PASCO capstone™

The New Standard in Data Collection and Analysis Software!

Now with Video Analysis

Capstone screen shows live video with sync to force and velocity data.

Try it!

Download a **FREE** 60-day trial at pasco.com/capstone

PASCO

Compatible with All PASCO USB Interfaces!

If you use these PASCO USB interfaces in your lab, it's time for PASCO Capstone Software.

850 Universal Interface (UI-5000)

750 (CI-7650)

500 (CI-6400)

USB Link (PS-2100)

Xplorer GLX® (PS-2002)

SPARKlink® (PS-2009A), SPARKlink® AIR (PS-2011), and SPARK Science Learning System® (PS-2008A)

Capture Data Remotely!

See how PASCO Capstone Software can revolutionize how you do labs.

Using PASCO's Wireless Multi-Port Interface SPARKlink®Air

With the SPARKlink Air Interface students can record the sensor data, and send it to the computer via Bluetooth. Used here with two Angle Sensors, part of the PS-2137 Goniometer System. The data is sent via Bluetooth to the desktop computer, and displayed live with the video being recorded by the web cam.

Webcam
Record live video synched to sensor data.

Goniometer Probes
The probes are fastened in place using the blue Velcro® straps, and can be positioned to measure the motion of the knee, hip, or elbow.

Data Playback
Play back the synched data and video at normal or slow speed.

Try it!
Download a FREE 60-day trial at pasco.com/capstone

Order Information

PASCO Capstone Software

Site License	UI-5400
Single User License	UI-5401

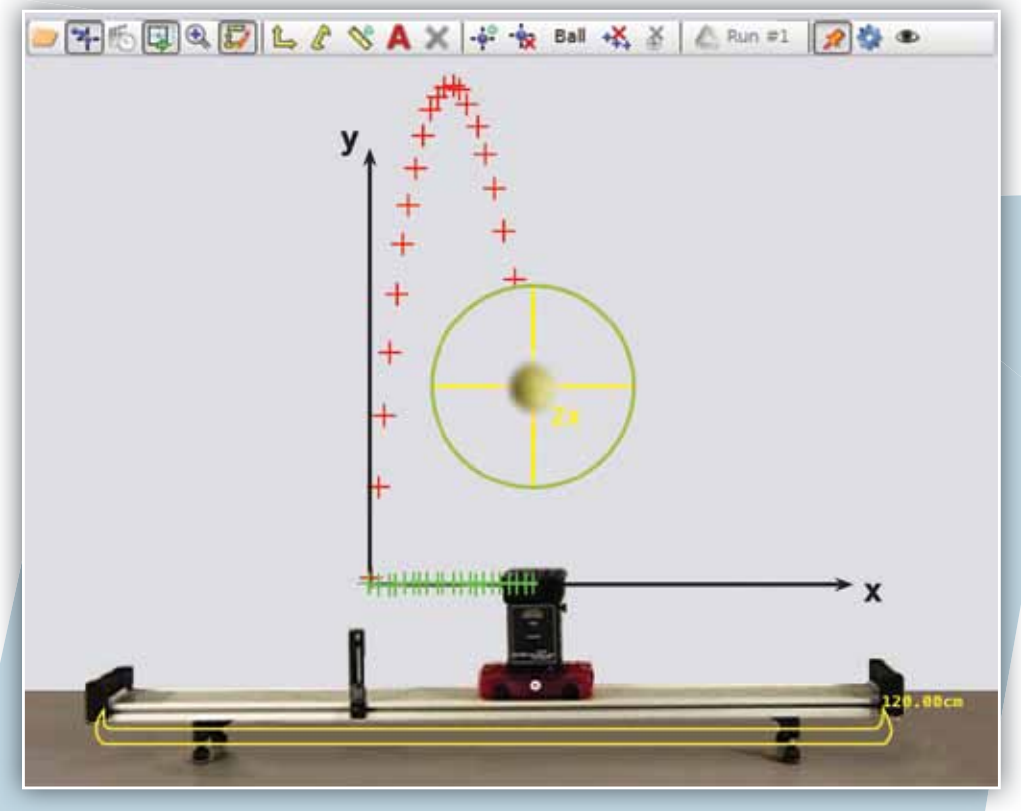
SPARKlink® Air	PS-2011
Goniometer	PS-2137
Additional Goniometer Probe	PS-2138
Field Bag	PS-2549

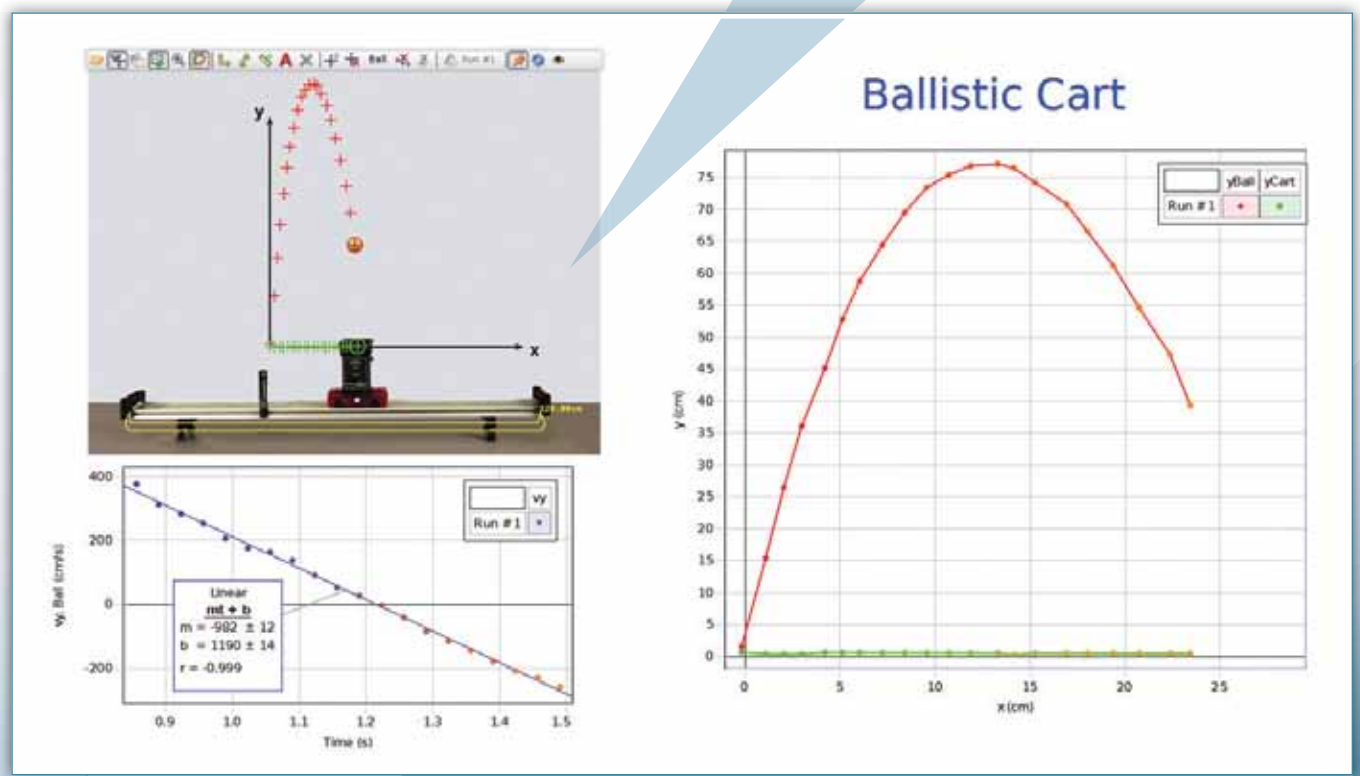
PASCO Capstone Analysis Tools

Video Analysis

Adding to the current capability of being able to synch sensor data to video, the new video analysis features allow you to easily track an object in two dimensions and display the data in a graph or table.

