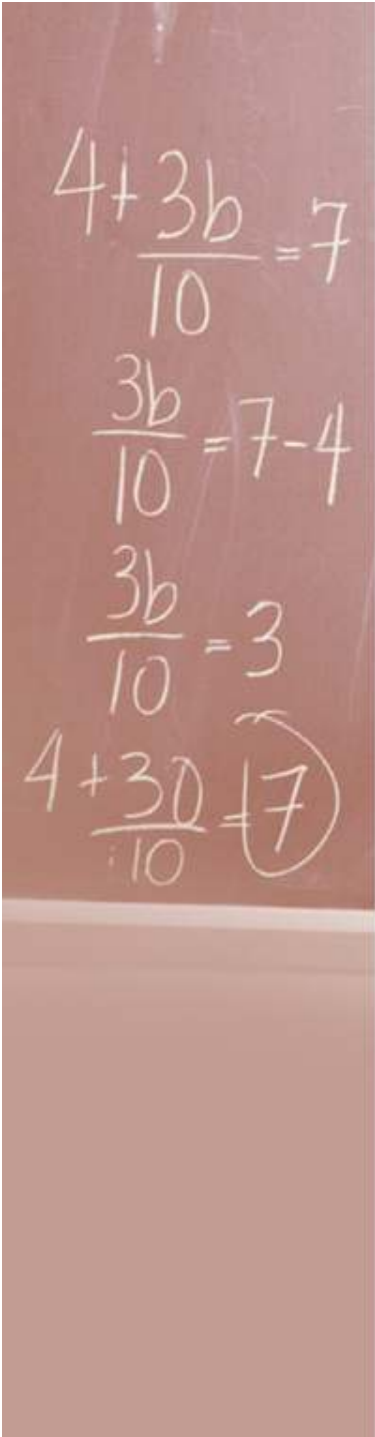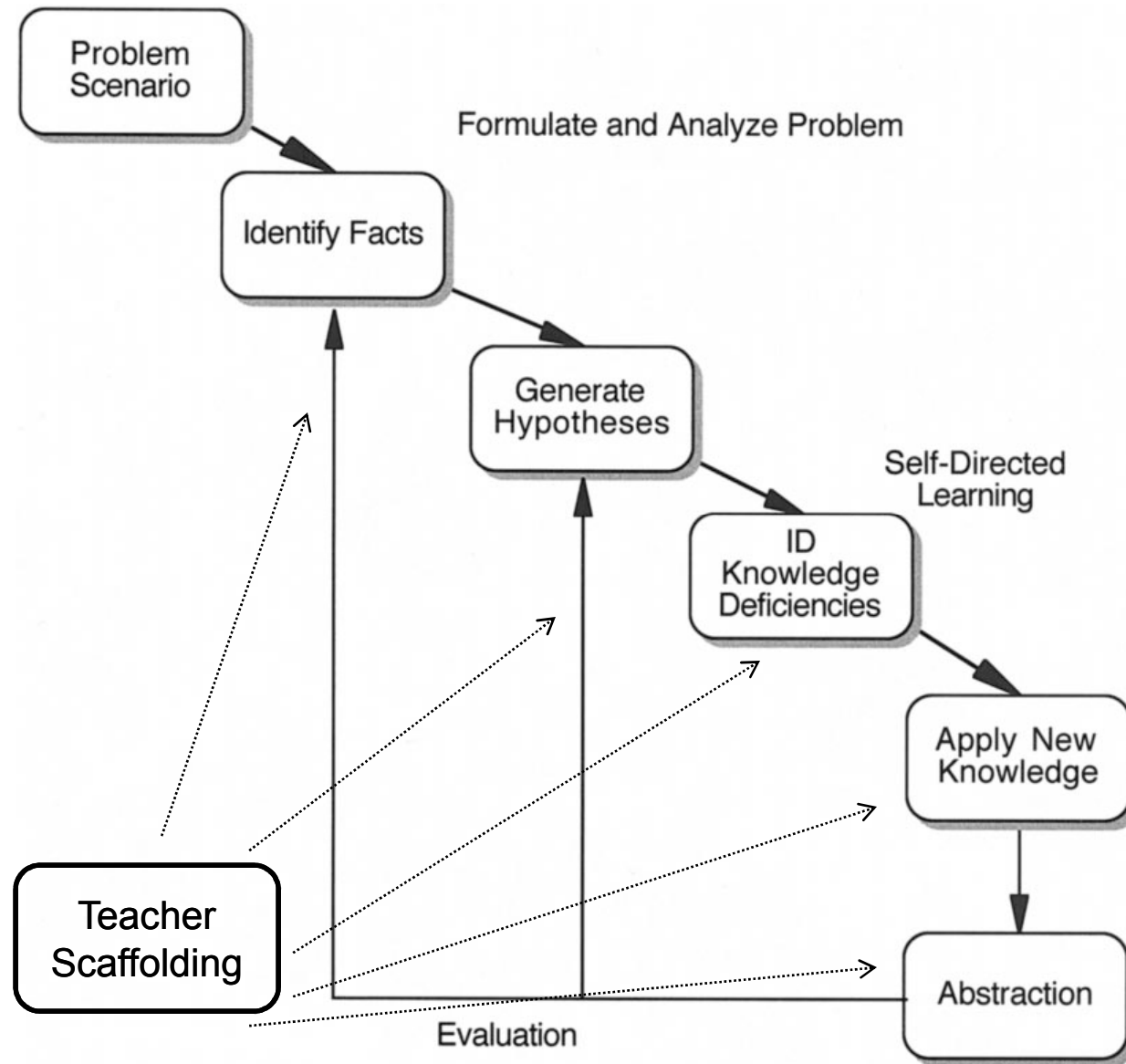# Encouraging Reasoning and Sense-Making with Problem-Based Learning

