Saint Patrick High School
Curriculum Guide: Robotics

Department:	Science	**Grade and Level:**	Varies
Class:	Robotics	**Term (Semester or Year):**	Year-long course

Required Text:	
Additional Resources (i.e. texts, materials, apps, etc.):	iPad Apps Showbie GoodReader Pages iMovie iBooks iTunes U Keynote BookPress Nearpod

Course Description

This year-long introductory robotics course is designed to expose students to the the design, construction, operation, and application of robotic mechanisms. Students will have the opportunity to explore this area of STEM (Science, Technology, Engineering and Mathematics) through computer programming, engineering, 3D design, and robot construction. This course will include hands-on activities and team projects as well as an investigation of current applications of robotics. Students will also gain experience in technical writing through the maintenance of engineering journals and presentations. Students will also be heavily encouraged to participate extracurricularly in SPHS's FIRST Tech Challenge and FIRST Robotics Competition teams; a good portion of time in class will be directly applicable and beneficial to the school's FIRST robotics teams. This course will also be adapted to meet the previous robotics background that students in it have.

Academic Standards Addressed:

The following aspects of the Next Generation Science Standards will be assessed throughout completion of this course:

HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

The following Engineering Practices listed in the Next Generation Science Standards will also be stressed in this course:

1. Defining problems
2. Developing and using models
5. Using mathematics and computational thinking
6. Designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Unit Themes (Table of Contents)

Theme 1:	Introduction and Safety
Theme 2:	Introduction to Robotics and Early Projects
Theme 3:	FIRST Tech Challenge Game Release Analysis
Theme 4:	FIRST Tech Challenge Design Phase
Theme 5:	FIRST Tech Challenge Building and Programming
Theme 6:	FIRST Tech Challenge Testing and Reiteration
Theme 7:	FIRST Tech Challenge Reflection
Theme 8:	Research Projects
Theme 9:	Additional Projects

Agreed Upon Assessments

Forms of assessments may include but are not limited to….

- Objective tests
- Essays
- Lectures/Discussions
- Group Projects
- Presentations
- Research Papers/Projects
- Homework Assignments
- Primary Source Document Analysis
- Supplemental Readings
- Engineering Notebook Entries

Research and Writing Expectations

Students will continually document their progress on course projects through the maintenance of an engineering notebook. Research skills will also be used by students to find current applications of robotics in society and find resources to aid them in robot design.

Unit:	Introduction and Safety	**Duration:**	2 weeks

Specific Unit Standards (define your year):

NGSS Engineering Practice 8: Obtaining, evaluating, and communicating information

Essential Questions:

- What do we mean when we talk about “robotics?”
- What are common safety hazards when working on robots?
- How will we stay safe when working in this class?

Affirmation Statements:

Students will be able to…:

- Describe the study of robotics as in simple language.
- Identify safety hazards in the robotics workspace.
- Describe an appropriate response to proposed safety hazards.
- Work in a team to develop, present, and defend a list of safety guidelines for the classroom.

Assessments:

- Safety Quiz
- Demonstration of Safe Use of Supplies
- Safety Presentation

Unit:	Introduction to Robotics and Early Projects	**Duration:**	6-7 Weeks

Specific Unit Standards:

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

NGSS Engineering Practices:

1. Defining problems
2. Developing and using models
5. Using mathematics and computational thinking
6. Designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Essential Questions:

- How do engineers and designers approach a project?
- How do engineers and designers document their progress?
- What content knowledge do roboticists need in order to build robots successfully?

Affirmation Statements:

Students will be able to…:

- Identify the key attributes that are necessary for an engineering notebook.
- Effectively communicate progress on daily engineering projects.
- Use beams, screws, and nuts to construct a sturdy rectangle.
- Construct a robot frame that will hold other robot components securely.
- Use screws to mount a wheel on a motor.
- Mount motors and wheels to a robot frame.
- Make a basic electronics board to power a motor.

- Mount an electronics board onto a robot.
- Troubleshoot electrical issues, checking for loose wiring and proper connections.
- Program a robot to move forward and backward.
- Program a robot to turn.
- Program a robot to adjust its speed based on position of joysticks.
- Program a robot to drive along a shape perimeter autonomously.
- Program a robot to follow a white line tape autonomously.

Common Assessments:

- Chassis construction project
- Drivetrain construction project
- Electrical practice project
- Programming practice project
- Engineering Notebook
- Peer Evaluation
- White Line Following Robot Project
- Robotics Topics Quiz

Unit:	FIRST Tech Challenge Game Release Analysis	**Duration:**	2 weeks

Specific Unit Standards:

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

NGSS Engineering Practices:

1. Defining problems

2. Developing and using models
5. Using mathematics and computational thinking
6. Designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Essential Questions:

- What things are important to consider when designing a solution to a problem?

