SUPPORTING K-12 COMPUTING EDUCATION

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OBJECTIVES

- Why care about Computer Science education?
- A definition of Computer Science
- Computer Science for K-12
- What is the CSTA?
- Professional Development
- Funding Opportunities
- Support from Colleges and Universities - 10 ways to help
- What YOU can do!
WHY CARE?

- Anticipated shortage of qualified candidates for 1.5 million computer and IT jobs by 2012
- HS CS programs disappearing in US but are new requirements in other countries
  
  *(Source: The New Educational Imperative: Improving High School Computer Science Education, 2006)*

- Force engagement with issues relating to CS education
The United States, a nation once proud of its leadership in education, is sitting quietly on the sidelines while other countries make improvements to ensure their high school graduates will be ready to meet the demands of tomorrow’s high-tech society.

Source:
The New Educational Imperative: Improving High School Computer Science Education, 2006
The lack of adequate computer science education in high schools is another major factor contributing to the dire state of computer science enrollment in colleges.

"Almost no place is looking at computer science as on par with learning physics or mathematics, which it should be“ (Stanford Professor Eric Roberts).

Source:
"There seems to be a sense in the curriculum in K-12 that technology is still PowerPoint and the Web."

(Robert Appelman, associate professor in the Instructional Systems Technology Department in Indiana University's School of Education).

Source:
“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.”
WHAT IS COMPUTER SCIENCE?

- Programming
- Hardware design
- Networks
- Graphics
- Databases and information retrieval
- Computer security
- Software design
- Programming languages

- Logic
- Programming paradigms
- Translation between levels of abstraction
- Artificial intelligence
- Limits of computation
- Applications of IT and IS
- Social issues
KEY K-12 ISSUES IDENTIFIED BY RESEARCH

- Shrinking pipeline
- Underrepresented populations
- No national curriculum standards
- Inappropriate and ineffective teacher certification
- Teachers feel isolated and in need of community
- No opportunities for skills upgrading
- A feeling of disconnect between K-12 CS educators and their college/university colleagues
- Need for improved public understanding of CS
KEY ISSUES IDENTIFIED BY RESEARCH

- Ubiquity of computers in the world
- Rapid evolution of CS as a discipline

- No strong voice to educate administrators, legislators, and congressional committees about the link between supporting K-12 computer science education and international economic issues
WHY DO WE NEED CS STANDARDS?

- Consistency
- Resources
- Teachers
  - What should I teach?
  - Am I prepared to teach this content?
  - What teacher certification do I need?
- Students and parents
  - What will I learn?
  - Will this help me in college?
- Administrators, teachers, and students
  - What is the difference between technology and Computer Science?
Goals of the Model Curriculum

- Introduce fundamental concepts of CS to all
- CS worthy of curriculum credit
- Secondary level computer courses for interested students
  - Work force
  - College
- Help ensure work-place readiness of US graduates by providing computing standards


http://csta.acm.org/Curriculum/sub/K-12ModelCurr2ndEd.pdf
### A Model Curriculum for K-12 CS

#### Recommended Grade Level

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**Figure 1. Structure of a K-12 Computer Science Curriculum**
Foundations of Computer Science
Grade K-8

- Foundational concepts
- Basic skills in technology + simple algorithmic thinking ideas (original NETS standards as guide)
- Hands-on activities
- Modules in science, mathematics, and social studies
Computer Science in the Modern World
Grade 9 or 10

• Prepare students for a technological world
• Acquire fundamental understanding
  - Operations of computers: Hardware, Software, Operating Systems, etc.
  - Computer networks
  - The Internet
  - Algorithmic problem-solving
• Expose students to computing careers
• Discuss ethical issues
LEVEL III

Computer Science as Analysis and Design
Grade 10 or 11

- One-year elective; earns curriculum credit
- Emphasis on scientific/engineering aspects of computer science
- Focus
  - Mathematical principles
  - Algorithmic problem-solving/programming
  - Software/hardware design
  - Networks
  - Social impact
- Explores interest in computing sciences as a profession/major
Topics in Computer Science
Grade 11 or 12

