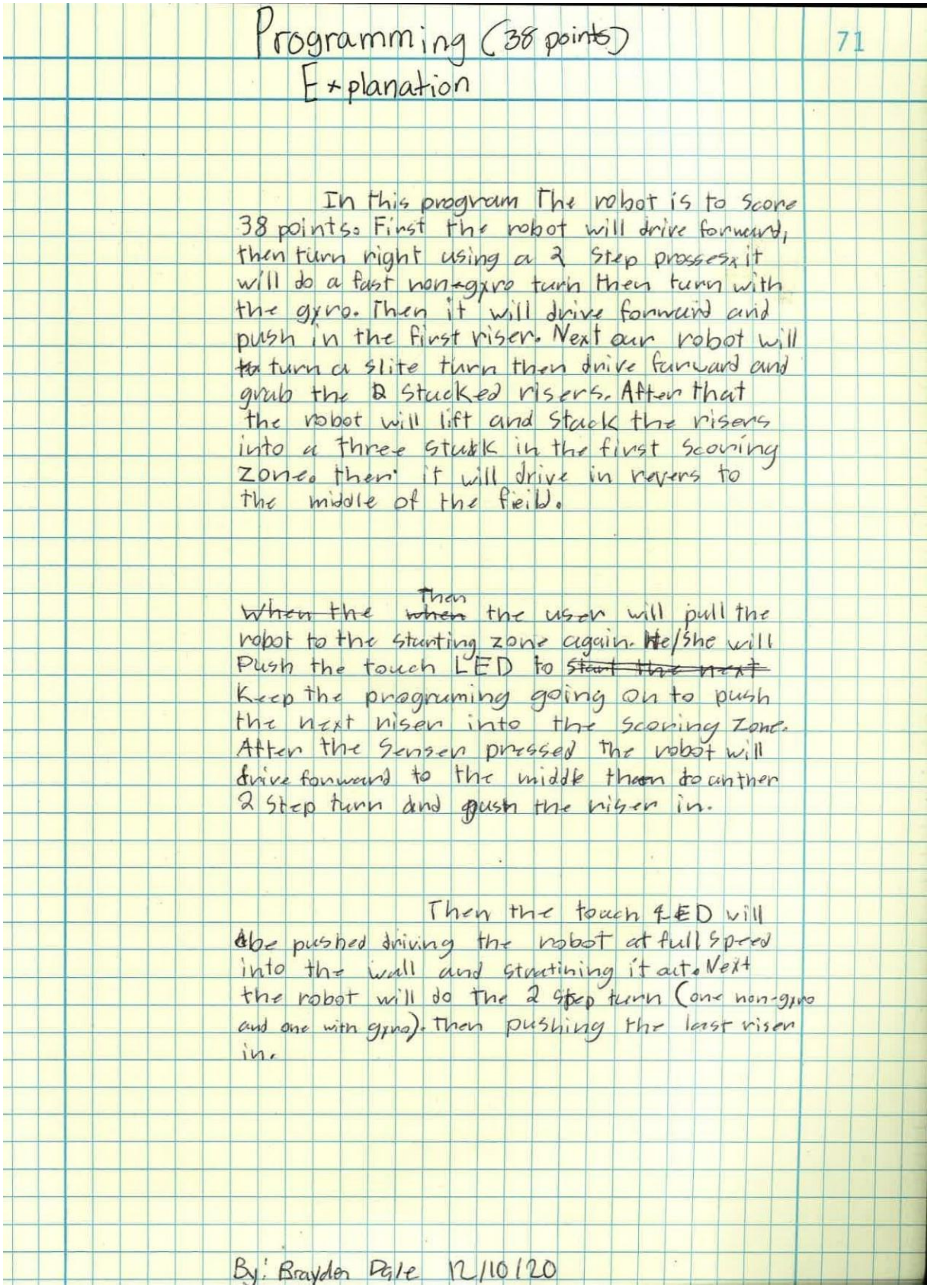
Testing the Robot

Here they are testing the drive train but relize it is too top heavy so they added Stabalizers.

Here Addie and Tyler are ~~pra~~ testing the robot to see if the robot can lift the risers.

