How Student questions and answers can bring quality learning to your high school science class

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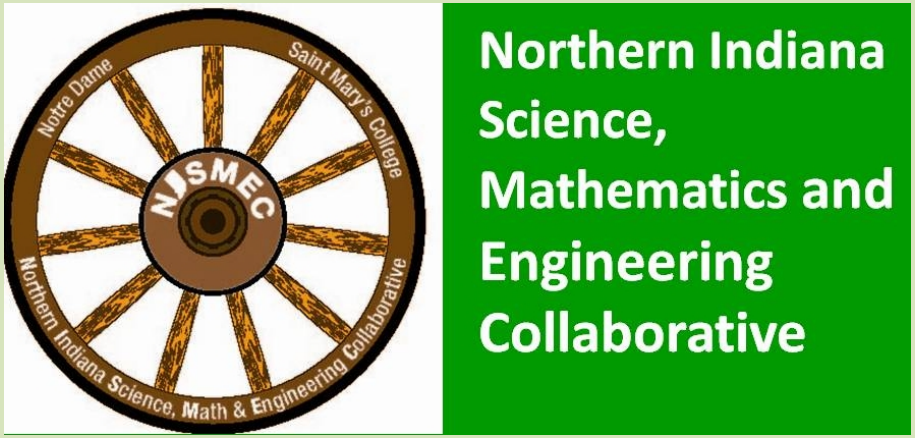
Mary Hynes-Berry, Erikson Institute, Chicago



How to enhance student learning in a science modeling class (and everywhere else?)

HASTI-2015 – Thursday, 12 February

The Essential ABCs of Learning

Always **B**e **C**onversing

Always **B**e **C**onnecting

Always **B**uild **C**ompetence
(**C**ompetence)

First: ***Some introductory ideas:***
SIP, question taxonomy, modeling

Second: **a modeling activity**
- to illustrate the question

Third: **extending the conversation**

Fourth: **Does it work?**
Analyzing our results, Evaluating learning
Trying again……

Conclusions: **Can you help our research?**

Tonight – a party for all……

Are all your science classes Satisfying, Intentional and Problem-Solving (SIP) for all your students?

The **SIP principle** [***Satisfying, Intentional Problem-Solving***] describes an effective classroom which uses these characteristics to reach the goal of quality intellectual *student* work.

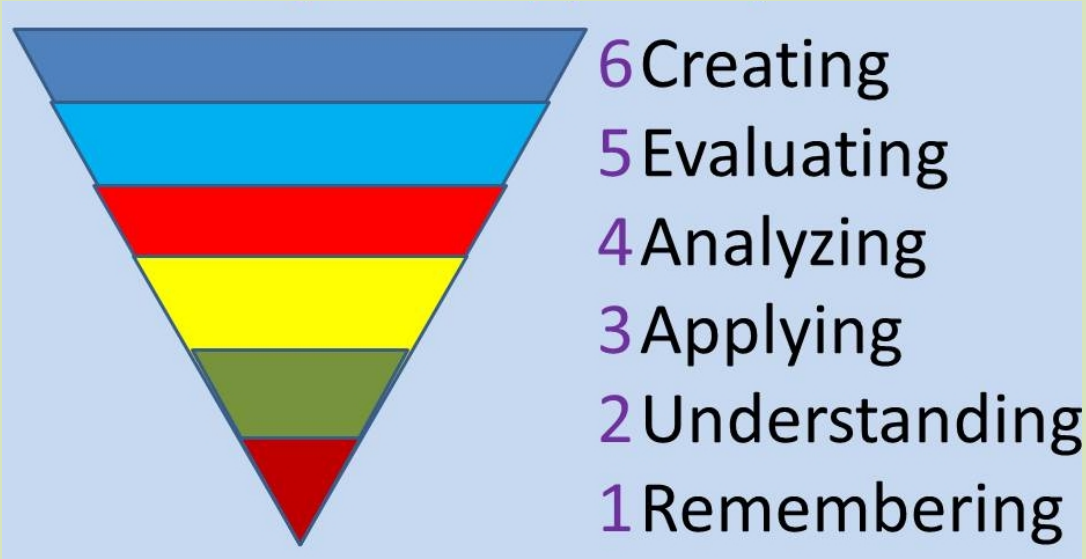
Satisfying: quality intellectual work which is engaging, intrinsically rewarding, and develops competence and confidence for the student

Intentional: students constructing models and strategies leading to the students' realization that they are building competence

Problem-solving: students developing their own progress milestones, accomplishing them and explaining their own achievements.

