Abacus

From the desk of the Abacus editor

Welcome back for another school year. I hope that you were able to relax and enjoy the great weather we had this summer. Now that you're back in the teaching mode, let me again encourage (beg?) you to submit activity ideas to the Abacus. I am particularly looking for les activitées en français and items that would interest Primary teachers.

In this issue of the Abacus, you will find a fascinating look at the mathematics underlying an ancient Mayan calendar, some games presenting variations on the traditional tic-tac-toe, and a multitude of suggestions for effectively teaching the concept of area using non-standard tiling materials. Finally, there is a reprint of an article first published in another journal in 1982, which is just as relevant for teachers today. Unfortunately a number of the items on this list still happen in math classes. Let's work to do the opposite, and teach children to LOVE mathematics, in 1994-95 and beyond. Have a terrific year!

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The Maya - Amazing Ancient Mathematicians



by M. Elaine Harvey

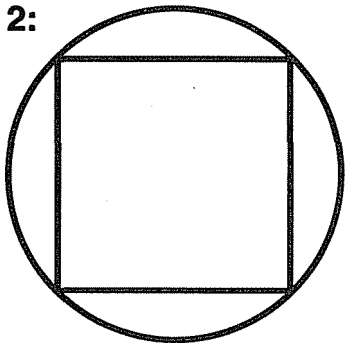
Introduction

What is special about January 1? February 2? April 1? May 24? or October 31? These are days in the Gregorian calendar that have special meaning for many of us every year. Sometimes Christians are named after the Saint on whose day they were born. Other cultures have similar practices. The Maya people of Mesoamerica — Mexico, Guatemala, El Salvador, Honduras and Belise — developed several different calendars. The most important was their Sacred Calendar called the Tzolkin. (See figure 1.)

The supreme being of the Maya world was called Hunab Ku. Hunab Ku was the god of measurement and movement. The symbol of Hunab Ku, who was considered the architect of the universe, was a circle with an inscribed square. (See figure 2.)

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Edited by Jennifer Weiner

Figure 2:



Pythagoras, who lived thousands of kilometres away from the Maya people, also represented the divine being as a square inscribed in a circle. The circle, to the Maya, symbolized the universe — the infinite, the spiritual. The square symbolized the earth — the material and the four elements: earth, air, fire and water. These elements actually represented the four states of matter: solid, gaseous, plasmic and liquid.

It was Hunab Ku as architect and god of measurement who designed the Sacred Calendar, the Tzolkin. The Tzolkin was divided into 13 months (each column is a month). Each month had 20 days (each row begins with a day name). The first day was 1 Imix; the second day was 2 Ik; and the last day of the first month was 7 Ahau. The last day of the Tzolkin cycle or year was 13 Ahau. Each of the twenty days was governed by a god who influenced the day for good or evil. Each of the thirteen numbers were also governed by gods with particular attributes. Maya people were named after the day on which they were born. It was felt that aspects of their personality were determined by the qualities of that day and its gods.

The Tzolkin not only represents a sacred year starting with the day identified as 1 Alligator, then 2 Wind, and ending with 13 Flower. (Read down the columns and from left to right.) This calendar also counts the Sacred Years. The first year of time was called 1 Alligator, and it started with Day 1 Alligator. It will take exactly 260 years to reach Year 1 Alligator again.



The Magic of the Calendar

1. Choose a number in a box on the calendar. Count 13 squares (not counting the square you started with) and the same number appears again. (Remember: Read down the columns and from left to right.)
2. Choose a number on the calendar. Note the numbers surrounding it. Now find the same number elsewhere on the calendar. The same numbers are arranged around it in the same pattern.
3. What number is at the very centre of the calendar? Of course, there is no number at all. The centre is between 13 Dog and 1 Monkey. This is the "great void" that Tezcatlipoca, the dark lord, spoke about in the sacred book of the Maya called the *Popol Vuh.* It is the point of total balance.
4. Mark off the centre "month" or column which is called the Mystic Column. Divide the rest of the calendar into 4 equal quarters by drawing a horizontal line across the middle (between Dog and Monkey).

   (a) How many squares are there in each quarter?