Entry by: Gracie & Jalayne 10/27/20

Figure 3.11



Programming (38 points)
Explanation

71

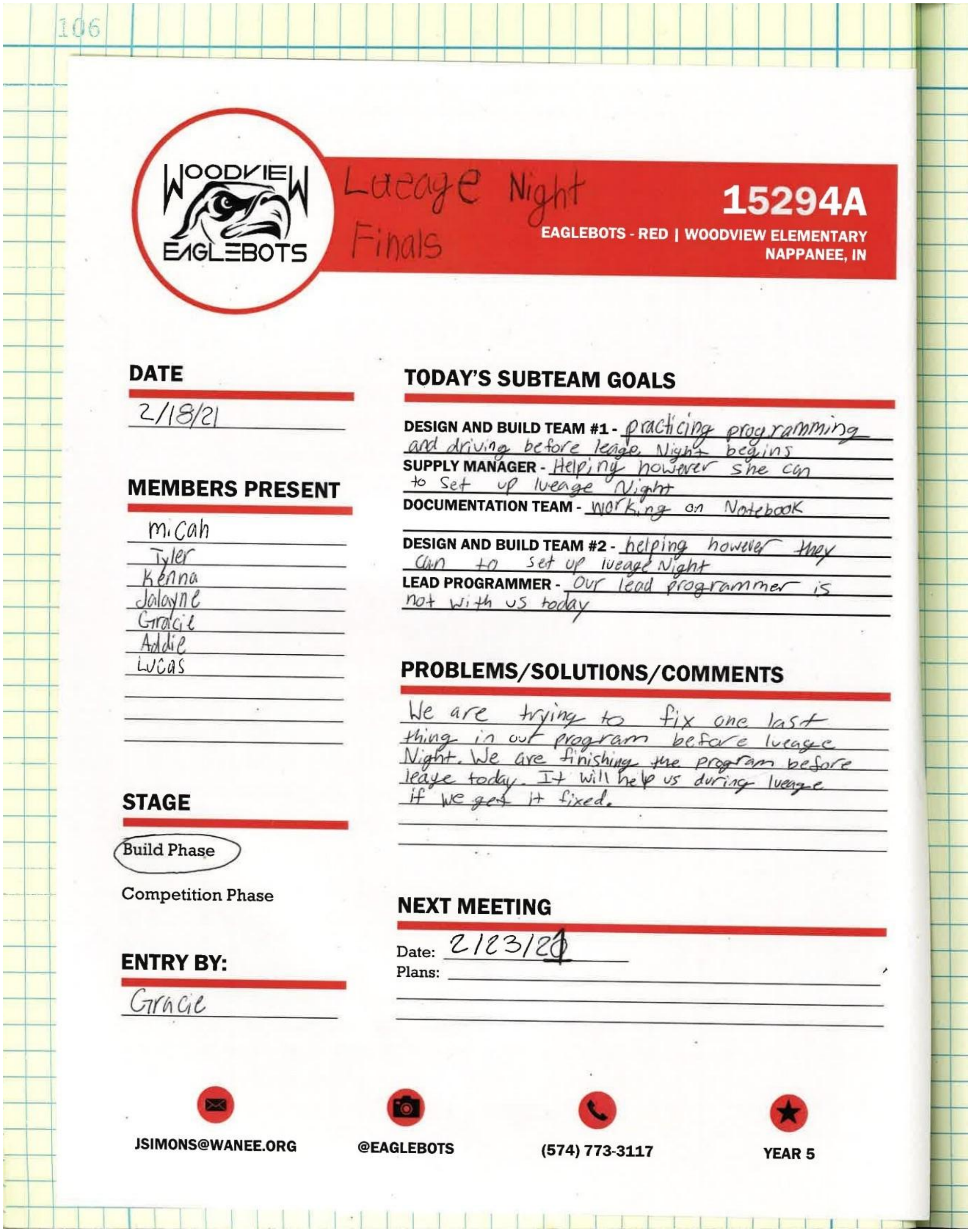
In this program The robot is to Score 38 points. First the robot will drive forward, then turn right using a 2 Step prosses, it will do a fast non-gyro turn then turn with the gyro. Then it will drive forward and push in the first riser. Next our robot will ~~to~~ turn a slite turn then drive forward and grab the 2 Stucked risers. After that the robot will lift and Stack the risers into a three Stuck in the first Scoring zone. then it will drive in revers to the middle of the feild.

~~When the~~ Then ~~when~~ the user will pull the robot to the starting zone again. He/she will Push the touch LED to ~~Start the next~~ Keep the programing going on to push the next riser into the scoring zone. After the Sensor pressed the robot will drive forward to the middle then do anther 2 Step turn and push the riser in.

Then the touch LED will be pushed driving the robot at full speed into the wall and straitining it out. Next the robot will do the 2 step turn (one non-gyro and one with gyro). Then pushing the last riser in.

By: Brayden Dale 12/10/20

Figure 3.12



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WOODVIEW EAGLEBOTS

Lueage Night Finals

15294A

EAGLEBOTS - RED | WOODVIEW ELEMENTARY
NAPPANEE, IN

DATE

2/18/21

MEMBERS PRESENT

Micah
Tyler
Kenna
Jalayne
Gracie
Addie
Lucas

STAGE

[✓ Build Phase]

Competition Phase

ENTRY BY:

Gracie

TODAY'S SUBTEAM GOALS

DESIGN AND BUILD TEAM #1 - practicing programming and driving before leage Night begins

SUPPLY MANAGER - Helping however she can to Set up lueage Night

DOCUMENTATION TEAM - working on Notebook

DESIGN AND BUILD TEAM #2 - helping however they can to set up lueage Night

LEAD PROGRAMMER - Our lead programmer is not with us today

PROBLEMS/SOLUTIONS/COMMENTS

We are trying to fix one last thing in our program before lueage Night. We are finishing the program before leage today. It will help us during lueage if we get it fixed.

