

Uses of the EA100 and Probes

Ideas for Informal Uses of the Data Collector:

1. **Temperature**/Measure soil temperature in your garden or water temperature in a pond at different depths over a “long” period of time.
2. **Temperature**/Measure temperature changes during a thermometric titration, the process of polymerization, or dissolution. Classify the reaction as endothermic or exothermic.
3. **Temperature, Dissolved Oxygen**/Study the effect of temperature respiration by monitoring a live pond or aquarium plant in a flask containing NaHCO_3 solution.
4. **Temperature, Dissolved Oxygen**/Determine the effect of temperature on the solubility of oxygen in water. Discuss whether pollution is a greater danger in summer or winter.
5. **Temperature**/Measure the energy stored in different food products by measuring the rise in water temp. as samples are burned. Compare your results to the manufacturers values on various food items.
6. **Temperature**/Place a temperature probe in an animal’s nest to monitor his behavior overnight or over several days. Be sure to place a second probe in open air as a control.
7. **Temperature**/Prepare one flask with treated yeast culture and one flask with untreated, monitor the temperature changes of each over the next several hours.
8. **Temperature**/Compare the effects of different reflective materials and their positioning relative to a heat source.
9. **Temperature**/Keep a record of changes in weather with a temperature probe. Can you use this to predict the length of a day?
10. **Temperature**/Monitor the defrosting Cycle of your freezer. How does the thermostat respond to changes in room temperature on your air conditioner or heater. Place one probe near the thermostat and another near a vent.
11. **Temperature**/Measure the rate of heat loss of your body from your head as compared to your hand, as you are walking as compared to running, As someone is yelling at you as compared to soothing music.
12. **Temperature**/Measure the increase of temperature of a liquid in a blender at various speeds.
13. **Temperature**/Measure the rate of increase of temperature in your car in the sun.
14. **Temperature**/Measure the solar energy absorption rate of several materials by wrapping the temp. probe with them and placing them in the sun. (paper, tinfoil, etc.)
15. **Temperature**/Place several glasses of water in a microwave oven in an organized manner, and then sample the resulting temperatures after the oven has been operating. Create a matrix in order to find the most efficient location for heating.
16. **Temperature**/Place a temperature probe in a common living area (Desk Chair, couch seat, etc.) and then sample the air temperature while adjusting the air vent in the room to several different positions. Which uses the air “most efficiently” for your living position?
17. **Temperature**/What type of “coozie” keeps an aluminum can the coolest?
18. **Temperature**/Is freezer gel in a sports bottle more efficient than ice?

19. **Temperature**/Record the temperature and count the number of chirps of a cricket.
20. **Temperature**/Compare the temperature change in a room with lights on, vs light off.
21. **Temperature**/Compare the change in temperature as calcium chloride is added to water.
22. **Temperature**/Compare the temperature change as baking soda is added to vinegar.
23. **Temperature**/Compare the temperature change of your favorite softdrink in 4 of your commonly used insulated glasses. See which one keeps the coke coolest.
24. **Temperature**/Compare the temperatures and rate of heating of several common curling irons.
25. **Light**/Stir in a spoon of dirt into a glass of water and notice the rate of sedimentation by taking brightness readings.
26. **Light**/Relate the amount of vegetation found in an area compared to the amount of light. Compare the rate of growth of plants to the light they receive.
27. **Light**/Monitor fish activity in an aquarium to see which side of the tank they prefer.
28. **Light**/Monitor formation of a precipitate in a reaction or change in color intensity.
29. **Light**/Use two light probes to check the speed or acceleration of moving objects.
30. **Light, temperature**/Compare the change in temperature vs change in brightness of the air next to a window at certain times in the day.
31. **Light**/Prove that the light goes off in the refrigerator when you close the door.
32. **Light**/Which Material, Black or white absorbs more heat from the sun? From an overhead projector?
33. **PH**/Which antacid best neutralizes stomach acid?
34. **Light**/Compare the relative brightness of 3 way bulb as compare to voltage. Compare the brightness of a bulb when more batteries are added in series. As the voltage increases how does the light intensity increase?
35. **Light, Temperature**/Compare how cloud cover affects air temperature by placing a light and temperature probe in an area directly affected with sunlight.
36. **Light**/Use the light probe to measure the flicker of a fluorescent light or TV.
37. **Light**/Use a dimmer switch in order to adjust a light source, make readings with a light probe and see what the minimal brightness is for you to read a book. Compare with a friend, is his minimal reading brightness the same as yours.
38. **Voltage**/Monitor the voltage and the current as a capacitor is charged and discharged.
39. **Voltage**/Study the effect of temperature and humidity on static electricity.
40. **Voltage**/Monitor the changes in voltage and current as a rheostat slider is moved.
41. **Voltage**/measure the voltage given off when making a "fruit battery", Compare different types of fruits. Which give off the most voltage, which last the longest?
42. **Motion**/Measure the movement of a "bungie barbie" as it bounces on an elastic cord.
43. **Motion**/Measure the rate of acceleration of a can rolling down an incline.
44. **Motion**/Measure the motion of a ball bouncing on a surface.
45. **Motion**/Measure the motion of something periodic, such as a pendulum swinging.
46. **Motion**/Measure the motion of a yoyo'er who is continuously adding energy to the system.
47. **Motion**/Measure the distances to the floor as a motion detector is passed across the room on a wire. This will form a topographical map of the room.
48. **Microphone**/Measure the sound of air passing over bottles filled to various heights with water.

