TEXAS SPACE GRANT CONSORTIUM
http://www.tsgc.utexas.edu/

GRACE Educational Curriculum GRAVITY	
Teachers	Grades 6-8
Science and Math	

A Gravity Connection

Background:

GRACE, Gravity Recovery and Climate Experiment, are twin satellites that will measure the Earth's gravity field as they orbit the Earth.

Objective: Using a relative surface gravity chart, students will find out how the force of gravity affects their weight on other planets.

Standards: Math: number and operations; problem solving
Science: science as inquiry; physical science; earth & space science

Vocabulary: gravity relative surface weight

Materials: Paper and Pencil
Planet Facts

Directions to the Teacher:

1. Start the activity with the following investigative questions: What if GRACE were orbiting another planet? What differences would there be in the relative surface gravity? Can you think of anything you have seen or read about that would lead you to believe the gravity is different there? (Students might mention pictures they have seen with the astronauts walking on the moon. The teacher might have these available or find footage of the moon walks. Astronauts bounced because the force of gravity was less on the moon, 0.17 compared to the Earth's value of 1.0.)
2. Have the students use the relative surface gravity chart to figure their weight on each of the other planets. If preferred, figure the weight of one of their pet or find some object in the classroom to weigh and find the object's weight on each of the other planets.

Planet	Relative Surface Gravity
Earth	1.00
Jupiter	2.34
Mars	0.38
Mercury	0.38
Neptune	1.19
Pluto	0.06
Saturn	1.06
Uranus	0.92
Venus	0.91

An example might be: I weigh 100 pounds on Earth. I will weigh 234 pounds on Jupiter, 38 pounds on both Mars and Mercury, 119 pounds on Neptune, 6 pounds on Pluto, 106 pounds on Saturn, 92 pounds on Uranus, and 91 pounds on Venus. (100 *2.34 will yield the weight on Jupiter.)

3. When weights have been determined for each of the other planets, set up a ratio comparing the weight on each of the other planets to that of Earth. To use the same example: 234/100 will give the ratio of Jupiter to that of Earth. If the student divides 234 by 100, they will arrive at 2.34, the relative surface gravity figure listed in the table.
4. Organize your weights on the planets in order from least to greatest. Be sure to note not only the weight, but the name of the planet beside it.
5. Using Charting the Planets, a table provided in Mission Mathematics, organize the following data in order from least to greatest: Mean Distance from the Sun, Period of Revolution, Equatorial Diameter, Inclination of Orbit to Ecliptic, Eccentricity of Orbit, Rotation Period, Inclination of Axis. Do you see any patterns? Does the order of any of your list of weights come close to the order that you found with data from the chart? What could account for the connection? As an extension, try to find out how the table with relative surface gravity was derived.
6. What is the weight of one of the GRACE satellites? Find it's weight if it were traveling above the other planets or the moon.

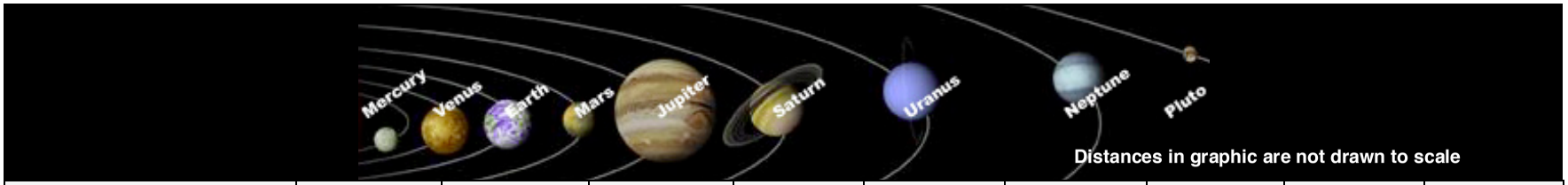
Extensions:

- Technology: Explore the Internet for other information about planets and look for patterns in the connections to the order of the data with the relative surface gravity order.
- Research: Look for information about how the relative surface gravity chart for the planets was derived.

References / Resources:

Mission Mathematics**,** National Council of Teachers of Mathematics, nctm.org .

CHARTING THE PLANETS



Categories	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
1. Mean Distance from Sun (millions of kilometers)	57.9	108.2	149.6	227.9	778.3	1,427	2,871	4,497	5,914
2. Period of Revolution	88 days	224.7 days	365.3 days	687 days	11.86 days	29.46 days	84 years	165 years	248 years
3. Equatorial Diameter (kilometers)	4,880	12,100	12,756	6,794	143,200	120,000	51,800	49,528	~2,330
4. Atmosphere (main components)	Virtually none	Carbon dioxide	Nitrogen Oxygen	Carbon dioxide	Hydrogen Helium	Hydrogen Helium	Helium Hydrogen Methane	Helium Hydrogen Methane	Methane +?
5. Moons	0	0	1	2	1	18	15	8	1
6. Rings	0	0	0	0	3	1000 (?)	11	4	0
7. Inclination of Orbit to Ecliptic	7°°	3.4°	0°	1.9°	1.3°	2.5°	0.8°	1.8°	17.1°°
8. Eccentricity of Orbit	0.206	0.007	0.017	0.093	0.048	0.056	0.046	0.009	0.248
9. Rotation Period	59 days	243 days Retrograde	23h 56m	24h 37m	9h 55m	10h 40m	17.2h Retrograde	16h 7m	6days 9h 18m Retrograde
10. Inclination of Axis*	Near 0°	177.2°	23°27’	25°12’	3°5’	26°44’	97°55’	28°48’	120°°

*Inclinations greater than 90° imply retrograde rotation.