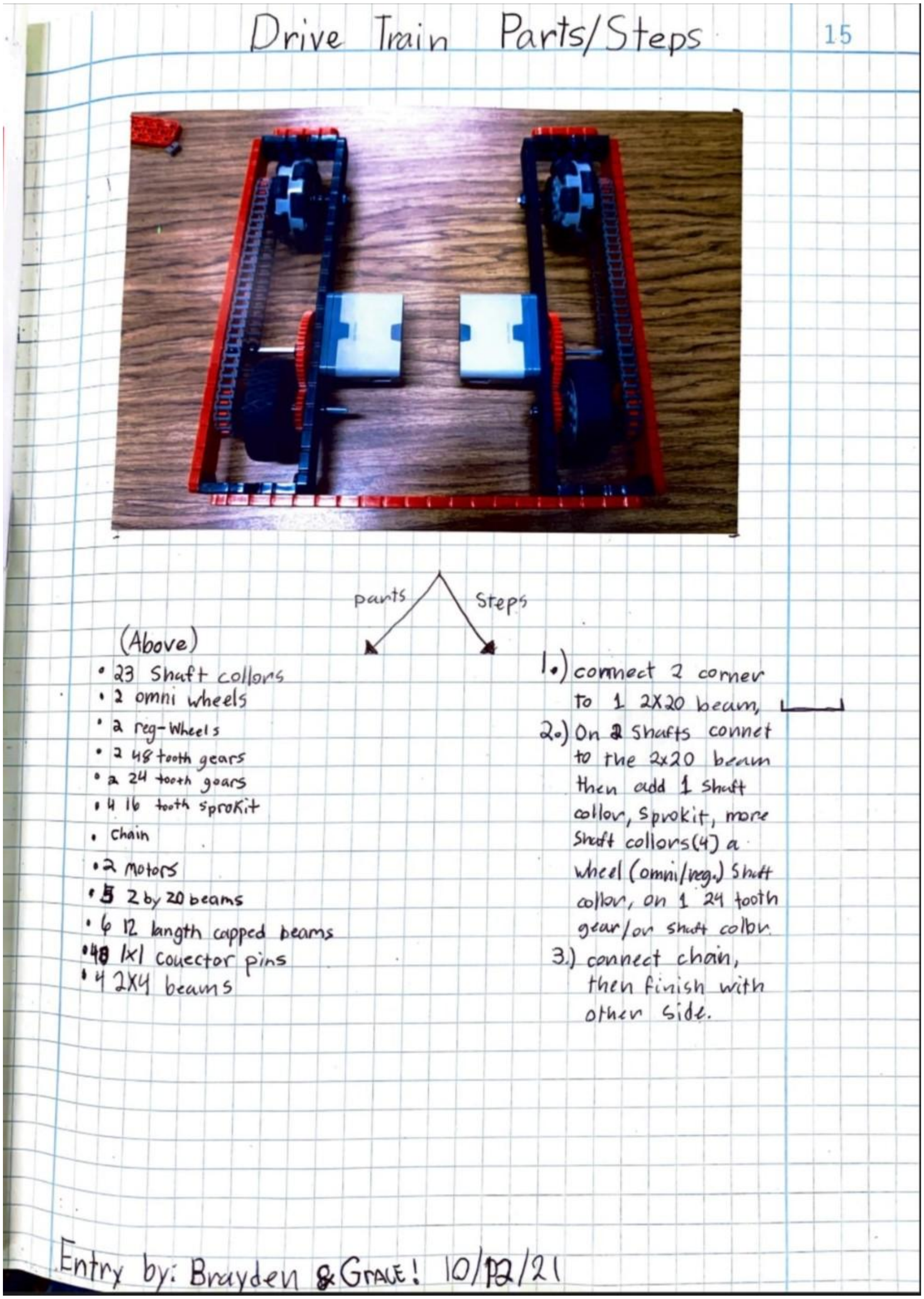
NEXT MEETING

Date: 2/23/21
Plans:

JSIMONS@WANEE.ORG @EAGLEBOTS (574) 773-3117 YEAR 5

Current Notebooks for the 2021-2022 Academic Year

Figure 3.13



Drive Train Parts/Steps

15

parts

Steps

(Above)

- 23 Shaft collors
- 2 omni wheels
- 2 reg-Wheels
- 2 48 tooth gears
- 2 24 tooth goars
- 4 16 tooth sproKit
- chain
- 2 motors
- 5 2 by 20 beams
- 6 12 langth capped beams
- 48 1x1 couector pins
- 4 2X4 beams

