Appendix

Workshop 2 Lesson Materials

THE PHONE BILL

AT&T

DETAILED CHARGES

ACIS

For Questions Regarding AT&T Charges Call 1-800-222-0300.

330 75

NOV 4, 1996

CURRENT CHARGES

AT&T Invoice Charges For Period Ending OCT 27, 1996

Long Distance

No.	Date	Time	Place Called		Number	Code	Min	Amount
1	9-28	728P	COLUMBUS	OH	614 688-	N	1	.14
2	10-01	635P	COLUMBUS	OH	614 688-	E	16	2.64
3	10-06	306P	COLUMBUS	OH	614 688-	E	25	4.13
4	10-13	913P	COLUMBUS	OH	614 688-	E	1	.16
5	10-24	952P	COLUMBUS	OH	614 688-	E	4	.66

Total Itemized Calls ....

Calling Card Calls

No.	Date	Time	Place Called		Number	Code	Min	Amount
1	10-15	914P	YOUNGSTOWN	OH	330 757	EC	15	4.45
		FROM	COLUMBUS	OH	614 621			
6	9-28	805P	YOUNGSTOWN	OH	330 757-	NC	16	4.22
		FROM	COLUMBUS	OH	614 621-			
7	9-30	604P	YOUNGSTOWN	OH	330 757-	EC	5	2.05
		FROM	COLUMBUS	OH	614 621-			
8	10-01	522P	YOUNGSTOWN	OH	330 757-	EC	1	1.09
		FROM	COLUMBUS	OH	614 621-			
9	10-08	854P	YOUNGSTOWN	OH	330 757	EC	32	8.53
		FROM	COLUMBUS	OH	614 621-			
10	10-13	535P	YOUNGSTOWN	OH	330 757-	EC	1	1.09
		FROM	COLUMBUS	OH	614 621			
11	10-13	957P	YOUNGSTOWN	OH	330 757-	EC	26	7.09
		FROM	COLUMBUS	OH	614 621-			

Workshop 3 Lesson Materials

Right Hand/Left Hand Experiment

The purpose of this experiment is to explore the patterns associated between time and the number of letters one can print on paper. Students will determine the difference in speed between the right hand and left hand.

1. **Gathering Data**
   Follow the instructions given by your teacher. Create a table of values for each data set.

2. **Displaying the Data**
   Make a scatterplot that shows both sets of data on the same coordinate grid.

3. **Analyzing the Data**
   a. Draw a line of best fit for each set of data on your graph.

   b. Find an equation for the line of best fit for each set of data.

   c. Compare your right-hand and left-hand models. How are they alike and how are they different?

   d. Are you right-handed or left-handed? Now analyze the data for your preferred hand. Is the slope greater than or less than the slope of your non-preferred hand? What does the slope represent in this situation?

   e. Do the graphs ever intersect? If so, where? What does it mean when the graphs intersect? If the graphs do not intersect, what does this tell you?

Workshop 3 Lesson Materials, cont'd.