   (b) Now take one-quarter of the number of squares in the mystic column and add your answer to part (a). What do you get?
5. Two of these quarters are "twins" — the upper right

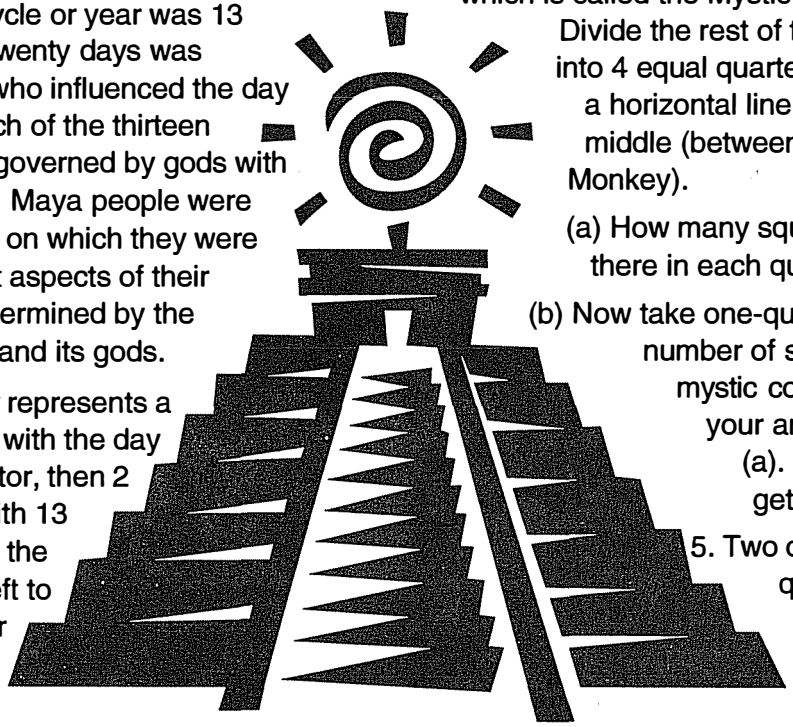


Figure 1: The Tzolkin, Sacred Calendar of the Maya

Imix	Alligator	1	8	2	9	3	10	4	11	5	12	6	13	7
Ik	Wind	2	9	3	10	4	11	5	12	6	13	7	1	8
Akbal	Night	3	10	4	11	5	12	6	13	7	1	8	2	9
Kan	Maize	4	11	5	12	6	13	7	1	8	2	9	3	10
Chicchan	Serpent	5	12	6	13	7	1	8	2	9	3	10	4	11
Cimi	Death	6	13	7	1	8	2	9	3	10	4	11	5	12
Manik	Deer	7	1	8	2	9	3	10	4	11	5	12	6	13
Lamat	Venus	8	2	9	3	10	4	11	5	12	6	13	7	1
Muluc	Water	9	3	10	4	11	5	12	6	13	7	1	8	2
Oc	Dog	10	4	11	5	12	6	13	7	1	8	2	9	3
Chuen	Monkey	11	5	12	6	13	7	1	8	2	9	3	10	4
Eb	Teeth	12	6	13	7	1	8	2	9	3	10	4	11	5
Ben	Reed	13	7	1	8	2	9	3	10	4	11	5	12	6
Ix	Jaguar	1	8	2	9	3	10	4	11	5	12	6	13	7
Men	Moon	2	9	3	10	4	11	5	12	6	13	7	1	8
Cib	Buzzard	3	10	4	11	5	12	6	13	7	1	8	2	9
Caban	Movement	4	11	5	12	6	13	7	1	8	2	9	3	10
Etznab	Obsidian	5	12	6	13	7	1	8	2	9	3	10	4	11
Cauac	Rain	6	13	7	1	8	2	9	3	10	4	11	5	12
Ahau	Flower	7	1	8	2	9	3	10	4	11	5	12	6	13

and the lower left. Add the corner numbers of the upper right quarter and circle them. Then add the corner numbers of the lower left quarter and circle them. Is your answer in each case the same perfect number?
(A perfect number is equal to the sum of its factors.)

6. The twins represent 2 of the 9 lords of darkness. There are 7 more that have the same moon value of 28. (The moon cycle is approximately 28 days.)

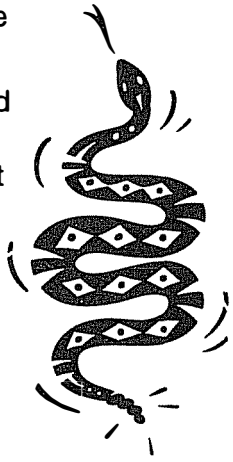
(a) Find some more lords of darkness by dividing each quarter into fourths. This gives us 4 more lords of darkness. Can you find them?



