The EUHSD Exploring Computer Science curriculum document identifies what students should be able to know by grade level in a comprehensive standards-based course of study in both Math and Information and Communication Pathway. This curriculum document may be revised based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD curriculum document contains the following documents and/or information:

A. Course Description
B. Course Guidelines/Requirements - graduation credit information, transcript information, adopted materials, adopted technology, assessment outline
C. Instructional Materials References
D. Scope and Sequence Map with Essential Standards outlined by Unit
E. References to key essential design and implementation documents

A comprehensive course of study and/or program is designed so that all students have access to the rigorous curriculum necessary to graduate high school demonstrating college and career readiness skills. Student-centered learning provides opportunity for collaboration, communication, and a robust learning environment and provides opportunities for all students to meet the goals of the district’s Instructional Focus at the time of this writing: “All students communicate their thinking, ideas and understanding by effectively using oral, written and/or non-verbal expression.” A key design consideration in the transition to the updated California State Standards is a focus on changes to pedagogy with an emphasis on ensuring students are engaged via relevant learning experiences.

A key design consideration in the transition to the new California State Standards is a focus on changes to pedagogy. The CA Learning Standards describe key instructional shifts, which guide classroom teaching and learning and provide a foundation of curriculum and instructional design based on student inquiry and a focus on rigorous literacy tasks. These instructional shifts are described on the California Department of Education’s website at the following URL: https://www.cde.ca.gov/Re/cc/

The curriculum document is aligned to the California Learning Standards and—more specifically—the Model Career Technical Education Standards, the CTE Knowledge and Performance Anchor Standards, and the Pathway Standards specific to this course of study. All CTE standards are located here: https://www.cde.ca.gov/ci/ct/sf/
Exploring Computer Science Course Description

*Exploring Computer Science* is a course designed to introduce students to the breadth of the field of computer science through an exploration of engaging and accessible topics. Rather than focusing the entire course on learning particular software tools or programming languages, the course is designed to focus on the conceptual ideas of computing and help students understand why certain tools or languages might be utilized to solve particular problems. The goal of *Exploring Computer Science* is to develop in students the computational practices of algorithm development, problem solving and programing within the context of problems that are relevant to the lives of today’s students. Students will also be introduced to topics such as interface design, limits of computers, and societal and ethical issues.

### Course Requirements

<table>
<thead>
<tr>
<th>Course Length: Year Long</th>
<th>Grade Level: 9-12</th>
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<tbody>
<tr>
<td>UC/CSU Requirement:</td>
<td>Graduate Requirement: Meets EUHSD CTE Requirement or Elective Credit</td>
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<tr>
<td>Course Number (Semester A): 0888</td>
<td>Transcript Abbreviation (Semester A): EXPLR COMP SCI A P</td>
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<tr>
<td>Course Number (Semester B): 0889</td>
<td>Transcript Abbreviation (Semester B): EXPLR COMP SCI B P</td>
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<td>Credits (Semester A): EUHSD CTE Requirement or Elective Credit</td>
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<tr>
<td>Required Prerequisite/s: None</td>
<td>Recommended Prerequisite/s: None</td>
</tr>
<tr>
<td>Board Approval Date (Curriculum): 5/15/18</td>
<td>Board Approval Date (Materials): 5/15/18</td>
</tr>
</tbody>
</table>

### Textbooks/Resources:

*Exploring Computer Science* by Joanna Gooide & Gail Chapman, Published by UCLA 5th Ed

1. [http://www.exploringcs.org/curriculum](http://www.exploringcs.org/curriculum)

### Technology Resources:

- Students utilize a variety of technical equipment in the work/lab space including computer workstations, design and drafting software, emerging technology and additional equipment as called upon by the learning tasks.

### Assessment:

- The course is designed as a project-based curriculum; students must complete a variety of hands-on projects both collaboratively and individually. Each unit outlines specific skills and/or long-term projects, which serve as unit and course assessments. Students are required to communicate acquired concepts and skills via completion of computational problem-solving projects, writing, verbal communication, etc., according to the Career Technical Education anchor standards and, once they are released, the pathway/industry specific standards. This course also utilizes the CA Common Core learning standards for mathematics which include the Standards for Mathematical Practice (see standards listed in each unit).

