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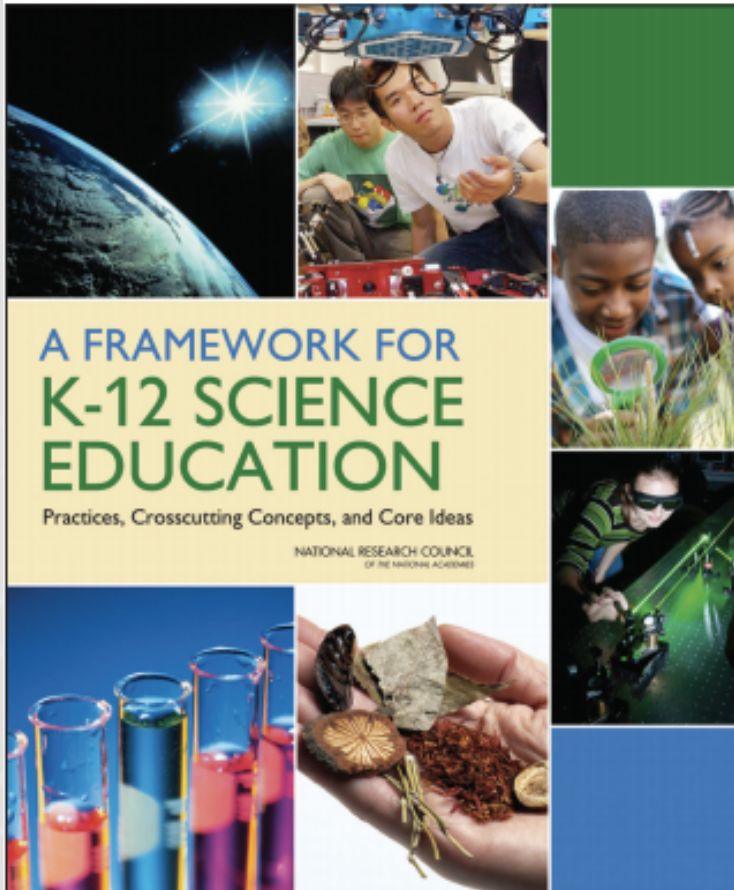
Research-Based Models for Professional Development

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NSF

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Framing Our Challenge

"Alignment of teacher preparation and professional development with the vision of science education advanced in this framework is essential for eventual widespread implementation of the type of instruction that will be needed for students to achieve the standards based on it." (NRC, 2012, p. 256)
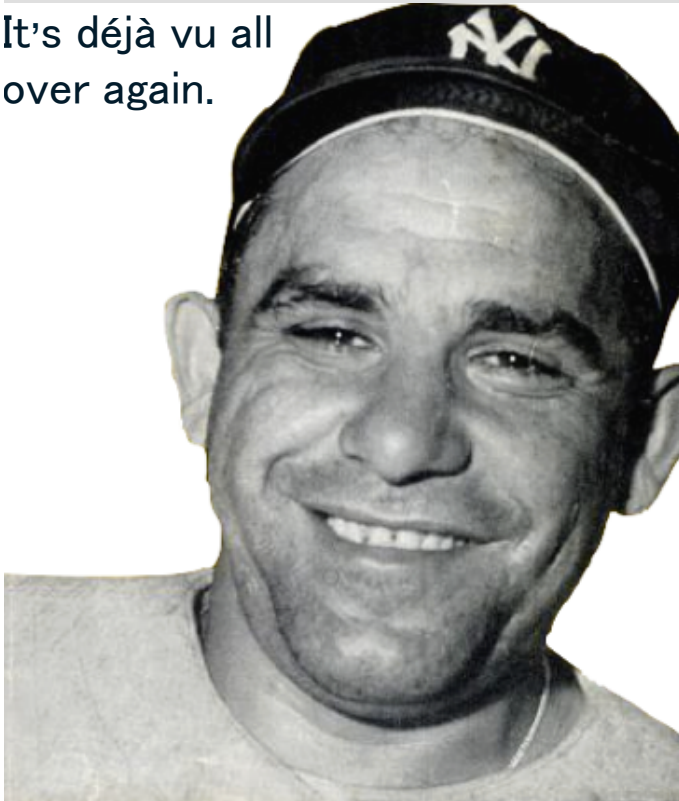
We've Been Here Before…

It's déjà vu all over again.

