

TI-TIME

Issue 1/00

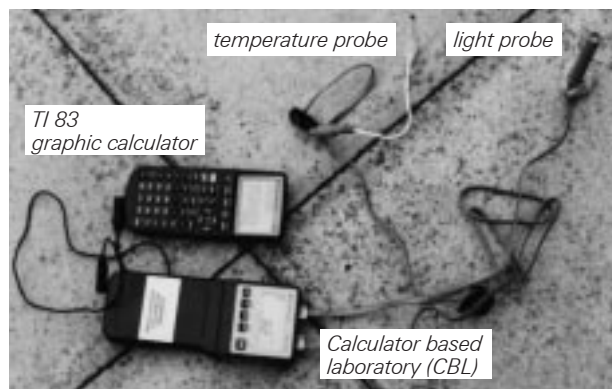
Peter Ransom

Modelling the 1999 Eclipse

Background

In 1715 Edmond Halley, of Halley's comet fame, publicised the eclipse across the UK and involved many others. Halley had been the financial backer of Newton's Principia, and this event provided an ideal test for the Newtonian lunar theory. He realised that if exact observations of the eclipse were made, then practice could be used to correct theory. I felt it would be an opportunity to do something similar with the 1999 eclipse. I am involved with the

TTA-funded project work *Collaborative approaches to teaching and learning in secondary mathematics, science and related subjects through the use of low cost portable technology* administered by Hampshire County Council, and an opportunity like this, linking science and mathematics was too good to miss. Information about the data to collect was put on our website at <http://www.cisc.soton.ac.uk> in the hope that others would collect data as well.



Equipment set up to record the temperature and light during the eclipse. Note that the light sensor points upward to catch the light and the temperature sensor is in contact with nothing but the air.

Information needed

- times of start and finish of partial and total eclipse,
- weather conditions.

We were in Soissons, about 55 miles north east of Paris for the fortnight that included the eclipse. The day dawned, disappointingly cloudy. The prospects were not good as I set up the apparatus and ran through the experiment to make sure the CBL™ collected the type of data I wanted. As the morning wore on, the clouds parted only briefly for us to get glimpses on the moon's steady progress across the sun. At last the darkness started to deepen and I started my experiment.

At 12h 15m 30s local time I pressed the enter key to start the data collection. Light intensity was to be recorded every 3 seconds, 360 times, giving an

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Dear Teacher

Welcome to the 14th issue of TI-TIME!

I have been spending a lot of time lately at various conferences, including the Association for Science Education National Conference in Leeds, and BETT in London. I will also be attending the ATM and MA National Conferences this spring, and several regional conferences around the UK, including Maths Year 2000 events. I would like to encourage you to attend these conferences, and look forward to perhaps meeting you at our stand.

This edition has several articles on the TI-73, Texas Instruments' new (to the UK anyway) graphics calculator aimed at upper primary and lower secondary schools. This calculator has many features of the TI-83 / TI-83 Plus, as well as fractions, category data plots, conversions, data logging and a number line. It has an extra rugged case for younger children, with Flash-ROM technology to allow future upgrades and the addition of applications. Further information on the TI-73 is included in TI Support.

TI Time is now available in electronic form from the TI calculator web site. You can download the latest

issues instead of, or in addition to, your paper copies. You can also register with the TI&ME service, which is designed to deliver “up-to-date” information to you via a personalised web page or via weekly e-mail newsletter.

I would like to thank those of you who have contributed to this issue with ideas and articles. Sharing articles in this way helps bring new and creative ideas into other classrooms across the United Kingdom and Ireland. If you have an activity that you or your students have enjoyed, please share it with us! You can send them to me at the address below.

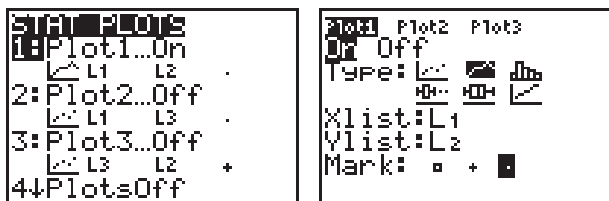
We are still in the process of updating the TI-TIME database. If you would like to continue to receive this newsletter, please e-mail us or send in the form on the back page of this newsletter.

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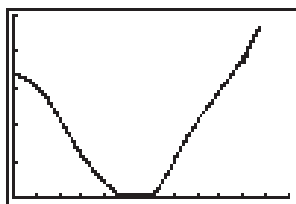
experiment lasting 18 minutes. The time for the start of the maximum eclipse at Reims was 12h 25m 33s with a duration of 2m 05s (or 1m 59s depending on your source of information). The shadow moves at 1800 miles per hour according to one of the websites I visited, corresponding to 30 miles per minute. Since we were 30 miles west of Reims I reckoned our eclipse would start around 12:24 with a similar duration. Starting the data collection at 12h 15m 30s should give a suitable overlap either side of the totality period.

The analysis

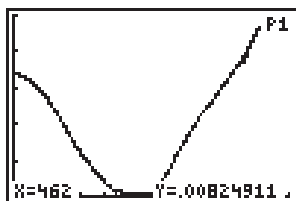
While the CBL™ was recording, the darkness fell and we experienced the eerie 'night' and then returning light. When my experiment finished I transferred the data from the CBL™ to the TI-83. Selecting the STAT PLOT menu and PLOT 1 allows the user to plot list 2 (the light intensity) against list 1 (the time).