### Meeting the Needs of ELs:

- Our student information system is used by site leaders and instructors to acquire the language levels of EUHSD English Learners to ensure they are identified and their specific needs are met.
- Our approach to supporting English learners in based on the CA Department of Education (CDE) adopted language level proficiency descriptors and updated ELD Learning Standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/cf/documents/eldstndspublis14.pdf](http://www.cde.ca.gov/sp/el/cf/documents/eldstndspublis14.pdf)
- EUHSD uses the ELA-ELD Framework to inform pedagogical practices related to supporting English Learners. Visit the following URL to learn more about the new frameworks which describe in detail specific best practices used to support English Learners: [http://www.cde.ca.gov/ci/lr/le/documents/elaeldfwchapter11.pdf](http://www.cde.ca.gov/ci/lr/le/documents/elaeldfwchapter11.pdf)

### Instructional Resources:

- Fully equipped computer lab with internet access, or
- Portable laptop cart with 1-1 student-device ratio
- Robot building kits for classroom use (example found at [https://meetedison.com/](https://meetedison.com/) or Lego Mindstorms)
- Student and teacher computers will need Scratch, Python, and JavaScript installed

### Sample Instructional Routines:

- Each class will follow a Launch, Explore Summarize format in which a contextual problem is posed to the students, they use multiple online resources to research and solve the problem, as summary debrief which could include presentations of learning through portfolios, projects, etc. will conclude each lesson.
Scope and Sequence Guide

The Scope and Sequence Guide for this course is informed by the California Learning Standards and delineates the concepts and skills students are expected to acquire in order to meet College and Career Readiness expectations set forth by the state and local board approved guidelines. Each unit of study is designed to build upon the previous unit and/or prerequisite coursework in support of student mastery of specific standards based skills. This Scope and Sequence document provides guidelines for instructors to ensure they have the necessary information related to content and pedagogy to guarantee students can meet the learning objectives of the course. The document is updated as needed based on input from all stakeholders to ensure it meets the needs of students.

All Career Technical Education coursework in the EUHSD is based on a series of state-adopted CTE standards which include the CTE Knowledge and Performance Anchor Standards, the California Standards for Career Ready Practice, and the CTE Model Curriculum Pathway Specific Standards. Not every standard and its related learning objective is included in the Scope and Sequence Guide since this document provides the essential focus standards and key learning objectives and the related assignments and assessments so teachers can exercise their best judgment and use formative assessment data to inform and guide their instruction.

The Standards for Career Ready Practice are integrated throughout the units and describe the fundamental knowledge and skills that a career ready student needs in order to prepare for transition to postsecondary education, career training, or the workforce. These standards are not exclusive to a career pathway, a CTE program of study, a particular discipline, or level of education. Standards for Career Ready Practice are taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study. These standards describe how students must:

1. Apply appropriate technical skills and academic knowledge.
2. Communicate clearly, effectively, and with reason.
3. Develop an education and career plan aligned with personal goals.
4. Apply technology to enhance productivity.
5. Utilize critical thinking to make sense of problems and persevere in solving them.
6. Practice personal health and understand financial literacy.
7. Act as a responsible citizen in the workplace and the community.
8. Model integrity, ethical leadership, and effective management.
9. Work productively in teams while integrating cultural and global competence.
10. Demonstrate creativity and innovation.
11. Employ valid and reliable research strategies.
12. Understand the environmental, social, and economic impacts of decisions.
Exploring Computer Science Scope and Sequence
Unit 1 – Human Computer Interaction
Length: (4 Weeks)

Unit Description: In this unit, students are introduced to the concepts of computer and computing while investigating the major components of computers and the suitability of these components for particular applications. Students will experiment with internet search techniques, explore a variety of websites and web applications and discuss issues of privacy and security. Fundamental notions of Human Computer Interaction (HCI) and ergonomics are introduced. Students will learn that “intelligent” machine behavior is not “magic” but is based on algorithms applied to useful representations of information, including large data sets. Students will learn the characteristics that make certain tasks easy or difficult for computers, and how these differ from those that humans characteristically find easy or difficult. Students will gain an appreciation for the many ways in which computing-enabled innovation have had an impact on society, as well as for the many different fields in which they are used. Connections among social, economic and cultural contexts will be discussed.

Students will work in groups to prepare written and oral presentations of the information necessary to purchase a home computer. Students will first work together to decide their requirements for a home computer taking into consideration costs, video and audio needs, storage, Internet access, and printing needs. The final project will include the requirements statement, the basic list of hardware needed to support the requirements, the basic list of software needed to support the requirements, the recommended computer to purchase, and a 3-paragraph justification of their recommendation.