- Intuitive user interface
- Track more than one object
- XY data includes position, velocity, and acceleration
- Rotate the coordinate axes to compensate for a camera that is not level
- Make measurements of the length or diameter of objects
- The Magnifying Tool allows for unobstructed placement of data points, improving your analysis of video data



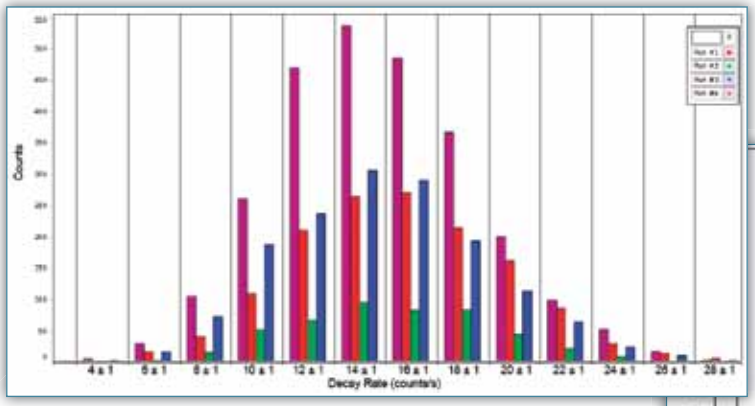


PASCO Capstone Analysis Tools

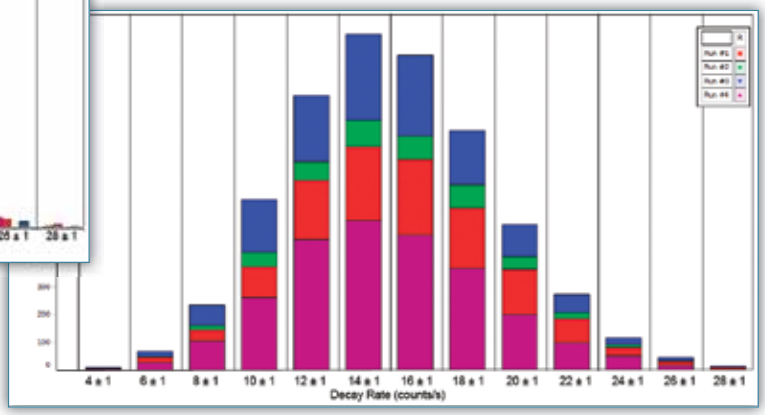
Histogram

The histogram accumulates the number of values of a measurement that fall within bin ranges of your specification. It is useful for statistical experiments.

- Display multiple runs side-by-side, stacked, or overlaid.
- Find statistics such as the mean, root mean square, and most probable value.
- Export data to the graph for curve fit analysis.



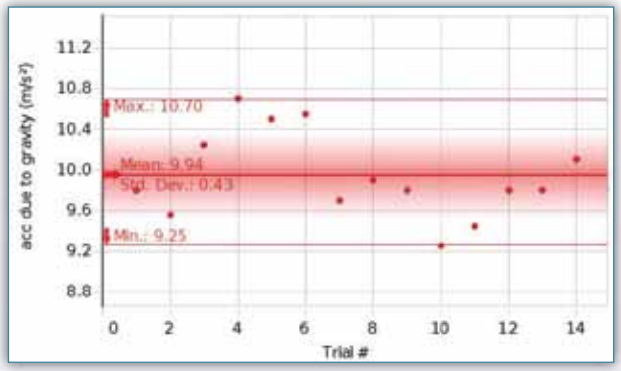
Side-by-side comparison of multiple runs.



In stacked mode, the counts from all runs are summed.

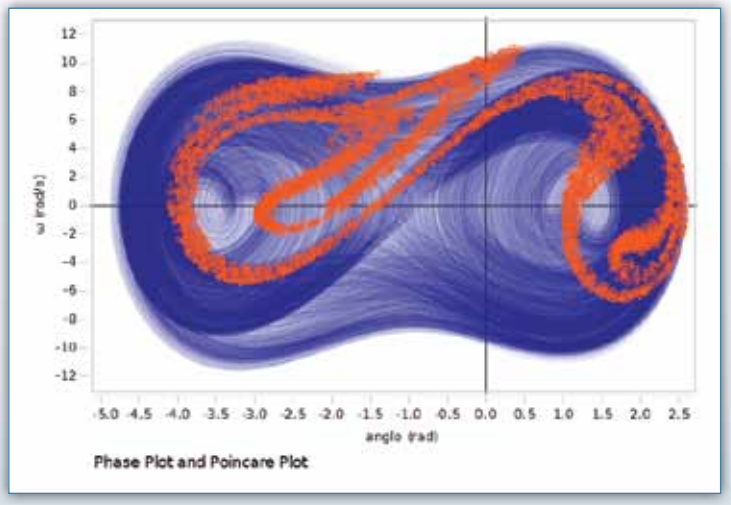
Visual Statistics

Statistics are displayed on the graph with lines at the maximum, minimum, and mean. The standard deviation is shown as a shaded area.



Transparent Plots

The data is painted in a transparent color, so multiple passes get progressively darker. Without this feature, this graph would be solid purple with no detail showing.



