Multicultural Mathematics

Interdisciplinary, Cooperative-Learning Activities

Claudia Zaslavsky

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Contents

Sequence of Activities

Many of the activities are self-contained and can be carried out independently of the others. However, it is advisable that the order indicated below be maintained for the following activities, unless the material has been adequately covered elsewhere.

Sequences

4 and 5

9–11

16 and 17

18 and 19

25 and 26

27 and 28

37–39

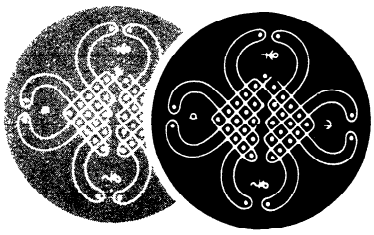
41 and 42

48 and 49

50 and 51

55 and 56

16 should precede 17, 22–24, and 44–47.



CHAPTER 2

Using Numbers in Real Life

Activities 16-24

Numbers are all around us. We need them for shopping, for sports, for making it in school and in the world. In this chapter students will practice mental arithmetic. They will simplify big numbers so that they are easy to deal with. Students will estimate answers to problems and decide whether the estimate is close to the exact answer. If they have not had much practice with estimation, their answers may be far from the exact answers at first. But, with experience, their skills will improve. Some real-world examples will give them the opportunity to use these skills.

The topics in this chapter are:

Activities 16 & 17: Exact and approximate numbers in real life.

Activities 18 & 19: Mental arithmetic applications to West African cowrie currency.

Activity 20: Tom Fuller, African-American slave recognized as a calculating genius.

Activities 21–24: Applications to natural phenomena, population growth, and the federal budget.

REQUIRED MATERIALS

Activities 19, 20, 22–24: Calculators (optional).

Activities 17, 22–24: Almanac or other reference book.

Name _____ Date _____

ACTIVITY 16 ■ Rounding Numbers

Often it is not convenient or not necessary to use an exact number. An approximate number will do as well, and is easier to work with. Write three different approximations to each exact number.

	(1) Exact number	(2) Nearest hundred	(3) Nearest thousand	(4) Two significant figures
	349,621	349,600	350,000	350,000
	483,450	483,500	483,000	480,000
	24,389			
	158,460			
	29,642			
	983			
	300,206			
Sums				

Find the exact sum of the last *five* numbers in each column. Calculate the difference between the sums in:

Columns 1 and 2: _____ Columns 1 and 3: _____ Columns 1 and 4: _____

Which difference is largest? _____

How do you know whether a number is exact or approximate? An exact number is usually obtained by counting. An approximate number is obtained by measuring, by estimating, or by rounding.

Name _____ Date _____

ACTIVITY 16 ■ *(continued)*

Decide whether each number is exact (E) or approximate (A). Write E or A in each blank space.

_____ 1. Thirty-two students were in class today.

_____ 2. The population of New York City is seven million.

_____ 3. Joe is 68 inches tall.

_____ 4. There are 12 inches in a foot and 3 feet in a yard.

_____ 5. About 40 people came to the gym.

_____ 6. In some languages of West Africa the word for *twenty* means "one whole person," and refers to the 20 fingers and toes.

_____ 7. The temperature at noon was 38.4 degrees.

_____ 8. Safe drinking water is not available to 1,200,000,000 people.

Think about this:

Find an article or a selection from a social studies book which contains at least five numbers. Copy each sentence or clause that includes a number. Decide whether each number is exact or approximate, and give a reason in each case.

Name _____ Date _____

ACTIVITY 17 ■ Big Numbers and Approximation

In a TV program about the human body, the narrator stated that there are fifty thousand billion cells in the human body. Of course, this number is not exact. For one thing, it is impossible to count all the cells. Besides, it would bore the audience to have to listen to a long string of words that express just one number.

Suppose that you are writing a script for a television announcer who will read the election results below. Write out in words an approximate number for each figure in the table.

