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EASY JAVA SIMULATIONS 101.5 BY KARIM DIFF

During the 20th century, nuclear physicists and chemists spent a fair amount of time measuring the half-life of radioactive elements. That is, the time it takes for half the amount of an initial quantity of radioactive material to decay. I often wonder whether instruction follows a similar pattern, but I have yet to find the energy and time to measure the "half-life of instruction" in my classes. Although less toxic than Plutonium, EJS seems to wither away much faster, so I would like to ask you: What time scale should we use to measure the half-life of EJS? Weeks,days? Hours perhaps? Please let me know.

These past few days I have made everyone on my campus laugh by sending them a link to a hilarious video available on YouTube about the difficulties with new technology. I am sure you will enjoy it as well: http://www.youtube.com/watch?v=xFAWR6hzZek
or http://www.devilducky.com/media/57946/

On the assumption that unless you have diligently built simulations every week-end, as suggested by your doctor, some of the details of building an EJS simulation may escape you at this very minute, let me offer a quick reminder of the sequence of steps in the table below. I will assume we are going to put a ball in the middle of the screen and attach an arrow to it to display its velocity.

Steps to building a simulation using EJS

Step #	Object to create	Location within EJS
1	"Frame"	View/Elements for the view/Swing/Containers/
2	"Drawing Panel"	View/Elements for the view/Swing/Containers/
3	"Particle"	View/Elements for the view/Drawables/Basic/
4	"Arrow"	View/Elements for the view/Drawables/Basic/

To check that everything works, click on the green arrow on the far right of the EJS panel and you should see the ball with a little blue arrow stick out of it. Not exactly the most exciting simulation, but if it has been a while since you played with EJS, I am sure you will take every little victory you can grab for now.

One of the confusing things about EJS, at least to me, is to decide whether what I see is the actual simulation or the EJS working window. If you look at the name that appears on the border of the window you should be able to see that one of them is called "Frame(Ejs window)" and the other is simply "Frame". The latter is your actual simulation. If you get tired of the generic "Frame", go back to the View (at the top of the EJ work environment you should see "Introduction", "Model", and "View") and double-click on the frame to open up its properties, and change the title to something more appealing. I mentioned the half-life of instructions earlier, and the commands to use a Mac last only a few hours in my case. So forgive me if I don't provide here the steps for EJS on a Mac. Speaking of Macs, if you are tired of those pesky TV ads where Mac is so cool watch this: http://www.youtube.com/watch?v=qC7jOLZd-mw

Going back to that arrow and ball simulation, unless you tell EJS how to make the ball move it is going to just sit there and stare at you. To get the ball moving you will need to do a number of things:

- Declare a set of variables. To do this switch to "Model" then select "Variables" and click to create a new page. The variables needed include at least:
  - the position ***x*** of the ball, unless you decide to make it move along the y axis or both the x and y axes
  - the time increment ***dt***, which tells EJS how often to update the simulation
  - the velocity ***v*** of the ball if you want it to move a constant speed. If you want to make the ball accelerate you will have to think about acceleration as well.
  - Choose small number if you don't want the ball to zip across the screen before you see it. Try 0.1 for the velocity and 0.02 for dt.
- Explain to EJS how the ball moves (i.e. write an equation). Within "Model" select "Evolution" and then click to create a new evolution page (be careful not to pick the Differential Equation page). In that page type the following if you used x, v, dt as variables.
  - x = x + (v * dt); (the semi-colon at the end is needed, it is part of the Java syntax)
- Attach the arrow to the ball and make it point in the right direction. Go back to the "View", click on the arrow and fill-in its properties as follows:
  - Position X : click on the link icon and select x (the ball's position)
  - Size X: use the link to select v (the ball's velocity)
  - Size Y: 0 this will force the arrow to point in only the horizontal direction as it should
  - Scale X: 4 this is a scale factor that makes the arrow look a little bigger, and easier to see
  - Leave all the other options unchecked (you can always play with them later)

This should do it. Click on the green arrow to run the simulation and check one more time that everything works fine. If you see the ball move slowly to the right with the arrow pointing in the correct direction, do the following very quickly:

- Save the simulation before everything crashes (remember where you put it though)
- Close EJS and give yourself a pat in the back for a job well done!

