



## Fundamentals of Robotics Course Outline

### **A. Information**

Course Title: Fundamentals of Robotics

Course Length: 1 Year

Grade Level: 9-12

Prerequisites: Algebra or Integrated Math I

Type of Course: Elective

### **B. Description**

Fundamentals of Robotics examines the intersection of science, engineering, and technology through the multidisciplinary field of robotics. The course is tailored to spark the interest of students in STEM fields and give them the confidence and drive needed to pursue higher degrees in these disciplines. Computer programming, collaboration, and mechanical and electrical engineering principles are emphasized throughout the course. Utilizing a hands-on, project-based learning model, students work in pairs to construct, program, and run robotic cars used in a number of in-class challenges and a final competition designed to represent the culmination of their learning. Fundamentals of Robotics helps students improve practical skills such as communication, interpersonal skills, problem solving, troubleshooting, and technological literacy.



## **C. Objectives**

### **Students will:**

- Develop an understanding of the relationship between science and technology.
- Understand the key elements of how the concepts underlying a problem can lead to the design and production of a viable solution.
- Apply tools and technologies employed by robotics engineers in the solution of problems.
- Participate in project-oriented technology education using engineering applications that reinforce academic core competencies.
- Construct robotic cars utilizing the Raspberry Pi computer.
- Address technological literacy through their projects by writing computer programs to control their robots, using conditional statements, loops, variables, timers, and functions.
- Identify and learn from unsuccessful outcomes.
- Work effectively in teams.
- Communicate effectively about their experience in writing and orally.

## **D. Outline**

### **First Semester**

#### 1. Introduction to Robotics

An Examination of Robotics in Our Society

What is Robotics?

Circuitry and Breadboards Part 1

Robot Assembly Part 1

Robot Research Project

**Common Core State Standards: Math Number and Quantity: 1, 3 Creating Equations: 4**

**Building Functions: 1a**

**CCSS Science Standards: Physical Science: 2-6, 4-5 Engineering, Technology, and**

**Applications of Science: 1-1,2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

#### 2. The Design Process

Circuitry and Breadboards Part 2

Robot Assembly Part 2

The Design Process

**Common Core State Standards: Math Number and Quantity: 1, 3 Interpreting Categorical and Qualitative Data: 9**

**CCSS Science Standards: Physical Science: 2-1 Engineering, Technology, and**



## **Applications of Science: 1-1,2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

### 3. Margin of Error

Raspberry Pi and GPIO Pins

Raspberry Pi vs. Dual H-Bridge

Making Circuits with the GPIO Pins

Robot Assembly Part 3

Margin of Error and Minimizing Error

**Common Core State Standards: Math Number and Quantity: 1, 3 Creating Equations: 1**

**CCSS Science Standards: Physical Science: 2-1, 2-6, 3-3, 4-2 Engineering, Technology, and Applications of Science: 1-1,2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

**Anchor Standards Engineering and Architecture: 2.3, 9.2**

### 4. Introduction to Programming

Secure Shell Connection

Python Lesson 1: Hello World

Rules and Syntax in Python

Forward Function Walkthrough

Assignment #1: Forward

Battery Loss Graph

Assignment #2: Backward

Finding Speed

**Common Core State Standards Math 1: Number and Quantity: 1, 3 Congruence: 1 Creating Equations: 1, 3 Building Functions: 1, 1b Interpreting Functions: 1, 2 Reasoning with Equations and Inequalities: 3.1 Linear, Quadratic, and Exponential Models 1b, 1c Interpreting Categorical and Qualitative Data: 1, 2, 3, 6c, 7, 8, 9**

**Common Core State Standards Math 2: Seeing Structure in Expressions: 1a Creating Equations: 2 Interpreting Functions: 4, 5, 6**

**CCSS Science Standards: Physical Science: 2-1, 2-2, 2-3 Engineering, Technology, and Applications of Science: 1-1, 2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