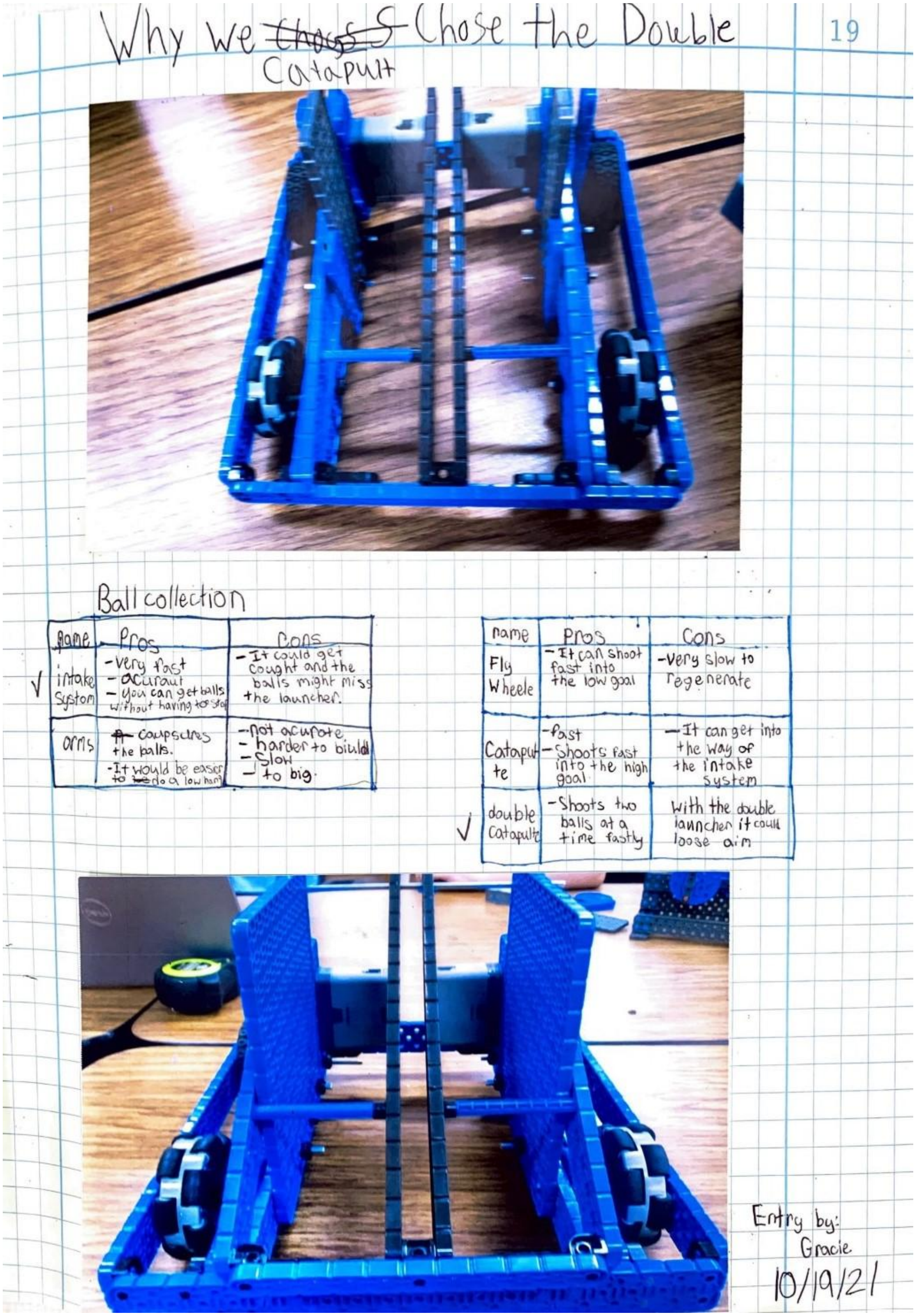
1.) connect 2 corner to 1 2X20 beam,

2.) On 2 Shafts connet to the 2x20 beam then add 1 Shaft collor, Sprokit, more Shaft collors(4) a wheel (omni/reg.) Shaft collor, on 1 24 tooth gear/or shaft collor.

3.) connect chain, then finish with other side.

Entry by: Brayden & Grace! 10/12/21

Figure 3.14



Why We ~~Chose S~~ Chose the Double Catapult

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Ball collection

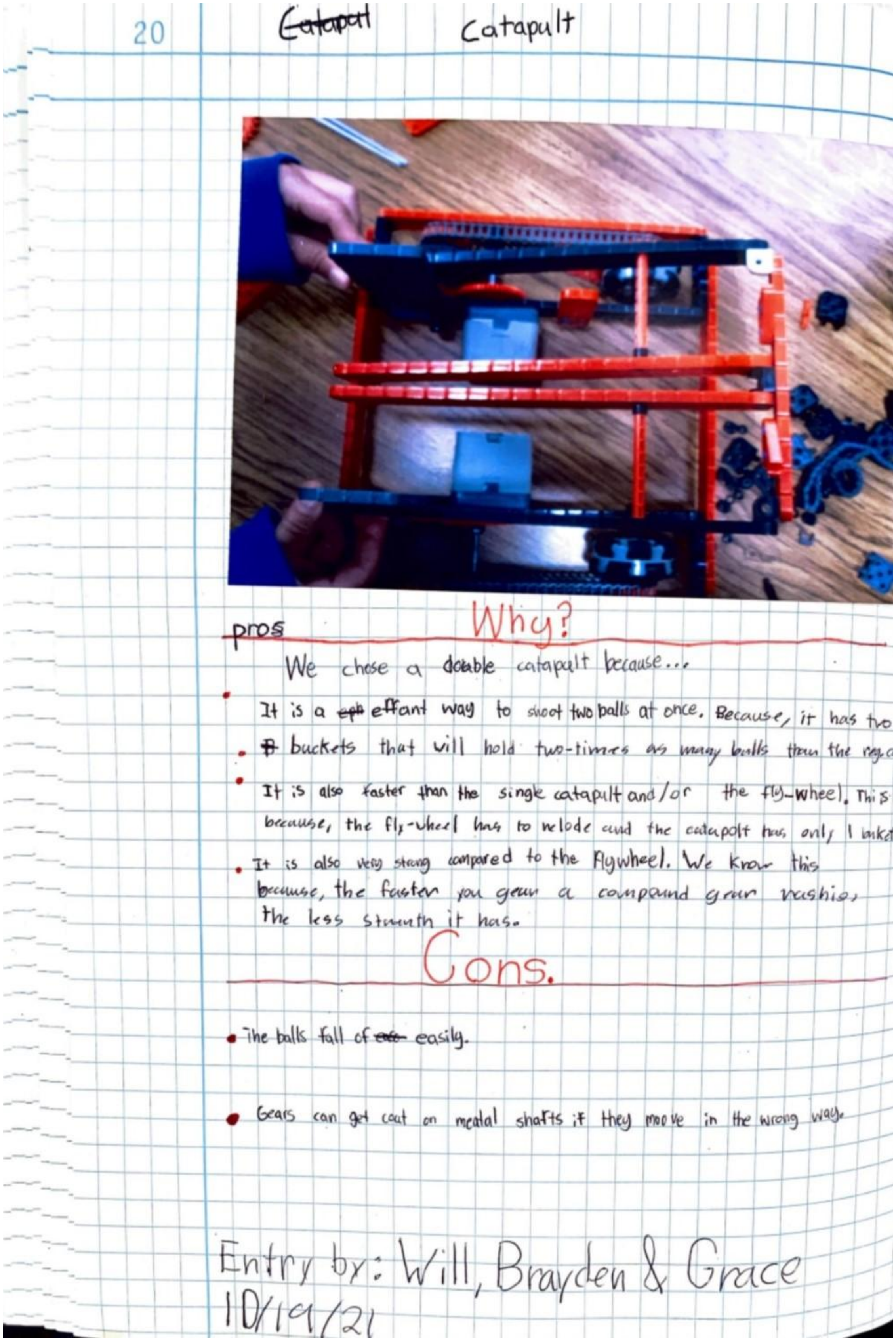
name	Pros	Cons
✓ intake System	-very fast -acuraut -you can get balls without having to stop	-It could get cought and the balls might miss the launcher.
arms	~~A~~ coupscures the balls. -It would be easier to ~~be~~ do a low ham	-not acurate -harder to biuld -Slow -to big.