Unless you've been hit by the "geekiness" bug, you may want to take a break here and come back later to add some features that will make your simulation look more interesting.

This semester at Santa Fe we are experimenting with a new curriculum, ICP21 developed under the direction of Alex Dickison at Seminole CC, and we needed a simple simulation of Coulomb's law to go with the rest of the hands-on activities of that module. I put together this simulation: http://inst.sfcc.edu/%7Enatsci/physics/simulations/electric_force_sim.htm

It is bare, and could use some improvements, but it worked well for now. We used it with a set of instructions to help students "discover" Coulomb's law by taking data for the value of the force as a function of position and charge (Jane Nelson wrote the instructions). I adjusted the controls so that the charges and forces change color depending on their sign. If you want to use it, or would like to improve it, let me know and I'll send you the EJS file.

Don't forget: You need to keep working on your programming skills, otherwise 5 years from now, all you will remember is what you could have learned at the 5 minutes university. http://www.youtube.com/watch?v=DRBW8eJGTVs

Karim Diff is at Santa Fe Community College. karim.diff@sfcc.edu

What did you learn participating in a Physics Workshop? How did you incorporate it into your classroom? How has it enhanced learning for your students? PWEN welcomes papers regarding your workshop experiences. In all submissions, please include the paper title and the author's name, school, and e-mail address. Submit workshop papers to Tom O'Kuma (tokuma@lee.edu) and Dwain Desbien (dwaindesbien@estrellamountain.edu).

Find information and apply now for upcoming workshops at www.physicsworkshops.org.

Currently scheduled workshops include:

Adaptable Curriculums for Introductory Physics (ACIP) Workshop, April 12-14,2007, at Florence-Darlington Technical College in Florence, SC. Joshua Phiri is the local site host. See website for workshop description.

Data Visualization Techniques and Strategies (DVTS) Workshop, June 28-30, 2007, at Mt. San Antonio College in Walnut, CA. Martin Mason is the local site host. See website for workshop description.

USING PhET SIMULATIONS TO IMPLEMENT DC CIRCUIT TIPERS

BY PAUL WILLIAMS

The Physics Education Technology (PhET) website developed at the University of Colorado (http://phet.colorado.edu) provides over 50 Physics simulations on topics ranging from 1-d motion to nuclear chain reactions. This semester I have made use of one of the simulations, the Circuit Construction Kit (CCK), to implement tipers as a small group activity during the lecture portion of a section of Conceptual Physics II. As an added wrinkle, students have been using clickers to record their answers to the tipers.

The CCK allows you to build DC circuits with elements including batteries, light bulbs, wires, and resistors. You can also insert ammeters into the circuit and use a voltmeter. Features such as internal resistance of the battery and resistance of the connecting wires and resistors and light bulbs are adjustable. In addition, the CCK shows electrons as blue spheres that move when current flows. Figures 1 to 3 give several examples of circuits built with the CCK. As an aid to class preparation, circuits built with the CCK can be saved and loaded into the CCK when needed.

Coupling tipers with simulations is a great way to make simulations a valuable teaching tool. Students pay attention to simulations when they have to obtain information from them in order to complete a task or if viewing the simulation will resolve an open question. The tipers that I implemented were designed to target some of the most common student difficulties in DC circuits. Many of these difficulties are summarized in *Five Easy Lessons* by Randall Knight. As one example I used a *ranking task* to confront the difficulty students have with a battery as a source of constant potential difference. Figure 1 shows a screen shot shown to the students of an open circuit and circuits with one, two, and three light bulbs in series. The students' task was to rank the potential differences measured between the terminals of the battery. Typically ranking tasks have six to eight variations to more fully probe different student models. Having students communicate their rankings with clickers necessitated a smaller number of choices, but at least three different common student models could be addressed with this task – including constant potential difference, a consumption model such as more resistors less potential difference, and a demand model such as more resistors more potential difference. The simulation was run and the terminal voltage (the internal resistance of the battery was set to 0) of the battery was measured with the CCK's voltmeter.

