
Directions to the Teachers:

After providing background information about the GRACE mission to the students, but do not show a picture of the satellites, copy and distribute the clues to "GRACE by the Numbers." Either have the students work individually or in groups. Using their mathematical abilities, students will complete the number problems relating to the GRACE satellite. Place the answers in their correct location on the number grid.

Extensions:

1. Ask student to reconstruct the shape of the satellite based on the information provided by the solved puzzle.
2. Ask them whether they can find out the size of the Earth after completing the puzzle. Hint: Look at 6 Across and 10 Down.
3. Develop a new space science themed puzzle. One copy should be blank and one copy should have the answers included. After review, the teacher will distribute puzzles for student completion in class. An example of a web site to use as a resource is:
<http://www.puzzlemaker.com/>

Complete the mathematics crossword at: <http://www.surfnetkids.com/games/math-cw.htm>

References / Resources:

To learn more about the mission, visit: <http://www.csr.utexas.edu/grace>

<http://www1.tpgi.com.au/users/puzzles/page2.html>

<http://www.rhlschool.com/math5n32.htm>

<http://www.mathgoodies.com/puzzles/>



GRACE Education Curriculum Satellites	
Teachers	Grades 6-8
Math	

GRACE by the Numbers Puzzle

Across:

- 2 GRACE was launched in 2002, although the original planned launch year was _____. Evaluate $(2 \times 10^3) + (0 \times 10^2) + (0 \times 10^1) + 1 \times 10^0$ to find out.
- 4 Multiply 19,437 by $1/10$, round the result to the nearest integer, and you discover the base length of GRACE's trapezoid panel in mm.
- 6 GRACE's altitude (the height above the surface of the Earth) reached $X \times X \times V$ km after insertion to orbit. Hint: the letters represent roman numerals.
- 7 When a satellite covers this many degrees along its orbit, it completed one full revolution.
- 8 Round 359.5096 to the nearest hundredth. Add 334.49. The number is the shortest side of the trapezoid panel in mm.
- 11 The factorization of this number is $2 \times 5^2 \times 7$. Note: The largest prime in this expression is equal to the orbital velocity of GRACE in km/sec.
- 13 Convert $1\frac{1}{2}$ hours into minutes. It is the orbital period of GRACE.
- 14 Write 8.16×10^2 in standard form to get the height of GRACE's trapezoidal side.
- 15 What is the maximum number of days of data used in a monthly gravity solution?
- 17 This simplified ratio for "2 in 250" is the failure rate for the booster rocket that launched GRACE into space. (Hint: it's 1 to what?)
- 19 Find $2^1 \times 3^3 \times 5$. This is the maximum distance in km the GRACE satellites are allowed to be separated.
- 20 Same as 12 DOWN, but in megabytes.

Down:

- 1 3×10^4 is the approximate number of observations GRACE makes every day.
- 4 If you add the number that is neither prime nor composite and multiply it by 10, you get the precision of GRACE's measurement in micrometers.
- 3 What percentage is represented by the decimal 0.15? That is about how many orbits GRACE completes in a day.
- 5 If you add 134.5 yards and 18 inches, you have _____ inches. It is the same as the number of seconds it took to put GRACE into orbit.
- 7 End to end, a GRACE satellite measures 0.0003161×10^7 mm.
- 9 The square root of this number is the same as GRACE's orbital speed in km/sec.
- 10 The next even number after six thousand eight hundred seventy-four gives you the distance from GRACE-1 to the center of the Earth in km.
- 12 Find 25% of 200. This is approximately how many megabytes of information are downloaded from GRACE each day. Express it in kilobytes before writing it in.
- 16 Information is being downloaded every XII hours from GRACE to the ground.
- 18 $16 \times 1\frac{1}{2}$ is the number of degrees the ground track shifts after each full orbit.



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GRACE BY THE NUMBERS GRACE SATELLITE NUMBER PUZZLE

GRACE SATELLITE

The crossword puzzle grid consists of white squares on a black background. The grid is shaped like a satellite. The numbers are placed at the start of the puzzle's paths:

- 1: Down, 10 squares
- 2: Down, 3 squares
- 3: Down, 3 squares
- 4: Down, 3 squares
- 5: Down, 3 squares
- 6: Down, 3 squares
- 7: Down, 3 squares
- 8: Down, 3 squares
- 9: Down, 3 squares
- 10: Down, 3 squares
- 11: Down, 3 squares
- 12: Down, 3 squares
- 13: Down, 3 squares
- 14: Down, 3 squares
- 15: Down, 3 squares
- 16: Down, 3 squares
- 17: Down, 3 squares
- 18: Down, 3 squares
- 19: Down, 3 squares
- 20: Down, 3 squares

**GRACE BY THE NUMBERS
ANSWER KEY**

A crossword puzzle grid is displayed on a black background. The grid contains the following numbers and digits:

- 1 3
- 2 2
- 3 0 0
- 4 1 9 4 4
- 5 4 4
- 6 5 0 0
- 7 3 6 0 0
- 8 6 9 4
- 9 4
- 10 6
- 11 3 5 0
- 12 5 0
- 13 9 0
- 14 8 7 6
- 15 3 1
- 16 1
- 17 1
- 18 2 5
- 19 2 7 0
- 20 5 0

GRACE
SATELLITE
answer key