Do students take ownership of their learning when **THEY** are asking and answering their questions?

Bloom's taxonomy as an inverted pyramid
(most important at the TOP)

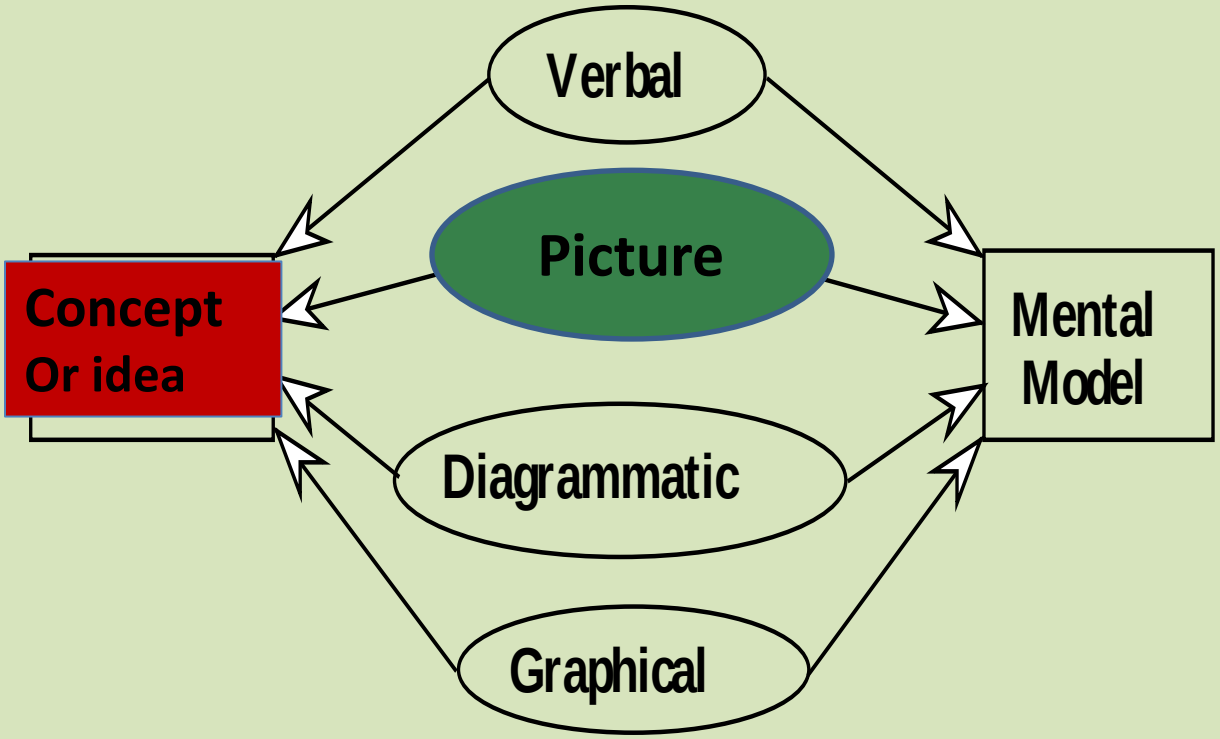


A simplified taxonomy of questions (Mary Hynes-Berry)

3 Evaluating/Synthesizing Inquiry Abstract/Symbolic
2 Analyzing/Applying Inquiry Pictorial
1 Knowledge & Comprehension Inquiry Concrete

What do we mean by "Modeling"*?

