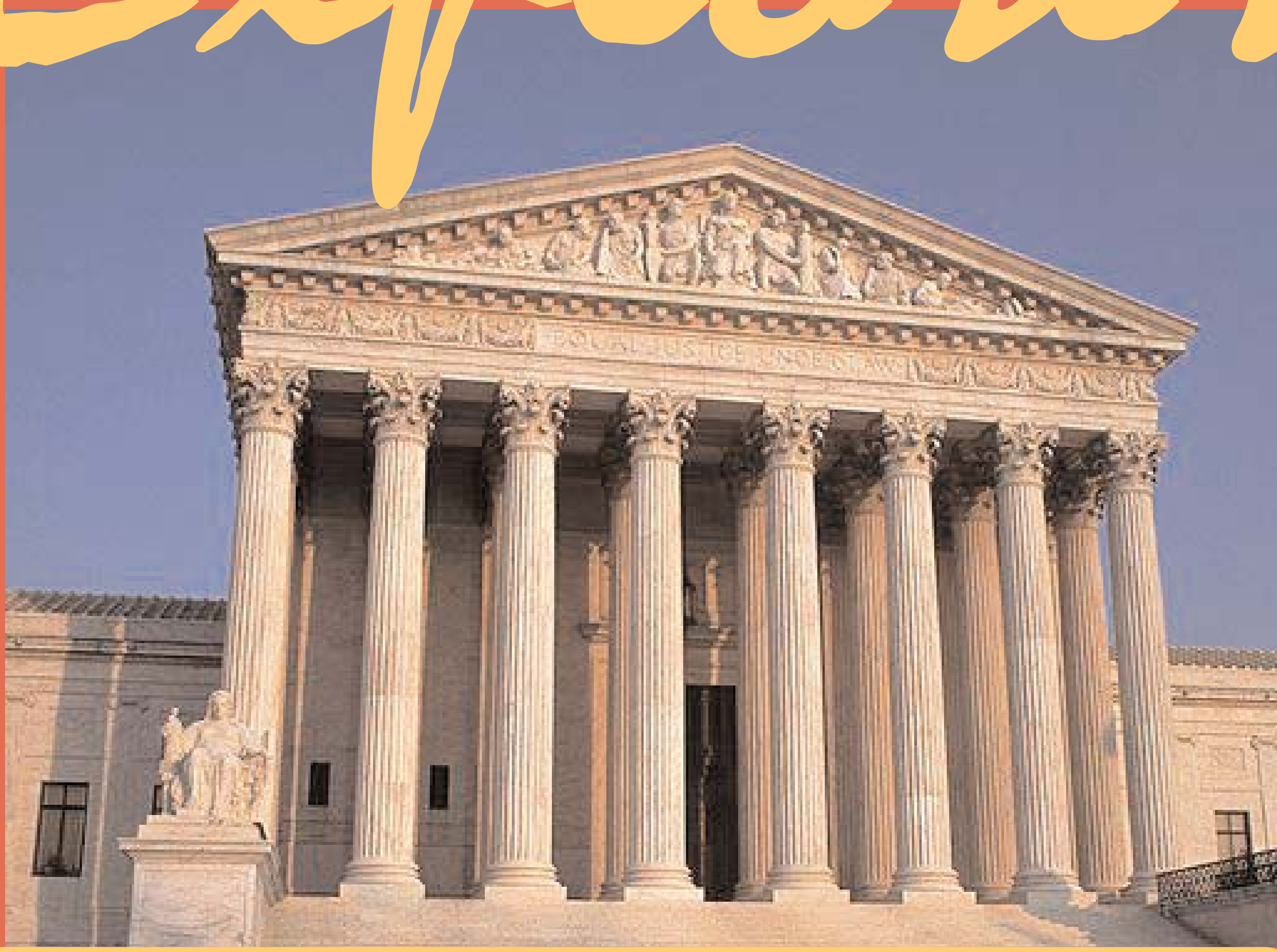
Math Explorer



MATHEMATICS AND GOVERNMENT

Presidential Mathematics

Banneker surveys problem

Tangram-a Chinese puzzle

Vol. 6.1 Fall 2003

Math Explorer

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Benjamin Banneker

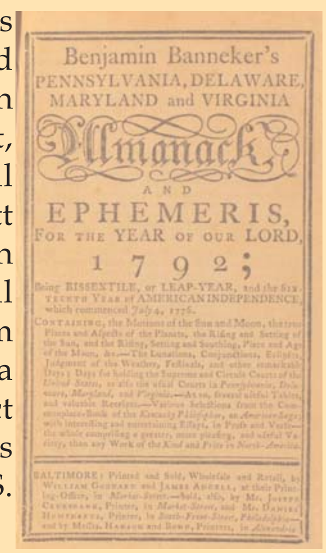
by Laura Chavkin

Benjamin Banneker, the grandchild of an African slave and an English indentured servant, was born in 1731 in Maryland. He grew up on the family farm, where his grandmother Molly taught him to read from the family Bible. Later he attended a Quaker school, where his interest in mathematics began.

At the age of twenty-one, Banneker saw a watch. He was so fascinated by this instrument that the owner gave it to him. Banneker took the watch apart to figure out how it worked, and then began to carve his own clocks out of wood. Soon he invented the first striking clock in America.

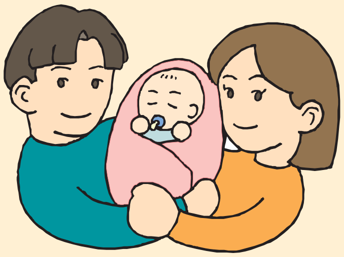
Banneker's clock was extremely accurate. It told the time correctly, striking every hour for the next forty years. He began to repair watches, sundials and clocks. Banneker met Joseph Ellicott, another clock maker, and the two became friends. Together they built a more complex clock. Ellicott and his brother gave Banneker books on astronomy and mathematics, as well as instruments for gazing at the stars. Banneker taught himself advanced mathematics so he could understand more about astronomy and clock making.

