Physics with CBL™

by John Gastineau, Ken Appel, Clarence Bakken, Richard Sorensen, and David Vernier

We are very excited about our new *Physics with CBL* book. Students will enjoy doing these physics experiments using the versatile and portable CBL. It is especially exciting for us, because it completes the sequence of books we started producing several years ago. We now have a *Biology with CBL, Chemistry with CBL, Physical Science with CBL,* and *Physics with CBL.*

Physics with CBL includes most of the experiments in our *Physics with Computers* book, with some extra labs that take advantage of the portability of the CBL. There are 34 experiments in all. We use motion detectors, force sensors, photogates, microphones, magnetic field sensors, light sensors, voltage probes, accelerometers, and current and voltage probes.

Like all of our other books, *Physics with CBL* includes disks with the word processing files of the student handouts. This means you can edit the experiments and change them if you choose. The disks also include our PHYSICS program for the TI-82, TI-83, TI-86, TI-89, and TI-92. Any of these calculators can be used for *Physics with CBL* labs.

Some of the experiments in *Physics with CBL* are

- Ball Toss
- Newton's Second Law
- Bungee Jump Accelerations
- Centripetal Accelerations on a Turntable
- Simple Harmonic Motion
- Accelerations in the Real World
- Impulse and Momentum
- Speed of Sound
- Magnetic Field in a Coil
- Electrical Energy

Physics with CBL (includes 310-page book and two disks) .... PWCBL $35.00

CBL News

by Rick Sorensen

A New Calculator: TI-89 (NEW!)

We are now shipping the TI-89, a calculator for advanced math, science, and engineering students. This new calculator is basically a TI-92 that has been put into a TI-83-type case. It lacks the keyboard and the geometry application of the TI-92; however, it has 500K of memory, 188K of RAM and 384K for data or program archive. It has plenty of room for calculator programs and data. Like the TI-86, it has Flash ROM, so it can be upgraded electronically. At $138, it is less expensive than the TI-92. Other valuable features include symbolic manipulation of mathematical expressions, symbolic differential equation solving, 3-D rotation and contour plots, units of measure and unit conversion, and constants with symbolic units.
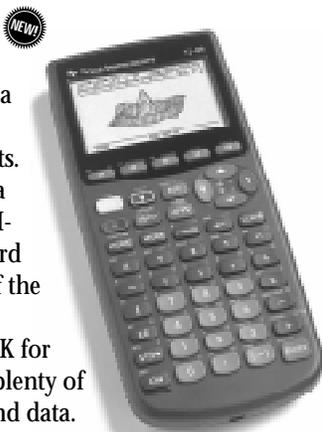
CBL™ Made Easy! (NEW!)

We have finished a new (free!) manual to help CBL users through the sometimes bumpy road of getting started with CBL data collection. Using *CBL Made Easy*, new CBL owners will find it easier to learn the ropes of loading Graph Link software, downloading programs onto a graphing calculator, and collecting data for the first time. Our own Erik Schmidt has written a compact manual that shows users everything they need to know. After learning how to get up and running, you can try our short tutorial for collecting temperature data. You will learn how to do more advanced tasks, such as uploading data to a computer via TI-Graph Link software or with our Graphical Analysis program. You will also learn how to print graphs and data tables. An extensive troubleshooting guide is included for those times when things don't work the way you expected.
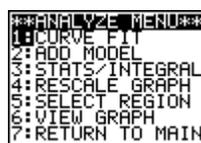
To obtain this guide, visit our web site at www.vernier.com, click on Free Stuff, and follow the directions to view or download *CBL Made Easy!* Or, you can order (at no cost) *CBL Made Easy!* (order code CME) and we will mail you a printed copy.

