

## Supporting Secondary Teachers' Conceptions of Mathematical Modeling

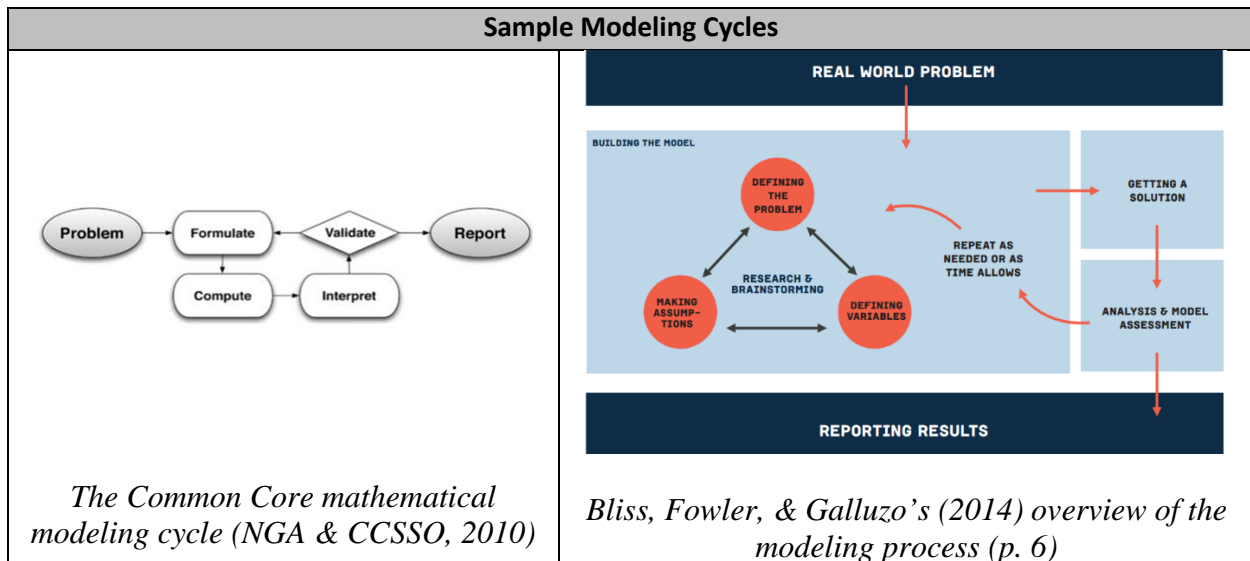
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### Important Features of Mathematical Modeling

1. Mathematical modeling *authentically* connects to the real world, starting with ill-defined, often messy real-world problems with no unique correct answer.
2. Mathematical modeling is used to explain phenomena in the real world and/or make predictions about future behavior of a system in the real world.
3. Mathematical modeling requires the modeler to be creative and make choices, assumptions, and decisions.
4. Mathematical modeling is an iterative process.
5. There are multiple paths open to the mathematical modeler, and no one, clear “right” approach or answer.



Summarized from:

Cirillo, M., Pelesko, J.A., Felton-Koestler, M., & Rubel, L. (2016). Perspectives on Modeling in School Mathematics in C. Hirsch (Ed.) *Mathematical Modeling and Modeling Mathematics*, pp. 3-15, NCTM: Reston, VA.

**The Question Formulation Technique**  
**Developed by Rothstein & Santana (2013)**  
*Make Just One Change*

Component	Description
The Question Focus	The Question Focus (QFocus) is usually developed by the teacher and serves as the jumping off point for student questions. It should be brief and provoke or stimulate new lines of thinking. The QFocus should not be in the form of a question.
The Rules for Producing Questions	The rules for producing questions must be discussed in advance and understood by the students. The rules for producing questions are: <ul style="list-style-type: none"> <li>• Ask as many questions as you can</li> <li>• Do not stop to answer, judge, or discuss the questions</li> <li>• Write down every question <i>exactly</i> as it is stated</li> <li>• Change any statement into a question.</li> </ul> Post or distribute the Rules for Producing Questions.
Producing Questions	After discussing the rules, divide students into groups of 3-5 students. Ask each group to identify a note-taker. Distribute or reveal the QFocus. Students should produce as many questions as possible in the allotted time (start with 10 minutes; decrease time as students master the technique). The rules should be followed, and the questions should be numbered. The note-taker should contribute questions.
Categorizing Questions	Questions should be categorized as closed or open-ended questions: <ul style="list-style-type: none"> <li>- <b>Closed-ended Questions</b> can be answered with a “yes” or “no” or with a one-word answer.</li> <li>- <b>Open-ended Questions</b> require more explanation.</li> </ul> Students should label the questions with a “C” or an “O” and practice changing closed questions to open questions and vice-versa.
Prioritizing Questions	Following criteria set by the teacher, students should prioritize their questions and choose three questions. Examples of criteria include questions that: most interest you, you consider to be the most important, will best help you solve a problem, or you need/want to answer first.
Sharing Questions & Next Steps	Students can be asked to share: <ul style="list-style-type: none"> <li>• Their three priority questions</li> <li>• Their reasons for choosing the priority questions</li> <li>• The numbers of the priority questions in the sequence of the entire list.</li> </ul> Students should use their questions to conduct research or write papers.
Reflection	Students should name what they have learned, how they learned it, and how they will use what they learned.

Learn more about the Question Formulation Technique (Rothstein & Santana, 2013)  
 here: <http://rightquestion.org/education/>