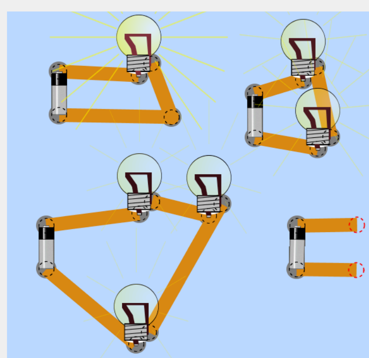


Figure 1. Four different "circuits" used for ranking task on terminal voltage of battery

As a second example, figure 2 shows a screen shot shown to students as part of a *what if anything is wrong task*. The figure shows ammeter readings that might be predicted by a student with a consumption model of current in a series circuit. The students were asked what if anything was wrong with the prediction. They responded with clickers with the choices including the prediction was correct, the constant current model, and several other variations of consumption models. After recording the answers, the simulation was run demonstrating that the current was constant in the circuit.

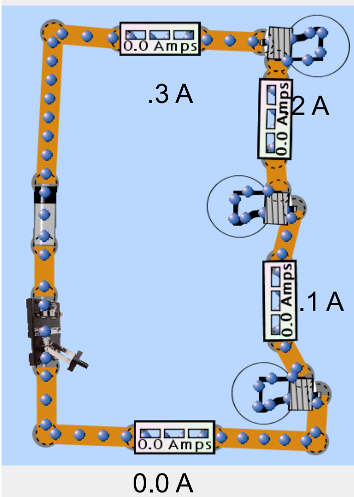


Figure 2 Circuit for what if anything is wrong task on electric current in a series circuit.

Other variations of tipers are possible. Figure 3 shows a circuit that was used as part of a *predict and explain* task. The students were asked to predict what would happen to the brightness of the light bulbs and the reading on the ammeter when an additional light bulb was added in parallel. Reasoning tasks involving brightness of light bulbs are quite difficult for students. They have to conceptually identify both how the potential difference and the current are affected when the switch is closed in order to answer questions about the brightness of the light bulb. Developing student reasoning with simpler circuits with two or three light bulbs is a valuable step prior to giving them a task such as ranking six light bulbs connected in various combinations of series and parallel.

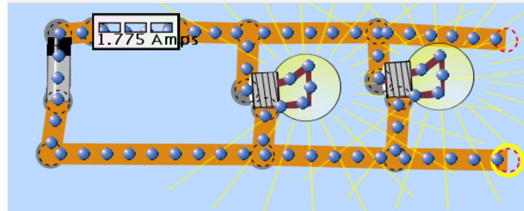


Figure 3 Circuit used for predict and explain task for parallel circuits

The CCK has been a great tool for developing simulation based tipers. It is easy to use and can be used in a number of ways.

Paul Williams is at Austin Community College.

American Association of Physics Teachers: Find information at www.aapt.org.

AAPT reminders:

Abstract submission deadline is March 15th.

