



The State of High School Computer Science Education

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Agenda

- Skills shortages and educational needs
- Computer science is crucial
- Challenges
- Transformation
- CSTA Resources and Projects

U.S. View of the New Global Economy

“We know that the nation that out-educates today will out-compete us tomorrow. And I don’t intend to have us out-educated.”

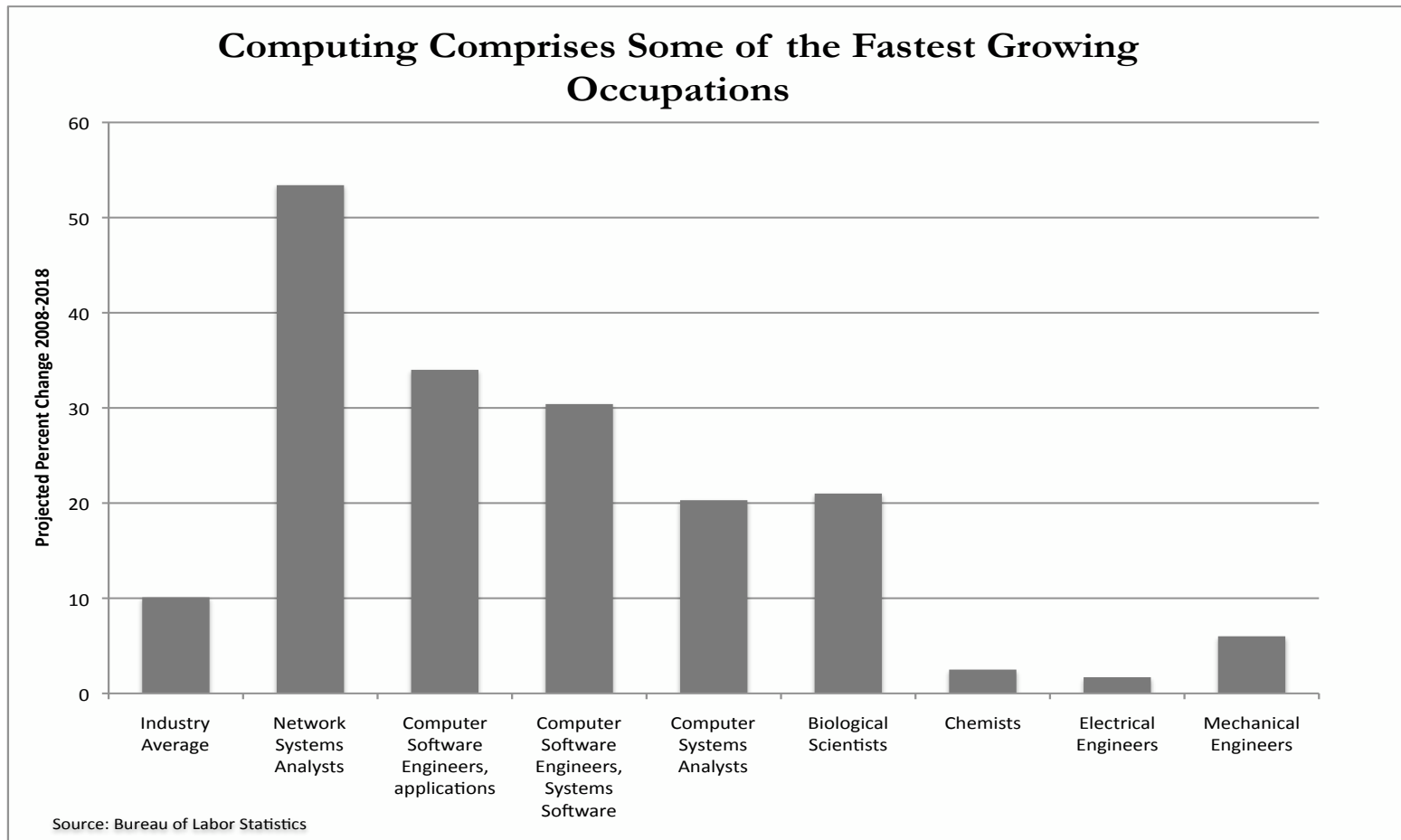
President Barack Obama

“Keeping America's brainpower advantage is the single best way in a global economy to keep good jobs from going overseas to China, India, and other fast growing countries. Congress will enact no more significant piece of legislation this year.”

