Year	Development	Grade	Overview
2001	Fuels for Tomorrow/Today?	Grades 10(Honors)-12, Algebra I, Algebra II, Pre-Calculus, Chemistry	Alternative fuels have been proposed for several years to replace fossil fuels used today. Due to the cost and availability of these fuels much research in this area is being encouraged. Different fuels possess different heat contents and subsequently are capable of generating different amounts of energy. While this is certainly not the only criteria for selection as a fuel, it is an important one. This activity demonstrates the difference in heat content of two organic compounds and is representative of a simple method for making the determination. The student will be given a specific substance, wax and ethanol and asked to determine the heat of combustion of each. Students will collect data on the temperature change that occurs when a specific amount of the fuel is burned. Using the collected data and the TI-83, students will analyze the experimental data and pooled class data. Students will also compare the heats of combustion of the two substances and make predictions to determine which one would be the better fuel. They will also make suggestions about the advantages of using one of them as a fuel.
2001	Heart Rate and Physical Fitness	Grades 9-12	The physical fitness of astronauts is important for many reasons, but the strenuous conditions put on the heart during space travel is among the top. In this activity, the students are able to test their own physical fitness, as well as see the effects of physical exertion on the heart rate.
2001	Modeling Genetic Drift in Geographically Isolated Wildlife Populations	Grades 9-12, Algebra I & II, Biology	Statistical modeling has proven invaluable to predicting dynamics of wildlife populations. Anthropogenic alteration of ecosystems often results in geographic isolation of subpopulations, which can result in genetic drift that endangers the smaller population. A mathematical model can simulate the effect of such an isolating event. This activity is to be implemented with the Probability Simulator application on the TI-83 graphing calculator. However, it is easily adapted to manipulatives such as dice, spinners, and coins.
2001	Paper Airplanes and Python	Grades 9-12	For this project, students first create paper airplanes, then measure the distance of 5 trials for each paper airplane, then write a computer program that accepts the input of 5 decimal (floating point) numbers and outputs the average of the 5 trials. Extensions are obvious (but also listed later in this document).

Year	Development	Grade	Overview
2001	Springs and Numerical Analysis	Grades 10-12, Honors or Gifted and Talented	Students will experimentally determine the force law for springs (Hooke's Law). Using the basic definitions of velocity and acceleration they will write equations for the velocity and distance a fraction of a second later, then write a calculator program which will loop through the equations to generate a time series of distance, velocity, and acceleration. Graphs will show the relationship between the three variables. The use of numerical analysis eliminates the need for calculus to arrive at the sinusoidal functions. The unit ends with a discussion of connections to more advanced problem solving using numerical analysis.
2001	The Control Line Plane, Quadratic Regression and Flight Theory	Grades 8-12	The major focus of this lesson is to instruct students about the theory of flight and then to design, and construct an electrically powered control line plane. The quadratic regression will be discussed in the follow up lesson. The cost of the supplies needed to construct each plane is approximately $2. The students can be organized into groups of 2 to 3 students to construct the motorized plane. The teacher will also need to spend $200 on a power supply and a center power pole. The mathematical connection is the quadratic regression that the student can perform on the data that is obtained from the plane launch and the calculation of the wings' Aspect Ratio.
2000	Buffers in Fruit Drinks	Grades 10(Honors)-12, Algebra I, Algebra II, Pre-Calculus, Chemistry	Human blood is buffered with a pH of about 7.4. If the pH of blood were to vary by 0.2, a person could become seriously ill. Buffers resist changes in pH because they contain an acidic species to neutralize hydroxide (OH 1) ions and a basic one to neutralize hydrogen (H+1) ions. In this activity several brands of commercial fruit drinks will be titrated to compare their effectiveness as buffers. Students will be given a specific volume of each drink and a known concentration of sodium hydroxide. They will titrate the drink with hydroxide solution and monitor the pH with a pH electrode. Students then will collect data on pH versus sodium hydroxide volume for each drink with the TI-83 and CBL. Using the collected data and the TI-83, they will analyze the experimental data and pooled class data. They also will compare the buffered drinks with unbuffered citric acid.
2000	Connecting Force and Energy...	Grades 9-12	Students will explore the relationship between force, distance, and energy through qualitatively and quantitatively recording and analyzing the behavior of a cart as it is first dragged up and then released down an inclined plane. The open format of the exploration will leave room for ingenuity and test students' understanding of the principles underlying force and energy.