2007 Summer Meeting, Greensboro, NC, July 28-August 1, 2007

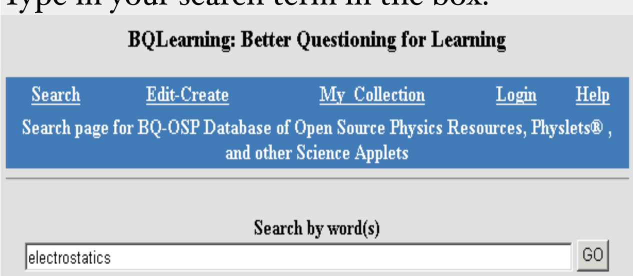
NAVIGATING THE DATABASE OF PHYSLET-OSP RESOURCES

BY ANNE COX

One of the resources you encountered as a part of the ASIP workshop was the Physlet-OSP Database at www.bqlearning.org. This is an easy way to deliver Physlet resources to your students for free. However, if you haven't used it recently, some reminders may be in order. As an instructor, you can either login into the database or simply choose to search without logging in (students do not need to login). The differences are as follows:

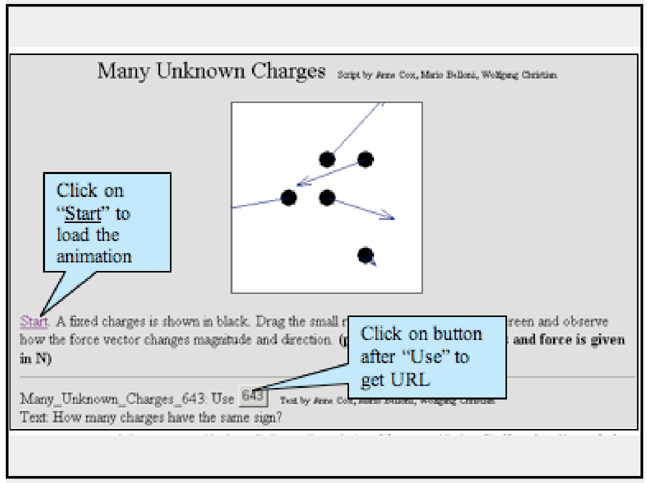
Database Use	Login	Don't Login
1) Search	yes	yes
2) Get URL of resource you want to use with students	yes	yes
3) Generate a course page (of links) for students associated with your school	yes	no
4) Modify resources	yes	no

1) Search: Go to http://www.bqlearning.org/. Type in your search term in the box:

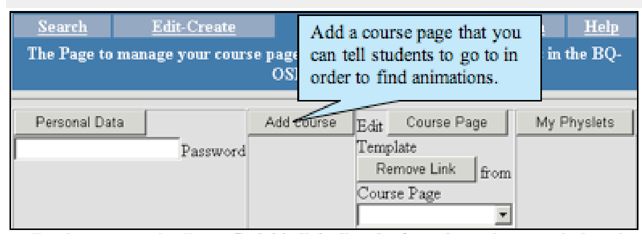


or Click on "Search" and browse by topic.

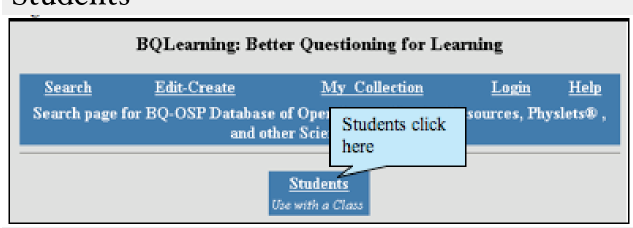
2) Get URL of resource you want to use with students:



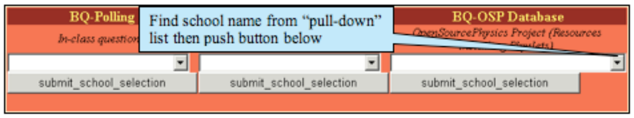
3) Generate a page with course links (Must Login): Choose "My Collection" and then "Add course," follow the instructions and then find a resource and add it as a link.



