

EXPLORING COMPUTER SCIENCE
COURSE CODE: 5023

COURSE DESCRIPTION: *Exploring Computer Science* is designed to introduce students to 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 the tools and languages that might be used to solve particular problems. The goal of *Exploring Computer Science* is to develop problem solving and critical thinking skills 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.

OBJECTIVE: Given the necessary equipment, software, supplies, and facilities, the student will be able to successfully complete the following core standards for courses that grant one unit of credit.

RECOMMENDED GRADE LEVELS: 9-12 (Preference 9-10)

PREREQUISITE: IT cluster declared on IGP **-OR-** Algebra I **-OR-** teacher recommendation

COURSE CREDIT: 1 Carnegie unit

COURSE REQUIREMENTS: Units A-I are required to be taught in the course. One additional unit, selected from Units J-N, must also be taught.

COMPUTER REQUIREMENTS: One desktop or laptop computer (with hard drive) per student

Required and/or Recommended Equipment:

One for each student - Desktop or notebook computer running Windows 7 or Windows 8 with Internet access

One for every five students - Tablet computer (7"-8" screen) running Android 4 or newer with Internet access (if teaching the additional Mobile App unit)

One for every two to three students - Programmable robots (if teaching the additional Robotics unit, the SC Department of Education can lend 10 robot kits, either Lego MINDSTORMS NXT or BirdBrain Technologies Hummingbird - contact Tony Dillon)

<http://mindstorms.lego.com/>

<http://www.hummingbirdkit.com/>

Required and/or Recommended Software:

Except for Microsoft Office (and depending on how/if you do the additional Robotics unit), all indicated software is free.

Web Browsers - Internet Explorer, Firefox, and Chrome (latest versions)

Open Office (free) OR Microsoft Office (latest versions for various activities and if teaching the additional Database unit)

Notebook++ <http://www.notepad-plus-plus.org/> and

W3Schools <http://www.w3schools.com/> for Web Design unit

Scratch <http://scratch.mit.edu> for Introduction to Programming unit

MIT's AppInventor 2.0 <http://ai2.appinventor.mit.edu/explore/> (if teaching the additional Mobile App unit)

Programming software for selected robot (if teaching the additional Robotics unit)

Hummingbird Robots <http://www.hummingbirdkit.com/>

LEGO Robots <http://mindstorms.lego.com/>

Additional software – can be used for enrichment activities and differentiating instruction:

Alice 2.4 <http://www.alice.org/>

Python 3.4 IDLE <http://www.python.org/>

Gimp <http://www.gimp.org/>

Trimble SketchUp <http://www.sketchup.com/>

Google Earth <http://www.google.com/earth/>

Jing <http://www.techsmith.com/jing.html>

INSTRUCTIONAL RESOURCES:

Every teacher should download and use the latest Exploring Computer Science curriculum and related resources found at:

<http://www.exploringcs.org/curriculum/>

Additional, related materials can be found at:

CS Unplugged <http://csunplugged.org/>

ISTE Standards for Computer Science Educators <http://www.iste.org/standards/iste-standards/standards-for-computer-science-educators>

Finch Robots <http://www.finchrobot.com/>

Raspberry Pi <http://www.raspberrypi.org/>

A. SAFETY AND ETHICS

1. Identify major causes of work-related accidents in offices.
2. Describe the threats to a computer network, methods of avoiding attacks, and options in dealing with virus attacks.
3. Identify potential abuse and unethical uses of computers and networks.
4. Explain the consequences of illegal, social, and unethical uses of information technologies, e.g., piracy; illegal downloading; licensing infringement; and inappropriate uses of software, hardware, and mobile devices.
5. Differentiate between freeware, shareware, and public domain software copyrights.
6. Discuss computer crimes, terms of use, and legal issues such as copyright laws, fair use laws, and ethics pertaining to scanned and downloaded clip art images, photographs, documents, video, recorded sounds and music, trademarks, and other elements for use in Web publications.
7. Identify netiquette including the use of email, social networking, blogs, texting, and chatting.
8. Describe ethical and legal practices in business professions such as safeguarding the confidentiality of business-related information.
9. Discuss the importance of cyber safety and the impact of cyber bullying.

B. EMPLOYABILITY SKILLS

1. Identify positive work practices (e.g., appropriate dress code for the workplace, personal grooming, punctuality, time management, and organization).
2. Demonstrate positive interpersonal skills (e.g., communication, respect, and teamwork).

C. STUDENT ORGANIZATIONS

1. Explain how related student organizations are integral parts of career and technology education courses.
2. Explain the goals and objectives of related student organizations.
3. List opportunities available to students through participation in related student organization conferences/competitions, community service, philanthropy, and other activities.
4. Explain how participation in career and technology education student organizations can promote lifelong responsibility for community service and professional development.

D. HUMAN COMPUTER INTERACTION

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.

1. Analyze the characteristics of hardware components to determine the applications for which they can be used.
2. Use appropriate tools and methods to execute Internet searches which yield requested data.
3. Evaluate the results of web searches and the reliability of information found on the Internet.
4. Explain the differences between tasks that can and cannot be accomplished with a computer.
5. Analyze the effects of computing on society within economic, social, and cultural contexts.
6. Communicate legal and ethical concerns raised by computing innovation.
7. Explain the implications of communication as data exchange.

