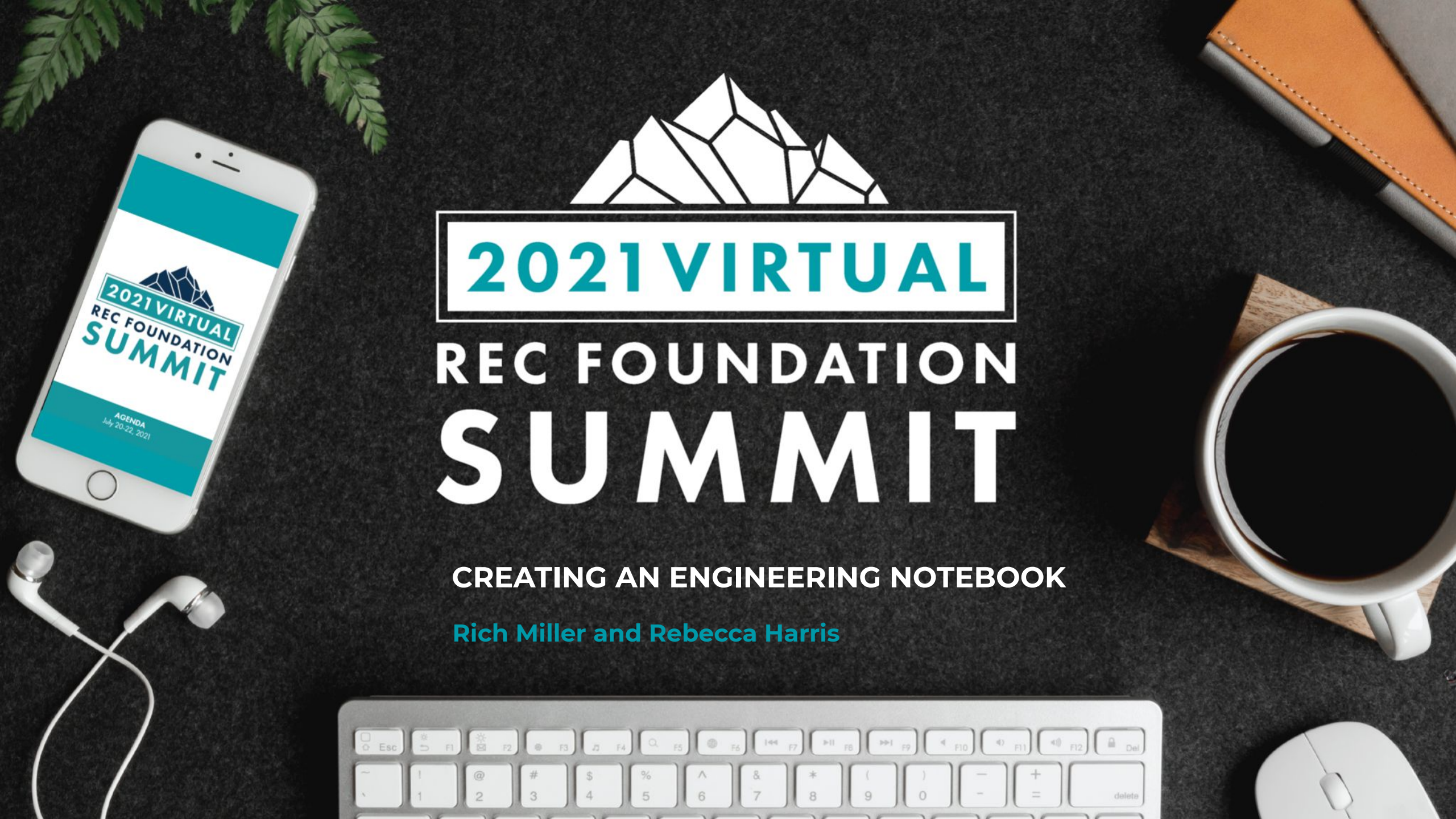


2021 VIRTUAL REC FOUNDATION SUMMIT

CREATING AN ENGINEERING NOTEBOOK

Rich Miller and Rebecca Harris

WHERE TO BEGIN. . .

3 most asked questions by coaches:

How do we get started?

We're going to answer that!

Mostly...set goals!

How do we get students to keep working?