National Election		**State Election**	
Smith	32,368,197		
Chen	15,172,803	Bilsky	1,275,691
Lopez	14,232,169	Perone	498,609
Rodman	1,029,320	Jones	20,142
Total Votes Cast	62,802,489	Total Votes Cast	1,794,442

APPROXIMATE NUMBER OF VOTES		
	Numerals	**Words**
National		
Smith	32,000,0000	thirty-two million
Chen		
Lopez		
Rodman		
TOTAL		
State		
Bilsky		
Perone		
Jones		
TOTAL		

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Name _____ Date _____

ACTIVITY 17 ■ *(continued)*

Four possible methods of rounding numbers are

1. nearest million
2. nearest hundred thousand
3. nearest ten thousand
4. two significant figures

Which of these methods would be appropriate for each set of votes?

National election: _____ . State election: _____ . Explain why.

Think about this:

1. Add the *approximate* number of votes cast in the national election. Do the same for the state election. Do these sums agree with the approximate figure for the total in each case? If not, explain why not.
2. Write a script for a television announcer to describe an actual election for a national or state office. You may use an almanac or other reference. Include approximate numbers.

Name _____ Date _____

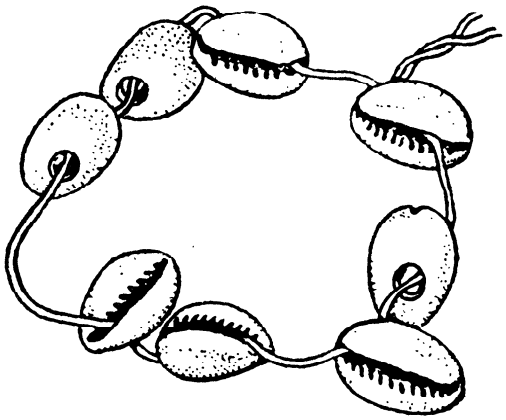
ACTIVITY 18 ■ Mental Arithmetic (Part 1): Money in West Africa

In the past many people had little or no formal schooling. Even today, almost one-third of the adults in the world cannot read or write. Yet some of these people learn to do complicated calculations in their heads. The market women of West Africa are a good example.

A century or more ago, in parts of West Africa, cowrie shells were used as money. Forty shells were strung to form a sort of necklace called a "string."

This table gives the different units of shell money. Calculate mentally the number of shells in each unit. Be sure that your calculation ends with 20,000 shells in a bag.

Units	Number of shells
String	40
Bunch = 5 strings	
Head = 10 bunches	
Bag = 10 heads	20,000



String of cowrie shells

Credit: C. Zaslavsky, Africa Counts

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Name _____ Date _____

ACTIVITY 18 ■ *(continued)*

Women usually operated the markets in parts of West Africa. In a certain market, women sold the items in the chart below.

1. Calculate *mentally* the number of shells paid for each purchase.
2. Calculate the cost on another sheet of paper, showing all work, and write that answer.
3. Compare the two sets of answers. Check those that agree.

   Find the errors if the answers do not agree.

	Item	Price	Mental arithmetic	Written arithmetic	Agree?
1	Chicken	4 strings, 15 shells			
2	Two mats	1 bunch, 2 strings, 10 shells			
3	Goat	8 bunches, 3 strings, 10 shells			
4	Yams	2 heads, 3 bunches, 1 string, 25 shells			
5	Herd of goats	6 heads, 5 bunches, 3 strings			
6	Household goods	1 bag, 7 heads, 4 bunches, 3 strings			

Think about this:

In Africa today 14,000 children die every day of hunger and hunger-related causes. Calculate mentally approximately how many African children die:

in a week _____ ;

in a year _____

Check your figure for a year by multiplying 365 × 14,000:

_____

Was your approximation a reasonable one?

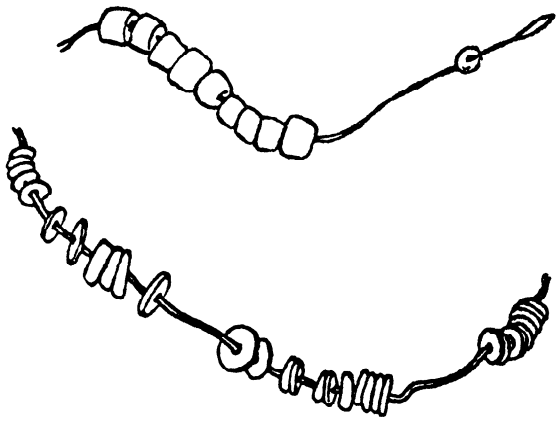
_____

Name _____ Date _____

ACTIVITY 19 ■ Mental Arithmetic (Part 2): More Cowrie Shells

Throughout history people often liked the kind of money that they could also use for other purposes. Cowrie shells and beads, for example, were very good decorative materials. Many games were played with cowries as game pieces. What can you do with a dollar bill besides spend it? Cowrie shells may have been the first kind of money. Loads of them were found in ancient Egyptian and Chinese graves.