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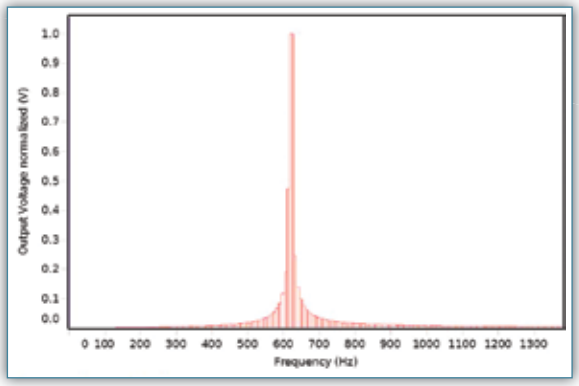
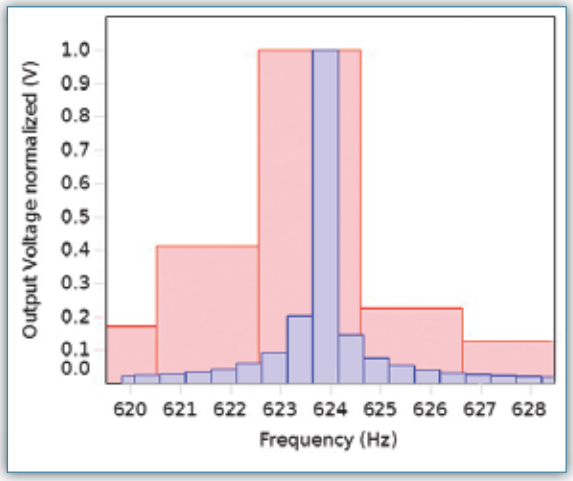
PASCO Capstone Analysis Tools

Zoom in on the FFT

This is the full-range FFT of a 624 Hz signal.



As you zoom in on the FFT, initially the bins are large (in pink), but the software automatically adjusts the bins to give greater detail (in blue).



Capture and Synch Video to Data

Any webcam can be used as a "video sensor" to record movies at the same time as data.

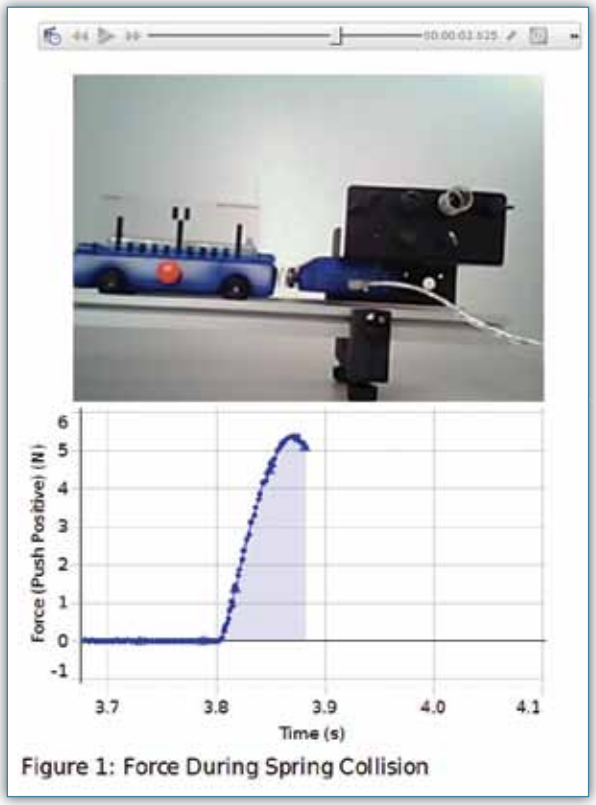


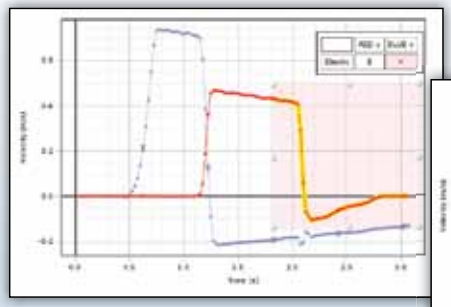
Figure 1: Force During Spring Collision

Exclude or Delete Data Points from Analysis

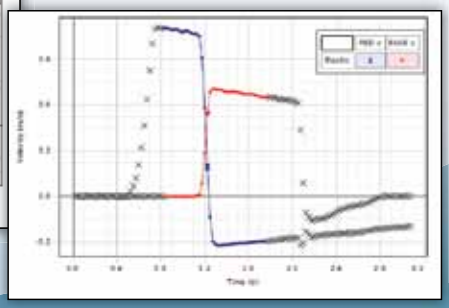
If there is a lag between when you start recording and the point in your data set where the action begins, you can exclude the data points at the beginning so they are not included in the range when you press the scale-to-fit button and are not considered in analysis such as curve fits and statistics.

- Temporarily exclude errant data points from curve fits and then re-include them to see the difference in the curve fit.
- Delete extraneous data at the beginning or end of a run.

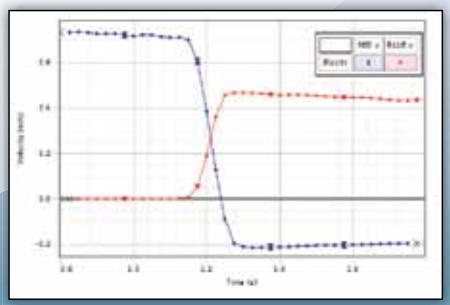
Highlight the points you want to exclude.



Excluded points are shown here as gray X's.



After excluding extraneous leading and trailing data, the excluded points will be ignored when you push auto-scale.



Whether you want your students to explore and create lab write-ups on their own, or you want to tailor a lab write-up with very specific instructions, PASCO Capstone™ has the power and flexibility to meet the needs of your lab.

Setup
The setup shows the interfaces and sensors you have connected. You can also select hardware that is not connected, so you can create files when you don't have the apparatus available.

Photogates/Timer Setup
This wizard helps you set up a photogate timer. Choose from an assortment of standard timers (such as Photogate with Picket Fence) or create your own timing sequence.

Data Summary
This is a list of the sensors and their measurements; their properties can be changed here.