Teach kids the benefit of notebooks

Not about the awards but the history and processes

If we learn something new should we start over?

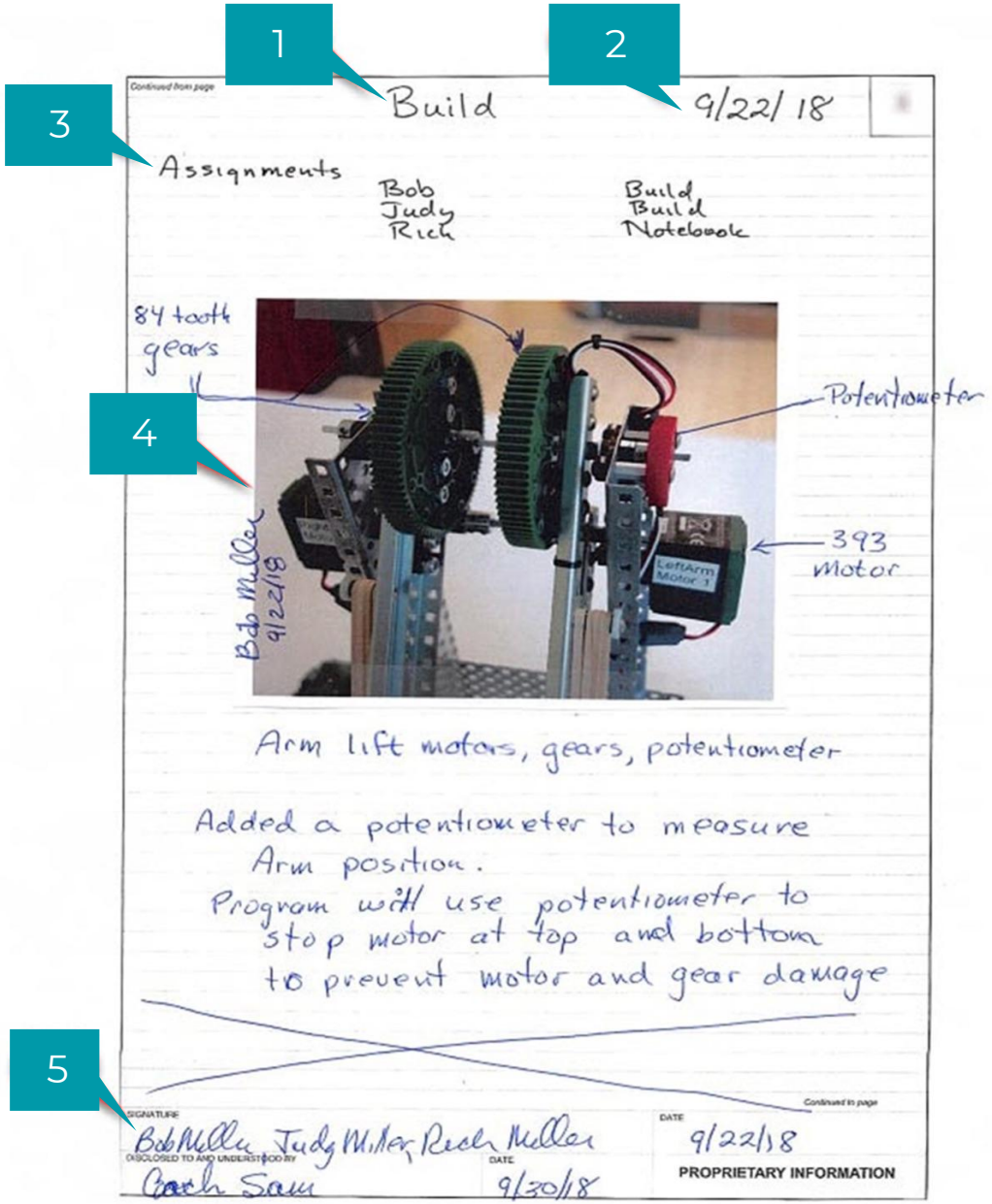
Absolutely not!

