

FLL - Introduction to Robotics (NXT)

Course: Introductory STEM Robotics	Total Framework Hours up to: 180
CIP Code: 150406	<input checked="" type="checkbox"/> Exploratory <input type="checkbox"/> Preparatory
Career Cluster: STEM	Cluster Pathway: Engineering & Technology

Course Resources

This is a STEM course which teaches Science, Technology, Engineering and Math concepts through the hardware and software of the LEGO® MINDSTORMS® NXT platform.

This Introductory Robotics Framework is aligned with the [STEM Robotics 101](#) curriculum developed by the Olympia School District. The curricular content and teacher collaboration resources are being hosted by Portland State University's Ensemble STEM Robotics site.

Many of the programming lessons use the *NXT Video Trainer 2.0* product purchased from the Carnegie Mellon Robotics Academy®.

The units in this framework are aligned with the Scope and Sequence of STEM Robotics 101 master curriculum and lessons.

Each lesson in contains an Overview, Objectives, Instructor’s Guide, Primary Instructional Material and Formative/Summative Assessments provided by the original author of the lesson. Lessons may also include Differentiated Instructional material and Additional Assessments provided by the original author or other teacher-contributors to the site.

**This framework has been designed for the classroom. If you are competing in FLL there are certain components that should be skipped or postponed until after the FLL competitions are complete:*

- *Each Unit’s title has description of what can be postponed/skipped to best fit the FLL timeline.*
- *Each Unit’s Leadership Alignment is appended with the added FLL tasks aligned with that Unit.*
- *The FLL alignment with the 21st Century Skills are provided in the table the end of this document*

Unit 0: Safety and STEM Career Awareness (covered as appropriate throughout course)

COMPONENTS AND ASSESSMENTS
<p>Performance Assessments: Student will demonstrate knowledge and skills of Robotics lab safety. Student will present a plan to pursue a self-selected STEM career pathway.</p>
<p>Leadership Alignment:</p> <p><i>Critical Thinking and Problem Solving:</i> 2.A.1, 2.C.4, 2.C.5</p> <p><i>Communication and Collaboration:</i> 3.A.1, 3.A.3, 3.A.5</p> <p><i>Information Literacy:</i> 4.A.1, 4.A.2, 4.B.1</p> <p><i>Initiative and Self-Direction:</i> 8.A.1, 8.A.2, 8.B.1, 8.C.2, 8.C.3, 8.C.4</p> <p><i>Social and Cross-Cultural Skills:</i> 9.A.1, 9.A.2</p>

Leadership and Responsibility:

11.B.1

* Safety plan for attending FLL competition

Standards and Competencies

Standard/Unit:

Describe health and safety procedures in a NXT Robotics lab.
Identify STEM careers and pathways.

Competencies

Total Learning Hours for Unit: 10

- Identify health and safety risks in a NXT Robotics lab
- Explain health and safety procedures which address risks in a NXT Robotics lab
- Describe the breadth of possible STEM careers
- Identify and explore a STEM career related to an area of student interest
- Explain the education pathway to a given STEM career

Aligned Common Core & Washington State Standards

Art

4.5.1: Applies and analyzes how arts knowledge, skills, and work habits are needed and used in the world of work.

Communications

SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
SL6-4: Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
SL7-4: Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
SL8-4: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation

Educational Technology

1.3.2: Locate and organize information from a variety of sources and media.
2.2.1: Develop skills to use technology effectively.
2.2.2: Use a variety of hardware to support learning

Technological Literacy

1. The characteristics and scope of technology.
2. The core concepts of technology.
3. The relationships among technologies and the connections between technology and other fields.
4. The cultural, social, economic, and political effects of technology.
5. The effects of technology on the environment.
6. The role of society in the development and use of technology.
7. The influence of technology on history.
12. Use and maintain technological products and systems.
13. Assess the impact of products and systems.
14. Medical technologies.
15. Agricultural and related biotechnologies.
16. Energy and power technologies.
17. Information and communication technologies.
18. Transportation technologies.
19. Manufacturing technologies.

	20. Construction technologies.
Math	6SP5: Summarize numerical data sets in relation to their context.
Reading	6-8RST1: Cite specific textual evidence to support analysis of science and technical texts. 6-8RST7: 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). 6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
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.
Writing	WHST6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently. WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Unit 1: Introduction to Robotics - *skip optional engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will create a research report on real and fictional robots.
Student will demonstrate key attributes of NXT components.
Student will assemble a NXT golfing machine.