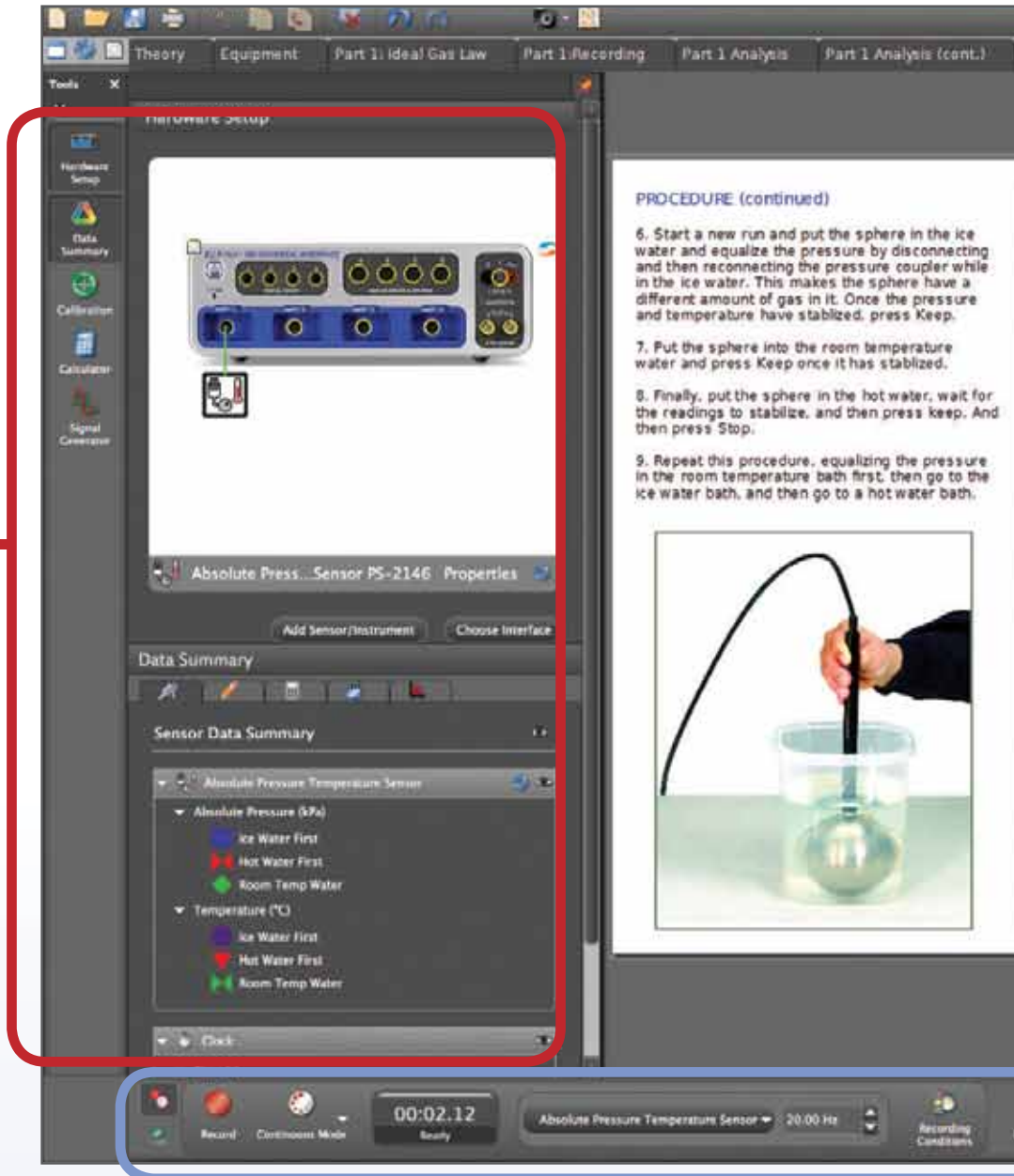
Tool Palette
Tool panels slide open.

Calibration
This wizard steps you through the calibration sequence, making it clear what you should do at each point.

Calculator
The calculator has the usual scientific functions, as well as special functions (period, amplitude, filters, and logic statements) required for analyzing data.

Signal Generator
For an interface that has a function generator, this is where you choose the wave type and settings such as DC offset or frequency sweep.

Curve Fit Editor
Choose to lock down parameters and try a new fit.



Record, Monitor, Stop

Keep Sample (for Keep Mode)

Choose Sampling Mode
- Continuous Recording
- Keep Samples
- Fast Monitor

Clock

Control Bar

Set Sample Rate
By default, all sensors are at the same rate but each sensor can have its own sample rate.

Minimum System Requirements
Windows: Windows XP SP2 or higher, 2 GHz processor, 200 MB available disk space, 2 GB RAM, Display size 1024 x 786

Macintosh: MAC OSX (v. 10.6 or higher)

Create Multiple Pages

Pages are easy to author
and each page can be customized to show only the needed tools.

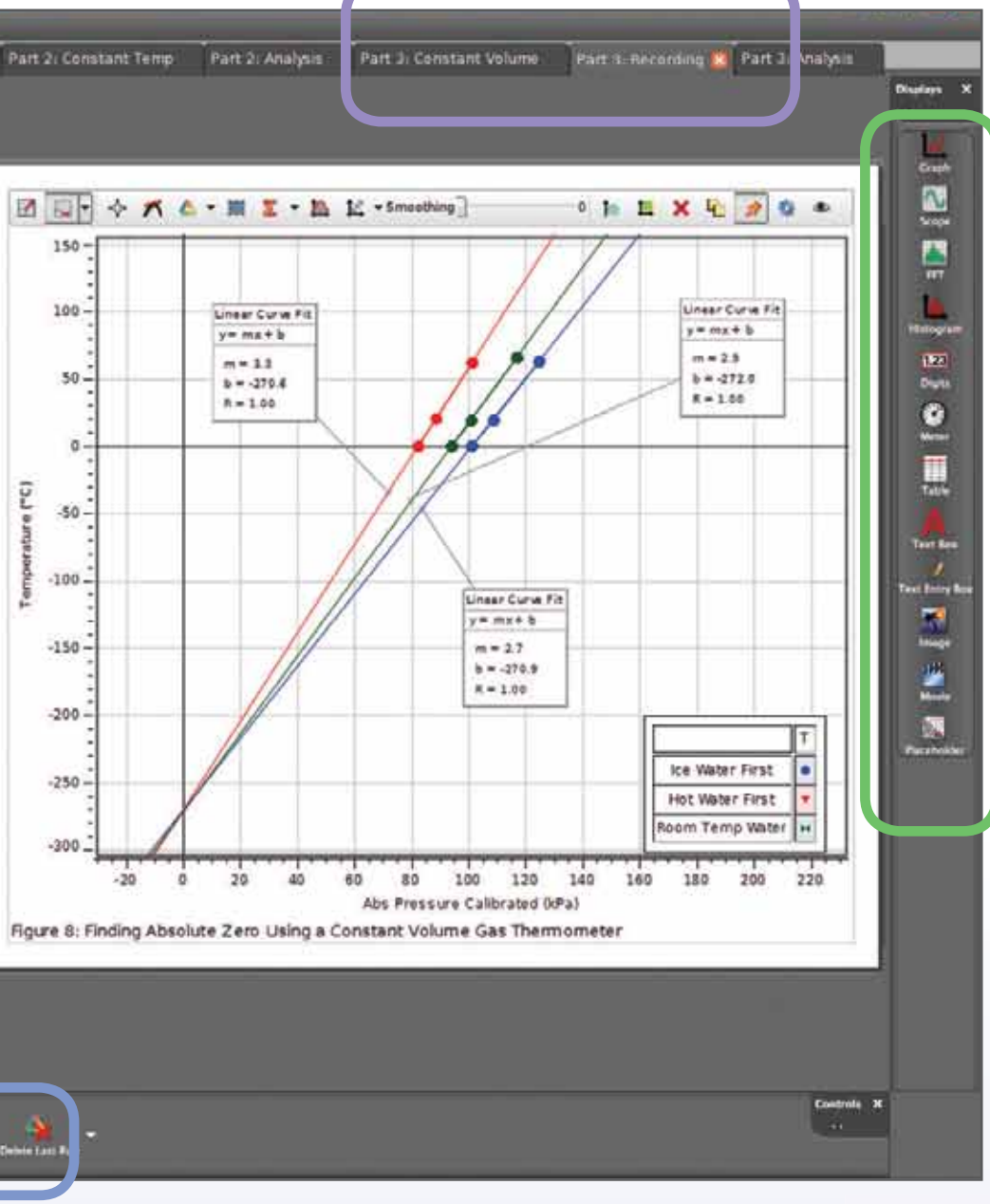


Figure 8: Finding Absolute Zero Using a Constant Volume Gas Thermometer

Graph
Create graphs with multiple y-axes and multiple stacked plot areas.