Progression, learning, and advancement

LEVELS OF ENGINEERING NOTEBOOK MASTERY

EDP = Engineering Design Process

Level	Description
1	Basic notebook practices
2	Organizing for judging (design award rubric)
3	Developing skills for EDP, goals, and planning
4	Skilled at EDP, goals, planning, and management
5	Mastery of EDF, goals, planning, and management



BASIC PRACTICES

LEVEL 1 - Notebook Practices

- ✔ Title is the type of work completed (always at the top!)
- ✔ Date the page was started/completed on every page
- ✔ List team members who worked that day
- ✔ All work completed that day - more detail = better
- ✔ Sign and date any items pasted or taped on page
- ✔ “X-out” any empty space
- ✔ Writer signs entry and a team member must witness

Design Award Rubric

Page 1 — *Engineering Notebook Review*

Rubrics are strictly confidential; they are not shared beyond the Judges/Judge Advisor and shall be destroyed at the end of the event.

Team #: _____

Program level: ☐ Elementary ☐ Middle ☐ High or VEX U

Judges: _____

Directions: Write the points in each row for the criterion that best describes the performance of the Engineering Notebook on each topic. Total the points.

	Topic	Criteria			Points
		Expert *(4-5 points)*	**Proficient** *(2-3 points)*	**Emerging** *(0-1 points)*	
ign Process	Identify game and robot design challenges and goals	Identifies the game challenge or robot design challenge in detail at the start of each design process cycle with words and pictures. States the goals for accomplishing the challenge.	Identifies the challenge at the start of each design cycle. Lacking details in words, pictures, or goals.	Does not identify the challenge at the start of each design cycle.	
	Brainstorm and diagram or prototype solutions	Lists three or more possible solutions to the challenge with labeled diagrams. Citations provided for ideas that came from outside sources such as online videos or other teams.	Lists one or two possible solutions to the challenge. No citations provided for ideas that came from outside sources.	Does not list any solutions to the challenge.	
	Select the best solution	Explains why the solution was selected through testing and/or a decision matrix. Fully	Explains why the solution was selected. Mentions the plan.	Does not explain why the solution was	

ORGANIZING THE NOTEBOOK

LEVEL 2 - The Design Award Rubric

ORGANIZING THE NOTEBOOK

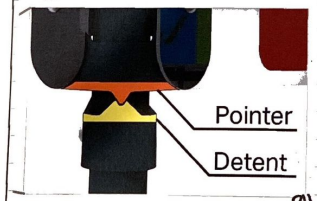
LEVEL 2 - What does the design award rubric mean?

Rubric Topic - Challenge or Problem	The Reader's Questions
Identifies the game challenge or robot design challenge in detail at the start of each design process cycle with words and pictures. States the goals for accomplishing the challenge.	▢ Is the challenge defined at the beginning of each cycle? ▢ Are other challenges defined after the initial challenge? ▢ What goals are stated or defined?

6 Continued from page 5

Analysis of Game Elements: Flags

- Flag dimentions:
  - width: 9.9"
  - height: 6.00"
- Flags have 2 sides (1 red 1 blue) with a pointer between
- A flag is toggled when the pointer is at of the detent on either side
- observations:
  - the flags are quite large and flexible
  - the pointers/detents are soft plastic
  - initially I thought the pointers would wear down so I asked on the forum and Grant Cox responded with how they tested it at vex →
  - the flags also require a lot of force to push out of the detent



RH

Grant Cox May 17 Administrator ANSWER Greenville, TX Edited 2 months ago by Grant Cox

So, this is actually something that we were very concerned about during the game design process as well, as robustness and consistency between events is key for a dynamic field element like this. So, we built a test bed out of VEX IQ parts.

This tester ran for about 3 weeks continuously, stopping only for battery changes, for a total of ~10,000 toggles. The detent and pointer were definitely a bit rounded down at the end of this test, but still functional, and in our testing we have never seen a pointer break or snap off.

It's tough to estimate how many matches are represented by 10,000 toggles, as it will depend on the competitiveness of teams playing at the event, and this post should not be used as a formal load rating guarantee. But, I would be comfortable in saying that it probably represents at least 15-20 competitive events, probably more.

That all said, if you do happen to have a very competitive series of events, or start to see excessive wear, each Flag is reversible - there is a pointer at the top and the bottom, and the bracket with the detent has an additional one on the back as well (see attached image for the reversible pointers). This doubles the lifetime of a given Flag/Detent from (my very rough estimate of) 15-20 events to 30-40 events. EP's running multiple events can also rotate their Flag positions during setup to distribute the load more evenly, as the bottom row is likely to see more engagement match-to-match than the top two rows.