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:
 11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

- * Identify FLL real world problem using robotics or technology
- * Analyze FLL game and develop strategy for prioritizing mission

Standards and Competencies

Standard/Unit:
 Describe characteristics of robots and explain/use NXT components

Competencies	Total Learning Hours for Unit: 10
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- Identify characteristics of a robot
- Create a research report on important/iconic robotics, both real and fictional
- Describe how the functions and characteristics of a robot can be seen in the NXT system
- Explain the sense and response systems of the NXT system
- Document/describe key attributes of the NXT electronic, mechanical and structural components
- Explain the function of a two-gear gear train through the bicycle analogy
- Construct an NXT Golfing Machine based on Faraday's Principle

Aligned Common Core & Washington State Standards

Communications	SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
Educational Technology	1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools. 1.2.1: Communicate and collaborate to learn with others. 1.3.2: Locate and organize information from a variety of sources and media.
Technological Literacy	1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 4. The cultural, social, economic, and political effects of technology. 5. The effects of technology on the environment. 6. The role of society in the development and use of technology. 7. The influence of technology on history. 8. The attributes of design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 14. Medical technologies. 15. Agricultural and related biotechnologies. 16. Energy and power technologies. 17. Information and communication technologies. 18. Transportation technologies. 19. Manufacturing technologies.
Math	6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems. 7RP2: Recognize and represent proportional relationships between quantities.
Reading	6-8RST1: Cite specific textual evidence to support analysis of science and technical texts. 6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

	<p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Social Studies	<p>4.1.1: Analyzes a major historical event and how it is represented on timelines from different cultural perspectives.</p>
Writing	<p>WHST6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.</p> <p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p>

Unit 2: Circuits and Computers - *postpone optional technology lessons until after competition for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will build NXT circuits and run test programs on the NXT processor

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4

Standards and Competencies

Standard/Unit:

Build Robotic circuits and run robotics programs

Competencies

Total Learning Hours for Unit: 10

- Explain the four parts of a circuit and give examples of each
- Differentiate between insulators, conductors and semiconductors
- Describe how the NXT acts as a circuit
- List examples of insulators, conductors and semiconductors within the NXT system
- Explain the advantage of each of the NXT power source options
- Build five NXT test circuits to demonstrate the capabilities of the various sensors
- Explain the four reasons tube based computers stagnated and how the transistor solved these issues
- Define and explain Moore's Law
- Describe the four parts of a computer
- Distinguish between the different type of storage in a computer
- Describe how the NXT acts as a computer and the role of its different types of memory chips
- Run five NXT test programs and identify the parts of the NXT computer used by each

Aligned Common Core & Washington State Standards

Communications	SL6-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL7-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL8-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Educational Technology	1.2.1: Communicate and collaborate to learn with others. 2.2.1: Develop skills to use technology effectively. 2.2.2: Use a variety of hardware to support learning.
Technological Literacy	1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 4. The cultural, social, economic, and political effects of technology. 5. The effects of technology on the environment. 6. The role of society in the development and use of technology.

	<p>7. The influence of technology on history.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>19. Manufacturing technologies.</p>
Math	<p>6NS5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.</p> <p>6EE1: Write and evaluate numerical expressions involving whole-number exponents.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>8EE3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p> <p>8EE4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.</p>
Reading	<p>6-8RST1: Cite specific textual evidence to support analysis of science and technical texts.</p> <p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p>
Science	<p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p>
Social Studies	<p>4.1.1: Analyzes a major historical event and how it is represented on timelines from different cultural perspectives.</p>
Writing	<p>WHST6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 3: Hardware - FLL, Software, Firmware -*postpone optional technology lesson and skip engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Students will build a robot and write simple programs to control it using firmware

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Build prototype robot for FLL

* Learn how to repair and replace Firmware

Standards and Competencies

Standard/Unit:

Understand the roles of hardware, software and firmware, and how they interact in the NXT

Competencies

Total Learning Hours for Unit: 10

- Describe the role of each of the three parts of a microprocessor's hardware
- Describe the nature and role of software in a microprocessor
- Explain how a microprocessor's hardware and software work together
- Update the NXT firmware and use it to explore the NXT systems and run test programs
- Use the NXT firmware to explore the NXT systems and run test programs
- Use the NXT hardware to build a robot from pictorial instructions
- Write 5-step on-board programs for the NXT using firmware capability

Aligned Common Core & Washington State Standards

Communications	SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study. SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study. SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
Educational Technology	1.2.1: Communicate and collaborate to learn with others. 2.2.1: Develop skills to use technology effectively. 2.2.2: Use a variety of hardware to support learning.
Technological Literacy	1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields.