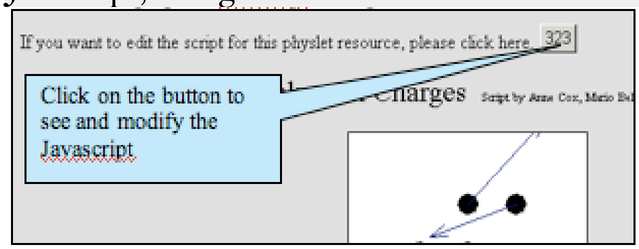
Students (Login not required) can find this link directly from the main www.bqlearning.org and clicking on "Students"



and then pulling down your school name from the BQ-OSP Database (right-hand column) and then push the "submit_school_selection" button:



4) Modify resources: Changing the Javascript, changes the animation:



Of course, if you have questions or encounter difficulties, contact Anne at coxaj@eckerd.edu. Also, if you want a local version of the database (to run on PC, also contact Anne.)

Anne Cox is at Eckerd College.

Find information for future workshops at www.physicsworkshops.org.

Future workshops include:

DVTS Workshop, Fall 2007, at Howard Community College in Columbia, MD. Russ Poch is the local site host. This workshop will be primarily on MBL (microcomputer-based laboratories) and new developments in data visualization techniques and strategies.

Instructional Strategies in Introductory Physics (ISIP) Workshop, November 8-10, 2007, at Lee College in Baytown, TX. Tom O'Kuma is the local site host.

New Faculty Training for Two-Year College Physics Faculty, March 6-8, 2008, at Delta College in University Center, MI. Scott Schultz is the local site host. This conference is for new physics faculty (in their first five years of teaching at a TYC) to provide training and experiences with technologies, curriculum models, and innovations that have been successfully implemented at TYCs.

TEACHING WITH PHYSLETS AND INTERACTIVE CURRICULAR MATERIALS

BY MARIO BELLONI

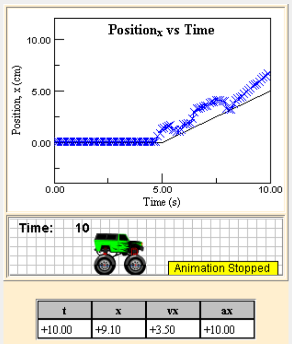
I was asked to write a short article on using Physlet- and OSP-based curricular materials in the classroom. As it turns out, I am beginning my first-semester algebra-based introductory physics course this week and so many of these issues are fresh in my mind. Perhaps like you, I hate the first week of the semester. I am faced with thirty to forty new students that do not know anything about Physlets and are indifferent to or skeptical about interactive teaching methods. After all, they survived all their other science courses at Davidson (and before) without worrying about such things. I think that there are a few important considerations:

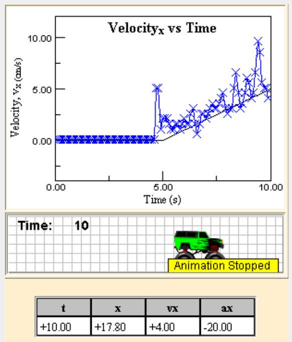
- **Motivate your students.** Given that many students will not immediately see value in interactive methods, you will need to motivate these methods. If students know that there is a reason to your technique, especially that these techniques are more effective than the standard, they often buy into the process. Some of them may still resist, but be persistent.
- **Motivate your administration.** Given students' resistance, making sure that you have the support of your administration is often crucial. Interactive teaching methods have been shown to increase student understanding, but they require both more work by the teacher and by the students. Even at Davidson there is resistance (some faculty and some students) to interactive teaching methods. As part of my tenure dossier, I wrote the following statement about why I taught the way I did:

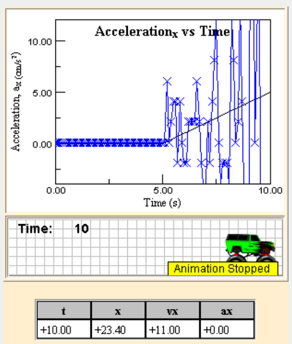
> "Student course evaluations of my teaching and my teaching methods have always been overwhelmingly positive. More importantly, however, students understand more physics when they are taught using this approach."

