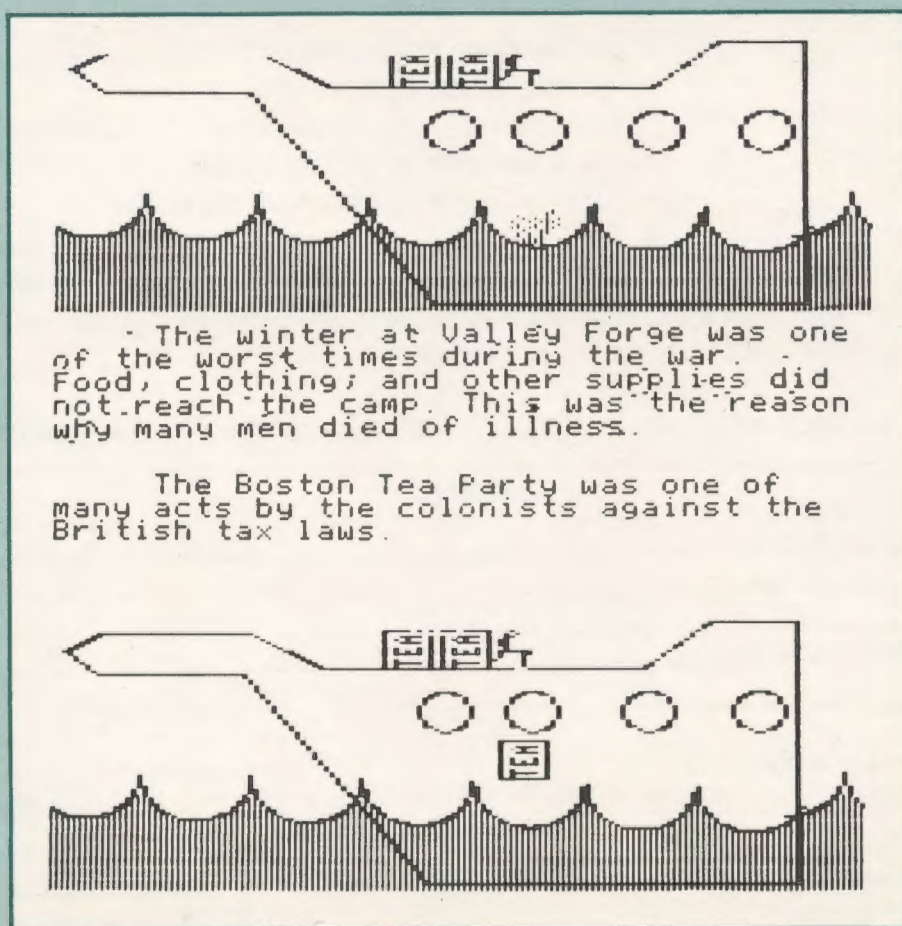




LOGO EXCHANGE

DECEMBER 1987

VOLUME 6 NUMBER 4



International Council for Computers in Education



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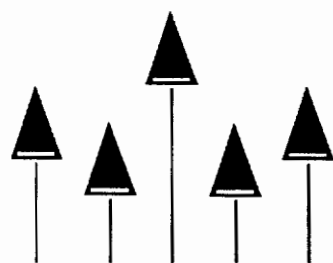
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LOGO EXCHANGE

VOLUME 6 NUMBER 4

Journal of the ICCE Special Interest Group for Logo-Using Educators

DECEMBER 1987

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From the Editor

Welcome to the December issue of the *Logo Exchange*. This month offers some unexpected variety for you Logophiles. Judi Harris gives us a chuckle to brighten the holiday season, while Eadie Adamson offers us some food for thought. This month, we are delighted to have more news from our international friends and hope we will continue to hear even more from them as the months go by.

No doubt many of you have breathed a sigh of relief to find your mail box again filled by issues of *LX*. You are reassured that indeed *LX* is alive and well. But, are you sure? Have you helped out? SIGLogo and *LX* are *yours*. They will become what you make them. Have you sent an idea to a columnist who requested feedback? Have you submitted a piece of student work for the cover? Have you sent a suggestion to a columnist or the editor? Have you submitted an article describing some of *your* Logo activity.

At the moment, *LX* is alive and well because of a large number of *dedicated* columnists who have continued to submit their work when no issues were appearing on their doorsteps. A couple of them have described these months as "writing into a black hole." So, even if you don't have an idea or artwork to submit, how about a greeting card or thank you note to your favorite columnist.

We all look forward to hearing from you in the near future! ▲

Sharon Burrowes Yoder
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Note on Formatting of Logo Code

For those using an unformatted version of Logo such as Apple Logo, Terrapin Logo, Commodore Logo, IBM Logo, etc: Anytime a line is indented do not press RETURN before typing the indented code.

Cover:

This month's cover is part of a 12-event animated timeline of the Revolutionary War done by fifth graders at the Lafayette School in Wayne, NJ. Steven Petrevski, Andrew Rubin, Sean Vij, and Jason Meyer have documented the Boston Tea Party. Arlene Schoenberger was their teacher and Gary Stager their Logo consultant.

A Problem Solving Contest... in Logo

Circle April 30th, 1988 right now. On this date, the International Computer Problem Solving Contest will be offered. This contest, which has been run for the past seven years, first offered problems specific to Logo last year. These problems aimed at elementary students, were well enough received that this year the Logo division will again be offered, but this time for all age levels. For more information about the ICPSC, write to Don Piele, University of Wisconsin-Parkside, ICPSC, Wood Road. - Box #2000, Kenosha, Wisconsin 53141-2000 or call 414-5532231.

Monthly Musings

by Tom Lough
Thinking About Thanking

Recently, I was doing a little general reading about Logo when I came upon a statement which made me stop in my tracks. It said: *The scandal of education is that every time you "teach" someone something you deprive him or her of the possibility of learning it.* The author was Seymour Papert, and the statement was in his classic article, "Computer as Mudpie," which appeared both in the January 1984 issue of *Classroom Computer Learning* and in Dale Peterson's excellent collection of essays, *Intelligent Schoolhouse: Readings on Computers & Learning* (Reston Publishing Co., 1984).

As I thought about those words, my mind raced back several years to a time when I had just learned my first few Logo commands. Was I excited! I signed up for as much computer time as I could spare (we were using TI Logo at the time), and devoured every Logo book I could get my hands on.

I remember keenly a chapter which featured an exploration of the relationship between the number of turns and the size of the turns for closed figures. I certainly don't blame the authors, but when I read the "secret" of the Total Turtle Trip Theorem, I felt an odd mixture of elation and disappointment. I was excited because I could use the theorem in other applications, but I was disappointed because I had deprived myself of the opportunity to learn it in my own way.

I quickly scanned my mental filecabinet of Logo teaching experiences. Had I ever deprived my students of the opportunity to learn something themselves? Oh, my. All too often, it seemed. What delight I would take in answering my students' questions about how to do this or that. I found it difficult to ignore their impatient pleas for

"the answer."

Didn't I learn anything from my teacher training? For example, Thomas Gordon's *T.E.T.: Teacher Effectiveness Training* (Peter W. Hyden Publisher, 1974) suggests active listening techniques for helping students solve their problems. In fact, Gordon says that advising students and offering solutions is a roadblock to effective problem solving because it interferes with the student coming to grips with his or her own problem. Thus, they are deprived of the opportunity to discover the answers to their questions.

The issue seems to be fundamental. One of my educational psychology texts had in it the following question for teacher candidates to consider:

"Which do you want? Students who can answer questions presented by others, or students who are capable of asking themselves questions and seeking their own answers?" [Robert F. Biehler and Jack Snowman in *Psychology Applied to Teaching*, Houghton Mifflin, 1986] Although the former would probably have high standardized test scores, the latter would likely make greater contributions to society. But students cannot acquire these skills without practice. This means they must be given the opportunity to explore, to discover, to learn on their own.

In my Logo teaching, I have tried to respond to students' questions with other questions or appropriate suggestions. However, if I want to help them grow and learn even more effectively, I must double my efforts to give them the opportunities to learn for themselves.

Tom Lough
PO Box 5341
Charlottesville, VA 22905



Stager's Stuff

by Gary Stager

"Playing With Music" Part 1: Problem Solving

"...In our society music creativity is poorly represented. At school you don't learn to compose, you learn to sing in tune and play the piano. Composition is only for specialists, and there is no reason it should be. Everybody draws, everybody writes, everybody talks, everybody does theater. I think one reason is that you need too much performance skill with music to be able to listen to your piece. With a computer as a musical instrument it becomes possible to create a piece of music and hear it independently of your performance skill." — Seymour Papert (Brand, Stewart "The Media Lab - Inventing the Future at MIT." New York: Viking Penguin, Inc. 1987)

Most Logo users have not explored Logo's potential for creating music and many music teachers are unaware of how Logo can be used to enhance their students' understanding of musical ideas. It is true that the marriage of Logo and music may provide Logo programmers with challenges for self-expression and is an excellent instructional tool for teaching components of the traditional music curriculum. These uses, however, fall dramatically short of the numerous powerful ideas learned by children exploring music and Logo.

In my work with elementary students I have observed the emergence of much deeper learning than that of specific music theory topics or Logo syntax. In fact, the type of learning is quite interdisciplinary. For example, many mathematically gifted students who "think" turtle graphics is too easy for them are challenged working with these

Logo music procedures. The parallels between music and mathematics are numerous and Logo music provides these students with a new Logo microworld which serendipitously enhances their understanding of mathematical concepts in a new and interesting domain.

I have isolated eight areas in which students develop intellectually and learn specific skills by "playing with" music and Logo. These areas are:

- 1) Problem Solving
- 2) Thinking Mathematically
- 3) Aural Development/Listening Skills/Attending
- 4) Aesthetic Development
- 5) Learning Logo
- 6) Learning Musical Issues
- 7) Logo as a Tool for Musical Composition
- 8) Language Arts

In my paper entitled, "Logo and Music - A Powerful Tool for Learning" (Cambridge, MIT: *Logo '86 Proceedings*), I explain these ideas in much greater detail. I would recommend this article and any of the MIT Logo Memos by Dr. Jeanne Bamberger as reading for any teachers interested in learning more about what students learn by working with Logo and music.

The current implementations of Logo don't help much by forcing users to deal with confusing and cumbersome frequencies rather than traditional music notation or pitches with a predictable numerical sequence. This article contains music tool procedures for playing with music in a much more flexible and intuitive fashion. I have included a few ideas for using these procedures and I would en-

courage you and your students to spend some time experimenting with them; first at the command level (immediate mode) and then by writing musical procedures.

Startup Procedure for LogoWriter (APPLE)

```
TO STARTUP
SET.TONIC 37
SET.TEMPO 20
MAKE "PITCHLIST [65 69 73 78 82 87
92 98 104 110 117 123 131 139
147 156 165 175 185 196 208 220 233
247 262 277 294 311 330 349 370 392
415 440 466 494 523 554 587 622 659
698 740 784 830 880 932 988 1046 1108
1174 1244 1318 1396 1480 1568 1660
1760 1864 1976 2092 2216 2348 2488
2636 2792 2960 3136 3320 3520 3728
3952 4184 4432 4696 4976 5272 5584
5920 6272 6640 7040 7456 7904 8368]
END
```

Startup Procedure and Variable for IBM Logo

```
TO STARTUP
SET.TONIC 47
SET.TEMPO 1
MAKE "PITCHLIST [36.7075 38.955
41.2025 43.6525 46.32625 49 52 55
58.3675 61.735 65.4079 6941 73.415
77.91 82.405 87.305 92.6525 98 104
110 11.735 123.47 130.815 138.82
146.83 155.82 164.81 174.81 185.305
196 208 220 233.47 246.94 261.63
277.64 293.66 311.64 329.62 349.22
370.611 392 415 440 466.94 493.88
523.26 555.28 587.32 623.28 659.24
698.44 741.22 784 830 880 933.88
987.76 1046.52 1110.56 1174.64
1246.56 1318.48 1396.88 1482.44
1568 1664 1760 1867.76 1975.52
2093.04 2221.12 2349.28 2493.12
2636.96 2793.76 2964.88 3136 3328
3520 3735.52 3951.04 4186.08
4442.24 4698.56 4986.24 5273.92
5587.52 5929.76 6272 6656 7040
7471.04 7902.08 8372.16 9397.12
9972.48 10547.84 11175.04 11859.52
```

```
12544 13312 14080 14942.08 15804.16
16744.32196 19500]
```

END

MAKE "STARTUP [STARTUP]

Startup Procedure and Variable for Logo II

```
TO STARTUP
SET.TONIC 49
SET.TEMPO 20
MAKE "PITCHLIST [33 35 37 39 41 44 46 49
52 55 58 62 65 69 73 78 82 87 92 98
104 110 117 123 131 139 147 156 165
175 185 196 208 220 233 247 262 277
294 311 330 349 370 392 415 440 466
494 523 554 587 622 659 698 740 784
830 881 932 988 1047 1109 1176 1244
1319 1398 1480 1566 1663 1761 1864
1973 2095 2213 2346 2495 2637 2797
2959 3142 3327 3510 3743 3946 4172
4426 4713 4990]
END
```

MAKE "STARTUP [STARTUP]

NOTE: All of the STARTUP procedures contain pitch lists which approximate the correct frequency inputs for each version of Logo and computer. You may have to adjust some of them to your sense of pitch.

The key to these music tools is the NOTE procedure.

```
TO NOTE :PITCH :DURATION
TONE ITEM (:PITCH + :TONIC)
:PITCHLIST (:DURATION * :TEMPO)
END
```

NOTE takes a simple positive or negative number as input and converts it to musical pitch (frequency). A tonic can be understood as the focal pitch or key signature. When the tonic is set with SET.TONIC in the STARTUP procedure, pitch 0 is the nth item of the pitchlist. For example, in LogoWriter, pitch 0 is MIDDLE C, pitch -1 = B, and pitch 1 = C#. The second input to NOTE is the duration (how long you want the note to be played).

Allow students to play around with the NOTE procedure. Let them try to discover how many inputs NOTE has and what the inputs represent. Are there numbers less than zero? Discuss the difference between pitch and duration. Can a duration be less than zero? Can you find the highest and lowest possible notes? Can you create a procedure that plays a song?

SET.TEMPO allows the Logo composer to change the tempo (speed) of their compositions without adjusting the durations they have already taught Logo. Tempo is a constant which is proportional to the duration of the notes.

```
TO SET.TEMPO :NUMBER
MAKE "TEMPO :NUMBER
END
```

As mentioned above, SET.TONIC basically tells Logo which item in the pitchlist should be note 0. In the startup procedures I've provided, the tonic is middle C.

```
TO SET.TONIC :PITCH
MAKE "TONIC :PITCH
END
```

There must be a more convenient way to play more than one note at a time. After all, musical ideas are usually made up of phrases. The PLAY procedure uses routine list processing to play a list of pitches with their corresponding durations.

```
TO PLAY :PITCHES :DURATIONS
IF OR EMPTY? :PITCHES EMPTY?
:DURATIONS [STOP]
NOTE FIRST :PITCHES FIRST :DURATIONS
PLAY BF :PITCHES BF :DURATIONS
END
```

For example, the command
PLAY [-5 7 2 -3] [2 2 4 8]
causes the following:

pitch -5 plays for a duration of 2
pitch 7 plays for a duration of 2

pitch 2 plays for a duration of 4 (twice as long as 2)
pitch -3 plays for a duration of 8 (four times as long as 2)

Keep in mind that there must be the same number of pitches and durations in PLAY.

UP is a procedure for playing an ascending musical sequence or scale. The student gains experience with seriation and mathematical skills, such as counting by an increment, while playing with music.

```
TO UP :START :LIMIT :DURATION :INC
IF :START > :LIMIT [STOP]
NOTE :START :DURATION
UP (:START + :INC) :LIMIT :DURATION :INC
END
```

Why does the music seem to be faster if you input a larger value for :INC?

DOWN works just like UP except now the scale is played down and a decrement is specified.

```
TO DOWN :START :LIMIT :DURATION :DEC
IF :START > :LIMIT [STOP]
NOTE :START :DURATION
DOWN (:START - :DEC) :LIMIT :DURATION :DEC
END
```

The value in the :DEC input must be a positive integer by which you will count down!

UP.DOWN plays an up scale followed by a down scale a specific number of times. The same number is used for the increment to UP and the decrement to DOWN.

```
TO UP.DOWN :START :LIMIT :DUR :INC
:TIMES
REPEAT :TIMES
[UP :START :LIMIT :DUR :INC
DOWN :STOP :LIMIT :DUR :INC]
END
```

Try playing UP.DOWN 15 20 1 1 10 Does it sound like the Centipede Video Game?

RETRO works in a similar way to PLAY except now the list of pitches and corresponding durations are played backwards.

```
TO RETRO :PITCHES :DURATIONS
IF OR (EMPTY? :PITCHES)
  (EMPTY? :DURATIONS) [STOP]
NOTE LAST :PITCHES LAST :DURATIONS
RETRO BL :PITCHES BL :DURATIONS
END
```

RETRO is short for retrograde, the musical term for melodic phrase played backwards. The same lists can be played by PLAY and RETRO with different results. You don't have to alter the pitch or duration lists at all. Like PLAY, there must be the same number of pitches and durations in RETRO.

An important compositional technique is sequencing and transposition. There are obvious parallels between musical transposition and mathematical transformations. TRANSPOSE plays a list of pitches and durations as in PLAY, but the plays the sequence beginning on a lower or higher note, a specific number of times.

```
TO TRANSPOSE :PITCHES :DURATIONS :INC
  :TIMES
IF :TIMES < 1 [STOP]
PLAY :PITCHES :DURATIONS
TRANSPOSE (MOVE :PITCHES :INC)
  :DURATIONS :INC (:TIMES - 1)
END
```

```
TO MOVE :PITCHES :INC
IF EMPTY? :PITCHES [OP []]
OP (SE (:INC + FIRST :PITCHES) MOVE
  BF :PITCHES :INC)
END
```

TRANSPOSE [-5 23 -12 5 4 3 - 5 4 3] [2 2 4 2 6 8 2 4 2 4] -4 3 plays the melodic phrase described by the first two lists three times, each time down two whole steps.

RTUNE allows the Logo composer to explore randomness while experimenting with a modern compositional technique - random music. The inputs to RTUNE are a list of any number of pitches that can be randomly chosen to be played, a

list of any number of durations that can be randomly chosen to be played, and the number of random notes you want to be played. RTUNE must also have the same number of items in the pitch and duration lists.

```
TO RTUNE :PITCHES :DURATIONS :TIMES
REPEAT :TIMES [NOTE PICK :PITCHES
  PICK :DURATIONS]
```

END

```
TO PICK :LIST
OP ITEM (1 + RANDOM (COUNT :LIST))
  :LIST
```

END

How would you "fix" RTUNE so that it plays certain notes more often than others while still being random? Can you make RTUNE play a collection of random notes all with them same rhythm? Can RTUNE play just one note and duration? Can you use RTUNE in place of NOTE?

Part two of this article in next month's issue will provide ideas for composing with tune blocks and creating graphic notation systems for Logo musical compositions. Logo procedures for experimenting with modern compositional concepts such as serial music and tone poems will also be explored.

Note: Music is possible also in Apple Logo. Send \$2.00 to Gary Strager at the address below for a disk containing the tool programs from the Apple Logo Toolkit (available from LCSi) and music tools like those described above.

I can also supply you with procedures for LCSi Mac Logo. Send a self-addressed stamped envelope with your request to:

Gary S. Strager
12 Locust Place
Wayne, NJ 07470



[Gary S. Strager is the Director of Training for the Network for Action in Microcomputer Education in New Jersey and the Vice President of

MathWorlds

edited by A. J. (Sandy) Dawson

"Wherefore Are Thou, Logo?"

In a column a couple of months back I raised a question about the potential of the future use of Logo in the schools. I reported enthusiastically about two conferences I attended last summer (LME3 and PME XI) where reports on the teaching and learning of Logo were prominent. I also talked about the creation of the CLIME group and its associated electronic network/bulletin board. These reports elicited some response which I joyfully took off the computer network.

First, Ihor Charischak, the Chair of the CLIME group, shared the essence of a conversation he had with the editors of *Kaleidoscope*, a New England based Logo publication. Five days later, Al Cuoco, a high school mathematics teacher from the Boston area, answered Ihor's invitation for responses.

The discussion which ensued touches on the relationship of Logo to the secondary school mathematics curriculum. Where I found excitement last summer about the use of Logo in the schools, Ihor and Al found both philosophical and logistic problems with implementing Logo along side the secondary school mathematics curriculum.

Let's listen in as Ihor and Al have their electronic discussion.

Ihor wrote:

I thought I would share some thoughts that the editorial staff of *Kaleidoscope* had shared in what I hear is their next to last issue. (I hope they change their mind!) This will be a condensed version of what they are saying. (My apologies to the editors if I'm off a bit.) Here goes:

"This editor continues to teach mathematics in a public school, tries to include some Logo programming in math courses, math in Logo courses, and

preaches to anyone who will listen about Logo as the computer notation system for creating and recreating a lot of mathematics. But I see few indications anywhere that a Logo revolution is about to sweep through the mathematics classroom. And frankly, right now I'm not sure it should."

He goes on to explain that when he tries to cover the curriculum disaster occurs. Teachers pose pseudo problem to which he provides, in due course, canned solutions. In the programming classes when he doesn't have to cover the curriculum, the kids do some very interesting and powerful mathematics. So here is the editor's dilemma...

"So it seems that if my goal in using Logo is to get kids doing mathematics on their own, then I can't teach a traditional course. But if I am required to teach a traditional course, then I can't figure out how to leave students well enough alone to construct the mathematics."

Any suggestions out there?

Using the electronic networks is somewhat like sending a message in a bottle out on the high seas. One can never be sure if the message will be received, or if received whether or not it will be answered. Ihor had put his message in an electronic bottle and sent it on its way. He was lucky. Five days later Al Cuoco responded to Ihor's query.

Al wrote:

The dilemma is a serious one. To some extent, we have all been spoiled by Logo. We always knew that students could discover most of what we teach them in mathematics class on their own, but we justified the "traditional"

methods of mathematics instruction (variations on the "definition-theorem-proof-remark" model) on the grounds that it would take too long for students to re-invent the wheel. Logo has made it much more feasible for many students to do mathematics ("do" - not "learn"), and it is very frustrating to see the differences between the creativity that students exhibit in programming class and the canned learning that we sometimes see in mathematics class.

Mindstorms called for a revolution in our educational system. The battle between covering the curriculum and encouraging students to discover things on their own should at the very least cause us to think about restructuring mathematics education from the ground up.

No one invents everything they know about mathematics. Sometimes, you simply have to dig in and study other people's results. For example, trigonometry is extremely important, but we'd be wasting time if we waited for our students to discover an alternate form for $\sin A + \sin B$. On the other hand, people who have made a few mathematical discoveries on their own seem to go at this "learning the facts" aspect of mathematics differently than people who think that learning facts is all there is to mathematics. They look for patterns, for extensions, and for generalizations. And they often do make discoveries as a result of their extensive calculations.

The trick, then, is to provide students with two kinds of mathematical experiences. Students should be exposed to the traditional (and important) mathematical topics. This doesn't have to be a bad experience. Many established mathematical topics contain beautiful ideas that are masterpieces of human ingenuity, and students can study them as works of art [the author of the Kaleidoscope editorial would never admit it, but he is a master at finding clever and elegant ways to present classical topics]. Students should also be exposed to the kinds of creatively charged and less structured environments that we usually associate with Logo. The emphasis here should be on discovery and on

creative play.

How do we do both things? We restructure the curriculum and we restructure how we spend our time with our students. The curriculum is already changing (witness the uproar in the journals over the "crisis in calculus" that is sweeping universities), and the forces that influence what we teach are finally realizing that we need to clean up (and pare down) the precollege curriculum. We also have to convince the establishment that we should be teaching fewer "classes" and doing more "advising". This year, I convinced the administration to let me teach a class called "independent study" as one of my preparations. Independent study amounts to an apprenticeship program; I work with about a dozen students (half of them are in my "regular" classes) using Logo and Scheme* (although sometimes we don't use computers at all) to study interesting mathematical phenomena. The students have all kinds of backgrounds and interests, but they all enjoy the contrast between this unstructured environment and the more traditional atmosphere that they find in their "real math class" (several of them are working on projects suggested by ideas from their traditional courses).

Suppose we tried to institutionalize this idea. Suppose we managed to reduce the typical classload from five classes to three, and in return, we each agreed to take a dozen students under our wing. The students would love it (they'd also find the extra time to devote to exploratory mathematics).

The school committee will say that it costs too much money. We'll have to convince them that they are currently underfunding education. That won't be easy. Revolutions are never easy.

So Al put his response in an electronic bottle and sent it on its way. The seas must have been choppy, or perhaps Ihor was busy and didn't get to read Al's response right away, because it was another week or so before Ihor once again signed onto the network and responded to Al.

Ihor wrote:

I'm glad to hear that you talk about revolution as something that is actually possible, Al. Too often I get the feeling that many Logo enthusiasts feel that not much can be done until the schools are burned down. Clearly we can do a lot, as you have pointed out, in moving from a sterile, purposeless approach in teaching mathematics to one that is engaging and empowering for the student. Unfortunately, it is not easy. We don't have many good models for how to do it. The textbook still dominates in determining how mathematics ideas are presented in most schools. But if there are enough of us willing to work a bit harder than most and not willing to give up when the system seems to be out to get us, we can make a difference! But we need to talk to one another, share our ideas, get our batteries recharged, and not give up. Al, I think you touched on the key to handling the dilemma that the editor of Kaleidoscope is up against. The job of the math teacher is twofold: (1) s/he has a responsibility to pass on the rich culture of the past to the student (The Curriculum); (2) the teacher should coach the student to become a mathematician. All this teachers must do within the context of the walls and blackboards with which they are familiar.

One thing I always appreciated about children is that they were always willing to learn something. Unfortunately, many times the situation prevented any meaningful learning from happening. But there were other times that I was able to capture the imagination of even the most mathphobic students. If we can share these moments with each other (strategies, lesson plans, resources) we can collectively make a dramatic impact on what happens in mathematics classrooms.

At this point in time I sent off messages to both Ihor and Al asking them for permission to use the discussion you have just read as the basis for a Mathworlds column. Within a week both agreed. Moreover, when indicating his agreement, Al asked

if it would be OK if the mathematics/Logo students with whom he was currently working could use the network to share their work with others. I said, "Sure," and in due course received the following response from Al.

Al wrote:

I'll tell my students tomorrow that they can use the network. It'll be a while before any of them is ready to write up results, but the knowledge that they can show their stuff to people outside the school will give them something to look forward to with anticipation.

Some of the projects they are working on are: modeling polynomial algebra, changing numbers from one base to another, modeling linear algebra, figuring out INSPI, solving the 'Simplex lock' problem, generating cellular automata and fractals, graphing equations, modeling function algebra, symbolic differentiation and number theory. Needless to say, it is great fun working with these people!

As I write this column I have been checking every few days to see if any bottles have arrived on the electronic seas carrying messages from Al's students.

What is your response to the ideas expressed by Al and Ihor? Write to me, or send me a message. I am on CompuServe every few days, and of course on the CLIME electronic network daily. I'd love to hear from you.

*SCHEME is a Logo like computer language developed by Al Cuoco. ▲

[Membership in CLIME costs \$5 and may be obtained by writing to CLIME, c/o Ihor Charischak, 445 Broadway, Hastings-on-Hudson, NY 10706.]

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“Logo LinX:” December 1987

Judi Harris

“Wifty Gifts”

I relish the moment when I introduce this procedure to my students:

```
TO SQUARE :NUM
OUTPUT :NUM * :NUM
END
```

PRINT SQUARE 5 returns the value 25.
PRINT SQUARE 10 yields 100. Invariably, someone laughs, and says: “Oh! I thought that you meant...”

```
TO SQUARE :SIDE
REPEAT 4 [FORWARD :SIDE RIGHT 90]
END "
```

In this month’s article, I mean BOTH—and more.

Double Trouble

Some of my favorite jokes involve double entendres. For example,

“Did you know there was a computer in the Garden of Eden?”

“No, I didn’t know that!”

“Yes: Eve had an Apple, of which Adam took a byte.”

Logo double entendres can inspire a special kind of divergent thinking.

Nifty Gifts

What makes a Logophile’s eyes sparkle, besides a LEGO TC Logo set?
(No, this is not another bad joke.)

New procedures to add to their Logo toolkit!

Glen Bull and Paula Cochran (1985) suggest that:

The extensible quality of Logo allows new commands to be added to the language that would be tedious for the average user to develop. These software tools allow the capabilities of Logo to be extended, just as slots on the IBM PC or Apple IIe make it possible to extend the hardware capabilities of the computer.

An important characteristic of a tool is that it may be used for tasks that the tool maker never envisioned. A hammer, for example, is traditionally used to build [a] dog house or a bird bath. It might also be used to prop open a door, smash bugs, or form part of a modern sculpture. (p.1)

Why not give a Logophile some new procedures during this holiday season? Even better, why not give Logo fans some new INTERPRETATIONS of their trusty tools?

Choices?

Bull and Cochran’s (September 1984) random selection tool, PICK, is an old friend.

```
TO PICK :LIST
OUTPUT ITEM 1 + (RANDOM COUNT :LIST)
:LIST
END
```

Here is another TO PICK "procedure:"



Uncharted Waters

Bull and Cochran's (September 1986) chart tools:

```
TO LINE :LENGTH
FORWARD :LENGTH
BACK :LENGTH
END
```

```
TO OVER :LENGTH
PU
RIGHT 90
FORWARD :LENGTH
PD
LEFT 90
END
```

```
TO BAR :HEIGHT
REPEAT 2 [FORWARD :HEIGHT RIGHT 90
FORWARD 20 RIGHT 90]
OVER 20
END
```

can help with bar graphing. They can also be "coded" like this:



TO LINE



TO OVER



TO BAR

Double Trouble

Some Logo double entendres have double representations. Martin and Bearden's (1985) work with bouncing balls, and Bull and Cochran's (May 1986) bounce tool:

```
TO BOUNCE :LIST
IF :LIST = [] [STOP]
SETY 50 * FIRST :LIST
BOUNCE BUTFIRST :LIST
END
```

might be restated in two different ways:



...and of course, the familiar fabric softener.

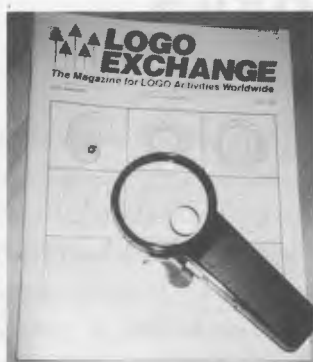
A Vision

Some tools, like Bull and Cochran's (November 1984) INSPECT, help us to examine lists.

```
TO INSPECT :LIST
IF EMPTY? :LIST [STOP]
PRINT FIRST :LIST
INSPECT BUTFIRST :LIST
END
```

Other tools make a different vision clearer.

TO INSPECT



Procedural Hues

Steve Tipps (1984) provided us with some spectacular spectral procedures:

TO GREEN	TO ORANGE	TO BLUE
OUTPUT 2	OUTPUT 4	OUTPUT 5
END	END	END

To use these tools, type SETPC GREEN, SETPC ORANGE, or SETPC BLUE. Or, you may wish to attempt a different method:



TO RED, TO ORANGE, TO GREEN, TO BLUE,
TO PURPLE, TO BLACK

Procedure Puns

Finally, there are those procedures that, when (mis)interpreted, yield mostly groans.

```
TO PLOT :NUMBERS
IF EMPTY? :NUMBERS [STOP]
SETPOS LIST (XCOR + 40) (FIRST
:NUMBERS)
PD
PLOT BUTFIRST :NUMBERS
END
(Bull and Cochran, March 1987)
```

TO PLOT



More "Procedures"

What will be in your students' Logo holiday toolkits?

- A lab notebook? (TO COLLECT.DATA)
- A wind-up toy? (TO MOVE)
- A slide rule? (TO CONVERT)

Here's hoping that you will have a happy, healthy, and DIVERGENT holiday season.

[Editor's note: Do you or your students have good additions to the above collection? If so, send your pictures and procedures to Judi Harris, and we'll publish the best in a future issue.]

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- ▲
- [Judi Harris, 621-F Madison Ave., Charlottesville, VA 22093; CompuServe: 75116, 1207.]

TEACHING TOOLS

Logophiles and Logo Files

Glen Bull and Gina Bull

It is a familiar story. A child raises his hand and asks for assistance. The teacher arrives and tries to help, but the original error has scrolled off the screen. Sometimes it is possible to reconstruct what happened, and sometimes not.

There is a way to record events even when you are not there. In this case, the child has typed the letter "O" instead of the number "zero."

FORWARD 50

Logo Doesn't Know How to 50

A DRIBBLE file provides a record of everything the child has typed. This enables the teacher to go back and examine everything which has taken place in the session. The simplest form of a DRIBBLE file sends everything to the printer. In Apple Logo II (or LCSII Logo II), the command to do this consists of the command DRIBBLE followed by the slot number in which the printer card is located. (Usually, though not always, the printer card will be in Slot 1.)

DRIBBLE 1

In IBM Logo, the equivalent command

consists of DRIBBLE followed by "PRN.

DRIBBLE "PRN

This is an easy enough command to try, and if you have one of these versions of Logo but have not used the DRIBBLE command, you should try it. Be sure that the printer is turned on and attached to the computer. If the printer is not turned on, Logo will politely wait forever for the printer to respond. The command to stop dribbling to the printer is (appropriately) NODRIBBLE.

Creating a File

Not every computer has a printer attached to it. Computers without printers can still DRIBBLE. It is just necessary to send the text to a file on a disk rather than to paper in the printer. In this case, the command is DRIBBLE followed by the name of a file. Try creating a test DRIBBLE file. Just type DRIBBLE "TESTFILE.TXT, and then type a few Logo commands. Be sure that you have a formatted disk in the disk drive when you do this.

DRIBBLE "TESTFILE.TXT
CLEARSCREEN

```
REPEAT 4 [FORWARD 50 RIGHT 90]
NODRIBBLE
```

After you have typed a few Logo commands, terminate the DRIBBLE file by typing NODRIBBLE. At this time, the light on the disk drive should come on, and the disk should whir as the file is written to the disk. Type CATALOG to see the file name on your disk directory. (If you are using IBM Logo, type DIR to see the directory.) You might see something like this on your screen:

```
SHAPES.LF
POETRY.LF
TESTFILE.TXT
```

At this point there is a new file on your disk, containing the text of the Logo commands that you typed. You can examine and change the contents of the file with the EDITFILE command. After typing EDITFILE and the filename, you will find yourself in the Logo editor. However, in this case you will be viewing the contents of a file on disk, rather than the contents of a procedure in memory.

```
EDITFILE "TESTFILE.TXT
```

Logo Editor

```
CLEARSCREEN
REPEAT 4 [FORWARD 50 RIGHT 90]
NODRIBBLE
```

Editing the File

Once you are in the Logo editor, you can make changes in the file, just as you can with Logo procedures. All of the editing commands are the same, so there is nothing new to learn. It is possible to insert the student's name and the date, and a few comments about his work. Commands in the DRIBBLE file which are not needed can also be deleted. In this case, the final NODRIBBLE has been erased.

Logo Editor

Logo Activity

Jimmy Hanes

December 15, 1987

Today Jimmy learned the REPEAT command. In the next class he will learn how to create procedures.

```
CLEARSCREEN
REPEAT 4 [FORWARD 50 RIGHT 90]
```

In the next session the use of the abbreviation CS for CLEARSCREEN will also be introduced.

Exit the Logo editor in the normal way. (Type OPEN-APPLE A in Apple Logo II or LCSI Logo, or ESC in IBM Logo.) As you exit the editor, you will hear the disk drive whir again as the changes are saved to disk.

The text file can be printed on the printer. You may want to send this annotated record of the student's activities home to his parents, or place it in his folder for a permanent record of his progress. The POFIL ("Print Out File") command is used to print the file on the screen.

```
POFILE "TESTFILE.TXT
```

(The text of the file will be printed on screen)

To send the file to the printer, it will be necessary to use the DRIBBLE command again.

```
DRIBBLE 1
POFILE "TESTFILE.TXT
NODRIBBLE
```

Text Screens

A DRIBBLE file can be a useful tool for tracking student activities. However, Logo files

have many other uses as well. In creating Logo games, it is common to develop screens of instructions for the players. A procedure to accomplish this might look like this.

```
TO INSTRUCTIONS
PRINT [Guestimation]
PRINT [ ]
PRINT [In this game, you will try]
PRINT [to guess how many steps the]
PRINT [turtle will take to reach]
PRINT [its target.]
END
```

The necessity of including PRINT in front of each line of text is cumbersome. It is also difficult to estimate the length of each line (since PRINT takes up some of the space). It is possible to insert spaces, by means of a backslash in front of a space "\", but this is also tedious. For example, in order to center the title "Guestimation, it would be necessary to write something like:

```
PRINT [\ \ \ \ \ Guestimation]
```

These difficulties can be eliminated by creating the instructions in a text file. Use the EDIT-FILE command to create the file. (In IBM Logo, you will need to type OPEN "INSTRUCT.TXT followed by CLOSE "INSTRUCT.TXT before you can edit a new file.)

```
EDITFILE "INSTRUCT.TXT
```

Logo Editor

Guestimation

In this game, you will try to guess how many steps the turtle will take to reach its target.

Enter the instructions just as you would with a word processor. Use the spacebar to space over to center the title. After the instructions have been entered, exit the Logo editor. The instructions can

be printed on the screen with the POFILE command.

```
CLEARTEXT
POFILE "INSTRUCT.TXT
```

You could also create a procedure to print out the file if you wished.

```
TO INSTRUCTIONS
TEXTSCREEN
CLEARTEXT
POFILE "INSTRUCT.TXT
END
```

The ability to create screens of text easily makes many projects possible that would not be feasible otherwise. For example, Logo adventure stories make a good class project. The screens of text can be saved as separate files on the disk, so that when you type.

```
CATALOG
```

```
you might see
STORY.LE
SCREEN1.TXT
SCREEN2.TXT
SCREEN3.TXT etc.
```

If you have many screens of text, you may want to use a word processor such as AppleWorks to produce them. These files must be saved as standard text files (sometimes called "ASCII" files) in order to use them in Logo. When you print in AppleWorks, one option available is PRINT TO DISK. (It has been there all along, but you may have not have noticed it because you never needed it until now.) When you print to disk in AppleWorks, a text file is created on the disk that can be used by Logo.

Poems and Scientific Data

Procedures which generate Logo poems always remain popular. Printing the poems to the printer as they are produced is one way to obtain a

NO LIMITS

THE LEGO® EDUCATIONAL SYSTEM



The LEGO® Educational System was developed to offer children of all ages and abilities a stimulating system of understanding concepts related to science, math and technology. With these materials all students can become scientists, mathematicians and inventors.

The LEGO Educational System takes learning a step farther than the two dimensional "pencil and paper" approach. Students using any of the sets are given the opportunity to build, test and modify working models of scientific and technological principles. Learning by doing transforms theoretical knowledge to applied knowledge and allows the child to claim "ownership" of that knowledge. "Hands on" cooperative group projects are not only effective in demonstrating concepts, but also serve to develop each student's communication skills as he or she works within the study group. This three dimensional teaching method stimulates children to investigate the endless creative possibilities offered by the LEGO Educational System.



ACTIVITY CARDS

All sets include a selection of activity cards. Each card contains a real life machine model on the front, step by step visual instructions for building LEGO models on the inside, and "challenge" models on the back. Visual instructions, rather than written instructions, ensure that the child of any age or language ability level can use the sets successfully.

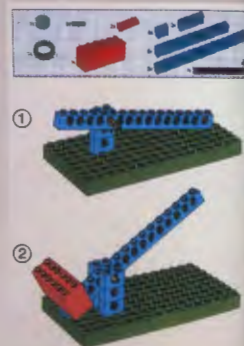


Activity	LEGO® TC Logo	New Logo	Science Concepts	Math Concepts	Social Studies
Simple Machines	Build a simple machine with LEGO® building blocks.		Simple machines: pulley, lever, wedge, screw, inclined plane, gear.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
Waterfall Car	Build a car that can move up a ramp.	an art project.	Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
Slide Light	Build a light that can turn on and off.	an art project.	Light, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
Shuttle up	Build a shuttle that can move up and down.	an art project.	Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
"Heavy" car	Build a car that can move heavy loads.	an art project.	Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.

Activity	LEGO® TC Logo	New Logo	Science Concepts	Math Concepts	Social Studies
Heavy-Goodies	Build a machine that can move heavy loads.		Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
Shuttle Machine	Build a machine that can move up and down.		Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.
Crane Machine	Build a machine that can lift heavy loads.		Force, motion, energy, simple machines.	Measurement: length, weight, volume, area, perimeter.	Science: motion, energy, force.

TEACHER'S GUIDES

Teachers are assisted by guides written by teachers for teachers. Each guide contains suggestions for project themes, teaching sequences, and activities for the individual or the group. The guides also include open-ended situations to encourage creative thinking and problem solving for the more advanced student. Use of the guides minimizes teacher's time spent organizing materials and maximizes teacher's time with students. Effective classroom management is the result.



Introduction

GROUP USE

All LEGO Educational sets are designed for groups of 2, 4 or 6 students. (See individual set descriptions for particulars.)

Cooperative learning encourages children to develop communication, organizational and project management skills.



CLASSROOM MANAGEMENT

- Sets 1030, 1032 and 1090 feature clear lids for a quick visual check of elements.
- Our workbenches hold each LEGO element in place and store flat for easy stacking.



- Sets 1092 and 9700 come in a blue carrying case containing two trays with a place for each piece. The lid pops off to hold the second tray.

- Team Kit Care Record master form is included in item 999. Sets can also be numbered so that teachers can monitor children signing sets in and out.



As a child grows older, his natural curiosity extends to things and events outside his immediate environment. Changes in society and advances in technology capture his interest and prompt questions such as: "What is that machine for?" and "How does it work?" The LEGO School Project Set can help to answer some of those questions. It is designed specifically for group activities in cross curricular areas involving environmental, technological, geographical and historical topics.

CLASSROOM SOLUTION \$256.00

For 24 students*
order:
(4) 1053 School
Project Sets

*For each additional
group of 6, add: (1) 1053

1053 SCHOOL PROJECT SET \$64.00

- designed for group of 6 students
- 886 elements including crane, hooks, winch
- building instructions for 6 models with varying degrees of difficulty
- 12 additional "idea" cards
 - 3 with building hints
 - 9 inspirational models for themes suggested in Teacher's Guide



1053 TEACHER'S GUIDE TO SCHOOL PROJECT SET

- included in project set
- 10 project themes including:
 - energy and power
 - transportation
 - space
 - oil drilling and refining



LEGO® School Project Set



CURRICULUM IDEA: DEVELOPING THE THEME

- What is oil? How do we get it?
Why is it important?

Investigation

- Who works on an oil rig?
- What do they do?
- What jobs are a result of the oil industry?

Construction

- Make a chart to follow oil from the oil platform to:
 - tanker/pipeline; refinery; gas station; cars, planes, etc.

Discussion

- What problems might occur if the above chain of events were broken?
- What might cause problems?
- What are oil spills?
- Are there any other dangers associated with oil? How are they prevented?
- Expand the theme to discuss:
 - other energy sources
 - industries dependent upon petroleum

TECHNIC I introduces the principles of simple machines. Commonly used in grades three through nine, it is appropriate for all students not yet exposed to the fundamentals of simple machines. TECHNIC I is concept specific rather than age specific. Exercises presented within the set stimulate children to utilize basic mechanical concepts to overcome practical problems. Designing and building a working model develops a child's constructional, numerical, graphical and problem solving skills while enhancing his interaction skills as he works with his partner. Active involvement in and successful completion of a project reinforces his understanding of the concept and encourages him to investigate the concept further.

CLASSROOM SOLUTION \$656.00

For 24 students*
order:

- (12) 1030 TECHNIC I Sets
- (1) 1034 TECHNIC Project Set
- (1) 999 Simple Machines Curriculum

*For each additional pair of students, add: (1) 1030

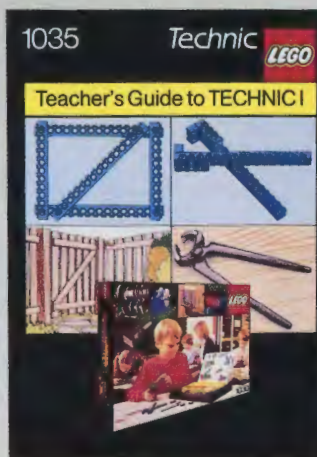
1030 TECHNIC I SIMPLE MACHINES SET \$40.00

- designed for 2 students
- 179 elements including gears, beams, pulleys, wheels, etc.
- 20 activity cards with step by step instructions to build 27 models
- 23 "challenge" models with no instructions
- storage workbench with transparent lid



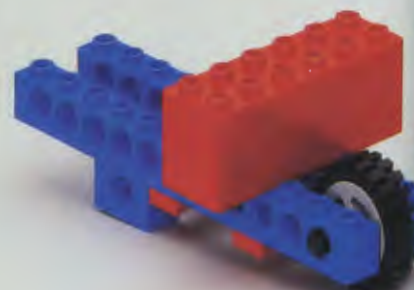
999 SIMPLE MACHINES CURRICULUM \$14.00

- 102 page lesson plan for in-depth study of simple machine concepts
- includes study masters and review sheets
- includes Team Kit Care Record form



1035 TEACHER'S GUIDE TO TECHNIC I \$8.00

- summarizes principles from activity card models
- suggests experiments and further activities
- 3 group project themes



Activity Card 4 examines the use of levers as a simple tool.

TECHNIC I



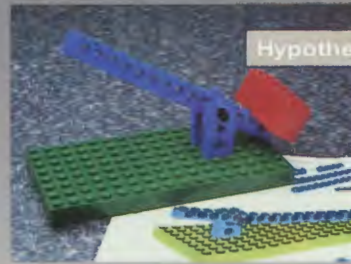
1034 TECHNIC PROJECT SET \$162.00

- Teacher's Guides to TECHNIC I and TECHNIC II included
- 1,516 elements including 2 motors, 2 switches and 2 battery boxes
- can be used for large group projects or demonstration models
- can also be used as "spare parts" box



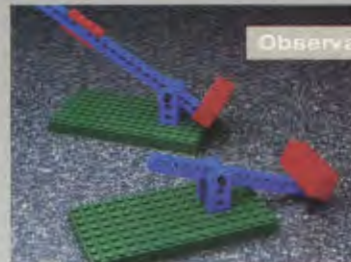
The windmill model from Activity Card 18 demonstrates the use of wind power as a natural source of energy.

CURRICULUM IDEA: SCIENCE



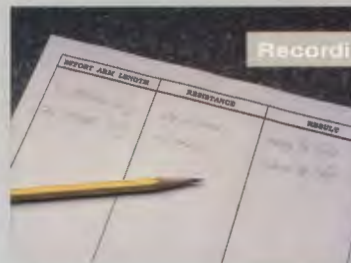
Hypothesis

Resistance is easier to lift when effort arm is longer.



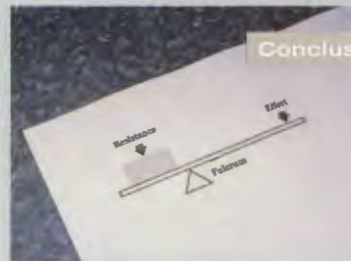
Observation

When the fulcrum is moved, is the resistance easier to lift? Harder? What happens when the effort arm is lengthened?



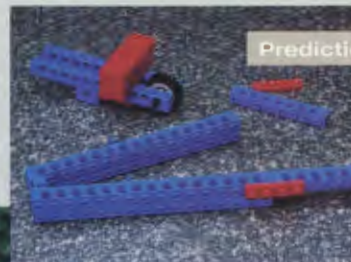
Recording Data

Maintain a careful record of the experiment describing data accurately and completely.



Conclusion

The longer the effort arm, the easier the resistance is to lift.



Prediction

The law will hold true for other classes of levers as well.



TECHNIC II extends the principles of simple machines a step farther to the complexity of motorized machines.

TECHNIC II is appropriate for students of upper elementary, middle or secondary class levels. This set increases the student's understanding of the progression of technology and deepens his understanding of mechanical principles through the use of realistic models demonstrating practical applications.

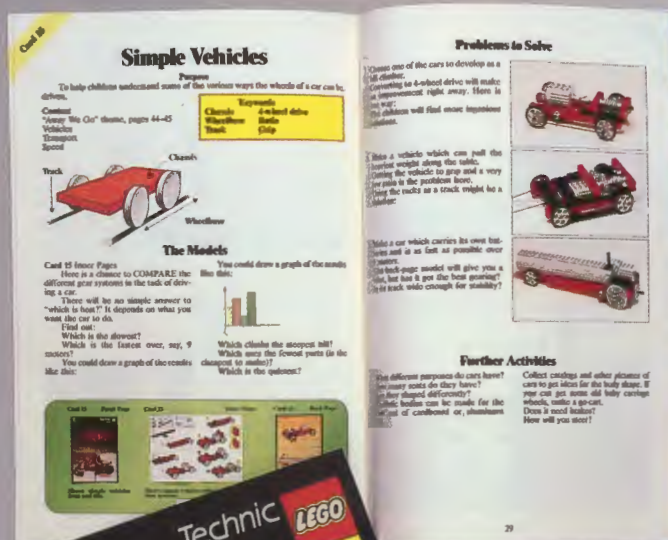
CLASSROOM SOLUTION

- \$912.00**
For 24 students*
order:
- (12) 1032 TECHNIC II Motorized Machine Sets
 - (1) 1034 TECHNIC Project Set
 - (1) 1038 Two-Motor Chassis
 - (1) 1039 Manual Control Panel

*For each additional pair of students, add: (1) 1032

1032 TECHNIC II MOTORIZED MACHINE SET \$55.00

- designed for 2 students
- 278 elements including chain-links, differential, worm gears, 4.5 volt motor and battery box for 3 "C" batteries
- 20 activity cards with step by step instructions to build 40 models
- 30 "challenge" models with no instructions
- storage workbench with transparent lid



1036 TEACHER'S GUIDE TO TECHNIC II \$8.00

- summarizes principles from activity card models
- suggests problem solving ideas and further activities
- 3 group project themes



TECHNIC II



1038 TWO-MOTOR CHASSIS \$45.00

- introduces basic concepts of control technology via "steerable" chassis
- 117 elements including 2 motors
- step by step instructions to build 2 models

1039 MANUAL CONTROL PANEL \$45.00

- controls up to 3 motors
- expands the student's understanding of motorized motion by introducing complex control
- bridges the gap between battery control and computer control
- 39 elements including 3 switch panels, battery box and leads to connect motors to panel



The power drill model from Activity Card 10 illustrates how real gears are used to increase the force and decrease the speed of the motor.

CURRICULUM IDEA: PROBLEM SOLVING



Define the problem

Build a car that can climb a steep hill.



Survey solutions

Many cars can climb hills. Students must determine what the best type of gearing is for this ramp. What size tires will provide the proper amount of friction?



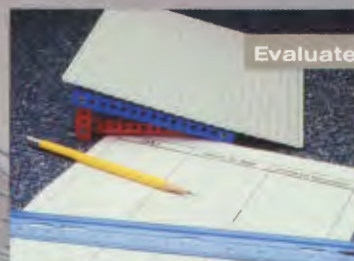
Select a solution

Choose and build the model best suited to climb the ramp. You may design and build your own model. Is your design realistic?



Test your solution

Did the gears provide enough force? At what slope of the incline is the vehicle unable to climb the hill?



Evaluate/Modify

Did the fastest car reach the top of the hill first? Why not?

Construction of a motorized forklift encompasses a combination of mechanical principles. Control of the forklift's dual motors requires the student to utilize a logical progression of commands.



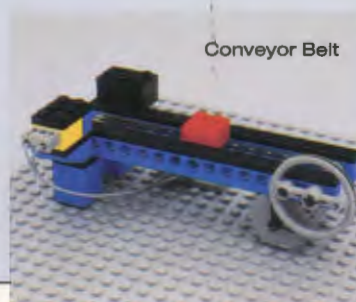
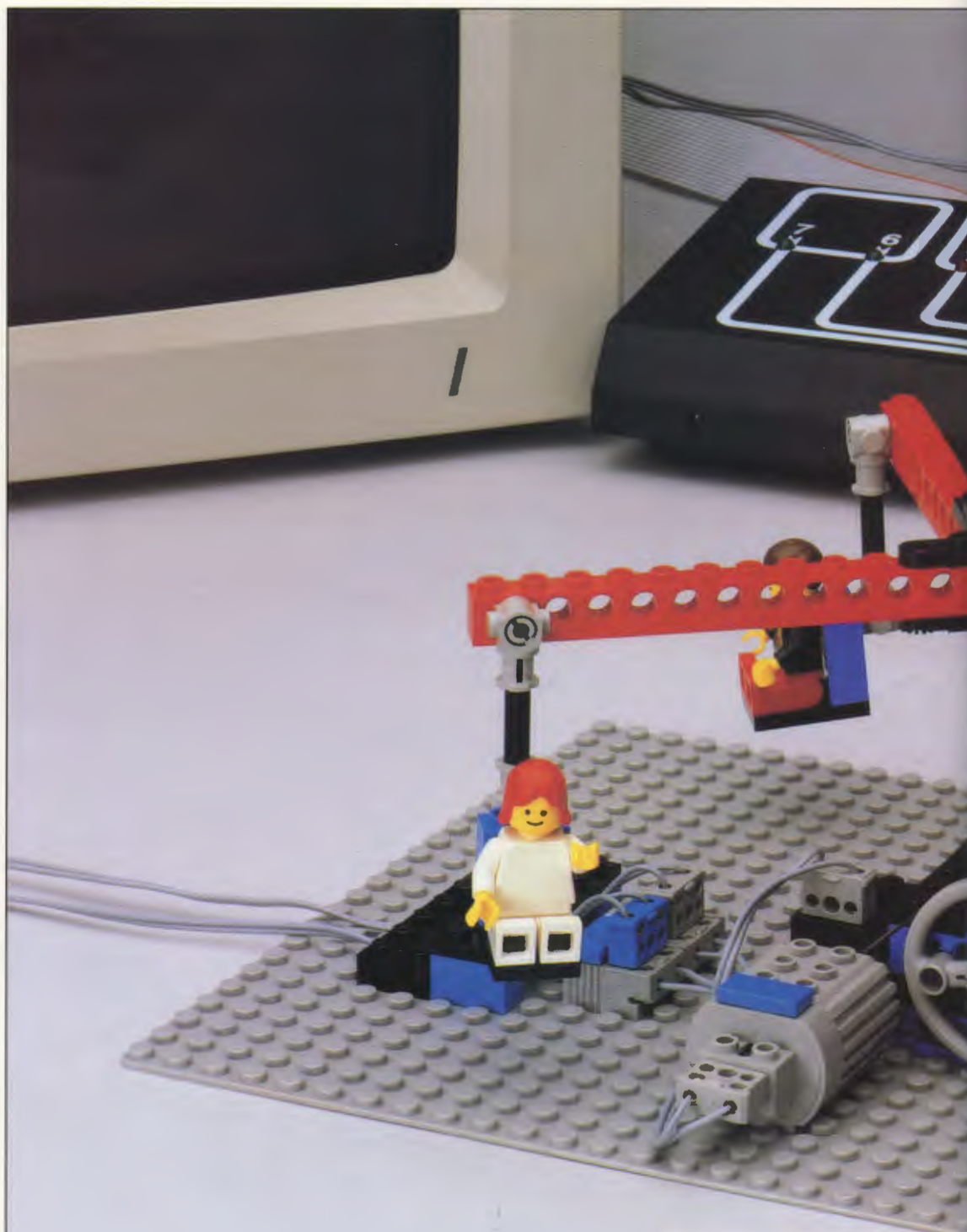
LEGO® and Logo are alike in many ways. Each is a playful construction set that gives children freedom to explore, to create and to build. In one case, the building blocks are LEGO bricks; in the other case, the building blocks are Logo procedures.

What do children learn from these building experiences? For one thing, they develop certain general skills one might call "project management." That is, they develop a sense of how to plan and execute a complex project. Beyond these general skills, children can learn quite specific principles of science, design, mathematics and engineering.

As powerful as LEGO and Logo are individually, they become much more powerful when joined together. As children write Logo programs to control their LEGO constructions, they come in contact with new ideas such as sensors and feedback. Moreover, the two systems reinforce one another: when children have two good examples of a general principle, they are much more likely to recognize that there is a general principle.

Joined together, the powerful elements of LEGO and Logo create one of the richest environments yet for children to explore. The possibilities are as unlimited as a child's imagination.

Seymour Papert
Professor of Mathematics
and Education
Massachusetts Institute of
Technology



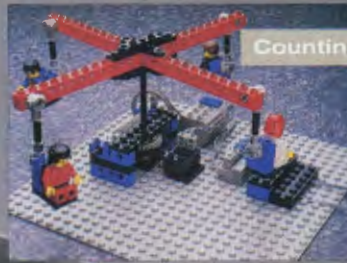
Conveyor Belt



Washing Machine

LEGO® TC logo TECHNIC CONTROL 0

CURRICULUM IDEA: MATH



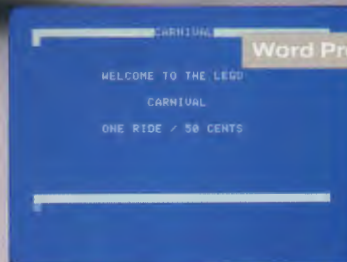
Counting

Decide how many revolutions your merry-go-round will turn for one full ride.



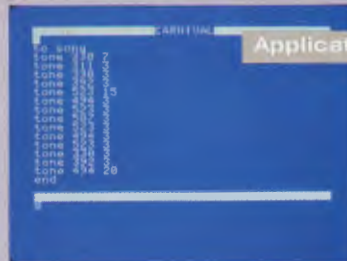
Fractions

Using the touch sensor and the counter, program your merry-go-round to stop every $\frac{1}{4}$ turn to let more people on. Now stop every $\frac{1}{2}$ turn to let some people off.



Word Problems

Your merry-go-round costs \$5,000 per year to operate. How much should you charge per ride? After how many rides would you break even?



Applications

Creating music for your merry-go-round involves math too! Each note has a frequency and a duration. Program a song for your model.

LEGO® TC logo uses simple, intuitive commands (such as "on" and "off") to control lights and motors.



Start/Stop Gates

Soap Box Car



Turtle



TECHNIC CONTROL simply means control of **TECHNIC** models through a computer. With **LEGO® TC logo**, students are able to write computer programs to control the machines that they have built. The automated environment of **LEGO® TC logo** creates a natural progression from the motorized control offered in **TECHNIC II**.

**CLASSROOM
SOLUTION
\$1,602.50**

For 24 students* and 2 computers** order:
(2) 951 Starter Packs
(4) 9700 TECHNIC CONTROL 0 Sets
(2) 1039 Manual Control Panels
(2) 954 Student Guide Packs
(see pages 18-19)

*For each additional group of 4 students, add: (1) 9700 and (1) 954

**Runs on 64K (or more) Apple® IIe or Apple IIGS™ computers.

**951 STARTER PACK
\$485.00**

The **TECHNIC CONTROL** Starter Pack contains everything (except the computer) to create one work station for four students. Included are the **TECHNIC CONTROL 0** set, hardware, literature and software pack.



**9700 TECHNIC
CONTROL 0 SET**

- step by step instructions to build 8 models
- 6 "challenge" models
- more than 450 elements including (2) 4.5 volt motors, (2) touch sensors, (1) optosensor, (1) counting wheel and (4) light bricks
- sturdy blue carrying case with 2 trays



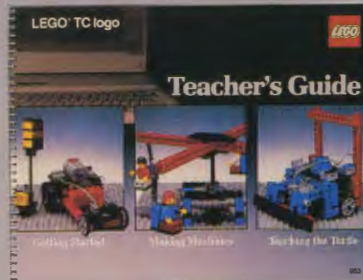
LEGO® TC logo TECHNIC CONTROL 0

952 TECHNIC CONTROL 0 LITERATURE/SOFTWARE PACK

- contains 2 copies of 3 different Student Guides, Reference Guide, Quick Reference Guide, Teacher's Guide, 1 Master disk and 1 Operating disk

HARDWARE

- slot card and cable
- interface box and transformer



Teacher's Guide To TECHNIC CONTROL 0

- 153 pages, spiral bound
- curriculum correlations for science, math, social studies and computer activities
- teacher tutorial
- classroom management suggestions
- annotated bibliography



Student Guides

- (2) *Getting Started* teaches students all the basic commands needed to control motors, lights and sensors by working on several simple projects.
- (2) *Making Machines* offers 3 project ideas for more advanced work on the basic ideas introduced in *Getting Started*, as well as new programming concepts.
- (2) *Teaching The Turtle* contains introductory and advanced activities using a LEGO® robotic and LEGO® TC logo screen turtle graphics.



Reference Guide

- a complete manual with illustrations for setting up LEGO® TC logo
- explanations and examples for all LEGO® TC logo commands



Quick Reference Guide

- summarizes and gives examples of the most frequently used commands

Software

- LEGO® TC logo is a complete computer language with 4 screen turtles for turtle graphics, simple word processing and printer interface capability
- Master Disk—write protected; used for making back-up copies
- Operating Disk—disk used to boot LEGO® TC logo and store programs that students write



TECHNIC CONTROL I provides students with a "hands on" learning environment to better understand the role of computers in today's technology. Students can understand and apply basic principles of programming, mechanical principles and basic control technology as used in real life situations. Experiments with programming and feedback enable students to form an in-depth understanding of control technology and information technology.

**CLASSROOM
SOLUTION
\$3,363.50**

For 24 students* and
4 computers** order:

- (12) 1090 TECHNIC
CONTROL I Sets
- (8) 1039 Manual
Control
Panels
- (4) 955 Slot Card
Packs
- (4) 9750 Interface
Box & Trans-
formers
- (1) 953 Teachers
Guide To LEGO®
TC logo TECHNIC
CONTROL 0
- (5) 1346 Touch Sen-
sor Packs

(see pages 18-19)

*For each additional pair
of students, add: (1) 1090

**For each additional
computer, add: (1) 9750
and (1) 955



LEGO® TC logo TECHNIC CONTROL I

1090 TECHNIC CONTROL I SET \$138.00

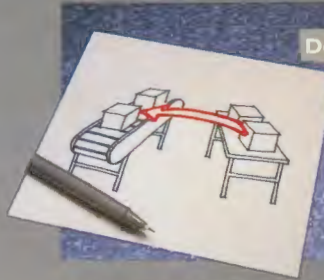
- designed for 2 students
- designed for more advanced projects in junior high and high school technology courses and problem solving activities
- 404 elements including (2) 4.5 volt motors, (2) optosensors, (2) counting wheels
- step by step instructions to build 5 models (robot arm, double conveyor belt, automatic door system, feris wheel and washing machine)
- storage workbench with transparent lid

Students program the computer to LISTENTO the optosensor and to TALKTO motors and lights.



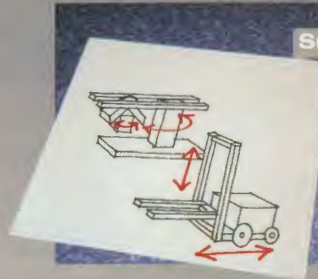
CURRICULUM IDEA: MODEL A SOLUTION

Define the problem



Design a device that can pick up LEGO® bricks from a platform and place them on a conveyor belt.

Survey solutions



What machines currently exist to perform these tasks?

Select a solution



Build a model using TECHNIC CONTROL I activity cards or design your own model.

Test your solution



Using the manual control panel, determine if all the motors and gears are functioning properly.

Program your model



To achieve precise movement, use feedback from the optosensor and counting wheel.

Evaluate

```

to turn right
  rotating motor
  on
end
to open
  saw motor
  tone 440
  onfor 10
end
to close
  saw motor
  tone 380
  onfor 10
end

```

Is the sequence correct? How about timing? If your model does not move correctly, you will need to modify your program or your model.

TECHNIC CONTROL II is especially appropriate for advanced junior high and secondary level classes. This set emphasizes the benefits of precise computerized control technology gained by developing advanced programming skills. TECHNIC CONTROL II enables the student to build, program and control complex models.

**CLASSROOM
SOLUTION
\$4,035.00**

For 24 students* and
4 computers**, order:

- (12) 1092 TECHNIC
CONTROL II
Sets
- (4) 9750 Interface
Box & Trans-
formers
- (4) 955 Slot Card
Packs
- (8) 1039 Manual
Control Panels
- (5) 1346 Touch
Sensor Packs

*For each additional pair
of students, add: (1) 1092

**For each additional
computer, add: (1) 9750
and (1) 955



**1092 TECHNIC
CONTROL II SET
\$195.00**

- designed for 2 students
- 458 elements including (3) 4.5
volt motors, (2) optosensors,
(2) counting wheels and (6)
light bricks
- step by step instructions to
build 5 models (plotter,
height measuring device,
caliper, rotating base
and 2 traffic lights)
- sturdy blue carrying
case with 2 trays

LEGO® TC logo TECHNIC CONTROL II



9750 INTERFACE BOX & TRANSFORMER

\$170.00

- 6 output ports, 2 input ports, 1 test port
- independently controls up to 3 motors or 6 light bricks and 2 sensors

955 SLOT CARD PACK

\$145.00

- contains Apple® IIe and Apple II GS™ slot card and cable
- contains Reference Guide and Quick Reference Guide
- contains 1 Master Disk and 1 Operating Disk

CURRICULUM IDEA: TOOL USE

Need

Year	Computers in Use	Year
1984	3,852	1986
1985	5,089	

Convert a table of data to graph form for easy visual reference

Design



Build and program a computer controlled plotter to draw your graph.

Feedback



Feedback from the optosensor and counting wheel accurately controls the movement of the motor.

Precision



The precise movement and programmable nature of the plotter makes it an excellent graphing tool.

Scope



Measuring tools use feedback from optosensors and counting wheels also. Can you think of other applications?

LEGO® TC logo software allows the student to control complex machines, such as the plotter, by building programs with one simple command after another.



1031
\$9.00 TECHNIC I Activity
Card Pack



1033
\$9.00 TECHNIC II Activity
Card Pack



1085
\$8.25 304 extra bricks.
Contains eight-stud, six-stud
and four-stud bricks



1072
\$13.60 48x48 base plate – gray

1314
\$5.50



Stop bush – gray
Small pulley – gray

1315
\$3.25



Piston rod – gray

1316
\$4.50



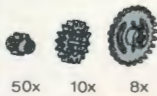
Connector peg – gray

1317
\$14.00



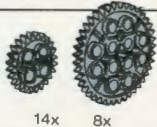
Chain link – black

1318
\$3.60



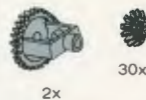
Gear wheel (8 teeth) – gray
Gear wheel (16 teeth) – gray
Crown wheel – gray

1319
\$3.60



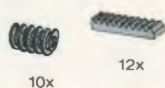
Gear wheel (24 teeth) – gray
Gear wheel (40 teeth) – gray

1320
\$3.60



Differential house – gray
Bevel gear – gray

1321
\$4.50



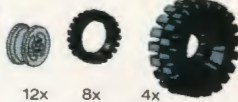
Worm – gray
Gear rack

1322
\$5.50



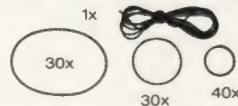
O-ring (tire) 20.2mm x
3.5mm – black
Pulley wheel 24mm – gray
Steering wheel – gray

1323
\$3.60



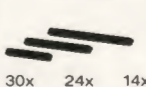
Spoked hub
Tire – black
Tractor tire

1324
\$4.50



Rubber band, small – black
Rubber band, medium – black
Rubber band, large – black
String – black

1325
\$3.60



Cross axle, 4-studs long –
Cross axle, 6-studs long –
Cross axle, 8-studs long –
black

1326
\$3.25



Cross axle, 10-studs long –
black
Cross axle, 12-studs long –
black

1327
\$2.20



Plate 1x3 studs – red
Plate 1x3 studs – black
Plate 1x4 studs – red
Plate 1x4 studs – black

1328
\$2.20



Plate 1x6 studs – red
Plate 1x6 studs – black
Plate 1x8 studs – red
Plate 1x8 studs – black

1329
\$2.20



Plate 2x3 studs – black
Plate 2x4 studs – black (with
holes)
Plate 2x4 studs – red (with
holes)

1330
\$3.25



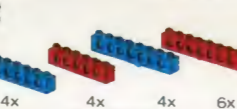
Plate 2x6 studs – red
Plate 2x8 studs – red (with
holes)
Plate 2x8 studs – black (with
holes)

1331
\$5.50



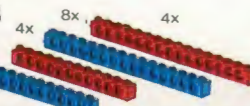
Brick 1x2 studs – blue
Brick 1x2 studs – red
Brick 1x4 studs – blue
Brick 1x4 studs – red

1332
\$3.25



Brick 1x6 studs – blue
Brick 1x6 studs – red
Brick 1x8 studs – blue
Brick 1x8 studs – red

1333
\$5.50



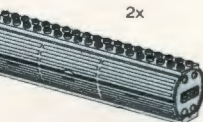
Brick 1x12 studs – blue
Brick 1x12 studs – red
Brick 1x16 studs – blue
Brick 1x16 studs – red

1334
\$21.00



Technic Motor 4.5 volts

1335
\$8.20



Battery box

1336
\$4.50



Pole reverser switch for
battery box

1337
\$7.25



Connecting lead

1338
\$7.25



Angle plate 2x2 studs – blue
Swivel plate 1x2 studs – blue
Swivel bearing 1x2 studs –
blue
Turntable – blue/gray

1339
\$4.50



Universal joint – gray
Piston head
Plate 2x2 studs round – red

1340
\$3.60



Brick 2x4 studs – red
Brick 2x4 studs – blue
Weight element (6x2x2)
studs – red

Spare Parts

1341
\$3.60
Building plate 8x16—green
3x

1342
\$10.90
Control panel
Flat tile 2x2 studs—red
Flat tile 2x2 studs—blue
Flat tile 2x2 studs—white
1x

1343
\$49.00
Optosensor
Counting disk
2x
2x

1344
\$7.25
Light brick 2x2 studs—4.5 volts
Transparent brick 1x2 studs—red yellow green
2x
2x

1345
\$4.50
Pinion—gray
Connector peg with stud—gray
Nut—gray
Connector peg with cross axle—gray
Connector peg with friction—black
Cross axle, 2 studs long—black
Cross axle, 3 studs long—black
Cross axle with thread, 4 studs long—black
4x
10x
6x
6x
10x
4x
12x
10x

1346
\$15.00
Touch sensor
2x

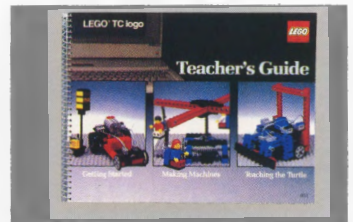
1347
\$13.50
Plug holder element
Spiral—black
3 m connecting cable
Flat tile 1x2 (5 different colors)
10 cm cable—gray
2x
12x
4x
2x
2x

1348
\$4.25
Building plate 24x24—gray
3x

5244
\$2.89
Broad chain link
54x



957
\$5.60 LEGO® TC logo
Reference Guide Pack



953
\$12.50 LEGO® TC logo
Teacher's Guide



954
\$22.25 LEGO® TC logo
Student Guide Pack

SPECIFICATIONS

The 4.5 volt DC motor is actually a 4.0 volt motor, but because it works well on a 4.5 volt power supply, it is referred to as 4.5 volt. The motor uses a current of approximately 1/10 amps without a load, and runs at approximately 6,000 r.p.m. When it stalls the motor uses approximately 1 amp.

The LEGO® Optosensor is specially developed for use with the LEGO Interface A. The infrared transmitter and receiver embedded in the optosensor functions as a digital sensor; it measures changes between

dark and light. When plugged into Interface A the optosensor has many applications. It can count revolutions by means of the black/white LEGO counting wheel. It can be placed in front of a LEGO light brick and can respond if the light beam is broken. The optosensor is built into a 2x6 stud LEGO brick.

The LEGO touch sensor is also specially developed for use with LEGO Interface A. The touch sensor consists of a touch sensor brick and a small axle. The axle acts as a pushbutton. If

something is pressing the button, the sensor reports "true." If nothing presses the button, it reports "false".

The LEGO Interface A connects to a special LEGO slot card for Apple II® and Apple IIGS™ computers. A transformer is included in the set. The interface box and computer are fully protected against incorrectly connected motors or sensors. The stop button on the interface box cuts off power to all output sockets. The interface box also withstands normal wear and tear from handling and dust.

CARE AND MAINTENANCE

The use of any lubricants should be avoided as they reduce the clutch power when assembling bricks.

Electrical and electronic components MUST NOT be washed. Standard components can be washed in lukewarm water.

All LEGO products are subject to strict quality controls which comply with all national and international safety requirements.

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LEGO® and the LEGO Logo® are registered trademarks of INTERLEGO A.G.
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PAID
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Sarah McDonald
The LEGO Educational Department
P.O. Box 39
Enfield, CT 06082
(203) 749-2291
(800) 527-8339 (Incl. CT)

Please route this brochure to ALL teachers of Computer Studies, Science, Math and Technology in your school. Thank you.

Teacher's Name	Room Number	Check Off
_____	_____	<input type="checkbox"/>
_____	_____	<input type="checkbox"/>
_____	_____	<input type="checkbox"/>
_____	_____	<input type="checkbox"/>
_____	_____	<input type="checkbox"/>

NSSEA
NATIONAL SCHOOL SUPPLY
& EQUIPMENT ASSOCIATION



record of them. However, if they are dribbled to a file on disk, it is possible to edit the poems later.

```
DRIBBLE "POETRY.TXT
REPEAT 25 [POEM]
NODRIBBLE
```

The favorite poems of the class can be saved and the remaining ones deleted. The Logo editor can be used to add titles and comments, and possibly alter a word in a poem that is almost, but not quite, perfect.

Data collected with external sensors (such as those in the Broderbund Science Toolkit) can also be saved to a file as they are accumulated. A Logo data logger makes it possible to record temperatures throughout the weekend and save them to disk. Data from light sensors and motion sensors can also be saved in a file for later analysis and graphing. We are currently working with a fifth grade science class which will use Logo in this way. After the data has been saved to a file, the class will use a telecommunications program to send it to another class. In this way a class in Virginia will be able to share data with a class in Alaska.

Summary

Almost all serious computing languages have file handling capabilities. Early versions of Logo for microcomputers did not have this capability, perhaps because there was not enough room in limited memory available to support it. In a sense, provision of file handling facilities in more modern versions represents a coming of age for Logo.

In some cases, teachers have been slow to take advantage of this capability. Traditions involving use of files have been lacking in the Logo culture, in part because file facilities were not available in the first microcomputer versions of Logo. The perception that file handling is an advanced feature of Logo and therefore is difficult has tended to discourage the extensive use of Logo files. In reality, use of a Logo file is no more difficult than sending information to the printer. In one case the information is written to the printer,

and in the other case it is written to the disk.

Another mistaken belief worth reconsidering is the idea that files have a place in the computer science or "computer literacy" class, but not in everyday use by other teachers. In fact, files can be useful for recording the keystrokes of first graders, for recording poems generated in third-grade English classes, for storing data from fifth-grade science experiments, and for many other applications. A Logo file can truly be regarded as a teaching tool for Logophiles. ▲

[Glen Bull is a professor in the University of Virginia's Curry School of Education and teaches Logo courses at both the graduate and undergraduate level. His CompuServe number is 72477,1637. Gina Bull combines an undergraduate degree in History of Art with a graduate degree in Computer Science. She is a programmer analyst for the University of Virginia Department of Computer Science. By day she works in a Unix environment; by night, in a Logo environment.]

Great Lakes/East Coast Logo Conference

Cleveland, Ohio
May 5-7, 1988

Educational Computer
Consortium of Ohio (ECCO)

with Cleveland State University, University of
Virginia Curry School of Education, John
Carroll University and Kent State University.

Three days of preconference workshops, panels and break-out sessions. Join Mike Battista, Alison Birch, Sharon Burrowes, Doug Clements, Brian Harvey, Tom Lough, Steve Ocko, Seymour Papert, Brian Silverman, Michael Tempel, Dan Watt, Molly Watt, Sylvia Weir, and many more.

See center of the November *Logo Exchange* for registration or contact ECCO, 1123 S.O.M. Center Road, Mayfield Heights, Ohio 44124; ph. 216/461-0800.

Logo Ideas

Logo and Aesthetics

Eadie Adamson

This summer, in a respite from teaching, I took a course entitled "Aesthetics and Education," taught by Professor Maxine Greene at Teachers' College, Columbia University. One of the primary ideas stressed in this course was that aesthetic values need to be included in our educational system, especially in light of the increasingly technological and product-oriented educational reports which often fail to give consideration to the importance of feeling, imagination, and creativity in the education of a whole person. We were challenged, as we read and talked about these complex philosophical ideas, to find ways in which the aesthetic ideas might be incorporated in our own teaching situations. To my delight, as we read selections from books and articles on aesthetics and discussed them in relation to art, drama, dance, and literature, I began to see that there was much to which a Logo teacher could relate. I began to feel fortunate to be teaching in a discipline, computer science, in which the aesthetic might be so easily, almost seamlessly, incorporated into the learning experience. What follows are my reactions to one essay which seemed especially relevant for Logophiles such as myself.

In an essay entitled "Education in the Arts," Leslie Perry talks about the necessity for the art-making situation in education (1978, pp. 108-135). His ideas seem particularly close to the philosophy behind Logo. Perry stresses the importance of the fine arts as an area for attempting to guide pupils to do things "for their own sake," a concept directly related to what I see as the Logo approach to learning. There is the necessity of involvement or motive in

order for a student to become actively engaged in working with Logo, posing his own problems, seeking his own solutions independently or with some help from teacher or colleagues. In a project-oriented approach to Logo, unless ground rules are set so tightly that no deviation and limited imaginative variation is possible, the student is to a large extent directing his own learning, motivated by the desire to program something in which he has a direct investment.

The "adventurous nature of the situation" is even more critical than motivation. When the problem is completely open, when, that is to say, we do not even know what to take to the solution of it, then (reliving a now forgotten childhood), we struggle on our own midden, hazarding a solution and learning from the failure of the hazard we made. (p. 120)

This, although Perry is speaking of the fine arts, encapsulates what a good Logo environment offers the student. Students working with Logo realize quickly that there is more than one way to accomplish a given task (even something as simple as drawing a square on the screen), that there is no single "right" answer, although, as programming knowledge builds, one solution may prove to be more efficient and elegant than others. The proliferation of standard solutions in much of our curriculum deadens this sense of adventure, limiting the creative impulse as the student learns to look for the correct rather than the creative answer. This world

of standard solutions is, as Perry says, clearly frustrating to many and "adventure seeks many alleviations in which the old situation of individual initiative is reasserted." A Logo environment can offer a student this sense of adventure and initiative. Seymour Papert, the developer of Logo, has described this as "learning... fueled by being rooted in desire: You learn what you have to learn through doing what you want to do" (April 1986, p.39). Papert has observed elsewhere that Logo's "Turtle Graphics has helped many children bridge the arts-science gap as they found that mathematical ideas could serve their aesthetic goals on the computer screen" (Autumn 1986, p.4). With the new LogoWriter, Logo's expanded capacity, incorporating text and graphics as well as sound and motion, encourages aesthetic approaches to writing, the learning of mathematics, and to programming.

"Adventure is not a luxury, it arises from the necessity of affirming oneself by trying out one's powers at stretch and overcoming difficulties" (Perry, 1973, p. 121). I like to think that working with Logo encourages this sense of adventure. I encourage my students to solve their own problems, offering help when the situation seems to be too discouraging, but otherwise trying to refrain from imposing my solutions upon their potential ones. It is important for a student to be able to strike out on his own in search of a solution, but it is equally important for the same student to know how to reach out and make use of the resources around him. Directing a student with a problem to seek assistance from someone who has found some creative solution and therefore become an "expert" at whatever it is gradually establishes an assurance of the student's own powers. "The knowledge of one's self, the increase of the assurance of one's sense of identity, involves experiencing the zest of complete reliance on one's powers" (ibid). Recognizing and sharing the creative solutions students bring to a specific problem is yet another way of affirming their own abilities.

Perry speaks of "the enterprise of a new exploration" in each work of art. This applies as well to working with Logo. We set ourselves a new

problem which requires new solutions or creative reforming of previous solutions. We set off, not knowing precisely how or where we will land. This element of adventure contains new opportunities to discover our own powers. We are aware of our old solutions, perhaps, but as we turn to new problems we find new solutions, new variations, and, perhaps, more new problems. The capacity for new adventure, which Perry says is essential to education, is central in the Logo experience.

Recent studies in imagination, says Perry, suggest that in one sense imagination is a variety of cognition. Perry talks of imagination as being of different kinds. Supposition leading to resolution of intellectual inquiries is the kind of imagination which bears most directly on the Logo experience. We have an idea, we wonder what will happen if we do something, we try it out. Sometimes we find "bugs" which end up in our imaginative incorporation of them into our project, a serendipitous result which enhances the creative process. What in a painting would be a mistaken brushstroke that takes the work of art off in a new direction is, in programming, that "bug" which suddenly brings forth new revelations of the possible to those imaginative enough to grasp it rather than restructure it because it is not "correct." Using our imagination, we not only generate change, we generate learning.

Perry says that the "fine arts center round a *situation*, not an account in terms of factual knowledge, and this complicates syllabus drafting" (ibid, p. 119). The problem is the same with writing a syllabus for a Logo class, since it is the situation, the particular projects that students create and the problems which they must solve in the creation of the projects, which result in what is learned. For writing a syllabus, this is difficult since Logo students work in a shifting world. "Currency of present achievement" is what is important. The only honest syllabus I can write is one written after the fact, and even it cannot be truly assumed to apply to the next occasion of teaching that class level. This is not to say that nothing is learned, or even that we begin with no idea of what we are going to do. It means rather, that our horizons are

unlimited as we give full rein to the imagination in a programming environment. The best learning occurs when a student has a real investment in what he sets out to do. For this reason, a project-oriented approach is used which encourages that sense of exploration and adventure and use of imagination applied to something the student is truly committed to working out. The learning attached to the project then becomes an integral part of the creative exploration of ideas, of the testing out of the "what-ifs" and application of the "how-to's" which may be supplied by the teacher to move the student along. Intuitive knowledge is gradually transformed into certain knowledge as things in a program begin to work satisfactorily. Confidence in a student's own ability is confirmed and strengthened by tackling a problem in this adventurous manner, especially as solutions or near-solutions are attained.

Perhaps the best thing we, as Logo teachers, can do for students is to set them off with this spirit of adventure and imaginative creativity. If we can empower the student by giving him this confidence in himself, we will have made a wonderful contribution to his education. If we can also imbue the student with the willingness to bring his imagination and creativity to bear in his work, we will not change his world entirely, but we may well add a wonderful new dimension which will have its effects upon all that the student does. We will not have neglected the intellectual, cognitive side of education if we approach our teaching in this manner; we will instead have enhanced it.

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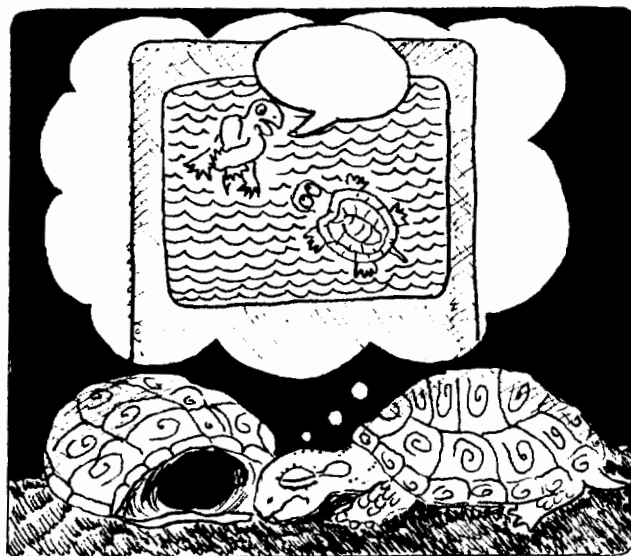
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The Adventures of Jacques and Elsie

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Linda Sherman is a freelance author and artist living in Shipman, VA., with her husband and two-year old son.

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Testudinal Testimony

by Douglas H. Clements

Getting into Shape: Logo and Geometry

In previous columns in the *Logo Exchange*, I have discussed the idea that Logo-based instruction can promote the learning of geometric ideas. Teachers and students in one study agreed (Carmichael, Burnett, Higginson, Moore, & Pollard, 1985). According to their teachers, elementary grade students became familiar with shapes, not only as things to name, but also as objects that can be modified, combined, and recreated repeatedly with different dimensions, positions, and rotations. They successfully explored relative size, congruence, similarity, symmetry, and tiling. Junior-level students "easily understood" flips, slides, and turns. The students themselves, when asked if working with Logo had helped them learn other things more easily, most often referred to having gained a better understanding of angles and degrees.

Bent Out of Shape: Limited Logo Learning

We cannot assume, however, that such benefits will occur in all cases. In earlier columns, I discussed the fact that Logo appeared to enrich students' ideas about angles and turns. In contrast, one study illustrates how even the "best laid plans" can fail to achieve such enrichment (Hoyles and Sutherland, 1986). This long-term Logo project was not designed specifically to investigate student's conceptions of turn and angle. Therefore, there were no on-going assessments or interventions on this topic. The researchers did wish to monitor the effects of collaborative learning, so all students worked in pairs. They found that coopera-

tion between students was indeed helpful. In the absence of teacher intervention, however, the nature of the collaboration between two girls, Janet and Sally, actually *impeded* the development of one girl's understanding of the concept of rotation. Only when the collaboration broke down did Janet make any progress. What happened?

In a way, the story begins at the end, when Janet was interviewed individually at the conclusion of the project. One task involved debugging a procedure that was to draw an "M." Janet confused left and right turns, measures of internal and external angles, and the concepts of orientation and turn. This surprised the researchers and prompted them to analyze Janet and Sally's work over the preceding three years, looking specifically at the notion of turn. They found that the girls only used turns of 45, 60, or 90. Janet's suggestions for inputs to RIGHT and LEFT commands were restricted to this set. So, the pair never turned the turtle through an obtuse angle using one command only. If they needed such a turn, they would combine their "standard set" of turns. That is, for a 135° turn they would turn 90, then 45, and only later tidy this up to 135 when recording their procedure. For a 120° turn, they used inputs of 60.

There were two reasons for this behavior. First, Janet and Sally preferred projects with loosely defined abstract goals. They would build simple procedures and then construct a superprocedure during experimental "hands on" activity. This required proceduralization but not specific attention to turtle turns. Second, they agreed on division of labor in which Janet controlled the experimental

activity and keyboard while Sally made decisions about the turtle turns! Throughout, Janet failed to connect her ideas (frames, schemas) for "arithmetic," "turtle," and "angle." She tidied up inputs but never reflected on the implications of the result in terms of the total turn. She calculated the angles required but only suggested turtle turns of 45, 60, or 90 (which were then amended by Sally). For example, when drawing a hexagon, she divided 360 by 60, got 60, and then suggested a turn of 45°! Often, she expressed what she wanted to do in general terms but never worked out the local details:

Janet: We have to make the angles so it will go like that and like that. How do we do that?

Sally: LEFT 30.

Finally, Janet always opted for her "standard" set of inputs without analysis of the geometry of the figure and without using estimation skills:

Janet: Shall I do 45?

Sally: No, it will be something like 50.

Janet: No, let's just use 60—it will probably go down that line anyway, won't it?

These results suggest that students may not perceive inputs to RIGHT and LEFT as rotations in circumstances where the nature of these inputs is determined by the context. That is, they may use rotation without reflecting on what turn has been made and without synthesizing what they are doing with their ideas about angle in other contexts. In such situations, students determine inputs to RIGHT and LEFT commands and add and subtract them without necessarily relating the resulting number to the total amount of turn. In fact, they may be adding "numbers" or "actions" but not amounts of turn! They will continue to be confused about turtle turns without teacher guidance. What shape should this guidance take?

Shaping Logo Experiences

We know that word processors alone often do little to improve students' composition abilities.

Embedded within a writing process framework, however, they can serve as significant tools for revising and editing. Similarly, Logo takes shape as a tool for geometric explorations when it is embedded in a framework. Such a framework should provide guidance regarding the goals and methods of instruction. For example, the van Hiele theory described in previous *Logo Exchange* columns suggests that one goal of geometry instruction should be increasing students' knowledge of the properties of shapes. In addition, it suggests that teachers must strive to help students become explicitly aware of and connect all aspects of geometric knowledge. Several studies have used frameworks consistent with these suggestions.

Lehrer and Smith (1986) believed that appropriate Logo experience could help make students more aware of geometric properties and relationships. For example, a student at level 0 in the van Hiele hierarchy may attend only to a gross visualization of a shape, possibly considering any four-sided shape a square. A student at level 1 might recognize that squares all have four equal sides and that the angles in a square are equal, yet not relate these pieces of information. In Logo, however, regular polygons are constructed through specific relationships between the number of sides and the exterior angle. Thus, both properties of shapes and relationships among those properties are embedded in Logo procedures.

Importantly, the researchers also believed that students need assistance in making such connections. To test their ideas, they taught Logo to two groups of students. Only one, however, used the "teacher-mediated approach" that included frequent opportunities for and guidance of practice. In this approach, teachers gave assistance according to the progress and capabilities of each student (i.e., "scaffolding"). They attempted to forge links between Logo learning and other knowledge the student might have; for instance, introducing Logo constructs through analogies.

On the posttest, students were asked questions designed to measure the extent to which Logo experiences enhanced their appreciation of either

the properties of figures or the relationships between these properties. Did the students integrate geometric knowledge in Logo and non-Logo contexts? Interviews revealed that most—but definitely not all—students recognized the relationship between components of a Logo procedure and properties of the figure it produced. Asked to compare and contrast two polygons, half of the students spontaneously demonstrated an integrated understanding of relations between Logo-based knowledge and the properties of polygons. For example, “The square has more sides so you don’t have to turn it as much...so the turtle turns less for a square and it looks like this [gestures to show a 90° angle], not this [120° angle].” Although most of these responses were classified as reflecting “surface” rather than “deep” structures, the concrete representations of procedures apparently enabled students to compare geometric figures at a higher level than is typical of students of this age. Only 25% of the students’ responses did not use Logo concepts. Thus, students used Logo to think about the properties of polygons.

Another Study of Shapes

In a similar study, third graders worked with Logo for 78 sessions (Clements & Battista, in press). These sessions emphasized multiple ways to represent geometric ideas (e.g., dramatizations, drawing, procedures), explicit discussion of what was being learned, and scaffolding. At the end of this experience, the students were asked various questions about shapes. They performed significantly better than the control students. But their answers were more revealing than their scores. When asked “What is a shape?” responses from students in both groups were influenced by a wide variety school and non-school experiences. For example, they referred to:

objects -- “They’re things, big or small”

instances of shapes -- “Like a triangle or square”

forms -- “Different kinds of forms....Their shape can not be changed.”

composition -- “Things that you can put together to make other things.”

The control students tended to say “I don’t know” or to name instances of shapes. In addition, they were more likely to refer to notions related to closed paths or area (e.g., “Things with space in between them and they close”). This may reflect a concern that to have substance in reality; a shape could not be open.

In comparison, the Logo group was more likely to give definitions concerned with the concept of form. In addition, more Logo students included curved lines and angles in their definitions, indicating a greater awareness of the components of shapes. This finding is supported by responses to the next item.

Students were asked to sort a group of quadrilaterals as many different ways as they could. Logo students appeared more likely to construct mathematically acceptable categories (e.g., control students more frequently separately squares because one group was “tilted” or larger). Logo students were more likely to discriminate on the basis of properties (“These all have right angles”), and to sort dichotomously (convex vs. nonconvex). The tendency to perceive nonconvex quadrilaterals as a mutated triangles (e.g., “triangles with notches,” “would have been a triangle if someone hadn’t pushed them,” “triangles with one side bent”), however, appeared with similar frequency in the groups.

In Summary

In summary, Logo’s potential to develop geometric ideas will be fulfilled to the extent that teachers help shape their students’ Logo experiences. Students do not automatically transfer knowledge gained in one situation to another. Repetition is not sufficient. Questions that cause students to reflect on what they were doing are instrumental. One researcher recorded the following: “Ingrid rotated a rectangle [one degree at a time] 540 times and produced a circle that was filled in. When I asked her if it had gone over part of the circle again she said ‘yes,’ thought for a minute and

then said, 'I bet 360 degrees would do it. I'm going to try it'" (Carmichael et al., 1985, p. 316). Such reflection engenders both cognitive and affective involvement with mathematics. One student stated, "I've thought about circles in ways I've never considered before" (p. 285).

The Shape of Things To Come

Future columns will consider other mathematical topics, such as algebra, number concepts, fractions, and problem solving. We'll also discuss specific groups, including special needs students and teachers, as well as specific programming topics, such as misconceptions, strategies, and teaching techniques. Write with your reactions and ideas...help this column take shape!

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IntLXual Challenges

by Robs Muir

Logo Challenge—Weighty Discourse on Gravity

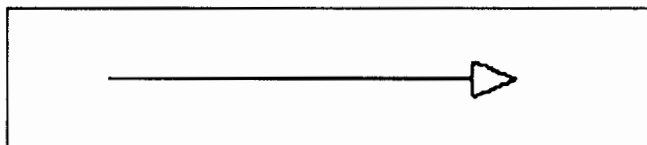
I've done so much with so little for so long that I can now do anything with nothing.

—Seen on a California bumper sticker

The plain-vanilla turtle is a plodding beast. It moves in fits and starts at the whim of our commands. FORWARD 100 RIGHT 90—first here, then there. With the exception of dynaturtle environments, Logophiles seldom experience turtle motion as something other than mere kinematics. Let's explore the world of turtle dynamics; the whys of motion, instead of the hows.

A simple dynamic motion can be created through the following procedure.

```
TO MOVE
FORWARD 5
MOVE
END
```



While the picture does not convey a lot of information, the MOVE procedure is very descriptive. MOVE is a simple recursive, oft repeated in manuals as TO DRIVE, etc. It is also the infinite version of REPEAT 100 [FORWARD 5]. Although MOVE *causes* dynamic turtle behaviors, it is a *static* process. With variables we can gain a modi-

cum of control, thus creating a *dynamic* procedure.

```
TO MOVE :DIST
FORWARD :DIST
MOVE :DIST
END
```

MOVE can now accept "speeds" of any value, e.g., MOVE 1.2 or MOVE 47. We now have the tools to demonstrate the two forms of uniform motion summarized by the first of Newton's three Laws of Motion, namely, rest and uniform velocity. What are these tools...? How about CS and MOVE 17, for example.

Sir Isaac was also concerned with bodies that moved with non-uniform velocities. His Second Law of Motion dealt specifically with accelerated motion. To understand the distinction between uniform velocity and uniform acceleration, let's modify MOVE to include some representation of position over time. A MARKing procedure might be instructive.

```
TO MARK
PD
FORWARD 1
BACK 1
PU
END
```

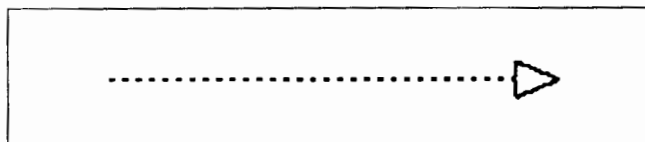
We may now rewrite MOVE to behave markedly different.


```

TO MOVE :DIST
PU
FORWARD :DIST
MARK
MOVE :DIST
END

```

Here is a sample of MOVE 5.



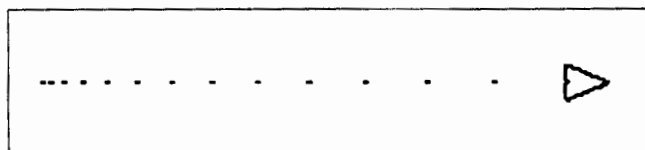
As you can see, this new MOVE procedure shows us that we have a regularity of motion which is the equivalent of FD 5 FD 5 FD 5 FD 5 FD 5... This is formally called uniform velocity—equal displacements over equal intervals of time.

Newton also identified another form of resulting from a constant, but unbalanced force. This is referred to as uniform acceleration. Accelerating turtles can be built with a slight modification to our MOVE procedure—notice the change in the last line.

```

TO MOVE :DIST :ACCEL
PU
FORWARD :DIST
MARK
MOVE (:DIST + :ACCEL) :ACCEL
END

```



As you can see, our new MOVE marks intervals not of equal distance but instead with constantly *increasing* intervals—the result of adding a constant, :accel, at each successive recursive call. In effect, our turtle is embarking on the series, FD 1 FD 3 FD 5 FD 7 FD 11 FD 13...

Newton's First Law says that an object in motion will continue in motion in a rectilinear

(straight-line) path unless there is an unbalanced force acting on it. When you kick a ball, fire a bullet, or roll an marble, horizontally, the only force of significance is gravity—this causes the object to accelerate downward, but does not affect its horizontal motion.

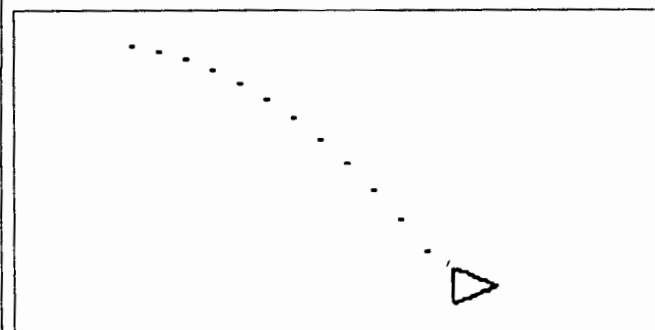
To simulate two dimensional motions with a turtle requires that we include both a horizontal and a vertical component combined in a single package. The horizontal motion is a constant velocity (our first MOVE procedure) while the vertical motion is constantly accelerating. One approach might look like this.

```

TO FALL :HORIZ :VERT :ACCEL
PU
FORWARD :HORIZ
RIGHT 90
FORWARD :VERT
LEFT 90
MARK
FALL :HORIZ (:VERT + :ACCEL) :ACCEL
END

```

Here is a FALL using 10, 1, and 1 respectively as inputs.



The turtle has moved with a uniform velocity horizontally (:horiz = 10), while the vertical component has been accelerating. That is, each displacement downward has increased one additional unit over the previous interval (each new :vert equals (:vert + :accel)). Notice the parabola—a turtle jumping off a cliff might follow such a curve.

Here is the picture of several FALLs from the same

starting position.

FALL 2.5 1 1

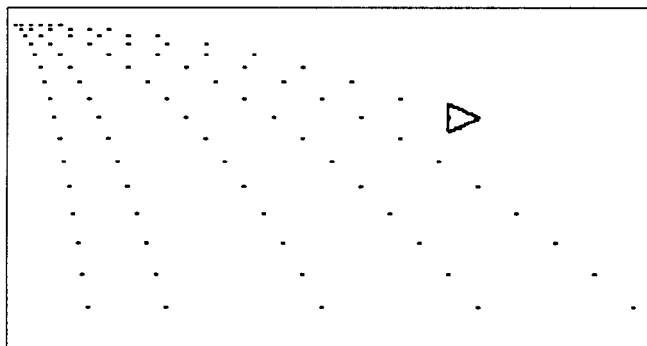
FALL 5 1 1

FALL 10 1 1

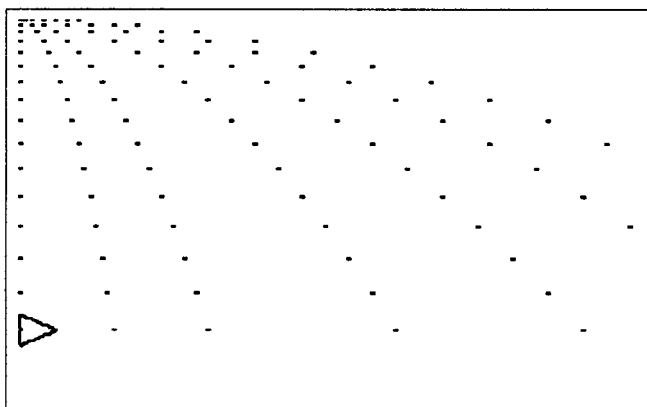
FALL 15 1 1

FALL 20 1 1

FALL 25 1 1



Observe what would happen if we added a FALL with no horizontal velocity (FALL 0 1 1).



With a little close analysis, you might notice that the time required to fall straight down a given distance is exactly equal to the time required to fall forward with any velocity. Regardless of the turtle's forward velocity, the time required to hit the ground is the same (as long as the vertical acceleration remains constant).

Here at sea level, our acceleration downward (due to gravity) is about 9.8 m/sec^2 , or 32 ft/sec^2 . This little simulation implies that a cannonball fired horizontally from a parapet will hit the ground at the same time that a dropped cannonball will fall, regardless of the muzzle speed of the projectile! Indeed, Galileo demonstrated precisely this in

1638.

A challenge... If gravity accelerates a body downward, and if gravity is responsible for keeping a satellite in orbit around the Earth, how can you simulate the orbit of such a satellite using a turtle and Logo. Can you build a FALL for circular motions? How?

For additional Logo ideas along this general theme, let me suggest Tom Lough's article, "ParaboLogo" (*National Logo Exchange*, April, 1984), or the excellent but rarely obtained book, *Logo Physics*, by James P. Hurley (Holt Rinehart and Winston, 1985, ISBN 0-03-002913-9). ▲

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LogoPALS

by Barbara Randolph

The holidays of December will soon be here followed closely by the New Year! All over the world people will be celebrating its arrival. Can you guess what these greetings say?

TO FRENCH
PRINT [UNE TRES BONNE NOUVELLE AN-
NEE]
END

TO RUSSIAN
PRINT [S NOVYM GODOM]
END

TO CHINESE
PRINT [HSIN NIEN KUAI LE]
END

You're right - each one says "Happy New Year!"

Here are some new LogoPals wishing to have their "holiday stockings" filled with a letter from a new Logo friend:

Suzanne Eveillard (New York, NY, USA): Comment ca va? I live in New York, but I am from France, where I lived three years before I moved. Every summer I visit there for a month. Please send me a Logo penpal.

Wing Yee Sang (Long Island City, NY, USA): I want a girl penpal from Europe. I am nine years old. My favorite sports are Newcomb and Kickball.

Daniela Shafir (New York, NY, USA): My best sports are gymnastics, horseback riding and swimming. I also like art. I would like to write to a girl from Chile. I was born there.

Brook LeFlore (New York, NY, USA): I am 10. I live in New York City. I love to shop. I also like to swim and ice skate. I would like a penpal from California.

Amanda Graupner (New York, NY, USA): Let me explain where I come from. My parents both come from Australia. My sister and I were born in London. We moved to New York when I was five. Now I am 10. Please send me a penpal from Sydney.

Nicole Bezjon (New York, NY, USA): I am a nine year

old girl. My hobbies are learning about wildcats and history. I would like a boy penpal from Florida.

Emily Ready (New York, NY, USA): I like sports, reading and opera. I am 10 years old. I love to ski. When I grow up, I want to be a tennis player, an opera singer or a skier. I would like a boy penpal from Germany.

Helen Leon (New York, NY, USA): I am in the fifth grade, and I am 10 years old. My hobbies are baseball, soccer, basketball, lacrosse and skiing. I would like a girl penpal from Oklahoma.

Kate DeScherer (New York, NY, USA): I am 11 years old. I like riding horses and soccer, swimming and drawing. I have a Cocker Spaniel dog. I would like a girl penpal (my age) from Hollywood.

Valentina Aulisi (New York, NY, USA): Hi! I like water skiing, tennis and baseball. I have a cat, a parrot, and a parakeet. I would like a penpal from Italy.

We received these letters from Karen Tracy, a Logo teacher from the Hewitt School in New York City - and our newest "LogoPal Ambassador." Thanks, Karen!

Would your students like to become Logo penpals? Have them write a letter telling their age and grade, their hobbies and interests, and their favorite Logo activities. We can match them with these students or others we have already in our network.

Children in the U.S. need to send a self-addressed, stamped envelope. Those outside the U.S. should enclose international postal coupons (purchased at the post office) for a 1-ounce or 28-gram reply.

Write to:

LogoPals
c/o Barbara Randolph
1455 East 56th Street
Chicago, Illinois 60637
USA

Paix, Mir, Ping An, Peace!

[Barbara Randolph is a library and instructional media center teacher in the Chicago Public Schools.]

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Global News

by Dennis Harper

Once again this column is being sent from Helsinki, Finland where I am completing a four month stay at the Department of Teacher Education of Helsinki University. As I set up shop and visit schools throughout the world, it is always interesting to see the direction educational technology is taking. In a recent discussion with teacher educators from East Germany (DDR), it was found that that nation's efforts in computer education for the secondary schools centered around teaching mathematics students how to program in BASIC and FORTRAN with little thought given to Logo. Although educationally effective Logo environments are very rare, readers of the *Logo Exchange* are aware that some nations have reached higher stages of Logo usage.

This month's column looks at three countries at different stages of Logo development. Harry Pinxteren, the LX European editor, describes Logo activity in the Netherlands; a country which may have taken Logo to a higher level and to a greater proportion of its society than any other country on earth. LX's African editor, Fatima Seye Sylla, describes activity in Senegal, a country which has been experimenting with Logo for many years and is on the verge of implementing it in all the schools. Finally, Mia Korhonen of Finland writes about Logo activity in one school in her country. Logo in Finland is breaking through the BASIC barrier in a few schools and is just beginning to be taken seriously.

The Netherlands

In August, 1982 a summer school course was

conducted by the Dutch LOGO group at Nijmegen to propagate Logo as an introduction to AI. The culmination of five years' work was evident at the first full Logo conference in the Dutch speaking world held this past November 14 in Nijmegen. The conference was organized by the faculty of the Educational Science of the University of Nijmegen and the Logo Centrum Nederland, a division of the Nijmegen LOGOgroup.

The following long term Logo projects from Belgium, Germany and Holland highlighted the proceeding.

- E. de Corte and L. Verschaffel from the University of Leuven, Belgium, presented the first results of a longitudinal evaluation project on the issue of the development of children's planning skills using Logo. This project is subsidized by the Belgian National Science Foundation and covers a period of three years.

- R. Overtoom and H. Kunst from the University of Utrecht, the Netherlands, presented the first results of a longitudinal Logo evaluation project which is sponsored by the Foundation for Educational Research of the Netherlands. In this project a new version of Logo, developed by the LOGOGroup Nijmegen is used. This Logo features, among other things, a new Structure Editor which supports a visualization of the syntax and structure of Logo programs.

- E. Hoenkamp and M. Pagen from the university of Nijmegen presented the results of a two-year

project aimed at the development of special interfaces and Logo information prostheses to be used by children with mental and physical handicaps.

- J. Ringelberg of the LOGOgroup of Nijmegen presented the new LCN Logo for MS-DOS machines which will be used in a national program on the introduction of IT in secondary schools. LCN Logo is based on the specifications of SCHEME and features a lot of new extras like a "direct mode" editor which is based on the principle of WYSIWYG and which allows for automatic visualization of errors, editing based on the principle of cutting and pasting, inbuilt search and debug facilities and a full integration of direct editing and 3D graphics.

- G. Bakema discussed the problems and issues of using turtle geometry to introduce secondary school students to different concepts of geometry.

- H. Loethe from the Pädagogische Hochschule in Stuttgart, West Germany, discussed some principles of using Logo to introduce students to 3D graphics to simulate movements in space.

- P. Deasain and G. Honing from the School of Modern Art in Utrecht, Holland presented an integrated Logo music system, called LOCO, which is based on quite advanced programming concepts like combinators and can be used by children as their own Logo music composing tool.

Other contributors covered issues like using Logo with very young children while experiences with LogoWriter and other versions of the language were demonstrated at workshops.

All participants at the conference had active experience with using Logo in the schools as five years after the initial push for Logo, Logo has become a regular part of the curriculum in Dutch elementary education and there is a strong interest in longitudinal research on the issue of integrating Logo into the every day school class.

Secondary schools seem to be catching up with the primary schools as a new national program is being aimed at the introduction of IT at all levels of secondary education and it will bring Logo to the attention of a larger number of secondary school teachers as well. The main tenet of this program is that Logo will be used as a first affordable step into the world of AI. In February, 1987, the Dutch Ministry of Economic Affairs granted a 12 manyear project to the LOGOgroup Nijmegen to develop and complete such a system by the end of 1989.

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Senegal

A conference entitled "Pedagogical Applications of the Computer in Senegal" was held from October 12-15 in Dakar, Senegal West Africa. Thirteen Senegalese speakers were divided into the following three groups (listed with presentations):

- I. Computer Policy, Training and Education:
 - Orientation of Senegalese Computer Education Policy
 - The New School and the Computer
 - International Cooperation and Computer Development
 - Young Senegalese and the Computer Revolution: Philosophy and Role of the Senegalese Association of Microcomputer Clubs.
- II. Equipment, Maintenance and Software
 - Computer Training at the Ministry of Finance: Actors and Future Projects
 - Professional and Technical Training in

Senegal with the Computer

III. Training, School Management and Research

- Future Projects in Computers at the University of Dakar
- Computer Education of Technicians and Engineers in Senegal
- Education and Research on/with the Computer at the Technology Research Institute of the University of Dakar
- Analysis of Computer Education in Senegal: the Job Market and Pedagogical Strategies of Education
- Computer Management in Senegal: the Experience of the African Center of Management Studies
- School Management with a 64K Microcomputer
- Report on the Logo Project of Dakar: Positive Aspects and Difficulties in the Use of Computers in Education in Developing Countries

These talks were followed up by a series of seminars and workshops. Any reader interested in obtaining the French proceedings of the conference should write to the LX African editor.

Finland

In contrast with the above national agendas, Mia Korhonen describes a Finnish elementary school's Logo experiences.

Although the Herttoniemi Primary School began teaching BASIC at the start of the 1983/84 school year, the language was soon found to be extremely laborious and time-consuming for both students and teachers. The switch to Logo made it much easier for the children to carry out their own project ideas with the instructor remaining more in the background.

The youngest students are using the floor turtle to explore distances and linear relationships. They investigate how many "turtle steps" it takes for the turtle robot to travel off the edge of the paper or how large a number is required to turn the turtle completely around. Next, the children progress to

making the "screen turtle" move and draw on the monitor.

The children then move on to programming and are encouraged to pose problems for themselves and then solve them as well as their age and skill levels permit. Herttoniemi's experiences suggest, however, that planning and implementing Logo sessions according to solid Logo principles is far from easy.

At first, one has a tendency to design unnecessarily difficult assignments, and at Herttoniemi, at least, instructors tried to link Logo to just about every possible discipline. They eventually realized that it isn't worthwhile to force linkages between Logo and subjects to which it isn't naturally applicable. In other words, using Logo for drawing pictures of animals or landscapes doesn't make the exercise biology or art.

Some examples of Herttoniemi Primary School Computer Club Logo projects include the following:

- Second grade students listen to a story told by the instructor. The theme is a storybook castle, stimulating various fanciful images in the youngsters' minds. The ideas begin to germinate rapidly, and soon everything from powerful fortifications to fairy castles are "under construction." Some of the youngsters suffer from having chosen overly ambitious castle designs, but the computer castle builders seem to find even modest results rewarding. The next stage consists of printing the castles on a printer, then coloring them and cutting them out by hand and gluing them into their club scrapbooks. During the third stage the children use a word processing program to write stories or poems about their castles. The stories are printed and glued into the scrapbook next to the appropriate pictures.

The story doesn't end there. In the castle is a room containing a stained-glass window. Hidden in the window's design is a secret word. Each youngster selects his or her own secret word (e.g., fish, flower, etc.) and designs a window from which the others will have to guess the secret word. Some fourth grades develop the idea a step further and use

the theme to make their own simple computer game.

- Logo's modularity has proven to be a difficult notion for third graders to comprehend. To make it clearer, a "wonder machine" project was developed. First the youngsters make little subprograms (such as those for drawing geometric shapes). With no prior planning, they then proceed to build "wonder machines." Each machine is given its own name, of course, and stories are written about them.

- Having mastered some of Logo's list processing techniques, the children indicated they wanted to make a computer game. That sounded difficult, but a club instructor's job is precisely that: to come up with the simplest ways for youngsters to follow through on their ideas. A simple computer game was born in the following way: having completed their stained glass window with its secret word, the children added a question to their program (e.g., PRINT [What secret word is contained in the glass window?]) followed by a test of the user's response against the "correct" answer.

- Sixth graders have made, among other things, an adventure program using Logo. Because they wanted to make it a branching program, they got the idea of dividing their program into three parts (requiring three separate disks) and setting up their game on three computers located in various parts of the school. In this way they added to the program's feeling of adventure while trebling the available computer memory.

The most important part of creating the adventure game was that all students could participate. With respect to the end result, simple drawings created with Logo graphics were just as important as more complex technical programming contributions. Not all the ideas that were suggested could be used, nor did all the subprograms created fit into the final product, but briefly the idea of the adventure was the following:

The adventure begins in the computer lab when a player types the program's name (ADVENTURE) on the keyboard. An introductory text appears on the screen, explaining, among other things, who created the program. The actual game gets underway with a space flight during which a rocketship searches for a suitable star on which to land. When such a star is finally found, a constellation, containing the star appears on the screen. The program asks the player to identify the constellation, then tests the response and answers either "GOOD, YOU GAVE THE RIGHT ANSWER!" or "WRONG, THE CORRECT ANSWER IS SCORPIO." As a way of closing the first segment, the program advises the player: "YOU HAVE LANDED. SEARCH FOR THE COMPUTER CONTAINING YOUR NEXT ASSIGNMENT. (HINT: IT IS IN A ROOM WHERE YOU CAN PRICK YOUR FINGER WITH A NEEDLE.)" This clue directs the player to the home economics classroom. The game continues to room 224 on the opposite end of the school with a final picture announcing the end of the program. Programs such as these are also enhancing children's English skills.

Experience at the Herttoniemi School has shown that complex Logo assignments requiring patience and perseverance are not for every child. It is important to plan club activities in such a way that each youngster can carry them out according to his or her own skill and interest level. Assignments should be varied, and breaks are sometimes needed. Some children want to use commercially prepared programs during club sessions. There aren't many such programs which stimulate creative activity available in the Finnish language for club or classroom use, which is why Logo is so popular.

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