Oscilloscope
The scope can be scaled directly by dragging the axes.

FFT
Create FFTs with multiple measurements, and zoom in on the data to get more resolution.

Histogram
Bin data for statistical experiments.

Digits
Increase/decrease the precision of the display by clicking a button.

Meter
Choose from small arc to full circle; includes special angle display.

Display Palette
Drag and drop displays onto the page. Automatic guidelines will appear to help arrange the displays.

Table
Add or subtract columns and rows with the click of a button. Also add calculated columns.

Text Box
Choose font type, size, and color to make the text more readable.

Text Entry Box
This box is for students to enter answers to questions.

Picture
Add a picture from a file and resize it to fit your layout.

Movie
Take a snapshot of your apparatus, load a movie from a file, record a webcam movie to explain something, or record a movie from a webcam simultaneously with recording data from sensors and synch them together.

Placeholder
Use this placeholder to create your own templates.

Recording Conditions
Set start and stop conditions.

Delete Runs
Just click to delete last run or use drop-down menu to select runs to delete.

Order Information

PASCO Capstone Software

Site License	UI-5400
Single User License	UI-5401

Site License *Install on all computers in a college department or a K-12 campus. Allows student use at home.*

Single License *Install on one computer.*

Try it!
Download a FREE 60-day trial at pasco.com/capstone

PASCO Capstone Analysis Tools

User-defined Error Bars

- Enter individual error values for each data point.
- Option to use unequal positive and negative error values

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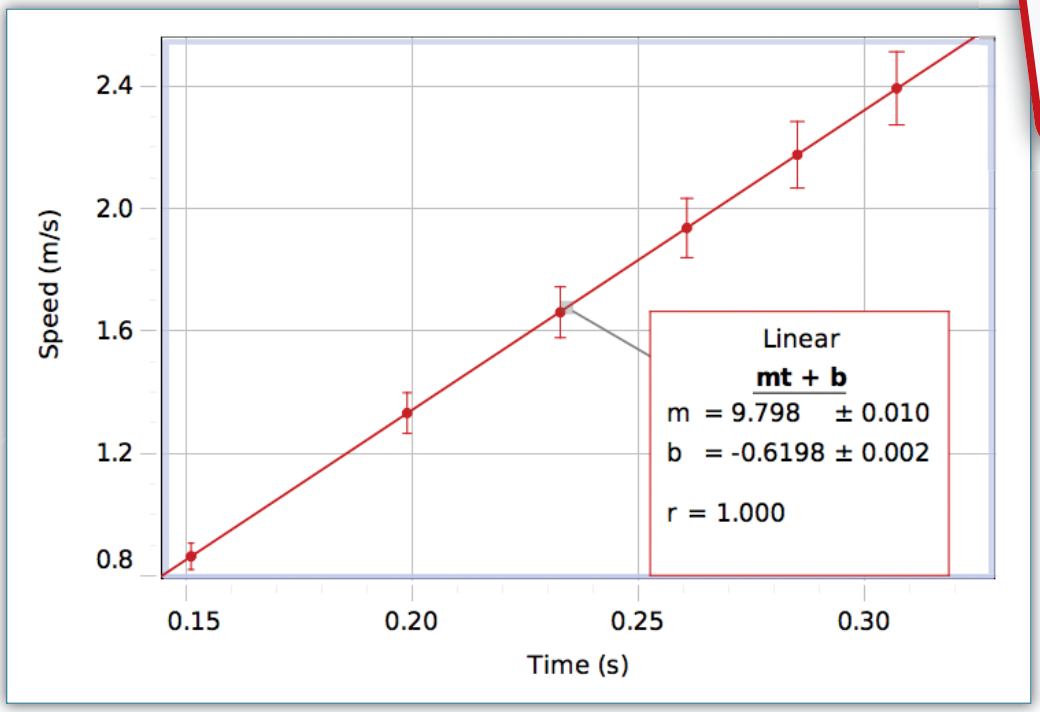


Sophisticated Calculator

Type calculations using Greek symbols, subscripts and superscripts, making equations look more like they do in textbooks.

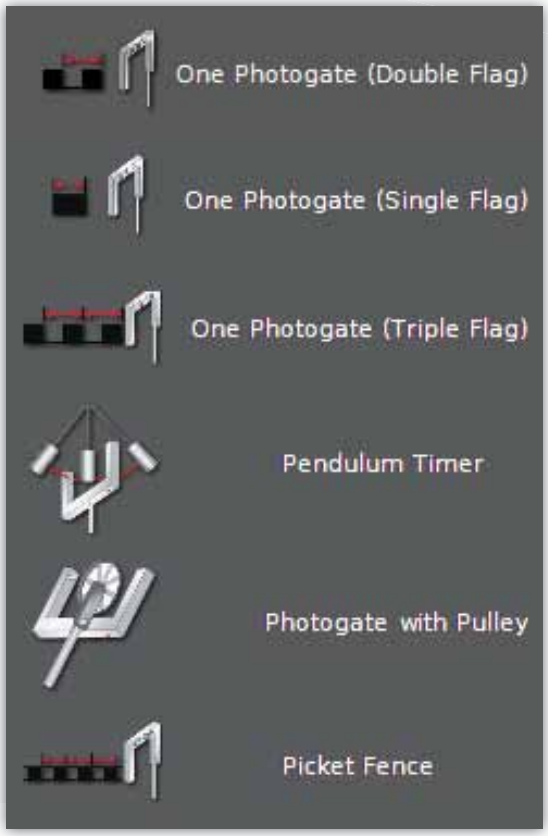
Import and Export txt, csv data files. Open GLX, DataStudio files. Import Movies, Images, and Videos

Use any PASCO USB Interface outside the lab to collect data and then return to the lab computer to analyze the data in PASCO Capstone. All PASCO interfaces have their own special data file format which can now be opened in PASCO Capstone.

PASCO Capstone Experiment Setup

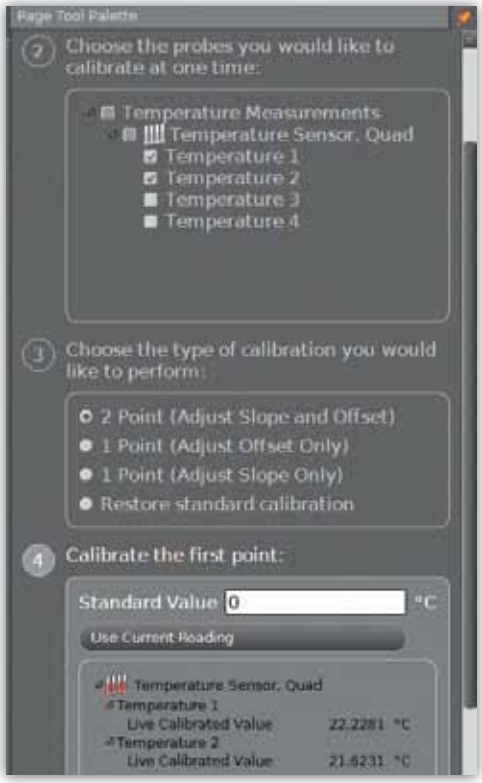
Photogate Timer Setup Wizard

The wizard takes you through the steps of creating a timer for the photogates, using graphics to make it clear which timing mode you are choosing.