RH

Continued to page 7

SIGNATURE Rebecca K Harris DATE 9/18/18

DISCLOSED TO AND UNDERSTOOD BY Hannah L. Master DATE 9/18/18

PROPRIETARY INFORMATION

Continued from page 6

7

Game Analysis (cont.)

- Possible ways to gain points: (+ 4pts for Auton)
  - turn flags
    - low flags are 1 pt each
    - high flags are 2 pts each
    - max flag points are 15 pts
  - caps
    - ground caps are 1pt each
    - pole caps are 2 pts each
    - max cap points are 14 pts
  - platforms
    - colored park is 3 pts
    - center park is 6 pts
    - max platform park (with alliance) is 9 pts
- Easiest to hardest ways to gain points
  - parking on platforms
  - flipping ground caps
  - turning low flags
  - caps on poles
  - turning high flags
- Possible ways to prevent points from being gained
  - blocking the poles
  - blocking the platform
- Descoring
  - pushing off center park
  - flipping caps
  - turning flags

Continued to page 8

SIGNATURE Rebecca K Harris DATE 9/18/18

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PROPRIETARY INFORMATION

8 Continued from page 7

Game Analysis (cont.)

- Build restrictions
  - Start in 18in x 18in x 18in
  - In expansion zone no height limit
  - Robot can expand width-wise to 36in
  - Cortex and 12/10 393 motors
    OR
  - V5 and 8/6 V5 motors

Robot Priorities

Qualities	Functions

- Impossible to tip
  - tipping at infinite height breaks 36" diameter rule
- Agile
- Fast
- Smart
  - Programmed to do many tasks only based on sensor input
- Sturdy
  - keep from being pushed off center platform
	- Be able to climb platforms
	- Be able to shoot and turn flags
	- Able to flip caps
	- Place caps on poles
	- Interchangable auton
	- Push other robots off platforms
	- Intake balls

Important rules:
- G12: vigarous interaction on the center platform is not protected
- SG3: Auton lines cannot be crossed before the match begins (driver control)

Continued to page

SIGNATURE Rebecca K Harris DATE 9/18/18

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PROPRIETARY INFORMATION

ORGANIZING THE NOTEBOOK

LEVEL 2 - What does the design award rubric mean?

Rubric Topic	The Readers Questions
Explains why the solution was selected through testing and/or a decision matrix. Fully describes the plan to implement the solution.	▢ Why was the solution selected? ▢ Did they use testing or a decision matrix? ▢ Is the plan to implement the solution fully described?

Skills cap flip bar

An issue we encountered when running skills (particularly programming skills) is that the first cap we run into to retreive the second ball doesn't flip to red.

Now in normal auton we don't want to flip the cap because it is already our color, but in skills we do want to because it is always blue.

To solve this problem we brain stormed a few ideas:

- make the skills auton go farther forward
  - this could be problematic because it may just cause the cap to continue to slide
  - Also driver skills wont be as reliable because it won't drive forward the same amount
- create a bar that stops the cap from sliding and actually pushes it over
  - this is a slightly more viable option because it would make auton and driver more consistant
  - However the bar must be removable (easily) so it can be taken off for normal auton

Continued to page 177

SIGNATURE Rebecca R. Hamm DATE 2/25/19

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Skills cap flip bar (cont.)

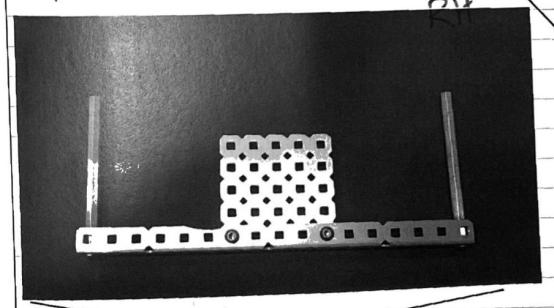
we decided to pursue the bar idea.

At first we added a 17 hole long bar in front of the intake dropped down 3 1/4 inches using standoffs (allowing easy removal)

This ideal almost worked, but it was slightly too high and didn't quite push the cap enough.