- Topics of personal interest
  - In-depth understanding
  - Special skills
- Elective
  - AP Computer Science
  - Projects-based course
  - Courses leading to Industry Certification
- Fluid Offerings based on current technology
LEVEL IV - IMPLEMENTATION

- Local district with existing faculty and equipment

- In conjunction with college
  - At local school
  - On college campus
  - Via distance education

- College credit may be available
  - Tech Prep / Articulation
  - Dual Credit / Concurrent Enrollment
  - Challenge Exams
  - CLEP Tests
  - AP Tests
ENDORSEMENTS
Using the Model Curriculum

- GA curriculum standards, Business and CS
- NH competencies for vocational programming
- CS standards for elementary/H.S. (Diocese, FL)
- Resource in writing state curriculum
- National curriculum for South African schools
- Advocate a national CS curriculum in Taiwan
- Topics guidelines for 2-year college core classes
- Increase problem solving in K-12 Math curriculum
- Outreach activities for K-8 students
- Develop the competencies and skill sets for the FL Teacher Certification Examination in K-12 CS
http://csta.acm.org/
The Computer Science Teachers Association supports and promotes the teaching of computer science and other computing disciplines at the K-12 educational level.
WHAT IS CSTA?

- CSTA is a limited liability organization under the auspices of ACM
- CSTA is a membership organization
- CSTA is an advocacy organization
- CSTA is a provider of professional development opportunities for teachers
- CSTA is a provider of research
- CSTA is a provider of resources
**Scope of CSTA**

- **Impact Areas:**
  - high school (all aspects of CS education)
  - middle school (to help teachers introduce problem solving and algorithmic thinking)
  - college/university (to provide better support and transitions for high school teachers and students)
  - industry (supporting CS education and teachers)

- **Who Can Join?**
  - high school teachers
  - middle school teachers
  - elementary school teachers
  - college/university faculty
  - industry folks
CSTA SUPPORT FOR MODEL

- Disseminating Model
  - Teachers
  - State legislators
  - State curriculum specialists
  - School district curriculum administrators

- Working with curriculum specialists to develop resources

- Working to build a national repository of learning materials aligned to the Model

- Working to provide professional development opportunities for teachers

- Advocating for the importance of K-12 computer science education at the national level
CS INSTRUCTION COULD BE THIS
OR THIS

Yawn
Boring
Dull
LET'S MAKE IT INTERESTING AND EXCITING

Lottery
Let’s pool our best resources to excite students to learn about computers and perhaps to explore a computing career!
RESOURCES: GENERAL

- CSTA Website
- Certification
- Curriculum
- Professional Development
- Advocate Blog
- CSTA Source: Web Repository
- Virtual Binders; Research
- Careers
- Publications - Voice
- Podcasts
- Downloadable Resources
RESOURCES: MODEL CURRICULUM

- Level I -- Foundations of CS
  - ISTE has resources available
  - Task Force beginning work

- Level II -- CS in the Modern World
  - Objectives and Outlines document
  - CSTA Source: Web Repository

- Level III: CS as Analysis and Design
  - Objectives and Outlines document
  - CSTA Source: Web Repository

- Level IV -- Topics in CS
  - AP: resources available
  - Projects-based: with college/university
  - Industry certification: resources available
CSTA SOURCE: WEB REPOSITORY

- Searchable database for K-12 teaching and learning
  - Instructional materials
  - Lesson plans
  - Other resources
- Seed content from TECS and JETT
- Submitted by high school and college educators
- Reviewed by a team of expert educators
- Collected for the first time in one place
- Accessible to CSTA members
TEACHER EDUCATION
TEACHER CERTIFICATION

FRANK & ERNEST

OOPS! MAYBE WE’D BETTER MAKE THE CHICKEN FIRST...

CREATION DEPT.