- We understand that major shifts in teaching require professional development for teachers, instructional coaches, and school and district leaders.

- We understand that teacher preparation programs will need to strengthen and align their focus on a new vision for student learning.

…You Can't Step into the Same River Twice

- The shifts we are asking teachers to make are from inquiry to 3D science learning.

- The landscape of teacher preparation, induction, and retention is different.

- Large public investments in new science curriculum and assessments are unlikely in the near future.

- Our student population is becoming ever more diverse.

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Take Home

- Since 1996, we've learned a lot from research about professional development in science from well-designed studies.

- We will all need to **be creative** in how we apply that research to design, implement, and sustain professional development in the *Framework*.

- Professional development is a key strategy for **promoting equity.**

Resources

http://learndbir.org/bundles/ bcsse-denver-june-2014

Supporting Teaching Shifts

First Generation Standards Teacher Development Research	Potential Application for Teacher Development in the Framework
Focus on science content.	Provide teachers with opportunities to analyze the *Framework* disciplinary core ideas, practices, and crosscutting concepts.
Develop content knowledge by helping teachers anticipate and make productive use of students' everyday ideas, even ones that are problematic.	Devise strategies to find out about students' interests and everyday practices. Ask teachers to look at student work (not charts of data) together to identify different kinds of learning needs.

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Connecting to students' interests and experiences

Supporting Teaching Shifts

Developing Evidence Statements for DCIs, Practices, and Crosscutting Concepts

- Provides an opportunity for teachers to discuss and make sense of shifts in the *Framework*
- Highlights differences and provides opportunities for developing shared meanings in a teacher community

3. Identify the evidence that you would expect to see for each component of the practice. **Questions to think about:** *What is a high level of performance that you would expect to see for each component?* *What are the different levels of performance for each component?*	**Evidence for each Component of the Practice**

Supporting Teaching Shifts

Unpacking DCIs, Practices, and Crosscutting Concepts

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3. Identify the evidence that you would expect to see for each component of the practice.

Questions to think about:

What is a high level of performance that you would expect to see for each component?

What are the different levels of performance for each component?

Complex Systems in Education:
Scientific and Educational Importance
and Implications for the Learning
Sciences

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The multidisciplinary study of complex systems in the physical and social sciences over the past quarter of a century has led to the articulation of important new conceptual perspectives and methodologies that are of value both to researchers in these fields as well as to professionals, policymakers, and citizens who must deal with challenging social and global problems in the 21st century. The main goals of this article are to (a) argue for the importance of learning these ideas at the precollege and college levels; (b) discuss the significant challenges inherent in learning complex systems knowledge from the standpoint of learning sciences theory and research; (c) discuss the "learnability issue" of complex systems conceptual perspectives and re-

Research on learning is relevant to activity of unpacking.

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Supporting Teaching Shifts

Micros & Me: Exploring personally consequential biology

- Use technique of photo-elicitation to bring young people's everyday practices into the classroom: *What do you do to stay healthy and protect yourself from disease?*

- Students' responses become basis for their own questions in the unit

Preparation, Induction, & Retention

First Generation Standards Teacher Development Research	Potential Application for Teacher Development in the Framework
Focus on science content.	Place strong emphasis on undergraduate research opportunities and internships in science.
Focus on "high-leverage practices" for teachers to help new teachers build a strong foundation for their teaching practice.	Link practices like setting classroom norms and orchestration of classroom talk to specific science practices.
Provide regular constructive feedback on teaching from observations to build relationship between principal and teacher.	Support principals with maps that show links between teacher evaluation schemes (e.g., Danielson Framework) and *Framework-aligned* teaching.

