COMPUTING EDUCATION FOR THE 21st CENTURY

CS4HS@UMBC sponsored by Google
July 17-20, 2011, Session 2
Dr. Susan Martin
UMBC Center for Women in Technology
So...

What are the trends and issues in computer science education?
We can’t solve the issues in 90 minutes, or in 3 days! So in this session we will...

- Begin a conversation among this group that will continue, here and beyond

- Create a common starting point by naming and framing key issues (15-20 minutes)

- Refer to key resources

- Do some reflection and small group discussion about your own situation (self, school, county) (60 minutes)
ISSUES

1. National crisis and SHORTAGE of new computer scientists and IT professionals

2. Diversity and Equity Issues

3. Standards and Curriculum

4. Teacher Preparation and Certification

5. Professional Development & Community Among Computer Science Teachers
ISSUE 1: DEMAND FOR COMPUTER SCIENTISTS GREATER THAN SUPPLY (AND A MATTER OF NATIONAL IMPORTANCE)

“Computing careers are projected to be the fastest growing professional occupations over the next decade. They are among the tops in salary and ranked as some of the best jobs in America. And they’re filled with tremendous intellectual excitement and the opportunity to change the world.”

CRA Taulbee Report: CS Enrollments, New Majors Up For 2nd Straight Year
March 24, 2010, In CRA, Events, People, By Peter Harsha
Employment growth within the 8 BLS "Professional and related" occupations, 2008-2018

- Professional and related occupations: 16.8%
- Computer and mathematical: 22.2%
- Architecture and engineering: 10.3%
- Life, physical, and social science: 19.0%
- Community and social services: 16.5%
- Legal: 15.1%
- Education, training, and library: 14.4%
- Arts, design, entertainment, sports, ..: 12.1%
- Healthcare practitioners and technical: 21.4%

http://www.bls.gov/opub/mir/2009/11/art5full.pdf, Table 2

- Computer specialists, 57.2%
- Engineers, 13.4%
- Drafters, engineering, and mapping technicians, 3.9%
- Architects, surveyors, and cartographers, 3.0%
- Mathematical science, 1.7%
- Life scientists, 5.6%
- Physical scientists, 3.1%
- Social scientists and related, 8.8%
- Life, physical, and social science technicians, 3.3%

According to ONET, the Computer Systems Analyst position has much faster than average growth through 2018 (20% or higher). Projected job openings (2008-2018): 222,800.

http://www.onetonline.org/
BS Degrees Earned

Figure 6. BS Production (CS & CE)

Versus number of openings....
1. Who are the major employers in your county? And what is the demand for computer science/IT graduates in your county?

2. What percentage of your high school’s graduating class go on to study computer science?
   - at a community college?
   - at a university?
ISSUE 2: DIVERSITY …STEM AND CS IS MISSING A LARGE PROPORTION OF THE US POPULATION…

- **Girls/women** and underrepresented minorities in all areas of STEM especially computer science
  
  [http://www.aauw.org/learn/research/whysofew.cfm](http://www.aauw.org/learn/research/whysofew.cfm)

- **Underrepresented minorities** are not entering STEM relative to their proportion in the US population
  
  [http://www.nationalacademies.org/morenews/20100930.html](http://www.nationalacademies.org/morenews/20100930.html)
Women are underrepresented in many science and engineering occupations.

Percentage of Employed STEM Professionals Who Are Women, Selected Professions, 2008


From presentation available at: http://www.aauw.org/learn/research/whysofew.cfm
**TAULBEE SURVEY: COMPUTING DEGREES BY GENDER**

<table>
<thead>
<tr>
<th></th>
<th>CS</th>
<th>CE</th>
<th>I</th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7,622</td>
<td>1427</td>
<td>1625</td>
<td>10,674</td>
<td>86.6%</td>
</tr>
<tr>
<td>Female</td>
<td>1,216</td>
<td>166</td>
<td>275</td>
<td>1,657</td>
<td>13.4%</td>
</tr>
</tbody>
</table>

**Table 9a. Gender of Bachelor’s Recipients**

Total have Gender Data for:
- Male: 8,838
- Female: 1,593
- Unknown: 170

Total: 12,501
Underrepresented minorities (African-Americans, Hispanics and Native Americans) represent 28.5 percent of the U.S. population but only 9.1 percent of college-educated Americans in the science and engineering workforce.

http://www.nap.edu/catalog.php?record_id=12984
STUDENT POPULATION PROJECTED TO BE 50% URMS BY 2050 U.S. POPULATION 18-24 YEARS OLD, BY RACE/ETHNICITY: JULY 1990-99 & PROJECTIONS TO 2050.
### Taulbee Survey: Degrees by Ethnicity

