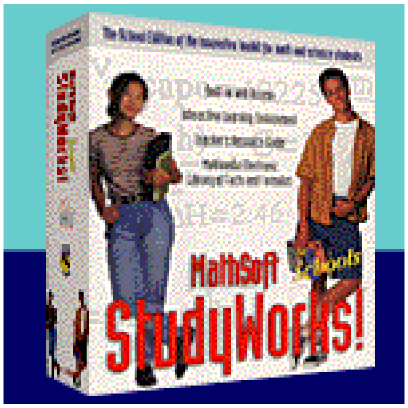
StudyWorks™ for Schools



Platform: Windows and Macintosh
Available on CD-ROM only
Available for ground shipment

StudyWorks for Schools provides the complete content and functionality in both StudyWorks for Math and StudyWorks for Science, along with at Teacher's Resource Guide to speed lesson preparation time and create dynamic, interactive classroom demonstrations. Just open up one of your own customized worksheets -- or use one of the many ready-to-use worksheets. Then demonstrate how formulas, equations, graphs and data are related. Because the math in your worksheet is "live", as soon as you change one value, related graphs and other values update and change automatically. StudyWorks lets you immediately engage your students while deepening their understanding of math and science and enabling them to collaborate on projects.

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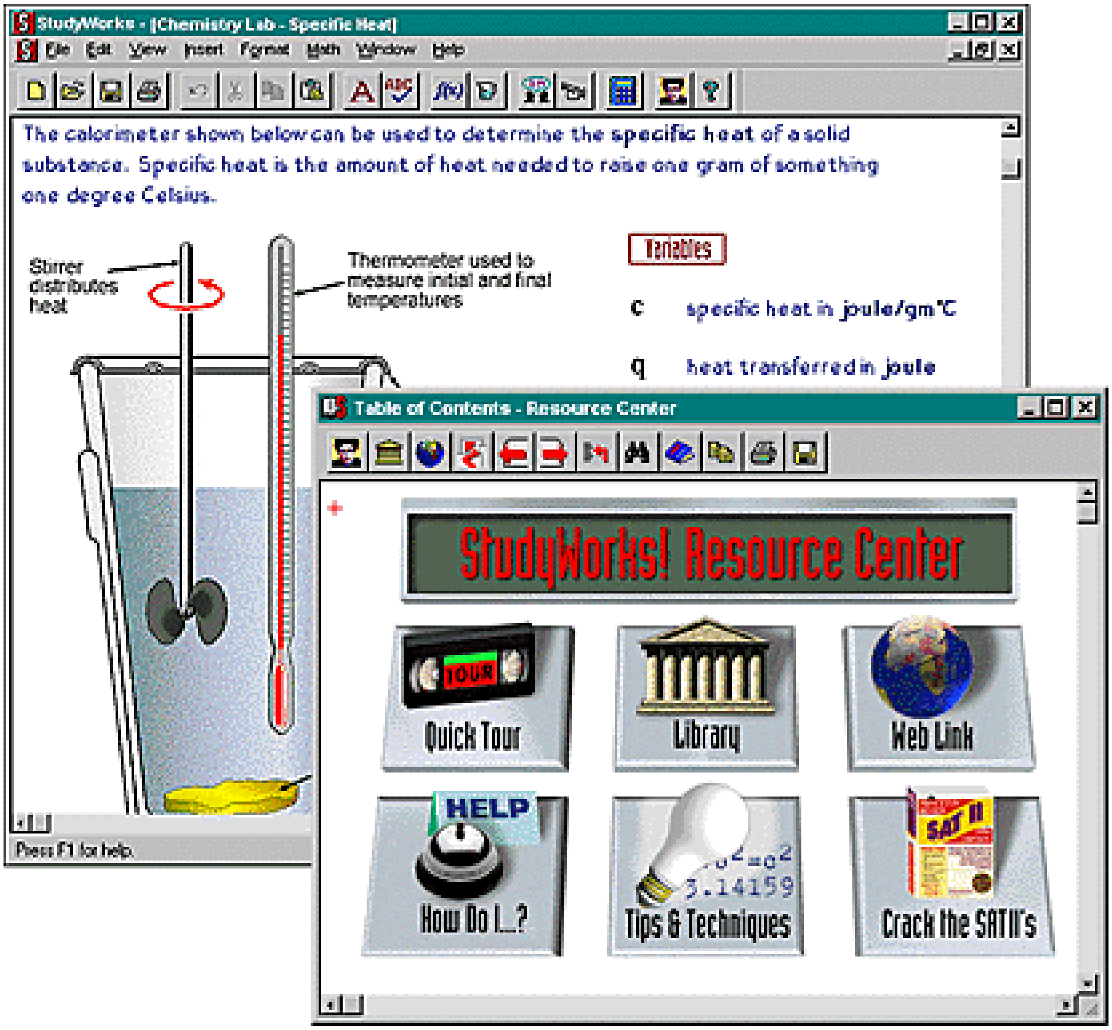

In the StudyWorks Resource Center you'll find math and science concepts, background information, "live" formulas, graphs, colorful pictures, animations and diagrams — all of which can be instantly incorporated into your worksheet.

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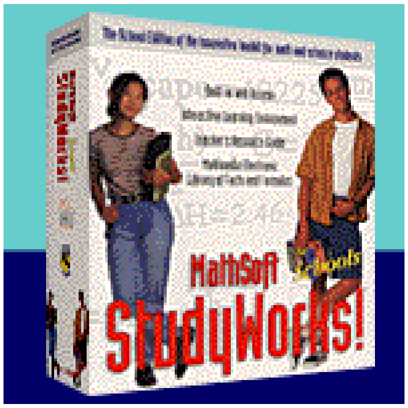

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With Internet access, the StudyWorks Web Link gives you and your class continuously updated reference information and links to other interesting sites on the WWW. Or access the Collaboratory where you can participate in discussion forums with other teachers and students. Even post homework assignments for students to complete. Use StudyWorks as a medium for distance learning courses, create virtual study groups, provide online tutoring and disseminate classroom materials. There's no better way to give your students a taste of what it's like to work together on real problems in the real world. You can order now by clicking on Add to Purchase List. Accelerated discounts are available for LAN and multi-user licensing by calling Education Sales at 1-800-628-4223.

