Shadow Math P+IA

Thales is famous for measuring the height of pyramids using their shadows. This is an at-home activity that replicates his method. The object is to find the height of your Cheops pyramid that you built in the previous activity, or any other object using Thales' method.

1) **Obtain a bright light** to model the sun. The brighter the better.

2) **Obtain a figure to stand in for Thales**. One way to make the math accessible to younger kids is to use a block from a base 10 set that is scored in units, say a three or four unit block. Older kids can use any figure and measure it.

3) **Position the bright light a distance away** so that it shines at an angle on the block or figure standing in for Thales. **Measure Thales' shadow**. To make the math simpler, intentionally position the light so that the shadow is an even number of units. For example, if you use a three-unit block, and position the light so the shadow is six units long, making the ratio of his height to his shadow 1 to 2, making the math easy enough for a any child who understands doubling to understand.

4) Compute the ratio of Thales' height to his shadow. (In the case above, this 1/2)

5) Now place your pyramid next to "Thales" (your block or figure). Find the center of the side, and **measure the shadow <u>from the center</u> to the end of the shadow**. Be sure to use the same units you used to measure Thales' shadow.

6) Multiply the shadow length by the ratio you calculated for Thales' height/shadow. This should be very close to the height of the pyramid.

7) You can check your answer by placing one other object, such as another block of a different number of units, and checking that the shadow length correctly predicts the height. The sharper the shadow, the more accurate the measurement.

	Height	Shadow length	Ratio H:S = H/S
Thales			
Pyramid			
Other Object			

Petals Around the Rose

Volume 2 of Historical Connections in Mathematics includes two handouts for the deductive puzzles, “Stars Around the Moon,” also known as the “Petals Around the Rose” puzzle. If you do not have the handouts, these are online versions of these puzzles, but is more fun to play it as a game.

The game is played with five dice.

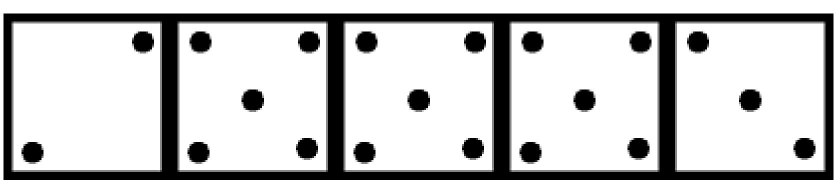
The dice are rolled by a person who knows the secret of the game. For each roll of all dice, there is a single solution. The players then attempt to arrive at this solution. If they do not, the Potentate of the Rose will tell it to them, and it is their task to figure out the solution for the next roll.

There are three rules:

1. The name of the game is "Petals Around the Rose," and the name of the game is the key to the game.
2. The answer is always zero or an even number.
3. Anyone who knows the game may give the answer to any roll, but they must not disclose the reasoning.

The leader, sometimes known as the **Potentate of the Rose,** can only tell others these three rules, as well as the "answer" to each roll. Getting six correct answers in a row is usually considered proof that you know the solution, and have become a new Potentate of the Rose.

Stars Around the Moon or Petals around the Rose logic puzzle



How many stars are around the moon? 14 in this case.

Petals Around the Rose Solution

The "rose" is the center dot on any face that has one (i.e., 1, 3, and 5) and the "petals" are all dots around it.

The 1 face has no petals, the 3 face has two petals and the 5 face has four petals. The dice faces without center dots (i.e., 2, 4, and 6) do not count, there is no center for a rose to have petals!

Counting the total petal dots yields that round's answer.

Another way to arrive at the solution is to sum the faces of odd dice, and then subtract the number of them. Thus, in a roll of 2, 3, 4, 5, and 3, the odd faces sum to 11. There are three odd dice, so the solution is 11 – 3, or 8.

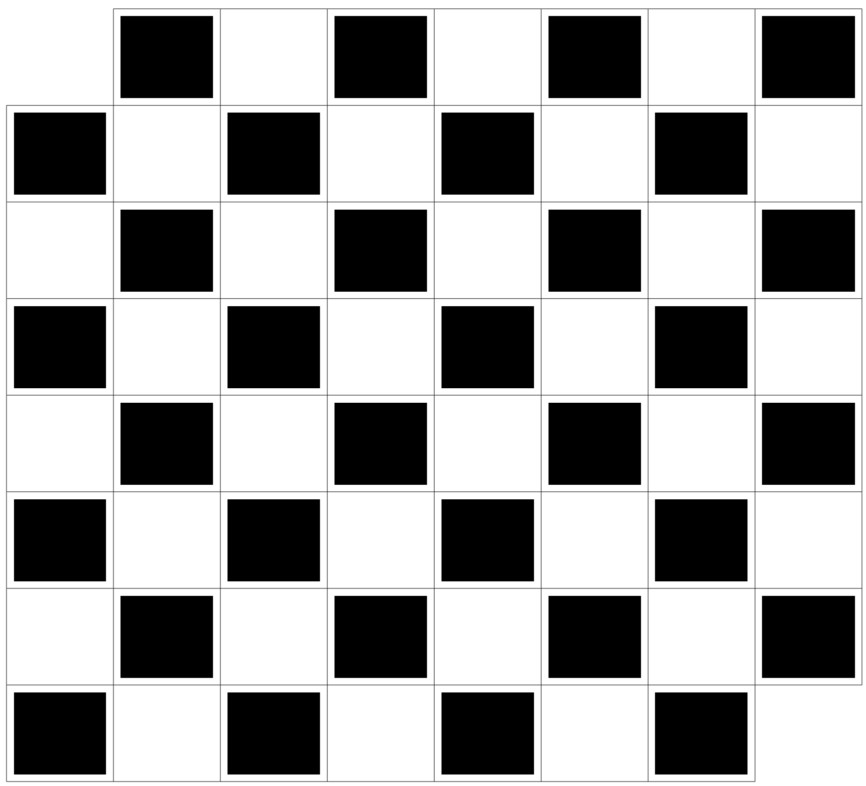
You can play this game online here: http://www.freeworldgroup.com/games/roses/

Dominoes on a Checkerboard Problem PIA

This is another classic puzzle that Historical Connections has a handout for, but there are extended versions of it here. Primary can do this if modeled with real objects.

Suppose you have a 64-square checkerboard and 32 dominoes. Each domino is the right size to exactly cover two squares on the board, and so they can cover all 64 of the chess board squares.

But now suppose we cut off two squares at diagonally opposite corners of the board and discard one of the dominoes. Let's take a checkerboard that has these two squares missing, like so:



Is it possible to place the 31 dominoes on the board so that all the remaining 62 squares are covered? If not, how can you prove it is impossible?

Here is an online version of this puzzle is found at:
http://www.teamten.com/lawrence/puzzles/dominoes_checkerboard.html

More puzzles like this can be found at http://www.cut-the-knot.org/do_you_know/chessboard.shtml

Pythagorean Discoveries (I)(A)

Historical Connections in Mathematics Volume 1 includes activities related to Pythagoras. The following have been suggested as activities. It is recommended, but not required, that Number Shapes and Figurate Families be done first. If you don't, be sure you understand what figurate numbers are from the Math Activities section of this lesson.

Use this table to find some of the relationships between triangular, square and oblong numbers*

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 plsu one is a(n) __________ number.
4) Three times any triangular number plus the next triangular 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.