Programs for New Calculators

We recently wrote versions of our popular CHEMBIO and PHYSICS programs for the new TI-73, TI-89, and TI-92 Plus calculators. We also created a TI-73 version of PHYSCI for *Physical Science with CBL.* You can download these programs, along with all of our calculator programs, from our web site.
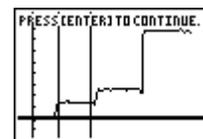
Revised PHYSICS Program

We made major improvements to our PHYSICS program as we wrote *Physics with CBL.* The Main Menu was changed to make it easier to collect and analyze data, but the biggest change was the addition of analysis tools you can use from within the program.

```
***MAIN MENU***
1:SET UP PROBES
2:COLLECT DATA
3:ANALYZE
4:TRIGGERING
5:ZERO PROBES
6:RETRIEVE DATA
7:QUIT
```

```
**ANALYZE MENU**
1:CURVE FIT
2:ADD MODEL
3:STATS/INTEGRAL
4:RESCALE GRAPH
5:SELECT REGION
6:VIEW GRAPH
7:RETURN TO MAIN
```

When you choose Analyze on the Main Menu, this menu appears. The first three options are new features. You can use the Curve Fit option to fit a variety of functions to the data. Add Model is used to overlay any function on the data. Stats/Integral is used to determine either the statistics or the integral of a portion of the data.

For example, in this *Physics with CBL* experiment, students use a Low-g Accelerometer to measure centripetal acceleration on a turntable as it is switched from 33-1/3, to 45, and finally 78 rpm. Here the 33-1/3 rpm region of data is being analyzed.

```
MEAN:      1.397
MIN:       1.283
MAX:       1.540
STD DEV:    .075
N:        18.000

          [ENTER]
```

In this run, the average centripetal acceleration near the end of the turntable at 33-1/3 rpm was 1.397 m/s². The PHYSICS program is included with *Physics with CBL,* or it can be download from our web site.

Updates to Graph Link Software

Did you realize you can get the latest versions of TI-Graph Link software from the TI web site? Just point your web browser to www.ti.com/calc/docs/link.htm. You can also get electronic copies of some of the Graph Link guidebooks.

Until recently, the Windows version of Graph Link worked only on Windows 3.1, 95, and 98, not on Windows NT. TI has developed a new version of the Windows software that supports Windows NT 4.0. This software can be downloaded from the TI web site. Users have reported problems using Graph Link on Macintosh G3 computers. This problem has been fixed and the new program can be downloaded from the TI web site.
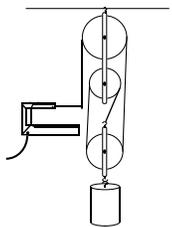
Physics

We recently updated the experiment files that support our physics-related curricular material. All of the following are now available in the "Free Stuff" section of our web site (www.vernier.com). If you do not have internet access, contact us and we will send the files on disk.

RealTime Physics

New versions of *RealTime Physics-Motion and Force* and *RealTime Physics-Heat and Temperature* are now available from John Wiley Publishing. We have updated our experiment files to match these new volumes. The files can be found on our web site in all the following formats: Logger *Pro* for Windows, Logger *Pro* for Macintosh, Data Logger/MacMotion/ MacTemp for Macintosh, Data Logger/ Motion/Temperature for MS-DOS.

Physics with Computers
*(experiment files for older computers and MPLI for Windows)*

Our new *Physics with Computers* book was written assuming that you are using Logger *Pro* software. If you have older computers that cannot run Logger *Pro,* we can make it easier for you to do these labs. We now have the experiment files for each of the experiments set up to be run using a ULI on older Macs and MS-DOS versions of our programs (Data Logger, MacMotion/Motion, Sound, etc). We also have files for use with MPLI for Windows for everything except the photogate experiments.

Demonstration Ideas
The October 1998 issue of *The Physics Teacher* has a good demonstration of coupled oscillations. The article is by Charles A. Sawicki (North Dakota State University). He uses our Magnetic Field Sensor to study a pendulum made of two small disk refrigerator magnets. If you set things up just right, energy is transferred between the torsional motion of the magnets and the pendulum motion. Very small motions of the magnet are involved.