Circle those moon value numbers. (Remember: Four numbers add together to give the moon value (28) in each case.)

(b) There are also 2 lords of darkness at the joining corners of the fourths. Can you find them? Again, circle the numbers.

(c) There is one, the divided one, at the very centre of the calendar. Does it also have the moon value? Circle these numbers.



You have circled the numbers that represent the 9 lords of the night. The moon is their sign.

7. (a) Add up the numbers at the corners of the whole calendar. Remember your answer and shade the numbers.

   (b) Continue inward, adding the numbers in the corners of each successive smaller rectangle shading the numbers of each corner.

   (c) When the squares touch the mystic column (the centre column), continue along the mystic column.

   (d) Now mark the corners of a rectangle that is 5 squares wide and 6 long that has the "great void" at its centre. Then continue by adding 1 to the left side and 1 to the right side, and subtracting 1 from the top and 1 from the bottom until the corners meet the line through the "great void". How many answers of 28 do you get?

The Maya called these the thirteen heavens, and the pattern you have shaded is called the harp of Maya. It resembles the Maya symbol for Movement, another symbol for Hunab Ku.

8. There are exactly 65 perfectly balanced 28's within the Sacred Calendar. Can you find them all? (We have found 9 + 13 = 22 so far.)

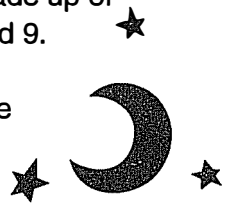
   These 28's are made up of 4 numbers. 4 x 28 = 260 which is the number of days in the calendar. 28 x 65 = 1820 and 1820 is a number that will appear again in our calculations. See if you can find it.

9. An astronomical priest would place one kernel of corn in the first square of the Sacred Calendar, 2 in the second, 3 in the third, and so on.

   (a) How many kernels would be needed for the first 13 squares?

   (b) After reaching the 13th square, start again with one kernel on the next square, etc. How many kernels would be needed for the whole Sacred Calendar?

10. The Maya believed that they were living in the 5th world. The first world was called 4 Jaguar, the second 4 Wind, the third 4 Rain, the fourth 4 Water, and the fifth 4 Movement. Each world consisted of twenty-two 52-year cycles of the Sacred Calendar. 22 is made up of the numbers 13 and 9. (Remember the 13 heavens and the 9 dark lords?)



   (a) How many sacred years are there in each world?

   (b) How many sacred years are there in 5 worlds?

The fifth world was thought to have ended on August 16, 1987. That is 5720 sacred years since the beginning of time.



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According to Arguelles, human history has been shaped during the time framed by the Mayan Calendar Great Cycle — 3113 B. C. to 2012 A. D. — by a galactic beam through which the Earth and Sun have been passing. This book offers a profound shift in consciousness which involves viewing time and evolution from a multi-dimensional perspective.

Freidel, David, Linda Schele, and Joy Parker. *Maya Cosmos: Three Thousand Years on the Shaman's Path.* New York: William Morrow and Company, Inc., 1993.



This is perhaps the most important book that has been published on the Maya. The authors are ethically aware and are careful not to culturally exploit the Maya. The incredible insights into this ancient culture are enhanced by both meticulous drawings and coloured photographs.

Shearer, Tony. *Beneath the Moon and Under the Sun: A Poetic Re-appraisal of the Sacred Calendar and the Prophecies of Ancient Mexico.* Santa Fe, New Mexico: Sun Publishing Company, 1975.

Tony Shearer, a Lakota (Indian), offers an ethnic and poetic interpretation of the ceremonial calendar used in Central America. Here one can begin to understand the spiritual prophecies and the metaphysical phenomena of the past and the future of the world as interpreted through the Sacred Calendar.

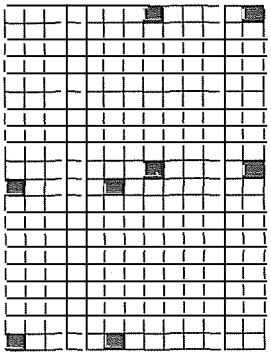
Stuart, Gene S. and George E. Stuart. *Lost Kingdoms of the Maya.* Washington, D.C.: National Geographic Society.

The Stuart family are outstanding Mayanists. This book and the video by the same name provide the kind of excellent visual representation of this culture that one has come to expect of the National Geographic Society. They can do nothing but enrich the written material.

