

# Lessons learned: How to Bring About Change in Learning

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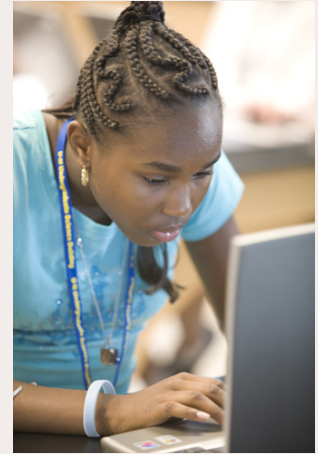


# What will we do today?

- Describe the current state of learning
- Explain four productive steps forward
  - Big Ideas
  - Learning progressions
  - Learning performances
  - Long term professional development
- Concluding comments

# Student learning

- Research shows that students:
  - Demonstrate little understanding of the of ideas critical for success
  - Lack interdisciplinary connections among the these ideas
  - Fail to apply ideas to explain phenomena and solve problems
  - Do not engage in scientific habits of mind
  - Lack motivation to pursue further study



# Why aren't we succeeding??

## Inadequacies of Teaching Materials

- Cover many topics superficially
- Focus on technical vocabulary
- Fail to consider students' prior knowledge
- Lack coherent explanations of real-world phenomena,
- Provide students with few opportunities to develop explanations
- Focus on discrete ideas

Inadequacies of appropriate, longer term professional development

Lack of appropriate resources

# Productive Steps Forward

- Design new curriculum that
  - Focuses on big ideas
  - Builds understanding of the big ideas over time
  - Engages students in scientific practices
  - Anchors instruction and student tasks in problems of interest
- Offer sustained professional development
- Provide necessary resources
- Develop aligned assessments
- Build partnerships between practicing teachers, scientists and science educators

# Why Focus on Big Ideas?

- Big ideas provide a framework for long-term development.
- The big idea can be revisited throughout K-12 schooling, so that knowledge becomes progressively more refined and elaborated.



# Criteria for “Big Ideas”

1. Helps learners to understand a variety of different ideas within and between disciplines.
2. Provides insight into the development of the field, or has had a key influence on the domain.
3. Accessible to learners through their cognitive abilities (age-appropriateness) and experiences.
4. Builds the foundation for continual learning.
5. Allows individuals to participate intellectually in making individual, social, environmental and political decisions.

# *Big ideas in Science*

*Structure-Function*

*Energy*

*Ecology/Interrelationships*

*Particulate Theory  
Of Matter*

*Laws of  
Conservation*

*Geologic Processes*

*Constructing  
explanations*

*Force and  
motion*

*Use of  
Evidence*

*Evolution/  
Natural Selection*

# Building Students' Ideas over Time: Learning Progression

- The soccer analogy



# LEARNING PROGRESSIONS: Assumptions

- Scientists and other professionals structure their knowledge around conceptual frameworks.
  - Guide how they solve problems, make observations, and organize and structure new information.
- Learning unfolds as a continuous process.
  - Learning does not occur in linear, discrete steps
- Learning difficult ideas takes time and often comes together as students work on a task that forces them to synthesize ideas.
- Therefore, learning is facilitated when new and existing knowledge is structured around the big ideas.
  - Not around small, discrete bits of information.

# Developing Competence Overtime

- **Learning progressions:**
  - A sequence of successively more complex ways of thinking about a practice or about content that develop over time
  - Consider how ideas build upon each other to form more complex practices or ideas
  - Are not developmentally inevitable. Rather instructional sequences support greater student understanding

# Development of Scientific Practices: What Typically Happens

	<i>Physics</i>	<i>Chem</i>	<i>Earth Science</i>	<i>Life Science</i>
<i>6th</i>				
<i>7th</i>				
<i>8th</i>				
<i>Student Understanding</i>	<b>Little understanding</b>			

# Development of Scientific Practices: Over Time

	<i>Physics</i>	<i>Chem</i>	<i>Earth Science</i>	<i>Life Science</i>
<i>6th</i>	<i>Explanation</i>	<i>Explanation</i>	<i>Explanation</i>	<i>Explanation</i>
<i>7th</i>				
<i>8th</i>				
<i>Student Understanding</i>				