Senator Lamar Alexander R-TN

Re: The America Competes Act of 2007

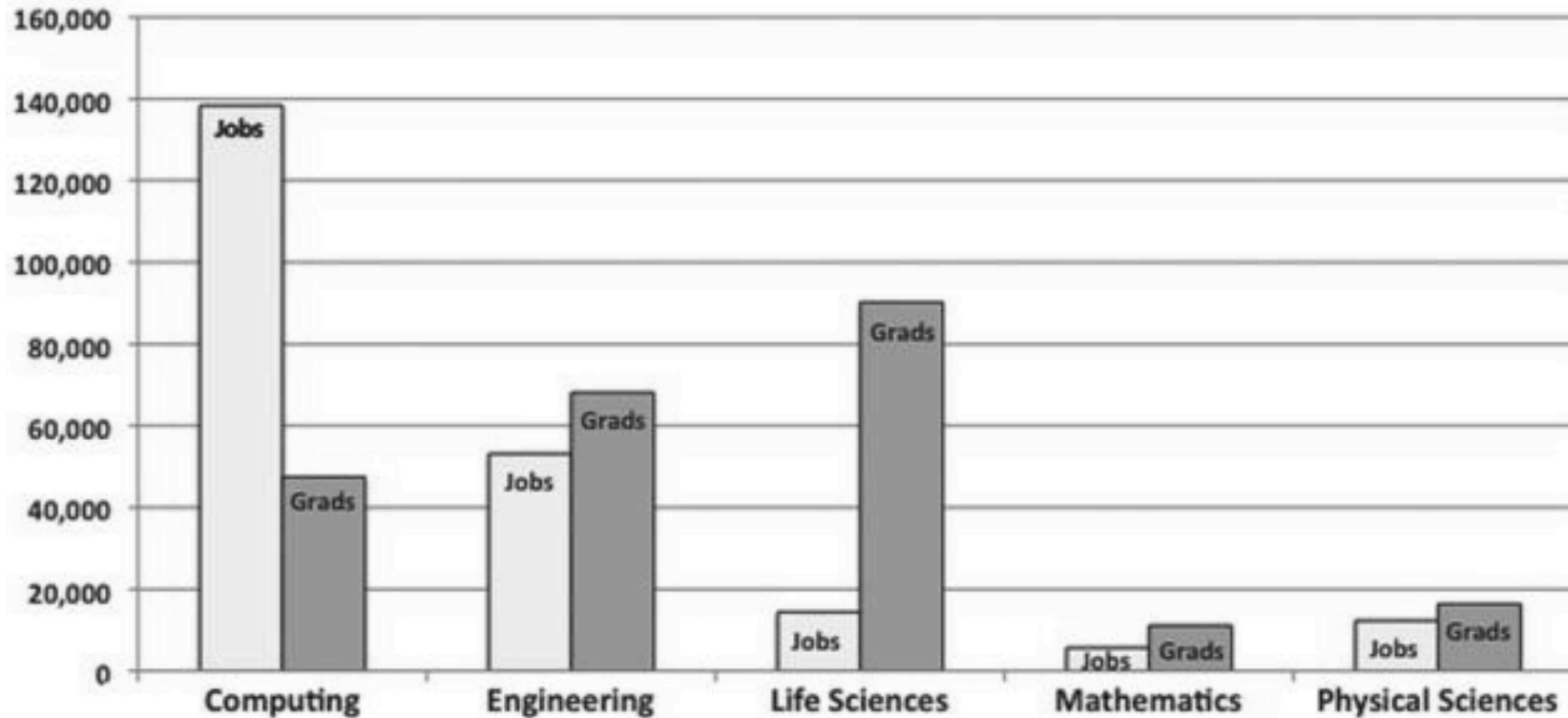
Fastest Growing Jobs



Jobs and Graduates

Annual STEM Job Openings vs College Graduates Through 2018

□ Job Openings ■ Bachelors Awarded



Data Sources: US-BLS Employment Projections, 2008-2018 (http://www.bls.gov/emp/ep_table_102.pdf), National Science Foundation Division of Science Resource Statistics (<http://www.nsf.gov/statistics/nsf08321/tables/tab5.xls>), and National Center for Education Statistics (http://nces.ed.gov/programs/digest/d08/tables/dt08_286.asp).

