# Visualizing the Hidden Earth - Learning with Interactive Animations

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Beginning with my origins as a field geologist and my more recent work in geoscience-education research, I have always appreciated the huge role visualization plays in all aspects of geologic research, geologic reasoning, communication, and teaching. Visualization is a critical control of what we and our students see and think about in the field, on maps, and from the many types of geologic diagrams we use. Yet we know very little about what our students actually see and how they learn from these different representations.

As part of my two NSF-funded Hidden Earth Projects, we have been developing interactive animations, building curriculum around these, and researching how students use and learn from these. Our research results indicate that these interactive animations are indeed very effective in helping students learn key concepts and skills, such as how to visualize topography from contours maps and how to visualize the 3D geometry of geologic structures. Also, using such visual materials increases the general spatial abilities of all types of students and can eliminate differences in performance between males and females.

Our more recent work has involved research and curriculum development into how students visualize the deposition of rock layers and how such layers are expressed in the landscape. We documented some student preconceptions that should be shocking to any introductory geology teacher, such as students thinking that limestone layers in the Grand Canyon were formed when seas came into the already existent canyon and coated the walls with limestone. Also, many students see stratigraphic sections as maps. We simply must do more research into what our students see from the many photographs, maps, and geologic diagrams we show in our classes – it is not what we think they are seeing! A preliminary version of some of the visualizations is at http://reynolds.asu.edu/seas.

Some of the visualization-rich websites we have created are:

**Arizona Geology 3D** – QTVR movies of the Geologic Map of Arizona draped over digital topography for each 1° X 1° quadrangle.

**Arizona Geophysics 3D –** Interactive QTVR movies of gravity, magnetic, and depth-to-bedrock maps draped over digital topography

**Arizona Satellite 3D –** Interactive QTVR movies of thematic map images draped over digital topography

**Arizona Topo 3D –** Interactive QTVR movies of 1x1 degree topographic maps draped over digital topography

**Biosphere3D**: Interactive globes showing factors of the environment, such as precipitation, soil pH, and rainfall.

**Geologic Scenery**: Images and movies showing how landscape features form

**Interactive 3D Geologic Blocks** – An educational module with QTVReality (QTVR) movies of interactive geologic blocks containing layer, folds, and faults. Spin them, cut into them, erode them, make them transparent, and move their faults.

**Painted Canyon – A Geologic Wonderland**: A virtual world used in GLG 103 labs at ASU

**Structure Map 3D Gallery** – QTVR 3D perspectives of geologic features on digital topography.

**Southwest 3D** – 3D perspectives, presented as pictures and QuickTime movies, depicting the landscape of the Desert Southwest with colors showing different elevations.

**Interactive 3D Geologic Maps** – Classic, quadrangle-scale geologic maps draped over digital topography for various regions and geologic features.

**Visualizing Topography** – Educational module to teach students about contours and visualizing topography.

**Some References**


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