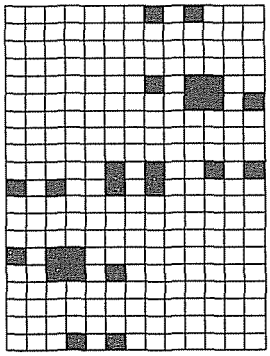
Answers

4. (a) 60 (b) 65

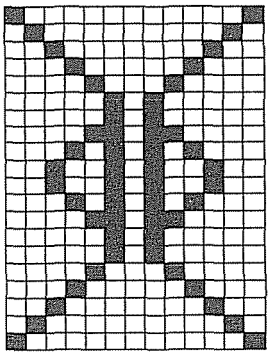
5. 28



6.

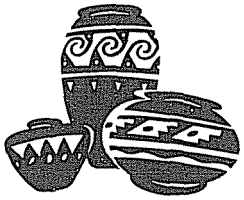


7. 13 answers of 28



9. (a) 91 (b) 1820

10. (a) 1144 (b) 5720



TILING EXPLORATIONS

Acknowledgement:
This activity was submitted by Wendy Ayoub-Wade, Jane Lind and Sharon Young, from the Wellington County Board of Education.

Objectives:

- to explore the concept of area with non-standard measuring tools
- to estimate and compare findings using different non-standard materials
- to record using chart format

Materials:

- objects to cover
  (e.g. coloured paper, table tops, books, floor tile, game box, poster, clothing, child's silhouette)
- measuring tools
  (e.g. ceramic tiles, playing cards, pattern blocks, paint chips, paper squares)

Teaching Strategies and Student Activities:

Students:

- estimate how many non-standard units it will take to cover a surface
  - do this each time before covering a surface area
- cover several surfaces with the same non-standard measuring materials
- cover one surface, several times, with a variety of non-standard measuring materials
- measure and record on individual charts
- use the chart information to estimate and measure other surfaces

Teacher:

- encourages students to use their findings for a comparative class chart (patterns should be noted and discussed)

Evaluation:

- improvement in estimating
- tiling accuracy
- the variety of materials used
- motivation to try more materials
- extends activity to include more surfaces
- extends activity to include more non-standard units

Extensions/Modifications:

- increase difficulty by using smaller units and larger surfaces
- teacher challenges students to cover a surface with the most or fewest number of materials
- increase or decrease the complexity of the shape of the region
- make as many different shapes as possible using only five squares, the sides must be touching
- create designs using geoboards and paper squares, record on geopaper
- calculate the perimeter and area of the region
- make a "blob" painting and use to compare areas of non-rectangular regions
- make pattern block designs that have the same area; record designs on paper using pattern block shapes

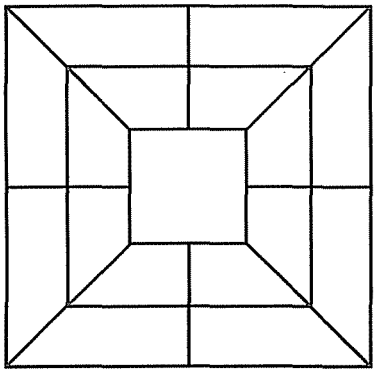
Resources:

Film: The Blob

Nine-Men-Morris

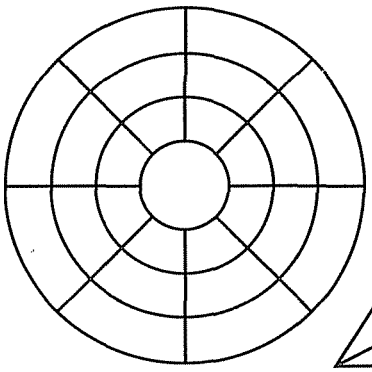
Acknowledgement:
This game, submitted by Gerry Vervoort from the Faculty of Education at Lakehead University, is recommended as a small group activity.

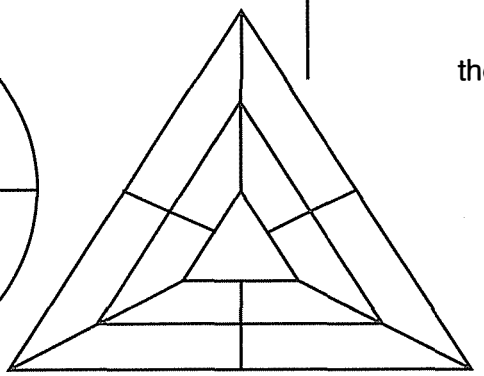
This is an ancient game, somewhat similar to tic-tac-toe. It was played by shepherds, who would scratch the following diagram in the sand. You may find it more convenient to draw your diagram on paper however.



