**­­** [**Computer Science: Principles**](http://www.collegeboard.com/prod_downloads/computerscience/CourseAnnotations_CSPrinciples.pdf)

**Computational Thinking Practices**

1. Connecting Computing

Developments in computing have far-reaching effects on society and have led to significant innovations. These developments have implications for individuals, for society, for commercial markets, and for innovation. Students in this course will study these effects and connections, and learn to draw connections between different computing concepts.

2. Developing computational artifacts

Computing is a creative discipline in which the creation takes many forms, ranging from remixing digital music to generating animations to developing websites to writing programs and more. Students in this course will engage in the creative aspects of computing by designing and developing interesting computational artifacts as well as applying computing techniques to creatively solve problems.

3. Abstracting

Computational thinking requires understanding and applying abstraction at multiple levels ranging from privacy in social networking applications to logic gates and bits to the human genome project and more. Students in this course will use abstraction to develop models and simulations of natural and artificial

phenomena, use them to make predictions about the world, and analyze their efficacy and validity.

4. Analyzing problems and artifacts

The results and artifacts of computation, and the computational techniques and strategies that generate

them, can be understood both intrinsically for what they are as well as for what they produce. They can also be analyzed and evaluated by applying aesthetic, mathematical, pragmatic, and other criteria. Students in this course will design and produce solutions, models, and artifacts and will evaluate and analyze their own computational work as well as the computational work that others have produced.

5. Communicating

Students in this course will describe computation and the impact of technology and computation, will explain and justify the design and appropriateness of their computational choices, and will analyze and describe both computational artifacts and the results or behaviors of such artifacts. Communication will

include written and oral descriptions supported by graphs, visualizations, and computational analysis.

6. Working effectively in teams

Innovation occurs through the work of individuals and teams. Individuals working effectively in teams can sometimes achieve more than individuals working independently. Students in this course will learn about effective teamwork and collaborate in the production of computational artifacts, by applying effective team practices, and by working to understand the different roles that are important in designing, building, and improving computational artifacts.

[**Computer Science: Principles**](http://www.collegeboard.com/prod_downloads/computerscience/ComputationalThinkingCS_Principles.pdf)

**Computational Thinking Practices**

**1. Connecting Computing**

a. Identification of impacts of computing.

b. Description of connections between people and computing.

c. Explanation of connections between computing concepts.

**2. Developing computational artifacts**

a. Creation of an artifact with a practical, personal, or societal intent.

b. Selection of appropriate techniques to develop a computational artifact.

c. Use of appropriate algorithmic and information-management principles.

**3. Abstracting**

a. Explanation of how data, information, or knowledge are represented for computational use.

b. Explanation of how abstractions are used in computation or modeling.

c. Identification of abstractions.

d. Description of modeling in a computational context.

**4. Analyzing problems and artifacts**

a. Evaluation of a proposed solution to a problem.

b. Location and correction of errors.

c. Explanation of how an artifact functions.

d. Justification of appropriateness and correctness.

**5. Communicating**

a. Explanation of the meaning of a result in context.

b. Description using accurate and precise language, notation, or visualizations.

c. Summary of purpose.

**6. Working effectively in teams**

a. Application of effective teamwork practices.

b. Collaboration of participants.

c. Production of artifacts that depend on active contributions from multiple participants.

**Computer Science: Principles**

**Annotated Big Ideas**

I. 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 and computer science facilitate exploration and the creation of knowledge. This course will emphasize these creative aspects of computing. Students in this course will create interesting and relevant artifacts with

the tools and techniques of computing and computer science.

II. Abstraction reduces information and detail to facilitate focus on relevant concepts.

Everyone uses abstraction on a daily basis to effectively cope with our world. 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 will include examples of abstractions used in modeling the world, in managing complexity, and in communicating with people as well as with machines. Students in this course will learn to work with multiple levels of abstraction while engaging with computational problems and systems.

III. Data and information facilitate the creation of knowledge.

Computing enables and empowers new methods of information processing that have led to monumental change across 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, creating information. Computation and computer science facilitate and enable a new understanding of data and information that contributes knowledge to the world. Students in this course will work with data using a variety of tools and techniques to better understand the many ways in which data is transformed into information and knowledge.

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

Algorithms are fundamental to even the most basic everyday tasks. Algorithms realized in software have affected the world in profound and lasting ways. The development, use, and analysis of algorithms is one of the most fundamental aspects of computing. Students in this course will work with algorithms in many ways: they will develop and express original algorithms, they will implement algorithms in some language, and they will analyze algorithms both analytically and empirically.

V. Programming enables problem solving, human expression, and creation of knowledge.

Programming and the creation of software have changed our lives. Programming results in the creation of software, but it facilitates the creation of more general computational artifacts including music, images, visualizations, and more. In this course programming will enable exploration as well as being the object of study. This course will introduce students to the concepts and techniques used in writing

programs and to the ways in which programs are developed and used by people; the focus of the course is not programming per se, but on all aspects of computation. Students in this course will create programs, translating human intention into computational artifacts.

VI. 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 will gain insight into how the Internet operates, will study characteristics of the Internet and systems

built upon it, and will analyze important concerns such as cybersecurity.

VII. Computing has global impacts.

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 will become familiar with many ways in which computing enables innovation, and will analyze the potential benefits and harmful effects of computing in a number of contexts.

**Computer Science: Principles**

**Big Ideas, Key Concepts, Supporting Concepts**

I. Creativity: Computing is a creative activity.

A. Computing fosters the creation of artifacts.

1. Computing enables people to create digitally—including creating knowledge, tools, expressions of ideas, and solutions to problems.

2. Computing enables people to translate intention into digital artifacts.

B. Computing fosters creative expression.

1. Computing extends traditional forms of human expression and experience.

2. Computing fosters the creation of new forms of expression.

3. Computing enables creative exploration that informs and inspires.

C. Programming is a creative process.

1. Some programs are developed to satisfy personal curiosity or for creative expression.

2. Some programs are developed to solve problems, develop new knowledge, or help people, organizations, or society

For the additional document [***Learning Objectives and Evidence Statements***](http://www.collegeboard.com/prod_downloads/computerscience/Learning_CSPrinciples.pdf)