MULTIPLE! **Symbolic Representations**



*Modeling in HS *physics* & *chemistry* as developed at Arizona State University
The American Modeling Association – AMTA - http://modelinginstruction.org/

An important part of the modeling procedure is to give students a chance to show each other (and the teacher)
To help explain – in their own words -what they have been learning…

One "modeling" way: transfer their group ideas ***to large whiteboards***
Which can then be presented (in various ways) to the other students

We add to this Modeling presentation system:

"Student" Questions…….. and their answers

As you all can expect, or know from experience, it is often **DIFFICULT** to persuade some (or most of the) students to make comments….**VERY OFTEN,** such discussions tend to be led or even monopolized by the teacher.

Let's try to CHANGE that…. (slowly, slowly)

A GROUP activity to illustrate modeling…with questions

A "Fermi" question for you:
How many helium balloons do you need to lift a house?

Form a group of 3-4 people –
you will need a "whiteboard", plus some writing implements.

1. Discuss the question amongst your group:
Does it trigger any thoughts about topics in high school science learning?
…….. In physics or in chemistry or in biology or in earth/space science…….

2. Prepare your whiteboard for a presentation to everybody,
following the precepts laid out it the previous slide –
Include several ***representations*** – e.g. verbal, algebraic, picture, diagram, graph….

Also **include 2 questions** raised by your group……..

Presentations

Do these numbers help?

Density of air = 2.5 kg/m^3

Density of helium = 0.2 kg/m^3

Reflecting on today's exercise

Who is doing the thinking and learning?

Who is making connections?

Did you use all 8 science practice standards? (next slide)

Do you remember your own question(s)?

Do you remember your own answer(s)?

Did you worry about "Peer pressure"?

Can you think of any extensions to this exercise that you might use in your classroom? Let's try……..

The NGSS Framework of Scientific and Engineering Practices

"The Practice Standards"

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

How many of these are STUDENT Developed and driven IN YOUR CLASSROOM?

The AIR Principle:

for teachers in all classrooms and all grades…

Attend & Intentionally Respond

Attend : *Keenly observe and reflect on the observable indicators of disposition, engagement, and of level of understanding or of misconceptions*

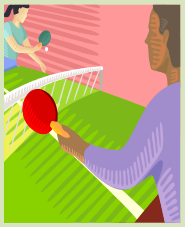
and

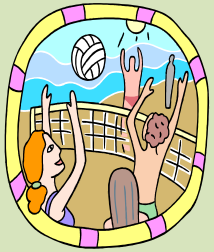
Intentionally*: plan what is likely to be a productive next step, based on observations and knowledge of the student as well as of developmental considerations*

Respond *in ways that will support the student in continuing to feel or be restored to feeling safe, valued and competent.*

A second visit to questions….

PING PONG	**Facilitator/teacher asks a question; labels response right or wrong** and then moves onto another question and another student
FEEDBACK LOOPs (Batting practice)	**Teacher/facilitator/(student) and responder engage in more than a single exchange** as point is clarified or expanded. May involve more than 1 participant
RICH CONVERSATIONS (Volleyball)	While the facilitator takes responsibility for guiding the conversation**, all members of the learning community** take active roles in commenting, questioning, offering clarifications and extending the thought.