This gave the following screen shot.

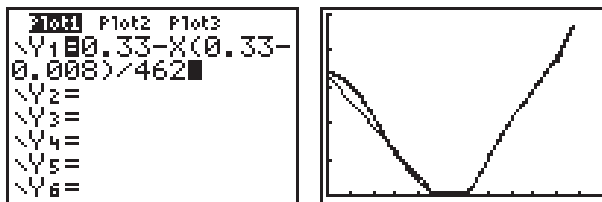


I decided that the period of totality would be the time when the light intensity was flat and parallel to the horizontal axis, so traced the graph until that point,

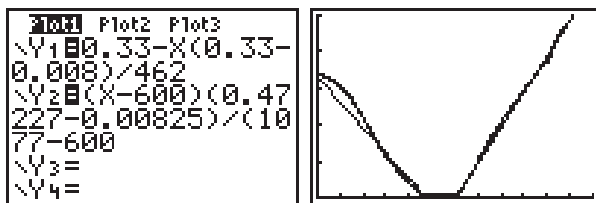


took the reading, then traced and took the reading at the end of the darkness. This gave a total of 600 – 462 = 138 seconds or 2 minutes 18 sec; not far from the time of totality predicted! (2m 5s). Since 462 seconds is 7 minutes 42 seconds, this makes the start of totality at 12h 15m 30s + 7m 42s = 12h 23m 12s, which is close to the predicted time of 12:24. This seems a nice curve to model, but the flat bit at centrality is annoying, so I thought I would deal with the first part of the curve when the light intensity diminishes to zero, then the last part where the light intensity increases.

Using the TRACE button allowed me to discover that the curve starts at 0:330 when x is zero. Tracing the curve along we find the light intensity is 0.008 when x is 462. I decided to look at a straight line fit to start so entered the line below. Plotting it gave the screen on the right.



A nice fit on the second part of this section for $220 < x < 420$, but not so good for $x < 220$. So a linear approximation does not seem appropriate here. What about the section of increasing light intensity? From the TRACE function I found that (600, 0.00825) and (1077, 0.47227) were at the limits of increasing light intensity. Here's the equation of the straight line I plotted and the line superimposed on the data. This is a far better fit!



I have since modelled the situation, but the analysis is more appropriate for post GCSE classes. I think this data and the straight line 'fit' is appropriate for GCSE work in mathematics to show the link with science and I will be using this data later in the year to review straight-line graphs.

If you wish to obtain the data please send me a disc and I'll return it with the data. If you email me at p_ransom@hotmail.com I'll email the data. You will need the TI-GRAPH LINK™ software to access the data.

I would be delighted to receive data from others who recorded the eclipse using the CBL™. Please email it to me at the above address, and I'll send you my data.



After the period of totality the clouds started to disperse and I was able to photograph the eclipse by projecting the image through binoculars onto a piece of card.

References: Chapman, A., The people's eclipse of 1715, *Astronomy Now*, vol.13 no 7, (July 1999) <http://www.ville-soissons.fr/eclipse.asp> has some nice images and eclipse information <http://www.cisc.soton.ac.uk> has my full eclipse report with the more advanced model and many illustrations.



Sheffield Hallam University

Good Mathematics Teaching Conference

“One that went well.”

**Sheffield Hallam University
City Campus
Pennine Lecture Theatre
Sat 24th June 2000 9.30–4.30**



It has become clear that many mathematics teachers would like a simple way of sharing and comparing their practice with others. We want to avoid isolation and spread good everyday practice.

The idea of this conference is for each willing participant to give a 10 minute talk on one of their favourite mathematics lessons, topics or problems that are interesting or that went well.

We will collate electronic forms of all the presentations before the conference, so the collection in book form will be available on the day.

What you put in

- A day of your valuable time
- A 10 minute presentation (if you are willing)
- An electronic form of the presentation (less than 4 sides A4)
- A small fee (£15)

What you get out

- A book full of good ideas for lessons and current practice from participants (bring 1 get lots free !)
- A publication (looks good on school reports, CV s)
- A chance to meet a wide variety of colleagues
- A chance to raise the profile of your school

Programme:

9.30 –10.00	Coffee and registration
10.00	Opening Plenary Session
	Keynote Speaker
	Professor Adrian Oldknow
	Kings College University of London
	Participants' talks
12.00–1.00	Buffet lunch
1.00	Participants' talks
	Closing Plenary Session
	T-TIME
	(Technology for Teachers In Mathematics Education)
	Dr Neil Challis Dr Harry Gretton
	Final Discussion
4.30	Conference ends

For more information contact:

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Sheffield Hallam University, Howard
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Or phone 0114 225 3935 or e-mail d.a.pitt@shu.ac.uk

Dr Dick Pitt

National Pop Maths Quiz

The first National Pop Maths Quiz was held at Sheffield Hallam University on 15th September 1999. Preliminary run-offs were organised in many parts of the country, with up to 20 teams taking part in each one. In spite of the fact that some students found the questions quite hard, everyone seemed to enjoy these events. Interest was even from as far as Abu Dhabi, India, Eire and Canada!

On the day 29 finalist teams turned up from all over the country. Two teams travelled from Plymouth on the Tuesday to be in time for the start of the quiz. In a close fought race Claydon High School, Ipswich won the T-Time cup which they keep for a year.



Each of the winners was given a TI-86 kindly donated by Texas Instruments.

The event was supported by the MA, the ATM, Sheffield TEC and Sheffield Education Business Partnership.