Then we added another 1/4 inch in standoffs (now 3 1/2 inches) and a 5x5 metal plate and attached it.

After multiple tests this design was consistant and easily removable so we decided to implement it. (see photo below)



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SIGNATURE Rebecca R. Hamm DATE 2/25/19

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ORGANIZING THE NOTEBOOK

LEVEL 2 - Using the Rubric Topics to Organize Information

Page	Project		Date
1	Challenge	Summary	9/5/18
2		The Robot	9/5/18
3 - 5		The Game	9/5/18
6		The Tournament	9/5/18
7 - 8		Field Layout	9/5/18
9 - 12		Game Objects	9/5/18
13		Robot Skills	9/5/18
14 - 16		Awards	9/6/18
17 - 19		Goals	9/6/18
20	Timeline	Goals and Initial Plan	9/6/18

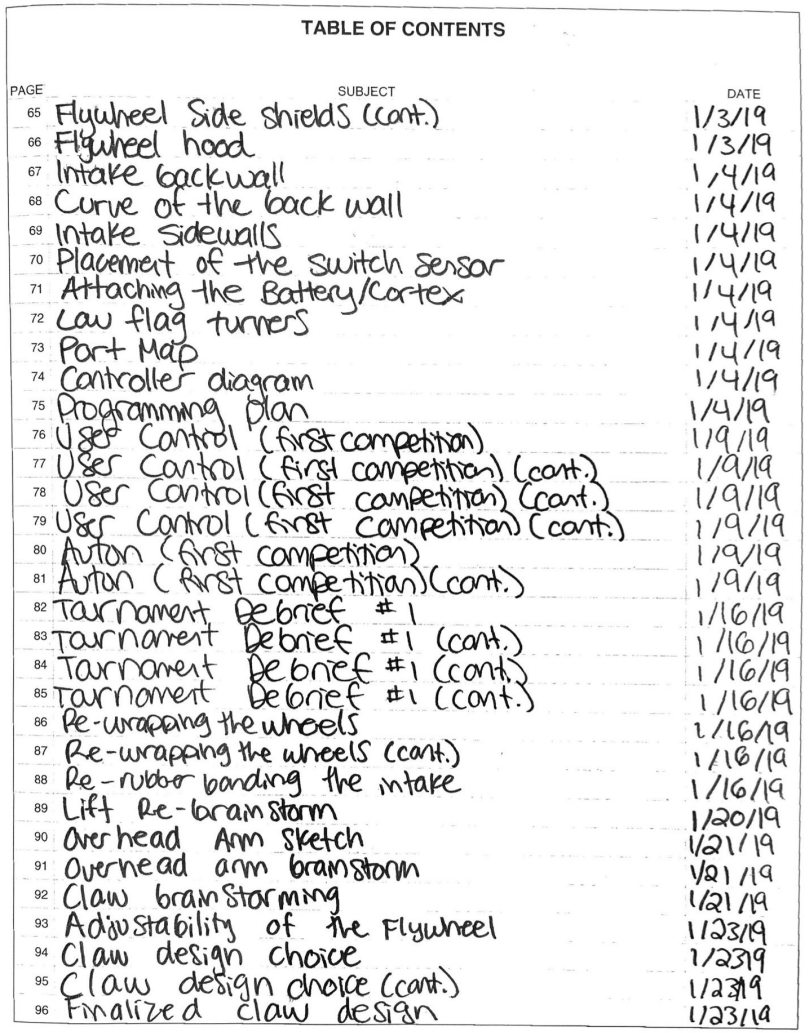


TABLE OF CONTENTS

PAGE	SUBJECT	DATE
65	Flywheel Side Shields (cont.)	1/3/19
66	Flywheel hood	1/3/19
67	Intake backwall	1/4/19
68	Curve of the back wall	1/4/19
69	Intake sidewalls	1/4/19
70	Placement of the switch sensor	1/4/19
71	Attaching the Battery/Cortex	1/4/19
72	Low flag turners	1/4/19
73	Part Map	1/4/19
74	Controller diagram	1/4/19
75	Programming plan	1/4/19
76	User Control (first competition)	1/9/19
77	User Control (first competition) (cont.)	1/9/19
78	User Control (first competition) (cont.)	1/9/19
79	User Control (first competition) (cont.)	1/9/19
80	Auton (first competition)	1/9/19
81	Auton (first competition) (cont.)	1/9/19
82	Tournament Debrief #1	1/16/19
83	Tournament Debrief #1 (cont.)	1/16/19
84	Tournament Debrief #1 (cont.)	1/16/19
85	Tournament Debrief #1 (cont.)	1/16/19
86	Re-wrapping the wheels	1/16/19