E. PROBLEM SOLVING

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.

1. Name and explain the steps they use in solving a problem.
2. Solve a problem by applying appropriate problem---solving techniques.

3. Express a solution using standard design tools.
4. Determine if a given algorithm successfully solves a stated problem.
5. Create algorithms that meet specified objectives.
6. Explain the connections between binary numbers and computers.
7. Summarize the behavior of an algorithm.
8. Compare the tradeoffs between different algorithms for solving the same problem.
9. Explain the characteristics of problems that cannot be solved by an algorithm.

F. WEB DESIGN

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.

1. Create web pages to address specified objectives.
2. Create web pages with a practical, personal, and/or societal purpose.
3. Select appropriate techniques when creating web pages.
4. Use abstraction to separate style from content in web page design and development.
5. Describe the use of a website with appropriate documentation.

G. INTRODUCTION TO PROGRAMMING

Students are introduced to some basic issues associated with program design and development. Students 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.

1. Use appropriate algorithms to solve a problem.
2. Design, code, test, and execute a program that corresponds to a set of specifications.
3. Select appropriate programming structures.
4. Locate and correct errors in a program.
5. Explain how a particular program functions.
6. Justify the correctness of a program.
7. Create programs with practical, personal, and/or societal intent.

H. COMPUTING AND DATA ANALYSIS

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 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.

1. Describe the features of appropriate data sets for specific problems.
2. Apply a variety of analysis techniques to large data sets.
3. Use computers to find patterns in data and test hypotheses about data.
4. Compare different analysis techniques and discuss the tradeoffs among them.
5. Justify conclusions drawn from data analysis.

I. SOCIETAL IMPACTS OF COMPUTING

Throughout the course, emphasis and focus should be placed on how computing enables innovation in a variety of fields and the impacts that those innovations have on society. Computing is situated within economic, social and cultural contexts and, therefore, influences and is influenced by each of these. The proliferation of computers and networks raises a number of ethical issues. Technology has had both positive and negative impacts on human culture. Students will be able to identify ethical behavior and articulate both sides of ethical topics. 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. They are introduced to the concept of open-source software development and explore its implications. Students identify and describe careers in computing and careers that employ computing.

1. Describe ways in which computing enables innovation.
2. Discuss the ways in which innovations enabled by computing affect communication and problem solving.
3. Analyze how computing influences and is influenced by the cultures for which they are designed and the cultures in which they are used.
4. Analyze how social and economic values influence the design and development of computing innovations.
5. Discuss issues of equity, access, and power in the context of computing resources.
6. Communicate the legal and ethical concerns raised by computational innovations.
7. Discuss privacy and security concerns related to computational innovations.
8. Explain positive and negative effects of technological innovations on human culture.

MUST COMPLETE ONE OF THE FOLLOWING UNITS

J. ROBOTICS

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.

1. Identify the criteria that describe a robot and determine if something is a robot.
2. Match the actions of the robot to the corresponding parts of the program.
3. Build, code, and test a robot that solves a stated problem.
4. Explain ways in which different hardware designs affect the function of a machine.
5. Describe the tradeoffs among multiple ways to program a robot to achieve a goal.

K. MOBILE COMPUTING

This unit introduces design and programming of mobile apps for smart phones and tablets. Students explore how to design and program software in order to solve problems. Students will apply previously learned topics to the study of mobile app programming.

1. Describe mobile applications and the constraints of mobile devices.
2. Design a user interface/screen layout for a mobile application.
3. Identify and implement the use of maps and location awareness in mobile applications.
4. Identify and implement the use of multimedia (i.e. audio, video, etc.) in mobile applications.
5. Identify and implement the use of device based sensors and actuators in mobile applications.
6. Identify and implement the use of information applications (e.g., address book, calendar) in mobile applications.
7. Code and test a mobile application that solves a stated problem.

L. DATABASE DESIGN AND PROGRAMMING

This unit introduces design and programming of relational databases. Students explore how to design, create, and query a simple relational database.

1. Relate the importance of databases to everyday life.
2. Distinguish between data and information and give examples of each

3. Define and use database design terms (entities, attributes, relationships, UIDs, etc.)
4. Define database table terms, including row, column, field, primary key, and foreign key.
5. Create, modify, and query database tables using SQL.
6. Identify and use basic data types.
7. Design, create, modify, and query a simple relational database.

M. NETWORKING SYSTEMS

1. Demonstrate knowledge of basic components of computer networks such as network media and devices.
2. Demonstrate knowledge of the issues involved in connecting a computer to a network.
3. Demonstrate an understanding of key issues in data transmission.
4. Demonstrate knowledge of networking trends and issues.

N. CYBER SECURITY

1. Explain the importance of data security.
2. Explain the concepts of confidentiality, integrity, and availability (CIA).
3. Describe current events on breaches; focus on particular Information Assurance (IA) areas that were compromised.
4. Explain the importance of physical security.