It was held as a pilot project during the annual meeting of the British Association.



Deidre Eastburn, Vice-Chair of NAEB, presents the cup to Claydon High School, Ipswich.

The fifth Sheffield

Pop Maths Quiz and Fair

The Sheffield Pop Maths Quiz is going from strength to strength! Last year 125 teams and over 1000 individuals participated. This year will be even bigger! It will take place on Saturday 18th March from 10.30 am to 12.30 pm in the Atrium at Sheffield Hallam University. There will be stalls, puzzles, and a family maths trail.

There will also be a popular maths lecture 1.30 p.m. to 2.30 p.m.

The competition will be run like a non-alcoholic pub quiz! There will be four sets of questions. The first is for children aged 11 or under, the second is for those between the ages of 11 and 14, the third is for all those between 14 and 16. The fourth set of questions is for those aged over 16 years. During the quiz, teams will write down their answers on a sheet of paper making a copy at the same time. After all the questions have been put, answer sheets will be

handed in to the scrutineers. The answers will be read out and teams will calculate their scores. The highest verified score wins the (small) prize. A sample of previous questions is obtainable from <ftp://maths.sci.shu.ac.uk/popmaths/>.

We are inviting your school to enter (at least) one team. A team should consist of no more than 6 students (any larger and getting a consensus for the answer is difficult!) The event is free!! If you would like to enter a team, please contact:

Dr Dick Pitt,
Pop Maths Coordinator, Sheffield Hallam University,
School of Science and Mathematics,
Howard Street, Sheffield S1 IWB
e-mail d.a.pitt@shu.ac.uk
Tel. 01 14 2 25 39 35

TI-73 Gets Into Action

Introduction

Plymouth's Education Action Zone ran a two-week summer school for higher ability Year 6 children at Tamarside Community College. Phillipa Cooke, a first year trainee teacher on the two-year Mathematics with Information Technology course at the College of St Mark and St John, was asked to assist in constructing and implementing accessible but challenging activities during one of the two weeks. Phillipa chose to put into practice some of her training in using TI graphing calculators in stimulating interest and understanding of mathematical concepts. The organisers of the summer school were keen to see the TI-73 calculator technology to which she had access.

Previously, Phillipa had used the TI-73 and TI-83 with year 8 and 9 classes to consolidate and extend their knowledge of co-ordinates and to introduce, with the support of the Calculator Based Ranger™ (CBR™), distance time graphs. The children had thoroughly enjoyed the lessons and had been very eager to use the calculators, Phillipa felt that even with young year 6 pupils, the technology could be used successfully. What follows is Phillipa's own report on her time with the EAZ's summer school.

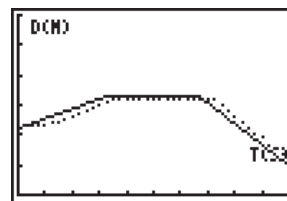
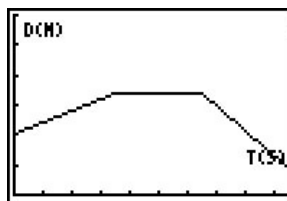
Summer School

The day ran from 9.30 to 2.30 and was split into two sessions. I ran a morning session with one half of the children and then the two groups swapped over for the afternoon. As I was setting the equipment up a small group gathered to see what I was doing and when they saw the calculators there was a chorus of

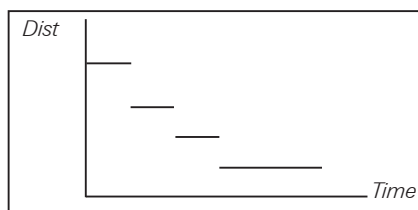
"Cool! Will we be using the calculators?"

Distance-Time Graphs

I started with the CBR™ and invited volunteers to walk up and down in front of the sensor so that they could all see the results on the OHP as they walked. There was certainly no shortage of volunteers and so I let three or four of them have a go before I began to ask a few gentle questions about what was happening as they walked. No one had any difficulty in understanding that as they walked away from the detector the line on the distant time graph would "rise" and conversely it would "fall" as they walked towards it. The concepts were clearly understood, yet without any technical talk about positive and negative gradients. Splitting into groups (which promoted healthy competition) we then did a few "walk this walk" challenges where the TI-73 drew a graph that the children had then to reproduce with their walk. Some very accurate walks were produced.

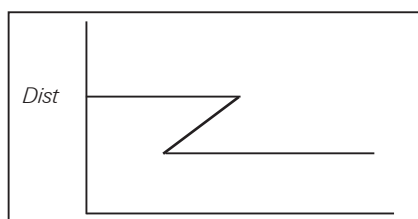


It was rewarding to see how the children were able to adapt their walks if they found they were beginning to deviate from the line. It showed clear evidence that the concepts were being understood. More rewarding still was the enthusiasm that the children were showing whilst they were learning! It was fun! By the end of the session everybody present had been involved in some way. I set challenges to the groups that made them think, such as steps:



They were quick to realise that they could do this graph more accurately if more than one person participated and it was nice to watch them working as a team to solve the problem.

As a final challenge I did the "back in time" challenge.