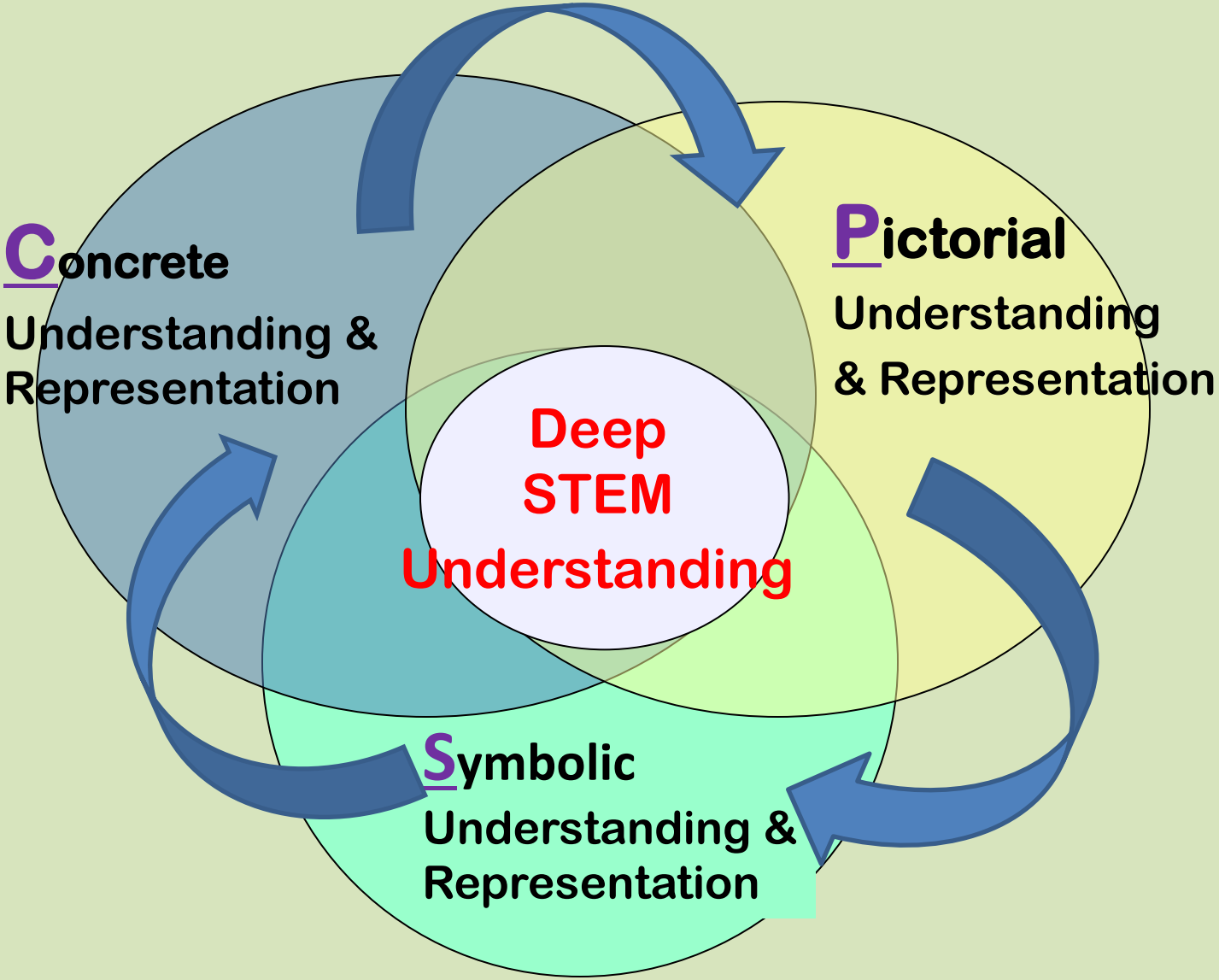


Question Rungs on the Ladder of Inquiry

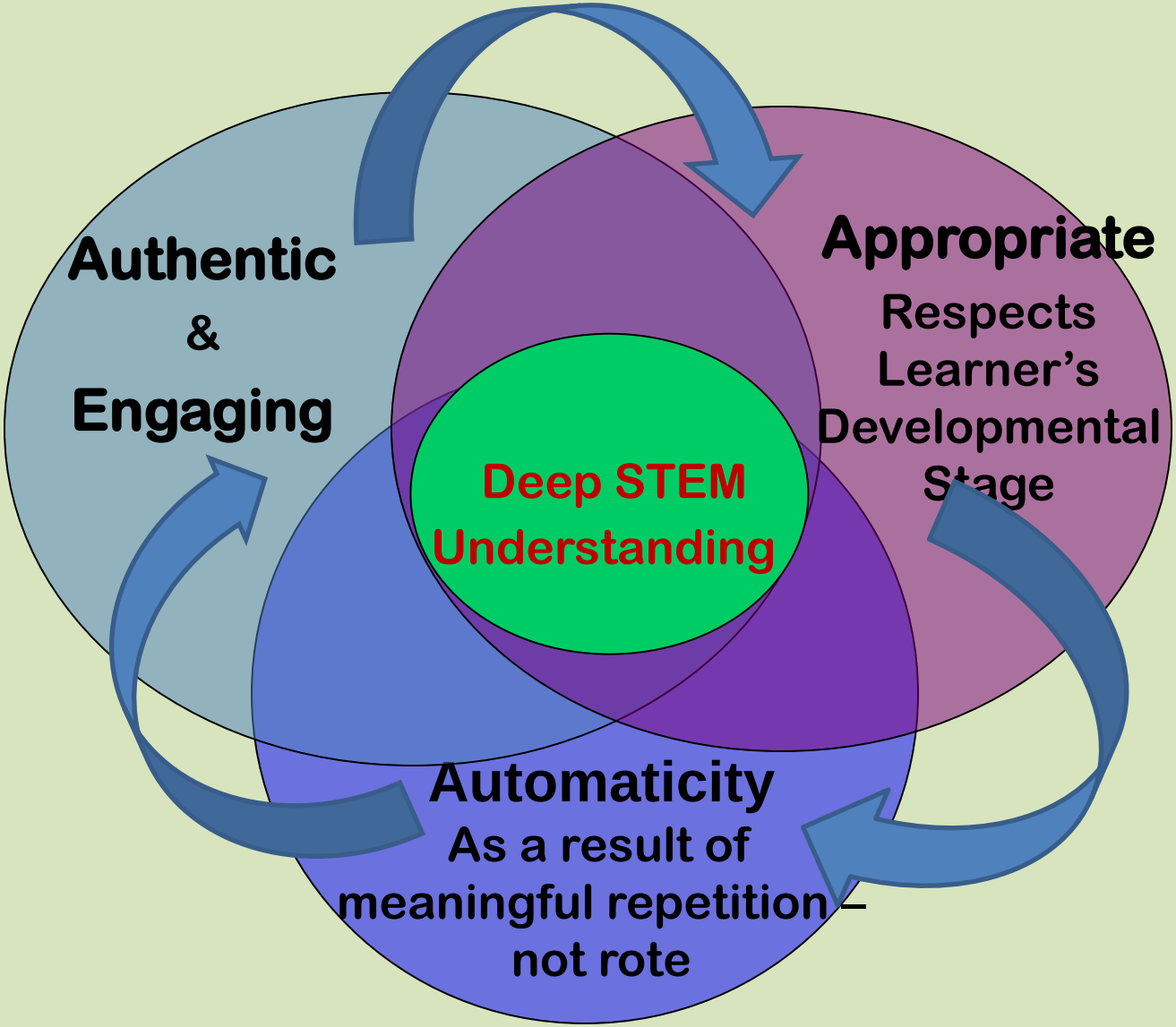
Reaching For the top – by going up and down

Closed Questions	Comprehension Level questions: "Right" or "Wrong" Answers
Level 3: Evaluating and synthesizing open questions	Call for "higher order thinking" Allow respondents to make highly personal, individual connections and synthesize understandings in a unique and creative way.
Level 2: Analyzing open questions	involve inferences as well as comparisons or other kinds of structural analysis; More than one response is possible, but all must include explanations or support that are likely to go back to the text or to further unpacking a previous statement,
Level 1: Unlocked closed comprehension questions	Ask for description, definition, examples from the text Useful for developing and clarifying comprehension of the text as well as of a respondent's meaning.
Locked closed questions	Call for a **yes or no** or can be answered with **a single word or phrase**. Often Ping Pong interactions. Emphasis on rote recall .