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>CS</th>
<th>CE</th>
<th>I</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresident Alien</td>
<td>584</td>
<td>99</td>
<td>73</td>
<td>756</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>27</td>
<td>6</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>Asian</td>
<td>1,034</td>
<td>250</td>
<td>173</td>
<td>1,457</td>
</tr>
<tr>
<td>Black or African-American</td>
<td>236</td>
<td>57</td>
<td>120</td>
<td>413</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>20</td>
<td>3</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>White</td>
<td>4,650</td>
<td>901</td>
<td>1,024</td>
<td>6,575</td>
</tr>
<tr>
<td>Multiracial, not Hispanic</td>
<td>65</td>
<td>13</td>
<td>1</td>
<td>79</td>
</tr>
<tr>
<td>Resident Hispanic, any race</td>
<td>373</td>
<td>65</td>
<td>116</td>
<td>554</td>
</tr>
<tr>
<td><strong>Total have Ethnicity Data for</strong></td>
<td>6,989</td>
<td>1,394</td>
<td>1,523</td>
<td>9,906</td>
</tr>
<tr>
<td>Resident, race/ethnicity unknown</td>
<td>455</td>
<td>96</td>
<td>119</td>
<td>670</td>
</tr>
<tr>
<td>Residency unknown</td>
<td>1,564</td>
<td>103</td>
<td>258</td>
<td>1,925</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9,008</td>
<td>1,593</td>
<td>1,900</td>
<td>12,501</td>
</tr>
</tbody>
</table>
Underrepresentation of this magnitude in the S&E workforce stems from the underproduction of minorities in S&E at every level of postsecondary education

- 38.8 percent of K-12 public enrollment
- 33.2 percent of the U.S college age population
- 26.2 percent of undergraduate enrollment
- 17.7 percent of those earning S&E bachelor’s degrees
- 17.7 percent of overall graduate enrollment
- 14.6 percent of S&E master’s
- 5.4 percent of S&E doctorates.

http://www.nationalacademies.org/morenews/20100930.html
FIXING THE PROBLEM (ACCORDING TO DR. HRABOWKSI AND THE NATIONAL ACADEMIES COMMITTEE....)

- Preparation, access, motivation, financial assistance, academic support, and social integration provide URM students the means for obtaining the ingredients for success in STEM
  - the acquisition of knowledge, skills, and habits of mind
  - opportunities to put these into practice
  - a developing sense of competence and progress
  - motivation for and a sense of belonging to the field
  - information about stages, requirements, and opportunities

- These ingredients require attention at every stage along the STEM educational continuum.
Questions for Discussion:

1. What is the gender and racial/ethnic breakdown of your high school?
   ___% women
   ___% African-American
   ___% Latino

2. What is the breakdown by gender and race of students taking computer science classes at your high school? In your county?
**Issue 3: Curriculum Standards**

ACM/CSTA recommended model K-12 curriculum

National Analysis (Running on Empty Report) of adoption of these standards
[http://csta.acm.org/runningonempty/fullreport.pdf](http://csta.acm.org/runningonempty/fullreport.pdf)
RUNNING ON EMPTY FINDINGS

- **Only 14 states** have adopted secondary state education standards for computer science instruction to a significant degree (defined as more than 50% of ACM and CSTA’s national model computer science standards), leaving more than two-thirds of the entire country with few computer science standards at the secondary school level.

- **Only 9 states** allow computer science courses to count as a required graduation credit for either mathematics or science. Further, no states require a computer science course as a condition of a student’s graduation.

- **No states** require a computer science course as a condition of a student’s graduation.

- There is deep and widespread confusion within the states as to what should constitute and how to differentiate technology education, literacy and fluency; information technology education; and computer science as an academic subject.
How does Maryland stack up against ACM/CSTA curriculum?

http://csta.acm.org/runningonempty/roemap.html
Questions for Discussion:

1. What computer science courses are offered in your high school? Are there any “academies” county wide?

2. What do these courses count as?

2. Is AP computer science offered in your school? What percentage of students take AP CS at your school?
ISSUE 4: TEACHER CERTIFICATION

CSTA 2007 Report on Certification
http://csta.acm.org/ComputerScienceTeacherCertification/sub/TeachCertRept07New.pdf

- Only 29% of states require CS certification at secondary level
- 53% granted a Computer Science Endorsement
  - 29% of states requiring an endorsement at high school level;
  - 27% for middle school; 13% at elementary; 13% K-12.
- Maryland Teacher Certification:
  - http://www.dsd.state.md.us/comar/comarhtml/13a/13a.12.02.06.htm
  - http://directory.msde.state.md.us/map/LocalFrames.asp
Questions for Discussion:

1. How did you come to teach computer science?

2. What was your major?

3. What is the background of other CS teachers at your school? In your county?
ISSUE 5: COMMUNITY AND PROFESSIONAL DEVELOPMENT

- Teachers come from various backgrounds and professional identities

- Maryland school systems function at the local level and many types decisions made at the school level

- Maryland does not have a CSTA chapter

- Current financial context of MD, counties, and school systems
1. **What professional development opportunities exist for computer science teachers at your school? In your county?**

2. **What professional development opportunities are you able to participate in or have you participated in at the state and/or national level?**

3. **What resources do you regularly utilize for curriculum ideas?**
WE ARE ALL PART OF A LONG-TERM NATIONAL SOLUTION

High School Teachers and Administrators

Federal, State & Local Government

Industry

Colleges and Universities
SO BACK TO THIS 3 DAY PROFESSIONAL DEVELOPMENT EVENT...OUR GOALS

1. Increase knowledge about national issues related to computer science in the K-12 curriculum
2. Initiate relationships among MD high school computer science teachers, UMBC faculty, CWIT
3. Increase sense of community among MD high school computer science teachers
4. Increase interest in establishing an active Maryland CSTA chapter
5. Gather information and data to inform future computer science education related research and projects