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2000	Life on the Bay	Grades 9-12	The objective of this unit is to utilize the Internet to gather data for the purpose of a PowerPoint presentation. Students will access sites chosen by the teacher with the assistance of eBoard. The focus of the presentation will involve environmental or political concerns of the Chesapeake Bay and should be supported with mathematical and scientific data.
2000	Liver Lab	Grades 9-12	This is a science lesson that can be used either during a digestive unit or chemistry unit. Students will use beef liver as a source of catalase to speed up the reaction of the breakdown of hydrogen peroxide to water and oxygen. They will observe how factors such as surface area, temperature, and pH affect the rate of a chemical reaction.
2000	Sketching DNA	Grades 9-12, Geometry, Biology	This unit will construct a DNA pattern using Geometer's Sketchpad. The construction will involve translation, rotations, and reflections. Students will use patterns to represent and identify traits.
1999	Analysis of Multispectral Imagery	Grades 9-12	Earth Resources Satellites, such as Landsat, record data in a multispectral format. Data is separated into several different bands each of which is highly sensitive to a particular portion of the visible and infrared spectrum. Vegetation patterns, land forms, and water resources can be studied and analyzed using these images. Combining image data with maps and other geographic or geologic resources yields a wealth of information about planet Earth. This Learning Unit focuses on the process of image analysis using Multispec Software.
1999	Astronomy and the Wave Formula...	Middle School (post Algebra I), High School (with extensions)	In astronomical investigations, viewing the universe is dependent on electromagnetic radiation from emitting bodies reaching instruments on earth by means of waves. A conceptual understanding of the relationships among velocity, frequency, and wavelength is used as the basis for understanding direct and indirect variation and their graphical representations. The wave equation that results when all three variables are combined becomes the basis for problem solving and computing values for charting a spectrum to display the various electromagnetic emissions from the universe. Enrichment activities extend the lesson on variation to an equation containing a quantity squared.

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1999	Coming Out of My Shell	Grades 10-12	The molting of Callinectes Sapidus, commonly known as the Blue Crab, is affected by various factors. One factor, salinity, changes by varying degrees from season to season. As part of a science project, experimental floats could be set up and monitored over an extended time period in order to test the effects of salinity on molting in Callinectes Sapidus.
1999	Concentration Versus Conductivity of NaCl	Grades 10(Honors)-12 Algebra I, Algebra II, Pre-Calculus Physical Science, Chemistry	The salinity of seawater is approximately 35 ppt (parts per thousand) or 35 g of salts per kg of salt water. Of the 35 ppt, about 30 ppt is attributed to NaCl. Students will collect data on conductivity versus salinity for several solutions of known concentrations with the TI-83 and CBL. Using the collected data and the TI-83, students will do statistical analyses on the experimental data and pooled class data. A regression curve fit will be done using the TI-83. The standard curve will be used to determine the salinity of several unknowns using interpolation techniques.
1999	Exploring Newton's 2nd Law...	Grades 11-12, Physics	With the increasing availability of computers in the classroom it is possible to collect data with precision and ease unheard of in decades past. This unit consists of a lab in which students test Newton's 2nd law using Pasco Smart Pulley hardware and Vernier Logger Pro software on Macintosh computers. If you have the hardware, it is possible to go an extra step and have the students submit their work electronically across a network to your teacher station. A dream today perhaps, but increasingly likely, as we enter the 21st century.
1999	Hotter Than Hot...	Grades 10/11, Algebra II, Chemistry, Probability & Statistics, AP Statistics	Colligative properties of a solution are properties that depend only on the number, and not the identity, of the solute particles. Boiling point elevation is such a property. A nonvolatile solute elevates the boiling point of the solvent in which it is dissolved. The boiling point elevation due to a specific solute is directly proportional to the molal concentration of the solution. Data is collected using the CBL with a temperature probe to record the boiling temperature of various concentrations of a given solution. Boiling point elevation at varying concentrations is then graphed and analyzed using the TI-82/TI-83 calculator. Separate electrolyte and non-electrolyte solutions are analyzed and compared using regression techniques.
1999	Physics of Model Rockets Addendum...	Grades 8-12	This unit is intended as an addition to the 1998 Learning Unit Physics of Model Rockets. It extends the previous work by introducing additional data and calculations made possible by the use of a computer and the PascoTM Rocket Engine Test Bracket.

