Exploring Computer Science – ECS

Exploring Computer Science (CS)
Levels: Grades 9-12
Units of Credit: 0.5
CIP Code: 11.0701
Core Code: 35-02-00-00-007

Prerequisite: Math 1
Skill Test: Exploring CS

COURSE DESCRIPTION
Exploring Computer Science is 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 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 thinking practices of algorithm development, problem solving and programming 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.

CORE STANDARDS, OBJECTIVES, & INDICATORS

Standard 1
Interacting with Computers (4 weeks) Students are introduced to the concepts of computers and computing while investigating the major components of computers and the suitability of these components for particular applications.

Objective 1: 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.
   a. Explain the differences between tasks that can and cannot be accomplished with a computer.

Objective 2: 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.

Objective 3: Students will experiment with internet search techniques, explore a variety of websites and web applications and discuss issues of privacy and security.
   a. Understand the concepts, differences, and uses of the Internet, browsers, and WWW.
   b. Navigate the Internet – domains, hyperlinks, home page, forward, back, refresh, favorites, plugins, history, search, tabs, downloading, uploading, etc.
   c. Evaluate the results of web searches and the reliability of information found on the Internet.

Objective 4: Students will demonstrate the ability to use digital communications.
   a. Use email to communicate appropriately with others with proper spelling, grammar, formatting, etc.
   b. Attach documents to an email to share it.
   c. Understand and use appropriate real time communication for given tasks – texting, SMS, VoIP, Skype, video conference, etc.
Standard 2:

**Problem Solving (4 weeks)** This unit focuses on developing computational thinking skills and understanding the connections between mathematics and computer science.

Objective 1: Students will be given 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.
   a. List and explain the steps they use in solving a problem.
   b. Solve a problem by applying appropriate problem-solving techniques.
   c. Communicate an algorithm to others.
   d. Determine if a given algorithm successfully solves a stated problem.
   e. Create algorithms that meet specified objectives.
   f. Compare the tradeoffs between different algorithms for solving the same problem.
   g. Explain the characteristics of problems that cannot be solved by a computer.

Objective 2: Students will be introduced to selected topics in discrete mathematics including Boolean logic, functions, graphs and the binary number system.
   a. Explain the connections between binary numbers and computers.
   b. Explore algorithms for fundamental practical problems, such as searching, sorting and finding paths in graphs.

Standard 3

**Introduction to Programming (6 weeks)** Students are introduced to some basic programming issues associated with code design and development.

Objective 1: Students design algorithms and create programming solutions to a variety of computational problems using an iterative development process in Scratch.
   a. Use appropriate algorithms to solve a problem.
   b. Design, code, test, and execute a program that corresponds to a set of specifications, with practical, personal, and/or societal intent.
   c. Select appropriate programming structures.
   d. Locate and correct errors in a program.
   e. Explain how a particular program functions.
   f. Justify the correctness of a program.

Standard 4

**Computing and Data Analysis (3 weeks)** Students explore how computing has facilitated new methods of managing and interpreting data.

Objective 1: Students will use computers to translate, process and visualize data in order to find patterns and test hypotheses.
   a. Describe the features of appropriate data sets for specific problems.
   b. Use computers to find patterns in data and test hypotheses about data.
   c. Justify conclusions drawn from data analysis.

Objective 2: Students will work with a variety of large data sets that illustrate how widespread access to data and information facilitates identification of problems.
   a. Apply a variety of analysis techniques to large data sets.
   b. Compare different analysis techniques and discuss the tradeoffs among them.
Objective 3: 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.

Standard 5
**Societal Impacts of Computing** (Woven throughout the course.)
Students discuss how computing enables innovation in a variety of fields and the impacts that those innovations have on society. The proliferation of computers and networks raises a number of ethical issues. Technology has had both positive and negative impacts on human culture.

Objective 1: Students will be able to identify ethical behavior and articulate both sides of ethical topics.
   a. Discuss issues of equity, access, and power in the context of computing resources.
   b. Communicate the legal and ethical concerns raised by computational innovations.
   c. Explain positive and negative effects of technological innovations on human culture.

