Mathematical Pre-Modeling in the Early Grades

SIAM-ASA-NSF

Modeling Across the Curriculum II

Rachel Levy

Mathematics, Harvey Mudd College

SIAM VP of Education

#SIAMCSE15 Twitter: @mathcirque

Working Group Participants

Michelle Cirillo – U Delaware

Matthew Ellinger – SERP Insitute

Laura Pahler – Pomona Schools

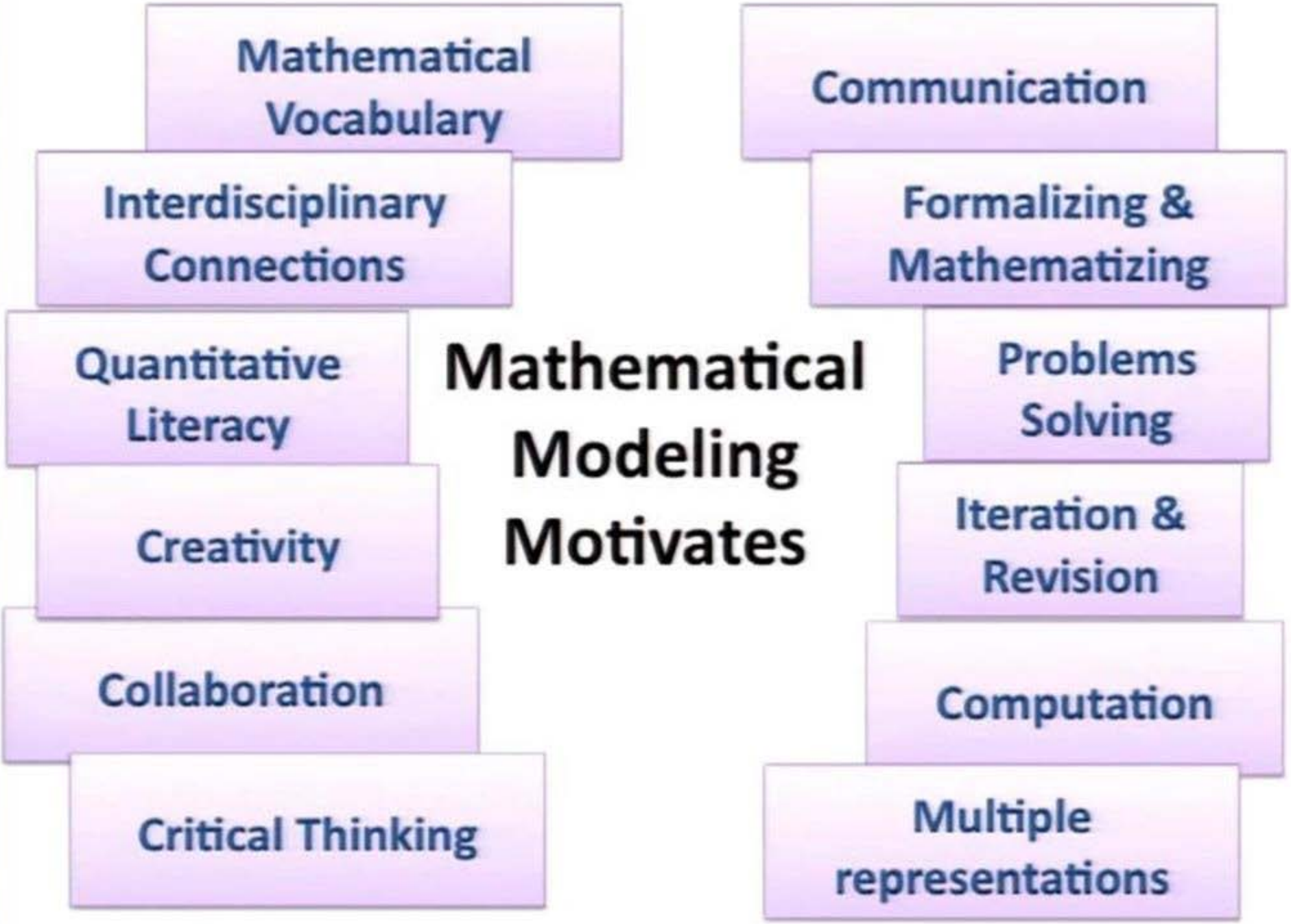
John Pelesko – U Delaware

Padhu Seshaiyer – George Mason University

Stacy Brown (off-site)– Cal Poly Pomona

Faciliator: Rachel Levy – Harvey Mudd College

Mathematical Modeling Motivates


Mathematical Vocabulary
Communication
Interdisciplinary Connections
Formalizing & Mathematizing
Quantitative Literacy
Mathematical Modeling Motivates
Problems Solving
Creativity
Iteration & Revision
Collaboration
Computation
Critical Thinking
Multiple representations

K-12 Common Core State Standards
8 Standards for Mathematical Practice

Make sense of problems and persevere in solving them.

Reason abstractly and quantitatively.

Construct viable arguments and critique reasoning of others.

Model with Mathematics.

Use appropriate tools strategically.

Attend to precision.

Look for and make use of structure.

Look for and express regularity in repeated reasoning.

Mathematically proficient students

- **apply the mathematics they know to solve problems**
- are comfortable making **assumptions and approximations** to simplify a complicated situation, realizing that these may need **revision** later.
- **identify important quantities** in a practical situation and **map their relationships** using such tools as diagrams, two-way tables, graphs, flowcharts and formulas.
- **analyze** those relationships mathematically to **draw conclusions**.
- **interpret** their mathematical results in the context of the situation and **reflect** on whether the results make sense, possibly improving the model if it has not served its purpose. **(CCSSMP4)**

What are the advantages of doing mathematical modeling with kids in grades K-6?

Advantages of working with K-6

- Get them early! **Creativity** may come more easily.

Advantages of working with K-6

- Get them early! **Creativity** may come more easily.
- Because early grades teachers are **generalists**, they can address several subjects simultaneously through modeling activities.
- Can lay the **groundwork** for mathematical modeling through pre-modeling activities.
- High potential for students to become **fluent** – native speakers, thinkers and dreamers of mathematics.
- Even if they have not learned particular mathematical concepts, they can make sense of a problem using **visualization** and **manipulatives**.

Jasper Study of 5th graders (1992, 1997)

Students engaged in real world problems

- Performed at least as well on standardized tests (w/ less dir. Instr.)
- Performed better on on one, two, and multi-step word problems.
- Performed better on planning and subgoal comprehension
- Were less anxious about mathematics
- Were more likely to see mathematics as relevant to everyday life.
- Were more likely to appreciate complex challenges.

Study showed positive effect for both previously high and low achieving students.

