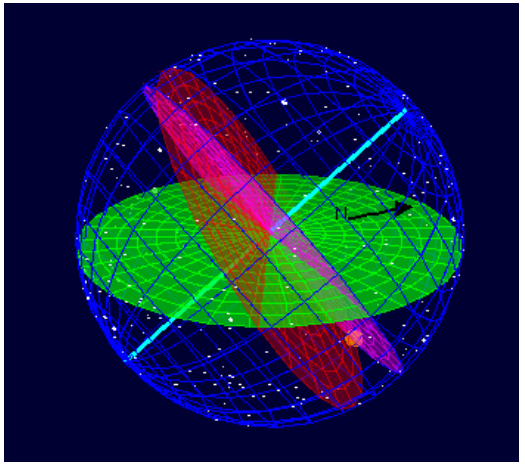
South African Institute of PHYSICS
THE VOICE OF PHYSICS IN SOUTH AFRICA

Building a National Digital Library for Computational Physics Education At All Levels

SAIP 2011 July 12-15, 2011
Pretoria, South Africa



Celestial sphere model.

Wolfgang Christian Davidson College, USA

Partial funding for OSP was obtained through NSF grant s DUE-0442581 and DUE-0937836. Opinions expressed here are not those of the NSF.

Teaching with Technology

Current technologies allow physics educators the ability to integrate instruction with computer-based modeling. This talk describes technologies that encourage interactive-engagement and limit the amount of programming when designing, implementing, distributing, and using computer models. It is based on:

- **Tracker** video analysis and modeling tool analyzes video clips. Students can both analyze the motion of objects and overlay simple dynamical models on the video and see how well the model matches the real-world.

- **Easy Java Simulations** (EJS) creates interactive simulations in Java (applications and applets) without the necessity of prior programming knowledge.

- **OSP ComPADRE Digital Library** archives and distributes curriculum resources that engage students in physics, computation, and computer modeling.

Traditional Education

The problem with our system of education is….

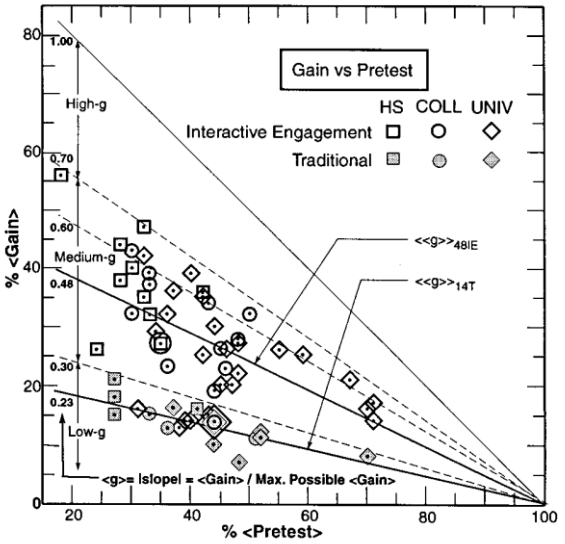
…that we reward students for knowing the answers….

….to questions they have never asked.

Interactive Engagement

- The premise of interactive engagement is that when students are not actively involved in the lesson they lose out on much of what can be learned.
- Interactive engagement has been shown to correct weaknesses of traditional instruction by engaging students in the design of physical models to describe, explain, and predict phenomena.
- Although interactive engagement can be used without computers, the use of computers allows students to study problems that are difficult and time consuming, to visualize their results, and to communicate their results with others.

Talk Premise: The combination of computer modeling with interactive engagement can motivate students and achieve additional insight and understanding.

