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INTRODUCTION AND SUGGESTIONS FOR TEACHERS

“I am sure that no subject loses more than mathematics by any attempt to dissociate it from its history.”

Glashier

Our goal in this book is to provide a collection of resources to make it easy for teachers to integrate the history of mathematics into their teaching. While mathematics history textbooks abound, there are not many sources which combine concise biographical information with activities to use in the classroom. We hope that the problem solving experiences, the portraits, and the anecdotal stories will facilitate a broad, natural linkage of human elements and mathematical concepts.

The value of using history in teaching mathematics is currently gaining emphasis. Providing a personal and cultural context for mathematics helps students sense the larger meaning and scope of their studies. When they learn how persons have discovered and developed mathematics, they begin to understand that posing and solving problems is a distinctly human activity.

Using history in the mathematics classroom is often a successful motivational tool. Especially when combined with manipulatives, illustrations, and relevant applications, historical elements have the power to make mathematics “come alive” as never before. By viewing mathematics from a historical perspective, students learn that the process of problem solving is as important as the solution.

This book can be used in many ways. The teacher may choose to read or share biographical information and anecdotes as an introduction to one or more of the activities in a particular section. Portraits may be posted or distributed, and puzzles or skits may be used independently. It may be most effective, however, to focus on one mathematician at a time. A wide range of activities may be incorporated into a unit on a specific mathematician, allowing the teacher to make cross-disciplinary connections with social studies, language arts, and science.

Mathematicians may be selected for emphasis according to the concepts being introduced in the mathematics curriculum or may be used at random for enrichment. While some of the activities do not replicate the exact problems the mathematicians worked on, they represent the areas of interest of those mathematicians.

Activities have been chosen to appeal to a wide range of interests and ability levels. Complete solutions and suggestions for use are included in the back of this book.

Wilbert Reimer
Luetta Reimer
Pythagoras

c. 560 - c. 480 B.C.
Biographical Information:

Pythagoras (pi-THAG-uh-rus) of Samos (c.560-c.480 B.C.) was a Greek philosopher and religious leader responsible for important developments in mathematics, astronomy, and music theory. Little is known about Pythagoras’s early life, except that he was born on the island of Samos and, as a young man, traveled extensively. His followers became a “secret brotherhood” which focused on religious rites as well as intellectual pursuits.

There are several legends about Pythagoras’s death: one says he was slain by enemies in the presence of his young wife; another says he was burned in a fire during a political riot.

Contributions:
The Pythagoreans:
- were the first to use letters on geometric figures.
- provided the first logical proof of the theorem \(a^2+b^2=c^2\).
- represented whole numbers as geometric shapes.
- divided all numbers into even and odd.
- demonstrated the construction of the five regular solids.
- asserted that the earth was round.

Quotations by Pythagoras:
“Number rules the universe.”

“Everything is arranged according to number and mathematical shape.”

“Number is the origin of all things, and the law of number is the key that unlocks the secrets of the universe.”

“Be silent, or say something better than silence.”

Anecdotes:

Hiring a Student

Pythagoras was excited about his mathematical discoveries. He wanted to share them with someone, but no one would listen. Finally, in desperation, he cornered a young boy in the marketplace and offered to teach him the arithmetic he had discovered. The boy refused. He had no time for such frivolity. He had to work to help provide for his family. “Tell you what,” Pythagoras implored. “I'll pay you daily wages if you'll just listen to me and try to learn.” It was a deal; Pythagoras had started his first school.

Eventually, Pythagoras ran out of money. By then, his student was so intrigued that he offered to pay Pythagoras to continue teaching him. Eventually, the teacher’s initial investment was returned!

The Pythagorean School

When Pythagoras was about 50 years old, he selected approximately 300 wealthy persons
their sacred symbol—the pentagram, a five-pointed star. They emphasized virtuous living and friendship, and believed that “Knowledge is the greatest purification.”

A Pythagorean Celebration

Legend says that Pythagoras was so excited when he discovered the Pythagorean theorem \((a^2 + b^2 = c^2)\) that he prepared an unusually generous sacrifice. He offered to the gods not one but a hundred oxen. For centuries, mathematicians have admired the beauty of this theorem, but most everyone agrees that Pythagoras got a little carried away in his celebration.

The Great Cover-Up

Pythagoras taught adamantly that everything in the world depended upon whole numbers. When one of his group discovered that some lengths cannot be represented as rational numbers, that is, they cannot be expressed as a whole number or the ratio of two whole numbers, the Brotherhood was scandalized. These new numbers, like \(\sqrt{2}\), were called irrational numbers.

At first, every effort was made to keep this shocking discovery of irrational numbers secret. Members were warned not to breathe a word about it. Eventually, the truth “leaked” out, but not without consequence. Hippasus, apparently guilty of talking, mysteriously fell off a boat and drowned.
The Pythagoreans represented whole numbers as geometric shapes, often with pebbles on the sand. The following definitions reflect this concept.

A square number is the number of pebbles in a square array.

A triangular number is the number of pebbles in a triangular array.

An oblong number is the number of pebbles in a rectangular array having one more column than rows.

An even number is the number of pebbles in a rectangle having two rows.

An odd number is the number of pebbles in a rectangle having two rows with one extra pebble.

Pythagoras demonstrated many number relationships using number shapes. Use practice golf balls and a glue gun to build these shapes and show the relationships.

The sum of two consecutive triangular numbers is a square number.

