

The Atomsmith® Classroom and Its Impact on Teaching and Learning:

- **SAME TECHNOLOGY USED BY SCIENTISTS:** Professional molecular designers (scientists) make extensive use of physics-based simulations tied to 3D visualization to conceptualize and test their ideas. *Atomsmith* products take the same models used by scientists and packages them in a way that allow teachers and students to easily interact with them and that allows them to explore and discover concepts in chemistry that are difficult to otherwise comprehend.
- **A WAY OF SEEING THE OTHERWISE UNSEEABLE:** The particles of matter comprising chemistry (subatomic particles, atoms, and molecules) are impossible to see, even with the most powerful optical microscopes. All students are visual learners (some more so than others). The inability to see atoms and molecules leads to levels of abstraction that some students never surmount. *Atomsmith's* physically accurate models allow students to "see" and manipulate the structure and behavior of atoms and molecules, enabling understanding for some, and deepening understanding for others. We often even hear from long-time teachers telling us that they're surprised when they actually see our visualizations (e.g., see the comments from Bob Worley about seeing the Electron Configuration Lab at ChemEd 2015 -- in the attached file *AtomsmithComments.txt*).
- **"DO SCIENCE" ON ACCURATE MODELS:** Because the models and simulations are interactive and physically accurate (not simple 2D cartoons and not videos), students can perform virtual experiments on them and compare the results to macroscopic experiments performed in the lab. Teachers report that by combining *Atomsmith's* models with physical lab experiments, students more readily connect three levels of chemistry: particulate (sub-microscopic), symbolic, and macroscopic.
- **EXTEND PHYSICAL MODELS:** *Atomsmith* models are a natural extension to physical (e.g., plastic "ball and stick") models. The tactile experience of manipulating simple molecular models is enhanced by interacting with the simulation models, which "know some physics."
- **LEVERAGING TECHNOLOGY INVESTMENT:** *Atomsmith* allows schools to take advantage of the large investments in computer technology to turn their computers into virtual laboratories - a very different, innovative and value-adding use of technology as compared to some other uses of computers in schools.
- **RIGOROUS, INQUIRY-BASED, AND EXTENSIBLE CURRICULUM:** *Atomsmith* models blend well with many of the modeling- and inquiry-based pedagogical ideas found in, e.g., POGIL, Modeling Instruction, and NGSS (see attached). *Atomsmith* provides an inquiry-based curriculum ("Experiments") that makes use of its models, supports the scientific method and requires students to explain their understanding. And teachers can design their own inquiry-based activities, as well. The models also work equally well as a tool to be used to demonstrate concepts in front of the classroom by teachers and students.
- **VIRTUAL 3D ENVIRONMENTS FAMILIAR TO (AND WITH *ATOMSMITH*, MAYBE INSPIRATIONAL TO) STUDENTS:** Today's students have grown up with (and expect) virtual, 3D computer games and environments. *Atomsmith* uses the same 3D computing technologies as the latest shoot-em-up computer games, but for a more peaceful purpose ☺