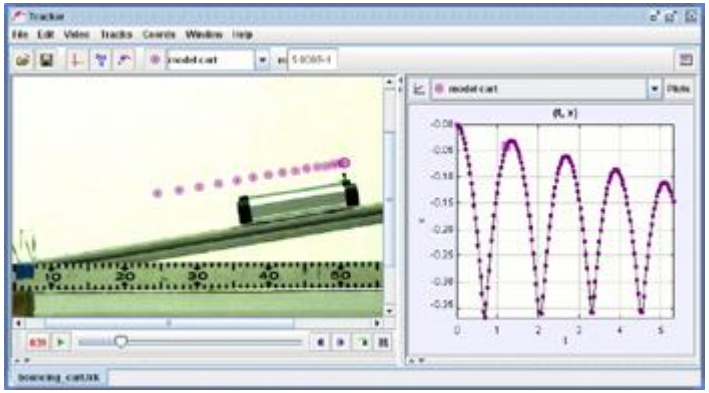


Interactive Engagement Example

Video Modeling with Tracker

Three easy steps:

- Load Video
- Set scale and origin
- Shift-click to take motion data



Pre-College Education

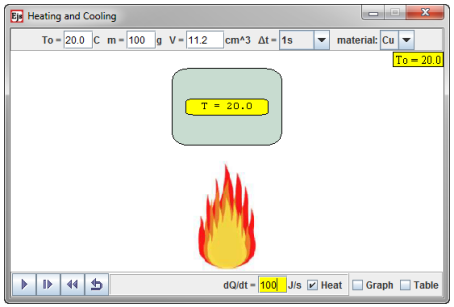
Base on a progression as described in Physics Standards for College Success by Pat Heller and Gay Stewart:

- **Interactions, Models, and Scales**
- **Conservation Principles**
- **Forces and Motion**
- **Energy Transfer and Storage**
- **Forces, Energy, and Fields**

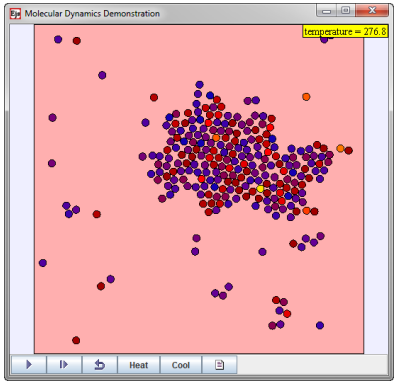
Pre-University Teaching

North Carolina COMPETENCY GOAL 6 for Middle School: The learner will conduct investigations and examine models and devices to build an understanding of the characteristics of energy transfer and/or transformation.

- Newton's model
  - Local jar
  - Lesson plan
  - Key



- Atomic model
  - Local MS jar
  - Lesson plan
  - Key

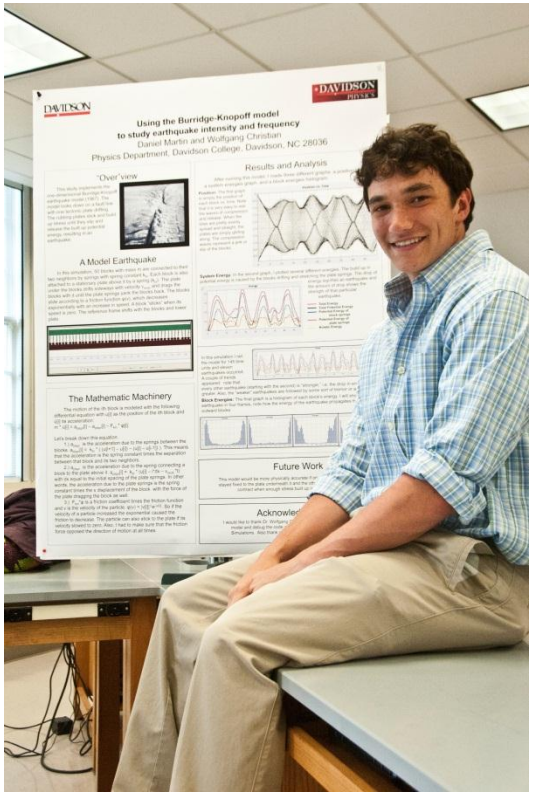


- Filing Cabinet

University Teaching

Teaching should reflect current research and professional practice. Every undergraduate physics major should know about computational physics, including essential algorithms, minimal level of programming experience, and computational ways of thinking.

- Differential equations and ODE numerical algorithms: oscillators, Newtonian orbits, and few-body problems.
- PDEs and boundary value problems: Laplace and Poisson equations.
- Stochastic models and Monte Carlo algorithms: Random walks and the Ising model.
- Chaos theory: Logistic map and driven pendulum.
- Final project of the student's choice.