At the Two-Year College Physics MBL II workshop at Forsyth Technical Community College, Winston-Salem, NC there was a nice demonstration of mutual induction using our Current & Voltage Probe System. Connect a large solenoid to a battery with one current probe and a switch in series. Connect a second solenoid to the other current probe and nothing else. Start data collection and you can nicely show the induced current in the second solenoid each time you close or open the switch. Thanks to Roger King (Southwestern Michigan College), Ntungwa Maasha (Coastal Georgia CC), and Dennis Richman (Waukesha County Technical College) for the idea.
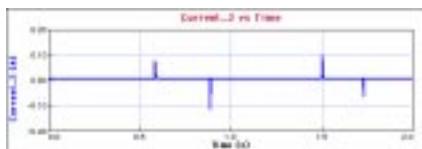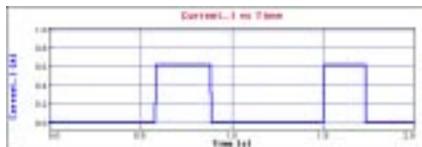
Project PHYSLab '99
Project PHYSLab will again be held at three sites next summer:

Omaha, NE: June 21–July 9
Palo Alto, CA: June 28–July 16
Portland, OR: July 5–July 23

Last summer's workshops were very popular and successful. These 3-week workshops include computer interfacing, spreadsheets, physics software, internet instruction, and low-cost physics equipment. Lodging, food, travel allowance, and a stipend are provided. Graduate credit is available. Contact Lowell G. Herr, The Catlin Gabel School, 8825 SW Barnes Rd., Portland, OR 97225, lherr@physlab.catlin.edu, http://physlab.catlin.edu.

Gordon Hoffman, a physicist from Portland, OR, took a trip across the Pacific Ocean on a container ship. He had with him a ULI and a 3-Axis Accelerometer (order code 3D-DIN). Here are some acceleration data during the worst storm on this unstabilized ship. It shows the net acceleration (magnitude of the vector sum of the three accelerations). For comparison, when we have taken measurements on a stabilized cruise ship, the maximum acceleration is typically about 0.6 m/s^2. On this voyage, the accelerations were 2 m/s^2.
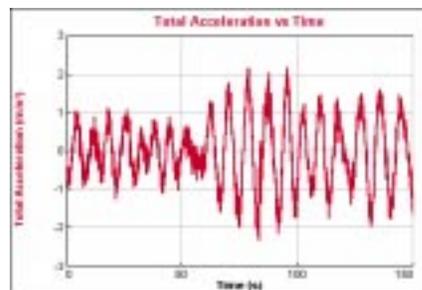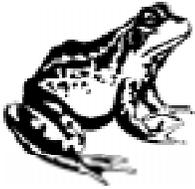
Biology

by Scott Holman

A Transpirational Seal

A number of teachers tell us that the most difficult part of performing the Transpiration experiment from *Biology with Computers* and *Biology with CBL* is getting a tight seal at the plant-tubing junction. We recently obtained a plastic hose clamp from Cole Parmer Instrument Company that solves this problem. In the past, it was necessary to select a portion of the plant stem slightly larger than the opening of the plastic tubing. The plant stem was then forced into the tubing, providing most of the seal and preventing any loss of water from the tubing. This is difficult to do and can lead to damaging the plant stem. Using the plastic hose clamp shown in Figure 1, the plant stem can be smaller than the tubing opening and still maintain a water-tight seal around the plant stem. The clamps are reusable and come from Cole Parmer in packages of 100 for $17.00 (Cat. #FK-06832-01). While 100 clamps may seem like a lot, it never hurts to have a few extra since they are small and may get lost in the lab. Order from Cole Parmer at (800) 323-4340.
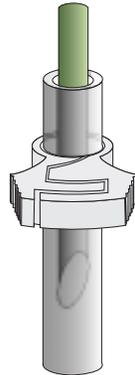