Very Scary Numbers

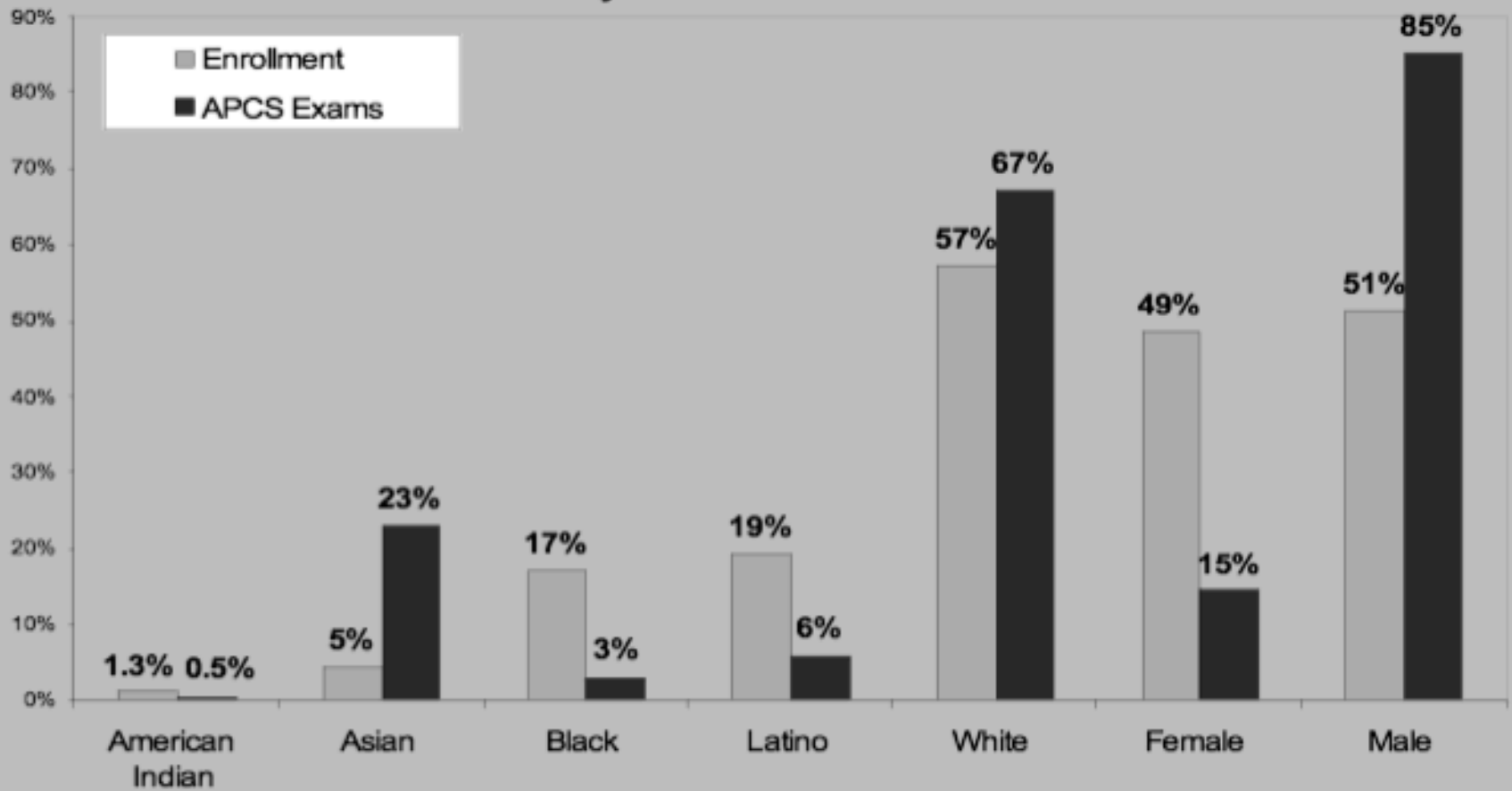
Schools Offering Introductory Computer Science

2005	2007	2009
78%	73%	65%

Schools Offering Introductory Computer Science

2005	2007	2009
40%	32%	27%

National School Enrollment and APCS Exam Participation by Race and Gender



Computer Science is Critical in High School



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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.