Computer Modeling with EJS

Recent student projects:

- Colliding Galaxy model and 3D Colliding Galaxy model.
- Double Pendulum model.
- Swinging Atwood's Machine model.

Need for Digital Libraries

A Google search for "***pendulum***" returns 11,600,000 pages; while "***pendulum simulation***" returns 2,490 pages (The search for ***pendulum simulation*** without the quotes returns 449,000 pages).

- Most of the simulations (or animations that "fake" the physics) are inappropriate for teaching.
- There is usually no instructional material, no support materials for teachers, and no information about how these materials are correlated to state or national science standards.
- Most of these simulations also support a passive (viewing) pedagogy versus an active (interacting) pedagogy.

In order to be effective for instruction, simulations need to be easy to find, simple, adoptable, adaptable, and coupled with support content for students and teachers.

ComPADRE

We are out of the business of web hosting and let the experts do it.

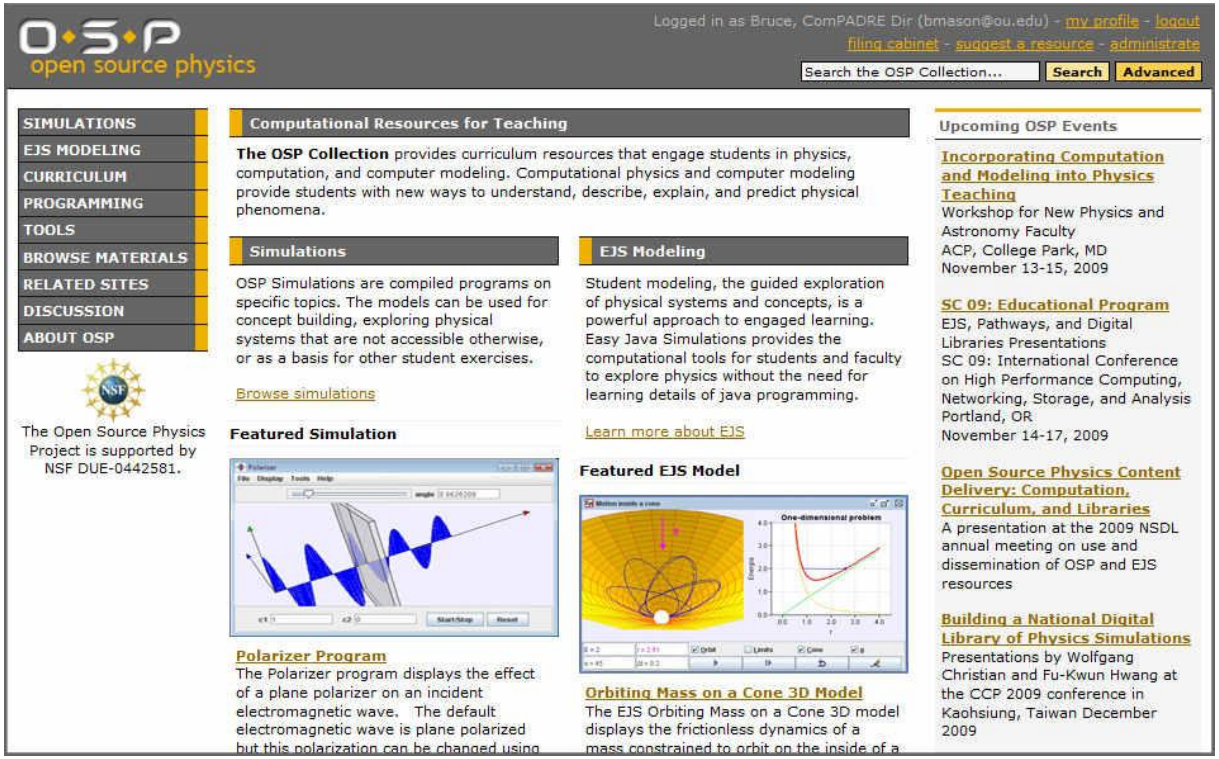
Standard and Custom Library and Web Services