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1999	Resistor Color Codes...	Grades 8-10	This lesson deals with the application and use of resistor color codes to solve mathematical valuations of standard electronic appliances throughout the home. Students will be involved in measuring and recognizing the codes, values, and application of resistors in their everyday lives.
1999	Soil as a Natural Filter	Grades 8-9	Most of the time when we speak of water pollution, we only refer to surface water pollution. Many people depend on well water from underground aquifers. Therefore, ground water pollution is a concern, as well. Fortunately, soil acts as a filter. Soil can filter heavy metals, as well as organic and inorganic pollutants. However, there are two main questions to be asked: “how much of these contaminates can soil filter?” and “which soils can filter best?”. In order to address these two questions, a soil filtration system can be used.
1999	Stand Up and Be Counted!	Grades 7-12	In this learning unit, students will explore plant populations and the dynamics of those populations. They will use the data they have gathered to compare it to data that they have collected for human populations in a surrounding area. They will use these models to come to conclusions about the effects of populations on an area.
1999	The Acidic Reaction Caused...	Grades 9-12	Students will use the pH Probe and the TI-83 Graphing Calculator in conjunction with the CBL Unit to test the acidic reactions of four various candies.
1999	Unraveling the Sickle Cell Puzzle	Grades 7-9	This learning unit is intended to make students more familiar with genetic diseases and their transmission from parent to offspring. This unit also exercises the student’s skills in predicting, estimating, collecting and reporting statistical data, expressing data in graphs and tables, answering questions using algebraic equations, and analyzing final results.
1999	When and Where Will It Stop?	Activity #1: Grades 9-12, Activity #2: Grades 11-12, (Pre-calculus recommended)	This learning unit provides two activities to investigate empirically how long (in both time and distance) it takes a vehicle to brake to a stop in relationship to its velocity. Activity #1 is suitable for all high school students, while Activity #2 is suitable for students with a somewhat higher level of mathematical maturity (typically pre-calculus or above). Analysis and data collection will involve the TI-83 and the CBR motion detector.