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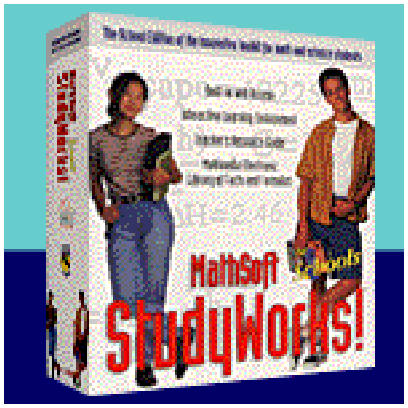

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The integrated learning and teaching tool

StudyWorks for Schools lets you teach and demonstrate step-by-step using the examples in each topic. This product helps you explain concepts better with the help of thousands of formulas, explanations, colorful diagrams, pictures and even animations.

- Provides a perfect environment for creating your own textbook-perfect texts, quizzes and more.
- Helps math educators put material in context by incorporating practical math applications.
- Helps science educators provide the underlying math that supports and reveals scientific mechanisms and relationships.

Math and science at your fingertips

Lets you reference a complete and integrated mathematics and science resource center covering all the essential topics for the following subjects -- Algebra, Geometry, Precalculus, Calculus, Statistics, Earth Science, Biology, Chemistry and Physics.

- Provides easy access to all the formulas, equations and constants you need.
- Lets you drag-and-drop information from the resource center into you workspace.
- Let's you explore background and history on math and science concepts.
- Lets you quickly find any topic using the built-in search engine.

Mathematics
Linear functions
Factoring
Quadratic equations
Graphing
Polynomials
Inequalities
Systems of equations
Conic sections
Areas and volumes
Polar coordinates
Logs and exponential functions
Sequences and series

Science
Earth and solar system
Erosion
Plate techtonics
Ecosystems
Weather and climate
Genetics
Population
Stoichiometry
Properties of gases
Thermochemistry
Properties of solids
Properties of solutions

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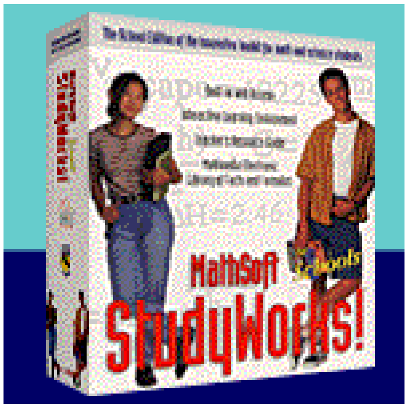

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Circular functions
Trigonometric identities
Parametric curves
Vectors
Matrices
Probability
Data Analysis
Complex numbers
Limits
Derivatives and integrals

Acids and bases
Reaction rates
Forces and momentum
Motion and acceleration
Energy
Waves
Thermodynamics
Light and optics
Electric currents
Electromagnetism
Quantum theory
Data Analysis
Probability
Correlation and regression

Crunch numbers and more

- Calculates trigonometric, log and exponential functions
- Simplifies, expands and factors
- Assists you with the units
- Handles vectors and matrices
- Solves equations and systems of equations
- Analyzes your data
- Finds derivatives, integrals, sums and products

StudyWorks' full listing of calculating abilities

- Operators and functions for manipulating equations, numbers, vectors, matrices
- Units of measurement and dimension checking
- Derivatives, integrals, summations and products
- Matrix operators include determinants, data product, cross-products, inverse and transpose
- Find roots of a polynomial
- Simultaneous equation solving
- Trigonometric, hyperbolic and exponential functions
- Calculus transforms
- Symbolic integration and differentiation
- Expand, simplify and factor expressions
- Statistics and data analysis functions

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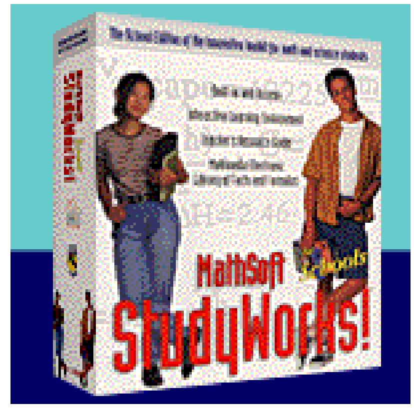

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Plot it perfectly

- Plot functions and surfaces
- Traces and zooms
- Makes scatter plots and bar charts
- Draws contours and vector fields
- Lets you make your own math animations
- Lets you view and transform images

StudyWorks' full listing of plotting and graphing abilities

- 2D rectangle, vector and polar plots
- 3D scatter, bar contour, surface and parametric surface plots
- Log, linear, 3D axis options
- Annotate and format graphs
- Trace and zoom
- Animation

And more essential features to augment your teaching efforts

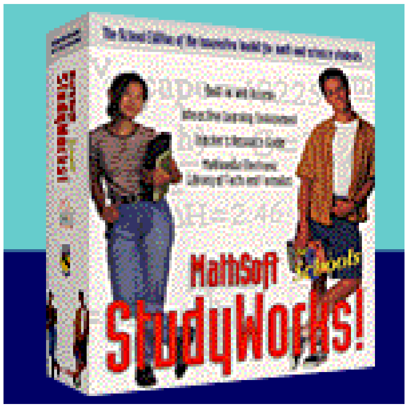
- Lets you upload lab data from graphing calculators directly into StudyWorks.
- Shows you how to use StudyWorks faster using the short animated tutorials.
- Provides you with e-mail connectivity so you can send math and science ideas conveniently.
- Lets you research projects using Web Link to find interesting and useful sites.
- Lets you engage in Web forums with other teachers and classrooms in the StudyWorks Collaboratory.