name	Pros	Cons
Fly Wheele	-It can shoot fast into the low goal	-Very slow to regenerate
Catapute	-fast -Shoots fast into the high goal	-It can get into the way of the intake system
✓ double Catapult	-Shoots two balls at a time fastly	With the double launcher it could loose aim

Entry by: Gracie

10/19/21

Figure 3.15



20 ~~Catapult~~ Catapult

pros Why?

We chose a double catapult because...

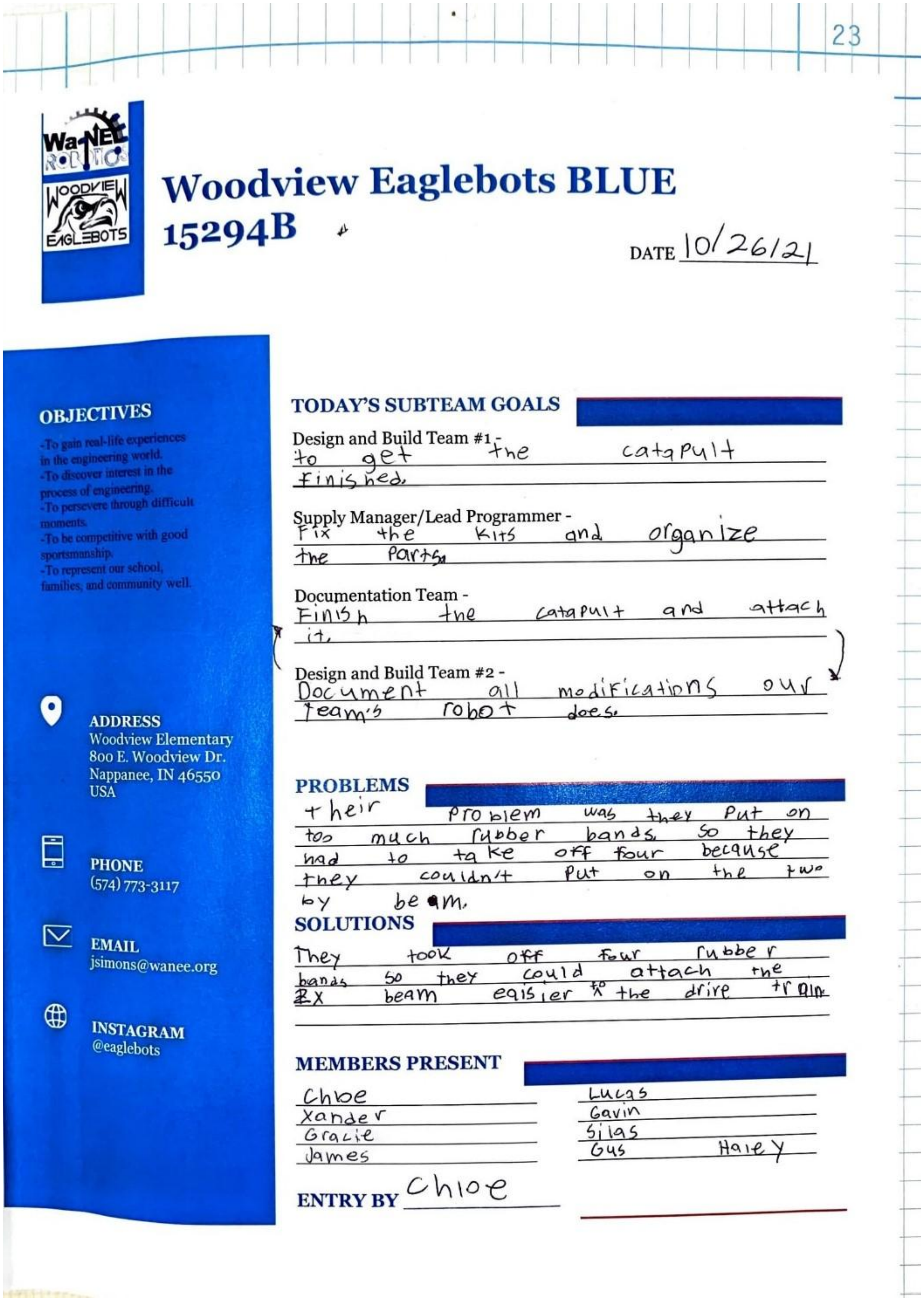
- It is a ~~eph~~ effant way to shoot two balls at once. Because, it has two ~~B~~ buckets that will hold two-times as many balls than the reg
- It is also faster than the single catapult and/or the fly-wheel. This because, the fly-wheel has to relode and the catapolt has only 1 bake
- It is also very strong compared to the flywheel. We know this because, the faster you gear a compound gear mashie, the less strunth it has.

