



# Laboratory Metrology Education and Training

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NCSLI VP Learning and Development

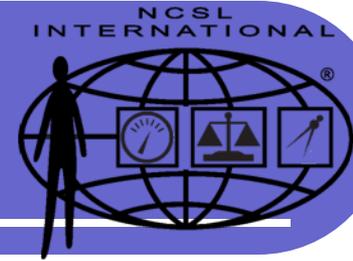
NIST Weights & Measures Division





- Established in 1961 as a not-for-profit Educational body (501c3):
  - National Conference of Standards Laboratories
  - CFC 26683
- Added:
  - International → NCSL International ('99)
    - Growing international membership
    - International metrology environment; e.g., ISO/IEC 17025
- Education and Training
  - Focus Education & Training Efforts, changed to Learning and Development ('05)

# Standards for Metrology



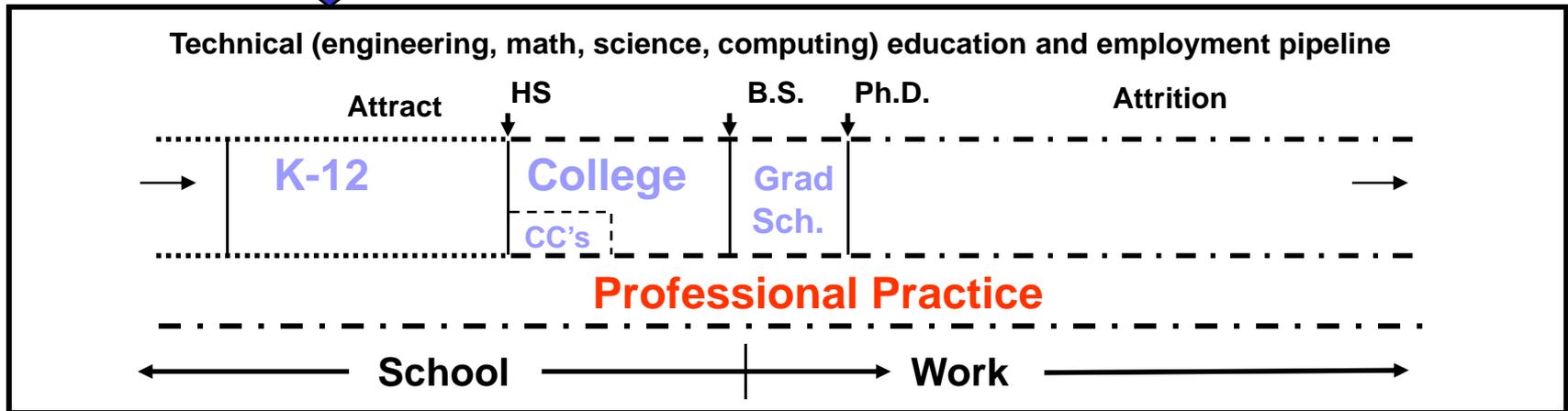
- NCSLI is an ANSI accredited SDO
  - Z 540 Committee
- International: Vocabulary of Metrology (VIM), Guide to the Expression of Uncertainty in Measurement (GUM), ISO/IEC 17011, 17025, 9000
- International Legal Metrology: OIML (e.g., R 111)
- Industry: ASTM (e.g., E 617)
- NIST Handbooks (adopted in State regulations): 44, 130, 105-x (e.g., 105-1)

# Metrology Pipeline



Scholarships; Community College Liaisons

Metrology Ambassador – Outreach; Professional Association Liaisons

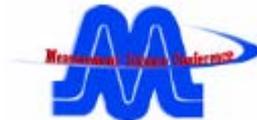


Measurement and Standards Training  
Am. Society for Quality (MQD) – Certified Calibration  
Technician

# Metrology Collaboration



- Liaisons with professional affiliates:



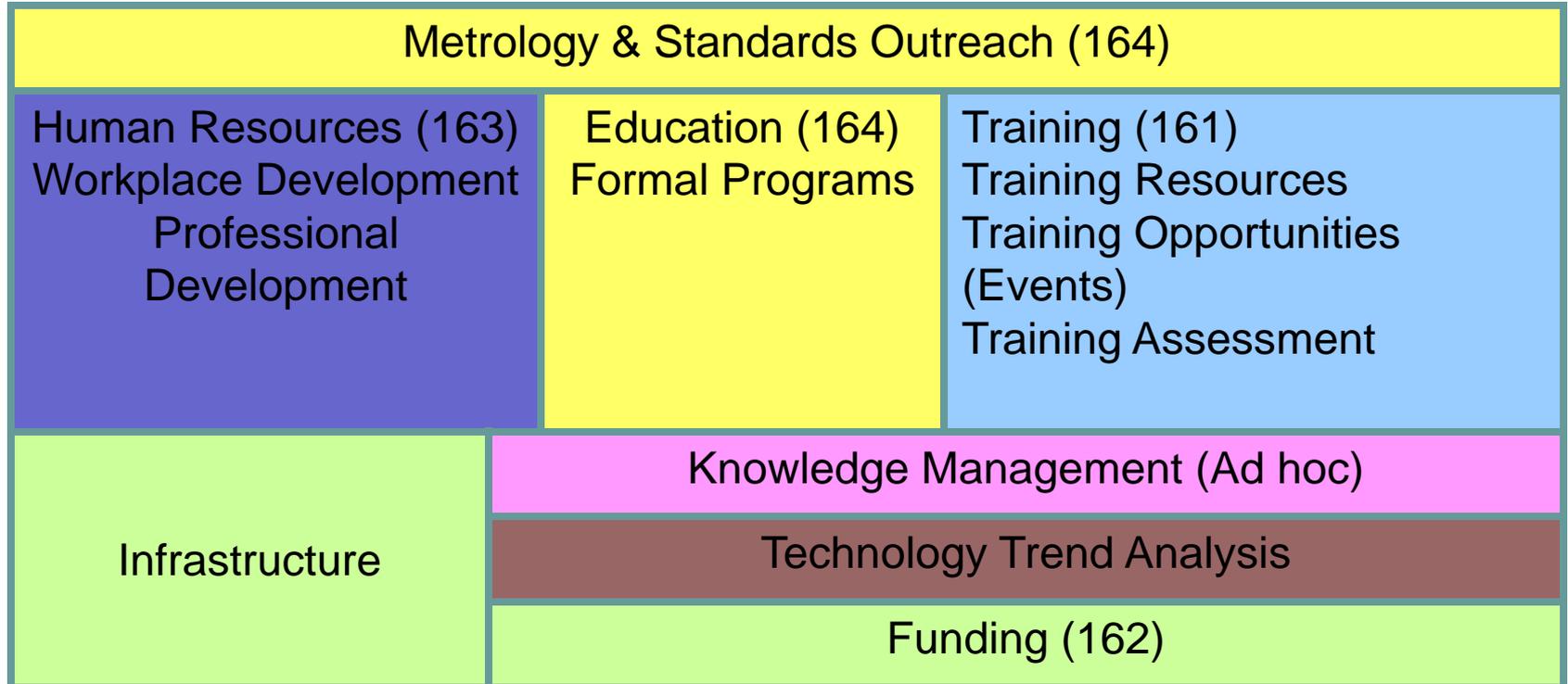
Measurement  
Science  
Conference



ASQ Measurement  
Quality Division

- Champions seek strategic informal liaisons: ASEE (shared metrology exhibit and session in 2009), ASTM, ANSI, NSTA, IEEE....

# Strategic Framework



*Numbers reflect assigned committees.*

# Scholarships for Metrology



- 2007-2008, awarded \$18,000
- 2008-2009, awarded \$24,000
- 2009-2010, awarded \$18,000
- Schools, supported at varying levels depending on relation to metrology and number of students
- <http://www.ncsli.org/trainin g/college.cfm>

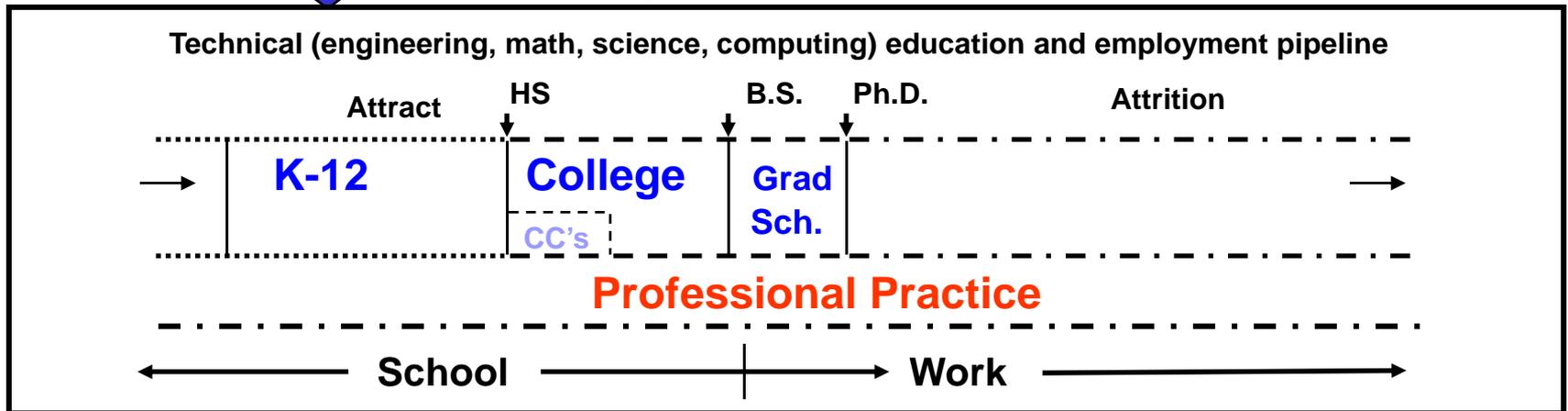
School	2005 to 2007
Butler County Community College (PA)	\$10,000
Ridgewater College (MN)	\$10,000
Central Georgia Technical College (GA)	\$9,500
Fleming College (Ont. Canada)	\$6,000
University of North Carolina at Charlotte (NC)	\$6,000
University of Central Florida (FL)	\$6,000
Tidewater Community College (VA)	\$2,000
Sinclair Community College (OH)	\$1,000
Purdue University School of Tech. New Albany (IN)	\$400
<b>Totals</b>	<b>\$50,900</b>