# Development of Ideas: What typically happens

	<i>Physics</i>	<i>Chem</i>	<i>Earth Science</i>	<i>Life Science</i>
<i>6th</i>				
<i>7th</i>	<i>energy</i>			
<i>8th</i>				
<i>Student Understanding</i>	<b>Little understanding</b>			

# Development of Big Ideas: Over Time

	<i>Physics</i>	<i>Chem</i>	<i>Earth Science</i>	<i>Life Science</i>
<i>6th</i>			energy	
<i>7th</i>	energy	energy	energy	energy
<i>8th</i>		energy		
<i>Student Understanding</i>	<b>Deep and Meaningful</b>			

# Curriculum Coherence

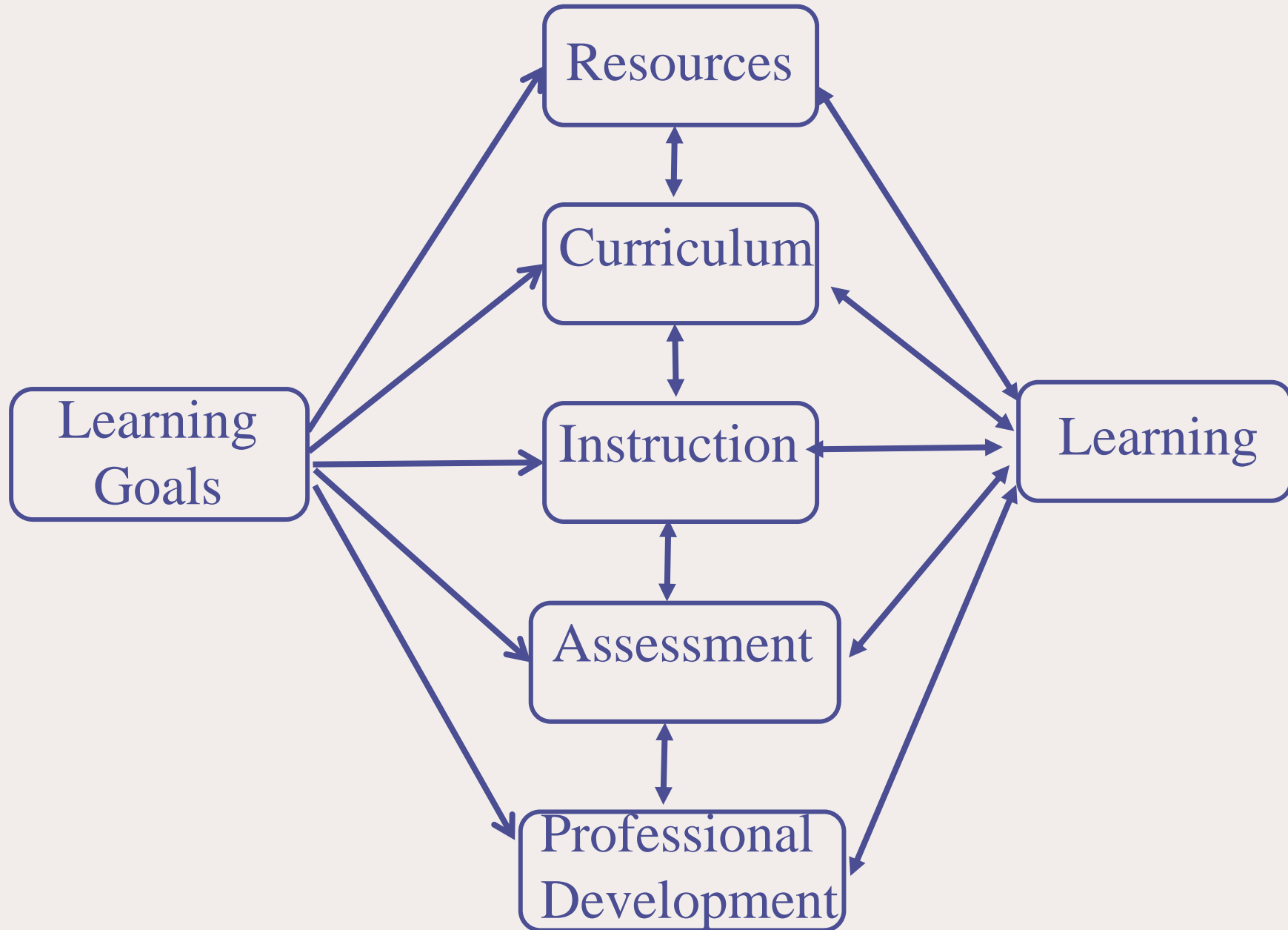
The alignment of the specified topic, the depth at which the topic is to be studied, and the sequencing of the topics within each grade and across the grades (Schmidt, Wang & McKnight, 2005)