Major Unit Topics:
• Computers and the internet
• Models of Intelligent Behavior
• Societal impacts of computing
• Principals of computer organization

Focus Pathway Standards:
A1.0 Describe the role of information and communication technologies in organizations.
A1.1 Describe how technology is integrated into business processes.
A2.0 Acquire, install, and implement software and systems.
A2.1 Identify and list the criteria and processes for evaluating the functions of information systems.
A2.2 Investigate, evaluate, select, and use major types of software, services, and vendors.
A2.3 Install software and setup hardware.
A3.0 Access and transmit information in a networked environment.
A3.2 Validate and cite Internet resources
A7.0 Support and train users on various software, hardware, and network systems.
A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
A8.0 Manage and implement information, technology, and communication projects.

Key Learning Objectives & Tasks:
Students will…
• Analyze the characteristics of hardware components to determine the applications for which they can be used.
• Use appropriate tools and methods to execute Internet searches, which yield requested data.
• Evaluate the results of web searches and the reliability of information found on the Internet.
• Explain the differences between tasks that can and cannot be accomplished with a computer.
• Analyze the effects of computing on society within economic, social, and cultural contexts.
• Communicate legal and ethical concerns raised by computing innovation.
• Explain the implications of communication as data exchange.

Key Unit Assignments & Assessments:
• The Shopping for a Computer project. This project will address the “Computers and the Internet” topic. Students (in small groups) will shop for and compare different computers based on predetermined criteria. They will do a requirements analysis, comparison chart, and in the end produce a presentation, which will be presented to the class. This project will serve as the main assessment for determining a student’s knowledge of major hardware and software systems in a computer, compare, and contrast between them.
• The Communications/Data Chart project. This project will address the “Models of intelligent Behavior” topic. Students will analyze data of communications methodologies used during a typical day. Usage, privacy, aggregation, and effectivity will be analyzed; presentations (typically PowerPoint with embedded spreadsheet data) will be made to the class.
• Design Tool project. This project will address the “Cultural and Societal Impacts of Computing” topic. This project will examine culturally appropriate subjects and make connections between a visual design and mathematical algorithms. Students will deconstruct an image of a pattern using Photoshop and break it down into its components, analyze those components, and build an algorithm or series of algorithms to re-create the pattern.
| A8.1 Develop the purpose and scope of a project.  
A8.3 Use various tools to manage projects involving the development of information and communication systems. |
| --- |
| B1.0 Identify and describe the principles of networking and the technologies, models, and protocols used in a network.  
B1.1 Define the terminology used in the design, assembly, configuration, and implementation of networks. |
| C3.0 Create effective interfaces between humans and technology.  
C3.1 Describe and apply the basic process of input, processing, and output. |
| Math Practice Standards:  
1. Make sense of problems and persevere in solving them  
2. Reason abstractly and quantitatively  
4. Model with mathematics  
5. Use appropriate tools strategically  
6. Attend to precision |
Exploring Computer Science Scope and Sequence
Unit 2 – Problem Solving
Length: (4 Weeks)

Unit Description: This unit provides students with opportunities to become “computational thinkers” by applying a variety of problem-solving techniques as they create solutions to problems that are situated in a variety of contexts. The range of contexts motivates the need for students to think abstractly and apply known algorithms where appropriate, but also create new algorithms. Analysis of various solutions and algorithms will highlight problems that are not easily solved by computer and for which there are no known solutions. This unit also focuses on the connections between mathematics and computer science. Students will be introduced to selected topics in discrete mathematics including Boolean logic, functions, graphs and the binary number system. Students are also introduced to searching and sorting algorithms and graphs.

Students will brainstorm in groups of three-four students a problem related to the high school or local community. They must determine and outline how they would approach the problem, what kind of data they might need to collect, what research questions might be asked, and how they would collect and analyze the data. Students will use pictures, charts, graphs, systematic lists, objects, or act out the solution to help devise a plan to solve the problem. Groups will present their findings to the class.

Major Unit Topics:
- Algorithms and abstraction
- Connections between Mathematics and Computer Science
- Societal impacts of computing
- Discrete mathematics
- Problem solving and sound design

Focus Pathway Standards:
A3.0 Access and transmit information in a networked environment.
A3.2 Validate and cite Internet resources.
A7.0 Support and train users on various software, hardware, and network systems.
A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
A8.0 Manage and implement information, technology, and communication projects.
A8.1 Develop the purpose and scope of a project.
A8.3 Use various tools to manage projects involving the development of information and communication systems.