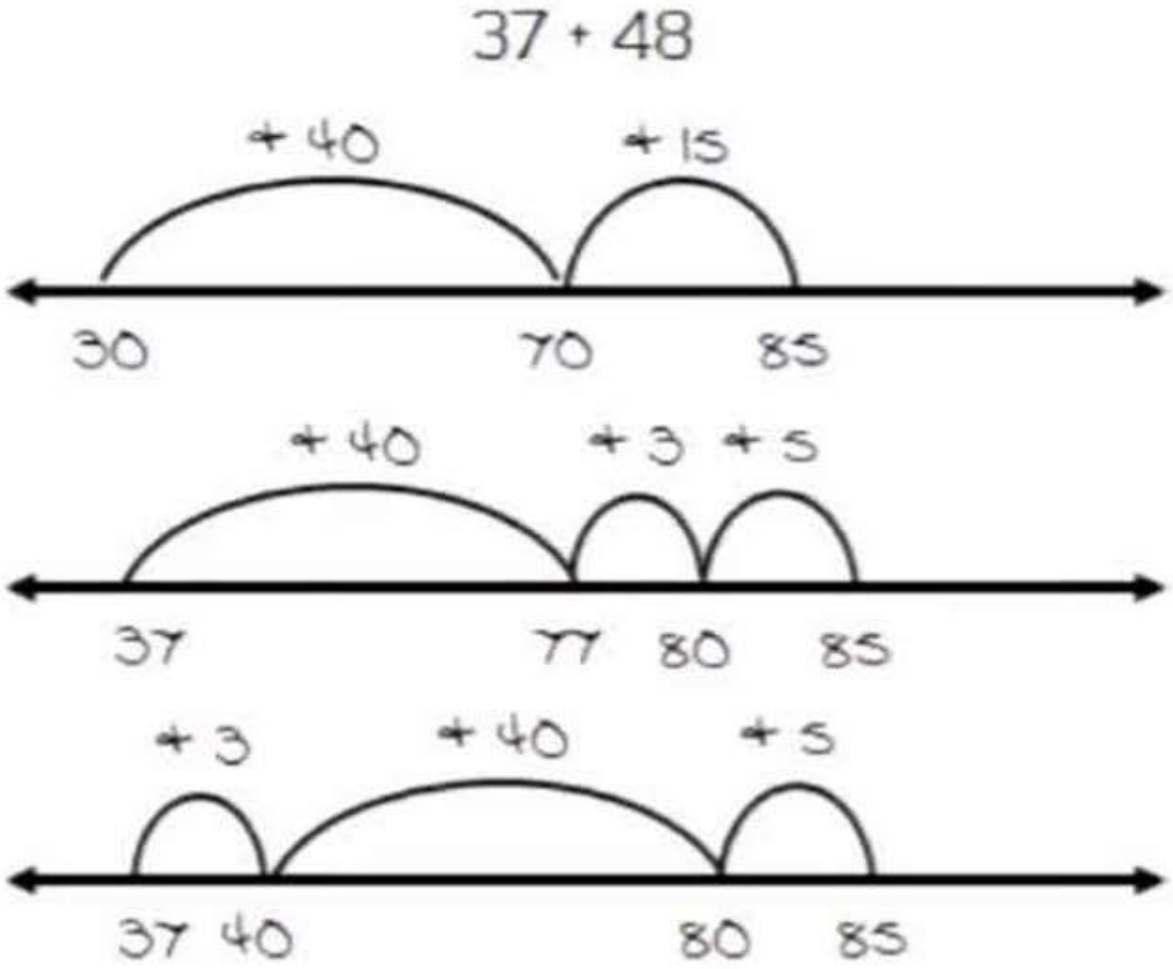
Challenges of working with K-6

If you ask the question,

"What is mathematical modeling?"