E-mail: FandEBobT@AOL.COM © 1995 by NEA, Inc.
Recent Research - 2-year project completed in 2006

In many states it is nearly impossible to determine what the requirements are to teach CS

Limited teacher education programs in CS
TEACHER EDUCATION PROFESSIONAL DEVELOPMENT

Computer Science and Information Technology Symposium (CS & IT)

- Annual event
- Full-day
- Relevant topics
- Interactive sessions
- HS teachers
Teacher Enrichment in Computer Science (TECS)

- Pedagogically-oriented programs
- Model Levels II-IV
- Community building
- Hosted by Colleges and Universities
- Planning group includes grade 6-12 teacher, college students, College faculty member
- Must include
  - Equity
  - Ethics
  - Careers
  - Problem Solving
  - Classroom activities
Teacher Enrichment in Computer Science (TECS)

- **TECS Workshop Modules**
  - Principles of Computer Organization
  - Computer Science, Mathematics and Interdisciplinary Inclusion
  - Models of Intelligent Behaviors
  - Internet and the World Wide Web
  - Multimedia and Computer Applications
  - Introduction to Programming and Programming Languages
  - Introduction to Objects and Object-Oriented Programming
  - Simple Data Structures and their uses
  - Principles of software engineering: software projects, teams, the software life cycle
  - Educating Others in Computer Science Education
Teacher Education Professional Development

Teacher Enrichment in Computer Science (TECS Workshops)
Executive Summary

- Your institution and workshop timeframe
- Name, title, and email address for at least four members of your TECS planning team (including yourself and a local area K-12 teacher who will participate in the planning process.)
- Target geographical area for workshop (your metro area, state, or surrounding states)
- Model for funding workshop (costs include providing simple breakfast and lunch -- Food for Thought -- for attendees.)
- A plan for continued community building following the workshop
Java Engagement for Teacher Training (JETT)

- Pedagogically-oriented programs
- HS teachers
- Focus on Java and OO concepts
- Online Java Repository
- Community building
- Hosted by Colleges and Universities
Java Engagement for Teacher Training

JETT Modules:
- Introduction to Objects
- Introduction to Programming
- Introduction to Object-Oriented Programming
- Arrays and Array Lists
- Interfaces and Inheritance
- Data Structures
- Algorithms
- Program Design and Testing
TEACHER EDUCATION
PROFESSIONAL DEVELOPMENT

Java Engagement for Teacher Training
GRANT OPPORTUNITIES

The following information is provided by:

Steve Cooper
St. Josephs University
Program Director, National Science Foundation
sccooper@nsf.gov
NSF Programs

EHR

- DUE
  - Advanced Technological Education (ATE)
  - Course, Curriculum, and Laboratory Improvement (CCLI)
- DRL
  - Innovative Technology Experiences for Students and Teachers (ITEST)
  - Discovery Research (DR K-12)

CISE

- Broadening Participation in Computing (BPC)
The ATE program promotes improvement in the education of science and engineering technicians at the undergraduate and secondary school level and the educators who prepare them, focusing on technicians for high-technology fields that drive the nation’s economy.
COURSE, CURRICULUM, AND LABORATORY IMPROVEMENT (CCLI)

- Focus - courses and labs
  - Improve a course
  - Create a new course
  - Improve the lab experience for students
- Connect your innovation to what others have done in the past
- Build community
- Share what works
- Define success via outcomes that can be measured
Creating new learning materials and teaching

Implementing educational innovations

Developing faculty expertise

Assessing learning and evaluating innovations

Conducting research on undergraduate STEM teaching
Goal: widen pipeline by improving student interest in careers in STEM

Specify deliverable
- Involve technology but does not need to be for computing
- Deliverable can be a process

Procedure
- Pick population - students and/or teachers
- Decide how to work with the population
- Execute idea

Tends to be extracurricular

Example: new process for encouraging a particular sector of the student population to enter a career in computing by working with new technologies like the iPhone.
Strategies projects:

- The design, implementation, and evaluation of models for classroom
- After-school, summer, virtual, and/or year-round learning experiences for students and/or teachers
- Encourage students’ readiness for, and their interest and participation in, the STEM workforce.
INNOVATIVE TECH EXPER FOR STUDENTS AND TEACHERS (ITEST)

Scale-up projects:
- Start small and then share with the larger community
- Evidence of demonstrated success
- Initial ITEST proposal - may want to spend a small portion of a page specifying how you envision the project can be scaled-up

ITEST may be a good choice for a TECS workshop
Collection of anything you want to do towards improving teaching of STEM in K-12
- Research and development projects
- Exploratory projects
- Synthesis projects