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Promoting Equity, Science is a Social Enterprise

Preparation, Induction, & Retention

Contingent Pedagogies:
Supporting a "high-leverage practice" (orchestrating discussion) in science

- Anchored in specific disciplinary core ideas

- Supports practice of argumentation with evidence

- Provides additional resources for teaching that engage students in developing and using models

Investigation 5:	Reflect and Revise
Erosional Landforms	Question 5.2

Goal Facet

The force of gravity acts to pull Earth's rocks and particles to the lowest surface possible. Material tends to accumulate where the land is flatter.

Pose the Question

How do valleys form? Be prepared to discuss evidence from the investigation that supports your conclusion.

   a. The action of gravity moves water and sediment down hill.

   b. Water causes the land around streams to sink.

   c. Volcanoes push up nearby rocks to make mountains, leaving valleys in between.

Spark Discussion

What evidence from the investigation supports conclusion [a, b, or c] about how valleys form?

Discussion Moves for Reflect and Revise Questions

To prompt student questioning

Identifying confusion	After thinking about this question and listening to your classmates, what still confuses you about…?
Inviting further investigation	If we were to conduct another investigation on this topic, what question would you most like to answer?

To invite students to explain their thinking and reasoning

Eliciting prior experience	What have you experienced or read about that might lead you to conclude…? What does [topic/process] make you think of that you understand pretty well?
Eliciting reasoning	Why might response [a, b, c, d] make sense to someone? How do you know that…? Can you say more about what you know or have observed in the investigation that leads to you to conclude that…? Do you think [response a, b, c, or d] is *always* true? How might we find out?

To encourage the class to take responsibility for advancing understanding

Adding on	Can anyone add to this idea?
Weighing perspectives	Who would like to argue against the idea that…? Let's start our responses to _____'s idea by saying, "I agree because" or "I disagree because".

Preparation, Induction, & Retention

- Efficacy Study of PBIS Curriculum: Large-scale study of a middle-school science curriculum that included PD in *Framework* and *NGSS*
  - State implemented new framework for teacher evaluation during the study
  - Study team provided teachers and principals with a "look-fors" document highlighting connections between *Framework*-aligned teaching and the state framework for observation

Curriculum and Assessment Design

First Generation Standards Teacher Development Research	Potential Application for Teacher Development in the Framework
The process of designing and adapting curriculum materials—when supported by subject matter and curriculum experts—can be a powerful form of professional development.	Design curriculum adaptation activities to build in support for teacher learning about the *Framework* and instructional models congruent with NGSS.
Formative assessment can be an effective focus of professional development when it helps teachers elicit, interpret, and make use of information about student thinking.	Support teachers in analyzing assessments for evidence of development of student thinking over time.

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Curriculum and Assessment Design

- iHub: A long-term partnership of Denver Public Schools, UCAR, CU Boulder, and BSCS
  - We work on district challenges together, applying what we know from research to develop solutions collaboratively.

Unit Driving Question: *How will an increase in the population of trees affect ecosystems in Denver?*

Phenomenon: Many cities are encouraging citizens to plant trees.

Phenomenon/Question	Engage in Practices	What Students Can Explain
Why should I care about trees?	Using mathematics and computational thinking to analyze cases of what happens when trees are removed from an ecosystem (e.g., fire, disease)	Can explain how changes in tree cover affect living and nonliving elements of an ecosystem
How do trees affect the air we breathe?	Developing and using models of the role of photosynthesis in carbon sequestering	Can explain how trees figure in the cycling of carbon in atmosphere
How many trees can we grow in Denver?	Planning and conducting investigations to develop accounts of resource needs, competition, and limiting factors on tree growth	Can explain how availability of resources and competition affect carrying capacity
What kinds of trees would provide the most benefit to the ecosystem?	Engaging in argument from evidence about species characteristics to advocate for the best type of tree is best to plant in a particular ecosystem	Can explain trade-offs in benefits of planting particular species to different organisms