	<p>8. The attributes of design.</p> <p>10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.</p> <p>11. Apply the design process.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>19. Manufacturing technologies.</p>
Math	<p>6EE1: Write and evaluate numerical expressions involving whole-number exponents.</p> <p>7NS1: Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers.</p> <p>7NS2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>8EE3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p> <p>8EE4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.</p>
Reading	<p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p>

Unit 4: Straight Ahead (programming precision forward and reverse motion) – *skip optional science lesson and engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will manipulate the straight movement of a robot through programming parameters

Leadership Alignment:*Creativity and Innovation:*

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Document FLL prototype robot's movement characteristics

Standards and Competencies**Standard/Unit:**

Program a robot for precise forward and reverse motion.

Determine and use the relationship between power level and travel time/speed

Competencies**Total Learning Hours for Unit: 15**

- Manipulate the Video Trainer software
- Download a program from NXT-G to a robot
- Calculate program parameters based on the circumference of a circle
- Program a robot for precision forward and reverse motion
- Measure, plot and interpolate travel time vs power level data
- Calculate, plot and interpolate speed vs power level data

Aligned Common Core & Washington State Standards**Communications**

SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

	SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
Educational Technology	1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools. 1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities. 1.2.1: Communicate and collaborate to learn with others. 2.2.1: Develop skills to use technology effectively. 2.2.2: Use a variety of hardware to support learning.
Technological Literacy	1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 8. The attributes of design. 9. Engineering design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 13. Assess the impact of products and systems. 16. Energy and power technologies. 17. Information and communication technologies.
Math	6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 6RP2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. 6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems. 6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? 6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. 6EE9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze relationships between the dependent & independent variables using graphs & tables, relate these to the equation. 7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. 7RP2: Recognize and represent proportional relationships between quantities. 7RP3: Use proportional relationships to solve multistep ratio and percent problems. 7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers. 7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers. 7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. 7EE4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. 7G4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. 8EE5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. 8EE7: Solve linear equations in one variable. 8SP3: Use equation of a linear model to solve problems in context of bivariate measurement data, interpreting the slope & intercept.
Reading	6-8RST1: Cite specific textual evidence to support analysis of science and technical texts.
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

	<p>that can be combined into a new solution to better meet the criteria for success.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p>
Social Studies	
Writing	<p>WHST2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.</p>

Unit 5: Sights, Sounds and Gears (using light sensors, sound sensors, and gearing)

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will program a robot to respond to light and sound sensors.
 Student will calculate gears ratios and design a robot to trade off speed vs torque

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:
10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:
11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

- * Calibrate light sensor threshold for FLL field
- * Determine gearing strategies for FLL competition

Standards and Competencies

Standard/Unit:

Build robots to responds to light and sound.
Calculate and use gear ratios to optimize robot performance

Competencies

Total Learning Hours for Unit: 20

- Explain each parameter of the light sensor configuration panel
- Calculate a light sensor threshold
- Program a robot to respond to the light sensor
- Explain each parameter of the sound block (audible output) configuration panel
- Program a robot to respond to give an audible response
- Explain each parameter of the sound sensor configuration panel
- Calculate a sound sensor threshold
- Program a robot to respond to the sound sensor
- Explain the timing sensitivity of the sound sensor
- Explain gearing up and down in relation to speed and torque
- Calculate gear ratios
- Describe the difference between Science and Engineering
- Build a robot using the Engineering Process which incorporates precision forward motion, gear ratios, light and sound sensors

Aligned Common Core & Washington State Standards

Communications

SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
 SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.
 SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
 SL6-4: Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.
 SL7-4: Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
 SL8-4: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
 SL6-5: Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.
 SL7-5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
 SL8-5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
 SL6-6: Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 6 Language standards 1 and 3 on page 52 for specific expectations.)
 SL7-6: Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grade 7 Language standards 1 and 3 on page 52 for specific expectations.)
 SL8-6: Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See

	grade 8 Language standards 1 and 3 on page 52 for specific expectations.)
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>1.3.2: Locate and organize information from a variety of sources and media.</p> <p>1.3.3: Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p> <p>2.3.1: Select and use common applications.</p> <p>2.4.1: Formulate and synthesize new knowledge.</p>
Technological Literacy	<p>1. The characteristics and scope of technology.</p> <p>2. The core concepts of technology.</p> <p>3. The relationships among technologies and the connections between technology and other fields.</p> <p>8. The attributes of design.</p> <p>9. Engineering design.</p> <p>10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.</p> <p>11. Apply the design process.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>18. Transportation technologies.</p>
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p> <p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p>
Reading	<p>RI6-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.</p> <p>RI7-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.</p> <p>RI8-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.</p> <p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p>

	<p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*</p> <p>MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</p> <p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave through various materials.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST6: Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.</p>

Unit 6: Taking Turns (programming precision turns and manipulators) - *skip optional engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot to maneuver through turns, control an appendage, and design a program from a flow chart

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Document robot's FLL turning characteristics

* Develop flowchart for FLL competition

Standards and Competencies

Standard/Unit:

Build robots capable of precision maneuvers, including movable appendages.