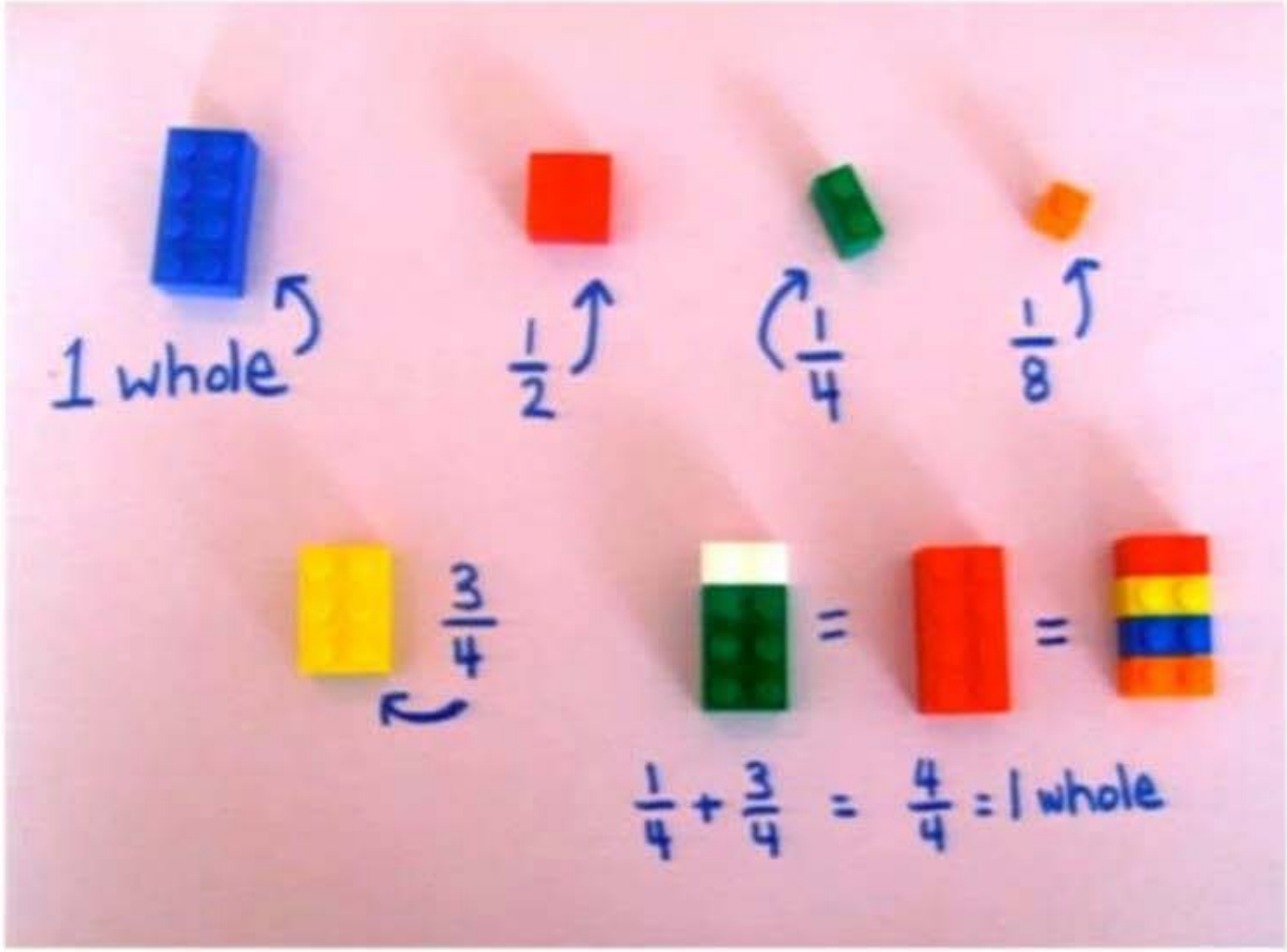
what are teachers likely to say?

Adding model (visualization)



