
Directions to the Teacher:

1. Review the background information about the GRACE satellite. Place emphasis on the mathematics of the GRACE mission. If you are using this activity as a group activity, distribute a copy of "The Cards" handout to each group. Distribute 24 colored index cards to each group. The students will cut the cards apart and glue the question to one side of the card and the answer to the other. If you are conducting a group or classroom activity, you may want to copy "The Cards" handout onto cover stock paper and fold the card so that the question is on one side and the answer is on the other. Additional cards could be made if there are more than 24 students in the class. If this is done in groups of three or four students, each group will need their own set of cards.
2. Choose one student to begin the activity.
3. The student should read "I Have....Who Has?" text question for the Mathematics of GRACE.
4. The person who has the matching numerical answer on their card responds with the correct answer.
5. The student then turns their card over and reads the question on their card.
6. The student that has the correct answer responds.
7. The students continue to answer until the last card is matched with the card that started the activity.
8. You can do this several times and try to beat the time of the previous round.

Extensions:

Use the GRACE website to find additional numerical answers that students can use to write additional "I Have....Who Has" questions for the cards.

Students will develop another "I Have...Who Has" card game related to space.

References / Resources:

<http://itss.raytheon.com/cafe/qadir/aearth.html>

<http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Space.Based.Astronomy/>

THE CARDS

<p>I have 2.001×10^3.</p> <p>Who has the first prime number?</p>	<p>I have 2, the number of satellites that make up GRACE.</p> <p>Who has a range of 100?</p>	<p>I have 170-270 km, the distance the GRACE satellites are apart.</p> <p>Who has $2 \times 3 \times 5$?</p>	<p>I have 30 days. This is how often GRACE will send information to Earth.</p> <p>Who has $2(2x+3)=26$?</p>
<p>I have 5 years, GRACE's lifetime.</p> <p>Who has 100010, base 2?</p>	<p>I have 34 kg, the fuel mass of GRACE.</p> <p>Who has the square root of 81?</p>	<p>I have 9, the number of minutes it takes GRACE to download data.</p> <p>Who has 8.59×10^7?</p>	<p>I have \$85,900,000, GRACE's price tag to NASA.</p> <p>Who has $5[2(5 \times 10)]$?</p>
<p>I have 500, the distance in kilometers that GRACE is above the Earth.</p> <p>Who has a composite number whose units digit is half its tens digit?</p>	<p>I have 63 degrees North latitude. GRACE will be launched here from Plesetsk, Russia.</p> <p>Who has a three digit number whose hundreds digit is twice its units digit?</p>	<p>I have the mass of GRACE, 432 kg.</p> <p>Who has 1.5 times a square number?</p>	<p>I have 150 Watts of power needed for GRACE.</p> <p>Who has 720 mm?</p>

<p>I have .72 meters, the height of the trapezoid of GRACE.</p> <p>Who has a prime number with a positive difference of one between its two digits?</p>	<p>I have 23. The GRACE mission will be launched just past the solar flux maximum of this cycle.</p> <p>Who has 50 megabytes of science data that will be down linked per day?</p>	<p>I have $(1000-500)/10$.</p> <p>Who has a ton minus 370?</p>	<p>I have 1630, the year Johannes Kepler died. Kepler discovered 3 laws that relate to satellites in orbit.</p> <p>Who has the fourth prime number?</p>
<p>I have 7. That's how fast GRACE travels in kilometers per second.</p> <p>Who has the square root of 225?</p>	<p>I have 15, the degrees per hour that GRACE shifts its orbit.</p> <p>Who has 211^0?</p>	<p>I have 1, the number of degrees GRACE is from the poles.</p> <p>Who has $3^2 \cdot 7 \cdot 11$?</p>	<p>I have 693 mm, the top width of GRACE's trapezoidal cross section.</p> <p>Who has 100-59.7?</p>
<p>I have 40.3 E longitude, the launch location.</p> <p>Who has the area of a 70 by 20 rectangle?</p>	<p>I have 1400, the number of seconds in an air-jet's burn.</p> <p>Who has $2.1 \cdot 10^5$?</p>	<p>I have 210,000. This is the number of weekly observations of GRACE.</p> <p>Who has $1/10$ of 98?</p>	<p>I have 9.8 meters per second squared. This constant is the acceleration of gravity.</p> <p>Who has 2002, the year GRACE will launch?</p>