Compatibility

- World Wide Web aware
- E-mail connectivity
- Windows 95 compatible
- TI, Casio and HP calculator compatible

Awards

- HomePC Editors' Choice Top 100
- 1996 Family PC Recommended



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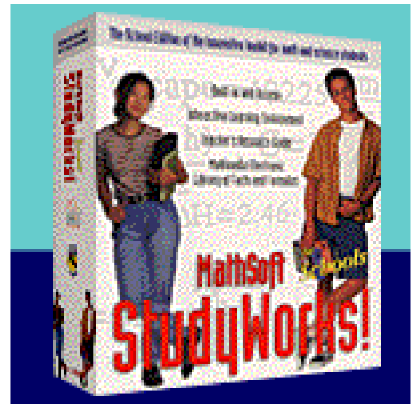
System Requirements

Windows

486 IBM PC or compatible or higher
Microsoft Windows 95, or Window v3.1 or higher
8 MB of RAM
14 MB free disk space
SVGA color monitor
CD-ROM drive
Web link requires Internet access.

Macintosh

Power Mac or 68040 (Power Mac recommended)
8MB of RAM
16 MB of hard disk space
CD-ROM drive
Macintosh System 7.1 or later
Web link requres internet connection and MacTCP



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Tuning a Stringed Instrument

Ever been to the symphony and heard the ear-wrenching sound of the string section tuning up? How about a rock concert as the guitarists warm up?

What are these musicians doing? These musicians are tuning their instruments using a method called beat elimination.

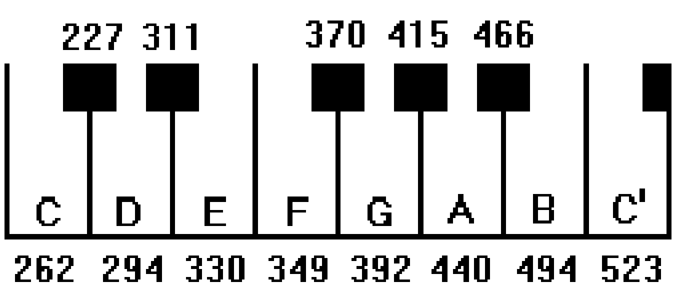
When the string of a guitar is plucked a musical tone is produced by the vibration of the string. The frequency or the number of vibrations per second, in hertz (Hz), is a function of the tension, length, and linear density of the string: The tighter the string, the higher the pitch; the shorter the string, the higher the pitch; and the denser the string, the lower the pitch.

The formula for frequency is

$$f = \frac{1}{2 \cdot L} \cdot \sqrt{\frac{t}{d}}$$

where L is the length of the string, t is the tension in the string, and d is the linear density of the string.

The A above middle C that orchestras tune to has frequency 440 Hz. Below is a chart of the frequencies for the C major scale (starting at middle C).



Frequency in Hz.

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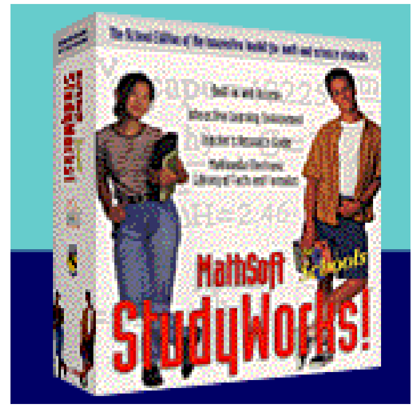

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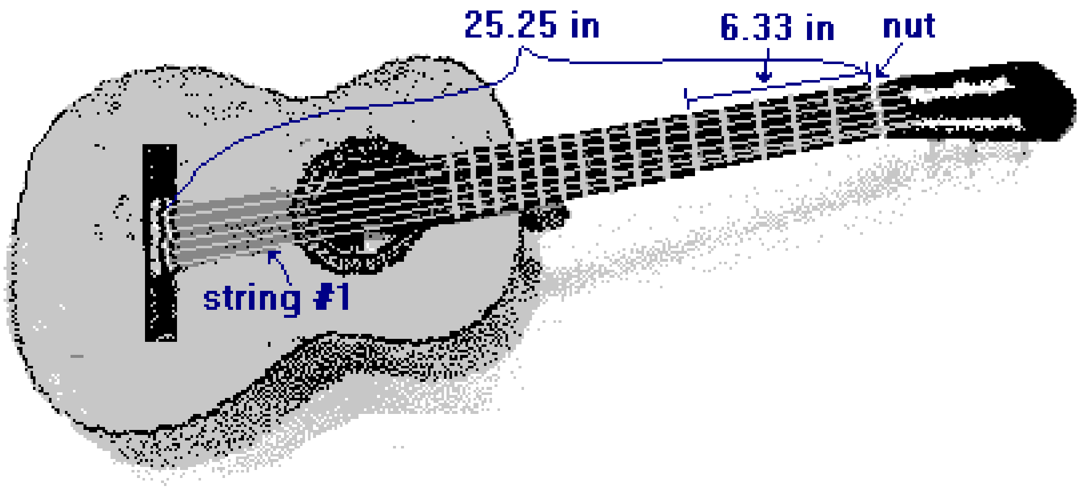
Example



The highest string (string #1) on a guitar is E and has a frequency of 330 Hz. The scale length of the string is 25.25 inches, and the 5th fret is placed 6.33 inches from the nut. If the string is shortened to this fret, what is the new frequency? What note is this?