Curriculum coherence should lead to integrated understanding in learners.

# Three Types of Curriculum Coherence (Shwartz, et al. 2008)

- Learning goal coherence: selecting key learning goals that build on each other
- Intra-unit coherence: coordination between content learning goals, scientific practices, and curricular activities within a project-based unit
- Inter-unit coherence: coordination among project-based units that support multidisciplinary connections.

# Why Learning Goals are Important!



# Creating Learning Performances

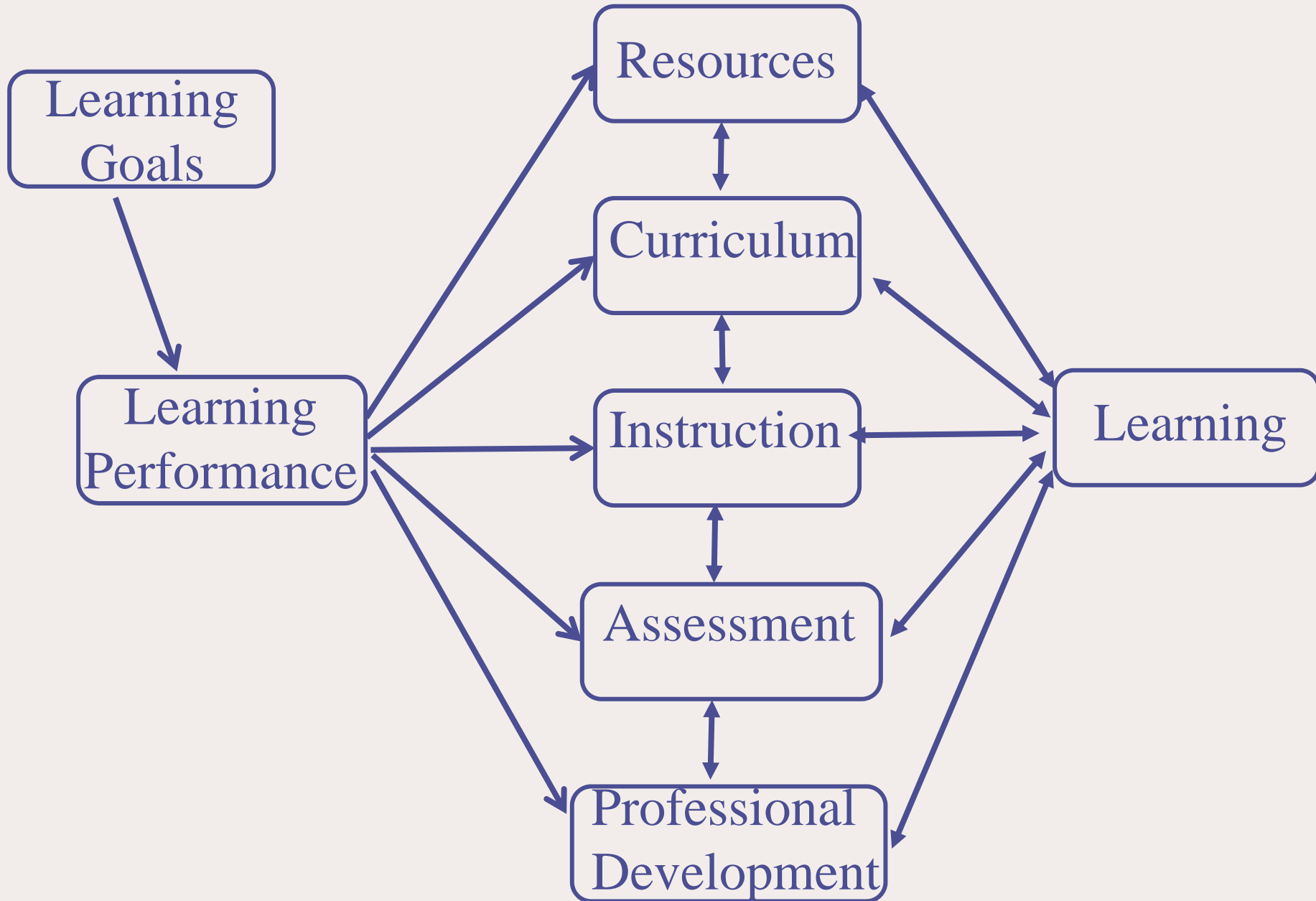
- What are Learning performances?
  - Learning performances define, in cognitive terms, what it means for learners to “understand” a particular idea
  - Learning performances define how the knowledge is used in reasoning about questions and phenomena
- Why Learning Performances
  - Know or understand is too vague
  - Performances require learners to use the ideas.
- Use terms that describe the performance you want students to learn and be able to do.
  - Identify, Define, Analyze and Interpret data, Explain, Build Model, Design an investigation, ...
  - Not “know” or “understand”