People in West Africa used cowrie shell money for many centuries. Foreign visitors were amazed to find that African merchants, both men and women, could do all the necessary arithmetic mentally. They could remember their sales figures and accounts for years.



Currency—Beads, Ivory Disks

Credit: C. Zaslavsky, Africa Counts

You can try your own ability to do math in your head. Don't be discouraged if it seems hard at first. People need lots of practice to develop this skill. Just keep at it, and practice whenever you have a chance.

How to play: Work with a partner. First read the question. Then one of you will do the calculations mentally, while the other works with a calculator or paper and pencil (or both). For the next question, change places. Don't try to rush. This is not a speed test.

The table in Activity 18 giving the different units of shell money is repeated here. Fill in the missing numbers, and check.

Units	Equivalent	Number of shells
String		
Bunch	5 strings	200
Head	10 bunches	
Bag	____ heads	20,000

Name _____ Date _____

ACTIVITY 19 ■ *(continued)*

1. It was recorded that the King of Dahomey was beaten by the Yoruba (of Nigeria) with a loss of "two heads, twenty strings, and twenty" soldiers. How many soldiers did he lose? _____ (You won't find Dahomey on a modern map of Africa. The name of the country is now Benin.)
2. A certain trader kept her accounts in her head. At the end of one week she had collected 10 bunches, 25 strings, and 128 shells. The following week she received 6 bunches, 20 strings, and 320 shells. How many shells did she receive the first week? _____ ; the second week? _____

In another part of West Africa these cowrie units were in use about 200 years ago. Fill in the missing numbers. Then use this table to play the game described below with a partner.

Units	Number of shells	Equivalent units
String	40	
Hen	200	_____ strings
Ackey	1,000	_____ hens
Head	4,000	_____ ackeys
Sack	16,000	_____ heads

How to play: Take turns filling in the numbers for the cost of each purchase. Then take turns calculating the total number of cowries in your head, while your partner checks with a calculator or pencil and paper (or both).

3.

Item	Price	Total cowries
Two pots	_____ hens, _____ strings, _____ shells	
Three mats	_____ ackeys, _____ hens, _____ strings	
Basket of yams	_____ ackeys, _____ strings, _____ shells	
Herd of cattle	_____ sacks, _____ heads, _____ ackeys	

Think about this:

At the time they were conquered by the Spanish conquistadores in 1519, the Aztecs of Mexico were using cocoa beans as currency; 8,000 beans were equal to one bag. Discuss these questions with your classmates and write your conclusions.

1. Compare the Aztec bag of cocoa beans with the bag or sack of cowries in West Africa in as many different ways as you can.
2. The Aztec number system, like the Maya system, was based on groups of twenty. How is this fact related to the number of 8,000? (See Activity 2.)
3. Research wampum of the northeast Native Americans. How were these shell beads used, besides for trade?

Name _____ Date _____

ACTIVITY 20 ■ Mental Arithmetic (Part 3): African Genius

Thomas Fuller was a remarkable mental calculator. Although, as a slave, he was not allowed to learn to read or write, he was able to do very long and complicated calculations in his head. For example, he could multiply two nine-digit numbers.

Fuller was born in Africa in 1710, and was brought to America in slavery at the age of 14. His fame as a calculator spread across the colonies. He came to the attention of members of the society to abolish slavery. In 1780 two men from the society came to test him. They wanted to tell the British antislavery society about his skill in mathematics.