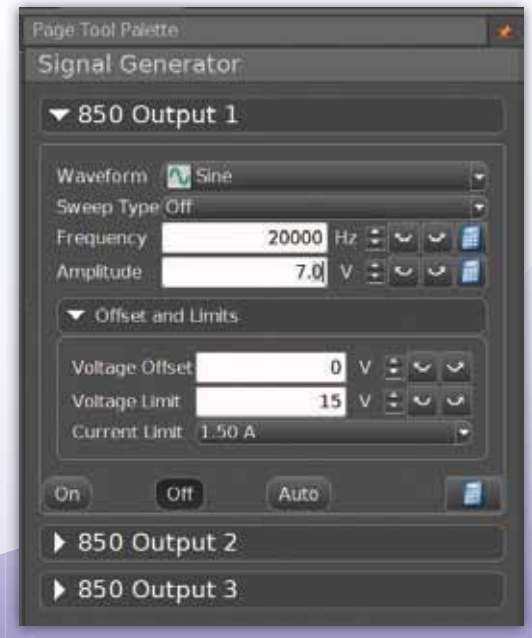
Calibration Wizard

The wizard makes sure you are sampling the correct standard at the correct time.



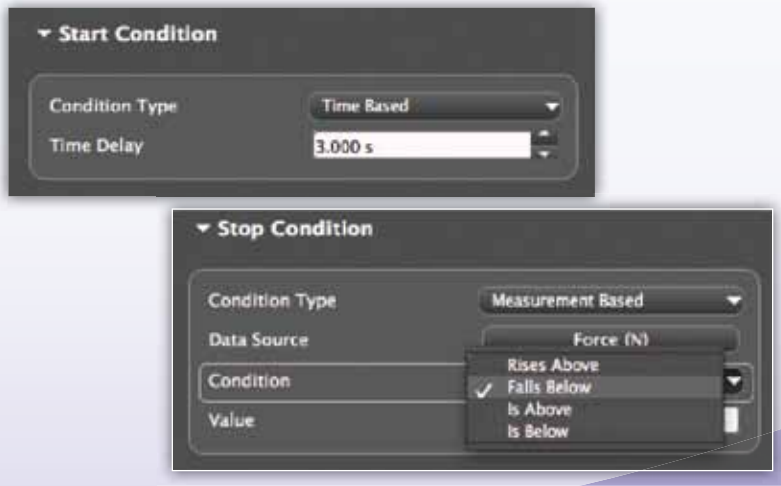
Control All Aspects of Function Generators

850 Universal Interface (UI-5000) and Function Generator (PI-8127)



Start Stop Conditions

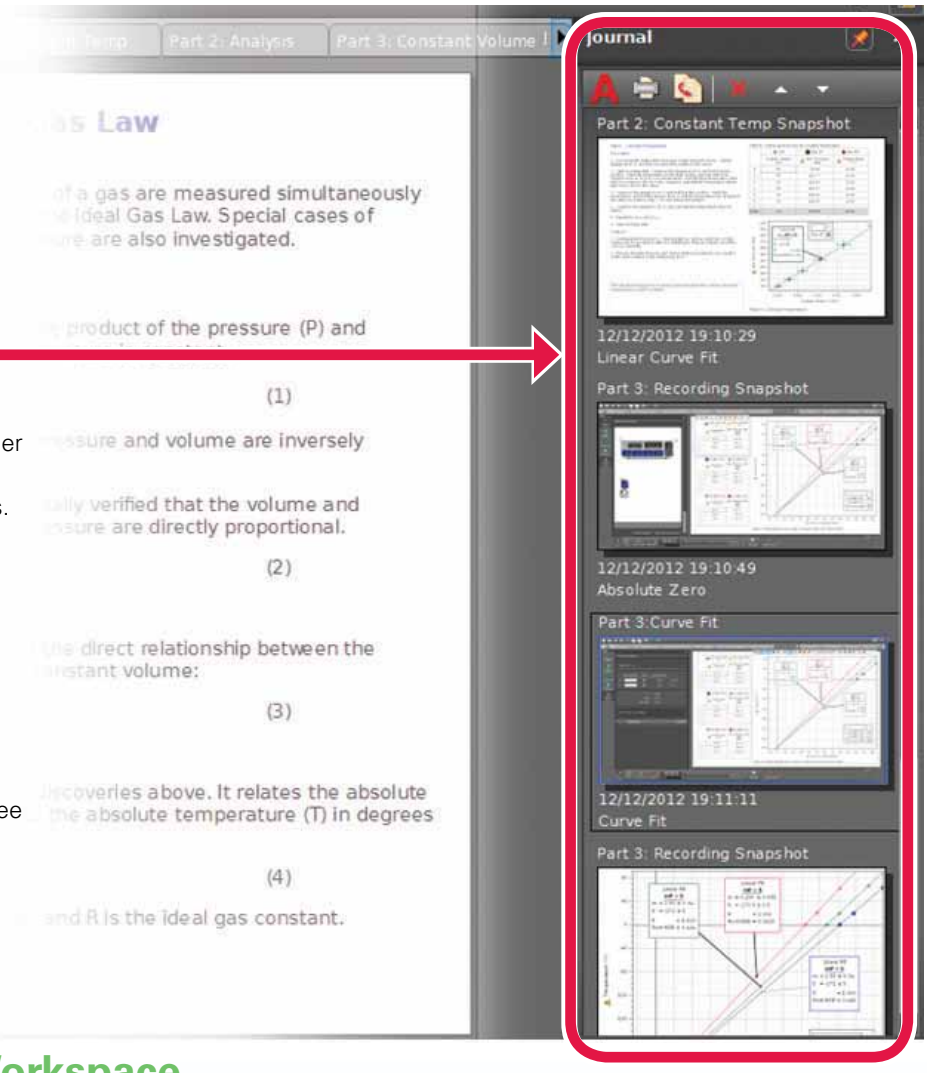
Set Start and Stop parameters based on time or measurements.