Figure 1

Maintaining Pressure

In February 1998, we began shipping accessories with the Biology Gas Pressure Sensor that are excellent for maintaining air-tight systems when using the Biology Gas Pressure Sensor. These accessories include the following:

■ two ribbed, tapered valve connectors inserted into a #5 rubber stopper

■ two Luer-lock connectors connected to the ends of a piece of plastic tubing

■ one 2-way valve

■ one 20-mL syringe

tapered valve connector

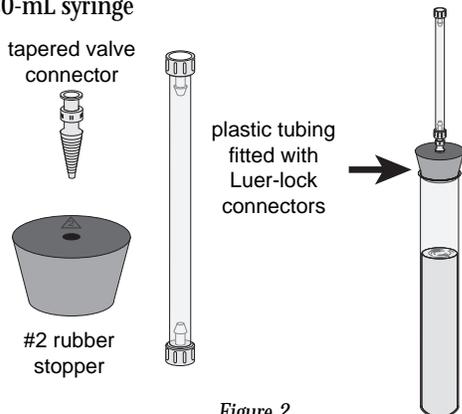plastic tubing fitted with Luer-lock connectors

#2 rubber stopper

Figure 2

These accessories are helpful when performing respiration/fermentation experiments, such as Experiments 6, 12, 16, 23, and 24 from the *Biology with Computers* and *Biology with CBL* manuals. It is easy to create an air-tight system between the Biology Gas Pressure Sensor and a 20 x 150-mm test tube using some of the accessories and a single-hole #2 rubber stopper. Take one of the tapered valve connectors and insert it into a single-hole #2 rubber stopper. The plastic tubing, fitted with two Luer-lock connectors, can then be connected to the tapered valve in the stopper. When the stopper is assembled and connected to the 20 x 150-mm test tube, it should look like the picture in Figure 2.

If your Biology Gas Pressure Sensor did not include the accessories, you can purchase the accessories as a kit from Vernier Software (PS-ACC, $5). The Pressure Sensor Accessories Kit includes all of the parts listed above (except the test tube).

Vernier Software at NABT

We will be at this year's NABT meeting in Reno, NV on November 5–7. Be sure to stop by booth #218 and say hello. We will also be doing two workshops demonstrating the use of our biology sensors with computers and CBLs. Our CBL workshop will be on November 6 at 9:00 a.m. Our computer workshop will be on November 7 at 9:00 a.m.

New Macintosh Computers

Apple has come up with several new (fast) computers and we have gotten a lot of questions about them. Here is a report on their compatibility with our products:

Power Macintosh G3: We tested our new G3 computer using Logger *Pro* with the ULI and Serial Box Interface. We found they work fine in all our tests.

iMac: We also purchased an iMac computer, but we cannot really test it yet. The problem is that the iMac does not have a built-in serial port, so we cannot connect our lab interfaces or TI-Graph Link. Serial port adapters have been announced, and they should provide the serial port connection we need. At press time, these adapters are still not available. Give us a call or check "What's New" on our web site for an update on our tests.

Some of the newer Power Macintosh computers would not find our Serial Box Interface. We worked with Apple and have finally solved (we think) all of these problems. Logger Pro for Macintosh incorporates the necessary changes and we have a new version of Data Logger that handles this problem. In some cases you also need to add an extension (provided on the Data Logger disk) to your system folder. Computers involved include Power Mac 4400, 5400, 5500, 6360, 6400, 6500, PowerBook 3400, and PowerBook G3.