One man asked Fuller how many seconds a man has lived, who is 70 years, 17 days, and 12 hours old. It took him one and a half minutes to give the answer: 2,210,500,800 seconds. Meanwhile the man was working it out on paper and got a smaller answer. When he told Fuller that his result was wrong, the old man reminded him that he had forgotten to count the leap years. As it turned out, Fuller's answer was correct.

An article in a Boston newspaper noted his death in 1790. The article had the headline: "Died—Negro Tom, the famous African Calculator, aged 80 years."

1. Test your own powers of mental arithmetic by trying these problems. If the numbers are too hard to work with, make an estimate. Don't be afraid to keep trying, even if you make many mistakes.
   - Calculate mentally and write your answer.
   - Work out the problem on another sheet of paper, showing all work, and write that answer.
   - Compare the two answers. Do they agree? If not, are they close? If the difference is large, try to find your errors.

Calculate	Mental arithmetic	Written arithmetic	Close or agree?
(a) Number of minutes in a day			
(b) Number of hours in a week			
(c) Number of minutes in a week			
(d) Number of hours in a year			
(e) Number of minutes in a year			

Name _____ Date _____

ACTIVITY 20 ■ *(continued)*

Do you wonder how Thomas Fuller got his answers?

Tom Fuller loved numbers. He could calculate how many shingles were needed to cover a house. He knew the number of seeds to plant in a field. He was an important man to have on a farm.

2. Try to estimate these measurements. Then measure to check your estimate. If the two numbers are very different, try to find your errors. You might work with a partner.

	Estimate	Measure	Agree?
(a) Length of your arm from shoulder to fingertip			
(b) Length of your leg from knee to heel			
(c) Length and width of this sheet of paper			
(d) Length and width of your desk or table			
(e) Length and width of the classroom door			
(f) Another object (name it)			

Think about this:

Many people of African origin fought in the Civil War. About 186,000 black soldiers served in the Union army. Of these, 38,000 lost their lives. Estimate what fraction of the soldiers lost their lives: _____

They also served in the navy and helped behind the battle lines. Harriet Tubman was called "the only American woman to lead troops on the field of battle." Find more information about these heroes.

Name _____ Date _____

ACTIVITY 21 ■ Benjamin Banneker's *Almanack*

Have you ever used an almanac? Several different almanacs are published every year. Each has about a thousand pages. There you can find information about all the countries of the world, people in sports, motion picture awards, and lots more. The numbers in some of the activities in this book come from almanacs.

In the early days of the United States most people did not own books, except for a family Bible and a yearly almanac. There were no calendars or daily weather forecasts. Farmers, shipmasters, and other people depended upon the almanac for this information. But how could anyone forecast the weather months ahead? The author of the almanac had to know astronomy and mathematics very well.

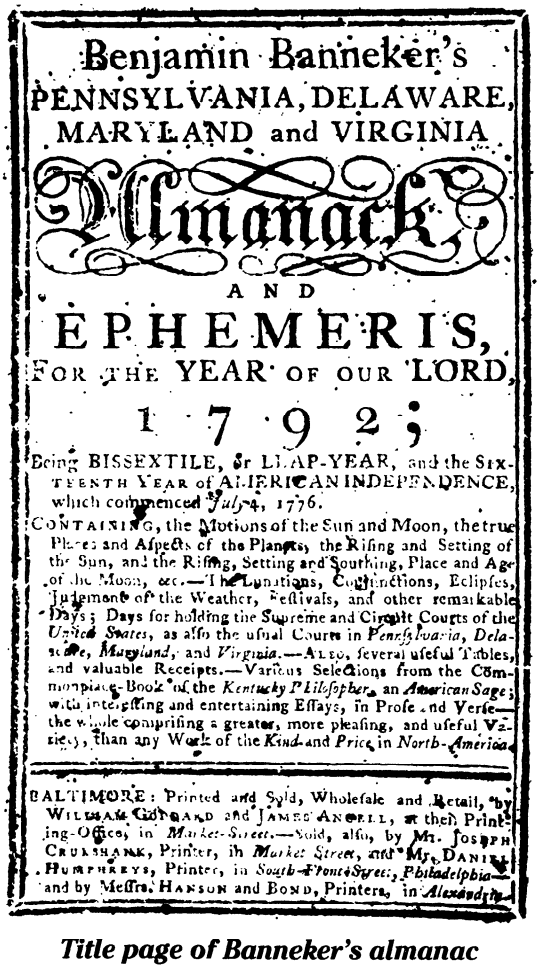
Such a person was Benjamin Banneker, a free African American born in 1730 in Maryland. Although he had very little schooling, he borrowed books and instruments to teach himself algebra, geometry, trigonometry, astronomy, and other sciences. His almanacs were widely used.