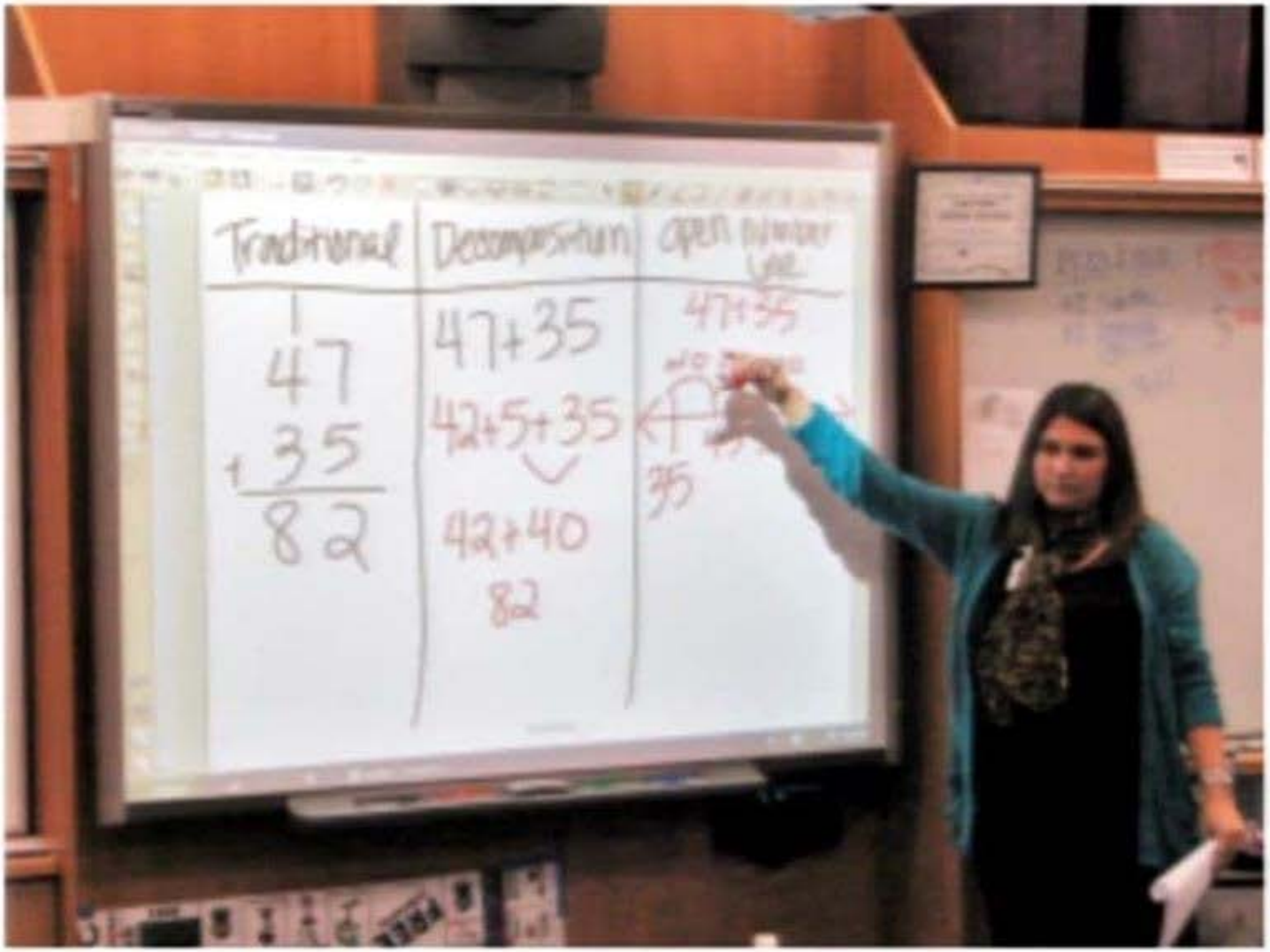
http://lisdelemmath.blogspot.com/2013/01/birds-on-number-line.html

Model of adding (manipulatives)