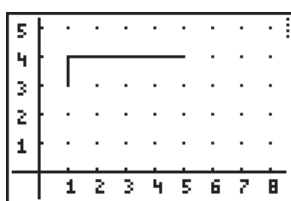
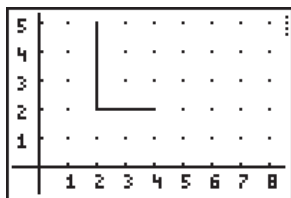
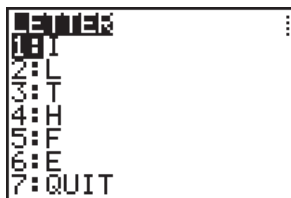


There were several attempts at this but **both** groups arrived at the conclusion that it was "mission impossible".

In one of the groups this response was given almost immediately although others in the group still wanted to be able to try to do the walk. In the other group someone offered the suggestion that it was impossible but had difficulty in explaining why this was so. I felt that this was an extremely difficult concept to understand, yet the calculator and CBR™ gave them chance to try to do it for themselves and this led to understanding.

Coordinates

When we moved on to co-ordinates I gave each of the pupils their own calculator and after a very brief introduction I let them engage in the activity. This required that they instruct the TI-73 to draw various letters of the alphabet using coordinates. The letters are arranged in sets according to difficulty and the child has the freedom to give an appropriate set of coordinates to draw the letter chosen.



They really enjoyed using the calculators and were totally absorbed in what they were doing. I needed to intervene very little.

Teacher's Reactions

The two teachers who were running the course were impressed with what they saw and enjoyed seeing the children having so much fun yet obviously having to think hard at the same time.

Mr Dave Adams said "It was demanding but interesting and provided a useful insight into co-ordinates as well as time/distance graphs. I feel we have only just scratched the surface of the uses and potential that these calculators have. There would be so much more to discover given the time and opportunity".

Roger Fentem teaches at the College of St Mark and St John, Plymouth e-mail: rogerfentem@netscapeonline.co.uk Philippa Cooke is a trainee teacher (secondary mathematics) at the College of St Mark and St John, Plymouth. She is in her final year of a 2-year BEd degree.

World Wide Web Sites

Here are a few web sites that you might find useful. If you visit one and find it particularly helpful, let us know so we can let other TI-Time readers know. If you would like to see a site listed in a future issue, send us the web address.

• TI FAQ

<http://tifaq.calc.org>

Unofficial TI Graphics calculator frequently asked question web site.

• Pre-Calculus Algebra TI-83 Tutorial Website

<http://academic.cuesta.cc.ca.us/tutorial/index.htm>

A web based TI-83 tutorial. The primary purpose is to provide instruction on the specific capabilities of the TI-83 or TI-83 Plus that are necessary for a Precalculus Algebra course in which the use of a graphing calculator is required.

• Maths Year 2000 Website

<http://www.mathsyear2000.org/>

The Maths Year 2000 web site provides resources, games, puzzles, information and interesting news in the world of mathematics.

• Eddy the Eco-Dog

<http://www.eddytheeco-dog.com/>

Eddy the Eco-Dog is aimed at girls and boys aged 6 to 12 years, and teaches them simple environmental lessons.

• Association for Science Education

<http://www.ase.org.uk/aseinfo.html>

The Association for Science Education.
"Teachers helping teachers to teach science"

• NASA Observatorium

<http://observe.ivv.nasa.gov/nasa/core.shtml>

NASA's Observatorium is a public access site for Earth and space data. We have pictures of the Earth, planets, stars, and other cool stuff, as well as the stories behind those images.

• SETNET

<http://www.setnet.org.uk/>

The Science Engineering Technology Mathematics Network provides curriculum support and professional development for mathematics, science and technology teachers.

• British Association

<http://www.britassoc.org.uk>

The British Association for the Advancement of Science promotes awareness and appreciation of science, engineering and technology.

“Step-by step with a TI-83 calculator” - a new book now available from Texas Instruments

The TI-83 is a great machine and is ideal for students who are learning mathematics. It is no secret, however, that many students and teachers find the manual daunting at first. Teachers often don't have access to textbooks about the TI-83 because of restricted budgets. Step by Step with a TI-83 calculator is an easy-to-read book that makes getting started as easy as possible.

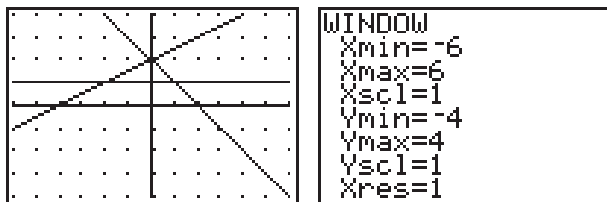
Before she left for the United States, Monika Blair asked me to write this book and her successor, Guy Harris, has arranged for it to be published. The result is 'Step-by step with a TI-83 calculator' which

includes topics ranging from simple calculations and graphing to regression, hypothesis tests, matrices and complex numbers. Examples which teachers can use in class are illustrated by key strokes, menus and screen dumps so that they are easy to follow. There are also 'quick page' summaries and advice on avoiding common errors.

I taught mathematics at secondary school level before I joined Napier University where I have used TI-82s and TI-83s for four years with first-year students. I hope that teachers will find this book very useful. Look out for more details soon.

Classroom graphing activities

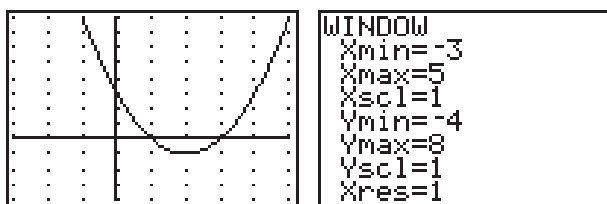
1. Three functions have been entered and graphed on a TI-83 calculator. The result is the following graph for the given WINDOW.