87	Re-wrapping the wheels (cont.)	1/16/19
88	Re-rubber banding the intake	1/16/19
89	Lift Re-brainstorm	1/20/19
90	Overhead Arm Sketch	1/21/19
91	Overhead arm brainstorm	1/21/19
92	Claw brainstorming	1/21/19
93	Adjustability of the Flywheel	1/23/19
94	Claw design choice	1/23/19
95	Claw design choice (cont.)	1/23/19
96	Finalized claw design	1/23/19

S.M.A.R.T GOALS

LEVEL 3 - Developing Skills for EDP, Goals, and Planning

Identify

Identify game and robot design challenges and goals

Brainstorm

Brainstorm and diagram or prototype solutions

Select

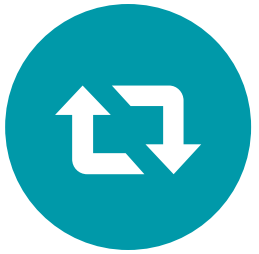
Select the best solutions and plan

Build

Build and program the solution

Test

Test solution



Repeat

Repeat design process

S.M.A.R.T GOALS

LEVEL 3 - Developing Skills for EDP, Goals, and Planning

Specific **Measureable** **Achievable** **Relevant** **Time-Bound**

S.M.A.R.T GOALS

LEVEL 3 - Supporting the Creation of the Project Plan

Goal 1	Tournaments - Compete and Qualify for State Championships
Measures	Compete at 3 local tournaments before 12/25
	Compete at 5 local tournaments before state championships
	Qualify for state championships (win a tournament, excellence award, or design award at a large event)
Tasks	Monitor robotevents.com and register for events
	Design/build robot - base, lift, manipulators
	Program robot - driver control, auton, prog skills
	Test robot - auton, prog skills, driver skills, scrimmage
	Redesign robot - base, lift, manipulators

S.M.A.R.T GOALS

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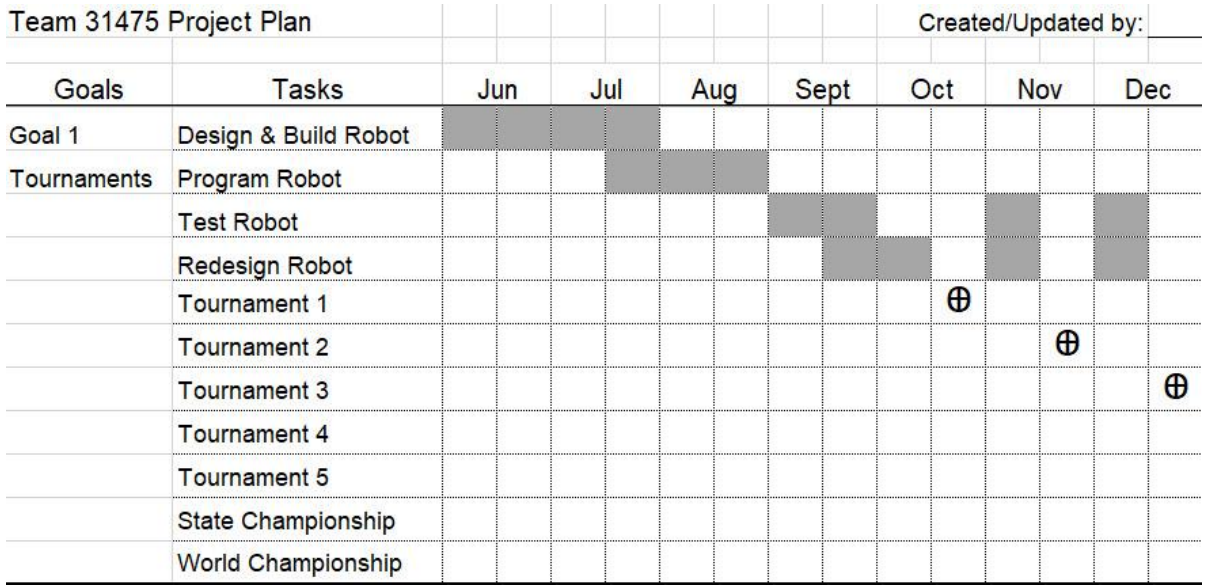


