Randolph Township Schools
Randolph Middle School
Robotics II Curriculum

"The best way to predict the future is to create it."
-Abraham Lincoln

STEM Department
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August 18, 2020

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Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Affirmative Action Statement
Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

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EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

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Introduction

Today's students will need to adapt to a future of rapidly changing technologies; therefore, need to be prepared with the skills to problem-solve, persevere, create, and innovate. Robotics II will immerse students in problem-based learning activities that will allow them to apply skills and problem-solving strategies obtained in Robotics I. This learning approach creates a student-centered environment by providing a *learning by doing* setting to develop and enhance communication, collaboration, and critical thinking skills. Robotics II focuses on transferable skills and stresses understanding and demonstration of the engineering design process. Through teamwork, students will engage in researching, designing, coding, developing, and operating robots, resulting in opportunities for realistic high-tech interdisciplinary applications of content to solve real-world problems. Students are encouraged to take ownership of their learning and will feel empowered solving real-world problems of their choice. This course will be guided by the current New Jersey Learning Standards in Computer Science and Design Thinking, Science, Mathematics, and English.

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Curriculum Pacing Chart

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
3 weeks	**I**	**First Lego League Challenge**
4 weeks	**II**	**Robotics, Automation, and Sustainability**
2 weeks	**III**	**Battle Bots**

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Unit I: First Lego League Challenge

TRANSFER: Students will be able to independently engage in the engineering design process to plan, design, collaborate, and develop solutions to real-world problems.		
STANDARDS / GOALS: **NJ 2020 SLS: Computer Science and Design Thinking** 8.1.8.CS.2: Design a system that combines hardware and software components to process data. 8.1.8.CS.3: Justify design decisions and explain potential system trade-offs. 8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems. 8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values. 8.1.8.AP.3: Design and iteratively develop programs that combine control structures,	**ENDURING UNDERSTANDINGS**	**ESSENTIAL QUESTIONS**
	The engineering design process allows engineers to move from finding "a" solution to finding "the best" solution to a problem.	• What makes a solution the best?
	The ability to understand and have a multi-step process that will help one solve a problem is a valuable life skill.	• What is the best way to solve a problem?
	<u>KNOWLEDGE</u> **Students will know:**	**<u>SKILLS</u>** **Students will be able to:**
	The engineering design process allows engineers to develop solutions. Robots are used in industry to aid humans in completing tasks or commands.	Create a plan for how each mission will be completed within the required criteria and constraints. Research, design, construct, code, and test a robot that will travel though a course using sensors to go around or remove obstacles.

Unit I: First Lego League Challenge

including nested loops and compound conditionals.	The design of the robot needs to consider the required task.	Compare the mission goals to the design of the robot.
8.1.8.AP.4: Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.	Different sensors (touch, ultrasonic, color, gyro sensors) can interact with the physical environment.	Use gears to create desired output to change the torque or speed of the robot.
8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users.	Robots can be designed and constructed to utilize different methods of mobility.	Code software programed to perform different mobility tasks.
8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.	Topography (terrain) can affect how robots are designed and how they function.	Develop robots that can successfully function on multiple terrains.
8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).	The gear ratio expresses the ratio of the output torque to the input torque and transmitting power through a series of gears can also affect rotational speed.	Use gears to create desired output to change the torque or speed of the robot.
NJ 2020 SLS: Science MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Reflection allows engineers to improve designs and products.	Reflect on improving designs.

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Unit I: First Lego League Challenge

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4: Develop a model to generate data for iterative and modification of a proposed object, tool, or process such that an optimal design can be achieved. **NJ 2020 SLS: Science – Crosscutting Concepts 6-8** • Cause and effect • Structure and function • Systems and system models **NJ 2020 SLS: Science – Science and Engineering Practices 6-8** • Asking questions and defining problems	**VOCABULARY:** topography, terrain, mobility, design, procedures, analysis, researching, brainstorming, developing, building, testing, reflection, criteria, constraints **KEY TERMS:** sensors (touch, ultrasonic, color, gyro), large motor, small motor, program, loops, conditional statements	

Unit I: First Lego League Challenge

• Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations and designing solutions **NJ 2020 SLS: Science – Disciplinary Core Ideas 6-8** ETS1.A: Defining and Delimiting Engineering Problems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects** RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).		