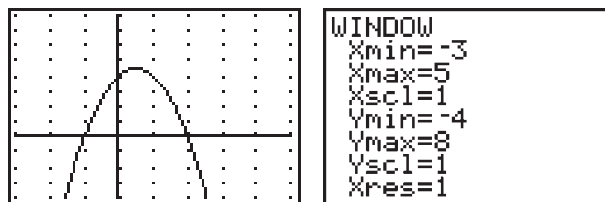
Note that the x-axis and y-axis have tick marks along them.

What are the equations of the 3 lines?

2. Find the equation of the quadratic function in the following graph whose WINDOW is shown.



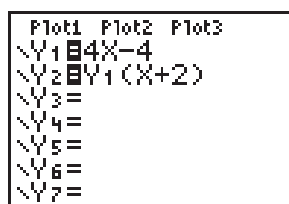
3. Find the equation of the quadratic function in the following graph whose WINDOW is shown:



4. Use a graph of 2 suitable functions to decide how many solutions there are of the equation

$$x^3 + 2x^2 - 8x = 5.$$

5. Functions are entered as follows:



Without using `VAR5`, what could you enter as the equation of Y_2 in order to produce the same line in the graph?

6. By graphing 2 functions and calculating their point of intersection solve the equation

$$x^3 + 2x + 4$$

rounding the answer to 3 decimal places.

7. By graphing 2 functions and calculating their point of intersection solve the equation

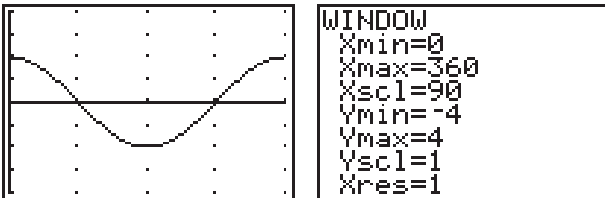
$$e^x + x = 2x$$

rounding the answer to 3 decimal places.

8. The curve in the following graph has an equation of the form

$$y = a \cos(x^\theta),$$

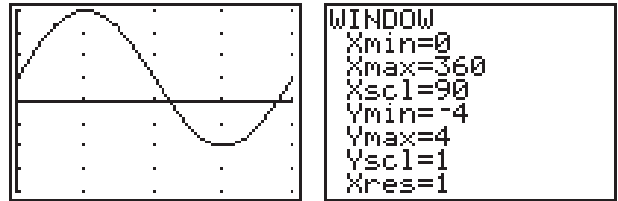
what is the value of a ?



9. The curve in the following graph has an equation of the form

$$y = p \sin(x^\theta) + q,$$

what are the values of p and q?



Answers to classroom graphing activities:

1. $y = \frac{1}{2}x + 2, y = 1, y = -x + 2$
2. $y = x^2 - 4x + 3$
3. $y = -2x^2 + 2x + 4$
4. three solutions.
5. $y = 4x + 4$
6. 1.521
7. 0.315
8. $a = 2$
9. $p = 3, q = 1$

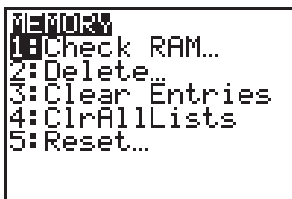
By Alan Graham

The TI-83 Problem Page

I admit to having a particular affection for the statistical facilities of the TI-83. To use them you must first enter data into one or more lists in the List Editor (sometimes referred to as the List screen). Here are a few questions that students ask in this area.

Q Sometimes I want to delete all six lists with a single command using ClrList L1, L2, L3, L4, L5, L6. This works OK but it's a bit cumbersome to enter. Is there an easier way?

A Yes! There is a nice command in the MEMORY menu, ClrAllLists, which will clear all the data in every list. At a stroke, this will clear not just the data in L1...L6 but also the data in any named list.



(Guidebook 18-4.)

Q Help! I've lost one of my lists and I don't know how to get it back. I thought I'd cleared list L2 but it has disappeared entirely from the list screen.

A Unlike with the TI-80, if a list is deleted it is no longer displayed on the list screen. But don't panic; the SetUpEditor command can be used to reset the list screen so that it displays only the lists L1...L6; simply press **STAT** 5 **ENTER**.

L1	L2	L3	L4
1	49	8	5
2	77	77	77
3	44	44	44
4	8	8	8

L2 = (9, 49, 8, 5, 77...)

Clearing a list and deleting it are two rather different things. You almost certainly deleted your list from the editor instead of clearing it. Try the

following to see the difference. Enter the list screen, move the cursor onto the list in question, say L2, and then upward to select the list name, as shown here. At this point you can choose whether to clear or delete it.

Pressing **CLEAR** here has the effect of removing the data contained in L2. Incidentally, clearing data is permanent – once cleared you can't subsequently get the data back again. If instead you press **DEL** at this point, all evidence of the list is removed from the list screen. However, as was described above, you can easily restore it using SetUpEditor and you get your data back again into the bargain.

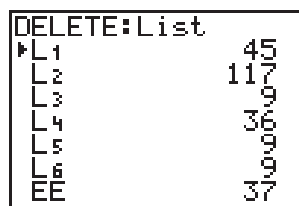
(Guidebook 12-23.)

Q If I delete a list, will all the data that it contains be lost forever?

