NEXT GENERATION
Science Education
Standards and Assessments

Glancing at the Present…
Gazing Into the Future

Connecticut Assessment Forum
August 16, 2011
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Session Topics

› Development of new national science standards
› Implications for CT standards and assessments
› Current state science assessments
› Discussion –
  ◦ Next generation science assessment: Where do we go from here?
Why New Science Standards?

- Lessons learned since NSES and AAAS;
- New research on how students learn science;
- International benchmarking & leadership;
- RTTT pressure toward common standards and assessments;
- Common Core State Standards in ELA and Mathematics

Current National Standards: What Happened?

- States “cherry-picked” to write their own standards
- Result: a national hodge-podge of varied rigor and clarity
- Varied treatment of “politicized” issues
- Too much content to be learned
- Inquiry widely interpreted; separated from content
- Bottom line: inconsistency and limited improvement in 15 years
Standards Development Process

› Stage 1: National Research Council develops a K–12 Framework.  **Released 7–18–11**
› Stage 2: Achieve Inc. coordinates standards writing;  **Completion late 2012?**
› NOT called “Common Core”
  ◦ Standards written first; states choose to adopt
› NRC web site – **http://nas.edu/BOSE**
› NRC Framework download: **http://www.nap.edu/catalog.php?record_id=13165**

Framework for K–12 Science Education

- Published July 18, 2011 by National Research Council (branch of National Academy of Science)
- Imperative to “get the science right”
- Written by committees of expert scientists, science educators, cognitive scientists
- Bundle best pieces of earlier standards projects
- Addresses only *content* standards (NSES lives on)
- Framework is NOT the standards or a curriculum
- Establishes guidelines for state-led initiative to write standards
- NRC web site - **http://nas.edu/BOSE**
New Features in Framework

- Science AND engineering “practices” unwrapped; unwraps “scientific inquiry”
- Engineering, Technology and Applications of Science as a 4th core disciplinary area
- *Learning progressions* trace coherent development of core ideas across grades
- *Performance Expectations* as evidence of learning
- Renewed emphasis: practices are used to deepen understanding of core ideas and crosscutting themes

Framework Organization

- Part I: A Vision for K-12 Science Education
- Part II: 3 Dimensions
  - Scientific and Engineering Practices
  - Core Disciplinary Ideas
  - Crosscutting Themes
- Part III: Realizing the Vision
  - Aligning policies, standards, curriculum, instruction, assessments, teacher prep and prof development
**Scientific & Engineering Practices**

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and information and computer technology
6. Developing explanations and designing solutions
7. Engaging in argument
8. Obtaining, evaluating, and communicating information

Turn & Talk: Which practices will require further explanation?

**Core Disciplinary Ideas**

Physical Sciences
- Matter & its Interactions
- Motion & Stability: Forces & Interactions
- Energy
- Waves & Their Applications in Technologies for Info Transfer

Life Sciences
- Structures & Processes
- Ecosystems: Interactions, Energy & Dynamics
- Heredity: Inheritance of Traits
- Biological Evolution

Earth & Space Sciences
- Earth’s Place in the Universe
- Earth’s Systems
- Earth & Human Activity

Engineering, Technology & Applications of Science
- Engineering Design
- Links Among Engineering, Technology, Science and Society
Crosscutting Concepts

**NSES Unifying Themes**
- Systems, order, and organization.
- Evidence, models, and explanation.
- Change, constancy, and measurement.
- Evolution and equilibrium.
- Form and function.

**AAAS Common Themes**
- Systems
- Models
- Constancy and change
- Scale

**NRC Framework**
- Patterns
- Cause/Effect
- Scale, Proportion, Quantity
- Systems & system models
- Energy & matter
- Structure & function
- Stability & change