Transferable Skills

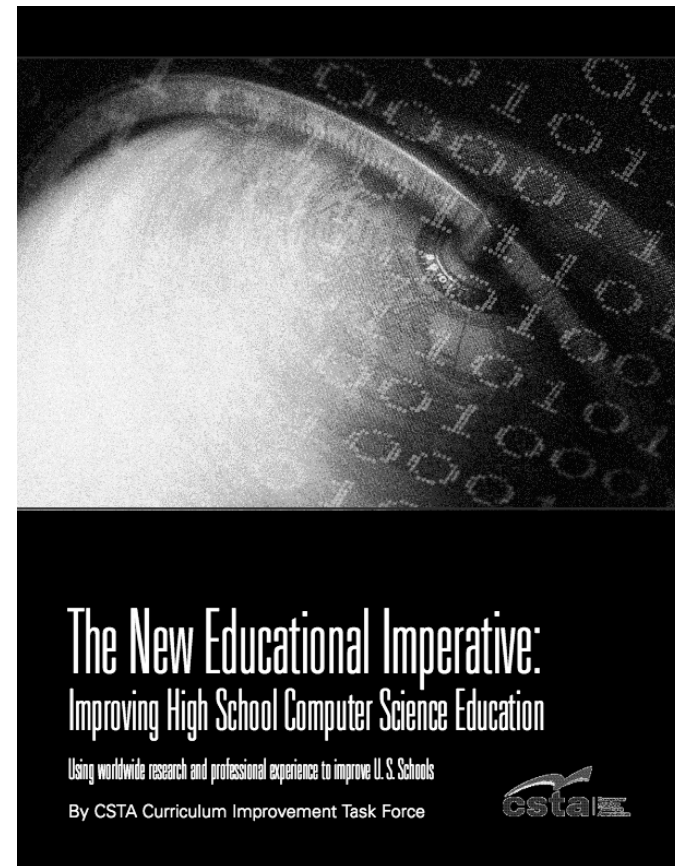
Students who study computer science learn a number of vital skills that can be transferred to any subject area and contribute significantly to their performance as professionals:

- Problem solving
 - Problem definition, solution design, implementation, testing, revision
 - Creativity, perseverance, teamwork
- Design
 - Designing and working to specifications
- Logic and reasoning
 - The ability to analyze a problem and break it down into a logical sequence of steps
- Computational thinking
 - Drawing on fundamental concepts in computer science to analyze and solve problems.
 - Thinking at multiple levels of abstraction

CS Education and National Security

- Powerful link to securing the cyber-infrastructure, protecting national security, and making the energy infrastructure more efficient. All of these are linked to computer science education.
- Without knowledgeable computer scientists, we cannot hope to secure these vital systems

Challenges



Decentralized Decision-Making

The decision-making authority for publicly funded schools is exceedingly complex, but it is safe to generalize in the following ways:

- Decisions regarding the distribution of federal funding are made at the federal level but these primarily affect low-income urban schools
- Most of the funding for schools is determined locally, so the quality of individual schools varies enormously based on the wealth of the school community
- Decisions regarding teacher qualifications and teacher certification are made at the state level, and the rules differ markedly from state to state
- Decisions about curriculum are made at the local level (there are no national curriculum standards for any academic discipline), so what students learn varies enormously from school to school and even from classroom to classroom

Systemic Issues

- Students (and parents) believe that there are no career opportunities in the high tech industry
- We are still battling the nerd stereotype
- Universities do not require incoming CS students to have taken CS courses in high school
- CS education is so fragmented that a CS course designation has no real meaning
- So many schools are placing their computers in the tech department that universities no longer believe that high school CS courses are academic courses like other sciences and math

Where is the C in STEM?

- Although computer science is a critical element of STEM learning, there is confusion about how it fits in the curriculum
- In K-12, the T (technology) is commonly translated to mean either access to hardware and software or learning to use applications
- State “computing” standards often include no computer science content