Unit I: First Lego League Challenge

WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research. **NJ 2016 SLS: Mathematical Practices** MP4: Model with mathematics. MP5: Use appropriate tools strategically.		

ASSESSMENT EVIDENCE: Students will show their learning by:

- Reflecting in engineering design journal entries to properly identify criteria, constraints, modifications, and redesigns
- Creating plaining journals which detail the sequence to complete the missions and the sensors required to complete each mission
- Engaging in weekly conference: How have groups progressed and implemented feedback since last conference?
- Creating a robot to complete tasks

KEY LEARNING EVENTS AND INSTRUCTION:

- Small group collaboration (planning, researching, analyzing criteria and constraints, and constructing)
- Daily reflections in engineering design journal
- Student modeling of constructed designs
- Programing robots
- Redesign of robot or program based upon feedback

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Unit I: First Lego League Challenge

SUGGESTED TIME ALLOTMENT	**3 Weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Resources: First Lego League Student Engineering Journal First Lego League Team Book Computers Lego Mindstorms software Lego Mindstorms Lego bricks First Lego League Challenge Suggested Resources: http://ev3lessons.com https://firstlegoleague.org/ “General Overview and Introduction to Challenge” “Challenge Research and Planning” “Challenge Execution”

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Unit II: Robotics, Automation, and Sustainability

<table>
<tr><td colspan="3">TRANSFER: Students will be able to independently engage in the engineering design process to plan, design, collaborate, and develop solutions to real-world problems.</td></tr>
<tr><td rowspan="5">STANDARDS / GOALS:
NJ 2020 SLS: Computer Science and Design Thinking
8.1.8.CS.3: Justify design decisions and explain potential system trade-offs.

8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.

8.1.8.AP.3: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.

8.1.8.AP.4: Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Robots can be used to improve the effectiveness of renewable energy such as solar, wind, geothermal, tidal and biofuel.</td><td>• How can robots aid in improving the collection of renewable energy?</td></tr>
<tr><td>The science and application of automation and robotics can be applied to protect the Earth’s resources and environment.</td><td>• How can autonomous robots be designed and used to perform tasks?</td></tr>
<tr><td><u>KNOWLEDGE</u>
Students will know:</td><td><u>SKILLS</u>
Students will be able to:</td></tr>
<tr><td>The engineering design process is a series of steps that engineers follow to come up with solutions to a problem.

The design of the robot needs to consider the required task.</td><td>Identify the different steps of the engineering design process and explain why they are important.

Compare the project’s criteria and constraints to the design of the robot.</td></tr>
</table>

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Unit II: Robotics, Automation, and Sustainability

8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users. 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem. 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team. 8.2.8.ED.5: Explain the need for optimization in a design process. 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product. 8.2.8.ITH.1: Explain how the development and use of technology influences economic, political, social, and cultural issues.	Robots can be programmed to sort items by color distinction and properly execute robotic commands. Autonomous robots aid in making the completion of tasks easier, safer, and more efficient. The burning of fossil fuels has increased CO_2 levels to record highs, but renewable energy can help mitigate CO_2 gas production. Robots improve productivity when they are applied to tasks that they perform more efficiently than humans. Solar energy uses PV cells (Photo Voltaic) to effectively turn sunlight into energy. Solar PV cells that follow the path of the sun are more efficient than fixed PC cells.	Design a functional robot that will sort material in a factory by color. Design a functional robot to use a claw to move objects. Design a functional assembly line to move objects. Identify how greenhouse gases affect the environment. Analyze how robots can impact productivity of renewable energy. Design an experiment to test the effectiveness of a Lego PV cell. Create a mounting system and computer program to improve the efficiency of a PV cell.