Objective 2: Students study the responsibilities of software users and software developers with respect to intellectual property rights, software failures, and the piracy of software and other digital media.
   a. Analyze how computing influences and is influenced by the cultures for which they are designed and the cultures in which they are used.
   b. Analyze how social and economic values influence the design and development of computing innovations.
   c. Discuss privacy and security concerns related to computational innovations.
   d. Explain the implications of communication as data exchange.

Objective 3: Students are introduced to the concept of open-source software development and explore its implications.
   a. Describe ways in which computing enables innovation.
   b. Discuss the ways in which innovations enabled by computing affect communication and problem solving.

Objective 4: 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, economical and cultural contexts will be discussed.
   a. Analyze the effects of computing on society within economic, social, and cultural contexts.
   b. Students identify and describe careers in computing and careers that employ computing.

Objective 5: Students will use skills and applications learned to complete a cross curricular project for the class.

Standard 6
**Computing Systems** (Woven throughout the course.)
Students will learn that computer systems include operating systems, hardware, software and networks.

Objective 1: Students will demonstrate an understanding of basic operating system features and functions.
   a. Demonstrate an understanding of an OS, its function, its relationship to hardware, common features, need for upgrades, etc.
   b. Explain the difference between operation system and application software.
c. Manage computer folder and/or files and use different OS tools.
d. Understand common file types and extensions.
e. Manage OS configurations, customize desktop settings, etc.

Objective 2: Students will demonstrate an understanding of computers, computer hardware, computing devices, computer performance, peripherals, etc.
   a. Identify computer hardware, peripherals, etc. and explain the functions of the item.
   b. Identify different storage media – external drives, flash drives, cloud storage, etc.
   c. Identify different computing devices – desktop, laptop, server, tablet, smart phone, etc.
   d. Explain how computing performance is affected by memory, processor, storage, network bandwidth, etc.
   e. Analyze the characteristics of hardware components to determine the applications for which they can be used.

Objective 3: Students will demonstrate an understanding of computer software and related concepts.
   a. Understand software management including install, uninstall, configuration, etc.
   b. Understand software licensing – freeware, shareware, open-source, End User License Agreements (EULAs), site licensing, etc.
   c. Understand and use software tools – file compression, updates, disk management, virus and malware software scanners, etc.

Objective 4: Students will use problem solving skills to troubleshoot software and hardware problems.
   a. Understand concepts related to software – updates, OS versions, virus or malware removal, Safe mode, Knowledge Base, Help, task management, etc.
   b. Identify and explain the uses of different cables and connections used on computers.
   c. Understand the need to backup a computing device to a external device, cloud, local drive, etc. and how to restore from a backup.

Objective 5: Students will demonstrate a knowledge of networking concepts.
   a. Understand the Internet concepts of speed, bandwidth, wired, wireless, cell wired, security, etc.
   b. Understand different network types, features, and capabilities – publicly switched networks, domain name server (DNS), addressing, LAN, WAN, VPN, etc.
   c. Show an understanding of common network problems, IP addressing, and how to solve simple network scenarios.

Standard 7.
Fundamental Applications (Woven throughout the course.)
Students will be introduced to a variety of applications that can be used for activities at school, home, business and careers.

Objective 1: Student will gain skills and use common features and commands used by key software applications.
   a. Learn and use features – shortcuts, cut, copy, paste, print, spellcheck, undo, find/replace, preferences, selection, etc.
   b. Learn and apply formatting – basic text formatting, styles, etc.
   c. Learn and use application document navigation – open, close, save, save as, search, views, etc.
   d. Learn and work with multimedia files – input, resize, crop, rotate, etc.
   e. Collaborate and share documents with others on the network, by email, or in the cloud.
Objective 2: Students will learn and use the key application of word processing to complete a variety of tasks.
   a. Learn and use document layout features – page layout, spacing, indentation, headers, footers, references, table of contents, graphics, etc.
   b. Organize data in the form of lists and tables.
   c. Create projects including: daily journal, project proposals, project reports, project documentation, letters, resume, etc.