# Developing Learning Performances



Content	Practice	Learning Performance
<i><b>BSL 4D/M3:</b> Atoms and molecules are perpetually in motion. In gases, the atoms or molecules have still more energy and are free of one another except during occasional collisions.</i>	Models are often used to think about processes that happen... too quickly, or on too small a scale to observe directly... (AAAS, 1993, 11B: 1, 6-8)	Students create models of a gas at the molecular level showing how the gas takes the shape of its container.

# Why Learning Goals are Important!



# Create Meaningful Learning Environments



- Use driving questions that learners find meaningful
- Use Anchoring Experience
  - Experience Phenomena in Context
  - Case Studies
- Engage in Professional Activities
  - Problems based in field
  - Present various disciplines as we know them today

# Teachers Face Challenges in Using Reform-based Curriculum

- New models of practice!
- New Pedagogical strategies
- New forms of content knowledge and PCK
- New Teaching Practices
- Appropriate infrastructure and resources



# Teacher Professional Development

- To learn how to enact and adapt inquiry-oriented, learning goals centered curricula
- To understand how learning theory forms the basis of the curriculum & technology
- To actively participate in the evaluation and adaptation of curriculum

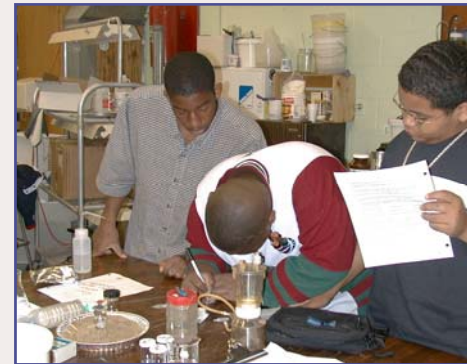


# Our Approach to Professional Development

- Provide sustained, long term PD
- Focus on practice-based features that teachers
  - find challenging,
  - revisit throughout the year
  - find essential to enacting instruction in a manner consistent with the intent of the materials.
- Use model teaching as an approach
- Allow teachers to adapt materials to local conditions
- Focus on student learning outcomes

# Concluding Comment

- To Promote Learning
  - Focus on “Big Ideas”
    - Less is more
  - Develop learning performances
  - Build learning over time
    - Learning takes time
    - Build multi-year sequences that build on each other
  - Provide long term professional development



# Thanks to many

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- Comments and Questions
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