Plan and develop linear programs.

Competencies

Total Learning Hours for Unit: 15

- Explain how each parameter of the Move Block can be configured to control a robot's turning response
- Write a program for a robot to maneuver with turns
- Write a program for a robot to maneuver with various precision turns
- Write a program for a robot to combine turning and sensor response
- Create a flowchart to represent a multi-step activity
- Develop a robot program from a flow chart
- Explain each parameter of the Motor Block
- Write a program using the Motor Block to control a third motor in a robot
- Design, build and program a robot to write block characters on a horizontal dry-erase board

Aligned Common Core & Washington State Standards

Art	2.3.1: Applies a responding process to a presentation/exhibit of visual art
Communications	SL6-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL7-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL8-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
Educational Technology	1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities. 1.3.2: Locate and organize information from a variety of sources and media. 1.3.4: Use multiple processes and diverse perspectives to explore alternative solutions
Technological Literacy	1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 8. The attributes of design. 9. Engineering design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 13. Assess the impact of products and systems.

	<p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>18. Transportation technologies.</p>
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p> <p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>7G4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.</p>
Reading	<p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p>

Unit 7: See, Touch, Repeat (using ultrasonic sensor, touch sensor and programming with loops) - *skip optional technology lesson and engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot to use all four sensors and create programs with repeating behaviors

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Finalize sensor choices for FLL competition

* Develop program flow for FLL competition

Standards and Competencies

Standard/Unit:

Build robots that respond to touch and their proximity to objects.

Plan and develop programs with repeating behaviors (loops)

Competencies

Total Learning Hours for Unit: 15

- Describe how computers use digital information to represent numbers, words and images
- Explain why computers only use digital information
- Explain each parameter of the touch sensor configuration panel
- Program a robot to respond to the touch sensor
- Explain each parameter of the ultrasonic sensor configuration panel
- Program a robot to respond to the ultrasonic sensor
- Explain each parameter of the loop configuration panel

- Program a robot for repeating behavior controlled by timers, counters and sensors
- Design, build and program an animatronic robot which resembles and behaves like a selected animal

Aligned Common Core & Washington State Standards

Art	2.3.1: Applies a responding process to a presentation/exhibit of visual art
Communications	<p>SL6-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL7-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL8-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL6-5: Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.</p> <p>SL7-5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p> <p>SL8-5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest</p>
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>1.3.2: Locate and organize information from a variety of sources and media.</p> <p>1.3.3: Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results</p> <p>1.3.4: Use multiple processes and diverse perspectives to explore alternative solutions</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p> <p>2.3.1: Select and use common applications.</p> <p>2.4.1: Formulate and synthesize new knowledge.</p>
Technological Literacy	<p>1. The characteristics and scope of technology.</p> <p>2. The core concepts of technology.</p> <p>3. The relationships among technologies and the connections between technology and other fields.</p> <p>8. The attributes of design.</p> <p>9. Engineering design.</p> <p>10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.</p> <p>11. Apply the design process.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>18. Transportation technologies.</p>
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p> <p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p>
Reading	6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

	<p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*</p> <p>MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.</p> <p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave through various materials.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 8: Decisions, Decisions (using switch blocks and advanced flow charts) - *skip engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot that makes decisions based on sensory input

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Finalize individual mission programs for FLL competition

Standards and Competencies

Standard/Unit:

Build robots that make binary decisions based on sensory input.

Plan and develop branching programs with switch blocks nested inside loops.

Competencies

Total Learning Hours for Unit: 15

- Explain each parameter of the switch block configuration panel
- Program a robot to make decisions based on sensory input
- Explain how a fast switch block nested inside a loop improves detection behavior
- Build and program a robot to continuously detect objects
- Build and program a robot to follow a line
- Create a flow chart to design a hierarchical program
- Design, build and program a sumobot robot which pushes an opponent out of an arena

Aligned Common Core & Washington State Standards

Communications	SL6-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL7-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL8-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. SL6-5: Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information. SL7-5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. SL8-5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest
Educational Technology	1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools. 1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities. 1.2.1: Communicate and collaborate to learn with others. 1.3.2: Locate and organize information from a variety of sources and media. 1.3.3: Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results