After his parents died, Banneker built a "work cabin" on the farm they left him. He calculated things such as the stars' distances and published his observations in an almanac. Soon Banneker had another new project, surveying or measuring the "Federal Territory" with Major Andrew Ellicott and Pierre L'Enfant, the architect in charge of planning the new capital Washington, D.C. L'Enfant was fired from the project because of his temper; in a rage, he took the plans for the project with him. Banneker recreated the plans from memory, saving the U.S. government countless time and money.

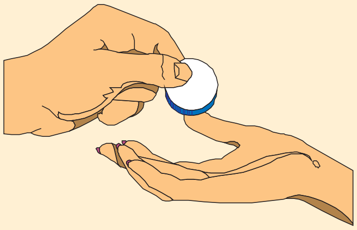


Banneker gained a reputation as a great problem solver, and could work any math problem given to him. He achieved great things and has been referred to as the first African American man of science and mathematics. He said: "The color of the skin is in no way connected with the strength of the mind or intellectual powers."

Laura Chavkin, a graduate of Yale and Stanford Law School, is currently an associate attorney in Palo Alto, CA.



1. In a class of 24 students, 13 of the students have a sister, 12 of the students have a brother, and 7 of the students have no sisters or brothers. How many students have both a sister and a brother?

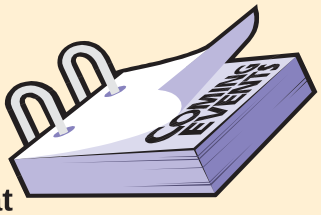


2. If you have 4 quarters, 10 dimes and 10 nickels, how many ways can you give change for a dollar?

3. Two positive integers multiplied together equal 360. What is the smallest total we could get if we added the numbers?

4. Patrick has scores of 83, 70, and 71 on the first 3 exams. What score does he need on the next exam to bring his average to 80?

5. The year 2003 is not evenly divisible by 11. Find the next year which is divisible by 11.



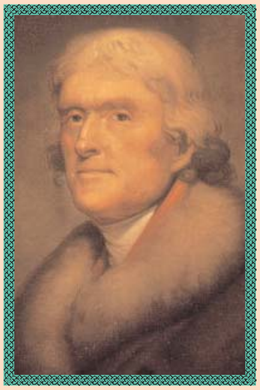
6. How many integers are there between 100 and 1000 that are written using only odd integers?