Currently Available Lessons for Data Collecting

Lessons written in CBL lingo:

1. **Colorimeter/Beers Law** (http://www.cci.unl.edu/calculators/activities/Beers_Law.html): Use the colorimeter to measure the amount of light transmitted and reports to you the percentage of light transmitted relative to the incident light in a solution of Copper Sulfate.
2. **Pressure Sensor/Boyle's Law** (http://www.cci.unl.edu/calculators/activities/Boyles_Law.html): Use a syringe and air to measure various pressures at various compression distances.
3. **Colorimeter**, (<http://www.cci.unl.edu/calculators/activities/ChemEquilibrium.html>) :determine the change of light absorption for the reaction, Fe^{3+} and SCN^- .
4. **Pressure Sensor & Temperature Probe** (Guy Lussacs Law), (http://www.cci.unl.edu/calculators/activities/Gay_Lussac.html), measure pressure vs temperature of several solutions.
5. **Colorimeter/Crystal Violet Bleaching**, (<http://www.cci.unl.edu/calculators/activities/CrystalViolet.html>) : In this experiment, you will observe the reaction between crystal violet and sodium hydroxide. One objective is to study the relationship between concentration of crystal violet and the time elapsed during the reaction.
6. **Temperature/Phase Changes of Water**, (<http://www.cci.unl.edu/calculators/activities/phase.html>): The purpose of this experiment is to observe the phase changes in water over a temperature range of approximately -10°C to 100°C and to describe the behavior of the molecules in the water at any temperature point in terms of their kinetic energy and/or potential energy.
7. **PH Probe, CONTINUOUS TIME pH TITRATION PROCEDURE**, <http://www.cci.unl.edu/calculators/activities/cttitrate.html>
8. **PH Probe, SMALL SCALE pH TITRATION PROCEDURE** (<http://www.cci.unl.edu/calculators/activities/sstitrate.html>)
9. **PH Probe, TRIGGER/PROMPT pH TITRATION PROCEDURE** (<http://www.cci.unl.edu/calculators/activities/fstitrate.html>)
10. **PH Probe, Titration of Diprotic Acid** (<http://www.cci.unl.edu/calculators/activities/DiproticAcid.html>)
11. **PH Probe, SPECIAL TITRATIONS USING A pH ELECTRODE** (<http://www.cci.unl.edu/calculators/activities/sptitrate.html>)
12. **PH Probe, Conductivity Titration Procedure**, (<http://www.cci.unl.edu/calculators/activities/cdtitrate.html>)
13. **Temperature Probe, Pressure Probe/Vapor Pressure** (<http://www.cci.unl.edu/calculators/activities/VaporPressure.html>) : In this experiment, you will

investigate the relationship between the vapor pressure of a liquid and its temperature. When a liquid is added to a test tube, it will evaporate into the air above it in the tube.