	<p>1.3.4: Use multiple processes and diverse perspectives to explore alternative solutions</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p> <p>2.3.1: Select and use common applications.</p> <p>2.4.1: Formulate and synthesize new knowledge.</p>
Technological Literacy	<p>1. The characteristics and scope of technology.</p> <p>2. The core concepts of technology.</p> <p>3. The relationships among technologies and the connections between technology and other fields.</p> <p>8. The attributes of design.</p> <p>9. Engineering design.</p> <p>10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.</p> <p>11. Apply the design process.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>18. Transportation technologies.</p>
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p> <p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p>
Reading	<p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*</p> <p>MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p>

	<p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 9: Get a Grip (using gripper arms and my blocks) - *skip optional tech lesson and engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot that manipulates objects with a gripper attachment.

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Finalize robot attachments and optimize programs for FLL

Standards and Competencies

Standard/Unit:

Build robots that can grip and manipulate objects.
Plan and develop hierarchical programs.

Competencies

Total Learning Hours for Unit: 15

- Describe how computers chip are designed and manufactured
- Explain why computers chips are manufactured in "clean rooms"
- Build a robot with a gripper attachment
- Program a robot to coordinate object manipulation with sensor input
- Design a hierarchical program using my blocks
- Design, build and program a robot capable of sorting objects by color

Aligned Common Core & Washington State Standards

Communications	<p>SL6-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL7-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p> <p>SL8-1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.</p>
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p>
Technological Literacy	<p>1. The characteristics and scope of technology.</p> <p>2. The core concepts of technology.</p> <p>3. The relationships among technologies and the connections between technology and other fields.</p> <p>8. The attributes of design.</p> <p>9. Engineering design.</p> <p>10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.</p> <p>11. Apply the design process.</p> <p>12. Use and maintain technological products and systems.</p> <p>13. Assess the impact of products and systems.</p> <p>16. Energy and power technologies.</p> <p>17. Information and communication technologies.</p> <p>18. Transportation technologies.</p> <p>19. Manufacturing technologies.</p>
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE1: Write and evaluate numerical expressions involving whole-number exponents.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p>

	<p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>8EE3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p> <p>8EE4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.</p>
Reading	<p>6-8RST3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</p> <p>6-8RST7: 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).</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave through various materials.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 10: Working with Data (using data hubs and wires) - *skip engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot that use parameters passed from one block of their program to another.

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Improve FLL programs through the use of data wires and advance My Blocks

Standards and Competencies

Standard/Unit:

Build and program robots that override block data with parameters passed from another block.

Plan and develop hierarchical programs which pass parameters between the levels of hierarchy.

Competencies

Total Learning Hours for Unit: 15

- Describe the purpose of a Data Hub in NXT-G
- Explain the parameters on the Move Block Data Hub
- Program a robot to move with a parameter driven from a Data Hub
- Explain the different Data Types in NXT-G
- Program a robot to display number-type data using Data Hubs and Conversion Blocks
- Design a hierarchical program which passes parameters using data wires with advanced my blocks
- Design, build and program a robot capable of line following under remote control

Aligned Common Core & Washington State Standards

Communications	<p>SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.</p> <p>SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.</p> <p>SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.</p>
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p> <p>2.3.1: Select and use common applications.</p>

	2.4.1: Formulate and synthesize new knowledge.
Technological Literacy	<ol style="list-style-type: none"> 1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 8. The attributes of design. 9. Engineering design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 13. Assess the impact of products and systems. 16. Energy and power technologies. 17. Information and communication technologies. 18. Transportation technologies.
Math	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.</p> <p>6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems.</p> <p>6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?</p> <p>6EE6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number.</p> <p>6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem.</p> <p>6EE9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze relationships between the dependent & independent variables using graphs & tables, relate these to the equation.</p> <p>7RP2: Recognize and represent proportional relationships between quantities.</p> <p>7RP3: Use proportional relationships to solve multistep ratio and percent problems.</p> <p>7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers.</p> <p>7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>7EE4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>8F1: Understand that a function is a rule that assigns to each input exactly one output.</p>
Reading	<p>RI6-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.</p> <p>RI7-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.</p> <p>RI8-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.</p> <p>RI6-7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.</p> <p>RI7-7: Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium's portrayal of the subject (e.g., how the delivery of a speech affects the impact of the words).</p> <p>RI8-7: Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea.</p> <p>RI6-9: Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person).</p> <p>RI7-9: Analyze how two or more authors writing about the same topic shape their presentations of key information by emphasizing different evidence or advancing different interpretations of facts.</p> <p>RI8-9: Analyze a case in which two or more texts provide conflicting information on the same topic and identify where the texts disagree</p>

	<p>on matters of fact or interpretation.</p> <p>6-8RST4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6–8 texts and topics</i>.</p> <p>6-8RST6: Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>6-8RST10: By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 11: Variables and Logic (using variables, math blocks and Boolean logic) - *skip engineering challenge for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design and build a robot that uses variable parameters, algebraic calculations and Boolean logic.