Cons.

- The balls fall of ~~eas~~ easily.
- Gears can get caut on metal shafts if they move in the wrong way.

Entry by: Will, Brayden & Grace
10/19/21

Figure 3.16



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Woodview Eaglebots BLUE
15294B

DATE 10/26/21

OBJECTIVES

-To gain real-life experiences in the engineering world.
-To discover interest in the process of engineering.
-To persevere through difficult moments.
-To be competitive with good sportsmanship.
-To represent our school, families, and community well.

ADDRESS
Woodview Elementary
800 E. Woodview Dr.
Nappanee, IN 46550
USA

PHONE
(574) 773-3117

EMAIL
jsimons@wanee.org

INSTAGRAM
@eaglebots

TODAY'S SUBTEAM GOALS

Design and Build Team #1 - to get the catapult finished.

Supply Manager/Lead Programmer - Fix the kits and organize the parts.

Documentation Team - Finish the catapult and attach it.

Design and Build Team #2 - Document all modifications our team's robot does.

PROBLEMS

their problem was they put on too much rubber bands. so they had to take off four because they couldn't put on the two by beam.

SOLUTIONS

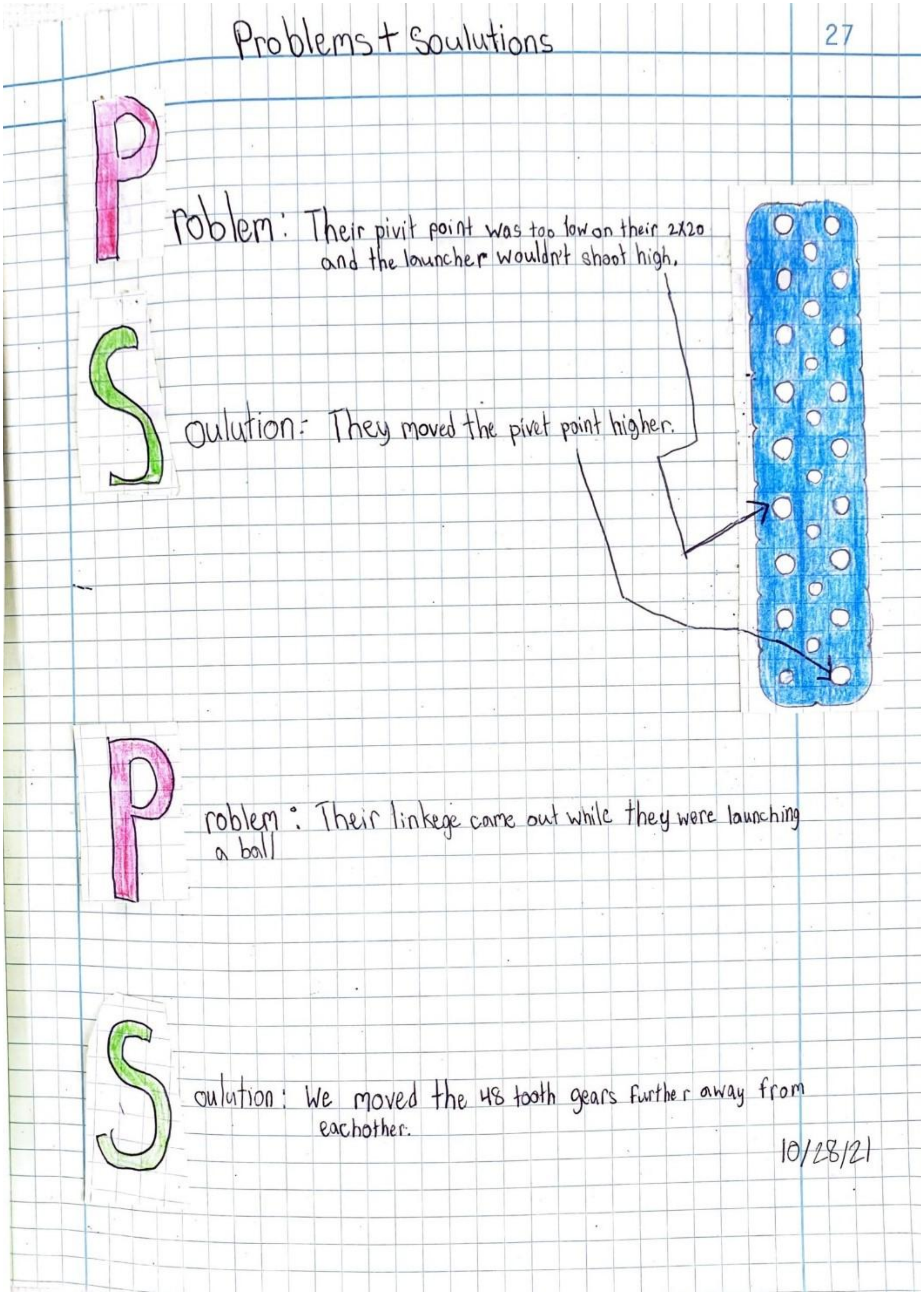
They took off four rubber bands so they could attach the 2x beam eaisier to the drive train