Math Practice Standards:
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision

Key Learning Objectives & Tasks:
Students will…
- Name and explain the steps they use in solving a problem.
- Solve a problem by applying appropriate problem-solving techniques.
- Express a solution using standard design tools.
- Determine if a given algorithm successfully solves a stated problem.
- Create algorithms that meet specified objectives.
- Explain the connections between binary numbers and computers.
- Summarize the behavior of an algorithm.
- Compare the tradeoffs between different algorithms for solving the same problem.
- Explain the characteristics of problems that cannot be solved by an algorithm.

Key Unit Assignments & Assessments:
Simple Algorithm project:
- Tower Building Activity. Students will be designing and build a tower where materials can be stacked only one story at a time. This activity teaches students the concept of a binary algorithm, useful in searches.

Algorithm project:
- Students will develop an algorithm to determine the shortest driving route. Trial and error cannot be used. Students will develop and present their own algorithm and explain it to the class in an oral presentation.
Exploring Computer Science Scope and Sequence
Unit 3 – Web Design
Length: (5 Weeks)

Unit Description: This section prepares students to take the role of a developer by expanding their knowledge of algorithms, abstraction, and web page design and applying it to the creation of web pages and documentation for users and equipment. Students will explore issues of social responsibility in web use. They will learn to plan and code their web pages using a variety of techniques and check their sites for usability. Students learn to create user-friendly websites. Students will apply fundamental notions of Human Computer Interaction (HCI) and ergonomics.

Students have two options for their final unit project. The first choice is to create a multi-page website. Students will need to create an organizational chart of the website; select images and text for the site; use a template file which includes navigation, header, body, and sidebar; use a CSS file to define layout and styling; and use a CSS file to define a menu from an unordered list; and give an oral presentation when the website is completed. The second choice is for students to design a flash-based game. For this option, students will need to draw a storyboard and description of their game concept; use movie clips; make use of collision detection and scoring scripts from the tutorial in the unit; use additional Flash scripting; and give an oral presentation when the game is completed.

Major Unit Topics:
- Web page design and development
- Computers and the internet
- Algorithms and abstraction
- Societal impacts of computing
- Design for usability

Focus Pathway Standards:
A3.0 Access and transmit information in a networked environment.
A3.2 Validate and cite Internet resources.
A7.0 Support and train users on various software, hardware, and network systems.
A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
A8.0 Manage and implement information, technology, and communication projects.
A8.1 Develop the purpose and scope of a project.
A8.3 Use various tools to manage projects involving the development of information and communication systems.
A8.5 Design, develop, implement, and monitor a project by creating and integrating technologies.
C6.0 Integrate a variety of media into development projects.
C6.1 Identify the basic design elements necessary to produce effective print, video, audio, and interactive media.
C6.4 Develop a presentation or other multimedia project: video, game, or interactive Web sites, from storyboard to production.
C6.7 Create and/or capture professional-quality media, images, documents, audio, and video clips.
C7.0 Develop Web and online projects.

Key Learning Objectives & Tasks:
 Students will…
- Create web pages to address specified objectives.
- Create web pages with a practical, personal, and/or societal purpose.
- Select appropriate techniques when creating web pages.
- Use abstraction to separate style from content in web page design and development.
- Describe the use of a website with appropriate documentation.

Key Unit Assignments & Assessments:
- The first mini-project will be to have students set up a blog, to introduce them to the concept of creating content on the web.
- The second mini-project will be to introduce students to html and have them set up simple html pages with embedded images.
- The third mini-project will be to have them create a CSS file and incorporate it into a site with multiple pages tied to a template.
- Students will speak, write and communicate their learning and apply it in a variety of ways in this unit. More information regarding these and all other leaning tasks can be found in the detailed lesson plans that accompany this curricular outline.
| C7.5 Create an online project, Web-based business, and e-portfolio. |
| C9.0 Develop software for a variety of devices, including robotics. |
| C9.1 Demonstrate awareness of the applications of device development work, including personalized computing, robotics, and smart appliances. |
| C9.2 Install equipment, assemble hardware, and perform tests using appropriate tools and technology. |
| C9.3 Use hardware to gain input, process information, and take action. |
| C9.4 Apply the concepts of embedded programming, including digital logic, machine-level representation of data, and memory-system organization. |
| C9.5 Program a micro-controller for a device or robot. |

**Math Practice Standards:**
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
Exploring Computer Science Scope and Sequence
Unit 4 – Programming
Length: (6 Weeks)

**Unit Description:** Students are introduced to select basic issues associated with program design and development. In this unit, they design algorithms and create programming solutions to a variety of computational problems using an iterative development process in Scratch. Programming problems include mathematical and logical concepts and a variety of programming constructs. This unit introduces data structures, including arrays, vectors, stacks, and queues, and their associated components, operations, and uses. Benefits and limitations of different data structures are presented. The concept that analysis and understanding of data structures can be used as a fundamental organizing principle in the design of solutions will be explored.