### 5. Expanding on Programming: Rotation and Loops

Turning

Assignment #3: Clockwork

Assignment #4: Zigzag

Definite While Loops in Python

**Common Core State Standards Math 1: Number and Quantity: 1, 3 Congruence: 1 Creating Equations: 1 Building Functions: 1, 1a, 1b Interpreting Functions: 1, 2 Reasoning with**



**Equations and Inequalities: 3, 3.1 Linear, Quadratic, and Exponential Models 1b, 1c  
Interpreting Categorical and Qualitative Data: 1, 2, 3, 6c, 7, 8, 9  
Common Core State Standards Math 2: Seeing Structure in Expressions: 1a Creating  
Equations: 2 Interpreting Functions: 4, 5, 6  
CCSS Science Standards: Physical Science: 2-1, 2-2, 2-3 Engineering, Technology, and  
Applications of Science: 1-1, 2  
CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

#### 6. Application of Functions: Robot Dance

Introduction to Functions

Robot Dance

SFTP Connection

**Common Core State Standards Math 1: Number and Quantity: 1, 3 Creating Equations: 1  
Building Functions: 1, 1a, 1b Interpreting Functions: 1, 2 Linear, Quadratic, and  
Exponential Models 1b, 1c Interpreting Categorical and Qualitative Data: 1, 2, 3, 6c, 7, 8, 9  
Common Core State Standards Math 2: Seeing Structure in Expressions: 1a Creating  
Equations: 2 Interpreting Functions: 4, 5, 6  
CCSS Science Standards: Physical Science: 2-1, 2-2, 2-3 Engineering, Technology, and  
Applications of Science: 1-1, 2  
CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

#### 7. Sensor Applications

Assemble IR Sensors

Indefinite While Loops

Indefinite While Loops in Real Life

**Common Core State Standards Math 1: Number and Quantity: 1, 3 Creating Equations: 1  
Building Functions: 1, 1b Interpreting Functions: 1, 2 Linear, Quadratic, and Exponential  
Models 1b, 1c Interpreting Categorical and Qualitative Data: 3, 6c, 7, 8, 9  
Common Core State Standards Math 2: Seeing Structure in Expressions: 1a Creating  
Equations: 2 Interpreting Functions: 4, 5, 6  
CCSS Science Standards: Physical Science: 2-1, 2-2, 2-3 Engineering, Technology, and  
Applications of Science: 1-1, 2  
CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

#### 8. Geometric Circuit

Introduction to Geometric Circuit

Correlation vs. Causation

**Common Core State Standards Math 1: Number and Quantity: 1, 3 Creating Equations: 1  
Building Functions: 1, 1b Interpreting Functions: 1, 2 Linear, Quadratic, and Exponential  
Models 1b,  
Common Core State Standards Math 2: Interpreting Functions: 6**



**CCSS Science Standards: Physical Science: 2-1, 2-2, Engineering, Technology, and Applications of Science: 1-1, 2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

**9. Competition Preparation**

Prepare for Competitions

Battery Loss Data Analysis

**Common Core State Standards Math 1: Building Functions: 1, 1b Interpreting Functions: 1, 2 Linear, Quadratic, and Exponential Models 1b,**

**Common Core State Standards Math 2: Interpreting Functions: 6**

**CCSS Science Standards: Physical Science: 2-1, 2-2, Engineering, Technology, and Applications of Science: 1-1, 2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

**10. Competition and Reflection**

Competition: Robot Dance

Competition: Geometric Circuit

Student Reflections

**Common Core State Standards Math 1: Building Functions: 1, 1b Interpreting Functions: 1, 2 Linear, Quadratic, and Exponential Models 1b,**

**Common Core State Standards Math 2: Interpreting Functions: 6**

**CCSS Science Standards: Physical Science: 2-1, 2-2, Engineering, Technology, and Applications of Science: 1-1, 2**

**CCSS English Language Arts Standards: Reading Informational Texts: 1, 7 Writing: 2.a-e, 9**

**Instructional Materials**

Robotics I Reference Material Guide for Windtree Robotics

Robotics I Science Notebook for Windtree Robotics