Affirmation Statements:

Students will be able to…:

- Analyze a posed challenge to determine steps that must be taken to complete the challenge
- Mathematically determine the most valuable actions to take in a points-based robotics challenge
- Present a strategy for solving a problem and defend that strategy

Common Assessments:

- Strategy presentations

Unit:	FIRST Tech Challenge Design Phase	**Duration:**	2-3 weeks

Specific Unit Standards:

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

The following Engineering Practices listed in the Next Generation Science Standards will also be stressed in this course:

1. Defining problems
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6. Designing solutions
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8. Obtaining, evaluating, and communicating information

Essential Questions:

- How can we design a robot-based solution to a problem?

Affirmation Statements:

Students will be able to…:

- Effectively communicate progress on daily engineering projects.
- Document the process of developing a design solution
- Draw or Model an engineered solution to a design problem
- Present and defend a design for an engineering design problem.

Common Assessments:

- Engineering Notebooks
- Peer Evaluations
- Robot Design Pamphlet and Presentation

Unit:	FIRST Tech Challenge Building and Programming	**Duration:**	7-8 weeks

Specific Unit Standards:

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

NGSS Engineering Practices:

1. Defining problems
2. Developing and using models
5. Using mathematics and computational thinking
6. Designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Essential Questions:

- How can we implement and construct a designed robot that solves a problem?

Affirmation Statements:

Students will be able to…:

- Effectively communicate progress on daily engineering projects.
- Document the process of developing a design solution.
- Build a robot chassis that will solve a design problem.
- Build a robot drivetrain that will solve a design problem.
- Design robot electronics that will solve a design problem.
- Program a robot to solve a design problem.
- Demonstrate and explain the final product design for solving an engineering problem.

Common Assessments:

- Engineering Notebooks
- Peer Evaluations
- Final product demonstration
- Final product presentation

Unit:	FIRST Tech Challenge Testing and Reiteration	**Duration:**	3-4 weeks

Specific Unit Standards:

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

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NGSS Engineering Practices:

1. Defining problems
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Essential Questions:

- Once a solution to a problem is designed, how can it be improved?
- How do we troubleshoot a problem in robotics?

Affirmation Statements:

Students will be able to…:

- Evaluate the success of a robot in a challenge
- Propose improvements for a designed robot
- Independently identify problems and solutions in robot design
- Troubleshoot mechanical problems in robotics
- Troubleshoot electrical problems in robotics
- Troubleshoot programming problems in robotics

Common Assessments:

- Robot evaluation report

- Proposed improvements report
- Engineering Notebooks
- Peer Evaluations

Unit:	FIRST Tech Challenge Reflection	**Duration:**	1 week

Specific Unit Standards:

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

NGSS Engineering Practices:
1. Defining problems
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Essential Questions:

- How successful was our work on this project?

Affirmation Statements:

Students will be able to…:

- Evaluate and reflect on the success of their designed robot.
- Identify their personal contributions toward the robotics project.
- Identify their strengths and weaknesses in the process of building a robot.
- Communicate goals for future build processes.

Common Assessments:

- Reflection Report
- Goal-setting discussion

Unit:	Research Projects	**Duration:**	3-4 weeks

Specific Unit Standards:

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1. Defining problems
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Essential Questions:

- What are current public concerns in the field of robotics?
- What are some current applications of robotics?
- What are some global problems that can be solved with robotics?

Affirmation Statements:

Students will be able to…:

- Choose a research topic involving robotics
- Describe a special topic consideration in the field of robotics through an essay
- Describe a special topic consideration in the field of robotics through a presentation
- Describe a special topic consideration in the field of robotics through a class debate
- Evaluate current robotic solutions to societal problems

Common Assessments:

- Presentation on special topics in robotics
- Essay on special topics in robotics
- Debate on special topics in robotics

Unit:	Additional Projects	**Duration:**	7-8 weeks

Specific Unit Standards:

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HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, aesthetics, as well as possible social, cultural, and environmental impacts.

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6. Designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Essential Questions:

- How can we design a robot-based solution to a proposed problem?

Affirmation Statements:

Students will be able to…:

- Effectively communicate progress on a group-directed engineering project.

- Document the process of developing a design solution.
- Build a robot chassis that will solve a design problem.
- Build a robot drivetrain that will solve a design problem.
- Design robot electronics that will solve a design problem.
- Program a robot to solve a design problem.
- Demonstrate and explain the final product design for solving an engineering problem.

Common Assessments:

- Engineering Notebook
- Peer Evaluation
- Final Project Presentation and Demonstration