The units for frequency Hz can be defined in terms of seconds:

$$Hz := \frac{1}{sec}$$

Since the tension and density of the string remain constant, the product of frequency and length is constant.

$$f = \frac{1}{2 \cdot L} \cdot \sqrt{\frac{t}{d}} \qquad f\,L = \frac{1}{2} \cdot \sqrt{\frac{t}{d}} = \text{constant}$$

Thus,

$$f_1 \cdot L_1 = f_2 \cdot L_2 \qquad f_1 := 330 \cdot Hz$$

$$L_1 := 25.25 \cdot in \qquad L_2 := 25.25 \cdot in - 6.33 \cdot in$$

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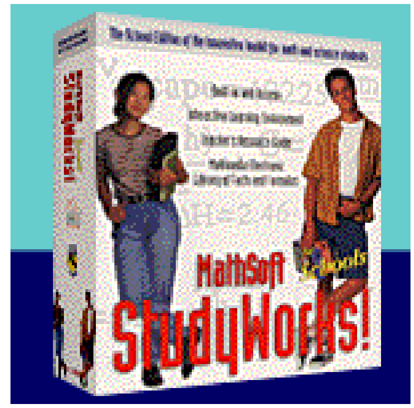

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Solving for f2 yields

$$f_2 := \frac{f_1 \cdot L_1}{L_2} \qquad f_2 = 440.407 \cdot Hz$$

The frequency is 440 Hz which is A above middle C.

The difference in frequency between notes is based on the equal-tempered scale. An octave is divided into 12 semitones (7 white keys and 5 black keys on the piano), in which the ratio of each successive semitone to the one before is

$$2^{\frac{1}{12}} = 1.0594630944$$

Example

The lowest string (string #6) on a guitar is also E but has frequency 82.401 Hz. The 5th string, A, is 5 semitones
higher. What is the frequency of the fifth string?

The next semitone higher has frequency

$$2^{\frac{1}{12}} \cdot 82.4 \cdot Hz = 87.3 \cdot Hz$$

Therefore, the frequency of A, 5 semitones higher, is

$$2^{\frac{1}{12}} \cdot \left[2^{\frac{1}{12}} \cdot \left[2^{\frac{1}{12}} \cdot \left[2^{\frac{1}{12}} \cdot \left(2^{\frac{1}{12}} \cdot 82.4 \cdot Hz \right) \right] \right] \right] = 110 \cdot Hz$$

or

$$2^{\frac{5}{12}} \cdot 82.4 \cdot Hz = 110 \cdot Hz$$

Can you write a **recursive function** that would solve the previous problem?

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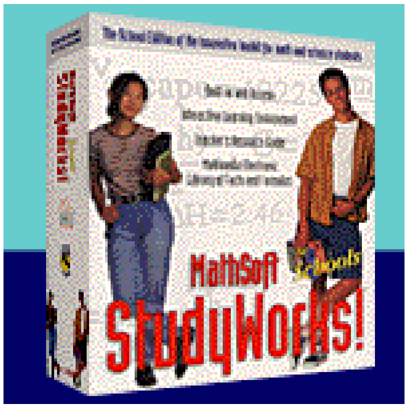

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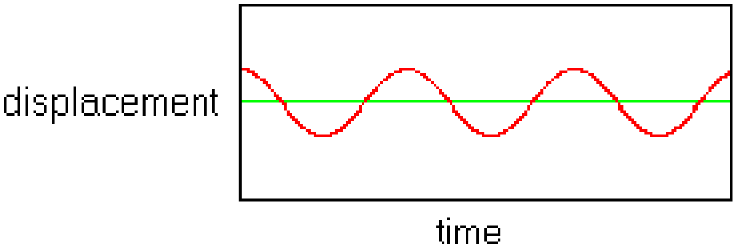
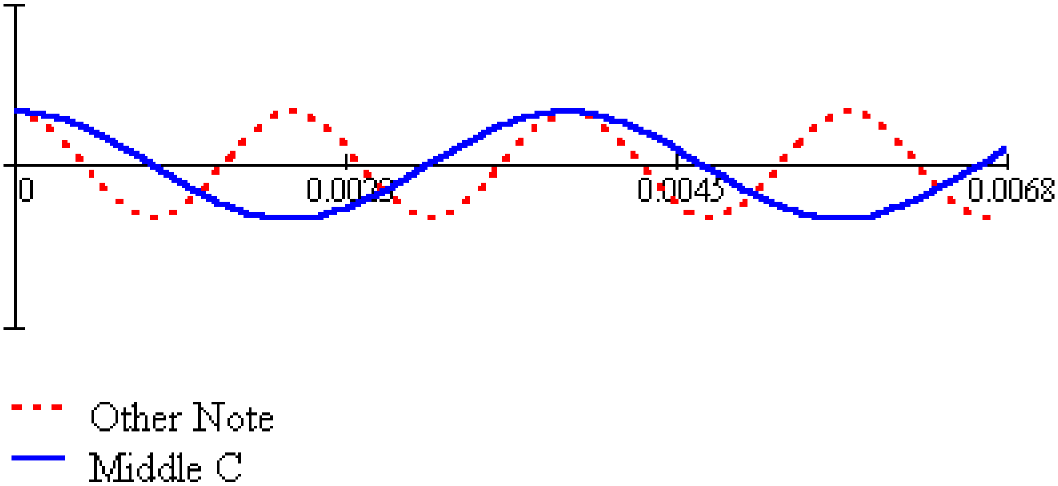
If the displacement of a point on a vibrating string is plotted over time, it exhibits sinusoidal behavior, as shown.



Below the sinusoid representing middle C is plotted (shown solid blue) along with the sinusoid representing C' (f = 523 Hz) one octave higher (shown dotted red). How do the periods of the two sinusoids compare?

$f := 523 \cdot Hz$ **Try changing the frequency of C' to G (f = 392 Hz).**

$f(x) := \cos(f\, 2 \cdot \pi \cdot x) \qquad x := 0 \cdot sec, .0001 \cdot sec .. \frac{3}{440} \cdot sec$



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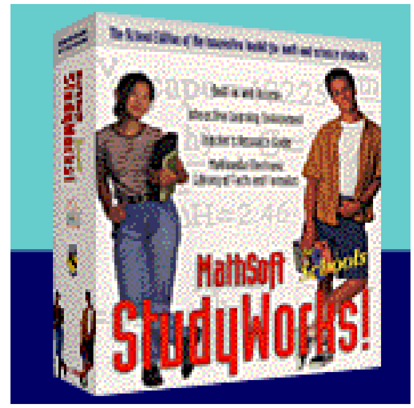

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One way to tune a guitar is called the 4-5 fret method. This method matches a fretted string with an open (unfretted) string. If the two tones have slightly disparate frequencies (are out of tune) the amplitude of the resultant wave (shown below) gives rise to a waxing and waning or beating of loudness.

