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Non-Routine Problem Solving Activities

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The National Council of Teachers of Mathematics (NCTM) has long advocated problem solving as a central component of the K-12 mathematics curriculum. The *Principles and Standards for School Mathematics* suggests that: "By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that will serve them well outside the mathematics classroom. In everyday life and in the workplace, being a good problem solver can lead to great advantages" (NCTM, 2000, p. 52). There are many types of problems that students encounter in their mathematics classes, but most are considered routine problem solving activities. These usually involve the direct application of an algorithm to a word problem.

On the other hand, non-routine problems focus on a higher level of interpretation and organization of the problem rather than on application of an algorithm. These problems tend to encourage logical thinking, expand students' understanding of concepts, develop mathematical reasoning power, develop students' abilities to think in more abstract ways, and allow for a transfer of mathematical skills to unfamiliar situations. Teachers usually have a more difficult time gathering these types of problems since there may not be many included in the textbooks they are using in their classrooms.

The internet can be a helpful resource in providing non-routine problem solving activities for elementary school students. Some of these sites post problems which change daily or weekly, while others post many types of problems on their sites which are more long term. This list is not meant to be exhaustive, it only offers a few suggestions for some established internet sites:

mathforum.org (homepage has problems of the week)

mathcats.com (homepage has problem of the day)

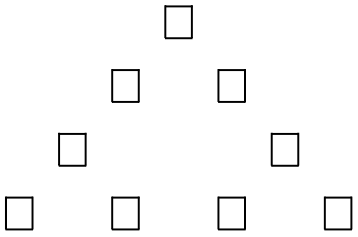
mathsurf.com (choose mathfun link and find elementary problem of the week)

eduplace.com/math/brain (choose a question of the day by grade level)

mathcounts.org (choose Problem of the Week)

The following are some non-routine problems which have appeared in some textbooks, on internet sites, or in children's magazines as "brain teasers." The answers are at the end of the problems.

(1) Use the numbers 1-9 and place them in the boxes of the triangle so that each side of the triangle has a sum of 20. All numbers must be used once and only once.



(2) In the yard there are some 3-wheel bikes and some 4-wheel wagons. If there are exactly 29 wheels, how many are bikes and how many are wagons?

(3) An amoeba is placed in a jar at 2:00 p.m. It reproduces every 20 minutes. How many amoebas will be in the jar just after 6:00 p.m. that day?

(4) How many eggs are in the basket if

(a) There are fewer than 6 dozen eggs, and

(b) Counted 2 at a time, there is 1 left over, and

(c) Counted 3 at a time, there are none left over, and

(d) Counted 4, 5, or 6, at a time, there are 3 left over?

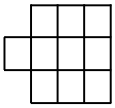
(5) In a non-leap year, what day is exactly in the middle of the year and what time is it?

(6) Which number is different? Explain.

$$25, 65, 51, 53, 93, 135, 55$$

(7) There are 6 people in the room. Each person shakes hands with every person except himself. How many handshakes would there be?

(8) Place the numbers 0-9 in the boxes so that no consecutive numbers are placed next to each other: horizontally, vertically, or diagonally.

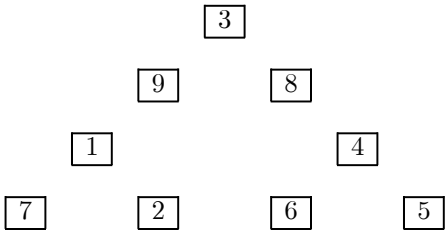


(9) What is the largest amount of money you can have using U.S. coins and still not be able to make a dollar exactly?

(10) There is a big jar of coins that contains nickels, dimes and quarters. There is the same amount of each coin. The total amount of money in the jar is $100. How many nickels, dimes, and quarters are in the jar?

Answers:

(1)



(2) Bikes: 7 and Wagons: 2, or Bikes: 3 and Wagons: 5

(3) 4,096

(4) 63

(5) July 2 at noon

(6) Answers will vary (e.g., 55 is the only "double-digit" number; 25 is the only square number; 53 is the only prime number.)

(7) 15

(8)

	4	2	6
1	7	0	8
	9	5	3

(9) $1.19 (3 quarters, 4 dimes, 4 pennies)

(10) 250 of each coin

Reference:

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.