MEMBERS PRESENT

Chloe
Xander
Gracie
James
Lucas
Gavin
Silas
Gus Haley

ENTRY BY Chloe

Figure 3.17



Problems + Soulutions

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Problem: Their pivit point was too low on their 2X20 and the launcher wouldn't shoot high.

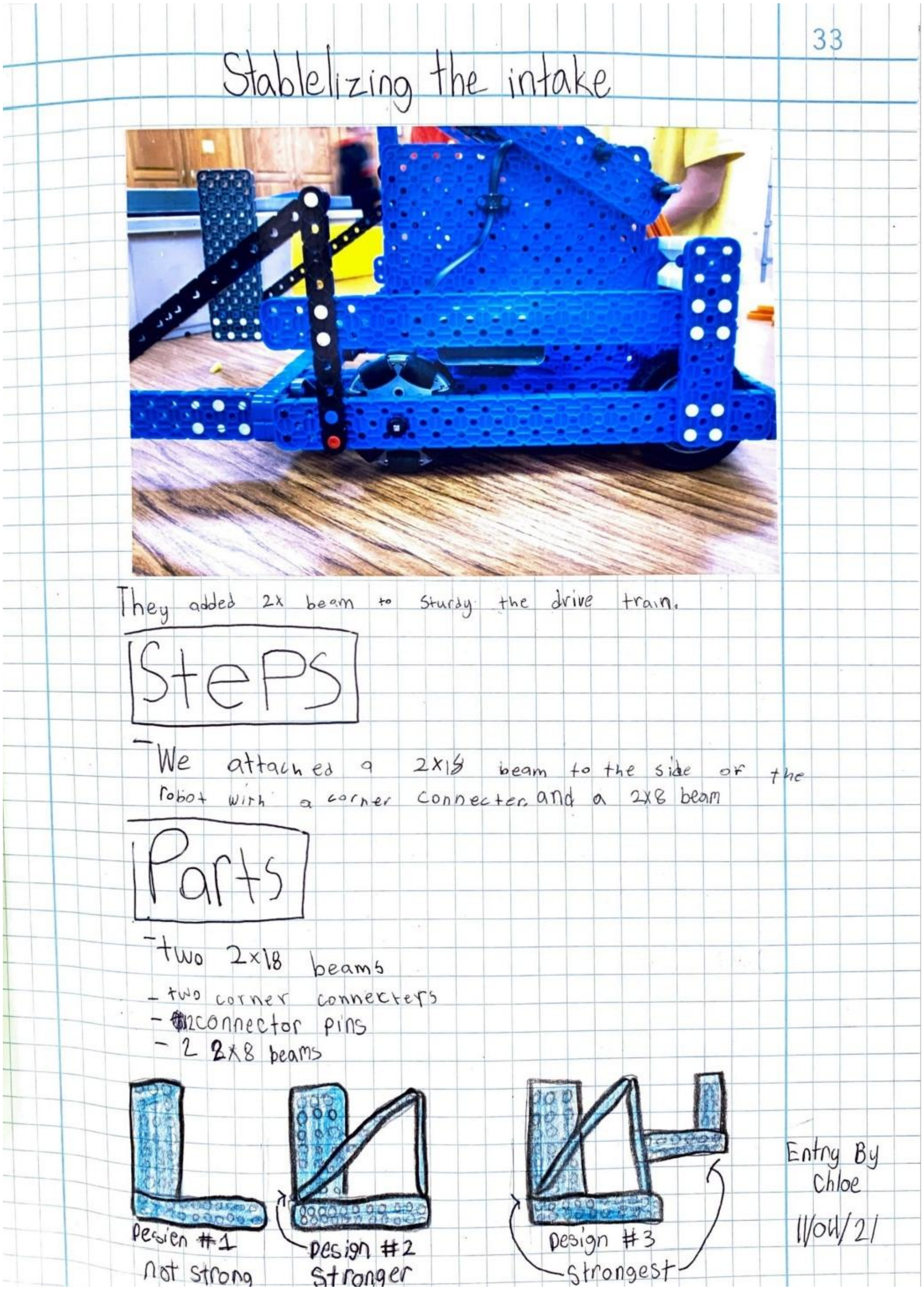
Soulution: They moved the pivet point higher.

Problem: Their linkege came out while they were launching a ball

Soulution: We moved the 48 tooth gears further away from eachother.

10/28/21

Figure 3.18



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Stablelizing the intake

They added 2x beam to sturdy the drive train.