In 1791 Banneker sent the manuscript of his first *Almanack* to Thomas Jefferson, with a long letter. In this letter he criticized Jefferson for holding slaves. Jefferson was so impressed by the almanac that he sent it to the French Academy of Science.

This reproduction of the first page of the 1792 *Almanack* tells you what you might find in the book:

> *CONTAINING, the Motions of the Sun and Moon, the true Places and Aspects of the Planets, the Rising and Setting of the Sun, and the Rising, Setting and Southing, Place and Age of the Moon, etc.—The Lunations, Conjunctions, Eclipses, Judgment of the Weather, Festivals, and other remarkable Days . . .*

and much more—tables of measures, recipes, essays and poems.



Benjamin Banneker's
PENNSYLVANIA, DELAWARE,
MARYLAND and VIRGINIA
ALMANACK
AND
EPHEMERIS,
FOR THE YEAR OF OUR LORD,
1792;
Being BISSEXTILE, or LEAP-YEAR, and the SIXTEENTH YEAR of AMERICAN INDEPENDENCE, which commenced July 4, 1776.
CONTAINING, the Motions of the Sun and Moon, the true Places and Aspects of the Planets, the Rising and Setting of the Sun, and the Rising, Setting and Southing, Place and Age of the Moon, &c.—The Lunations, Conjunctions, Eclipses, Judgment of the Weather, Festivals, and other remarkable Days; Days for holding the Supreme and Circuit Courts of the United States, as also the usual Courts in Pennsylvania, Delaware, Maryland, and Virginia.—Also, several useful Tables, and valuable Receipts.—Various Selections from the Commonplace-Book of the Kentucky Philosopher, an American Sage; with interesting and entertaining Essays, in Prose and Verse—the whole comprising a greater, more pleasing, and useful Variety, than any Work of the Kind and Price in North-America.
BALTIMORE: Printed and Sold, Wholesale and Retail, by WILLIAM GODDARD and JAMES ANGELL, at their Printing-Offices, in Market-Street.—Sold, also, by Mr. JOSEPH CRUKSHANK, Printer, in Market Street, and Mr. DANIEL HUMPHREYS, Printer, in South-Front-Street, Philadelphia; and by Messrs. HANSON and BOND, Printers, in Alexandria.

Credit: Silvio Bedini, The Life of Benjamin Banneker

Title page of Banneker's almanac for 1792, published in Baltimore by Goddard & Angell

Name _____ Date _____

ACTIVITY 21 ■ *(continued)*

Class Project

Form groups of three or four. Each group will design part of an almanac that would be of interest to the school.

Procedure

- List the topics that your group would like to write about. Then compare all the lists in the class to make sure that they are all different.
- For each topic, list the kind of information you will need and where you expect to find this information.
- Discuss and make notes on how you can bring mathematics into each topic (or most of the topics).
- Decide who will be responsible for each topic and each job (research, writing, art, etc.).
- Complete the almanac.

Think about this:

Banneker was well known as a scientist. When the new government decided to build the city of Washington as the capital of the United States, Banneker was chosen to a team of three men to survey and plan the site.

Look for more information about the scientist Benjamin Banneker. Discuss this information with the class.

Credit: Silvio Bedini, The Life of Benjamin Banneker

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Name _____ Date _____

ACTIVITY 22 ■ Change in Population of Four Cities

Some cities grew between 1970 and 1980, while others lost population. These are the population figures for four cities of different sizes, in 1970 and in 1980.

City	1970	1980
Anchorage, Alaska	48,081	173,017
Houston, Texas	1,233,535	1,594,066
New York, New York	7,895,563	7,071,030
Washington, D.C.	756,668	637,651

Complete the table below.