Two players take turns placing circles and crosses where the lines intersect. The first player to get "three-in-a-row" on any straight line wins.

1) Play the game several times with a friend to get a feeling for it.
2) Find a strategy so that the person who starts can always win.
3) Extend the strategy so that the person who starts can always win regardless of where the first mark is placed.
4) Change the diagram and make the rules for a variation in the game (concentric circles, nested triangles, four-in-a-row). Is your variation an improvement?





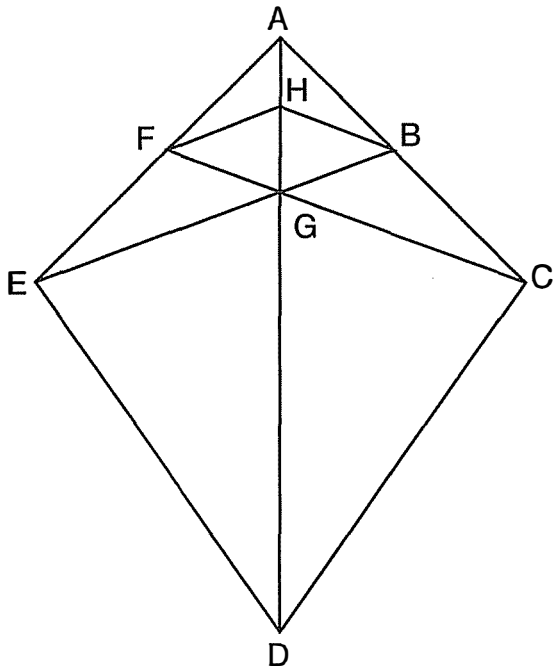
Jam

Acknowledgement:
This game, invented by John A. Michon, was originally included as an Abacus activity in the February 1984 issue. It provides an interesting variation on both the Nine-Men-Morris game and on the traditional tic-tac-toe game.

The game is played on a network similar to the one shown below.

The players take turns, using different coloured pens or pencils, to "eliminate" one of the nine roads. Roads are "eliminated" by colouring the entire length of the road segment, even though it may go through one or two towns.

Whoever manages to take all the roads through a town wins.



Who has the advantage, the first player or the second player?

Will there always be a winner?

This game is really tic-tac-toe in disguise. Can you explain why?

HOW TO TEACH CHILDREN TO HATE MATHEMATICS*

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Children generally do not hate mathematics when they start school. This is a trait which they acquire as a part of their elementary school training.

The feat of loathing mathematics can generally be accomplished if the teacher will use one or more of the following procedures.

1. Assign the same work to everyone in the class. This technique is effective with about two-thirds of the class. The bottom third of the class will become frustrated from trying to do the impossible while the top third will hate the boredom. WARNING: This MAY NOT be effective with about the middle third of the students.

2. Go through the book, problem by problem, page by page. In time, the drudgery and monotony is bound to get to them. Assign written work every day. Before long, just the word "mathematics" will remove every smile in the room.

4. Be sure that each student has plenty of homework. This is especially important over weekends and vacation periods.

5. Never correlate mathematics with life situations. A student might find it useful and get to enjoy math.

6. Insist there is ONLY one correct way to solve each problem. This is very important as some creative student might look for different ways to solve a problem. He or she could even grow to like math.

7. Assign mathematics as a punishment for misbehaviour. The association works wonders. Soon math and punishment will take on the same meaning.

8. Be sure that ALL students complete ALL the review work in the front of the textbook. This ought to last until Thanksgiving or Christmas, and is certain to kill off the interest of most students.

9. Use long drill type assignments with many examples of the SAME type of problem. (For example: 30 long column addition problems.) This type of assignment requires little teacher time and keeps the student occupied for a long time. The majority of the pupils are sure to dislike it.

10. Always insist that papers are prepared in a certain way. Name, date, page number, etc., must each be placed in a specific spot. If a student fails to follow this procedure, tear up his or her paper and let the student start over again. Instant humiliation and despair are almost guaranteed.

11. Lastly, insist that EVERY problem worked incorrectly be reworked until it is correct. This procedure is most effective in promoting distaste for math and if followed very carefully, the student may even learn to detest his or her teacher as well!

***Editor's note:** This article was previously published in* **School Science and Mathematics,** *Volume 82, March 1982, p.261. However, I feel that its message is still relevant today and deserves to be stated again.*