Carmel Schettino
NCTM High School Institute, Orlando FL

What is Problem-Based Learning?

- instructional approach of curriculum and pedagogy

- student learning and content material is constructed and co-constructed

- use, facilitation and experience of mostly contextual problems in a decompartmentalized, threaded topic format

- discussion-based, student-centered classroom

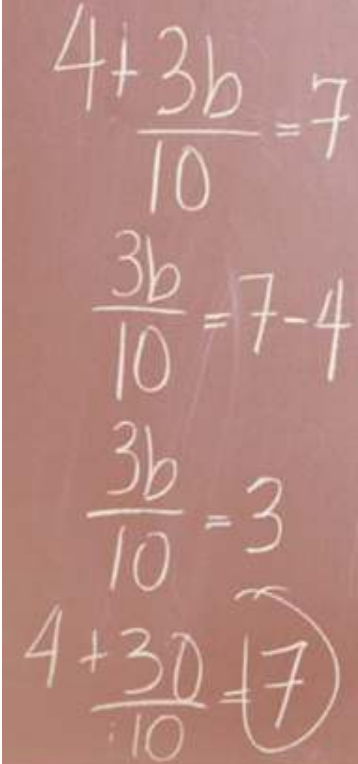- student voice, experience, and prior knowledge are valued in construction of new knowledge

Schettino, (2010)

How Do Students Learn with PBL?

Problem Scenario

Formulate and Analyze Problem

Identify Facts

Generate Hypotheses

ID Knowledge Deficiencies

Self-Directed Learning

Apply New Knowledge

Abstraction

Evaluation

Teacher Scaffolding

Hmelo-Silver, C.(2004). Problem-Based Learning: What and how do students learn? *Educational Psychology Review* ,16 (3), 235-266.

Problem-Based vs. Project-Based

- What's the difference?

- Direct Instruction vs. Student Constructed Learning

- Reasoning and Sense-Making of Curriculum and Content

- Buck Institute, New Tech Foundation, Illinois Math Science Academy PBL network, SIMMS, Phillips Exeter Academy
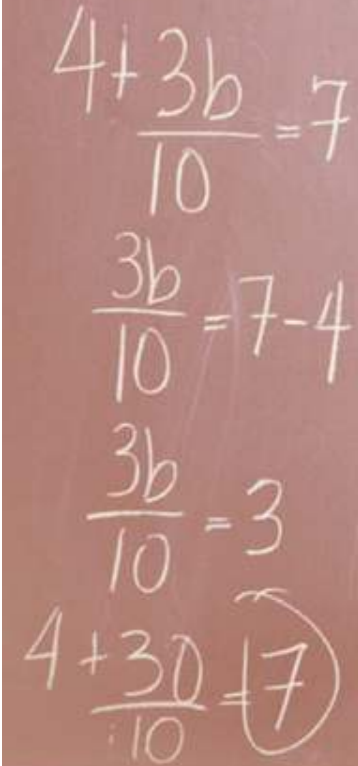
Where do you get problems?

- Problems need to
  - **motivate discussion**
  - **Create interest in the idea**
  - **Connect to prior knowledge**
  - **Inspire thinking**
  - **Allow for open communication & student presentation of ideas**
  - **Scaffold construction of new knowledge**
- Exeter Course Materials at http://www.exeter.edu/academics/72_6539.aspx
- AERA Special Interest Group for PBL

  at http://tinyurl.com/aerasigpbl
- NCTM publications

# Common Core Standards for Mathematical Practice & PBL

- Make sense of problems and persevere in solving them.

- Reason abstractly and quantitatively.

