The Indiana HS Science Modeling Curricula

**Focus 2015:** Science teachers in Northern & Southern Indiana

The *NISMEC* Modeling curriculum workshops in Earth Science, ICP and biology

Gordon Berry (Notre Dame), Bob Pustek (Hammond), Lynda Rose (PHM, Mishawaka); *also* Lynne Barden (Union North), Pat Robison & Christine Campbell (Merrillville), Dawn Slein (Triton)
First - *an introduction*: a modeling activity
   - to illustrate the modeling procedures

Second – a quick report on the 2014 workshops

Third – Our plans for 2015….. And beyond

Fourth – How can we best help you?
   - your suggestions for us......
   (as a modeling activity......)

Tonight – a party for all......
What do we mean by “Modeling”?*

MULTIPLE! Symbolic Representations

Concept Or idea

Verbal

Picture

Mental Model

Diagrammatic

Graphical

*Modeling in physics & Chemistry as developed at Arizona State University
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 way of achieving this ----
---- is to present the students’ group activities to the other groups by transferring their group ideas to large whiteboards
Which can then be presented (in various ways) to the other students
How can we enhance this procedure???

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.

And so we will include ....

An addition to the Modeling presentation system: “Student” Questions – and answers

(more details on this topic in another talk at this HASTI meeting Room 208 Thursday, 2/12/2015  8:30 AM - 9:15 AM) You can get the slides by email from the presenter
An activity to illustrate modeling...

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

Here is a statement that I saw in a recent Indiana newspaper:

“Solids are heavier than liquids”

1. Discuss this statement 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 in the previous slide – Include several representations – e.g. verbal, algebraic, picture, diagram, graph ....

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

→ Presentations
Reflecting on today’s introductory exercise

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
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
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.
Why modeling?!

- To help students see science as a way of viewing the world rather than as a collection of facts.
- To make the *coherence* of scientific knowledge more evident to students by making it more explicit (quantitative).
- *Models and Systems* are explicitly recognized as major unifying ideas for all the sciences by the AAAS Project 2061 and the NGSS for the reform of US science education.
Why Models?

• Models are basic units of knowledge

• In all Science Research:
  – A few basic models are used again and again with only minor modifications.

• Models help students connect
  – Macroscopic observations
  – Sub-microscopic representations
  – Symbolic representations

The students become SCIENTISTS – learning by DOING
Professional Development in Modeling in NW Indiana in Physics, Chemistry, ICP and Biology

Summer 2014: at Hammond, Merrillville – 1 week each workshop
(1) introduction to Modeling (2) ICP modeling, (3) Biology Modeling
Instructors:
Gordon Berry (NISMEC, Notre Dame), Bob Pustek, (Morton HS, Hammond)
Lynda Rose (Penn-Harris-Madison HS), Lynne Barden (LaVille HS),
Dawn Slein (Triton HS), Patti Robison (Merrillville)

Summer 2014: the Indianapolis area – 2 weeks each workshop –
Instructors
at University High School, Carmel, – ICP, Chemistry modeling
at Guerin HS, Noblesville, - Hugh Ross(Guerin), Ben Grimes (Roncalli HS)

Funding support: ICHE – Improving Teacher Quality (2013-14)
Some Statistics of the NISMEC Modeling workshop program 2010-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Teacher-weeks</th>
<th># of teachers</th>
<th>No. of workshops</th>
<th>Noshows</th>
</tr>
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<tbody>
<tr>
<td>2014</td>
<td>93</td>
<td>65</td>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>2013</td>
<td>112</td>
<td>82</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>2012</td>
<td>110</td>
<td>92</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>2011</td>
<td>195</td>
<td>132</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2010</td>
<td>54</td>
<td>28</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>564</td>
<td>399</td>
<td>26</td>
<td>64</td>
</tr>
</tbody>
</table>

**Note 1.** We encourage teachers to attend at least 2 weeks of workshops each year

**Note 2.** Several teachers have attended more than one year

**Note 3.** In 2014 many teachers registered but then withdrew from the workshops
NISMEC Modeling Workshops in the coming year – summer 2015
Preliminary schedule

1- Funded:

15-19 June  Introductory Modeling (at Merrillville)
22-26 June  ICP Modeling (at Notre Dame)
22-26 June  Biology Modeling (at Merrillville)

2- still needing funding:

University of Notre Dame: 29 June - 3 July: Development of ESS modeling – 1wk
Evansville, North HS:  6-10, 13-17 July Development of ESS modeling – 2wk
Guerin HS, Noblesville ----  1or2 weeks June or July: Phys modeling (Adv.)
University HS, Carmel   ---  1or2 weeks June or July: Chem modeling (Adv.)

Sign up sheets at the NISMEC Hasti booth or on the NISMEC website.
http://www3.nd.edu/~nismec/nismec11.htm
Contact:  hgberry@nd.edu
Final interactive session

1 - Discuss with your group your top priority for Professional Development modeling workshop needs for the summer of 2015 and beyond...

2 – Present your results ....→ brief discussion
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

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

2 – Further details on the 2015 Modeling workshops Are also available on the NISMEC website These will be updated on a regular basis

3 – Visit the NISMEC booth at HASTI-2015 For more information

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

For a copy of these slides, email me at hgberry@nd.edu