Which Courses Count and Who Can Take Them

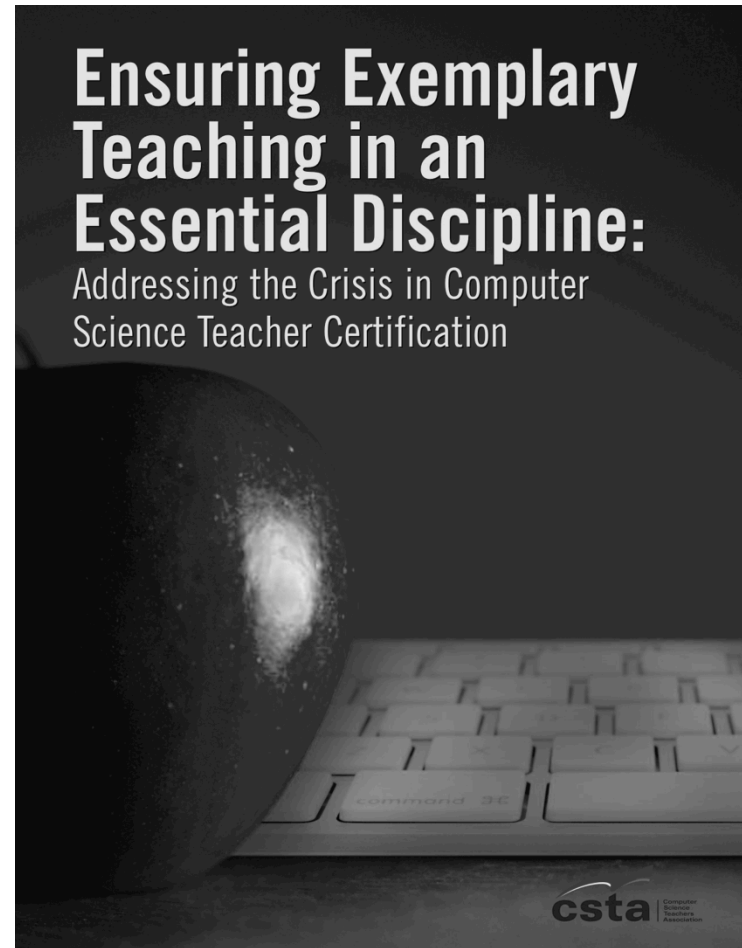
- Because computer science is an “elective” rather than a “core” course it is becoming increasingly difficult for students to fit it into their schedules
- This situation is exacerbated by the trend to increase the number of math and science courses students must take in order to graduate (with CS counted as neither)
- Computer science courses are often classified as a “technology credit” rather than an “academic credit”
- Access to rigorous computer science courses is often limited to high end schools with low minority populations

CS Teacher Certification is a Total Mess

- Many states have no requirements at all, so anyone can teach computer science
- Most people (teachers and administrators) don't know what the requirements are in their own states
- Some states have requirements that have absolutely no connection to computer science content or teaching
- Some states have requirements that are impossible to meet (requiring teachers to have taught courses that do not exist)
- Teacher preparation programs are not preparing computer science teachers because they are designed to prepare teachers for professional certification

Ensuring Exemplary Teaching in an Essential Discipline:

Addressing the Crisis in Computer Science Teacher Certification



Local Success vs. National Disaster

- In the last few years the commitment to improving computer science education has resulted in pockets of excellence:
 - New tools (Alice, Scratch, Kodu, Phrogram, Bootstrap...)
 - New curricula (Exploring Computer Science, Media Computation...)
 - New ways of thinking about equity and engagement
- If we are going to achieve a true renaissance in CS education in K-12 we need to make both curriculum and policy changes at the state and national level

COMPUTING

Expand Your Connections...



...to people and places



...to the world



...to limitless opportunities



...to every field



...to the future

Computing is Computer Science Computing is Computer Engineering
Computing is Informatics Computing is Information Technology
Computing is Software Engineering Computing is Information Systems



The Computer Science Teachers Association



CSTA's Commitment

- Work with the Review Commission and NSF to create a new introductory AP CS course
- Work at the state level to have CS classified as math or science credit for graduation purposes
- Commit professional development efforts to prepare teachers to teach high school computer science
- Provide resources to colleges and universities to promote computer science as an educational pathway and career
- Provide expertise and guidance on curriculum implementation
- Work at the state level to ensure teacher certification requirements are revised so that teachers are adequately and appropriately prepared
- Work at the federal level to impact STEM policy

Why CSTA?