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8.2.8.ITH.3: Evaluate the impact of sustainability on the development of a designed product or systems. 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. **NJ 2020 SLS: Science** MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century. MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Wind energy is generated by converting wind into electricity by using wind turbines. Wind turbines that can change with the direction of wind and change blade angle are more efficient than fixed turbines. Renewable energy does not consume earth's finite resources. Robots can be used in agriculture to assist in the farming process by harvesting and picking, controlling weeds, autonomously mowing, pruning, seeding, spraying, phenotyping, sorting and packing. Reflection and modifications allow engineers to improve designs and products.	Describe how wind energy is generated. Create a mounting system and computer program to improve the efficiency of a wind turbine. Identify the positive effects of renewable energy. Design a functional robot to increase the productivity of agricultural processes. Reflect on improving designs and make modifications based on feedback from the robot.

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Unit II: Robotics, Automation, and Sustainability

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4: Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. **NJ 2020 SLS: Science – Crosscutting Concepts 6-8** • Cause and effect • Structure and function • Systems and system models **NJ 2020 SLS: Science – Science and Engineering Practices 6-8** • Asking questions and defining problems	**VOCABULARY:** design, procedures, analysis, researching, brainstorming, developing, building, testing, reflection, criteria, constraints, mitigate, climate, impacts, atmosphere, phenomena, catastrophic, engineering, carbon dioxide, ecosystem, methane, nitrous oxide, alternative energy (PV photo voltaic cell, solar, wind, geothermal, tidal and biofuel) **KEY TERMS:** conveyor belt, transporting and sorting materials, welding, turbine, volts, loops and conditional statements	

Unit II: Robotics, Automation, and Sustainability

• Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations and designing solutions **NJ 2020 SLS: Science – Disciplinary Core Ideas 6-8** ETS1.A: Defining and Delimiting Engineering Problems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects** RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).		

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Unit II: Robotics, Automation, and Sustainability

NJ 2016 SLS: Mathematical Practices MP4: Model with mathematics. MP5: Use appropriate tools strategically.		

ASSESSMENT EVIDENCE: Students will show their learning by:

- Creating a robot to improve efficiency of a process
- Reflecting in engineering design journal entries to properly identify criteria, constraints, modifications, and redesigns
- Engaging in weekly conference: How have groups progressed and implemented feedback since last conference?

KEY LEARNING EVENTS AND INSTRUCTION:

- Small group collaboration (planning, researching, analyzing criteria and constraints, and constructing)
- Daily reflections in engineering design journal
- Research, create and program a robot to improve upon an existing technology
- Redesign of robot or program based upon feedback

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Unit II: Robotics, Automation, and Sustainability

SUGGESTED TIME ALLOTMENT	**4 weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Resources: Computers Lego Mindstorms software Lego Mindstorms Lego bricks Lego PV Lego Turbine Lego Energy Kits Ping Pong Balls Suggested Resources: http://ev3lessons.com https://firstlegoleague.org/ “The Claw” “Ping Pong ball Mover” “Color Sorter” “Conveyor Belt” “Assembly Line” “Seed Planter” “PV Optimization” “Wind Turbine Optimization”

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Unit III: Battle Bots

<table>
<tr><td colspan="3">TRANSFER: Students will be able to independently engage in the engineering design process to plan, design, collaborate, and develop solutions to real-world problems.</td></tr>
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NJ 2020 SLS: Computer Science and Design Thinking
8.1.8.CS.3: Justify design decisions and explain potential system trade-offs.

8.1.8.CS.4: Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.

8.1.8.AP.6: Refine a solution that meets users' needs by incorporating feedback from team members and users.

8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>The engineering design process allows engineers to create and build items to meet their needs.</td><td>• What role does creativity have in the engineering design process?