The dynamic C-P-S Principle



Learning from each other by DOING



Our Follow-up group activity…..

Design a classroom experiment to help estimate how many balloons are needed to lift a house

In a few minutes , make up a whiteboard which **includes**

A - At least 3 representations – extra credit given for 4 or 5 !!
(verbal, picture, diagram, algebraic, graphical…)

B – and **TWO** questions – one each from levels 2 and 3….

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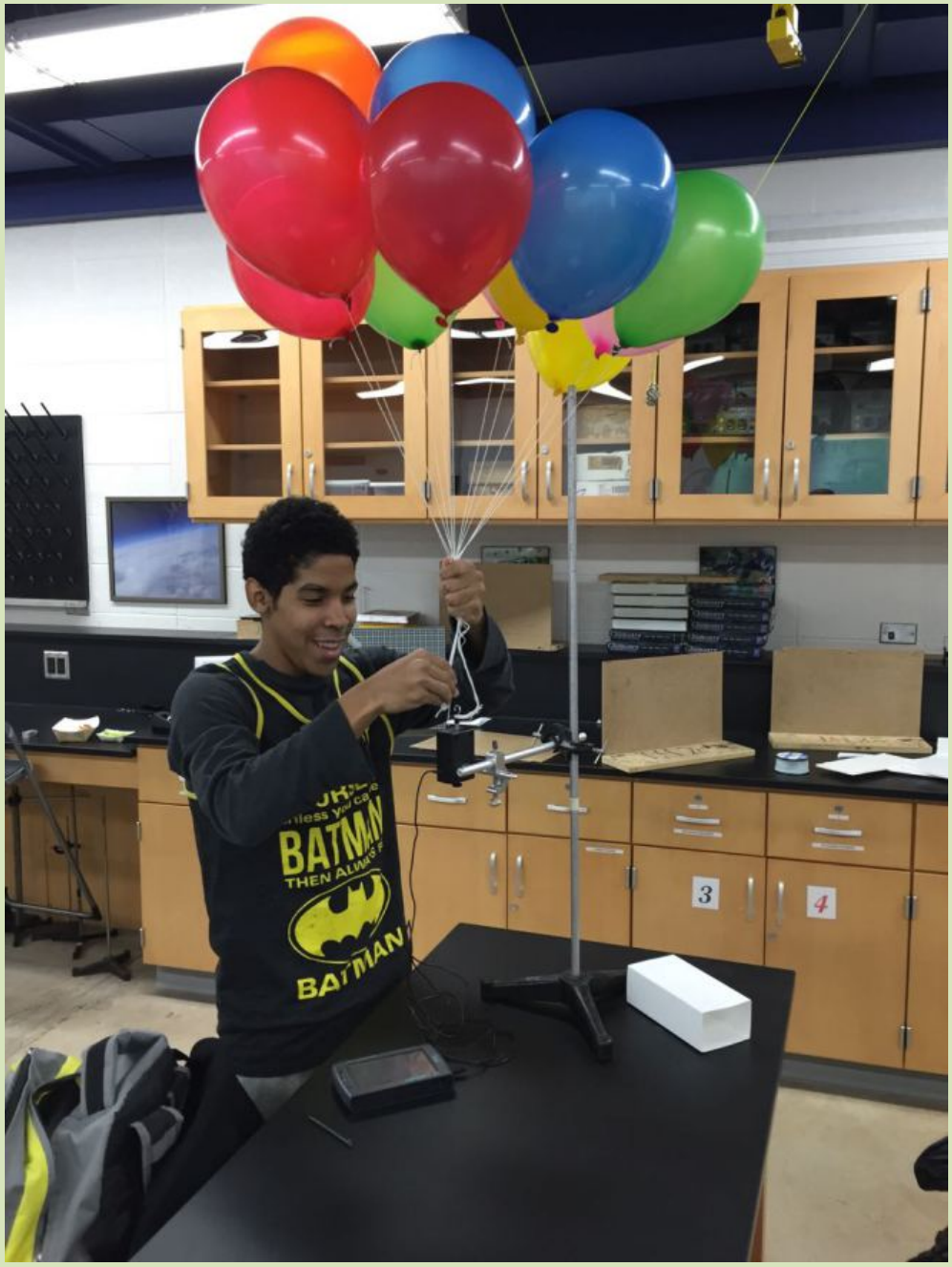

Helium balloons attached to a Vernier force probe

A personal request…..