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4; 11.B.1

* Improve FLL programs with variables, math blocks, and logic loops

Standards and Competencies

Standard/Unit:

Build and program robots that override block data with parameters passed from a Variable Block.
Build and program robots that use algebraic combinations of multiple variables through Math Blocks.
Build and program robots that use Boolean logic to control program flow.

Competencies

Total Learning Hours for Unit: 20

- Describe the purpose of a Variable Block in NXT-G
- Explain the parameters on the Variable Block
- Program a robot to write and read variables
- Program a robot to display variables on the NXT screen
- Describe the purpose of a Math Block in NXT-G
- Explain the parameters on the Math Block
- Program a robot to respond to algebraic combinations of variables using Math Blocks
- Describe the Boolean logic data type and operators in NXT-G
- Explain the Boolean logic data plugs in various NXT-G blocks
- Program a robot to respond to a logic-controlled Loop Block

Aligned Common Core & Washington State Standards

Communications	<p>SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.</p> <p>SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.</p> <p>SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.</p>
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>1.3.2: Locate and organize information from a variety of sources and media.</p> <p>1.3.4: Use multiple processes and diverse perspectives to explore alternative solutions</p> <p>2.2.1: Develop skills to use technology effectively.</p> <p>2.2.2: Use a variety of hardware to support learning.</p> <p>2.3.1: Select and use common applications.</p> <p>2.4.1: Formulate and synthesize new knowledge.</p>
Technological Literacy	<p>1. The characteristics and scope of technology.</p> <p>2. The core concepts of technology.</p> <p>3. The relationships among technologies and the connections between technology and other fields.</p>

	<p>8. The attributes of design. 9. Engineering design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 13. Assess the impact of products and systems. 16. Energy and power technologies. 17. Information and communication technologies. 18. Transportation technologies.</p>
Math	<p>6NS1: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. 6NS5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. 6NS7: Understand ordering and absolute value of rational numbers. 6EE2: Write, read, and evaluate expressions in which letters stand for numbers. 6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? 6EE6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number. 6EE7: Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. 6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. 6EE9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze relationships between the dependent & independent variables using graphs & tables, relate these to the equation. 7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers. 7NS2: Apply & extend previous understandings of multiplication & division & of fractions to multiply & divide rational numbers. 7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers. 7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. 7EE4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. 8F1: Understand that a function is a rule that assigns to each input exactly one output. 8F4: Construct a function to model a linear relationship between two quantities.</p>
Reading	<p>RI6-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings. RI7-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone. RI8-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts. RI6-7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue. RI7-7: Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium's portrayal of the subject (e.g., how the delivery of a speech affects the impact of the words). RI8-7: Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea. RI6-9: Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person). RI7-9: Analyze how two or more authors writing about the same topic shape their presentations of key information by emphasizing</p>

	<p>different evidence or advancing different interpretations of facts.</p> <p>RI8-9: Analyze a case in which two or more texts provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.</p> <p>6-8RST4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6–8 texts and topics</i>.</p> <p>6-8RST6: Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>6-8RST10: By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.</p>
Science	<p>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.</p> <p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p>
Writing	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

Unit 12: Data Logging with Sensors (using sensors for scientific experimentation) - *postpone for FLL

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Student will design experiments and program the NXT to perform scientific data logging of sensor readings

Leadership Alignment:

Creativity and Innovation:

1.A.1; 1.A.2; 1.A.3; 1.B.1; 1.B.2; 1.B.3; 1.B.4; 1.C.1

Critical Thinking and Problem Solving:

2.A.1; 2.B.1; 2.C.1; 2.C.2; 2.C.3; 2.C.4; 2.C.5; 2.D.1; 2.D.2

Communication and Collaboration:

3.A.1; 3.A.2; 3.A.3; 3.B.1; 3.B.2; 3.B.3

Information Literacy:

4.A.1; 4.A.2; 4.B.1

Information, Communications and Technology (ICT) Literacy:

6.A.1; 6.A.2; 6.A.3

Flexibility and Adaptability:

7.A.1; 7.A.2

Initiative and Self-Direction:

8.A.1; 8.A.2; 8.A.3; 8.B.1; 8.C.1; 8.C.4

Social and Cross-Cultural Skills:

9.A.1; 9.A.2; 9.B.1; 9.B.2; 9.B.3

Productivity and Accountability:

10.A.1; 10.A.2; 10.B.1 (a, b, c, d, e, f, g, h)

Leadership and Responsibility:

11.A.1; 11.A.2; 11.A.3; 11.A.4

Standards and Competencies

Standard/Unit:

Program the NXT to perform real time data logging with NXT sensors.
Program the NXT to perform remote logging with NXT sensors.
Program the NXT to perform data logging with advanced sensors.
Analyze logged data with NXT-G analysis tools and spreadsheets.
Design, build and program a robot to perform active data logging.