PASCO Capstone User Interface

Journal

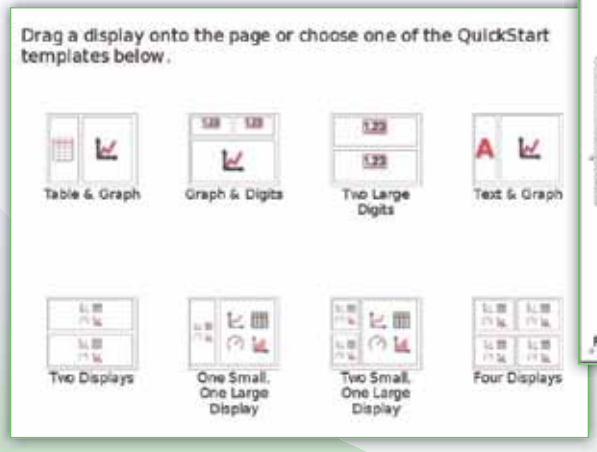
Snapshot your workspace pages into the Journal and save or print them.

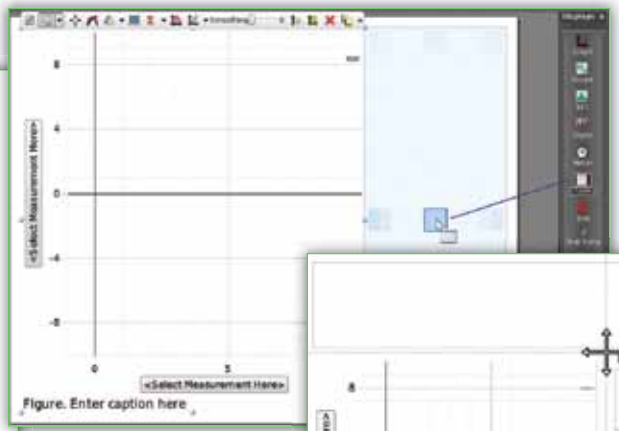


- Take a snapshot of a page once you have done the analysis, analyze another run, then snapshot the page again to preserve the way you did the analysis.
- Choose to snapshot an individual display or a whole page.
- Save as a set of .png pictures and an html file so you can view the journal pages with an internet browser.
- Add annotations for each page.
- Click on the pages in the Journal to see a magnified view of the page entry.

Easy Layout of Workspace

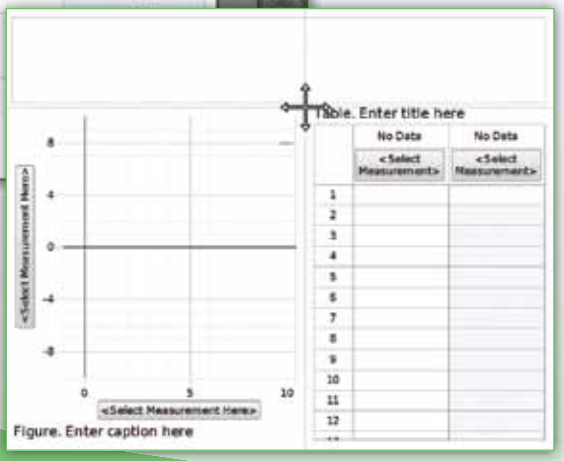
Choose from a template and fill it in with data.





Drag a display onto the page, and other displays will move and resize to make room.

Click and drag dividers to resize and realign multiple displays at once.



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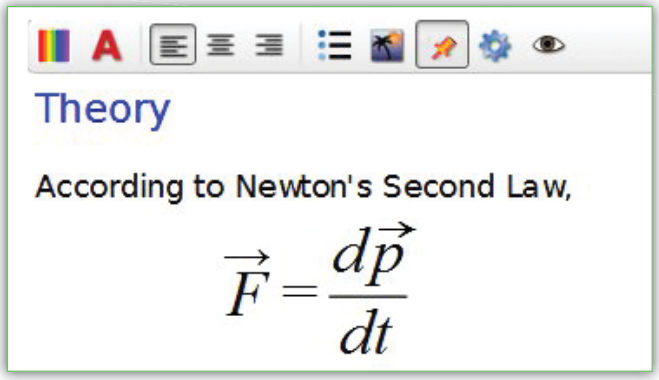
PASCO Capstone User Interface

Put Equations in Text Boxes

Equations created in a word processor can be copied into a text box.



Made a Mistake? Just Undo!

Being able to undo actions gives students the freedom to explore, allowing them to learn the program faster.

Create Text and Calculated Columns with Ease

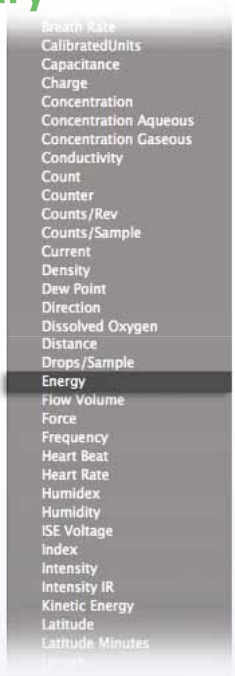
Insert a column in the table by simply clicking a button. Insert a calculated column and create an equation directly in the table.

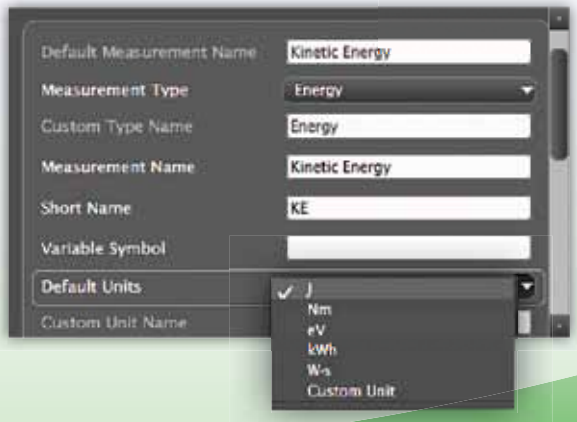
[Table title here]

Kinetic Energy= .5 (.750) [Velocity (m/s), ▼]^2

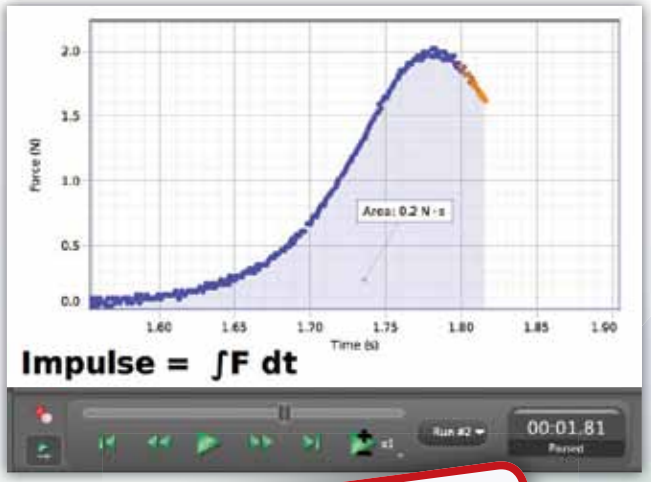
	Run #1	Run #1
	Velocity (m/s)	Kinetic Energy (J)
298	0.12	0.01
299	0.12	0.01
300	0.13	0.01
301	0.13	0.01
302	0.13	0.01
303	0.14	0.01