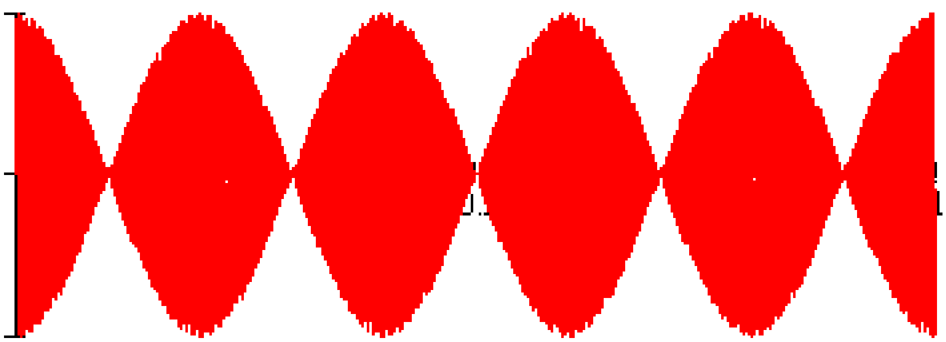
Fretted string, E:

$f_1 := 330 \cdot Hz \qquad f_1(x) := \sin\left(f_1 \cdot 2 \cdot \pi \cdot x\right)$

O

$f_2 := 325 \cdot Hz \qquad x := 0 \cdot sec, .0001 \cdot \pi \cdot sec .. 1 \cdot sec \qquad f_2(x) := \sin\left(f_2 \cdot 2 \cdot \pi \cdot x\right)$

H cond.



Try tightening the open string by changing f2 to 326 Hz. How many beats per second are there now?

Keep adjusting the tension on the open string. Notice that as the frequency of f2 approaches f1 the beats become slower and are eventually eliminated. This is called tuning by beat elimination.

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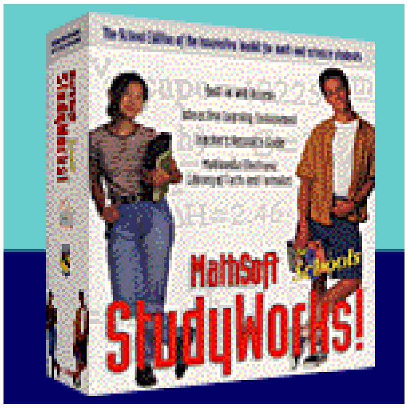

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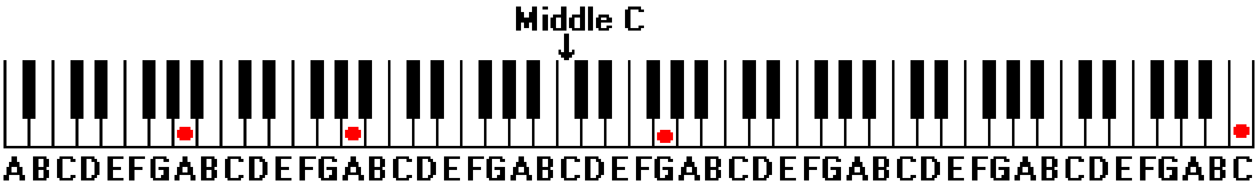
Exercises

1. There are 88 keys on a piano each separated by a semitone. The lowest key is A with frequency 27.500 Hz.

a. Write a recursive function that generates the frequencies of each key.

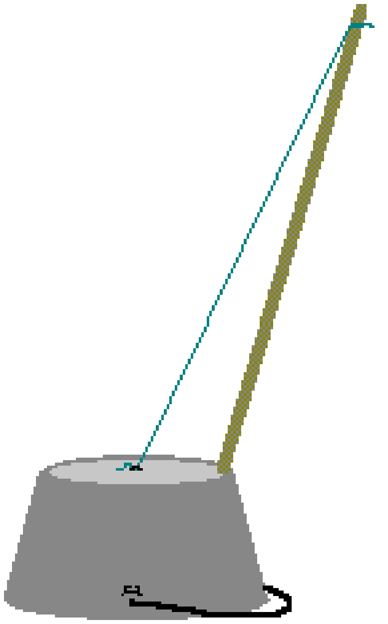
b. Find the frequency of the next two A's (keys 13 and 25), the G above middle C (key 47) and the highest C (key 88).



1. A homemade stringed instrument is made out of a bucket, broomstick, and piece of nylon string. The length of the string is 38 inches, the linear density is 0.05 gm/cm and 40 pounds (lbf) of tension is applied.

a. Find the frequency of the string.

b. Use the function defined in Exercise 1 to determine what note this will be.



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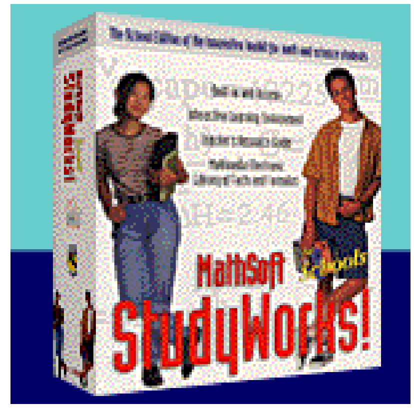