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1998	Drawing the Line on Diffusion	Grades 9 - 12, All levels of Biology, Algebra I, Algebra II	The students will perform CBL activities using the conductivity and temperature probes to measure the rates of diffusion at different temperatures. The data from these activities will be used to determine the best fit line for diffusion as a function of time. Students will determine the domain and the range of the functions and compare the rates of change from the graphic, symbolic, and numeric representations. (Note: This unit is designed as an interdisciplinary activity with day one conducted in biology and day two for Algebra I/II.)
1998	Far Light, Star Bright?	Grades 9-12, Algebra I, Algebra II, Pre-Calculus; Earth Science, Physical Science, Physics, Astronomy	This activity has been developed to provide opportunities for students to investigate relationships between light intensity and distance with possible applications to mass and distance relationships. Students will have the opportunity to determine the type of regression equation that will best-fit data that has been collected, and use this equation to make predictions about various mathematical relationships. Communication and graphing skills, use of technology, and team work are incorporated throughout this activity.
1998	Image Compression Activity...	Grades 9-11	A critical component of multimedia communications is the ability to transport real-time and non-real time video and images over a network. A major issue is that video traffic is very bandwidth intensive, often making it prohibitive to carry video effectively in its original uncompressed format. In this exercise, students will deduce algorithms for compressing the information contained within the pixels of various sample "images," in an attempt to reduce the volume of information that needs to be transmitted across the network. This is done by members of the team agreeing on an encoding scheme for the pixels within each image. Each team is split into two equal groups, with one half acting as the senders or "encoders" and the other half acting as the receivers or "decoders". The groups are separated such that the image is initially seen only by the senders. The senders encode the pixels of the image onto index cards which are passed to the receivers. The receivers try to decode the pixels and reconstruct the image as quickly and as accurately as possible.
1998	Physics of Model Rockets	Grades 8-12	This unit is intended as a culminating activity for Physics students who need a “real-world” connection. The students build a simple model rocket and compare its performance to predictions. Their prediction can involve the use of conservation of momentum, conservation of energy, Newton’s Laws of Motion, kinematics formulas, and friction.

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1998	Projectile Motion Analysis...	Grades 10-12, Trigonometry, Physics	This unit integrates the subjects of trigonometry and physics to develop a model of projectile motion using parametric equations. Given a set of data provided in the lesson, the student will generate the parametric equations for x and y that models the movement of a projectile. The TI-82/83 calculator will be used to facilitate the model development.
1998	Running Hot and Cold	Grades 11-12	This lesson is a demonstration of the affects of temperature on dexterity. They then will be asked to perform a simple task while their hand is submerged in cold water, and again in warm water. Students will collect their own data from the experiment and perform a statistical analysis on the data with respect to the aforementioned hypotheses.
1998	Surface Temperature Measurements	Grades 9-12	This lesson details how surface temperature may be used as a descriptor of an area's physical make-up. Students create a temperature map of a selected location by gathering surface temperature data over several days. In addition, since temperature data exhibits cyclic variation and both diurnal (day-night) and seasonal cycles are present, students fit a sine curve to a data set. If the students cannot obtain nighttime data, several monthly data sets are available from NOAA and are also included with this lesson. The NOAA data set will be used in this lesson to demonstrate the sine function.
1998	Under Pressure	Grades 10 (gifted)-12 Chem/AP Chem	This unit will explore the relationships between temperature and pressure, as well as between volume and pressure. Air will be trapped in a flask with a two hole rubber stopper. A syringe and a temperature probe will be attached. The students will vary both the volume (using the syringe) and the temperature (using hot and cold water baths) of the air. Data will be collected using the TI-8x series calculator and the CBL via the Vernier program CHEMBIO.
1995	DNA Extraction from Onions/Marmur Preparation	Grades 9-12	Deoxyribonucleic acid, or DNA, is the informational substrate used by the cells of all living organisms. The purpose of the lesson is to provide students with visible evidence of the existence of DNA and to provide an opportunity for the use of tools and terms relevant to the biological sciences in general, with a specific focus upon recombinant DNA technology.

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1995	The Hypercard Project	Grades 6-12	Initially, students run through a stack titled, “HyperCard Tour,” and complete a corresponding packet. Students then work in groups to design, analyze , build, draw, and program a HyperCard stack. Each member has an individual task that helps create the stack. When the individual task is completed, all students give the evaluation of the completed rough design. Each member has the task of creating the appropriate amount of cards for the stack. The difficulty level of programming can vary from novice to expert.
1995	Your Local Pond: A Delicate Aquatic Biome	Grades 10-11	In most communities there is a delicate balance among living organisms and abiotic factors. When people disturb that balance by altering the abiotic factors, the results are usually detrimental. In this unit the basic biology of living organisms will be challenged by chemical solutions introduced by humans. The students should be able to connect basic concepts such as eutrophication, dissolved oxygen, population density, and the societal role in maintaining this balance. They will determine the effects of phosphate concentration on dissolved oxygen and algae.