Activities are meant for the classroom in a school

Examples:
- Creation of resources for use in the classroom
- Modeling a style of teaching
BROADENING PARTICIPATION IN COMPUTING (BPC)

- Aims to significantly increase the number of Americans receiving post secondary degrees in the computing disciplines
- Emphasis on students from communities with longstanding underrepresentation in computing
  - Women
  - Persons with disabilities
  - Minorities
- Developing and implementing innovative methods to improve recruitment and retention
  - Undergraduate and graduate levels
  - Can involve activities in the K-12 arena
NSF SUMMARY BY GRANT

- General Criteria
  - Intellectual merit
  - Broader impact

- EHR-DUE
  - ATE
    - Anything relating to computing
    - Are we improving America’s workforce?
  - CCLI
    - Courses / lab experience
    - Active learning, new ways of communicating between instructor and student
    - Overlap with ATE
NSF SUMMARY BY GRANT

- EHR-DRL
  - ITEST
    - Widen pipeline
    - Involve technology but does not need to be about computing
    - Extra curricular
  - DR K-12
    - Very broad
    - Anything involving teaching of K-12 STEM
    - Delivered in classroom in school

- CISE
  - BPC
    - Increase student population in computing
    - Emphasis on underrepresented groups
HOW TO GET STARTED WITH THE GRANT PROCESS

- Have an idea!
- Identify the appropriate NSF program
- Search the NSF database to see what similar projects have been funded
- Contact the PIs to request copies of their proposals
- Contact NSF to request to serve as a reviewer for the program for which you wish to submit an application (optional: but very helpful!)
- Contact an appropriate NSF program officer to discuss aspects of your proposal
NSF Awards Search:
http://www.nsf.gov/awardsearch/

Hint: The text field below 'Search Award For' searches the title, abstract, and award number fields.

Search Award For: ____________________________
Restrict to Title Only: ☐

Awardee Information

Principal Investigator

First Name: ____________________________
INFORMATION AND INQUIRIES

- **DUE Information System**
  - Email: undergrad@nsf.gov
  - Phone: 703-292-8670
  - Fax: 703-292-9015

- **DUE Web Site**

- **DUE Project Information Resource System**
  [https://www.ehr.nsf.gov/pirs_prs_web/search/](https://www.ehr.nsf.gov/pirs_prs_web/search/)

- **DUE Mailing Address**
  NSF, Division of Undergraduate Education
  4201 Wilson Boulevard, Room 835
  Arlington, VA 22230
10 WAYS TO HELP COLLEGE FACULTY

The New Educational Imperative: Improving High School Computer Science Education, 2006

1. Support HS CS education - require entering students to have at least 1 CS course

2. Provide different entry points based on computing experience

3. Interact with local HS teachers - invite them to the college, speak at local schools, send students to speak at local schools

4. Provide details as to anticipated CS skills for incoming students

5. Start student-to-student (college-to-HS) mentorship programs, particularly for female and minority students
10 WAYS TO HELP COLLEGE FACULTY

The New Educational Imperative: Improving High School Computer Science Education, 2006

5. Create and support professional development opportunities for teachers

6. Provide info about computer careers and computing education to counselors, teachers, students

7. Ensure that Schools of Education are preparing teachers to teach CS

9. Help schools obtain new technology resources by working together on grant applications

10. Read and share the Model Curriculum for K-12 Computer Science Education
SUMMARY

- CSTA
  - Supports CS education for K-12
  - Advocates on behalf of K-12 CS educators
  - Standards for curriculum and certification
- Why?
  - Declining enrollment despite career opportunities
  - Need to force the US Educational system to recognize computing education as necessary for today’s students
What can YOU do?

- Be aware that the problem begins in elementary school
- Open a dialogue with a local school (college faculty) or your school administration (teachers)
- Provide / take advantage of professional development opportunities for teachers
- Join CSTA... It’s FREE! 😊
  - Stay up to date on CS “happenings” in K-12
  - Volunteer to assist on a project
Acknowledgements

Works Cited


Provide Help at the Beginning
and we all will see the Rewards
at the End!