Mole Relationships: Mass, Volume & Pressure

By Dan Holmquist and Robyn Johnson

In celebration of Mole Day '98, we have written an experiment that many of our chemistry teachers have requested: a CBL/MBL experiment that emphasizes mole relationships in chemical reactions. In this experiment, students not only observe what happens to the amount of a product as the amount of one reactant increases; they also discover there can be a limit to the amount of product that can be produced due to a limiting reactant. The reaction is:

$$Mg_{(s)} + 2\ HCl_{(aq)} \longrightarrow H_{2(g)} + MgCl_{2(aq)}$$

Students begin with six different lengths of magnesium ribbon. In each of the six trials, a length of magnesium is reacted with 5.0 mL of 1.0 M hydrochloric acid in a closed 125-mL Erlenmeyer flask connected to a Pressure Sensor. Instead of weighing out the small masses of magnesium, cut one longer piece of magnesium ribbon (~4 meters for eight lab stations), and then divide the total mass by the length in centimeters—our value was 0.00758 g/cm. The masses of magnesium that students use in each trial should be similar to those shown here (the lengths are based on our 0.00758 g/cm constant).

Trial	1	2	3	4	5	6
Mass of Mg	0.015 g	0.030 g	0.045 g	0.060 g	0.075 g	0.090 g
Length of Mg	~2 cm	~4 cm	~6 cm	~8 cm	~10 cm	~12 cm

Students will set out to discover what happens when they increase the mass of magnesium in each trial. Will the amount of hydrogen gas (and the resulting pressure of the closed system) increase, decrease, or remain the same when one of the reactants is increased in each trial? The mass of magnesium needed to react with all of the HCl would be:

$$\frac{1.0\ mol\ HCl}{1L} \times \frac{0.0050\ L}{1} \times \frac{1\ mol\ Mg}{2\ mol\ HCl} \times \frac{24.3\ g\ Mg}{1\ mol\ Mg} \times \frac{1.0\ cm}{0.00758\ g} = 8.0\ cm\ Mg$$

Students do not need to see the results of this calculation. As shown in the results below, they should discover the concept of limiting reactants for themselves. Here is a summary of the student procedure:

1. Obtain the first piece of magnesium ribbon for Trial 1. Record its precise length, in cm.

2. Add about 600 mL of room-temperature water to a 1-liter beaker. Obtain about 50 mL of 1.0 M HCl solution in a 100-mL beaker. Place the magnesium ribbon into a clean 125-mL Erlenmeyer flask.

3. Twist the rubber stopper snugly into the neck of the Erlenmeyer flask. It is very important that the stopper be firmly in place, so that the hydrogen gas produced in this experiment does not pop the stopper out of the neck of the flask. Close the 2-way valve on the rubber stopper assembly, but leave the blue 3-way valve of the Pressure Sensor open to the atmosphere until Step 6.

4. Draw precisely 5 mL of 1.0 M HCl up into the syringe. Screw the syringe onto the 2-way valve on the rubber stopper. Submerge the Erlenmeyer flask into the room-temperature water bath, so the water comes up to the neck of the flask. The temperature of the air in the flask should be the same as the temperature of the water bath (allow about 1 minute).

5. Set up your data collection to take a reading every 2 seconds, for a period of 300 seconds (150 points). Set up the y axis so pressure is scaled from 700 to 1100 mm Hg.

6. Close the blue handle on the 3-way valve of the Pressure Sensor. With the flask still submerged in the water bath, begin collecting pressure vs. time data. After about 20 seconds, open the 2-way valve directly below the syringe, squirt the HCl into the Erlenmeyer flask, then close the 2-way valve. Gently swirl the contents as the reaction proceeds. Observe both the pressure reading and the amount of magnesium ribbon that remains unreacted. When the pressure reading levels off and there is only minimal bubbling from the ribbon (or no ribbon remains), stop the data collection, or simply let the data collection end after five minutes.

7. Examine your data on the graph of pressure vs. time and determine the initial pressure reading, p_1, for the trial (the original pressure before the HCl was added to the flask). Then determine the final pressure reading, p_2, after the pressure stabilized upon addition of HCl to the magnesium. Calculate the pressure change, $\Delta p = p_2 - p_1$. Record this value. Repeat Steps 2–7 for each of the other pieces of magnesium ribbon (4, 6, 8, 10, or 12 cm). Cut each piece into several ~2-cm lengths before adding it to the flask.