Curriculum and Assessment Design

Daphne Project: Focus on using learning progressions to design, implement, and analyze data from assessments
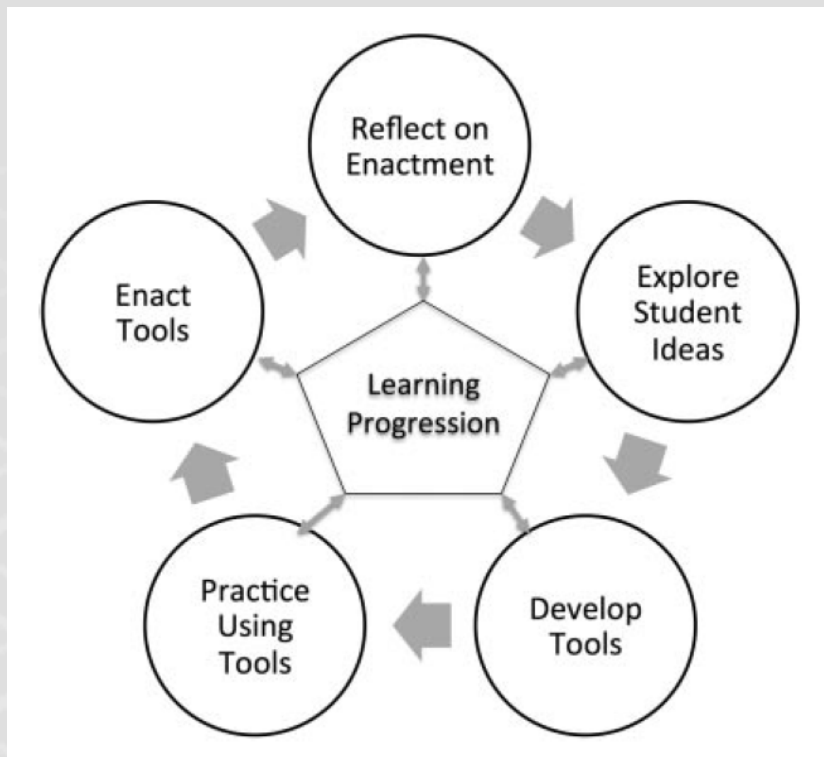
Key Findings

- Teachers in one school used the project as an opportunity to bring previously disparate units into sync, and to develop and enact a common sequence of formative assessments within their unit

- Teachers in another made limited use of the project tools, because they were not congruent with existing accountability requirements.

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Crafting Coherence Among States

- There are many professional development providers across the states, operating largely independently of one another.
- An updated set of *professional learning standards for science education* can provide:
  - Foundation for a network of professional development activities to emerge that aligns with the vision of the *Framework*
  - Guidance to providers, educational leaders, and teachers regarding professional development.

Professional Learning Framework

- An initiative of the Council of State Science Supervisors' Professional Learning Committee
- Charge of Committee:
  - to identify professional learning needs of CSSS members and coordinating professional learning activities that addresses these needs
  - to provide information to CSSS members on best professional development models being used throughout the country
  - to open lines of communication between in-service and pre-service providers and CSSS state members.
- Committee is state-led, includes research support

Professional Learning Framework

- In an *early draft* form seeking your input on:
  - Need
  - Content
  - Models
- Organization
  - Focus of Professional Learning
  - Design and Implementation of Professional Learning
  - Evaluate and Sustain Professional Learning
  - Guidance for Teachers and Policymakers

Table Talk

Table Talk Questions Related to Professional Development
Choose <u>one or two questions</u> from this worksheet to discuss in depth with people at your table. We'd like to collect this page back with your response(s) to questions so we can improve and expand the Professional Development Standards document.

Motivating the Need for PD Standards
With respect to the *Framework*, what are the most pressing learning needs of:

teachers?

Thank You

Contact

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http://learndbir.org/bundles/bcsse-denver-june-2014

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