Competencies

Total Learning Hours for Unit: 20

- Describe the role of data logging in the Scientific Method
- Program the NXT to perform real time data logging with NXT sensors.
- Program the NXT to perform remote logging with NXT sensors.
- Program the NXT to perform data logging with advanced sensors (real time and remote)
- Analyze logged data with NXT-G analysis tools
- Upload logged data to a spreadsheet for advanced analysis
- Program an embedded Data Logger into a NXT-G program
- Design, build and program a robot to perform active data logging with NXT-G

Aligned Common Core & Washington State Standards

Communications	<p>SL6-2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.</p> <p>SL7-2: Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.</p> <p>SL8-2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.</p> <p>SL6-5: Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.</p> <p>SL7-5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.</p> <p>SL8-5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest</p>
Educational Technology	<p>1.1.1: Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2: Use models and simulations to explore systems, identify trends, and forecast possibilities.</p> <p>1.2.1: Communicate and collaborate to learn with others.</p> <p>1.3.2: Locate and organize information from a variety of sources and media.</p> <p>1.3.3: Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results</p> <p>1.3.4: Use multiple processes and diverse perspectives to explore alternative solutions</p> <p>2.2.1: Develop skills to use technology effectively.</p>

	<p>2.2.2: Use a variety of hardware to support learning. 2.3.1: Select and use common applications. 2.4.1: Formulate and synthesize new knowledge.</p>
<p>Technological Literacy</p>	<ol style="list-style-type: none"> 1. The characteristics and scope of technology. 2. The core concepts of technology. 3. The relationships among technologies and the connections between technology and other fields. 5. The effects of technology on the environment. 8. The attributes of design. 9. Engineering design. 10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. 11. Apply the design process. 12. Use and maintain technological products and systems. 13. Assess the impact of products and systems. 14. Medical technologies. 15. Agricultural and related biotechnologies. 16. Energy and power technologies. 17. Information and communication technologies. 18. Transportation technologies. 19. Manufacturing technologies.
<p>Math</p>	<p>6RP1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. 6RP2: Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. 6RP3: Use ratio and rate reasoning to solve real-world and mathematical problems. 7RP1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. 7RP2: Recognize and represent proportional relationships between quantities. 7RP3: Use proportional relationships to solve multistep ratio and percent problems. 6NS1: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. 6NS5: Understand that positive and negative numbers are used together to describe quantities having opposite directions or use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. 6NS7: Understand ordering and absolute value of rational numbers. 7NS1: Apply & extend previous understandings of addition & subtraction to add & subtract rational numbers. 7NS2: Apply & extend previous understandings of multiplication & division & of fractions to multiply & divide rational numbers. 7NS3: Solve real-world and mathematical problems involving the four operations with rational numbers. 8NS1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. 6EE1: Write and evaluate numerical expressions involving whole-number exponents. 6EE2: Write, read, and evaluate expressions in which letters stand for numbers. 6EE5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? 6EE6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number. 6EE7: Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. 6EE8: Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. 6EE9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze</p>

	<p>relationships between the dependent & independent variables using graphs & tables, relate these to the equation.</p> <p>7EE3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</p> <p>7EE4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.</p> <p>8EE3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.</p> <p>8EE4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used.</p> <p>8EE5: Graph proportional relationships, interpreting the unit rate as the slope of the graph.</p> <p>8EE7: Solve linear equations in one variable.</p> <p>8F1: Understand that a function is a rule that assigns to each input exactly one output.</p> <p>8F3: Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.</p> <p>8F4: Construct a function to model a linear relationship between two quantities.</p> <p>8F5: Describe qualitatively the functional relationship between two quantities by analyzing a graph.</p> <p>6SP5: Summarize numerical data sets in relation to their context.</p> <p>7SP5: Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.</p> <p>8SP2: Know that straight lines are widely used to model relationships between two quantitative variables.</p> <p>8SP3: Use equation of a linear model to solve problems in context of bivariate measurement data, interpreting the slope & intercept.</p>
Reading	<p>RI6-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.</p> <p>RI7-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.</p> <p>RI8-4: Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.</p> <p>RI6-7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.</p> <p>RI7-7: Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium's portrayal of the subject (e.g., how the delivery of a speech affects the impact of the words).</p> <p>RI8-7: Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea.</p> <p>RI6-9: Compare and contrast one author's presentation of events with that of another (e.g., a memoir written by and a biography on the same person).</p> <p>RI7-9: Analyze how two or more authors writing about the same topic shape their presentations of key information by emphasizing different evidence or advancing different interpretations of facts.</p> <p>RI8-9: Analyze a case in which two or more texts provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.</p> <p>6-8RST4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6–8 texts and topics</i>.</p> <p>6-8RST6: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.</p> <p>6-8RST9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.</p> <p>6-8RST10: By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.</p>
Science	<p>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.</p>