14. **Voltage Probe**, Voltaic Cells and the Nernst Equation
(http://www.cci.unl.edu/calculators/activities/Volt_Cells.html) The voltage of an electrochemical cell is related to the concentration of the solutions involved in the cell. A change in concentration of cell solutions results in a change in voltage that can be quantitatively described by the Nernst equation.
15. **Motion Detector/Stealth Technology**
(<http://www.cci.unl.edu/calculators/activities/stealth.html>) : This experiment shows the basis of stealth technology. Researchers found the size of the aircraft meant nothing as far as avoiding detection was concerned. Instead, shape was the most important factor The F I 1 7A Stealth Fighter was composed of flat, angular surfaces resembling four faceted diamonds which reflected the radar waves away from it instead of back to the radar scope.
16. **Light Probe/Oscillating Waves**
(<http://umastr1.math.umass.edu/~frankw/ccp/ccpwrite/alightfl.htm>): you probably noticed that no matter how carefully you aimed the light probe at a fluorescent light or television screen the readings jumped around quite a bit. This contrasts with an incandescent light.
17. **Light/Motion** Using two probes together
(<http://umastr1.math.umass.edu/~frankw/ccp/ccpwrite/amotlite.htm>): This experiment looks at the way the intensity of light drops off as we move away from a light source.
18. **Temperature/Hot Stuff** (<http://umastr1.math.umass.edu/~frankw/ccp/ccpwrite/arealtmp.htm>): We will just use it to see what happens to the temperature of the temperature probe when you try to warm it in your hand.
19. **Motion Detector**
(<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/width.html>): Find the Width of the lab table using a motion detector.
20. **Motion Detector**
(<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/conacc.html>): Purpose: to determine The Equation of Motion for an object traveling with constant acceleration.
21. **Motion Detector/Newton's Second Law of Motion**
(<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/seclaw.html>), what effect does changing the force have on the acceleration?" In this experiment we will use a variety of forces to produce different accelerations, and then graph the force vs. the acceleration.
22. **Motion Detector**, Bouncing Ball
(<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/BallBounceLab.html>): to determining the motion of a bouncing ball
23. **Force Probe**, Motion of a Spring
(<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/springenergy.html>): Purpose: to examine the dynamics of a mass oscillating on a spring, especially to determine the relationship between the force on a spring and its stretch when the force and stretch are constantly changing.

24. **Temperature**/Energy vs Temperature (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/bulbtemp.html>): to determine the relationship between the rise in temperature of a substance and the energy added to it.
25. **Voltage Probe**/Pulling a magnet through a coil (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/apphysics/inductance/inductance.html>) A rod magnet was positioned half way through the coil, with the center of the magnet at the central plane of the coil and aligned with the axis of the coil. When the program was run, the CBL said "Ready" and continuously collected points while it waited for the trigger event. When I pulled the magnet rapidly out of the coil, an EMF was generated.
26. **Voltage Probe**, Capacitance (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/apphysics/capacitance/capacitance.html>) The leads of a capacitor and resistor were twisted together so that the two components were in parallel with each other, and the leads were positioned so that they could be touched to a 9 V battery. The voltage probes of the CBL were connected across the resistor.
27. **Microphone**/Tuning Forks (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/honors/freqtunfrk.html>): to use the microphone probe to examine the waveform from a tuning fork to determine the frequency of a tuning fork to model the waveform from a tuning fork.
28. **Microphones**/Speed of Sound (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/CBLPrograms/othercblstuff/speedofsound.html>): to directly measure the speed of sound by timing the passage of a sound wave over a known distance
29. **Student Force Probe**/Amusement Park Physics (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/SixFlags/SixFlagsCBL.html>): Analyze the forces of many of your favorite rides at an amusement park near you.
30. **Description of Digital Ports on the CBL** (<http://risdwww1.richardson.k12.tx.us/schools/phs/academics/physics/CBLPrograms/othercblstuff/trigdigshville.html>)
31. **PH Probe**, Cellular Respiration (<http://www.ti.com/calc/docs/act/vern3.htm>) : In this experiment you will verify that humans exhale carbon dioxide. You will also determine what effect exercise has on the production of carbon dioxide. Carbon dioxide is produced when sugar and oxygen are combined during respiration
32. **Gas Pressure Sensor**, Transpiration (<http://www.ti.com/calc/docs/act/vern1.htm>) Water is transported in plants, from the roots to the leaves, following a decreasing water potential gradient. Transpiration, or loss of water from the leaves, helps to create a lower osmotic potential in the leaf..
33. **Colorimeter**, Alcohol Assimilation (http://www.ti.com/calc/docs/act/cbl2_maturo1.htm): The color of an object is the result of reflected waves of light; complementary wavelengths are absorbed. The concentration of colored solutions, therefore, can be determined by measuring the absorption of a specific transient wavelength of light. This concept is utilized to collect data on the rate of assimilation of drugs in the human body. Solutions of alcohol are prepared to represent concentrations found within the body as the result of ingestion.

