Dan MacIsaac, Column Editor
Physics Department, SUNY-Buffalo State College,
Buffalo, NY 14222; macisadl@buffalostate.edu

This year *WebSights* is featuring a collection of select sites appropriate for teaching a standard-topic year-long introductory physics survey course. This month's column presents some sites for teaching Newton's Laws, forces, and uniform circular motion; next month will feature sites for teaching work and energy. All sites are copyrighted by the authors, and most of the sites below are typical of others of a similar genre. This column is also available as a web page at http://PhysicsEd.BuffaloState.Edu/pubs/WebSights/. If you have successfully used a site to teach physics that you feel is appropriate for WebSights, please email me the site and how you use it for teaching. The best site monthly will receive a T-shirt.

Sites for Teaching Newton's Laws, Introductory Forces, and Uniform Circular Motion

The Mechanical Universe. Fifty-two physics lessons as free video-on-demand. A great reference for teachers before teaching any topic, or as enrichment. Seven episodes cover introductory forces and motion (especially gravity and circular motion via animation) and four cover Kepler's laws, simple orbits, and (my students' favorite) simple interplanetary navigation: http://www.learner.org/resources/series42.html. DOI: 10.1119/1.1804670

Spacecraft Piloting Games. Many teachers use friction-free simulations to practice students' conceptual development of Newton's first law and circular motion. See the *Gravity* and *Little Rocket Man* games at http://www.miniclip.com. A simpler *Asteroids*-like game is at http://www.mediamacros.com/item/item-973543631/ and another is http://www.ncsu.edu/sciencejunction/station/gameroom/spacetrak/index.html. Have students write out the piloting rules for starting and stopping motion, accelerating, braking, and flying the ship in a circle. Suggested by M. Rose, F. Nochese, and J. Yap. DOI: 10.1119/1.1804671

Personal Hovercraft. Many sites describe how to make one-person plywood hovercraft powered by household vacuums and blowers. These are a lot of fun to build as student projects and are great low-friction high-inertia devices for starting Newton's laws studies. Summary at http://physicsed.buffalostate.edu/WNYPTA/meetings/2003-04/12Jun04/hover.doc. Also great for recruiting students to enroll in physics when running up and down hallways. DOI: 10.1119/1.1804672

Tutorials and Simulations for Free-Body Diagrams. Sites for classroom projection or individual review. The Guelph FBD Tutorial site includes a self-test: http://www.physics.uoguelph.ca/tutorials/fbd/FBD.htm. Glenbrook South HS has a similar tutorial at http://www.glenbrook.k12.il.us/gbssci/phys/shwave/fbd.html. Suggested by C. Olszewski and D. Pulhamus. DOI: 10.1119/1.1804673

Tutorials and Simulations for Vectors. These allow the graphical and numerical breakdown of vectors into components, add and subtract and sometimes calculate vector products. These can be used to show fast "what if" situations projected in class or to check homework problems. Components are nicely shown at http://www.pa.uky.edu/~phy211/VecArith/. Resultants are shown at http://www.walter-fendt.de/ph11e/resultant.htm. Suggested by F. Nochese. DOI: 10.1119/1.1804674

Students Like to See Newton's Laws Analyzing Their Own Bodies and Interesting Situations. Students are excited to see Newton's laws analyzing their own bodies and in particular situations. N. Childs says his students like the *Physics of Skydiving* site http://ffden-2.phys.uaf.edu/211.fall2000.web.projects/Vlad% 20Paverman/forces.htm, *Forces in Car Crashes* http://hyperphysics.phy-astr.gsu.edu/hbase/carcr.html, and the *Physics of Skiing* site http://www.hesston.edu/academic/faculty/nelsonk/PhysicsResearch/Ski/matts_page.htm, which include momentum and energy conservation. Coaches Walters and Greenhall suggest the famous Nebraska *Physics of Football* site, http://physics.unl.edu/outreach/football.html. My students like the car driving and racing analyses at http://www.miata.net/sport/Physics/ and http://rubble.ultralab.net/simulations/newton_home.htm. S. Johnston suggests *Cartoon Physics* http://world.std.com/~jimf/humor/cartoon.laws.html and *Insultingly Stupid Movie Physics* at http://www.intuitor.com/moviephysics/. Also suggested by J. Lewocz, D. Doty, K. Hebden, and K. Benson. DOI: 10.1119/1.1804675

Gravity, Orbits, and Kepler's Laws. Students love black holes. R. Romer suggests the time-lapse video data at http://www.mpe.mpg.de/ir/GC/index.php showing actual stars at our galactic core moving in orbit about an unseen object—almost certainly a black hole. The original woodcut figure from Newton's *Principia* animated to show orbital motion is found at http://www.physics.purdue.edu/class/applets/NewtonsCannon/newtmtn.html. NASA simulates Kepler's laws at http://observe.arc.nasa.gov/nasa//education/reference/orbits/orbits.html and tracks Earth satellites at http://liftoff.msfc.nasa.gov/academy/rocket_sci/satellites/. DOI: 10.1119/1.1804676

Visualizing Inclined Planes, Banked Roads, and Newton's Third Law. Animated FBDs for inclined planes at http://zebu.uoregon.edu/nsf/friction.html and banked road animations at http://courses.ncssm.edu/physics/physlets/CURVE/curveintro.htm help visualize and analyze complex 3-D scenarios. A compelling demo for showing micro-flexure in solid walls is available from http://physicsed.buffalostate.edu/pubs/TPT/TPTApr01WallFlex/. DOI: 10.1119/1.1805897

Unit-Level Curricula for Forces. Classroom worksheets, labs, and teachers' guides featuring Newtonian curricular activities include Hake's Socratic Dialog-Inducing (SDI) Labs from http://physics.indiana.edu/~sdi and the early units of the award-winning ASU Modeling Physics Curriculum, http://modeling.asu.edu/Curriculum.html. These freely downloadable and reproducible curricula are researched and reported in the literature. Suggested by F. Sita. DOI: 10.1119/1.1805898