Students will have two options for their final project, both of which will use Scratch software to develop a programming project. In the first choice, students will develop a project about their community, using at least three different pages or scenes. Students will use at least one statistic and at least one personal comment/recording and one picture to illuminate a positive highlight of their community. Students will also need to include at least one observation from a classmate about the topic focused on to represent the community.

**Major Unit Topics:**
- Programming
- Algorithms and abstractions
- Connections between mathematics and computer science
- Societal impacts of computing

**Focus Pathway Standards:**
- A3.0 Access and transmit information in a networked environment.
- A3.2 Validate and cite Internet resources.
- A7.0 Support and train users on various software, hardware, and network systems.
- A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
- A8.0 Manage and implement information, technology, and communication projects.
- A8.1 Develop the purpose and scope of a project.
- A8.3 Use various tools to manage projects involving the development of information and communication systems.
- A8.5 Design, develop, implement, and monitor a project by creating and integrating technologies.
- A8.6 Use a systematic method of continual improvement; plan, do, check, act (PDCA), total quality (TQ), or Six Sigma.
- C1.0 Identify and apply the systems development process.
- C1.1 Identify the phases of the systems development life cycle, including analysis, design, programming, testing, implementation, maintenance, and improvement.

**Key Learning Objectives & Tasks:**
- Use appropriate algorithms to solve a problem.
- Design, code, test, and execute a program that corresponds to a set of specifications.
- Select appropriate programming structures.
- Locate and correct errors in a program.
- Explain how a particular program functions.
- Justify the correctness of a program.
- Create programs with practical, personal, and/or societal intent.

**Key Unit Assignments & Assessments:**
- Small mini programs will be assigned to teach students the mechanics of Scratch programming and sprite manipulation. Once variables, conditionals, and AND/OR logic are mastered, students will create their first full-featured program, Rock-Paper-Scissors.
- The second mini-project will be a timer-based game. This will be peer-reviewed and presented to the class.
- The final, cumulative project will be one of the student’s own choosing. Students will be writing a game for My Community or the Game Project. Games must be interactive and draw upon the material presented in the class, although students are not limited to that subset of material. Projects will be presented to the class.
C1.4 Work as a member of, and within the scope and boundaries of, a development project team.
C4.0 Develop software using programming languages.
  C4.4 Identify and apply data types and encoding.
  C4.6 Use proper programming language syntax.
  C4.7 Use various data structures, arrays, objects, files, and databases.
  C4.8 Use object oriented programming concepts, properties, methods, and inheritance.
  C4.9 Create programs using control structures, procedures, functions, parameters, variables, error recovery, and recursion.
  C4.10 Create and know the comparative advantages of various queue, sorting, and searching algorithms.
C5.0 Test, debug, and improve software development work.
  C5.1 Identify the characteristics of reliable, effective, and efficient products.
  C5.2 Describe the ways in which specification changes and technological advances can require the modification of programs.
  C5.3 Use strategies to optimize code for improved performance.
  C5.4 Test software and projects.
  C5.5 Evaluate results against initial requirements.
  C5.6 Debug software as part of the quality assurance process.

Math Practice Standards:
  1. Make sense of problems and persevere in solving them
  2. Reason abstractly and quantitatively
  4. Model with mathematics
  5. Use appropriate tools strategically
  6. Attend to precision
Exploring Computer Science Scope and Sequence
Unit 5 – Computing and Data Analysis
Length: (6 Weeks)

**Unit Description:** In this unit, students explore how computing has facilitated new methods of managing and interpreting data. Students will use computers to translate, process, and visualize data in order to find patterns and test hypotheses. Students will work with a variety of large data sets that illustrate how widespread access to data and information facilitates the identification of problems. Students will collect and generate their own data related to local community issues and discuss appropriate methods for data collection and aggregation of data necessary to support making a case or facilitating a discovery.

Using a large-scale set of real-world environmental data, students will create algorithms to analyze the data and arrive at conclusions about the implications of this data. Students will be provided data from multiple sources and will choose one source for a final project. Students will create new knowledge and conclusions about their data and will present their findings to the class in PowerPoint, Scratch, or Web-related presentations.