7. If we continue the sequence 1, 3, 6, 10, 15, ... there will be 2 numbers side by side whose sum is 100. What is the larger of those two integers?

8. What day of the week will it be 1000 days from now if today is Monday?

9. There are 8 teams in a soccer league, and each team plays all other teams once. How many matches need to be scheduled?

Answer: 1) 8 2) 21 3) 38 4) 96 5) 2013 6) 125 7) 55 8) Sunday 9) 28 matches



Thomas Jefferson

the mathematician president

by Jean Davis

Did you know that the very first presidential veto in the history of the United States was about mathematics? In 1791, President Washington vetoed Congress' approval of Alexander Hamilton's method for apportionment – or how many representatives to the United States Congress each state receives.

Unable to override the veto, Congress then chose the method created by Thomas Jefferson. Jefferson's method went like this:

1. First find the Standard Divisor. The Standard Divisor is the average number of people per seat over the entire population.
In 1791, the population of the United States was approximately 3,893,874, and there were 105 seats in the House of Representatives. So the standard divisor was

$$\text{SD} = \text{Standard Divisor} = \frac{\text{Total Population}}{\text{Number of Seats}}$$

Remember, that's the average number of people per congressional seat.

$$\text{SD} = \frac{3893874}{105} = 37084.5$$

2. Next find the Standard Quota.
The Standard Quota is the total number of seats a state would be entitled to if the seats were not indivisible.
Note: SD is the Standard Divisor
The population of the state of Virginia from the 1790 census was 747,550. So the standard quota for Virginia was

$$\text{SQ} = \text{Standard Quota} = \frac{\text{State Population}}{\text{SD}}$$

This means Virginia gets 20.158 representatives!

Of course, a state cannot have 20.158 representatives, so the Standard Quota must be rounded up or down to the nearest whole number.

<u>Lower Quota</u>: The Standard Quota rounded down. Virginia's Lower Quota is 20.

<u>Upper Quota</u>: The Standard Quota rounded up. Virginia's Upper Quota is 21.

Jefferson's method assigned to each state its lower quota.

If the sum of the lower quotas of all the states is exactly equal to the total number of seats, then we're finished. Each state receives its lower quota of representatives.

If not, we find, by trial and error, a modified divisor (MD), that gives a modified quota to each state. When all the modified lower quotas are added, the sum is equal to the total number of representatives.

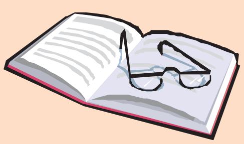
This apportionment procedure was not Thomas Jefferson's only contribution to mathematics.

Article I, Section 8 of the U. S. Constitution gives Congress the power to "fix the standard of weights and measures" for the nation. Thomas Jefferson, who was then serving as the first Secretary of State, proposed a base-ten system with a mixture of familiar and unfamiliar names for the units.

His basic unit of length was called a foot. The foot was divided into 10 inches. Each inch was divided into 10 lines, and each line into 10 points. 10 feet equaled a decade, 100 feet was a rod, 1000 feet a furlong, and there were 10,000 feet in a mile (making the Jeffersonian mile about twice as long as the traditional mile). His basic volume unit was the cubic foot, which he proposed to call a bushel. The basic weight unit was the ounce, defined so that a bushel of water weighed 1000 ounces. (This is very similar to the metric system, in which a liter of water weighs 1000 grams).

Jefferson thought mathematically all the time. His enthusiasm for a constant arithmetical monitoring of what went on around him was carried to remarkable lengths. For example, while watching a workman move dirt with a wheelbarrow, he would think, “It takes 7 minutes to fill the wheel barrow, and 5 minutes to move it to the new location. How many times must this be done to move the entire pile? How long will it take?” Sounds like a typical word problem used in one of today’s textbooks, doesn’t it?

Jefferson writes of his delight at helping his grandson with his math homework and explaining just what it was about mathematics that he found so satisfying.

