CSTA K–12 (Primary – Secondary School) Computer Science Standards
Knowledge for Today and Beyond

We consider it critical that students be able to read and write and understand the fundamentals of math, biology, chemistry and physics. To be a well-educated citizen in today’s computing-intensive world, students must have a deeper understanding of the fundamentals of computing as well.

Note – US centric but generalizable
New Standards Task Force

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Why Standards?

• In the US many states have a computer education requirement at the K-12 (primary through secondary) grade level but this has many different meanings.

• General computer knowledge and skills have been moving…
  – Traditional secondary school courses may now be in primary (and middle) schools
  – Keyboarding, General Computers, Office Programs, Computing Concepts are all clumped under "computing courses".
  – Trends in the Secondary School Curriculum
    • CS is found in an elective environment
    • Focus is on Standards and Assessment
    • Computer Teachers – Certification requirements vary (if existent!)
The ACM/CSTA Model Curriculum

• Published in:
  – 2003
  – 2006: revised forward
• More than 40,000 copies distributed
• Used as the basis for curriculum development at the state and national level
Context for New Standards

• CSTA Model Curriculum was last revised in 2006
• Much has been learned since then, including how to write standards that are consistent in format with those of other disciplines
• New tools and pedagogies have been developed to make computer science more accessible for all students
• There is still confusion between educational technology (the use of computers to support learning in other disciplines) and computer science
• We define computer science as:

  “Computer science (CS) is the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society.”
CSTA K–12 Computer Science Standards

Revised 2011

The CSTA Standards Task Force
Organizing Structure

Level 1
Grades K-6
- Computer Science and Me

Level 2
Grades 6-9
- Computer Science and Community

Level 3
Grades 9-12
- Computer Science in the Modern World
- Computer Science Concepts and Practices
- Topics in Computer Science

Applying Concepts and Creating Real-World Solutions
Level Definitions

- **Level 1** (recommended for primary grades K–6) *Computer Science and Me*
- **Level 2** (recommended for grades 6–9, late primary, early secondary) *Computer Science and Community*
- **Level 3** (recommended for grades 9–12, secondary) *Applying concepts and creating real-world solutions*
Computer Science and Me

Level 1 (recommended for primary grades K–6)

– elementary school students are introduced to foundational concepts in computer science by integrating basic skills in technology with simple ideas about computational thinking.

– The learning experiences created from these standards should be inspiring and engaging, helping students see computing as an important part of their world.
Computer Science and Community

Level 2 (recommended for grades 6–9 late primary, early secondary)

• begin
  – using computational thinking as a problem-solving tool.
  – appreciating the ubiquity of computing and the ways in which computer science facilitates communication and collaboration.
  – experiencing computational thinking as a means of addressing community-relevant issues.

• should be relevant to the students
• should promote their perceptions of themselves as proactive and empowered problem solvers.
Applying concepts and creating real-world solutions

Level 3 (recommended for grades 9–12 secondary)

- divided into three discrete courses, each of which focuses on different facets of computer science as a discipline.
- students can master more advanced computer science concepts and apply those concepts to develop virtual and real-world artifacts.

• The learning experiences created from these standards should focus on the exploration of real world problems and the application of computational thinking to the development of solutions.
Learning Outcomes Organized by Strands

- Computational Thinking
- Collaboration
- Computers and Communication Devices
- Community, Global, and Ethical Impacts
- Computing Practice
Example Strand for Level 2

Computing Practice & Programming / Careers
The student will be able to:

1. Use a variety of multimedia tools and peripherals to support personal productivity and learning throughout the curriculum.
2. Select appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
3. Design, develop, publish, and present products (e.g., webpages, mobile applications, animations) using technology resources that demonstrate and communicate curriculum concepts.
4. Implement problem solutions using a programming language, including: looping behavior, conditional statements, logic, expressions, variables, and functions.
5. Demonstrate an understanding of algorithms and their practical application.
6. Demonstrate good practices in personal information security using passwords, encryption, and secure transactions.
7. Demonstrate dispositions amenable to open-ended problem solving and programming (e.g., comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge).
8. Identify interdisciplinary careers that are enhanced by computer science.
9. Collect and analyze data that is output from multiple runs of a computer program.
Computers Communication Devices

Level 3A

3A-6. Apply strategies for identifying and solving routine hardware and software problems that occur in everyday life.

Level 2

2-5. Apply strategies for identifying simple hardware problems that can occur during everyday computer use.

Level 1:6

1:6-3. Apply strategies for identifying simple hardware and software problems that may occur during use.
How Can the Standards Be Used?

- Curriculum Design
- Curriculum Review / Modification
- Improving Instruction
- Advocacy
- Planning Resource
- Reference
- Teacher Certification
Getting the Standards

• You can access a downloadable, hyperlinked version of the standards at:

http://csta.acm.org/Curriculum/sub/K12Standards.html

• To request hardcopies for advocacy events, contact:

Chris Stephenson
cstephenson@csta.acm.org
Sample curricula: CS Principles

- Available from csprinciples.org
  - Click on “About the Project” to access
    - Course Annotations
    - Computational Thinking Practices and Big Ideas, Key Concepts, Supporting Concepts
    - Learning Objectives and Evidence Statements

- Level 3B: Computer science concepts and practices
CS Principles

• Background
  – History
    • NSF funded
    • Creating a new AP CS exam?
    • Pilots
    • This is a framework for a course rather than a specific course specification
CS Principles
7 big ideas

• **Creativity**: Computing is a creative activity.
• **Abstraction**: Abstraction reduces information and detail to facilitate focus on relevant concepts.
• **Data**: Data and information facilitate the creation of knowledge.
• **Algorithms**: Algorithms are used to develop and express solutions to computational problems.
CS Principles
7 big ideas

• **Programming**: Programming enables problem solving, human expression, and creation of knowledge.

• **Internet**: The Internet pervades modern computing.

• **Impact**: Computing has global impacts.
CS Principles

• Mapping to Level 3B:
  – Computational Thinking
  – **Collaboration**
  – Computing Practice and Programming
  – Computers and Communication Devices
  – Community, Global and Ethical Impacts
Sample curricula: ECS Exploring Computer Science

• Available from www.exploringcs.org
  – Click on Curriculum, and download from: http://www.exploringcs.org/curriculum
  – Can also access the curriculum from: http://csta.acm.org/Curriculum/sub/CurrResources.html

• Level 3A: Computer science in the Modern World
ECS

• Background
  – History
  – NSF-funded
  – Working with the LAUSD
  – A specific course
  – Mapped to 2006 CSTA standards
  – Engage, Explore, Explain, Elaborate, Evaluate
ECS Features

• The three themes are:
  – The creative nature of computing
  – Technology as a tool for solving problems
  – The relevance of computer science and its impact on society
ECS Computational Practices

• Analyze the effects of developments in computing.
• Design and implement creative solutions and artifacts.
• Apply abstractions and models.
• Analyze their computational work and the work of others.
• Connect computation with other disciplines.
• Communicate thought processes and results.
• Work effectively in teams.
ECS

Topic areas

• HCI
• Problem Solving
• Web Design
• Introduction to Programming
• Computing and Data Analysis
• Robotics
ECS

• Mapping to Level 3A:
  – Computational Thinking
  – Collaboration
  – Computing Practice and Programming
  – Computers and Communication Devices
  – Community, Global and Ethical Impacts