

**The Picturing to Learn Database :
a new open source tool for teaching science with drawings**

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The *Picturing to Learn (PtL)* project has released a new database that supports interactive science teaching and learning for college students via the open access website, www.picturingtolearn.org, by clicking the “explore the database” button. Containing over 3000 digitized student drawings, this database covers complex topics in biology, chemistry and physics that require integration of multiple concepts or processes, such as diffusion and boiling point. The *Picturing to Learn* database is a tool for teachers that diagnoses errors in understanding revealed through drawing, and emphasizes these errors as creative opportunities for learning, discussion, and clarification.

A novel approach to measuring learning outcomes, the *Picturing to Learn* database emerged from a 4-year NSF study about peer-explanation conducted at six colleges and universities. The idea began with Principal Investigator Felice Frankel’s experiences while working with scientists to visually express their research. It was clear that when the researcher created drawings to explain to her the phenomena, the process itself seemed to clarify the science in the mind of the researcher. All drawings in the database were created by students explaining fundamental concepts to each other or high school students using metaphor and process diagrams. After thorough evaluation, each drawing was scanned into the database with tags for explanatory value and misconceptions. To use the database, a user can select a science topic, see each drawing, enlarge them and then filter the stack of student drawings based on common misconceptions, efficacy, and creativity, among other variables. The *Picturing to Learn* database offers an advantage to any undergraduate science teacher approaching challenging concepts, as it provides both discussion points for class planning as well as examples of successful and unsuccessful communication of science concepts. It may also be use for high school courses.

Common themes among student drawings revealed student misunderstandings not otherwise discernable from a written or multiple-choice assessment. Teachers can use this database to identify points of emphasis or clarification as they introduce concepts to new students. Teachers can also use many of the drawings in the database as a launching point for their own class exercise, or a discussion point for inquiry-based learning. In the words of Donald R. Sadoway, John F. Elliott Professor of Materials Chemistry, MIT, “I was able to teach the material far better after seeing the students’ drawings....They revealed misconceptions in a way that text does not.”

See: <http://www.picturingtolearn.org/drawings/chemicalBonding.html>

There is a growing revolution in the teaching of science, as digital resources become more widely available, and teachers look for new creative ways to engage students while tackling complex science concepts. Some topics in particular provide challenges for the teacher, as they include abstract concepts involving molecules students can’t see, or such a variety of different components that students lose track of the meaning and give up in frustration among the weeds. The *Picturing to Learn* database is a resource for imaginative approaches to teaching that involve probing a student’s current understanding by asking them to report their knowledge in a creative, explicit way.

ABOUT: The *Picturing to Learn* project was created by Felice Frankel, and originally supported by NSF DUE funding from 2007-2010, A pioneer in the art of visualizing science, Felice Frankel has published several books about the intersection of design and science, including *Envisioning Science*, *No Small Matter*, and *On the Surface of Things*, among others, and is a research scientist in the Center for Materials Science and Engineering at MIT.

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