Constants, Measurement and Units Library





Data Replay Playback Mode



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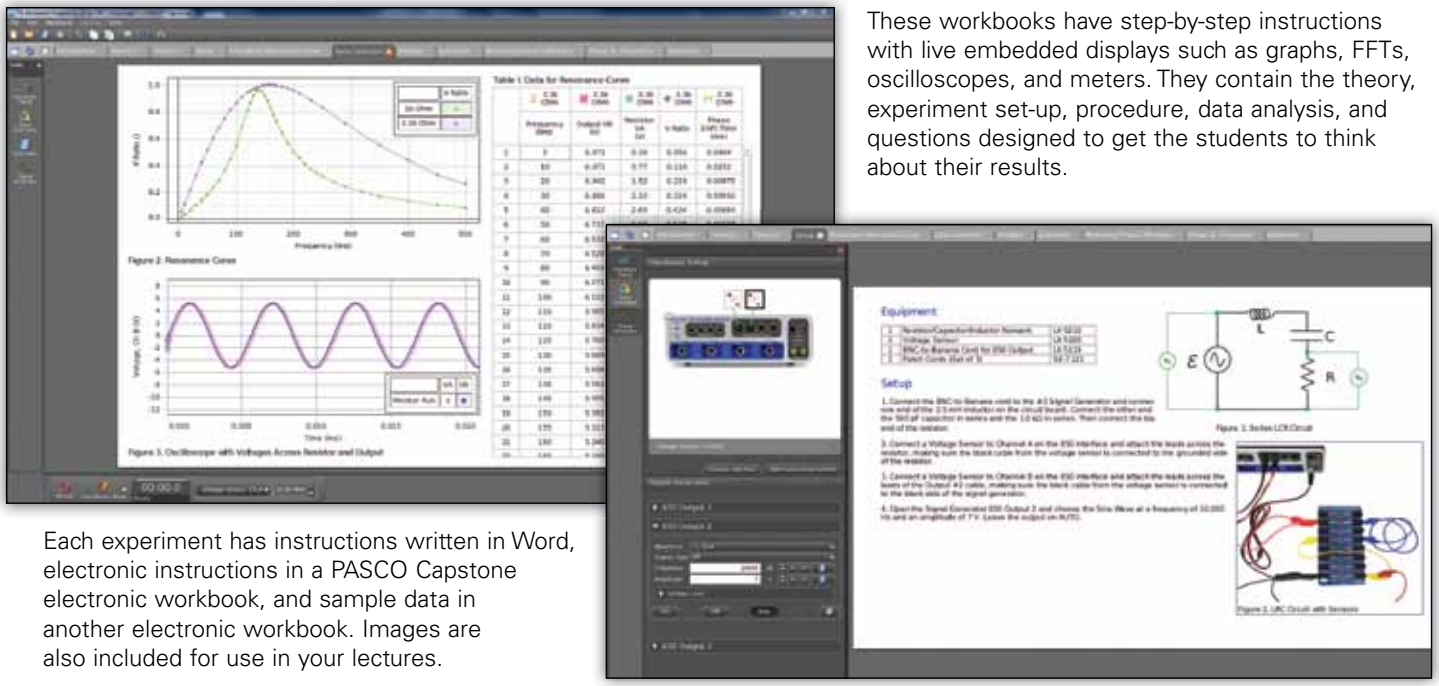
Download FREE PASCO Capstone Experiments

www.pasco.com/CapstoneExperiments

- **Experiment Manual:**
  A detailed experiment manual helps ensure student success. An electronic Word® version is included for modification by the teacher.
- **PASCO Capstone Workbook File:**
  Included for each experiment, these files contain workbooks with step-by-step instructions with embedded live data displays. Use these files with students. A file with sample data is also included.

Experiment Software Setup Simplified with "PASCO Capstone electronic workbook."

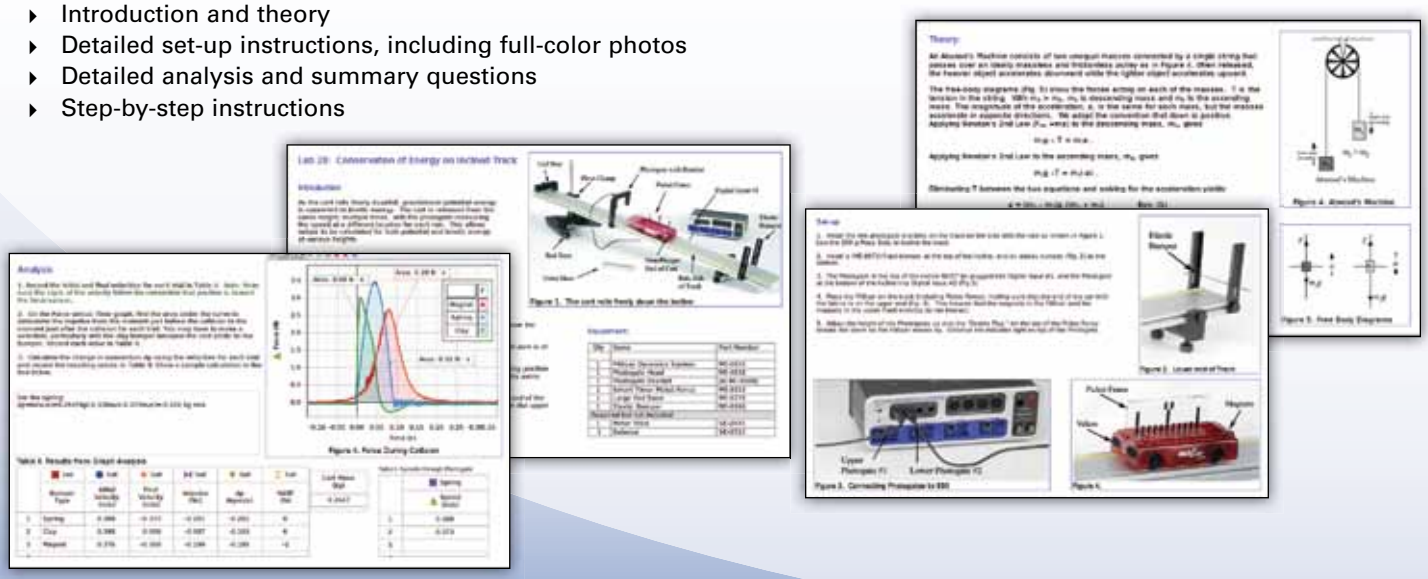


These workbooks have step-by-step instructions with live embedded displays such as graphs, FFTs, oscilloscopes, and meters. They contain the theory, experiment set-up, procedure, data analysis, and questions designed to get the students to think about their results.

Each experiment has instructions written in Word, electronic instructions in a PASCO Capstone electronic workbook, and sample data in another electronic workbook. Images are also included for use in your lectures.

Workbooks include all instructions needed to perform the experiment:

- Introduction and theory
- Detailed set-up instructions, including full-color photos
- Detailed analysis and summary questions
- Step-by-step instructions



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