- **Give a low-stakes introduction.** At Davidson we have a Lab #0 which is an introduction. Students access this preliminary exercise from our computer-based introductory physics lab and are therefore all guaranteed that the exercise will run and that they will all be successful.
- **Give your best exemplar as the first example.** Do not overestimate the power of "lying" to your students! Not all exercises are as fun as others, so demonstrate an exemplary exercise early in the course even if it does not quite fit. If there is some humor in it, even better. (I have gotten a lot of mileage from my "yellow Lamborghini" joke.) In our Lab # 0 we also have students do a Physlet-

based matching motion (match position, then velocity, then acceleration graphs) exercise which is both rather educational and entertaining and relates to the later use of "motion sensors."



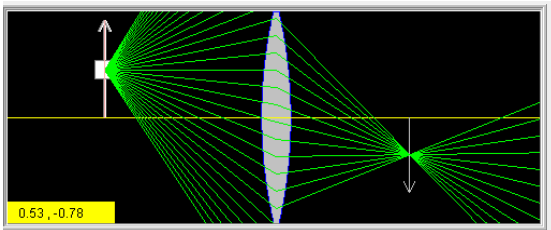


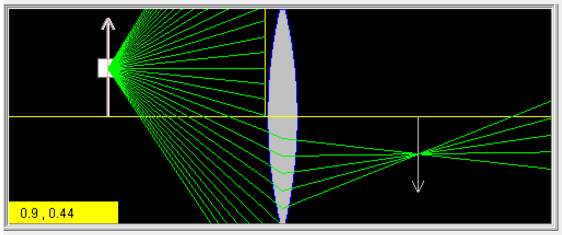


A virtual position, velocity, and acceleration matching exercise from Laboratory #0 at Davidson College. Students drag the rear bumper of the monster truck to try and mimic the given curve. This exercise can be found at: http://webphysics.davidson.edu/Course_Material/Py120L/Lab0/JiTT.html.

- **Don't go overboard.** You have just found or written the "Best Physlet Ever," and you want everyone to know about it. Resist the temptation to do too much. I typically do not show more than one Physlet-based example per class period. I could show many more, but it seems to be counterproductive. Because my class is a mix of lecture, student problem solving, interactive exercises, Just-in-Time Teaching, and Peer Instruction, doing more of one comes at the expense of another technique.

Having a multi-pronged teaching approach allows me to "offer" something for most students. I am sure you are all familiar with the image-formation (tutorial) question, "What image will result when you block off half of a lens with a screen?" In the fall, I asked my class this question, and had them predict their results after seeing the simulation (left) from "Exploration 35.1" in *Physlet Physics*. I then asked them to test their results with a real source, lens, and screen. Only then could they look at the simulation with the screen in front of the lens (right). Half of the class initially determined that there should be a dimmer image and the other half predicted only half of the image would show up. When they conducted the experiment those that predicted incorrectly had a common refrain, "that's weird!" Then everyone analyzed the simulation and both groups could easily visualize why the dimmer image actually results.





Exploration 35.1" in *Physlet Physics.* The box on the arrow (source) represents the diverging rays from that point on the arrow and it can be moved up and down to show how the image is formed (left). In the second part of the exercise, a screen can be added (right).

- **Don't assign an interactive exercise as busywork.** Do not do or assign an interactive exercise just because you want one. The exercises you show to your class and assign as homework should have a purpose.
- **Use materials as a natural extension of classroom discussion.** Do not have interactive exercise time at the beginning or end of class. Instead, introduce interactive exercises as part of the topic you are discussing, introducing it where it fits. This time may be at the beginning of class, middle of class, or at the end of class.
- **Blame me (or Wolfgang or Anne) and praise yourself.** Things do not always go as planned. Keep yourself above the fray and blame me (or Wolfgang or Anne) when things do not work the way they are supposed to. Say it is a bug and you will e-mail the authors and they will fix the problem (because they are friends of yours). On the contrary, when something works well that you have created (or borrowed), take the credit.

Finally, have fun and your students will too. When you introduce something interactive, you and your students should be having fun.