# Metrology Pipeline

↓ NIST NRC Postdoctoral Program

↓ SURF Program

↓ Summer Institute for Middle School Science Teachers,  
Boulder PHASE\* Program; add Teacher Research



University and Industry Collaboration  
(Continuing Education and Curriculum Enhancement)

NIST Measurement and Standards Training

# NIST Training Efforts



- We began tracking NIST-wide training efforts in 2006
  - With support and input from Measurement Services Advisory Group (MSAG) and Conference Facilities in 2007
- Technology Services began having discussions about
  - Training – as related to Technology Transfer efforts
  - Effective measures of impact for training as a part of our Baldrige journey
    - Output (counting) vs Outcome (measuring impact)

- Weights and Measures Enforcement
  - Specifications and Tolerances for Commercial Devices (Handbook 44)
    - Scales
    - Vehicle-Tank & Loading-Rack Meters
    - Grain Moisture Meters
    - Railway Track Scales-AREMA (Rick)
    - Small Volume Provers
  - Checking the Net Contents of Packaged Goods (Handbook 133)
  - Price Verification
- Standards in Trade Workshops
  - Middle East, North Africa, and Pakistan on Standards, Codes, and Conformity Assessment for Life Safety and Building Construction
  - Oil and Gas for South America
  - US-China: Intelligent Transportation Systems
  - Support of the Asia Pacific Partnership (APP) on Harmonization of Test Procedures
- Training for US Trade Representatives, Standards Attaches, Foreign Commercial Service Officers

FY: 2007

# Measurement Courses

- TS Laboratory/Metrology Seminars
  - Basic Metrology - States
  - Basic Mass - Industry
  - Intermediate Metrology
  - Advanced Mass, Advanced Mass Hands-on
  - 6 Regional Measurement Assurance Programs
  - MSC - NIST Seminars: Accreditation (NVLAP), Practical Measurement Assurance
  - NCSLI - Balance & Scale Tutorials
- Summer Institute for Teachers
- Display Metrology
- Laser Measurements
- ARFTG Microwave Measurements
- Microwave Measurements for Emerging Materials
- Near-Field Antenna Measurements and Microwave Holography
- Instrumentation, Metrology, and Standards for Nanomanufacturing
- Gage Blocks
- MSC - NIST Seminars: Pressure and Vacuum, Fluid Flow, Uncertainties
- Mini-Workshop on ITS-90 Fixed Points
- The Role of NIST in Improving the Accuracy of Natural Gas Flow Measurements
- Spectrophotometry
- Time and Frequency Metrology Seminar
- High-Frequency Characterization of Printer-Circuit Board materials
- Optimum CMOS Integrated LNA Design Techniques for Handsets

FY: 2007

# Evolving Measures

- Part of our TS Baldrige journey
  - Beginning to implement formal learning evaluation methods and techniques<sup>1</sup>
  - Also tracking requests for training and conducting needs assessments—by group
  - New course evaluation forms
- Levels include:
    - Level 1: REACTION
      - Customer Satisfaction
    - Level 2: LEARNING
      - Increased knowledge or skill
    - Level 3: BEHAVIOR
      - Application
    - Level 4: RESULTS
      - Impact
    - Level 5: Return on Investment

<sup>1</sup>Training Evaluation methods based on formal work by Phillips, Kirkpatrick

# Evolving Measures

- What did you apply? Impact?
  - ...**achieved A2LA accreditation....**
  - ...**revising our quality manual...**
  - ...**helped locate some problem areas in the lab.**
  - ...**used to throw away glass thermometers ...**
  - ...**Make my assessment more presentable to my leadership....**
  - ...**New control charts are easier to understand and record data on....**
- Barriers that prevented implementation?
  - #1 response: TIME
    - ...**don't allow sufficient time....**
    - **Identified large steps we have to make [for accreditation] before we begin...**

# NRC – NIST Post Doctoral Opportunity

- **Methods and Trends in Measurement and Standards Education**

1. Conduct and report on needs assessments among government and industries who hire graduating students to determine if their application needs are being met by students of measurement and standards programs;
2. Assessment and determination of the effectiveness of current programs in metrology and standards that could direct future investment priorities in effective courses/curricula;
3. Compilation and assessment of investment priorities of other government agencies in the educational pipeline and workforce development related to measurements and standards;
4. Study of other similar/related programmatic efforts or combination of the previous proposed concepts;
5. Assessment of curriculum across the US in community colleges and universities for content specific to measurement sciences (metrology) and standards, whether individual courses, portions of a course, or an entire curriculum; and
6. Comparison of curricula from established metrology and standards programs to develop “best practice curricula” to be implemented in other colleges/universities.

# Thank You!

For more information:

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