8. After you have finished the six trials, calculate the mass of each of the six magnesium strips you used. Do this by multiplying the length times the mass per length (mass = cm $\times$ g/cm). Using Graphical Analysis, a graphing calculator, or graph paper, plot a graph of the pressure change vs. mass, for each of the six trials.
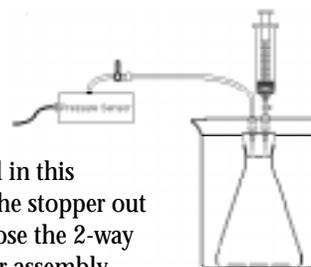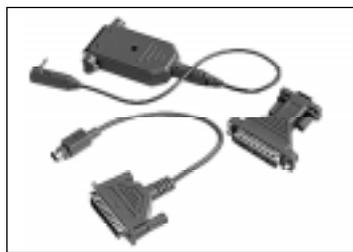
Graph Link Cables 🆕

If you are a CBL user, you know how important it is to have a TI-Graph Link. The TI-Graph Link package (order code TI-GL, $55) contains a cable, adapters, software and manuals. Teachers quickly realize how valuable it is to have additional Graph Links, but since they already have software and manuals, there is no need for a complete $55 Graph Link package. Vernier Software now sells the Graph Link hardware by itself, which will save you money. The Graph Link Cable (order code GLC) sells for $37. It contains adapters for Macintosh and IBM-compatible computers, along with the Graph Link cable.

TI-Graph Link Package
(Order Code TI-GL, $55)

Graph Link Cable
(Order Code GLC, $37)

New Versions of Graphical Analysis

Graphical Analysis for Windows and Macintosh has been modified to work with the new TI calculators. You can now import data from the TI-73, TI-89, and TI-92 Plus. Contact us if you are using one of these new calculators with Graphical Analysis.

Science Humor

Q: What happens when an alpha particle goes in a cow's ear?

A: It goes in one ear and out the utter. (Thanks to Lois E. Lyons, High Tech HS, Lincroft, NJ)

From our 1988 newsletter:
It is the first day of school and mother goes in to see why her son has not gotten up to get ready for school.
Mother: "You're going to be late for school!"
Son: "I'm not going to school."
Mother: "Why not?"
Son: "The kids hate me and the teachers hate me."
Mother: "I'll give you two good reasons why you have to go to school: You're 45 years old, and you're the principal."

Here are sample data we collected. Note that the pressure increases during the first three trials, but remains nearly constant in the last three. Magnesium is the limiting reactant in the first three trials. The amounts are stoichiometrically "just right" in the fourth trial (see the earlier calculation). After the fourth trial, the magnesium reacts with all of the hydrochloric acid solution, leaving excess magnesium that students will observe—hydrochloric acid is now the limiting reactant.
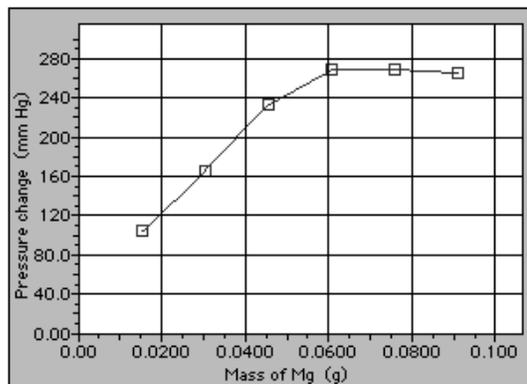
Extension: Students who have already studied mass-volume relationships in chemical reactions can calculate the pressure that should be produced, then do one or two trials to confirm the results. Instruct students to collect data as described above, then toward the end of the data collection, open the 2-way valve and pull the plunger of the syringe to the original 5-mL mark—hold the plunger at the 5-mL mark, and record this pressure reading for p_2. This way, the increase in pressure is due entirely to hydrogen gas. (Leaving the syringe compressed by 5 mL would increase the pressure by ~30 mm Hg.) Leave the inside of the flask wet prior to doing the experiment so water vapor pressure is kept nearly constant. Our volume was found by adding the volume in the flask (148 mL), the volume in the tubing (~4 mL), and the volume in the syringe (5 mL). The following calculation was done for our second trial (P = nRT/V):