A The answer to this question depends on how you deleted the list in the first place. There are two ways of deleting a list; from the List screen (or the Home screen) and from Memory.

If you delete a list using the first of these methods (i.e. from the List editor or the Home screen) and then restore it using the SetUpEditor command, then the data are preserved. However, if the list is deleted via the Memory menu, the data it contained are lost forever.

The procedure for deleting a list via the Memory menu, is as follows.



Press **2nd** [MEM] 2 4 to see a screen similar to that shown here. Then move the cursor down the screen so that the arrowhead points at

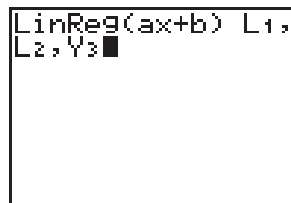
the list you wish to delete, say L1. At this point press **ENTER** if you are using a TI-83 or, if you are using a TI-83 Plus, press **DEL**. If you now return to the list screen, you will find that all traces of L1 are gone.

Of course, as described earlier, the list L1 can easily be restored to the List editor using SetUpEditor, but when you do so it will be bereft of its data, which can never be recovered. There is a certain logic to this; if an item (a list, a program, etc) has been deleted from the calculator's 'memory', it seems reasonable to expect that the calculator will no longer be required to remember anything about it! (Guidebook 11-5 and 12-23.)

Q One command I find confusing is the regression equation command, RegEQ. Can I get the calculator to plot the regression line without going through all the palaver of using RegEQ?

A The calculator won't respond to the regression equation command until it knows which form of regression you want to use. In effect, RegEQ is a store which will contain a regression equation

only after you have applied a particular regression model to the two lists in question. To see this, try scrolling down the STAT CALC menu and notice the range of different regression models available (linear, quadratic, cubic, and so on). Choose one of these models and apply it to the two lists. This will cause the corresponding regression equation to be calculated and the results automatically stored in RegEQ. If you use the RegEQ command at this point, it will display the appropriate regression



equation. There is a quick way of plotting the regression equation without having to use RegEQ. Suppose you want to apply linear regression

to the lists L1 and L2 and store the regression equation in Y3.

Enter the following on the Home screen:

STAT **▸** 4 **2nd** [L1] **,** **2nd** [L2] **,** **VAR** **▸** 1 3 **ENTER**

(Guidebook 12-24.)

Q I have entered a list of numbers into L1 and now want to sort them into ascending order (using SortA in the STAT EDIT menu). But afterwards I'd like to be able to return them to the original entry order.

A There are two ways of doing this. One simple approach is to store your numbers temporarily in another list, say, L6 (you can do this from the Home screen using L1 **STO** L6). At this point you can do what you like to L6 (including sorting) as you still have the original data safely in L1.

There is an alternative and sneakier approach. Suppose that there are 40 values in L1. Store the counting numbers 1 to 40 (this can be done using seq) into L2. Use the command SortA (L1, L2) to sort L1 into ascending order while at the same time placing the values in L2 in the same order as the corresponding values in L1. Afterwards use SortA (L2,L1) to sort L2 in ascending order (i.e. its original order) and place the values in L1 in the same order as the corresponding values in L2 – which will return both lists to their original state.

(Guidebook 11-13 and 12-22.)

Alan Graham works at the Centre for Mathematics Education, The Open University.

Using the TI-73 at Ringwood Junior School

We have been using TI-73 graphic calculators to explore how new portable technologies can enhance the teaching and learning of mathematics and science. This is being supported by members of the Hampshire's Inspection and Advisory team, external advisers from University College Chichester and Kings College London advisors and Texas Instruments. We have been using 16 calculators, a viewscreen (for showing the display of the calculator on an O.H.P.), a CBL™ (calculator based datalogging device) unit with light and temperature sensors, and a CBR™ (calculator based ranger) unit for detecting motion, measuring distance. The following is an account of how we used them to support and enhance the teaching of mathematics. We are just beginning to see the potential of this new graphing calculator but hope the following gives a flavour of the kind of initial activities that are possible with Year 5 and 6 pupils using this calculator.

Equivalent Fractions

We began using the calculators with a half an hour familiarisation session. The children shared calculators one between two. I used the viewscreen so that the whole class could see how the calculator worked. We started by discussing the buttons and their functions. We looked at the fact that one of the buttons was labelled ENTER and we found out that it was similar to an equals button on a "normal" calculator. Other functions we discussed were the b/c (fraction) button, how to clear the screen and how to scroll up and down. This last feature is particularly useful for looking at pupils' previous work and their calculations and the functions they have been using.

As a class, the children were having problems with recognising equivalent fractions, so we started out with inputting $\frac{1}{2}$ and I asked the question, "What other fractions give $\frac{1}{2}$ as an answer?"

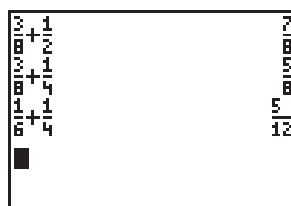
Using the viewscreen, and the children's suggestions, all the class could see that the calculator automatically simplified the fraction to its lowest term.



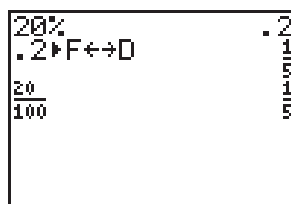
We entered the fractions and there was a discussion of what made a fraction equivalent to $\frac{1}{2}$.