Objective 3: Students will learn and use the key application of a spreadsheet to create a variety of documents to solve problems.
   a. Learn and use spreadsheet layout features – insert/delete rows & columns, adjust cell sizes, change alignment, merge cells, change formatting, etc.
   b. Create and use cell formulas – order of operations, +, -, *, /, ^, etc.
   c. Implement functions in cells – sum, min, max, average, count, if, etc.
   d. Insert charts and graphs.
   e. Use data management to sort and filter data.
   f. Create projects including: grade sheet, data analysis etc.

Objective 4: Students will use the key application of a presentation program to create a variety of documents to present and publish project ideas and results.
   a. Plan or storyboard a presentation prior to creation.
   b. Design slides based on good design principles, applying layout, animations, timing, transitions, etc.
   c. Insert a variety of content in a presentation – text, lists, tables, media, charts, graphics, hyperlinks, Web links, etc.
   d. Manage the presentation by adding slides, deleting slides, revising the slide order, etc.
   e. Create projects including: ePortfolio, project proposals, project presentations, etc.
Common Core Standards

Introduced, Practiced and Applied by the Exploring CS curriculum

Mathematics: High School

The Exploring Computer Science curriculum teaches all eight of the Standards of Mathematical Practices described in the Common Core:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The ECS curriculum also teaches many of the Common Core’s Standards of Mathematical Content for High School, including:

Numbers & Quantities: Reason quantitatively and use units to solve problems.
- N-Q.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas;
- choose and interpret the scale and the origin in graphs and data displays.
- N-Q.2. Define appropriate quantities for the purpose of descriptive modeling.
- N-Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Numbers & Quantities: Represent and model with vector quantities.
- N-VM.1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., \( \vec{v} \), \(|\vec{v}|\), \(||\vec{v}||\), \(\nu\)).
- N-VM.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors.

Algebra: Interpret the structure of expressions.
- A-SSE.1. Interpret expressions that represent a quantity in terms of its context.
- A-SSE.2. Use the structure of an expression to identify ways to rewrite it.

Algebra: Write expressions in equivalent forms to solve problems.
- A-SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

Algebra: Create equations that describe numbers or relationships.
- A-CED.1. Create equations and inequalities in one variable and use them to solve problems.

Modeling: The Common Core does not isolate modeling standards, but rather emphasizes modeling throughout the other areas. The Exploring CS curriculum uses models throughout the course to solve real world problems.

Geometry: Experiment with transformations in the plane.

Geometry: Apply geometric concepts in modeling situations.
- G-MG.1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Statistics and Probability: Summarize, represent, and interpret data on a single count or measurement variable.
• **S-ID.1.** Represent data with plots on the real number line (dot plots, histograms, and box plots).
• **S-ID.2.** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
• **S-ID.3.** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

The ECS curriculum also teaches many of the Common Core’s Standards of Language Arts Content for High School, including:

**Language Arts: Writing**

**Text Types and Purposes**

1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

**Production and Distribution of Writing**

5. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
6. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
7. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

**Research to Build and Present Knowledge**

8. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
9. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
10. Draw evidence from literary or informational texts to support analysis, reflection, and research.

**Range of Writing**

11. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

**Language Arts: Speaking and Listening**

**Comprehension and Collaboration**

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
3. Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric.

**Presentation of Knowledge and Ideas**
4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

**Language Arts: Language**

**Conventions of Standard English**
1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

**Knowledge of Language**
3. Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

**Vocabulary Acquisition and Use**
4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
5. Demonstrate understanding of word relationships and nuances in word meanings.
6. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

**21st Century Essential Skills**
Exploring CS will reinforce the 21st Century Skills

**Learning and Innovation “The 4C’s”**
- Critical thinking & problem solving
- Creativity and innovation
- Communication and Collaboration

**Digital Literacy**
- Information literacy
- Media Literacy
- ICT Literacy

**Career & Life**
- Flexibility & adoptability
- Initiative & self-direction
- Social & cross-cultural interaction
- Productivity & Accountability
- Leadership & responsibility