**Major Unit Topics:**
- Data and information
- Algorithms and abstraction
- Connections between mathematics and computer science
- Programming
- Societal impacts of computing

**Focus Pathway Standards:**
- A3.0 Access and transmit information in a networked environment.
- A3.2 Validate and cite Internet resources.
- A7.0 Support and train users on various software, hardware, and network systems.
- A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
- A8.0 Manage and implement information, technology, and communication projects.
- A8.1 Develop the purpose and scope of a project.
- A8.3 Use various tools to manage projects involving the development of information and communication systems.
- A8.6 Use a systematic method of continual improvement; plan, do, check, act (PDCA), total quality (TQ), or Six Sigma.

**Math Practice Standards:**
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Model with mathematics
4. Use appropriate tools strategically
5. Attend to precision

**Key Learning Objectives & Tasks:**
Students will...
- Describe the features of appropriate data sets for specific problems.
- Apply a variety of analysis techniques to large data sets.
- Use computers to find patterns in data and test hypotheses about data.
- Compare different analysis techniques and discuss the tradeoffs among them.
- Justify conclusions drawn from data analysis.

**Sample Unit Assignments & Assessments:**
- Working in collaborative groups, students will create a research project where they will collect a large set of survey data based on a topic of their choice. They will collect this data by using a combination of their own mobile devices and by pencil and paper. Pencil and paper data will be transcribed into a data analysis tool (such as Deducer, Microsoft Excel, or other tool). Demographic, geographic, time, spatial, and survey data will be analyzed; various charting techniques and other data analysis tools. Student groups will create written reports presenting data and subsequent analysis.
- Students will develop a website or Scratch program to present a data analysis campaign, given the research findings from their study.
Exploring Computer Science Scope and Sequence
Unit 6 – Robotics
Length: (7 Weeks)

Unit Description: This unit introduces robotics as an advanced application of computer science that can be used to solve problems in a variety of settings from business to healthcare and how robotics enables innovation by automating processes that may be dangerous or otherwise problematic for humans. Students explore how to integrate hardware and software in order to solve problems. Students will see the effect of software and hardware design on the resulting product. Students will apply previously learned topics to the study of robotics. Students will work in pairs or groups of three to build and program a Lego Mindstorms robot to perform a required task (i.e. kick a ball into a goal). They will make use of a programming language to control the behavior of these robots in dynamic environments. They will also rely on robot sensors (light, sound, etc.) to create dynamic robots. As a class (or a district), they will test out their robots under a specific set of circumstances in a robotics competition.

Major Unit Topics:
- Robotics
- Algorithms and abstraction
- Connections between mathematics and computer science
- Programming
- Societal impacts of computing

Focus Pathway Standards:
A3.0 Access and transmit information in a networked environment.
A3.2 Validate and cite Internet resources.
A7.0 Support and train users on various software, hardware, and network systems.
A7.3 Use technical writing and communication skills to work effectively with diverse groups of people, including users with less technical abilities.
A8.0 Manage and implement information, technology, and communication projects.
A8.1 Develop the purpose and scope of a project.
A8.3 Use various tools to manage projects involving the development of information and communication systems.
A8.6 Use a systematic method of continual improvement; plan, do, check, act (PDCA), total quality (TQ), or Six Sigma.
C1.0 Identify and apply the systems development process.
C1.5 Track development project milestones using the concept of versions.
C5.0 Test, debug, and improve software development work.
C5.1 Identify the characteristics of reliable, effective, and efficient products.
C5.2 Describe the ways in which specification changes and technological advances can require the modification of programs.
C5.3 Use strategies to optimize code for improved performance.
C5.4 Test software and projects.

Key Learning Objectives & Tasks:
Students will…
- Access and transmit information in a networked environment.
- Identify the criteria that describes a robot and determines if something is a robot.
- Match the actions of the robot to the corresponding parts of the program.
- Build, code, and test a robot that solves a stated problem.
- Explain ways in which different hardware designs affect the function of a machine.
- Describe the tradeoffs among multiple ways to program a robot to achieve a goal.

Sample Unit Assignments & Assessments:
- The Tic-Tac-Toe game. Students will program “robots” to play tic-tac-toe. Since this is an advanced-level programming task for real robots, human “robots” will suffice. Granular precision instructions will be developed and followed. This is a RoboCup activity.
- Dancing” robots performance task: Students will choreograph robots dancing to music. This is also a RoboCup activity.
C5.5 Evaluate results against initial requirements.
C5.6 Debug software as part of the quality assurance process.

**Math Practice Standards:**
1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision