Algebra Activities from Many Cultures

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Background

Thousands of years ago, in the northwestern sector of the Indian subcontinent, the flooding Indus River deposited silt on the lands it crossed between the mountains and the sea. Early farmers grew many crops in the fertile alluvial soil—so many that, by 2500 B.C.E., cities like Mohenjo-Daro and Harappa came to be built. The streets of these cities were planned. The buildings were made of bricks, shaped to a regular size and baked in wood-fired ovens. Most houses had several rooms, a courtyard, a well, and a bathroom. A system of brick sewers kept the cities clean and healthful.

The people of the Indus Valley were the first to make cloth from cotton. They used the wheel to make pots and traded with people as far away as Persia and Mesopotamia. A standard system of weights and measures was developed, as well as a system of writing, using pictograms. Some progress is being made in deciphering the writing system.

Indian Numerals: From Harappan to Modern

Materials

Reproducible 18

Procedure

1. Distribute the handout.
2. Ask students to study the numerals.
3. Have students answer the questions.

Answers

1. Answers will vary
2. Answers will vary
3. Answers will vary.
4. (a) 850
   (b) DCCCL

Discussion

Have students discuss the following question: Do you think the Vedic and Harappan were related?

Extension Activity

Divide the class into groups. Give each group the following prompt: Suppose you were in a market. You do not know the language spoken there and have no way to write numerals. With hand signals only, can you represent numbers so others in your group will know what number you are showing?

When all groups have developed a system of hand signals, combine groups and see if different groups can understand each others' signals.

Indian History: A Puzzle

Materials

Reproducible 19

Procedure

1. Distribute the handout.
2. Have students study the table comparing Harappan and Vedic weights.
3. Tell students to answer the questions.

Answers

1. Yes
2. $y = 18x$
3. $z = (80/9)y$
4. $z = (80/9)18x$, $z = 160x$

Indian Numerals

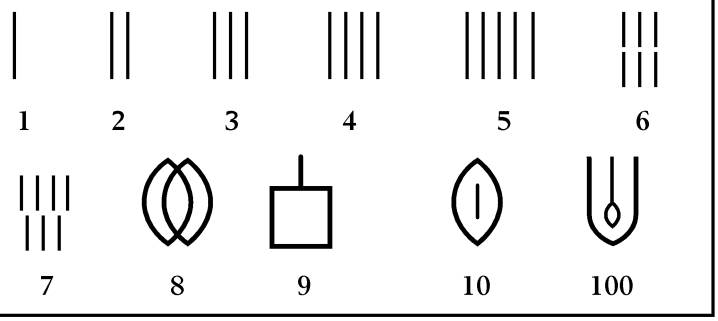
From Harappan to Modern

The great subcontinent of India is home to a large part of the world's population. It is also the home of one of the world's oldest civilizations. Great buildings and baths that are over 4000 years old still stand at cities with names like Mohenjo-Daro and Harappa. The Harappans cultivated cotton, domesticated the chicken, and may have invented the game of chess. They seem to have standardized many things: brick sizes, weights and measures, and building plans. These standards are part of the evidence that links the Harappan civilization with modern village India.

The Harappans had a class of scribes in charge of standard measures and the distributing of supplies. The script they used is still largely untranslated, even after years of modern research. Recently, the Harappan language was identified as one of the Dravidian languages, a family of languages spoken in India today.

Harappan numerals have been deciphered. They show that Harappans used tally marks for 1 through 7. For 8, they used a double sun; for 9, a foundation post. Symbols for 10 and 100 are also known, which suggests that an original base-8 system was later modified to a base-10 system of numbers.

Harappan Numerals



(after Walter Fairservis, Jr.)

(continued)

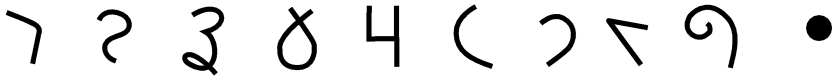
Indian Numerals *(continued)*

About 1500 B.C.E., a Sanskrit-speaking people entered India from the north. There was a mingling of cultures in India and extensive trade with China, Mesopotamia, and Africa. There was also a rapid growth in all of the sciences, especially astronomy. Astronomers had to work with large numbers and needed an efficient system of numerals. A process began in India that ended with the invention of the numerals we use today.

In India, mathematicians took the best of the old ideas and made their own giant step forward. By the year 600, Indians had invented ciphers for numbers 1 to 9 and used them in a place value system. Soon after, a small circle was employed as a zero placeholder. These are the numerals we use today, called the Indo-Arabic numerals. Islamic mathematicians expanded the system to include decimal fractions. They also introduced the numerals to Europe where Indo-Arabic numerals gradually replaced Roman numerals.

Stages in Development of Indian Numerals

The table below shows three stages in the development of Indian numerals.

Brahmi Numerals										
Gwalior Numerals										
Modern Indo-Arabic Numerals	1	2	3	4	5	6	7	8	9	0

Questions for Critical Thinking

1. Why do you think Harappans standardized brick sizes?

_____

_____

_____

_____

(continued)

Indian Numerals *(continued)*

2. Why do you think Harappans standardized weights and scales for length?

_____

_____

_____

_____

3. Refer to the chart of Brahmi numerals, Gwalior numerals, and modern numerals. Select some numerals that changed the most. Show possible intermediate stages for the changes.

Early numeral	**Intermediate stages**	**Modern numeral**
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4. Multiply 25×34 using

   (a) Indo-Arabic numerals

   (b) Roman numerals

Group Discussion

What are the advantages of Indo-Arabic numerals compared to Roman numerals?

Name _____

Date _____

Indian History

A Puzzle

Archaeologists are fascinated by the Harappan civilization of India dating back to 2500 B.C.E. These ancient people of India left imposing buildings, weights and measures, and a script that is still being deciphered. Who were they? And are the modern people of India their descendants?

Indian scientists are using mathematics to help solve this puzzle. They are exploring possible connections between Harappan weights and Vedic weights. The Vedic civilization is considered the parent of modern India and appeared hundreds of years after the Harappan. The Vedic unit of weight for precious metals was the gunja seed, similar to the grain in English measure. If the Harappan and Vedic systems of weights are related, that would show continuity from the earlier to the later civilization. The following table compares the two systems of weights. Values have been rounded off.

Comparison of Harappan and Vedic Weights*		
Harappan Weights		Vedic Weights
Relative Size	Grams	Number of Gunja Seeds
x	y	z
0.05	0.9	8
0.1	1.8	16
0.2	3.6	32
0.5	9.0	80
1	18.0	160
2	36.0	320

1. On a piece of graph paper, plot the number of grams *vs.* relative size. Select suitable range values. Is this a linear function?

2. Write an equation in the form of $y = f(x)$ to represent this graph.

   _____

3. Write an equation for z, the number of gunja seeds, as a function of y, or $z = g(y)$.

   _____

4. Use composition of functions $g[f(x)]$ to write z as a function of x.

   _____