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**CT vs. NRC Frameworks**

<table>
<thead>
<tr>
<th>Framework</th>
<th>CORE CONCEPTS</th>
<th>BIG IDEAS</th>
<th>DOING SCIENCE</th>
<th>PERFORMANCE EXPECTATIONS</th>
<th>GRADE SPECIFICITY</th>
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</thead>
<tbody>
<tr>
<td>2004 CT Framework</td>
<td>Content Standards in life, physical &amp; earth sciences integrated with STS</td>
<td>11 conceptual themes</td>
<td>Scientific Inquiry, Literacy and Numeracy (INQs)</td>
<td>GLEs and CMT/CAPT Expected Performances</td>
<td>PK-8: Grade-by-grade</td>
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<td>Integrated approach PK-10</td>
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<td>Gr 9–10: Gradespan</td>
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<td></td>
<td>Revisited each gradespan at progressively greater depth</td>
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<tr>
<td>2011 NRC Framework</td>
<td>13 disciplinary ideas</td>
<td>7 crossingcutting concepts</td>
<td>Scientific &amp; Engineering Practices</td>
<td>Examples</td>
<td>Grade Band Endpoints (Gr. 2, 5, 8, 12)</td>
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<tr>
<td>2012 Next Generation Science Standards</td>
<td>TBD–content standards</td>
<td>Integrated with content and practices</td>
<td>TDB–explicit expectations for science AND engineering integrated with content and theme</td>
<td>Yes</td>
<td>TBD</td>
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Next Generation Science Standards: Who Is Doing the Work?

Coordinated by Achieve; internationally benchmarked

STRATEGIC DIRECTION GROUP:
- Carnegie Corporation, Achieve, NSTA, NAS, AAAS

WRITING TEAMS: 32 writers (notable teachers and scientists) nominated or recommended

LEAD PARTNER STATES to provide guidance and develop plans for adoption, transition and implementation (6 to be selected by application)

CRITICAL STAKEHOLDER TEAM: industry, College Board, science ed leaders from every state

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Standards Development Process

- 1st draft ready by December 2011?
- PROJECTED COMPLETION LATE 2012
- Feedback Opportunities
  - 1st draft review open only to State Education Agencies and Council of State Science Supervisors
  - 2nd and 3rd draft reviews online by states, organizations and general public
- Feedback will be published
- CSDE will recruit an advisory committee to participate in 3 draft reviews; also CS3 and SCASS reviews
- Districts, schools and individuals can provide feedback independently
Too early to revise district science curriculum; wait until NGSS published in late 2012;
- 2004 Framework, GLCs and GLEs in effect until at least 2013;
- CMT and CAPT Science assessments unchanged until 2015;
- **2013**: CT may adopt Next Gen Sci Stds
- **2014–15**: first administration of new ELA and Math assessments (SBAC Consortium – Common Core Stds)
- **2013–15**: Development of new assessments based on Next Gen Sci Stds (consortium-developed or state-developed?)

**Discussion and Survey**

DISCUSS what you like, dislike or have concerns about in the NRC Framework and the Next Gen Standards coming next year.

RESPOND:
- Are you apprehensive about the prospect of adopting new science standards?
- Do you agree that engineering standards should be included as part of K–12 science?
- At this time, do you believe CT should adopt Next Gen science standards in 2013?
SCIENCE in Connecticut’s Common Core Standards for ELA and Mathematics


- Part of CT Common Core Stds for ELA Gr.6–12
- Reading and writing in the content areas (not science standards)
- All teachers are teachers of literacy skills and strategies
- Will be tested in 2014–15
- H–S–T teachers: get to know them now!
Integrating WRITING in Science

- Grade 5: “Write informative/explanatory texts to examine a topic and convey ideas and information clearly.”
- Grade 6: “Write arguments to support claims with clear reasons and relevant evidence.”
- Grade 8: “Produce clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience.”

Integrating READING in Science

- Grade 1: “Know and use various text features (e.g., headings, tables of contents, glossaries, electronic menus, icons) to locate key facts or information in a text.”
- Grade 4: “Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.”
- Gr. 6–8: “Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.”
Gr. 2: “Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.”

Gr. 6: “Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread and overall shape.”