Two times a triangular number is an oblong number.

Eight times any triangular number plus one is a square number.

An odd number plus an odd number is an even number.

An even number plus an odd number is an odd number.

An even number plus an even number is an even number.
### SQUARE NUMBERS
Square numbers are numbers which can be represented by dots in a square array. The first four square numbers are pictured below.

<table>
<thead>
<tr>
<th>Square Number</th>
<th>Number of Dots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>1</td>
</tr>
<tr>
<td>2nd</td>
<td>4</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td></td>
</tr>
<tr>
<td>50th</td>
<td></td>
</tr>
<tr>
<td>nth</td>
<td></td>
</tr>
</tbody>
</table>

Complete the table to find the number of dots in the nth square number.

### OBLONG NUMBERS
Oblong numbers are numbers which can be represented by dots in a rectangle having one dimension one unit longer than the other. The first four oblong numbers are pictured below.

<table>
<thead>
<tr>
<th>Oblong Number</th>
<th>Number of Dots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>2</td>
</tr>
<tr>
<td>2nd</td>
<td>6</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td></td>
</tr>
<tr>
<td>50th</td>
<td></td>
</tr>
<tr>
<td>nth</td>
<td></td>
</tr>
</tbody>
</table>

Complete the table to find the number of dots in the nth oblong number.

### TRIANGULAR NUMBERS
Triangular numbers are numbers which can be represented by dots in a triangular array. The first four triangular numbers are pictured below.

<table>
<thead>
<tr>
<th>Triangular Number</th>
<th>Number of Dots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>1</td>
</tr>
<tr>
<td>2nd</td>
<td>3</td>
</tr>
<tr>
<td>3rd</td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td></td>
</tr>
<tr>
<td>50th</td>
<td></td>
</tr>
<tr>
<td>nth</td>
<td></td>
</tr>
</tbody>
</table>

Complete the table to find the number of dots in the nth triangular number.
PYTHAGOREAN DISCOVERIES

The Pythagoreans discovered many relationships between triangular, square, and oblong numbers. Use this table to find some of these relationships.

| Triangular | 1 | 3 | 6 | 10 | 15 | 21 | 28 | 36 |
| Square     | 1 | 4 | 9 | 16 | 25 | 36 | 49 | 64 |
| Oblong     | 2 | 6 | 12| 20 | 30 | 42 | 56 | 72 |

1. The sum of two consecutive triangular numbers is a(n) _________ number.

2. Two times any triangular number is a(n) _________ number.

3. Eight times a triangular number plus one is a(n) _________ number.

4. Three times any triangular number plus the next triangular number is a(n) _________ number.

5. An oblong number plus the corresponding square number is a(n) _________ number.

6. The sum of two consecutive oblong numbers is twice a(n) _________ number.

7. A triangular number plus the corresponding square number minus the corresponding oblong number is a(n) _________ number.

A **triangular number** is the number of dots in a triangular array.

A **square number** is the number of dots in a square array.

An **oblong number** is the number of dots in a rectangular array having one more column than rows.
Numbers that can be represented by dots arranged in specific geometric shapes are called figurate numbers. These numbers can be divided into “families” according to their shapes.

Discovering the relationship between these number families can be as much fun as making a family tree!

Complete the table below. Note the many horizontal and vertical relationships. Take advantage of these patterns as you work.

<table>
<thead>
<tr>
<th>Family</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>7th</th>
<th>8th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Square</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentagonal</td>
<td>1</td>
<td>5</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexagonal</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heptagonal</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octagonal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PENTAGONAL NUMBERS

HEXAGONAL NUMBERS
A room is 30 feet long, 12 feet wide, and 12 feet high. At one end of the room, 1 foot from the floor, and midway from the sides, is a fly. At the other end, 11 feet from the floor, and midway from the sides, is a spider. Determine the shortest path by way of the floor, ends, sides, and ceiling, the spider can take to capture the fly. How long, in feet, is this path?
A PYTHAGOREAN PUZZLE

The Pythagorean theorem says that the sum of the areas of the squares on the two legs of a right triangle is equal to the area of the square on the hypotenuse.

In the puzzle shown, notice that the two squares on the legs of the right triangle are made up of five pieces.

Cut out the puzzle and arrange the five pieces to make one square on the hypotenuse. This illustrates the Pythagorean theorem!
A significant contribution of the Pythagoreans is the representation of whole numbers as geometric shapes. Imagine Pythagoras taking a number of round pebbles and stacking them to make a triangular pyramid.

Numbers which take this shape are called tetrahedral numbers.

Two popular puzzles which involve tetrahedral numbers can easily be made with practice golf balls and an electric glue gun.

The objective of both puzzles is to put the pieces together to form a triangular pyramid. One puzzle uses 6 pieces and the other 4 pieces. Use your glue gun to construct the individual pieces and then solve the puzzle!

PUZZLE NO. 1

These six pieces can be assembled to form a triangular pyramid.

\[
\begin{align*}
\circ\circ\circ\circ\circ + \circ\circ\circ\circ\circ + \circ\circ\circ + \\
\circ\circ\circ + \circ\circ\circ + \circ\circ\circ
\end{align*}
\]

PUZZLE NO. 2

These four pieces can be assembled to form a triangular pyramid.

\[
\begin{align*}
\circ\circ\circ\circ\circ + \circ\circ\circ\circ\circ + \circ\circ\circ + \circ\circ\circ
\end{align*}
\]