Steps

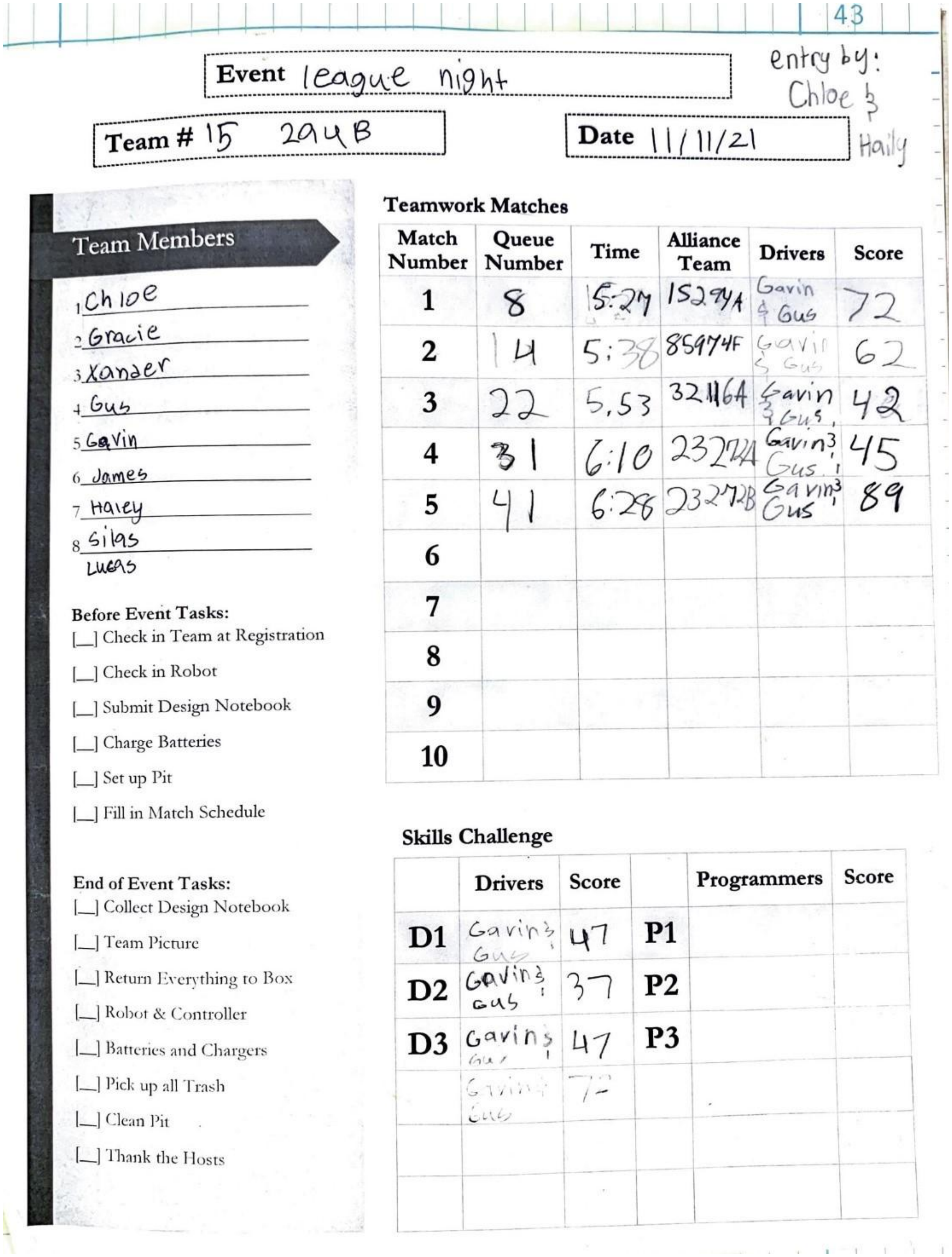
-We attached a 2x18 beam to the side of the robot with a corner connecter and a 2x8 beam

Parts

-two 2x18 beams
- two corner connecters
- 2connector pins
- 2 2x8 beams

Entry By
Chloe
11/04/21

Figure 3.19



Event league night

entry by:
Chloe &
Haily

Team # 15 294B

Date 11/11/21

Team Members

1. Chloe
2. Gracie
3. Xander
4. Gus
5. Gavin
6. James
7. Haley
8. Silas

Lucas

Before Event Tasks:

☐ Check in Team at Registration

☐ Check in Robot

☐ Submit Design Notebook

☐ Charge Batteries

☐ Set up Pit

☐ Fill in Match Schedule

End of Event Tasks:

☐ Collect Design Notebook

☐ Team Picture

☐ Return Everything to Box

☐ Robot & Controller

☐ Batteries and Chargers

☐ Pick up all Trash

☐ Clean Pit

☐ Thank the Hosts

Teamwork Matches

Match Number	Queue Number	Time	Alliance Team	Drivers	Score
1	8	5:27	15294A	Gavin & Gus	72
2	14	5:38	85974F	Gavin & Gus	62
3	22	5,53	32116A	Gavin & Gus	42
4	31	6:10	23272A	Gavin & Gus	45
5	41	6:28	23272B	Gavin & Gus	89
6					
7					
8					
9					
10					

Skills Challenge

	Drivers	Score		Programmers	Score
D1	Gavin & Gus	47	P1		
D2	Gavin & Gus	37	P2		
D3	Gavin & Gus	47	P3		
	Gavin & Gus	72			