I am looking for some research-based evidence
for the ideas presented today:
For enhancing the modeling teaching process
through the use of student questions

Would you be interested in helping?

The procedure will include a questionnaire to identify the changes between including and excluding student questions and answers
Especially in whiteboard presentations
But also in other classroom formats

Please contact me now or later or by email at hgberry@nd.edu or at 574-514-4009 (cell)

Thank you for any help

Reflecting on today's session

Who is doing the thinking and learning?
Who is making connections?
Did you use all 8 science practice standards?

The ABCs of learning (Mary Hynes-Berry)
Always Be Connecting
Always Be Communicating
Always Build Confidence

Contacts: *Gordon Berry:* hgberry@nd.edu
NISMEC: http://www3.nd.edu/~nismec/nismec11.htm

HASTI - - February 12-13, 2015
NISMEC presentations and other Modeling presentations

Time	Title	Presenters
Thursday 8:30 am	How Student Questions and Answers Can Bring Quality Learning to Your High School Science Class	Gordon Berry Mary Hynes-Berry
Thursday 10:45 am	Modeling Chemical Bonds and Reactions with Legos	Craig Williams
Thursday 10:45 am	The Indiana Modeling Program for High School Science Teachers - Are You In It? Join Now!	Gordon Berry, Robert Pustek, Lynda Rose
Thursday 12:30 pm	The Scientist Notebook: A Rhythmic Framework to Guide Teachers and Students in Any Classroom Investigation	Joseph Bellina
Thursday 12:30 pm	So You Want to Try Modeling -- A Pedagogy Not a Curriculum	Lynda Rose
Thursday 1:30 pm	Focus Question and Making Meaning Conference, the Bookends for A Classroom Investigation	Joseph Bellina
Thursday 1:30 pm	How to Engage Students in a Whiteboarding Session	Lynda Rose
Thursday 2:30 pm	Using Goal-less Problems in the Chemistry and Physics Curriculum	Amanda Horan, Hugh Ross, Gary Pritts, Karen Kennedy
Thursday 2:30 pm	Making Sense of Graphs, a Natural Math Extension from Science	Joe Bellina
Friday 12:30 pm	Hoosier Modeling Connection: Q & A with New and Experienced Modelers	Erica Posthuma-Adams Amanda Horan, Lori White
Friday 8:30 am	AP Science Courses Redesigned: Impacts and Lessons Shared	Karen Morris, Maureen McGrail
Friday 8:30 am	Using Bar Charts to Introduce the Momentum Conservation Model	Hugh Ross, Ben Buehler, Ben Grimes
Friday 9:30 am	Physical Challenges: Using Lab Practicums in the High School Physics Classroom	Ben Buehler
Friday 12:30 pm	Hoosier Modeling Connection: Q & A with New and Experienced Modelers	Erica Posthum-Adams, Amanda Horan, Lori White
Friday 12:30 pm	Focus: Authentic Learning	Lori White
Friday 2:30 pm	Modeling Chemical Equilibrium: A Conceptual, Particle-Based Approach for High School Chemistry	Jeremy Horner

1 - **The Indiana** ICP and Biology Modeling Curricula are available on the NISMEC website (Password required – ask me)

2 – Further details on the 2015 Modeling workshops are also available on the NISMEC website and will be updated on a regular basis this spring

3 – For more information

Visit the NISMEC booth at HASTI-2015

and our website:

http://www3.nd.edu/~nismec/nismec11.htm