They then went away and found their own. The AUTOSIMP mode on the calculator made it very easy for the children to find simplified fractions and this made the exploration of equivalence so much easier.

We progressed to adding fractions and discussing the relationship between denominators of the original question and the answer the calculator gave us. E.g.



The TI-73 also allows you to easily convert from % to fractions to decimals. All of which can be displayed simultaneously. E.g.



This multiple display made it easy to spot the patterns and the children were able to discuss and investigate the relationships between fractions, percentages and decimals. Generally, I found that the fraction function of the TI-73 was a very useful one. Being able to see several lines of calculation and the different or simplified forms made this a particularly useful activity for exploring patterns and equivalent fractions with pupils of all ability.

Algebra

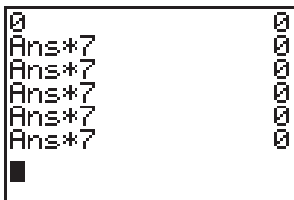
I then used the TI-73 as a tool for our extension maths group who were working on level 5-6 tasks. They were having problems generating algebraic formulae for describing number sequences and patterns, and so I tried the following:

We started by showing how we could get the calculator to count by pressing

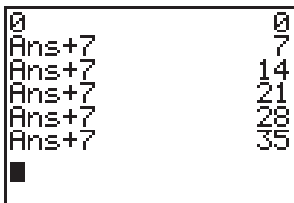
0 ENTER +1 ENTER and continuously pressing **ENTER**



We then talked about how we might generate the multiplication tables, the sevens were attempted and an early guess of the pattern being $\times 7$ generated a sequence as seen here –



We discussed why this occurred and quickly came up with the fact that if you started with 0, then the answer multiplied by 7 would continue to get 0 as an answer. So, $+7$ must be the rule and this was shown as this –



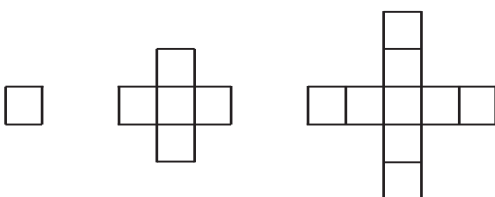
I then showed the children how to put this into a table using the LIST function. This enabled us to put a formula to the pattern, we soon found out that the pattern was as below with the formula being as shown on the screen –

L1	#	L3	Z
0	0	-----	
1	7		
2	14		
3	21		
4	28		
5	35		

L2 = "L1*7"

This instigated a discussion about the “going down” rule being “ $+7$ ”, but the formula being “the term $\times 7$ ”.

This was a simple enough pattern so we progressed onto finding the expression for the number of tiles needed in the following sequence –



They were sent away to find the first ten terms and then to generalise a rule for the n th term, so we could then find the 20th and 100th, and even the millionth term!

Using the LIST function they began inputting the first few numbers into L1 and then they began experimenting with expressions for generating the required number pattern using expressions involving $L2 = L1$ and a function.

Where L1 was the number in the series and L2 was the number of cubes required.

After a few attempts they arrived at a solution of $L2 = L1 \times 4 - 3$.

The calculator would then if we inputted 20, 100 and 1000000 into L1, the calculator would automatically calculate the numbers of tiles required and place the answer in L2.

L1	L2	#	L3	Z
4	13			
5	17			
6	21			
7	25			
8	29			
20	77			
1E6	4000007			

L2(10) = 3999997

We experimented with this now and it became more open ended. Pupils thought of their own rules and inputted them into their calculator and their partner had to calculate which formula they had used to generate the sequence.

Discussion came about when the rule was not the same, but it generated the same series as an answer. E.g. $L1 - 3 \times 4$ generated the same series of numbers as L1-12.

We then discussed why this had occurred and we found out that the TI-73 (like a calculator or a maths teacher!) calculates the multiplication and then the subtraction. We began looking then at what it would calculate first in other calculations and we found that it calculated division and multiplication before addition and subtraction. I then introduced then to BODMAS, which was an acronym for the order you calculate. (Standing for Brackets, Order, Division, Multiplication, Addition, Subtraction).

We could by now generate an algebraic formula in terms of the in-built labels for data lists L1 and L2. The calculator also has the facility for drawing functions (in terms of symbols X and Y) and tabulating values of Y against X. A number of the text books use X and Y when writing function and it was a useful exercise to convert what the children had found out about the crosses problem in terms of L1 and L2 into X and Y. The children could automatically see the relationship between L1 and X and L2 and Y.

The formula they inputted was $Y = 4X - 3$, the calculator automatically produced a table of values for X starting at 0 and going upwards in steps of 1, and a list for relevant values of Y. There is also the facility for generating their own step size for the independent variable X.

This was a breakthrough; we had generated formulae for working out the terms in a pattern.

X	Y
0	-3
1	1
2	5
3	9
4	13
5	17
6	21

Y1 4X-3

The children found this facility very useful and they later used the TABLE function to create the list of numbers and their squares to solve a problem.

Data Handling

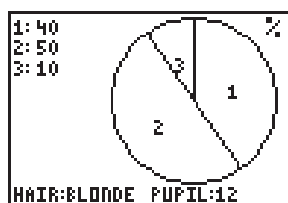
We used the TI-73's to help pupils interpret, look at different types of graph and particularly for deciding which graphs are better for showing the information that we have gathered.

We gathered information about pupils and input the data into a LIST. We then selected all the different ways of displaying the information and could look to see which way was the most appropriate for our data.

You can choose from line graphs, pie charts, bar charts, pictograms and scatter graphs.