• How does understanding criteria, and constraints affect the design of an object?</td></tr>
<tr><td>Pairing two or more devices allows for control of robots remotely.</td><td>• How do systems interact to perform a task?</td></tr>
<tr><td><u>KNOWLEDGE</u>
Students will know:</td><td><u>SKILLS</u>
Students will be able to:</td></tr>
<tr><td>The engineering design process is a series of steps that engineers follow to develop solutions to a problem.

The design of the robot needs to consider the required task.</td><td>Identify the different steps of the engineering design process and explain why each is important.

Compare the project's criteria and constraints to the design of the robot.</td></tr>
</table>

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Unit III: Battle Bots

NJ 2020 SLS: Science MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-4: Develop a model to generate data for interactive testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	A vehicle is comprised of a body or frame and chassis. A robot is designed to move through an area while considering its environment. Sensors and motors can be added to a robot to provide additional and new functions. Robots can be paired via Bluetooth and controlled by a remote control. Reflection and modifications allow engineers to improve designs and products.	Construct and test a robot that can drive in all directions. Design a robot's body, chassis, and wheels to move through changing environments. Create a new function for a robot by adding a motor or sensor to a robot. Create a robot to perform actions within the given challenge constraints to move the robot using an iPad or personal device. Assess and incorporate feedback from team members and to improve a solution. Reflect on improving designs and make modifications based on feedback from the robot.

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Unit III: Battle Bots

NJ 2020 SLS: Science – Crosscutting Concepts 6-8 • Cause and effect • Structure and function • Systems and system models **NJ 2020 SLS: Science – Science and Engineering Practices 6-8** • Asking questions and defining problems • Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Using mathematics and computational thinking • Constructing explanations and designing solutions **NJ 2020 SLS: Science – Disciplinary Core Ideas 6-8** ETS1.A: Defining and Delimiting Engineering Problems ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution	**VOCABULARY:** mobility, design, procedures, analysis, researching, brainstorming, developing, building, testing, reflection, criteria, constraints **KEY TERMS:** Bluetooth connectivity, technological communication, chassis, armor, defense and offensive weapons, Bluetooth, controller	

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NJ 2016 SLS: Literacy in History, Social Studies, & Technical Subjects RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **NJ 2016 SLS: Mathematical Practices** MP4: Model with mathematics. MP5: Use appropriate tools strategically.		

ASSESSMENT EVIDENCE: Students will show their learning by:

- Creating and redesigning a robot that can be controlled by a Bluetooth device
- Reflecting in engineering design journal entries to properly identify criteria, constraints, modifications, and redesigns
- Engaging in weekly conference: How have groups progressed and implemented feedback since last conference?

KEY LEARNING EVENTS AND INSTRUCTION:

- Small group collaboration (planning, researching, analyzing criteria and constraints, and constructing)
- Daily reflections in engineering design journal
- Research create, design, and build battle bot that meets the criteria and constraints of the project
- Navigating robot by remote control
- Redesign of robot or program based upon feedback

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Unit III: Battle Bots

SUGGESTED TIME ALLOTMENT	**2 Weeks**
SUPPLEMENTAL UNIT RESOURCES	Required Resources: Computers Lego Mindstorms software Lego Mindstorms Lego bricks Battle Bot Arena Suggested Resources: http://ev3lessons.com https://firstlegoleague.org/ “Battle Bot”

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APPENDIX A

Resources:

Suggested Web Addresses:

http://ev3lessons.com
https://firstlegoleague.org/

Software Names:

Lego Mindstorms Software
Microsoft Word
Microsoft PowerPoint
Microsoft Excel
Internet Sources

APPENDIX B

Template of Engineering Design Journal:

