**Our Framework: The C-R-M Model**

**Modeling Visualizations and Interpreting External Representations (ERs)**

**Conceptual (C)**
- Prior Conceptual Knowledge
  - Science concepts
  - Research concepts (e.g., design, hypothesis, control, variable, sampling)

**Reasoning (R)**
- Total Reasoning Skills
  - Interpreting representations. Includes R-M and R-C

**Visual Skills**
- Decode, manipulate, translate, spatially manipulate, construct, interpret, apply

**Nature/Quality of ER itself**
- Experiments, graphs, tables, equations, models, micrographs

**Propositional Knowledge**
- The ER and its symbolism in relation to prior concepts

**Cognitive Skills**
- Memorization, analysis, transfer, application, integration, system thinking, analogical reasoning

**Visual Literacy** ★ **Scientific Process** ★ **Faculty & Curriculum Development**

**System Thinking in Metabolism**

**Research Focus:** Students’ conceptual and visual understanding of metabolic systems

**Propositional Knowledge**

**Using the Delphi Method for Curriculum Design**

**Research Focus:** Students’ visual difficulties interpreting representations of microscopic images

**C-R-M Model**

**Nature/Quality of ER itself**

**Prior Conceptual Knowledge**

**Propositional Knowledge**

**Cognitive Skills**

**Visual Skills**

**Total Reasoning Skills**

**Ability to visualize, understand and learn from the ER**

**Ability to engage all factors of the model**

**Explanations of Molecular Mechanisms**

**Research Focus:** Expert-novice mechanistic explanations

**Experts and Novices’ Tree Thinking Abilities**

**Research Focus:** Tree Thinking Understanding & Application

**Visualization & Understanding of Physics at Science Shows**

**Research Focus:** Effect of culture on students’ learning experiences

**Contact us:** Trevor Anderson

**Divisions of Chemical Education & Biochemistry**

**Research Focus:** Development of a Rubric for assessing experimental reasoning

**Experimental Design in the Life Sciences**

**Research Focus:** Using remote devices for online learning and assessment

**Using 3D Biochemistry Classrooms**

**Research Focus:** Use of physical models and symbolism charts to represent protein structure based on structural motifs & topology

**International Collaborations**

**Using 3D Biochemistry Classrooms**

**Research Focus:** Use of remote devices for online learning and assessment

**Experts and Novices’ Tree Thinking Abilities**

**Research Focus:** Using multimedia design principles for improving ER quality.

**Improving ER Design**

**Gordon Research Conference (GRC) Visionary Grant**

**Taking educational research into the classroom**