CMT and CAPT Science

Past, Present and Future
Background and Purpose

- 1985 Educational Enhancement Act
- Summative assessments; criterion-referenced
- Purpose: periodic checkpoints of student progress
- CMT designed to assess “mastery” of material after multiple years of instruction
- CAPT designed to assess “academic achievement” after multiple years of instruction
- NOT designed to inform timely instructional decisions, diagnose learning difficulties or evaluate teacher quality

CMT and CAPT Science Snapshot

- Based on Expected Performances in 2004 Science Framework and Curriculum-embedded tasks
- Cumulative tests administered in March:
  - Elementary Science CMT (assesses Gr. 3–5 at Gr.5);
  - Middle School Science CMT (assesses Gr. 6–8 at Gr.8)
  - High School Science CAPT (assesses Gr. 9–10 at Gr.10)
- Assess content knowledge and scientific inquiry, literacy, and numeracy (50/50)
- Not currently part of AYP accountability
CMT and CAPT Science Curriculum–Embedded Performance Tasks

- Inquiry–based extended investigations; open–ended (no single correct outcome)
- Instructional materials; not tests
- Model interdisciplinary lessons that can be modified
- Task “scenarios” are referenced in CMT/CAPT questions that assess INQUIRY (not the task)

CMT/CAPT Question Types

- Multiple choice and short written responses
- Depth of knowledge assessed:
  - basic factual knowledge
  - conceptual understanding
  - application of knowledge & skills
- INQUIRY is assessed, in part, by questions related to curriculum–embedded task contexts
- No hands–on task on the testing day
Score Reporting

- Raw scores, scale scores and strand scores
- Elementary and Middle Grades CMTs:
  - Content knowledge
  - Scientific Inquiry, Literacy and Numeracy
  - Physical
  - Life
  - Earth
- CAPT:
  - Conceptual Understanding
  - Scientific Inquiry, Literacy and Numeracy
  - Energy Transformation
  - Chemical Structures and Properties
  - Global Interdependence
  - Cell Chemistry and Biotechnology
  - Genetics, Evolution and Biodiversity

Released Items

- CSDE policy and rationale
- Released item access (CAPT only)
- Sample item types in CMT/CAPT Handbook
Science Assessment Resources

www.sde.ct.gov (click on Teaching & Learning/Science)
- 2004 CT Framework Expected Performances – knowledge and skills tested on CMT and CAPT Science
- 2010 K–8 Curriculum Standards (GLCs and GLEs)
- Curriculum–Embedded Tasks & Teacher Manuals – inquiry pedagogy and sample task-related CMT questions
- CMT and CAPT Science Assessment Handbook – test blueprints, standards, effective teaching strategies, sample items, vocabulary lists
- Item Banks for making diagnostic and practice tests:
  - NAEP Questions Tool www.nces.ed.gov/nationsreportcard/ITMRLS
  - TIMSS Released Items http://nces.ed.gov/timss/educators.asp
  - Performance Assessment Links in Science http://pals.sri.com/
  - SCASS Item Bank: http://sciencescass.org, User: ctsci, Passwd: 5ct6mb
  - AAAS Item Bank: http://assessment.aas.org/topics (Gr.6–12)

NAEP Interactive Computer Tasks

1) **Information Search and Analysis**: Pose a scientific problem and ask students to query an information database and analyze relevant data to address the problem.

2) **Empirical Investigation**: place hands–on performance tasks on the computer and invite students to design and conduct a study to draw conclusions about a problem.

3) **Simulation**: model systems (e.g., food webs) and ask students to manipulate variables, and predict and explain results changes in the system.

4) **Concept Maps**: probe aspects of the structure or organization of students’ scientific knowledge by providing concept terms and having students create a logical graphic organizer.
Future of Science Assessment in CT

Future unclear...many unknowns:
1. CT develops its own statewide assessment (i.e., next generation of CMT and CAPT Science).
2. Utilize science assessments made available by testing contractors.
3. Join existing (i.e., NECAP) or newly-formed consortium (e.g., SBAC Science?).
4. End-of-course tests instead of CAPT?

*Outcomes depend on federal and state legislation and budgets; as well as public opinion.*

*Make your voices heard!*

Current State Science Assessment System: Room to Improve?

- Tests administered in March – 3 months too early?
- Scores not reported until July
- Reports not specific enough to inform curriculum
- Scores not reported by content standard
- Data too late to inform instruction
- Items and stats not released
- Cumulative test with limited number of items per standard
- Other concerns?
Opinion Survey

How could our current state science assessment system be improved to yield more useful info about student learning?

1. Should we add voluntary end-of-grade assessments to our system?
2. Should we add performance tasks (real or virtual) to the test?
3. Should curriculum-embedded tasks be separated from CMT/CAPT; just offered as sample lessons?
4. Should locally-scored student work factor into state accountability?
5. Should science count equally with reading and math tests when ESEA is reauthorized?

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