Phase of the EDP	What that is for this challenge?
Identify the problem	*Summarize the goal of the challenge.*
Explore	*What are all the different types of things that your robot will need to do. (list in bullet form)*
Design your plan	*What are the constraints of this project?* *How will you construct your robot? How will everything work? Make a drawing on separate piece of paper with labels and brief explanations.*
Create	*Include a screenshot of the program you created at the bottom*
Try it out	*Describe the results of each of the test runs you did. Did you make any changes to your design?*
Make it better	*Describe the final Sumo Bot and why you think that it is designed and program the most efficient for the challenge.*

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First Lego League Robot Design Rubric:

		Beginning	Developing	Accomplished	Exemplary
Mechanical Design	**Durability**	Robot designed to maintain structural integrity and have the ability to withstand rigors of competition			
	ND	quite fragile; breaks a lot	frequent or significant faults/repairs	rare faults/repairs	sound construction; no repairs
	Mechanical Efficiency	Robot designed to be easy to repair, modify, and be handled by technicians			
	ND	excessive time to repair/modify	inefficient to repair/modify	appropriate time to repair/modify	streamlined time to repair/modify
	Mechanization	Robot mechanisms designed to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)			
	ND	imbalance of speed, strength and accuracy on most tasks	imbalance of speed, strength and accuracy on some tasks	appropriate balance of speed, strength and accuracy on most tasks	appropriate balance of speed, strength and accuracy on every task
Programming	**Programming Quality**	Programs are appropriate for the intended purpose and should achieve consistent results, assuming no mechanical faults			
	ND	would not achieve purpose AND would be inconsistent	would not achieve purpose OR would be inconsistent	should achieve purpose repeatedly	should achieve purpose every time
	Programming Efficiency	Programs are modular, streamlined, and understandable			
	ND	excessive code and difficult to understand	inefficient code and challenge to understand	appropriate code and easy to understand	streamlined code and easy for anyone to understand
	Automation/Navigation	Robot designed to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing)			
	ND	frequent driver intervention to aim AND retrieve robot	frequent driver intervention to aim OR retrieve robot	robot moves/acts as intended repeatedly w/ occasional driver intervention	robot moves/acts as intended every time with no driver intervention
Strategy & Innovation	**Design Process**	Developed and explained improvement cycles where alternatives were considered and narrowed, selections tested, designs improved (applies to programming as well as mechanical design)			
	ND	organization AND explanation need improvement	organization OR explanation need improvement	systematic and well-explained	systematic, well-explained and well-documented
	Mission Strategy	Clearly defined and described the team's game strategy			
	ND	no clear goals AND no clear strategy	no clear goals OR no clear strategy	clear strategy to accomplish well-defined goals	clear strategy to accomplish most/all game missions
	Innovation	Team identifies their sources of inspiration and creates new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks			
	ND	No original feature(s)	original feature(s) with some added value or potential	original feature(s) with the potential to add significant value	original feature(s) that add significant value

Comments

Great Job…	Think about…

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First Lego League Mission Completion Rubric:

TEAM #: ____________ REFEREE: ____________

ROUND: ____________ TABLE: ____________

FIRST LEGO LEAGUE CITY SHAPER

(please circle one selection or fill in the blank for each item)

ADVANTAGE
Your Robot and Equipment fit in the Small Inspection Area: No Yes

1 **M01 – ELEVATED PLACES**
The Robot is Supported by the Bridge: No Yes
Number of flags that are clearly raised any distance, only by the Robot: 0 1 2

2 **M02 – CRANE**
The Hooked Blue Unit is clearly lowered any distance from the Guide Hole: No Yes
The Hooked Blue Unit is Independent and Supported by another Blue Unit: No Yes
AND Level 1 is Completely in the Blue Circle: No Yes

3 **M03 – INSPECTION DRONE**
The Inspection Drone is Supported by the axle on the Bridge: No Yes

4 **M04 – DESIGN FOR WILDLIFE**
The Bat is Supported by the branch on the Tree: No Yes