Connections to Users and NSDL

400 OSP Resources

10,000+ visitors/month

5,000 simulation downloads/month



Library Information

Phases of Moon Model

written by Todd Timberlake

The EJS Phases of Moon model displays the appearance of Moon and how it changes depending on the position of Moon relative to Earth and Sun. The main window shows Earth (at the center) and Moon, as well as a circle tracing out Moon's orbit. Sun is far to the right in this picture and therefore the right side of Earth and Moon are bright while the left sides are dark. By using the Options Menu the Moon View window shows the appearance of Moon as seen from Earth when Moon is in the position shown in the main window. You can modify this simulation if you have Ejs installed by right-clicking within the plot and selecting "Open Ejs Model" from the pop-up menu item.

The EJS Phases of Moon model includes three supplemental documents (see below) that include a middle school lesson plan, a college level worksheet, and the student version of the program.

EJS Phases of Moon model was created using the Easy Java Simulations (Ejs) modeling tool. It is distributed as a ready-to-run (compiled) Java archive. Double clicking the ejs_astronomy_MoonPhases.jar file will run the program if Java is installed. Ejs is a part of the Open Source Physics Project and is designed to make it easier to access, modify, and generate computer models. Additional Ejs models for astronomy are available. They can be found by searching ComPADRE for Open Source Physics, OSP, or Ejs.

Please note that this resource requires at least version 1.5 of Java (JRE).

download 923kb .jar
Last Modified: April 14, 2010
previous versions

⊞ View the supplemental documents attached to this resource (3)

⊞ View the source code document attached to this resource

Subjects	Levels	Resource Types
Astronomy - Astronomy Education = Curricula - Fundamentals = Lunar Phases - Solar System = The Moon	- Lower Undergraduate - Middle School - High School	- Instructional Material = Curriculum support = Interactive Simulation - Audio/Visual = Image/Image Set

Intended Users	Formats	Ratings
- Learners - Educators - General Publics	- application/java	★★★★★ Rated **5.0 stars** by 9 people Want to rate this material? Login here!

Item Details | Related (2) | Standards (7) | Comments (3) | Cite | Shared Folders (13)

Save to my folders

Supplements
Standards (7)
Comments (3)
Shared Folders (13)

Contribute
Make a Comment
Relate this resource
Contact us

Related Materials
Is Based On
Easy Java Simulations Modeling and Authoring Tool
Is the Basis For
www.phy.ntnu.edu.t...
See details...

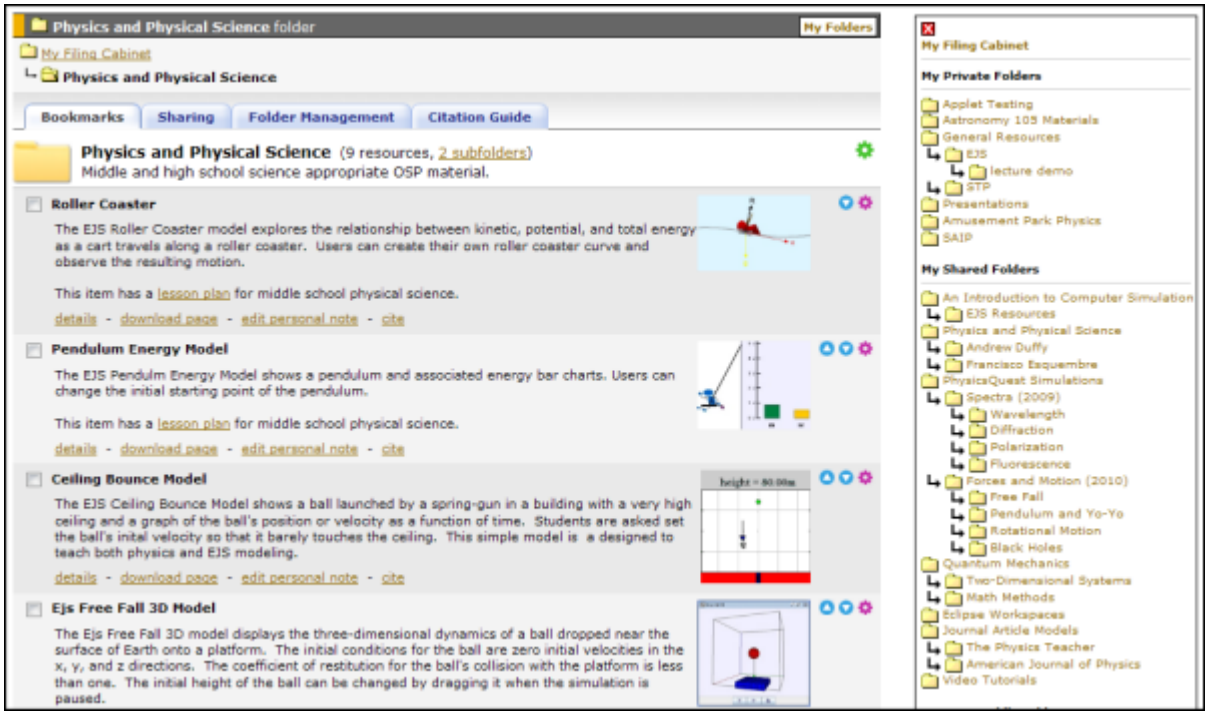
Similar Materials
Phases of Venus Model
Solar and Lunar Eclipse Model
Superior Ptolemaic Model
More...