1. Round each population number to two significant figures (2 sf).
2. Find the approximate *amount* of increase or decrease in population from 1970 to 1980. Write a plus sign (+) in front of an increase, and a minus sign (–) in front of a decrease.
3. Find the *percent* of increase or decrease to the nearest whole number. Show your work below, as in the example. You may want to use a calculator.

City	Population (2 sf)		Increase or Decrease	
	1970	1980	Amount	Percent
Anchorage	48,000	170,000	+122,000	+254%
Houston				
New York				
Washington				

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Name _____ Date _____

ACTIVITY 22 ■ *(continued)*

To find the percent (p) of change in population:

$$\frac{\text{Percent}}{100} = \frac{\text{Amount of change}}{\text{1970 population}}$$

Example: Anchorage

$$\frac{p}{100} = \frac{122{,}000}{48{,}000}$$

Reduce the fraction: $\frac{p}{100} = \frac{122}{48}$

$p = (100 \times 122) \div 48 = 254\%$

Think about this:

1. Arrange the four cities in order, from smallest to greatest, according to the change in population.

	Smallest	**Greatest**
Amount of change:		
Rate (percent) of change:		

2. Explain why the two lines in the table are different.

3. Look up the latest population of each city and compare it with the 1980 figure.

Name _____ Date _____

ACTIVITY 23 ■ Growth of the Population of the United States

The population of the United States grew tremendously from 1820 to 1980. Did it increase at the same rate all through that period? Let's investigate.

U.S. POPULATION FROM 1820 TO 1980

	Population		Increase	
Year	**Exact**	**Rounded (in millions)**	**Amount (in millions)**	**Rate (percent)**
1820	9,638,453	10	—	—
1860	31,443,321	31	21	210%
1900	76,212,168			
1940	132,164,569			
1980	226,545,805			

Complete the table above.

1. Round the population figures to the nearest million. Notice that "population in millions" is at the top of the column.
2. Find the *amount* of increase, in millions, for each 40-year period.
3. Find the *rate* of increase, in percent, to the nearest whole number, for each 40-year period. Show your work on another sheet. Use the formula:

$$\frac{\text{Percent}}{100} = \frac{\text{Amount of increase}}{\text{Population in earlier year}}$$

Example: For the period 1820–1860,

$$\frac{p}{100} = \frac{21}{10}$$

$$p = (100 \times 21) \div 10 = 2100 \div 10 = 210\% \text{ increase}$$

Describe the *trend* (type of change) in the rate of increase from 1820 to 1980.

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Name _____ Date _____

ACTIVITY 23 ■ *(continued)*

Think about this:

1. For the period 1820–1980, the amount of increase was about _____ and the rate of increase was _____. The population in 1980 was _____ times that in 1820. The 1820 population was _____ (fraction) of the 1980 population.

2. Estimate how many years it took for the population to double, starting in 1820 _____; in 1860 _____; in 1900 _____; in 1940 _____. Look up the latest population figure _____.

Name _____ Date _____

ACTIVITY 24 ■ Spending Our Money: The Federal Budget

How big is a million? a billion? a trillion? Can you imagine spending a trillion dollars?

The budget of the United States government was about a trillion dollars for the year 1987. The government spent about $280 billion that year for military purposes. Let's see what that figure means.

Try to do some of the calculations mentally, using approximate numbers. Show necessary work in the space below.

1. Write $280 billion as a numeral: _____

2. If this sum were divided equally among all the 240 million people in the U.S., how much would each person pay?

   _____

3. On the average, about how much money is spent for military purposes:

   every week _____ ; every day _____ ;

   every hour _____ ; every minute _____ ?

4. The government spends more money than it takes in, and it must borrow money. In 1990 the national debt, the amount that the government owes, was over $3 trillion. Write this number as a numeral: _____ .

   If this sum were divided equally among all the people of the United States, each person would owe: _____ .

5. Find recent figures for the national debt and the federal budget. How was the money spent? (You might use an almanac.)

Think about this:

The national debt was over $3 trillion in 1990. If three trillion one-dollar bills were laid end to end, approximately how many times would they go around the equator, a distance of about 25,000 miles? A dollar bill is about 6 inches long. One mile equals 5,280 feet. Use approximate numbers, and show all your work on another sheet.