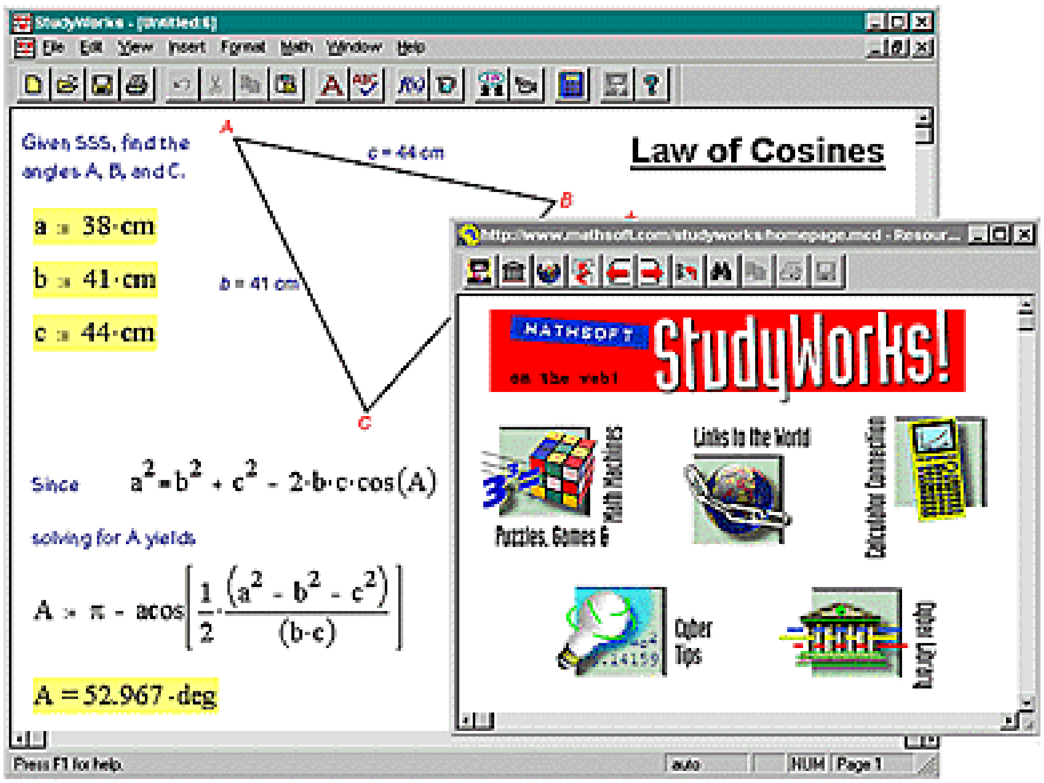

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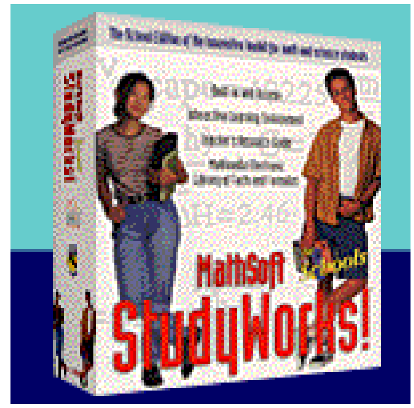

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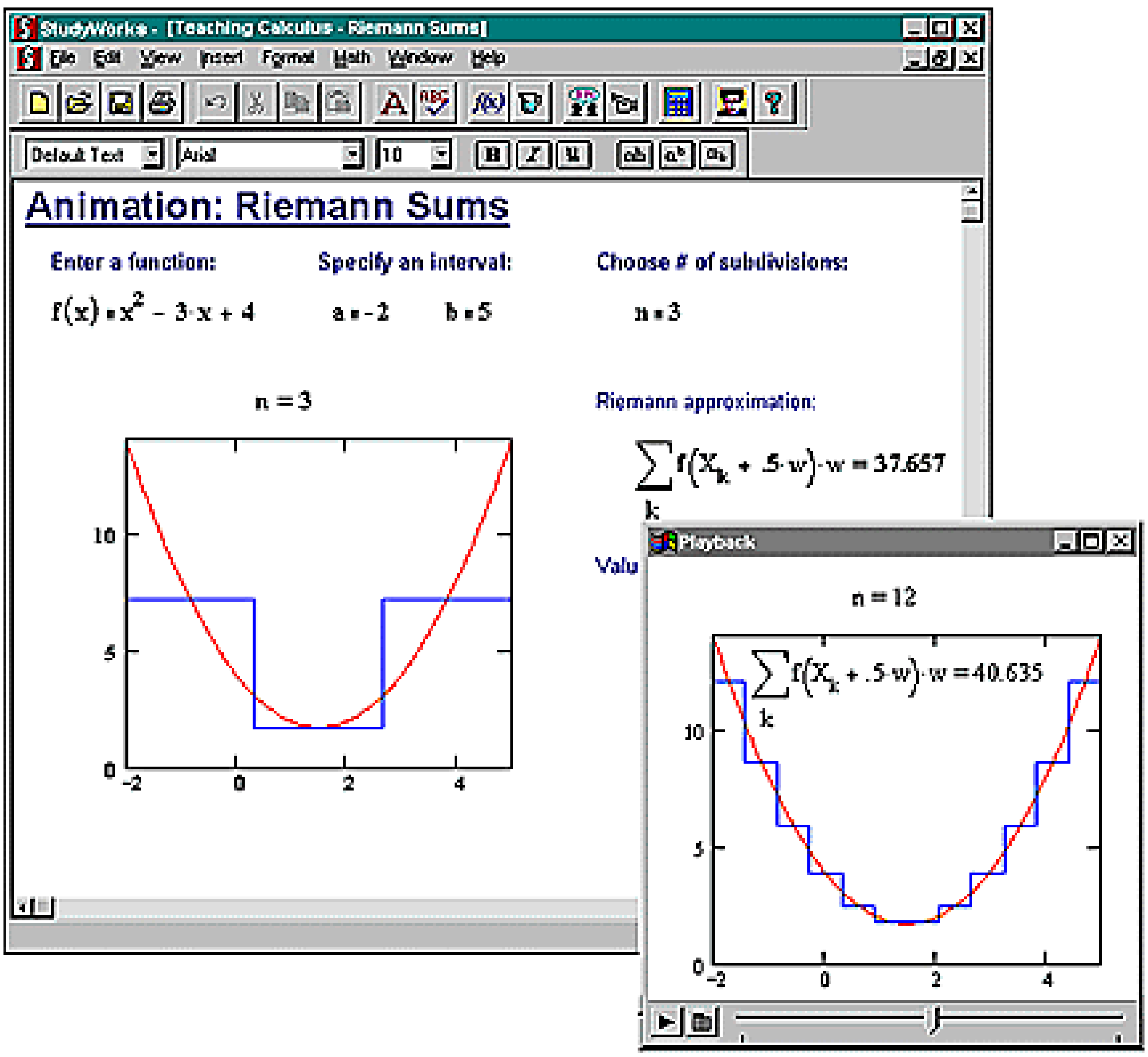

StudyWorks is a great tool for teaching math concepts. Write equations in StudyWorks just like you would on a chalkboard, then create instant graphs to illustrate your ideas. Because the math is "live" you can change variables and StudyWorks recalculates the equations and redraws the graphs instantly.