ORGANIZING THE NOTEBOOK

LEVEL 2 - Using the Rubric Topics to Organize Information

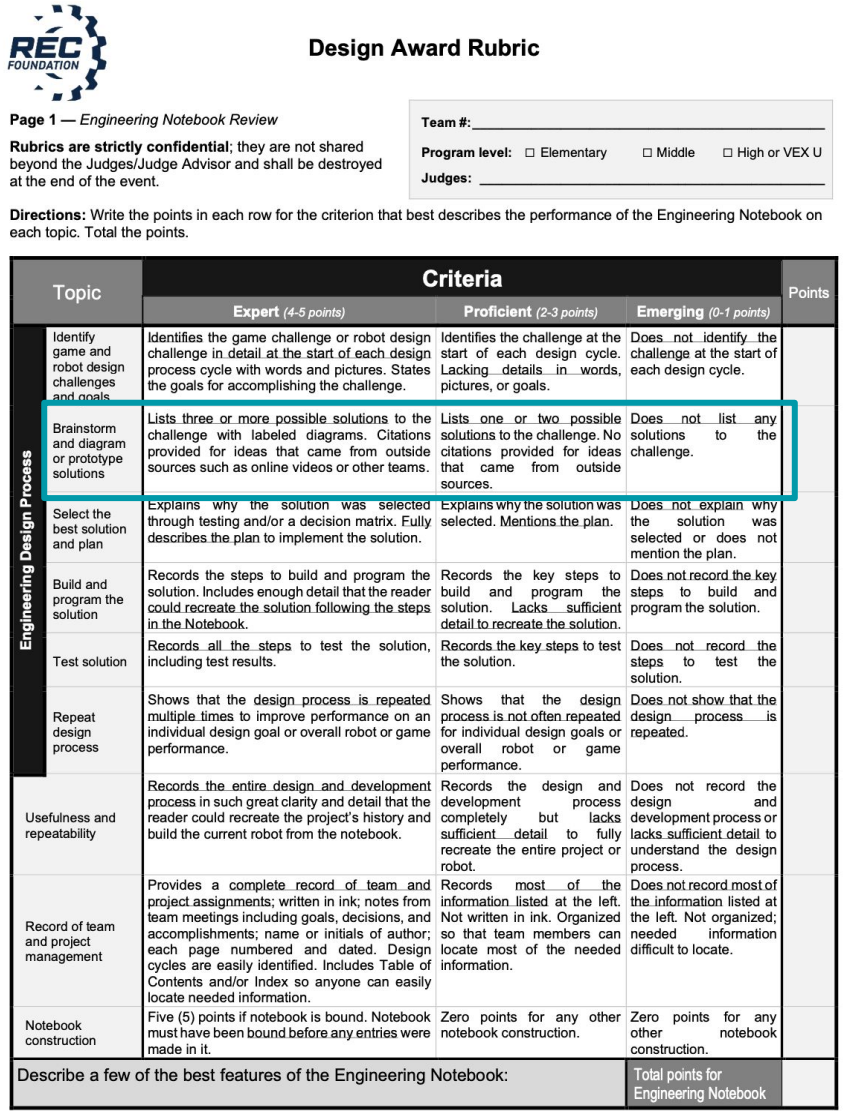
Each rubric topic had more intention than just the topic name:

Example:

“Brainstorming” identifies the need for citations from research!

Citation Examples:

- https://www.youtube.com, 31415A VEX Change Up RI24H, Andrew Jesus, 4/26/2020
- VEX Robotics Game Manual, VRC Change Up, 5/25/2020
- Personal communications, Team 31475A, Alliance strategy, 11/2/2019



Design Award Rubric

Page 1 — *Engineering Notebook Review*

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Team #: _____

Program level: ☐ Elementary ☐ Middle ☐ High or VEX U

Judges: _____

Directions: Write the points in each row for the criterion that best describes the performance of the Engineering Notebook on each topic. Total the points.

