Evidence based approaches to teaching and learning are the focus of Dr. Cooper’s research. One of the prime outcomes of this research is the development and assessment of evidence-driven, research-validated curricula. For example: *Chemistry, Life, the Universe and Everything (CLUE)* is a new general chemistry curriculum that is based on three core ideas of chemistry - structure, properties and energy as three intertwined learning progressions that are developed simultaneously over the two semester course (3). CLUE represents a model for curriculum development based on five important questions:

(i) What do students bring with them to the course? (ii) In what order should they learn it? (iii) What should students know and be able to do? (iv) What materials are best suited for different purposes? and (v) How can student arguments and to construct explanations to do? (ii) In what order should they learn it? (iii) What should students know and be able to do? (iv) What materials are best suited for different purposes? and (v) How can student arguments and to construct explanations for phenomena, to use data to support and develop models, and to develop explanations for phenomena. Our system beSocratic (http://besocratic.chemistry.msu.edu) is designed to recognize and respond to student input. We are developing and assessing the effect of tutorials and formative assessment activities using beSocratic (2).

To design effective curricula we need to know what students bring to the table in terms of knowledge and science practices, and we also must understand how and why (under traditional curriculum structures) students develop ideas that are not scientifically sound. For example we have shown that for many students, when they consider how the molecular level structure of a substance can be used to predict macroscopic properties, their ideas are often a loosely woven tapestry of concepts, facts and skills, rather than a useful framework of ideas (4). We have used this work to design a more coherent approach to structure property relationships, and have shown that students who learn in this way are significantly better at both constructing and using structures to predict properties (7). We have followed these students through organic chemistry and find that the CLUE students are significantly better than a matched cohort of students who learned general chemistry in a more traditional setting (in preparation).

Similarly our recent work on the central (and cross cutting concept of energy) has focused on how students think about energy in chemical systems (1), and this work has informed our learning progression for energy.

We are also interested in developing formative assessment systems that allow students to construct (free form) structures, diagrams, and models, and to develop explanations for phenomena. Our system beSocratic (http://besocratic.chemistry.msu.edu) is designed to recognize and respond to student input. We are developing and assessing the effect of tutorials and formative assessment activities using beSocratic (2).

**Design research cycle**

**SELECTED PUBLICATIONS**


