

## Web Resources for Teaching Astronomy with Simulations

Simulations on the Web (pointers to particularly useful collections and individual simulations)

*Note that many (but not all!) are Java-based and may no longer work with specific browser platforms. Success has been achieved with most by whitelisting the sites in the Java control panel (Win: [https://www.java.com/en/download/help/win\\_controlpanel.xml](https://www.java.com/en/download/help/win_controlpanel.xml) | Mac: [https://www.java.com/en/download/help/mac\\_controlpanel.xml](https://www.java.com/en/download/help/mac_controlpanel.xml)) then using IE (restart browser after whitelisting). You may also need to lower IE's internal security settings.*

- PhET– <http://phet.colorado.edu> Excellent set of simulations covering all of physics and some of astronomy (Discharge Tubes, My Solar System gravity simulator, Greenhouse Effect, etc.) Entire set can be downloaded.
- Astronomy Education at the University of Nebraska – <http://astro.unl.edu> Simulations for student laboratories or feedback during peer instruction. All simulations are indexed and can be downloaded at <http://astro.unl.edu/animationsLinks.html>
- Astronomy and Physics Simulations – <http://hypnagogic.net/sim/> A collection of ~ 15 java simulations. These are older simple simulations, but several are quite useful for demonstrating concepts such as “Fusion in the Sun”, “1 over R squared”, and “Proper Motion”.
- Physics Applets – <http://jersey.uoregon.edu/vlab/> A large collection of physics applets with an astronomy section of ~20 applets. The quality and level of documentation varies considerably between simulations. The “Elemental Spectra” applet which illustrates spectra by clicking on an element in the periodic table is very useful. (May only work with IE and appropriate security permissions, including whitelisting the site in the Java control panel)
- Web Simulations – <http://astrosun2.astro.cornell.edu/academics/courses/astro101/java/simulations.htm> Java simulations on Stellar Parallax, Eclipsing Binary Stars, Spectroscopic Binaries, and Stella Evolution. Useful for getting at the basic concepts, but the graphics and user interfaces are primitive.
- Astronomy Workshop – <http://janus.astro.umd.edu/> A collection of resources for teaching solar system astronomy. The Flash-based Solar System Viewer at <http://janus.astro.umd.edu/SolarSystems/> is particularly useful.
- Down2Earth – [http://down2earth.eu/impact\\_calculator](http://down2earth.eu/impact_calculator) Excellent Impact Simulator
- Project Lite Spectrum Explorer – <http://lite.bu.edu/spex/v3/index.html> – A powerful tool for exploring spectra

Other Large Collections (most are older java)

- <http://www.jgiesen.de/GeoAstro/GeoAstro.htm>
- [http://galileo.phys.virginia.edu/classes/109N/more\\_stuff/Applets/home.html](http://galileo.phys.virginia.edu/classes/109N/more_stuff/Applets/home.html)
- <http://www.uni.edu/morgans/ajjar/>
- <http://astro.u-strasbg.fr/~koppen/apindex.html>
- <http://burro.astr.case.edu/JavaLab/> -- largely galaxy related
- <http://www.walter-fendt.de/> -- lots of good physics, some astronomy

## Other Simulation-Related Software

- Stellarium – <http://www.stellarium.org> A particularly visually attractive desktop planetarium that is very useful for teaching basic sky motions. Must be downloaded and installed but runs reliably on a number of platforms.
- Celestia – <https://celestiaproject.net/> Another free desktop planetarium program. Open-source with addons here (<http://www.celestiamotherlode.net/>). Must be downloaded and installed but also runs reliably on a number of platforms.
- CLEA (Contemporary Laboratory Exercises in Astronomy) -- <http://www3.gettysburg.edu/~marschal/clea/CLEAhome.html> A substantial set of PC-based astronomy laboratories involving simulated astronomical detectors. Old and no longer supported but some are salvageable (and worth it), depending on your OS version.

## References (discussing the effectiveness of teaching with simulations)

- Aldrich, C. (2005). *Learning by doing: a comprehensive guide to simulations, computer games, and pedagogy in e-learning and other educational experiences*. John Wiley and Sons.
- De Jong, T. Technological Advances in Inquiry Learning <http://users.edte.utwente.nl/jong/JongScience2006.pdf> This is a shorter version of a 1998 paper “Scientific Discovery Learning with Computer Simulations of Conceptual Domains” downloadable at <http://www.jstor.org/stable/pdfplus/1170753.pdf> that describes the great potential and obstacles involved in teaching with simulations.
- Publications of the PhET group may be found at [http://www.colorado.edu/physics/EducationIssues/research/papers\\_topic.htm](http://www.colorado.edu/physics/EducationIssues/research/papers_topic.htm) including: "PhET: Interactive simulations for teaching and learning physics", "When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment." & “A Study of Educational Simulations Part I – Engagement and Learning.”