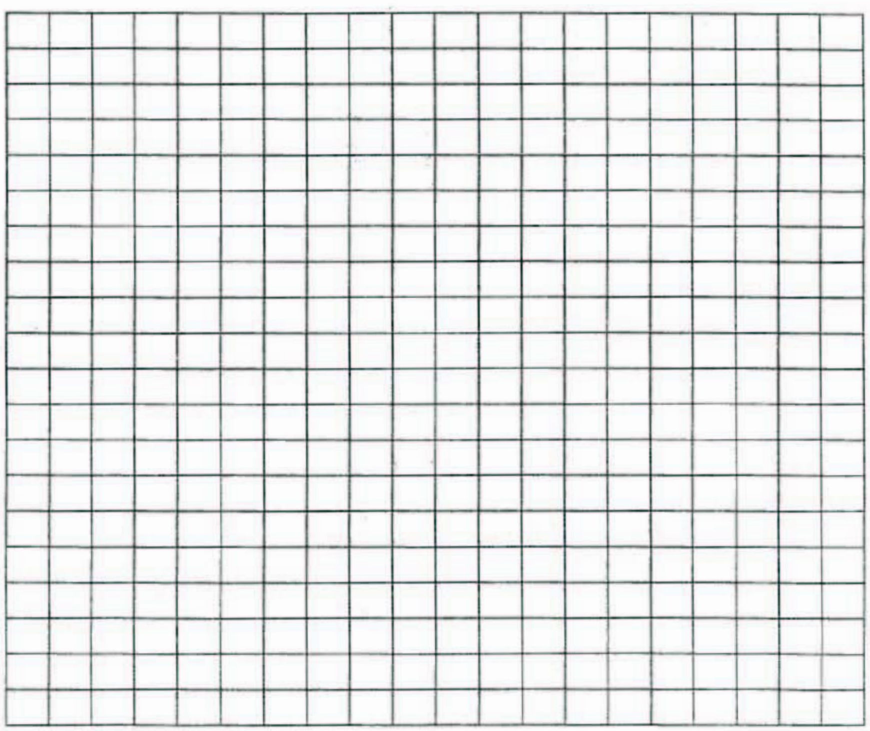
Displaying Data

Right-Hand Data

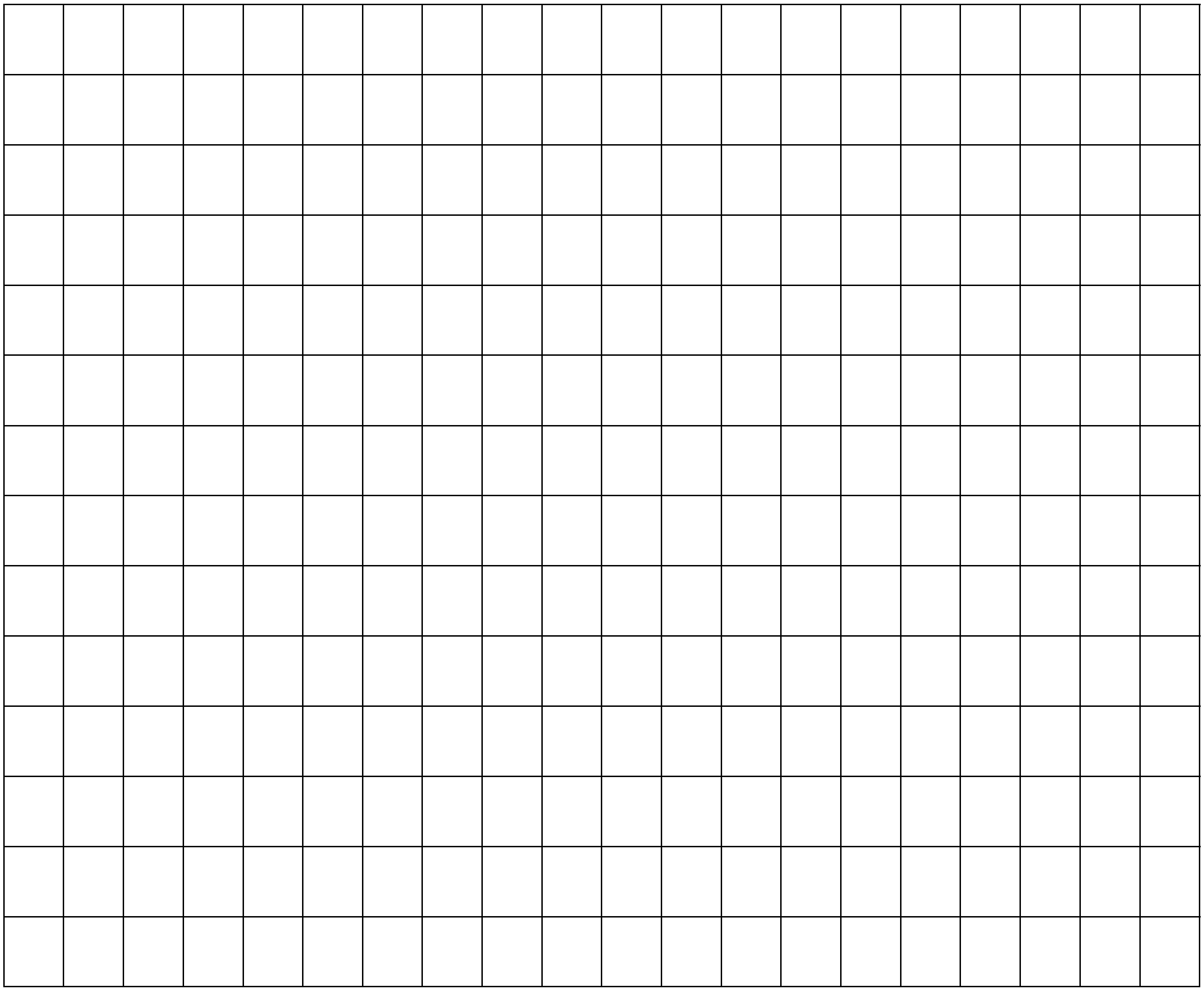
Time	0										
Number of letters	0										

Left-Hand Data

Time	0										
Number of letters	0										



Workshop 3 Lesson Materials, cont'd.



Homework 8 — Picturing Pictures

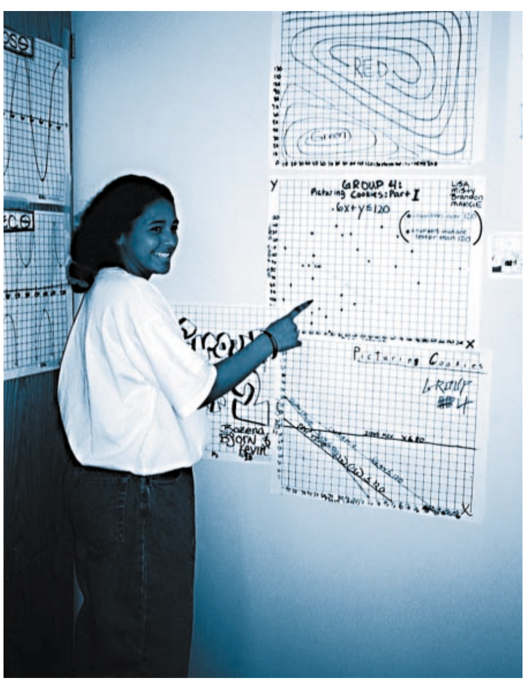
Hassan is an artist who specializes in geometric designs. He is trying to get ready for a street fair next month.

Hassan paints both watercolors and pastels. Each type of picture takes him about the same amount of time to paint. He figures he has time to make a total of at most 16 pictures.

The materials for each pastel will cost him $5 and the materials for each watercolor will cost him $15. He has $180 to spend on materials.

Hassan makes a profit of $40 on each pastel and a profit of $100 on each watercolor.

1. Use symbols to represent Hassan's constraints.
2. Make a graph that shows Hassan's feasible region; that is, the graph should show all the combinations of watercolors and pastels that satisfy his constraints.
3. For at least five points on your graph, find the profit that Hassan would make for that combination.



A student at West High School in Tracy, CA, explains a plot for **Picturing Cookies —Part 1.**

Workshop 6 Lesson Materials

Name: ___________________________________ Date: _______________ Period: ____
Team: ____

SKEETERS ARE OVERRUNNING THE WORLD

How does the size of the population change over the time? In this module, you use a simple model to shed light on some complicated issues.linear.avi,exp2.avi

Introduction

At last count, more than 5.4 billion people inhabited the Earth. If each of us laid head to toe, we would make a chain of humanity long enough to wrap around the equator 250 times.

How many people can live on Earth without destroying the environment? How many people can our planet successfully feed? Several organizations studying the ever-increasing human population are concerned with just these questions.

While foretelling the future is never a sure bet, you can gather information about the past and present, find any existing patterns, and use these patterns to make predictions.

Graph can be useful tools for determining patterns. For example, Figure 1 shows the world population since 1650.

(Power Point Presentation with the graphs and questions for discussion.)
world Pop. Slide show.ppt

EXPLORATION

Statistics like those shown in Figure 1, along with an appropriate mathematical model, allow researchers to make forecasts about population trends. For example, scientists at the United Nations predict a world population of at least 8.2 billion by the year 2020.

To help make predictions in real-world situations, researchers often use experiments known as **simulations.** The results of the simulations are gathered and analyzed. This data is then compared with known information abourt the actual population. If the result seems questionable, the simulation may be revised. This modeling process can be summarized by the following five steps:

1. creating a model
2. translating the model into mathematics
3. using the mathematics
4. relating the results to the real-world situation
5. revising the model

In the following exploration, you investigate this modeling process using a population of Skeeters.

a. Obtain a large, flat container with a lid, a sack of Skeeters, and several sheets of graph paper.

Name: ______________________________ Date: ______________ Period: ____
Team: ____

b. Before beginning the simulation, read Steps 1-7 below and predict how you think the number of Skeeters will change.

1. Place two Skeeters in your container. This is the initial population.
2. After closing the lid, shake the container.
3. Open the lid and count the number of Skeeters with the marked side up.
4. Skeeters reproduce asexually (by themselves). Reproduction is triggered when the marked side of a Skeeter is exposed to light. Add one Skeeter to the container for each mark counted.
5. Record the total number of Skeeters now in the container. This is the end of one "shake".

   The end of each shake represents the end of one time period. The number of Skeeters present at the end of a shake is the total population at that time. (Remember that at shake 0, the number of Skeeters was 2)
6. Design a method of recording and organizing your data.
7. Repeat Parts 2-5 for 10 shakes.

c. 1. Create a scatterplot to display the data you recorded. Represent the shake number on the x-axis. Select a scale for each axis that will allow you to make predictions for shake numbers through 20.
2. Describe any patterns you see in your data.

d. 1. Use the pattern described in Part c to predict the number of Skeeters after shake 20.
2. How large a box would be necessary to hold this population? Explain how you came to this conclusion.
3. Predict how many shakes it would take for the Skeeter population to reach 1000. Describe how you reached your prediction.

Discussion 2

a. Discuss any similarities or differences you observe between your scatterplot and those of your classmates.
b. How did the number of Skeeters in your population change during the exploration?
c. Consider your scatterplot as describing the change in the population of Skeeters over time. Use this idea to explain the shape of the graph.
d. What other types of living creatures might show the same pattern of population growth as the Skeeters?
e. What limitations might this simulation have in modeling a real-world population?

Workshop 6 Lesson Materials, cont'd.

Rallods in Rednow Land

Which is more money?

a. One billion rallods

b. The amount obtained by putting 1 rallod on one square of a chessboard, 2 rallods on the next square, 4 on the next, and so on, until all 64 squares are filled.

Solution: To find the total number of rallods on the chessboard, students must add $1 + 2 + 4 + 8 \ldots + 2^{63}$. The solution is $2^{64} - 1$, which is approximately equal to 1.84 ? 10^{19}. However, finding the total on all 64 squares is not necessary to answer the question, since the running total surpasses 1 billion by the 30th square.

Workshop 8 Lesson Materials

Name: ________________________________ Date: ______________ Period: ____
Team: ____

ACTIVITY 1

Within any population, there are differences in appearance and behavior due to genetics and environment. In this activity, you investigate some Skeeter populations with different growth characteristics.

Exploration
In this exploration, each color of Skeeter has its own growth characteristics and initial population. Table 1 shows a list of these characteristics for each color.

Table 1: Skeeter growth characteristics

Color	Growth Characteristics	Initial Population
Green	After every shake, for every green Skeeter with or without the mark showing, add 2 green Skeeters.	1 green
Yellow	After every shake, for every yellow Skeeter with or without the mark showing, add 1 yellow Skeeter.	1 yellow
Orange	After every shake always add 2 orange Skeeters	40 orange
Red	After every shake always add 20 red Skeeters	5 red
Purple	After every shake, for every purple Skeeter with a mark showing, add 1 purple Skeeter.	5 purple

a. Consider the information given in table 1.
  1. Predict the population of yellow Skeeters after shake 6.
  2. Predict the population of orange Skeeters after shake 6.
  3. After shake 6, which one will be larger?

b. Obtain a large, flat container with a lid, a sack of Skeeters of a chosen color, and a sheet of graph paper. Place the initial population of the chosen color (according to Table1) in the box.
c. Place the lid on the container and shake it.
d. At the end of each shake, use the growth characteristics from Table 1 to add the appropriate number of Skeeters of the chosen color.
e. Record the total number of Skeeters at the end of six consecutive shakes, on the provided table. (Record the initial population as the number at shake 0.)
f. By filling the Pattern and Process columns of the corresponding table, make a prediction of the population of Skeeters of the chosen color, at the end of shake 11, and for any number of shakes (n).
g. After 6 shakes, graph the data for the chosen Skeeter population on a rectangular coordinate system. (Label the x-axis as Shake Number, and the y-axis as Color of Skeeter Population.)
h. Repeat Parts b-g for the other populations of Skeeters.

Workshop 8 Lesson Materials, cont'd.

Name: ________________________________ Date: ______________ Period: ____
Team: ____

Table 2: Growth of the Green Skeeter Population.

Shake Number	Skeeter's Population	Pattern	Process
0	1		
1			
2			
3			
4			
5			
6			
11			
n			

Table 3: Growth of the Yellow Skeeter Population.

Shake Number	Skeeter's Population	Pattern	Process
0	1		
1			
2			
3			
4			
5			
6			
11			
n			

Table 4: Growth of the Orange Skeeter Population.

Shake Number	Skeeter's Population	Pattern	Process
0	40		
1			
2			
3			
4			
5			
6			
11			
n			

Name: ______________________________ Date: ______________ Period: ____
Team: ____

Table 5: Growth of the Red Skeeter Population.

Shake Number	Skeeter's Population	Pattern	Process
0	5		
1			
2			
3			
4			
5			
6			
11			
n			

Table 6: Growth of the Purple Skeeter Population.

Shake Number	Skeeter's Population	Pattern	Process
0	5		
1			
2			
3			
4			
5			
6			
11			
n			

Discussion

a. Describe the relationship between the numbers of yellow Skeeters at the end of two consecutive shakes.

b. 1. Describe the relationship between the number of yellow Skeeters at the end of a shake and the shake number.
2. Restate this relationship as a mathematical equation.

c. Describe the relationship between the numbers of orange Skeeters at the end of two consecutive shakes.

d. 1. Describe the relationship between the number of orange Skeeters at the end of a shake and the shake number.
2. Restate this relationship as a mathematical equation.

e. What differences and similarities do you observe between the yellow and orange Skeeter Populations?

f. At the beginning of the lesson, we presented You with 2 different models of growth in Nature. Write a mathematical equation for each example.

Production Credits

Thirteen/WNET New York

A major American cultural and educational institution for nearly four decades, Thirteen/WNET supplies more than one-third of all primetime programs aired on PBS, including acclaimed cultural, science, and public affairs series and specials. The award-winning Children's and Educational Programming group is a leading and innovative provider of programming for a variety of projects, from teacher professional development to instructional television and interactive multimedia. Broadcast series that further the station's educational mission include the daily animated PBS Kids math program *Cyberchase*, the history series for families *Freedom: A History of US*, *ZOOM Local/National*, *What's Up?*, and *In the Mix* specials. Many projects promote implementation of national and state education standards. These include *Science ... Simply Amazing*, *Learning Science Through Inquiry*, and *The Expanding Canon: Teaching Multicultural Literature in High School* for Annenberg/CPB, and *PBS TeacherLine*, *Mathline*, and *Scienceline*.

Thirteen is also a pre-eminent source of Web-based educational content and workshops, providing courses that have reached thousands of teachers, teachers-in-training, administrators, and others involved in pre-K-12 instruction. These workshops are currently used by professors and students at Harvard University, Pace University, and Teachers College at Columbia University. Thirteen's award-winning Web site features online companion pieces to national series and original online content to complement Thirteen's educational initiatives. Projects include *New York: A Documentary Film*, *African American World*, *Cyberchase Online*, *Great Performances Online*, *Nature Online*, and *American Masters Online*.

Video Production Credits

Produced by
Naomi Edelson

Math Content Director
Karen A. Longhart

Project Officer, Annenberg/CPB
Deborah A. Batiste

Program Producers
Arash Hoda
Eva Zelig

Math Content Consultant
L. Carey Bolster

Project Advisory Board
Daniel T. Dolan
Ana England
Carol R. Findell
Janis M. Palkowski

Editor
Mary Ann Toman

Camera
Greg Barna

Additional Camera
Arash Hoda
Michael Pruitt-Bruun

Sound Engineers
Diana Cleland
John Duvall
Steve Guercio
Ed Jennings
Matthew G. Monroe
Fred Runner
Richard Yeats

Production Coordinators
Michael Colombo
Elizabeth de la Garza

Graphic Design
B.T. Whitehill

Original Music Composed by
Julian Harris

Production Credits, cont'd.

Video Production Credits, cont'd.

Production Manager
Rekha Menon

Director of Children's and Educational Programming
Sandra Sheppard

Executive Producer
Jill Peters

Web Site Production Credits

Executive Producer
Brigitte Magar Matsuoka

Producer
Sandy Goldberg

Associate Producer
Jesse Gale

Project Coordinator
Laura Leung

Content Production
Patrick Vennebush, Writer
Fred Longhart, Writer
Karen A. Longhart, Math Content Director
Naomi Edelson, Editorial Supervisor
Todd Schindler, Copy Editor

Math Content Consultant
L. Carey Bolster

Math Content Reviewers
Jennifer Bay-Williams, Kansas State University
Michael B. Scott, Kansas State University

Advisors
Daniel T. Dolan
Ana England
Carol R. Findell
Janis M. Palkowski

Web Site Production Credits, cont'd.

Interactive and Broadband Unit
Anthony Chapman, Director of Interactive and Broadband
Mikki Monkolchayut, Technical Producer
Ana Giron, Production Assistant
Jeremy Duff, Production Assistant
Sabina Daley, Art Director
Karen Mattson, Designer
Ruiyan Xu, Graphics Production
Brian Santalone, HTML Implementation
Ben Chappel, Interactive Programming
Brian Lee, Technical Director

Interns
Penny Pan
Sonal Thacker

Logo Design
B.T. Whitehill

Supplemental Curriculum Materials provided by
Glencoe/McGraw Hill
Kendall/Hunt Publishing Company
Key Curriculum Press