- Construct viable arguments and critique the reasoning of others.

- Use appropriate tools strategically.

- Look for and express regularity in repeated reasoning.

- Look for and make use of structure.

http://www.corestandards.org/the-standards/mathematics/introduction/standards-for-mathematical-practice/

Your packet and tasks

- Two strand problem packet
  - **Slope and Pythagorean Theorem**

- Work individually for about 15 minutes

- Present to each other for about 15 minutes

- Come together

- Work individually for about 15 minutes

- Present to each other for about 15 minutes

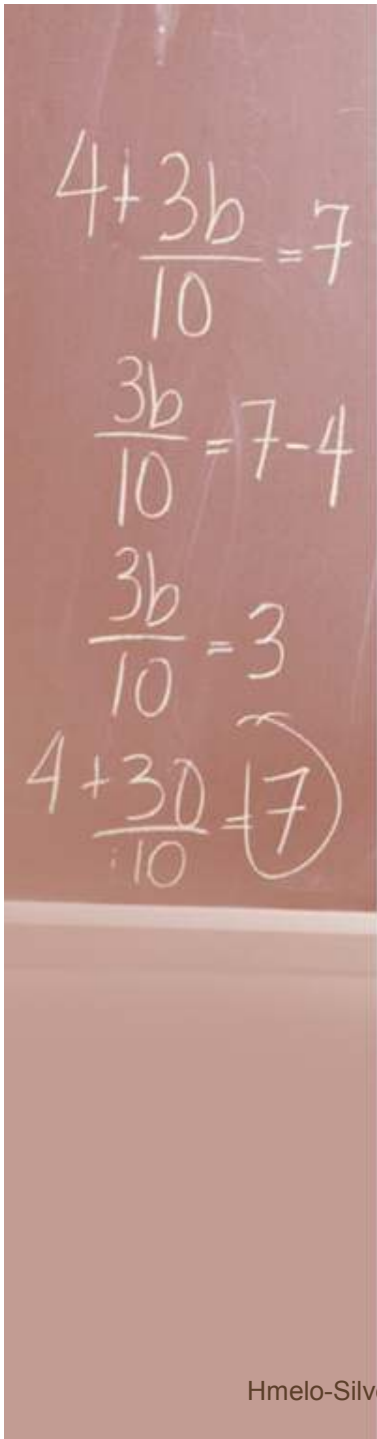- Wrap Up
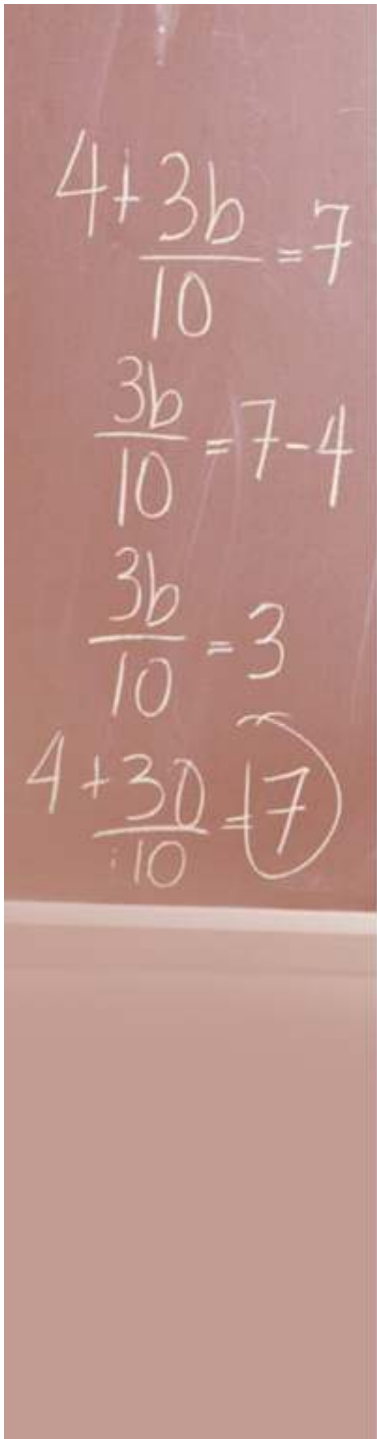
Sample Comparison for #3
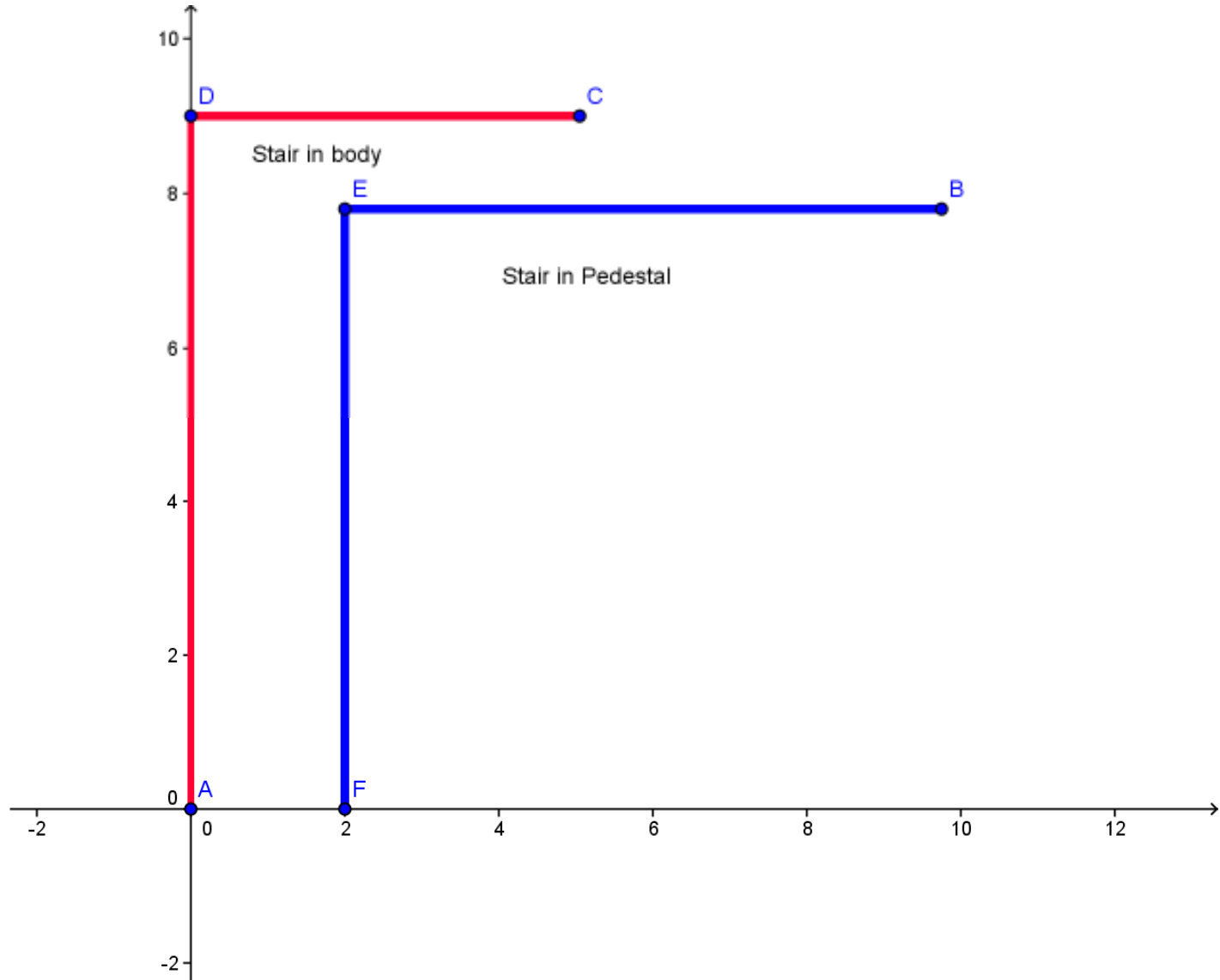
Teaching for Reasoning and Sense-Making

- Provide tasks that require students to figure things out for themselves (NCTM, 2009)
- Resist the temptation to tell
- Stop teaching decontextualized content
- Stop giving students the final product of our thinking
- Problems first, teaching second
- Progressively withdraw from helping students
- Reevaluate evaluation

McCain, Ted (2005) Teaching for Tomorrow:Teaching Content and Problem-Solving Skills. Corwin Press, Thousand Oaks, CA (44).

Characteristics of a PBL Teacher

- Probing students for deep explanation
- Open-ended metacognitive questions
- Revoicing
- Summarizing
- Explicit Mapping between cause and effect
- Checking consensus on board
- Cleaning up board
- Encourage construction of visual representation

Hmelo-Silver & Barrows (2006). Goals and strategies of a PBL Facilitator. *Interdisciplinary Journal of Problem-Based Learning* , 1(1), 21-39

Last thoughts…

- Be open to the unknown

- Get comfortable with learning happening through discussion, not necessarily through planned instruction (that wasn't a guarantee anyway)

- Recycle through topics regularly - PBL

- Allow students to go with their ideas

Resources

- All of these hand outs are on my website at:

- www.carmelschettino.org

- carmel@carmelschettino.org

- Or cschettino@deerfield.edu

- Join a forum at my website