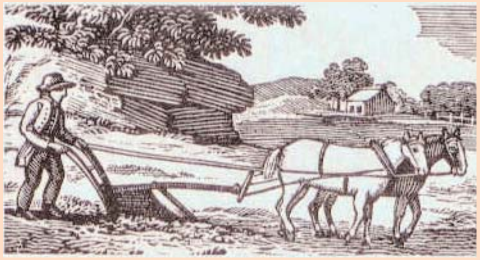


August 17, 1811

"Having to conduct my grandson through his course of mathematics, I have resumed that study with great avidity. It was ever my favorite one. We have no theories there, no uncertainties remain on the mind; all is demonstration and satisfaction."

At age 70, Jefferson described his passion in even more glowing terms:

"When I was young, mathematics was the passion of my life."



Jefferson also helped invent modern agricultural science and technology. He believed agriculture was the most important science. On his own, he re-engineered the plow according to scientific principles that came from Sir Isaac Newton, the inventor of mathematical physics. Re-inventing the plow may sound boring, but ask yourself: In Jefferson's time, what technological devices were more important than the plow?

Jefferson invented methods for excavating archeological sites. If you go to Jamestown today and watch researchers dig to discover how things really looked in the time of Pocahontas, you'll see them using methods first devised by Thomas Jefferson. He worked on what the best currency would be for the new country, coming down on the side of a dollar with decimal subdivisions.

Throughout his life, Jefferson kept up with the mathematical world, and spread knowledge about it to others. He also recognized good scientific work by other people, and he made sure that the world knew about it. When he came across the excellent mathematical work of Benjamin Banneker, America's first black man of science (see his biography on page 2), he sent it to Europe's greatest scientists.

Thomas Jefferson – President, diplomat, political thinker, author of the Declaration of Independence, architect, farmer, inventor, writer, musician – and mathematician.

Jean Davis teaches mathematics at Texas State University-San Marcos.

Puzzle Page

Math Explorers: We want to print your work! Send your original math games, puzzles, problems, and activities to Texas Mathworks, 601University Dr., San Marcos, TX 78666

Word Jumble

Unscramble the letters below and discover words that relate to:

Thomas Jefferson

TDAIOPL TQAUO

PUTNOLIPAO

IVIRIGNA CSSEUN

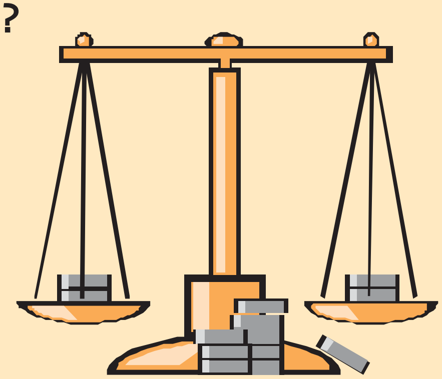
MNAATIHCEIMTA

TDENIRESP STRDANDA

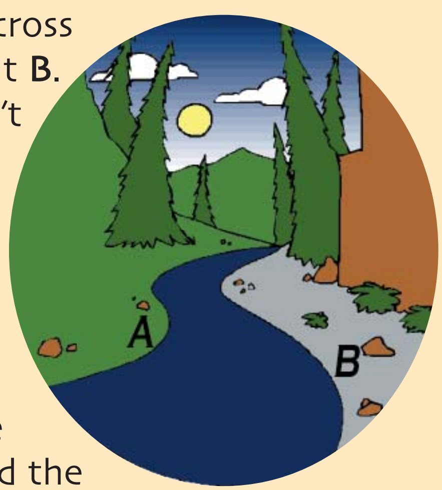
IHTCERCAT IDVOSIR

A camel must travel 200 miles across a desert to the nearest city. She has 300 bananas but can only carry 200 at a time. For every mile she walks, she needs to eat a banana. How can she get across the desert and still bring bananas to the city?

Drake has twelve coins. One coin is a counterfeit. The counterfeit coin is either lighter or heavier than a real coin. How can you find the counterfeit by weighing the coins only three times with a balance?



A traveler reaches a river at point **A** and wants to know the width of the river across to point **B**. He can't cross the river. What is the easiest way he can find the width?



Bulletin Board

Mathematics Competitions

The American Mathematics Competition (AMC) seeks to increase interest in mathematics and to develop problem solving ability with friendly mathematics contests for junior and senior high school students. Check out http://www.unl.edu/amc for more information.