Topic		Criteria: Expert (4-5 points)	Criteria: Proficient (2-3 points)	Criteria: Emerging (0-1 points)	Points
Engineering Design Process	Identify game and robot design challenges and goals	Identifies the game challenge or robot design challenge in detail at the start of each design process cycle with words and pictures. States the goals for accomplishing the challenge.	Identifies the challenge at the start of each design cycle. Lacking details in words, pictures, or goals.	Does not identify the challenge at the start of each design cycle.	
	Brainstorm and diagram or prototype solutions	Lists three or more possible solutions to the challenge with labeled diagrams. Citations provided for ideas that came from outside sources such as online videos or other teams.	Lists one or two possible solutions to the challenge. No citations provided for ideas that came from outside sources.	Does not list any solutions to the challenge.	
	Select the best solution and plan	Explains why the solution was selected through testing and/or a decision matrix. Fully describes the plan to implement the solution.	Explains why the solution was selected. Mentions the plan.	Does not explain why the solution was selected or does not mention the plan.	
	Build and program the solution	Records the steps to build and program the solution. Includes enough detail that the reader could recreate the solution following the steps in the Notebook.	Records the key steps to build and program the solution. Lacks sufficient detail to recreate the solution.	Does not record the key steps to build and program the solution.	
	Test solution	Records all the steps to test the solution, including test results.	Records the key steps to test the solution.	Does not record the steps to test the solution.	
	Repeat design process	Shows that the design process is repeated multiple times to improve performance on an individual design goal or overall robot or game performance.	Shows that the design process is not often repeated for individual design goals or overall robot or game performance.	Does not show that the design process is repeated.	
Usefulness and repeatability		Records the entire design and development process in such great clarity and detail that the reader could recreate the project's history and build the current robot from the notebook.	Records the design and development process completely but lacks sufficient detail to fully recreate the entire project or robot.	Does not record the design and development process or lacks sufficient detail to understand the design process.	
Record of team and project management		Provides a complete record of team and project assignments; written in ink; notes from team meetings including goals, decisions, and accomplishments; name or initials of author; each page numbered and dated. Design cycles are easily identified. Includes Table of Contents and/or Index so anyone can easily locate needed information.	Records most of the information listed at the left. Not written in ink. Organized so that team members can locate most of the needed information.	Does not record most of the information listed at the left. Not organized; needed information difficult to locate.	
Notebook construction		Five (5) points if notebook is bound. Notebook must have been bound before any entries were made in it.	Zero points for any other notebook construction.	Zero points for any other notebook construction.	
Describe a few of the best features of the Engineering Notebook:				Total points for Engineering Notebook	

Design Award Rubric 9/19/2019

RUBRIC POINTS

LEVEL 3 - Developing Skills for EDP, Goals, and Planning

Rubric points vary based on skill level of entries!

Consider a minimal entry vs. a more fully developed entry about team goals:

Goals:
- Win robot skills award

Goals:

- Top 8 ranking at 50% of local tournaments
- Driver skills
  - ≥ ___ pts at least 50% of runs by 12/31
  - ≥ ___ pts at least 50% of runs by states

RUBRIC POINTS

LEVEL 3 - Developing Skills for EDP, Goals, and Planning

Rubric points vary based on skill level of entries!

Consider a minimal entry vs. a more fully developed entry about testing:

Testing:
- We tested the robot and decided to rebuild the intake

Testing:
- 10 driver skills runs   - (game manual, appendix B) - Diver = Sarah - Average score was ___ pts. - Best score was ___ pts. - New intake improvement ___ pts.

STUDENT IMPROVEMENT

LEVEL 4 - Skilled at EDP, Goals, Planning, and Management

Differences between level 3 and level 4 (from an mentor's perspective):

Shift

A shift from teaching to mentoring the students

Initiation

Students initiate questions and conversations

Management

Students self-manage members and they all contribute

Structure

Transition from a team captain model to a project management model

STUDENT IMPROVEMENT

LEVEL 5 - Mastery of EDP, Goals, Planning, and Management

Differences between level 4 and level 5 (from an engineer's perspective):

An engineering team doing a robotics project	VS.	**A robotics team doing an engineering notebook**

THANK YOU

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