

Concept Outline

Big Idea 1: Creativity

Computing is a creative activity. Creativity and computing are prominent forces in innovation; the innovations enabled by computing have had and will continue to have far-reaching impact. At the same time, computing facilitates exploration and the creation of computational artifacts and new knowledge that help people solve personal, societal, and global problems. This course emphasizes the creative aspects of computing. Students in this course use the tools and techniques of computer science to create interesting and relevant artifacts with characteristics that are enhanced by computation.

Essential Questions:

- How can a creative development process affect the creation of computational artifacts?
- How can computing and the use of computational tools foster creative expression?
- How can computing extend traditional forms of human expression and experience?

Big Idea 2: Abstraction

Abstraction reduces information and detail to facilitate focus on relevant concepts. Everyone uses abstraction on a daily basis to effectively manage complexity. In computer science, abstraction is a central problem-solving technique. It is a process, a strategy, and the result of reducing detail to focus on concepts relevant to understanding and solving problems. This course requires students to use abstractions to model the world and communicate with people as well as with machines. Students in this course learn to work with multiple levels of abstraction while engaging with computational problems and systems; use models and simulations that simplify complex topics in graphical, textual, and tabular formats; and use snapshots of models and simulation outputs to understand how data changes, identify patterns, and recognize abstractions.

Essential Questions:

- How are vastly different kinds of data, physical phenomena, and mathematical concepts represented on a computer?
- How does abstraction help us in writing programs, creating computational artifacts, and solving problems?
- How can computational models and simulations help generate new understanding and knowledge?

Big Idea 3: Data and Information

Data and information facilitate the creation of knowledge. Computing enables and empowers new methods of information processing, driving monumental change across many disciplines — from art to business to science. Managing and interpreting an overwhelming amount of raw data is part of the foundation of our information society and economy. People use computers and computation to translate, process, and visualize raw data and to create information. Computation and computer science facilitate and enable new understanding of data and information that contributes knowledge to the world. Students in this course work with data using a variety of computational tools and techniques to better understand the many ways in which data is transformed into information and knowledge.

Essential Questions:

- How can computation be employed to help people process data and information to gain insight and knowledge?
- How can computation be employed to facilitate exploration and discovery when working with data?
- What considerations and trade-offs arise in the computational manipulation of data?
- What opportunities do large data sets provide for solving problems and creating knowledge?

Big Idea 4: Algorithms

Algorithms are used to develop and express solutions to computational problems.

Algorithms are fundamental to even the most basic everyday task. Algorithms realized in software have affected the world in profound and lasting ways. Secure data transmission and quick access to large amounts of relevant information are made possible through the implementation of algorithms. The development, use, and analysis of algorithms are some of the most fundamental aspects of computing.

Students in this course work with algorithms in many ways: They develop and express original algorithms, they implement algorithms in a language, and they analyze algorithms analytically and empirically.

Essential Questions:

- How are algorithms implemented and executed on computers and computational devices?
- Why are some languages better than others when used to implement algorithms?
- What kinds of problems are easy, what kinds are difficult, and what kinds are impossible to solve algorithmically?
- How are algorithms evaluated?

Big Idea 5: Programming

Programming enables problem solving, human expression, and creation of knowledge. Programming and the creation of software has changed our lives. Programming results in the creation of software, and it facilitates the creation of computational artifacts, including music, images, and visualizations. In this course, programming enables exploration and is the object of study. This course introduces students to the concepts and techniques related to writing programs, developing software, and using software effectively. The particular programming language is selected based on appropriateness for a specific project or problem. The course acquaints students with fundamental concepts of programming that can be applied across a variety of projects and languages. As students learn

language specifics for a given programming language, they create programs, translating human intention into computational artifacts.

Essential Questions:

- How are programs developed to help people, organizations, or society solve problems?
- How are programs used for creative expression, to satisfy personal curiosity, or to create new knowledge?
- How do computer programs implement algorithms?
- How does abstraction make the development of computer programs possible?
- How do people develop and test computer programs?
- Which mathematical and logical concepts are fundamental to computer programming?

Big Idea 6: The Internet

The Internet pervades modern computing. The Internet and the systems built on it have had a profound impact on society. Computer networks support communication and collaboration. The principles of systems and networks that helped enable the Internet are also critical in the implementation of computational solutions. Students in this course gain insight into how the Internet operates, study characteristics of the Internet and systems built on it, and analyze important concerns such as cybersecurity.

Essential Questions:

- What is the Internet? How is it built? How does it function?
- What aspects of the Internet's design and development have helped it scale and flourish?
- How is cybersecurity impacting the ever-increasing number of Internet users?

Big Idea 7: Global Impact

Computing has global impact. Computation has changed the way people think, work, live, and play. Our methods for communicating, collaborating, problem solving, and doing business have changed and are changing due to innovations enabled by computing. Many innovations in other fields are fostered by advances in computing. Computational approaches lead to new understandings, new discoveries, and new disciplines. Students in this course become familiar with many ways in which computing enables innovation, and they analyze the potential benefits and harmful effects of computing in a number of contexts.

Essential Questions:

- How does computing enhance human communication, interaction, and cognition?
- How does computing enable innovation?
- What are some potential beneficial and harmful effects of computing?