$$\frac{0.0303 \text{ g Mg}}{1} \times \frac{1 \text{ mol Mg}}{24.3 \text{ g Mg}} \times \frac{1 \text{ mol H2}}{1 \text{ mol Mg}} \times \frac{62.4 \text{ L·mm Hg}}{1 \text{ K·mol}} \times \frac{297 \text{ K}}{0.157 \text{ L}} = 147 \text{ mm Hg}$$

$$\% \text{ error} = \frac{147-136}{147} \times 100 = 7.5\%$$

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10 Years Ago in This Newsletter . . .

We announced our first MS-DOS version of Graphical Analysis and both Apple II and MS-DOS versions of our Millikan Oil Drop Experiment simulation. We still sell all three programs. There was also a discussion of the new Apple IIc+, the last computer introduced in the Apple II line. We also had some pretty good jokes, one of which we are repeating in this newsletter.
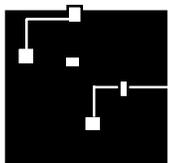
Bits & Bytes

We are very excited about our two new technical support people at Vernier Software. Robyn Johnson has eleven years of teaching experience including chemistry, ChemCom, earth science, biology, and physical science. Erik Schmidt is the soothing voice on the phone that helps with CBL and TI-Graph Link questions. He has a B.S. in Psychology and a Master of Fine Arts degree. Erik enjoys the challenge of creating technical manuals and guidebooks that won't put the reader to sleep.

Dr. John Young of Saint Mary's University in Halifax, Nova Scotia has been conducting chemistry labs in Gambia, West Africa using our equipment with donated computers. Gambia is a very poor country, so low cost is important. We are happy to report the program is a big success!

Lisa Manning, a student of Sister Mary Ethel Parrott (Notre Dame Academy, Covington, KY), won awards and scholarships at the Junior Science and Humanities Symposium and also at the International Science and Engineering Fair. She used CBLs and ULIs to measure the voltage output of bioelectrochemical fuel cells.

Chautauqua Short Courses: Promoting Active Learning in Introductory Physics Courses

Instructors: Priscilla Laws, David Sokoloff, and Ronald Thornton

June 3-5, 1999–Dickinson College, Carlisle, PA
June 17-19, 1999–University of Oregon, Eugene

These NSF-sponsored courses are open to college teachers. High school teachers are also admitted if space is available. There is a small application fee, but no tuition. For more information contact David Sokoloff, Department of Physics, 1274 University of Oregon, Eugene, OR, 97403-1274, sokoloff@oregon. uoregon.edu, (541) 346-4755.

Student Contests

Help your students earn the recognition they deserve by encouraging them to enter one or more of these contests. A little healthy competition is often the "catalyst" needed to make students become more excited about science and technology.

Duracell/NSTA Scholarship Competition
Who: One or two students in grades 6-12 and a teacher sponsor. **What:** Design and build a battery-operated device that performs a practical function. **Deadline:** January 15, 1999. **Prizes:** $20,000 for 1st place; $200 to $10,000 for other winners; teacher sponsors are eligible for prizes. **For more information:** Call (888) 255-4242 or visit www.nsta.org/ programs/duracell.htm.

Toshiba/NSTA ExploraVision Awards
Who: Team of three to four students in grades K-12 and one teacher-advisor. **What:** Envision how present technologies could be used 20 years in the future. **Deadline:** February 3, 1999. **Prizes:** Top twelve teams go to Washington, DC; $10,000 U.S. Savings Bond for each member of top four teams, $5,000 U.S. Savings Bond for each member of the eight 2nd place teams. Regional prizes as well. **For more information:** Call (800) EXPLOR-9 or visit www.toshiba.com/tai/exploravision/ index3.htm.