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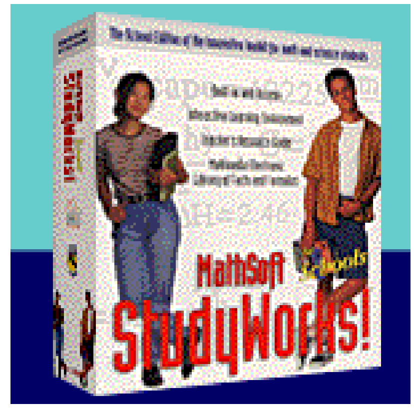

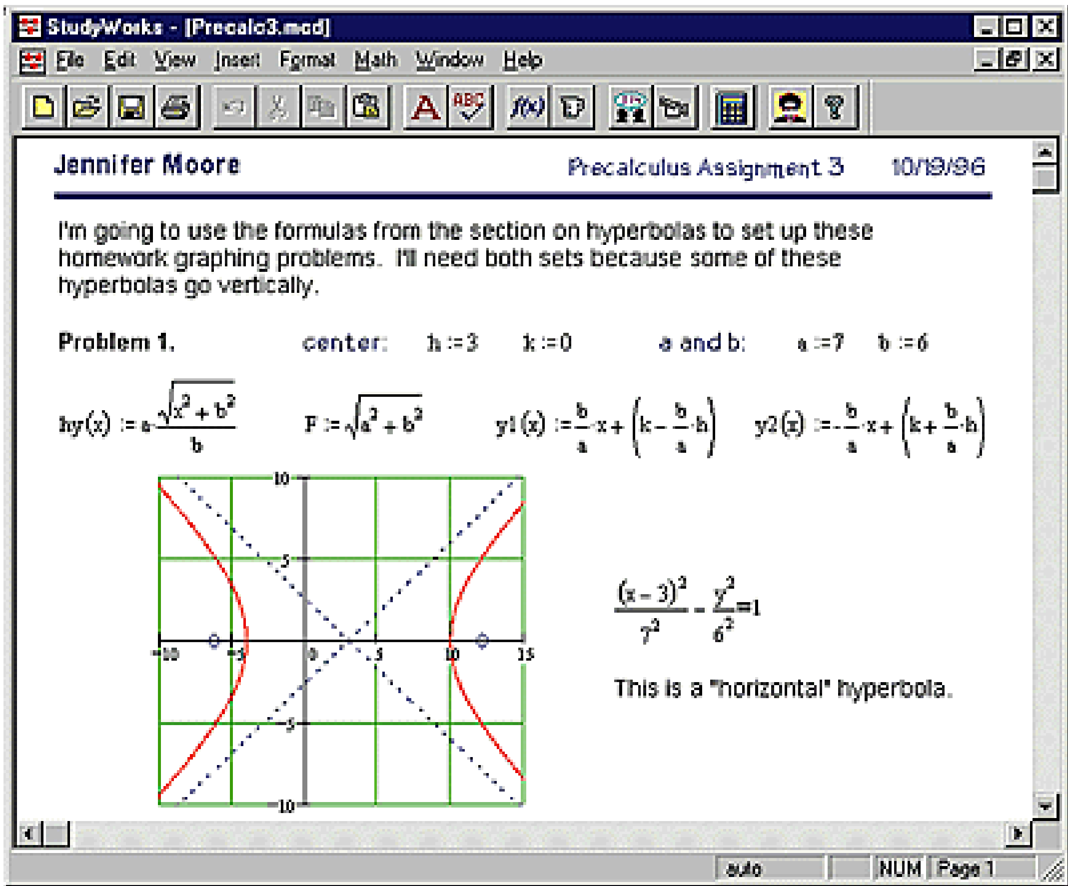

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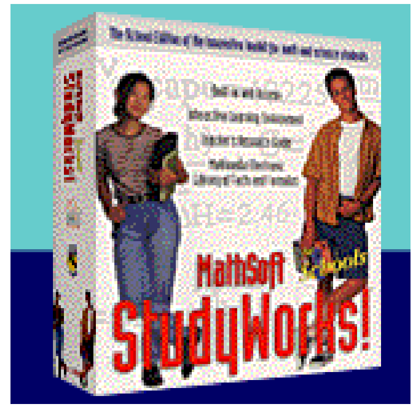

