Pure Primes

A new game inveted by Ali Adams ©2009

What's in the Box

- **A 10x10 square board with 100 squares numbered 1 to 100.**

  Odd number squares are colored black text on white background [white].

  Even number squares are colored white text on black background [black].

  Prime numbers are colored vividly red text on white background [red] except square 2 which is colored red text on black background [2] because 2 is an even prime number.

  Square 1 is colored blue text on white [1] because 1 is not a prime number but is the Unit for all numbers.

- **Two cubed dice with faces numbered 1, 2, 3, 4, 5 and 6.**
- **Four colored markers [ ] [ ] [ ] [ ].**

Game Goal

The goal of the game is to reach 100 without exceeding it.

Game Rules

Dice values can be added or subtracted to move forward if the player is currently on an odd number square (1, 3, 5, 7, 9, …), or backward if the player is currently on an even number square (2, 4, 6, 8, 10, …).

If the player is currently on a prime number square (2, 3, 5, 7, 11, …).then dice values can be added, subtracted or multiplied to move forward.

Note that although 2 is an even number, it is also a prime number and a player moves forward if he or she is currently on it. 2 is the only even prime number.

Any player reaches 100 without exceeding it wins.

How to Play

2-4 players can play against each other. Each player rolls the dice and the sum of each player's dice value determines the starting order from highest to lowest.

All players start outside the board. Each player rolls the dice and choose to add or subtract the two dice values and put his or her colored marker on the square corresponding to the addition or the subtraction result (even if already occupied by another player) and wait his or her turn.

Once a player gets his or her turn, he or she rolls the dice again and based on his or her current square number (even, odd, or prime) choose to add, subtract or multiply and move forward or backward a number of steps equals to the result of addition, subtraction or multiplication. See rules above.

If a player goes backward beyond 1 to outside the board then he or she must restart the game.

Game Education

This game introduces players to prime numbers and their secrets.

Natural numbers are the normal counting number people use like 1, 2, 3, 4, 5, …

Prime numbers are those natural numbers that can only be divided by 1 and themselves like 2, 3, 5, 7, 11, 13, 19, 23, …

All other natural numbers (except 1) are called composite numbers and are divisible by more than two numbers. For example: 6 is divisible by 1, 2, 3, and 6.

1 is neither prime nor composite. 1 is the basic building block for all natural numbers. It is called the Unit. For example: 5=1+1+1+1+1 or five units.

Prime numbers are the basic building factors for all natural number. Any natural number is equal to a unique multiplication of one or more prime numbers. For example: 1=1, 2=2, 7=7, 9=3x3, 12=2x2x3, or 60=2x3x5.

Prime numbers become less and less frequent as we go up but never end. Their distribution of prime numbers among natural numbers does not follow any regular pattern but a German mathematician named Riemann proposed that the distribution of prime numbers is hidden within his generalized zeta function:

$$\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s} = \frac{1}{1^s} + \frac{1}{2^s} + \frac{1}{3^s} + \cdots.$$

Currently there is a $1,000,000 prize offered by the Clay Mathematics Institute to anyone who can prove or disapprove the Riemann hypothesis.

Another German mathematician called Euler made a direct relationship between natural numbers and prime numbers. He proved that the Riemann zeta function above (sum of a series of natural number terms) is equal to his product formula (multiplication of a series of prime number terms):

$$\prod_{p \text{ prime}} \frac{1}{1-p^{-s}} = \frac{1}{1-2^{-s}} \cdot \frac{1}{1-3^{-s}} \cdot \frac{1}{1-5^{-s}} \cdot \frac{1}{1-7^{-s}} \cdots \frac{1}{1-p^{-s}} \cdots.$$

Is 1 a Prime Number?

1 was considered a prime number until 1899 when it was dropped to simplify mathematics with heated arguments for excluding or including it.

See this mirror symmetry within 1 to 10 if 1 was considered a prime number ☺

1 2 3 _ 5 _ 7 _ _ _ mirror _ _ _ 4 _ 6 _ 8 9 10

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Riemann Hypothesis

Some numbers have the special property that they cannot be expressed as the product of two smaller numbers, e.g., 2, 3, 5, 7, etc. Such numbers are called *prime* numbers, and they play an important role, both in pure mathematics and its applications. The distribution of such prime numbers among all natural numbers does not follow any regular pattern, however the German mathematician G.F.B. Riemann (1826 - 1866) observed that the frequency of prime numbers is very closely related to the behavior of an elaborate function

$$\zeta(s)=1 + 1/2^s + 1/3^s + 1/4^s + \ldots$$

called the *Riemann Zeta function*. The Riemann hypothesis asserts that all *interesting* solutions of the equation

$$\zeta(s)=0$$

lie on a certain vertical straight line. This has been checked for the first 1,500,000,000 solutions. A proof that it is true for every interesting solution would shed light on many of the mysteries surrounding the distribution of prime numbers.

Millennium Problems

In order to celebrate mathematics in the new millennium, The Clay Mathematics Institute of Cambridge, Massachusetts (CMI) has named seven *Prize Problems*. The Scientific Advisory Board of CMI selected these problems, focusing on important classic questions that have resisted solution over the years. The Board of Directors of CMI designated a $7 million prize fund for the solution to these problems, with $1 million allocated to each. During the Millennium Meeting held on May 24, 2000 at the Collège de France, Timothy Gowers presented a lecture entitled *The Importance of Mathematics*, aimed for the general public, while John Tate and Michael Atiyah spoke on the problems. The CMI invited specialists to formulate each problem.

One hundred years earlier, on August 8, 1900, David Hilbert delivered his famous lecture about open mathematical problems at the second International Congress of Mathematicians in Paris. This influenced our decision to announce the millennium problems as the central theme of a Paris meeting.

The rules for the award of the prize have the endorsement of the CMI Scientific Advisory Board and the approval of the Directors. The members of these boards have the responsibility to preserve the nature, the integrity, and the spirit of this prize.

Paris, May 24, 2000

Please send inquiries regarding the Millennium Prize Problems to prize.problems@claymath.org.

	99	98	97	96	95	94	93	92	91
81	82	83	84	85	86	87	88	89	90
80	79	78	77	76	75	74	73	72	71
61	62	63	64	65	66	67	68	69	70
60	59	58	57	56	55	54	53	52	51
41	42	43	44	45	46	47	48	49	50
40	39	38	37	36	35	34	33	32	31
21	22	23	24	25	26	27	28	29	30
20	19	18	17	16	15	14	13	12	11
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PurePrimes Demo

www.heliwave.com/PurePrimes.zip