LG	HAIR c	PUPIL g
-----	BLENDE	12
	BLACK	15
	BROWN	3
	-----	-----

PUPIL(4) =



The data we gathered was about hair colour and the children decided that it looked best as a pie chart. As you can see you can give the chart a title and present the information as numbers or percentages. This is just a start. We have also used the CBL™ to help pupils carry out a number of science experiments. The portability of the technology, the speed with which real data can be collected, graphs and charts drawn and interpreted has encouraged us to extend it's use into science. The children are certainly motivated and have few problems mastering the technology.

Steve Cox, Maths Co-ordinator,
Ringwood Junior School.

Free Workshops and Demonstrations

We can send an instructor to your school to help support the use of graphics calculators in education ! Just put together a group of teachers who would like to attend a workshop or get some specialised training, and call one of the instructors below. Best of all, these workshops are completely free !

In England and Wales, contact Barrie Galpin
Phone: 01780 444360.
e-mail: barrie@fineshade.u-net.com

Barrie taught Maths for 13 years in comprehensive schools in Cambridgeshire before moving to Leicester University where he was involved in research and

teacher training. From 1990 to 1998 he worked in the Centre for Maths Education at the Open University where he worked on a range of projects linked to graphics calculators.

In Scotland, contact David McLaren
Phone: 0141 956 4090.
e-mail: dmclaren@email.menet.net

David taught mathematics and was a Principal Teacher of Mathematics in the east end of Glasgow before joining the advisory service, from which he retired prematurely some two years ago.

Welcome to T³ Scotland

Until recently the T³ (Teachers Teaching with Technology™) Programme for the UK, was run from the University of Plymouth. Over the last three years many countries have developed their own programmes to meet the needs of their own particular curricula. During 1999, negotiations took place between Texas Instruments and the University of Edinburgh to launch a programme unique to Scotland to meet the needs of Scottish Teachers. This agreement was signed in October of 1999. Since that date T³ Scotland has operated as an organisation in it's own right.

T³ Scotland is part of a European T³ organisation, hosted by the University of Edinburgh, and supported by Texas Instruments. The objective of the programme is to help teachers become familiar and comfortable with the use of hand held technology, in particular graphics calculators, and to help them introduce this technology into their mathematics teaching.

The recommendations of the major review into hand-held technology in the Scottish curriculum, Advanced Calculators and Mathematics Education (ACME), were recently approved as an agenda for action by the Minister for Education and Children. The report outlined the benefits of effective use of graphics calculators and the consequent effect on students' enjoyment of the subject and motivation to learn. The ACME report also recommended that the Scottish CCC should "...initiate, in conjunction with local authorities, staff development for teachers in the use of graphics and CAS calculators, particularly in the context of Higher Still."

The aim of the Scottish T³ programme is to build an organisation which will help to address these recommendations and which will use classroom-ready materials produced by the SCCC. There is currently a core of four teachers in Scotland able to deliver the type of training which teachers have requested.

They have delivered successful course varying in length from the 3 day Summer School held in Perth College, to two day courses held for Local Authorities such as North Lanarkshire, to one day and half day courses run in South Lanarkshire and Dumfries and Galloway.

The aim is to be flexible in the method and duration of delivery to meet local needs.

T³ Scotland will need to grow to meet the demands for training and in January there was a team-building weekend, again at Perth College to recruit new trainers and select writers to prepare course materials. The four 'seasoned' trainers will be able to provide valuable expertise to help with the growth process.

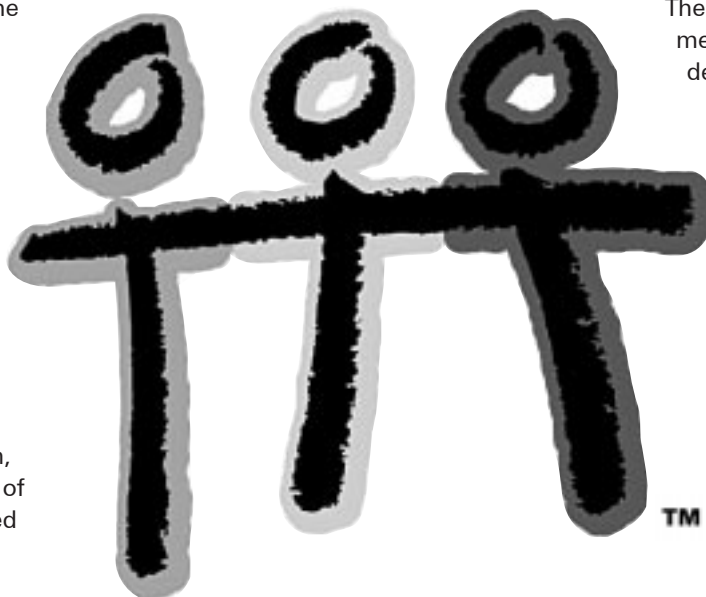
In the year 2000 a number of courses are planned throughout the country from Stirling and East Renfrewshire to Dumfries and

Galloway to East Lothian. The National Conference which will examine ways of implementing the ACME recommendations and models of training, to be held in Falkirk in March, will no doubt generate demand for further T³ courses.

T³ Scotland looks forward to a long and successful programme of events in this new millennium.

For more information about T³ Scotland courses, please contact Ian Forbes:

Phone: 0131 651 6034
e-mail: ian_forbes@education.ed.ac.uk
Address: Faculty of Education
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