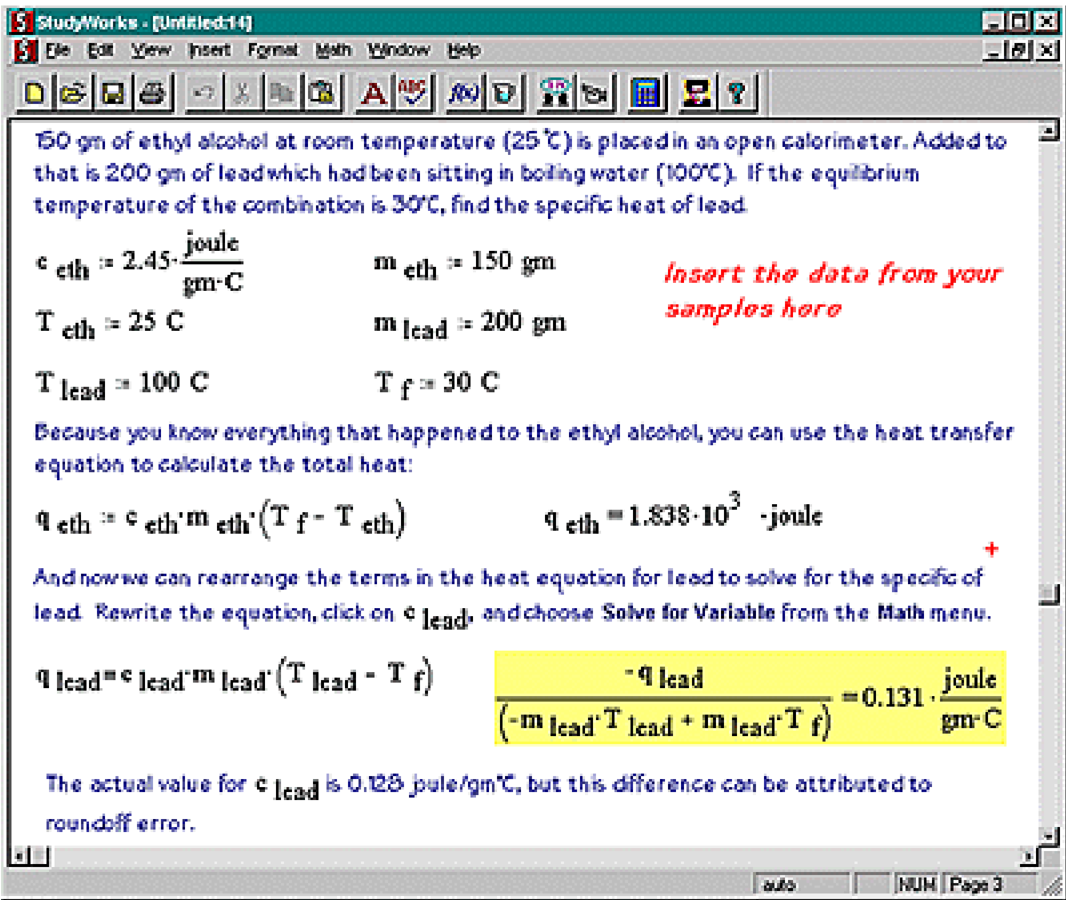

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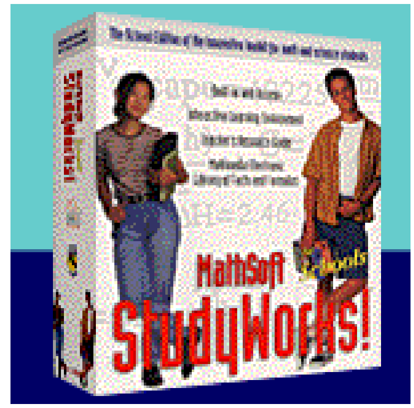

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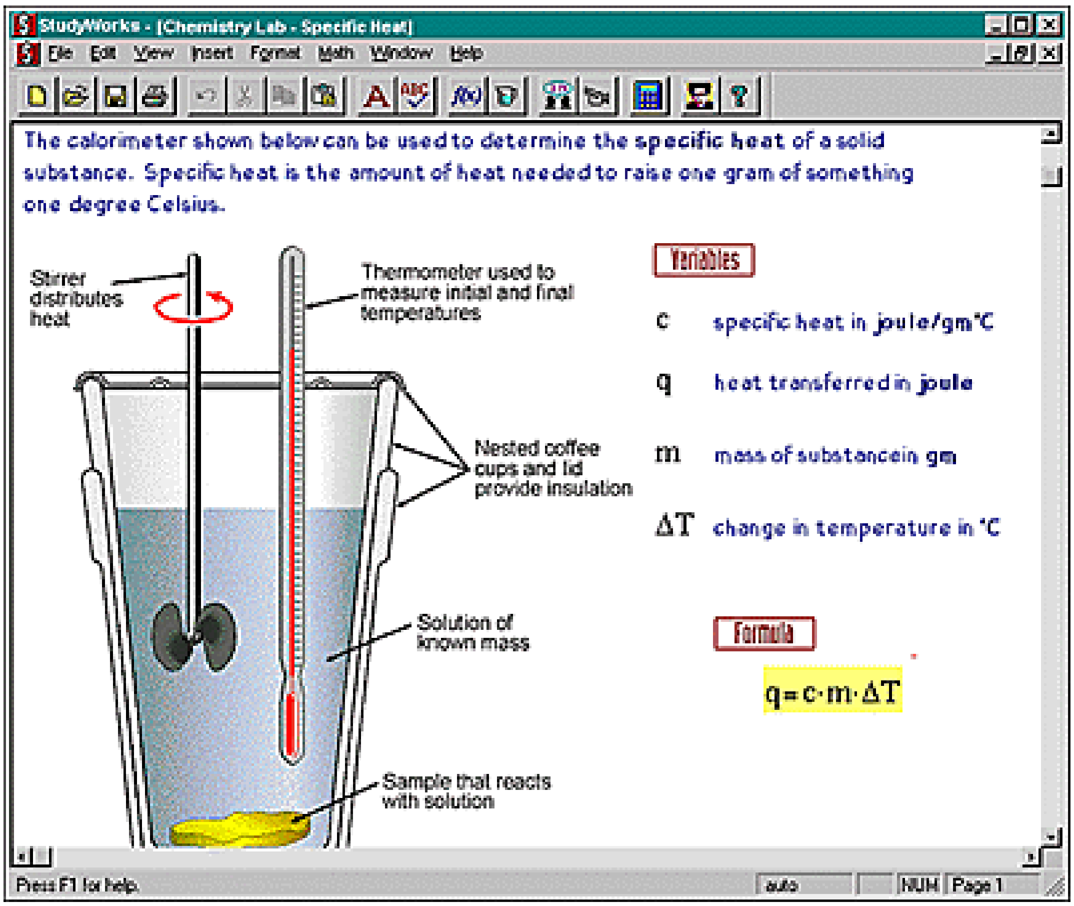

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