- CSTA was founded in 2004 in response to growing concern about the state of computer science in secondary schools
- Substantial body of research points to key role of professional associations in systemic educational improvement
- Teachers are too isolated in their schools and too rarely offered real support by post-secondary institutions or government

CSTA Today

CSTA is an international membership organization of 10,000 members

- CSTA is a learning community
- CSTA is an advocacy organization
- CSTA is a provider of professional development for teachers
- CSTA is a research body
- CSTA is a provider of resources



CSTA's Mission

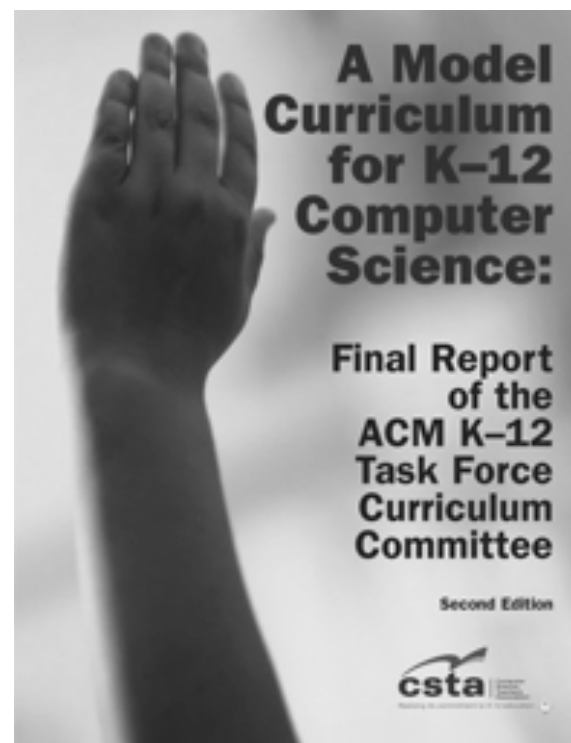
CSTA is a membership organization that supports and promotes the teaching of computer science and other computing disciplines. CSTA provides opportunities for K-12 teachers and students to better understand the computing disciplines and to more successfully prepare themselves to teach and learn.

Local Capacity and National Impact

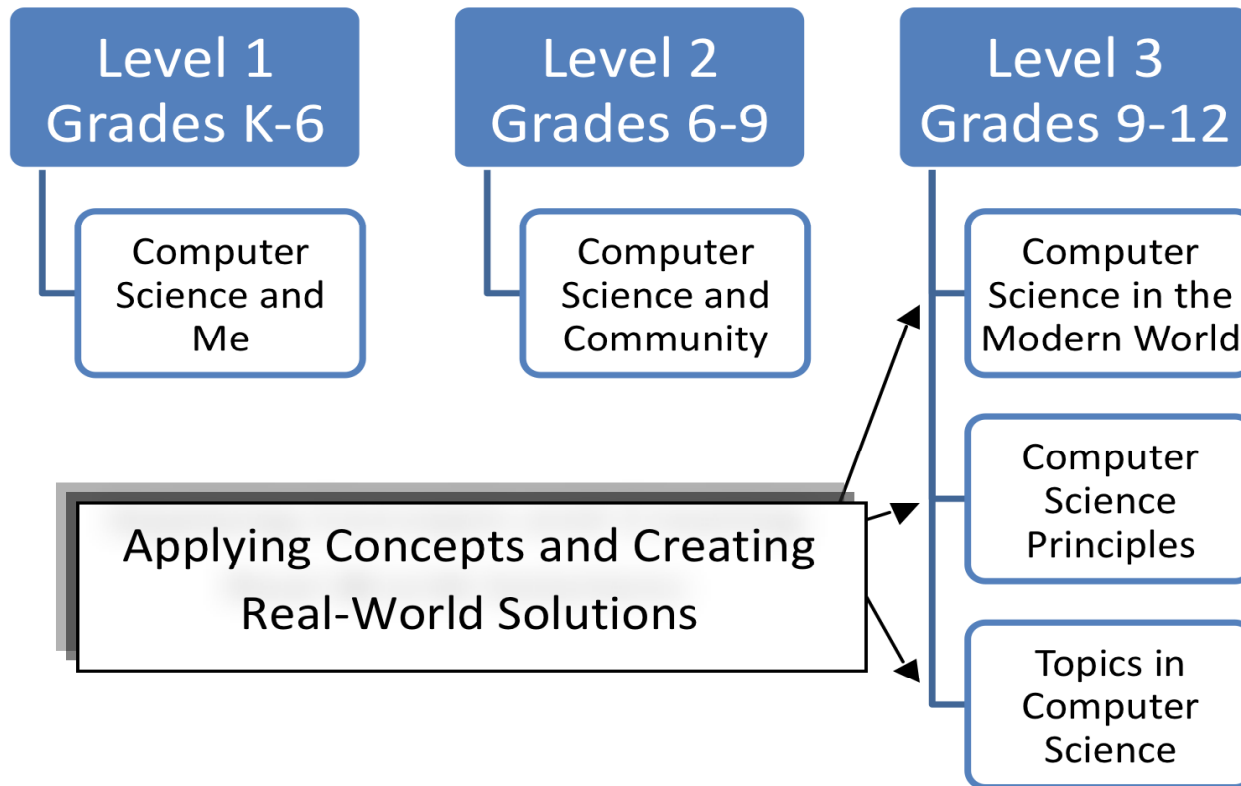
- CSTA chapters address local needs and offer local learning communities and professional development opportunities
- Efforts to form a chapter in Indiana now underway with the help of Mindy Hart of Purdue University
- CSTA Leadership Cohort is a group of two teachers from each state who receive leadership development and advocacy training to help them advocate for improvements to K-12 computer science education at the state level
- If you are interested in being a rep for IN, please see me!