34. **Ph Probe**, Sour Chemistry (http://www.ti.com/calc/docs/act/cbl3_14.htm): In this activity, the conditions found in an acid stomach will be simulated using a solution of lemon juice and water. The effectiveness of an antacid remedy will be tested by monitoring the pH of the solution after an effervescent antacid tablet has been added to it. The resulting data will be modeled using a modified exponential function.
35. **CBL Activities for Algebra**, Downloadable in PDF format:
<http://www.ti.com/calc/docs/actcblalge.htm>
36. **Exploring Chemistry with the CBL**, 6 activities in PDF format,
<http://www.ti.com/calc/docs/actcblchem.htm>
37. **Activities for Algebra 2/Precalculus for CBL**, 25 of them:
<http://www.ti.com/calc/docs/actcbltrig.htm>
38. **7 Activities for Statistics/Probability for CBL**, <http://www.ti.com/calc/docs/actcblstat.htm>
39. **21 Experiments for the CBL** <http://www.ti.com/calc/docs/cblwb1.htm>
40. **48 Experiments in Math and Physics for the CBL**
(<http://www.ti.com/calc/docs/cblwb2.htm>)
41. **Barometers/Germinating Peas vs Earthworms**
(<http://www.gene.com/ae/21st/TE/PW/EXP/CBRESP/cbpmater.htm>): In this experiment we will determine the breathing rate (oxygen utilized per gram of tissue) of earthworms and germinating peas. Respirometers will be constructed and attached to barometer probes to detect pressure differences.
42. **Colorimeter**, Photosynthesis in Isolated Chloroplasts
(<http://www.gene.com/ae/21st/TE/PW/EXP/CBPHOTO/index.html>) -In this experiments we will determine the rate of photosynthesis in isolated chloroplasts. Specifically we are measuring the rate of the light reaction. Reduction of DPIP by photosynthesizing chloroplasts will be monitored with a colorimeter. •Teacher Information for Photosynthesis in Isolated Chloroplasts -This section includes tips for conducting the experiment and analyzing the data, sample data and answers to questions posed to the students.
43. **Temperature Probes**, Shivering Isn't Enough
(<http://www.gene.com/ae/21st/TE/PW/EXP/HEAT/main.html>): Heat Conservation In Homeotherms-In this experiment we will examine the relationship of insulation and body shape to heat loss in homeothermic animals. Temperature probes will be used to analyze the amount of heat loss in animal models. •Teacher Information for Shivering Isn't Enough: Heat Conservation In Homeotherms-This section includes tips for conducting the experiment and analyzing the data, sample data and answers to questions posed to the students.
44. About 200 cool experiments and activities: <http://physlab.catlin.edu/chbin/files/start>
45. **Listing of currently available TI CBL resources and books:**
<http://cesme.utm.edu/resources/GRPHCALC.HTM>

Lessons written in EA100 lingo:

1. 8 Activities located on Casio's education page:
<http://pegasus.cc.ucf.edu/~ucfcasio/activity.htm>
2. 8 Activities by the Northern Arizona University Modeling Workshop Group:
<http://purcell.phy.nau.edu/courses/98/summer/sci599/CasioCBL/projects/casio.html>

3. A complete translation of EA100 programming keystrokes compared to the CBL system: <http://purcell.phy.nau.edu/courses/98/summer/sci599/CasioCBL/CASIOSW/CasiotoTI.html>
4. 14 Activities using the four simple probes for the EA100: http://www.casio.co.jp/edu_e/education/ea100.html

Lessons from “Bringing the World to your Fingertips”, Edited by Joe Schumacher:

1. How High Does it Bounce/**Motion**
2. Bouncing Exponentials/**Motion**
3. What Goes Up/**Motion**
4. Modeling a Parachute/**Motion**
5. Light at the End of a Tunnel/**Light**
6. Twinkle Little Star/**Light**
7. Blinded by the Light/**Light**
8. Light Flicker/**Light**
9. Escaping Electricity/**Voltage**
10. Sea Cell/**Voltage**
11. What’s my temperature/**Temperature**
12. Cold Rid/**Temperature**
13. Getting Specific about Specific Heat/**Temperature**
14. Newton’s Law of Cooling/**Temperature**
15. Rate of Respiration/**Temperature**
16. Balancing Chemical Equations/**None**

Activities by Becky Pittman, Gloucester High School:

1. Jussst Right, **temperature probes**, To fix a cup of cocoa that is not “too” hot.
2. Controlling Yeast Growth Rate, **Light and Temperature Probes**, Investigate the effects of water, temperature, and nutrients on the growth of yeast.
3. Light Energy and Angle of the Sun, **Light Probe**, To investigate how the angle of light rays affect the “brightness”.

Activities from Unknown Source:

1. **Temperature**/Making a Hot Pack Stay Hot: Using a commercial hand warmer to investigate the heat of fusion of sodium acetate as it crystallizes.
2. **Temperature**/Boiling Over: To investigate the boiling point of deionized water.
3. **Temperature**/Minnesota Freeze: Investigate the concentration of salt in an ice bath effect the rate of temperature change.
4. **Temperature**/Anti-Freeze or Anti-Boil: Compare the temperature effects of several brand name antifreezes.
5. **Light**/What is the Best Light for Photosynthesis?: Use a variety of light sources to determine which causes the highest rate of photosynthetic activity.
6. **Motion Detector**/Ramp Riding: Graph the motion of a ball rolling down a ramp to show the effect of gravity toward acceleration.

7. **Temperature**/Enzyme Liver Lab: Test animal tissue for the presence of catalase, and to see how this is affected by temperature, by counting the number of bubbles that are released. (Pat Fahey)
8. **Temperature**/Crashing Heat: To test how the movement of bb's in a tube increase the temperature after constant shaking. (John E. Pearson/Southwest High School, Mpls. MN)
9. **Motion Detector**/The Effects of Surface Area on a Falling Object: To analyze the rate of falling of parachutes designed in different shapes.
10. **Temperature**, Dissolved Oxygen/Where is the Gas?: Measure the relationship between temperature and dissolved oxygen in a source of water.
11. **Light Probe**/Concentration as a function of Light Transmission: You will make a prediction of the concentration of a solution by the amount of light transmission.
12. **Temperature Probe**/Rates of Evaporative Cooling: Investigate the rate of evaporation of several liquids.
13. **Temperature Probe**/Exploring with a Density Ball: Students work with a ball to show how the density of a liquid varies with the temperature of the liquid.
14. **Temperature Probe**/The Hotter you are the quicker you cool: Compare the rate of cooling of water at various temperatures, compared to room temperature.
15. **Voltage Probe**/RC Circuits: Compare the rates of discharge of several capacitors and resistors.
16. **PH Probe**/Rainbow Colors: Manipulate the color purple by adding chemicals and compare the resulting colors PH levels.
17. **Temperature**/Supercooled H₂O: Use rock salt to manipulate the freezing point of water.
- 18.