Mathcounts is another competition program for middle school students. For more information go to www.mathcounts.org

Mathcamp 2003

Over 200 students attended the 8th annual Mathworks Junior Summer Math Camp held in San Marcos, Texas from June 3 to June 14. Students ranged in age from 7 to 13 and studied topics that included integer operations, fractions, functions, combinatorics, and contest math.
Go to http://www.txstate.edu/mathworks/ for details.

The Kodosky Foundation gives grant to Texas Mathworks Foundation

Mathworks received $25,000 from The Jeff and Gail Kodosky Foundation. This gift supports the Mathworks Junior Summer Math Camp, providing scholarships for students who could not otherwise attend.

Name Changes

As of September 1, 2003, Southwest Texas State University is Texas State University-San Marcos. We are now Texas Mathworks. Contact us at www.txstate.edu/mathworks

Joking Aside

Euclid: Dad, will you do my math for me tonight?
Dad: No son, it wouldn't be right.
Euclid: Well, you could try.

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MATH ODYSSEY

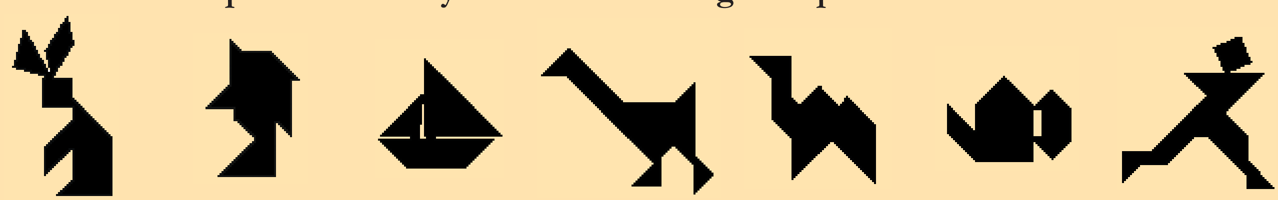
by Hiroko Warshauer

Chinese Puzzles

What do spaghetti, papermaking, gunpowder and tangrams have in common? They all originate from the ancient and great civilizations of China. There are many Chinese puzzles besides Tangrams that fascinate audiences worldwide. These puzzles include the Nine-ring Puzzle, which incorporates topological principles; the Hua-rang Trail puzzle, a figure-moving game; and the Lu Ban Lock, a puzzle consisting of 6 wooden bars that must be disassembled.

The earliest known reference to the tangram is in a Chinese book published in 1813. However, a tangram appears in a 1700's Japanese woodblock print by Utamaro. The tangram is a geometric puzzle consisting of 7 shapes cut from a square.

The shapes can then be arranged to create geometric figures. You may wish to copy the tangram and cut out the pieces. See if you can then arrange the pieces to form these various shapes.



Can you put the pieces back together to form a square? Can you create other shapes besides the ones above?

In 1942, two Chinese mathematicians determined that only 13 convex polygons (polygons that contain any line segment connecting two points inside the polygon) are possible.
Can you make the shapes?

If you use two 7-piece tangrams, you can prove the Pythagorean Theorem! There are variations of the tangram including a 15-piece tangram. A tangram is one way to combine mathematics and art along with mental recreation. Have fun!

Reference: China's Ancient Mathematical Toys Exhibition booklet by the China Science and Technology Museum and the Beijing Toys Association.
http://www.curiouser.co.uk/frames/creframe.html
http://www.curiouser.co.uk/tangram/tangram.html

Dear Math Explorers,

Welcome to a new season of Math Explorer! This fall, with elections and redistricting in the news, we start off with a timely article about one of our past presidents, Thomas Jefferson, and his mathematical interests. We revisit the biography of Benjamin Banneker, a contemporary of Thomas Jefferson, and his contribution to mathematics and government. The Math Odyssey looks at mathematical puzzles thought to have originated in China, including the Tangram. Explore the possibilities when you make your very own.

We look forward to bringing you interesting articles and biographies along with challenging puzzles and problems throughout the school year. We welcome hearing your solutions to puzzles and any suggestions or news you may wish to share with our readers.

Sincerely,

Hiroko K. Warshauer

Hiroko K. Warshauer, executive editor