Intel Science Talent Search *(formerly Westinghouse)*
Who: Individual high school seniors. **What:** Students complete independent research projects and submit an entry. Each completed entry consists of a written description of the student's research, plus a lengthy entry form that elicits evidence of student creativity and interest in science. **Deadline:** December 2, 1998. **Prizes:** $50,000 for 1st place, $40,000 for 2nd place, $30,000 for 3rd place, and more. **For more information:** Visit www.sciserv.org/stshome.htm.

Teacher Awards/Grants

Where can I get the money for new technology? Grants and awards are one way to help supplement that shrinking science or technology budget. Many more opportunities are out there, but here are a few we thought you should check out.

Toshiba Laptop Learning Challenge
Who: Math and science teachers who use laptops. **What:** Write a lesson plan using a laptop. Must include math and science. **Deadline:** January 20, 1999. **Prizes:** 20 teachers will receive Toshiba laptop computers plus additional prizes. **For more information:** Call (703) 312-9390 or visit www.nsta.org/ programs/laptop.htm.

Presidential Awards For Excellence
Who: K-12 science teachers. **What:** Honors teachers for implementing new, standards-based curricula in the classroom and engaging students in active, hands-on learning. **Deadline:** February 28,1999. **Prizes:** $7500 grant to awardee's school, additional prizes. **For more information:** See the September 1998 issue of *The Science Teacher*, p. 84, or visit www.ehr.nsf. gov/EHR/ESIE/awards/core.htm.

Toyota TAPESTRY Grants for Teachers
Who: K-12 science teachers. **What:** Awarded to science teachers who have demonstrated exemplary approaches to science teaching and new designs using science equipment and facilities. **Deadline:** January 15,1999. **Grant size:** Up to $10,000. **For more information:** Visit www.nsta.org/programs/ toyota.htm.
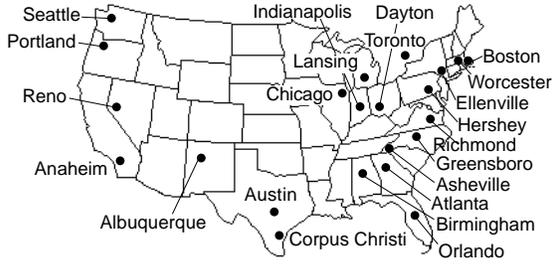
UPCOMING EVENTS

We will be exhibiting at all of the following conferences. If you attend, stop by and say hello.

NSTA Northwestern Area Convention	Seattle, WA	October 29-31
Virginia Association of Science Teachers	Richmond, VA	October 30-31
New York Science Teachers	Ellenville, NY	November 1-3
North Carolina Science Teachers	Greensboro, NC	November 4-6
Massachusetts Association of Science Teachers	Worcester, MA	November 5-6
National Association of Biology Teachers	Reno, NV	November 5-7
Science Teachers Association of Ontario	Toronto, Ontario, Canada	November 5-7
American Mathematical Association of Two-Year Colleges	Portland, OR	November 5-8
AAPT Sectional Meeting	Asheville, NC	November 6-7
Texas Science Teachers, CAST	Corpus Christi, TX	November 19-21
NSTA Southern Area Convention	Birmingham, AL	November 19-21
Pennsylvania Science Teachers	Hershey, PA	December 3-4
NSTA Southwestern Area Convention	Albuquerque, NM	December 3-5
AAPT National Convention	Anaheim, CA	January 10-13
T^3 (Teachers Teaching with Technology)	Chicago, IL	January 22-24
Ohio Science Teachers Association	Dayton, OH	February 11-13
Texas Computer Education Association	Austin, TX	February 14-17
Indiana Science Teachers Association	Indianapolis, IN	February 17-19
Georgia Science Teachers Association	Atlanta, GA	February 25-27
Michigan Science Teachers	Lansing, MI	March 5-6
Florida Educational Technology Conference	Orlando, FL	March 18-20
NSTA National Convention	Boston, MA	March 25-28