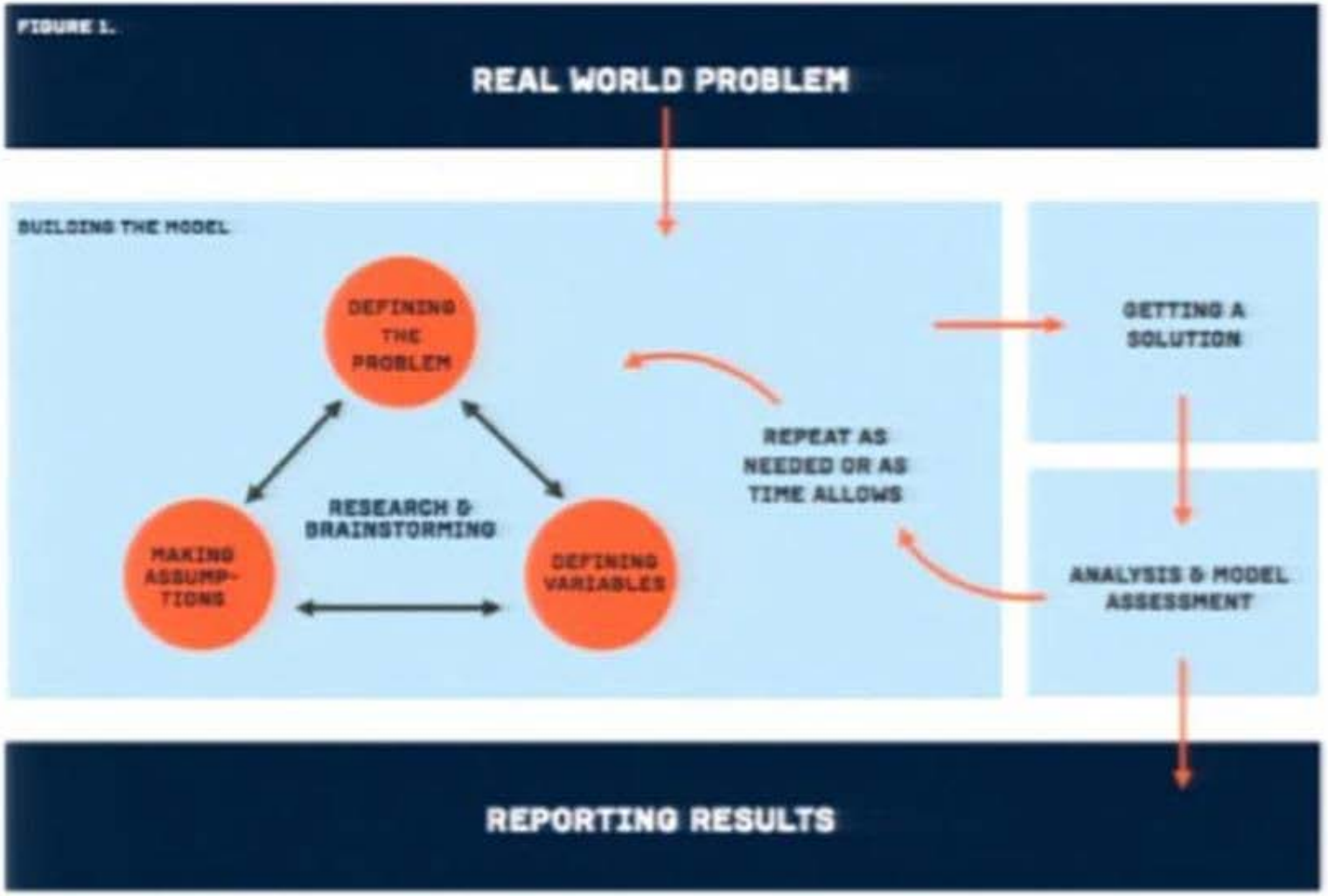
http://www.scholastic.com/teachers/top-teaching/2013/12/using-lego-build-math-concepts

Model adding (demonstration)



Challenges of working with K-6

A model of mathematical modeling



K. Bliss, K. Fowler, B. Galluzzo http://m3challenge.siam.org/about/mm/pdf/siam-guidebook-final-press.pdf

Mathematical modeling involves much more than the presentation of models.

Ideally, students are making many genuine decisions.

Current Ventures

Current Ventures

- **Mathematical modeling repository** (SIAM/COMAP)
- Upcoming SIAM/COMAP sponsored **GAIMME Report** (Guidelines for Assessment and Instruction in Mathematical Modeling Education) will have an early grades section
- **NCTM-SIAM** Joint Committee
- **SIAM Student Chapters** staffing MoMath Math Midway and SIAM Booth at USA Science and Engineering Festivals
- From MAC2 Workshop: NSF-funded **IMMERSION** project exploring mathematical modeling in K-8 (HMC/Pomona, Montana State/Bozeman, GMU/Fairfax)
- New SIAM proposal for **infrastructure to connect mathematical sciences students with internships**

Please contact me if you are interested in these efforts.

Rachel Levy
levy@hmc.edu