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



Standards are Organized into Levels



Learning Outcomes Organized by Strands



Example Strand for Level 2

Computing Practice & Programming / Careers

The student will be able to:

- Use a variety of multimedia tools and peripherals to support personal productivity and learning throughout the curriculum.
- Select appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
- Design, develop, publish, and present products (e.g. Web pages, mobile applications, animation, etc.) using technology resources that demonstrate and communicate curriculum concepts.
- Implement problem solutions in a programming environment using: decomposition, looping behavior, conditional statements, logic, expressions and variables.
- Demonstrate an understanding of algorithms and their practical application.
- Demonstrate good practices in personal information security using passwords, encryption, and secure transactions.
- Develop dispositions amenable to open-ended problem solving and programming. (e.g. comfort with complexity, persistence, brainstorming, adaptability, patience, propensity to tinker, creativity, accepting challenge)
- Identify jobs, professions and careers that use computing.
- Collect and analyze data that is output from multiple runs of a computer program.

Timelines

- April 1: Draft completed
- April 15: Community review and feedback process begins
- June 5: Revision process begins
- August 1: Second draft completed
- August 15: Community endorsement process begins
- September 16: Final draft to layout
- November 18: Final version to printer
- December 16: Publication



Draft Document and Feedback

The entire draft document is available at:

http://csta.acm.org/includes/Other/CS_Standards.html

From this page you can also access the feedback/
comment process.

CSTA Resources

- Policy and Information Documents: *The New Educational Imperative (International Ed.)*, Ensuring Exemplary Teaching in an Essential Discipline
- The **Imagine Your Future in Computing** brochure helps students make connections between the technologies they use every day and the courses and the career opportunities available to them.
- The CSTA posters: ***IT is All About Me, CS Connections***, and ***Computer Science and Sports*** bring a positive message to the classroom
- The **Source** web repository is a searchable database with more than 200 unique resources: lesson plans, modules, presentations
 - Every resource is reviewed by a committee of experts to ensure that it is complete, relevant, appropriate, and pedagogically sound
 - The classification system links directly to CSTA standards so you know immediately which course and learning outcomes it addresses



CSTA Publications

- CSTA website (csta.acm.org)
- *CSTA Voice* (published bi-monthly)
- *Advocate* blog (blog.acm.org/csta/)
- Podcasts
- Videos
- Original research (national studies tracking CS education)

The screenshot shows the CSTA website homepage. At the top left is the CSTA logo (Computer Science Teachers Association) and a search bar. On the right, there are links for 'contact us' and 'join now - it's FREE', along with a 'CS ROCKS!' banner. The main content area is divided into several sections: 'Home' with a navigation menu (About CSTA, Membership Information, CSTA Advocate Blog, CSTA Source: A Web Repository, Computer Science Teacher Certification); 'Welcome to CSTA' with a sub-header 'The Voice for K-12 computer science education and its educators.' and a paragraph describing the organization; 'BIG NEWS!' with two items: 'New Download: Computational Thinking' and 'New State-Level Data Available for National CS Survey'; and 'CSTA's Focus' with a sub-header 'CSTA works at many levels to support computing education.' and three categories: 'Middle school', 'High school', and 'College/university'. A 'Become a Member' button is located at the bottom right.



THANK YOU!

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