5 **M05 – TREEHOUSE**
Number of Units Independent and Supported by the Tree's Large Branches: ________
Number of Units Independent and Supported by the Tree's Small Branches: ________

6 **M06 – TRAFFIC JAM**
The Traffic Jam is lifted, its moving part is Independent, and it is Supported only by its hinges: No Yes

7 **M07 – SWING**
The Swing is released: No Yes

8 **M08 – ELEVATOR**
The Elevator's moving parts are Independent and Supported only by its hinges, in the following position:
Neither Blue Car Down Balanced

9 **M09 – SAFETY FACTOR**
The Test Building is Independent and Supported only by the blue beams: No Yes
Number of blue beams knocked out at least half way:
0 1 2 3 4 5 6

10 **M10 – STEEL CONSTRUCTION**
The Steel Structure is standing, and is Independent and Supported only by its hinges: No Yes

11 **M11 – INNOVATIVE ARCHITECTURE**
The Structure is bigger than a Blue Building Unit and built from the team's white LEGO bricks: No Yes
The Structure is in any Circle: No Partly Completely

12 **M12 – DESIGN & BUILD**
Number of Circles with a color-matching Unit, flat down on the Mat, and Completely in Circle: 0 1 2 3
Sum of height Levels of Independent Stacks at least partly in any Circle: ________

13 **M13 – SUSTAINABILITY UPGRADES**
Number of Upgrades that are Independent and Supported only by a Stack which is at least partly in a Circle: 0 1 2 3

14 **M14 – PRECISION**
Number of Precision Tokens left on the field:
0 1 2 3 4 5 6

RETURN LOOSE ITEMS
(4x) Blue Units, (4x) White Units, (4x) Red Units, (4x) Tan Units, (1x) Bat, (1x) Drone, (1x) Solar Panel Upgrade, (1x) Insulation Upgrade, (1x) Garden Upgrade, (1x) Hooked Blue Unit, (1x) Test Building, and (6x) Precision Tokens

TEAM INITIALS: ______________

Battle Bots Rubric:

Team:____

Category	Exemplary	Proficient	Partially Proficient	Incomplete	Points
RESEARCH:	5 points	3 points	1 point	0 points	
There are specific examples provided.	3 or more very relevant examples are provided.	2-4 relevant examples are provided.	Only 1 somewhat relevant example is provided.	There were no examples provided.	
WORKS CITED:	5 points	3 points	1 point	0 points	
Multiple reliable sources have been referenced or cited in the research.	3 or more very reliable sources have been referenced or cited in the research.	2 reliable sources have been referenced or cited in the research.	Just 1 somewhat reliable source was referenced or cited in the research.	There were no sources referenced or cited in the research.	
SPECIFICATIONS:	5 points	3 points	1 point	0 points	
The dimensions and components of the robot are clearly listed with multiple pictures.	All dimensions/components are listed and there are 3 or more pictures of the robot.	Dimensions/components are listed and there are 2 pictures.	Missing dimensions or components and has just 1 picture.	Missing dimensions and components and there are no pictures.	
PROGRAMMING:	5 points	3 points	1 point	0 points	
It is very clear how the programming makes the robot complete the tasks.	It is very clear how the programming works.	It is somewhat clear how the programming works.	It is unclear how the programming works.	There is no explanation of the programming at all.	
TESTING:	5 points	3 points	1 point	0 points	
There was significant testing to improve the speed, maneuverability, and attack of the robot.	5 or more modifications were very clearly described in the testing.	3 modifications were clearly described in the testing.	Fewer than 3 modifications were somewhat described in the testing.	There were no adjustments or modifications described in the testing.	
DATA TABLE:	5 points	3 points	1 point	0 points	
A clear and detailed data table was included to show results of the testing.	The data table was very clear and easy to read with multiple entries and detailed results.	The data table was clear with but lacked specific detail.	The data table was confusing and lacked detail.	There was no data table in the design document.	
				Total Score (30 max)	