Mario Belloni is at Davidson College.

Photograph:

ASIP Workshop, Lee College, Oct. 2006

"Education is what remains after one has forgotten everything he learned in school."

---Albert Einstein

ONLINE ANIMATIONS FOR THE PHYSICS CLASSROOM

BY BRIAN LAMORE

Java simulations or animations, or "Applets," are commonly available from a variety of sources on the Internet. One need only Google a topic followed by the work "applet," and many sources are likely to appear. For example, a search for "projectile motion applet" returns a variety of links to animations that could be very helpful to students in both high school and college level physics courses.

A great advantage these physics applets, or "Physlets[1]," as they are sometimes called, provide is they immediately and cost-effectively increase the level of technology in the classroom. Another great advantage is they are essentially free. The only equipment you need is a computer connected to the Internet. A classroom LCD projector is also needed if each student does not have access to a computer.

There are some drawbacks to employing online applets, however. Because they are free, they are not guaranteed to be bug-free, may not run on all platforms and browsers, are vulnerable to network troubles, and may unexpectedly "go away" (i.e., 404 error). The lesson here is to try them before class to be sure all is in order.

Here are some links to some physics applets and some notes as to how I have used them in my own physics classroom.

Link:
http://www.falstad.com/mathphysics.html
Topic: Virtual Ripple Tank
Notes: One of my favorites. You can spend an entire class period just playing with this incredibly powerful applet.
Students can explore concepts such as waves, reflection, refraction, diffraction, interference, and the Doppler Effect. The 3-D View is an excellent feature.

Link:
http://surendranath.tripod.com/Applets/Optics/Slits/SingleSlit/SnglSltApplet.html
Topic: Single Slit Diffraction
Notes: This applet may be used as students are exploring the phenomenon of diffraction. The students can see there is a relationship between the diffraction pattern and wavelength of light and slit width. The author, Reddy Surendranath, has produced many other excellent applets.

Link:
http://www.walter-fendt.de/ph14e/singleslit.htm
Topic: Single Slit Diffraction
Notes: One of many excellent applets from Walter Fendt. This applet is similar to the applet above, but also shows an intensity profile.

Link:
http://www.walter-fendt.de/ph14e/stlwaves.htm
Topic: Standing Longitudinal Wave
Notes: Great explanation of a sound wave produced when you blow across the top of a bottle. When sound is produced, do the air particles move from one end of the pipe to the other?

[1] "Physlet Physics: Interactive Illustrations, Explorations, and Problems For Introductory Physics", Wolfgang Christian and Mario Belloni, Pearson Education, Inc., 2004

Link:
http://illuminations.nctm.org/tools/soundwave/
Topic: Sound Produced By A Vibrating String
Notes: Shows relationship between transverse wave in the vibrating string and longitudinal sound wave produced.
Questions for students: How does string displacement change the sound intensity? How does it change the pitch? How does the string tension affect the intensity? The pitch?

Link:
http://phet.colorado.edu/web-pages/simulations-base.html
Topic: Sound
Notes: Phet is a *superb* source of physics applets! The sound applet allows students to measure wavelength and compare it to the frequency, investigate interference, and sound intensity versus distance. Tired of the Bell-in-a-Jar Demo? Try the simulation that removes the air from around the speaker. Simulations may be downloaded if you don't have Internet access.

Good luck using these and other applets you find. Be sure to bookmark your favorites. After a short time you should have your own library of physics applet resources.

Brian Lamore is at The Chinquapin School.

ATE Program for Physics Faculty Project Supported by Lee College (TX), Estrella Mountain Community College (AZ), and a grant from the Advanced Technological Education Program of the National Science Foundation (NSF #0603272)
http://www.physicsworkshops.org

Ginny Saiki-Desbien, Editor, Buckeye, AZ
gindesbien@cox.net

"We can't solve problems by using the same kind of thinking we used when we created them."

---**Albert Einstein**