	<p>MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>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.</p> <p>MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p> <p>MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.</p> <p>MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</p> <p>MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*</p> <p>MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.</p> <p>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</p> <p>MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.</p> <p>MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</p> <p>MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*</p> <p>MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.</p> <p>MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.</p> <p>MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave through various materials.</p> <p>MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.</p> <p>MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.</p> <p>MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.</p> <p>MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.</p> <p>MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.</p> <p>MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.</p> <p>MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.</p> <p>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</p> <p>MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.</p> <p>MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p> <p>MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.*</p> <p>MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.</p> <p>MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.</p>
<p>Writing</p>	<p>WHST4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>WHST5: With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.</p> <p>WHST10: Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p>

**This framework has been designed for the classroom. If you are competing in FLL there are certain components that should be skipped or postponed until after the FLL competitions are complete:*

- *Each Unit's title has description of what can be skipped to best fit the FLL timeline.*
- *Each Unit's Leadership Alignment is appended with the added FLL tasks aligned with that Unit.*
- *The FLL alignment with the 21st Century Skills are provided in the table below*

21st Century Skills - * with FIRST® LEGO League (FLL) Skills Alignment

Check those that students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

FLL Skills Alignment

Project

- Present team's innovative solution to a real world problem to panel of adult judges
- Evaluated on analysis of real world problem and existing solutions
- Evaluated on creativity in developing an innovative solution to the identified problem
- Evaluated on effectiveness of team presentation and extent to which they shared their new learning with others

Robot

- Present team's hardware and software design as well as game strategy to a panel of adult judges
- Evaluated on design process, game analysis and innovative approaches to solve game challenges
- Evaluated on robot's durability, efficiency

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- Access and /evaluate Information
- Use and Manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

FLL Skills Alignment

Project

- Research real world problems and existing solutions
- Develop innovative solution to identified problem
- Document learning and progress throughout for use in presentation
- Create interactive presentation of research results and innovative solution

Robot

- Analyze robot game scoring and develop data driven game strategy
- Research robot design techniques and analyze impact on robot performance
- Research robot programming techniques and analyze impact on robot performance
- Document engineering design process throughout for use in presentation
- Create interactive presentation of robot hardware/software design and game strategy

Core Values

- Document team's demonstrations FLL Core

LIFE & CAREER SKILLS

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

Productivity and Accountability

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others

FLL Skills Alignment

Project

- Develop plan to both partition work and coordinate integration of everyone's work
- Complete research on real world problems and existing solutions early in season
- Select and develop innovative solution in time to prepare presentation
- Create and practice interactive presentation with individual and group responsibilities

Robot

- Develop plan to both partition work and coordinate integration of everyone's work
- Analyze robot game scoring and develop

<p>and mechanical innovation</p> <ul style="list-style-type: none">• Evaluated on program's quality, efficiency and automation <p>Core Values</p> <ul style="list-style-type: none">• Present team's application of Core Values to panel of adult judges• Demonstrate real time group problem solving skills in Core Value mystery challenge• Evaluated on both the effectiveness and efficiency of their teamwork• Evaluated on inclusion and respect within team and cooperation with other teams	<p>Values throughout season</p> <ul style="list-style-type: none">• Create interactive presentation of team's Core Values activities	<p>data driven game strategy early in season</p> <ul style="list-style-type: none">• Ensure synchronization of parallel hardware and software design tasks• Complete design earlier enough to practice match performance• Create and practice interactive presentation with individual and group responsibilities <p>Core Values</p> <ul style="list-style-type: none">• Develop plan to both partition work and coordinate integration of everyone's work• Document team's demonstrations FLL Core Values throughout season• Practice solving mystery challenges as a group• Create and practice interactive presentation with individual and group responsibilities
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