Featured By
Open Source Physics
Nov 11 - Aug 31, 2011
Physics Front
May 3 - Jun 3, 2011

Personalization

Content …

- **Find**
- **Collect**
- **Sort**
- **Relate**
- **Annotate**
- **Share**



OSP Collection Team

- **OSP Managing Editor:**
  - Wolfgang Christian - Davidson College
- **OSP and EJS Curriculum Authors:**
  - Mario Belloni - Davidson College
  - Anne Cox - Eckerd College
  - Fu-Kwun Hwang – National Taiwan Normal University
  - Harvey Gould - Clark University
  - Jan Tobochnik - Kalamazoo College
- **Tracker and OSP Tools Developer:**
  - Doug Brown - Cabrillo College
- **Easy Java Simulations Developer:**
  - Francisco Esquembre - Universidad de Murcia
- **OSP Java Library Editor:**
  - Wolfgang Christian - Davidson College
- **ComPADRE :**
  - Bruce Mason – University of Oklahoma
  - Lyle Barbato- AAPT
  - Matt Riggsbee- AAPT
  - Caroline Hall- AAPT

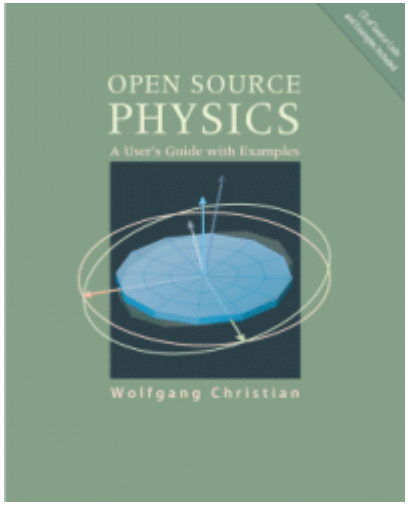
Summary

The **OSP-EJS-ComPADRE platform** removes many of the complicated tasks involved in integrating computation into the classroom allowing teachers to focus on the science.

- OSP provides the computational structure, including a computational physics textbook, for our project.
- EJS allows learners to engage in computational physics modeling.
- EJS encourages the sharing of curricular materials by allowing instructors to adapt existing EJS models to their particular needs.
- ComPADRE supports distribution and collaboration by providing an internet portal and a web service of models that are directly downloadable into the EJS modeling tool.

The OSP Collection in ComPADRE is a repository where programs, models, and curricular materials can be organized and shared by developers and instructors around the world.

The ComPADRE OSP Collection



In 2010, the OSP Collection had 500,000 page views and 10,000 visitors who visited the site six or more times. More importantly, there were 50,000 simulations downloaded from the Collection and an additional 5,000 downloads from within EJS into users' workspaces. The OSP Collection is also recognized by over 22% of United States physics faculty as a research-based instructional strategy they are familiar with or have used.

www.compadre.org/osp

Partial funding for OSP was obtained through NSF grant DUE-0442581.