Quiz.

1. Newton's universal law of gravity states that _____. (Circle all that apply.)
    a) you can NEVER escape gravity
    b) the force of gravity is inversely proportional to the square of the distance between two objects
    c) the force of gravity between two objects depends on the masses of the two objects

2. Why does the Earth exert a gravitational force?
    a) it has mass
    b) it has an atmosphere
    c) it has a magnetic field
    d) it rotates

3. Gravity obeys the inverse square law.
    a) True
    b) False

4. Tides are caused by
    a) the moon only
    b) the moon and the sun
    c) the sun only

5. When astronauts feel "weightless," they are actually _____.
    a) less massive
    b) in "freefall"
    c) weightless

6. Isaac Newton realized the moon was attracted by Earth's gravity because _____.
    a) Newton didn't realize this; Galileo did
    b) an apple fell on his head
    c) the moon did not follow a straight line path but a curved one

7. Which has more of an effect on gravity?
    a) the mass of an object
    b) the weight of an object
    c) the distance of an object from the source of gravity

8. At the height of an object's trajectory, the velocity is zero, and the gravity acting on the object is _____.
    a) zero
    b) not zero

9. If an object increases its distance from the center of the Earth by a factor of 3, then gravity on that object will become _____ times ____
   a) three, weaker
   b) three, stronger
   c) nine, weaker
   d) nine, stronger

Answer Key.
1. a), b), c)

The universal law of gravity tells us that every object in the universe gravitationally attracts every other object in the universe. The equation that expresses this is $F = G\frac{m_1 m_2}{r^2}$, where F is the force due to gravity between the objects, G is the gravitational constant, m_1 and m_2 are the masses in question, and r is the distance between the masses.

2. a)

All masses exert a gravitational force on all other masses in the universe, according to Newton's law of universal gravitation. While Earth does have an atmosphere, Asteroids do not, yet asteroids still have gravitational fields. Earth's magnetic field and rotation may affect masse on or near its surface, but they do not contribute to its gravitational field.

3. a)

Anything that depends on the inverse square of distance obeys the inverse square law. Another example would be the Coulomb force, which is the electric force between charges. Light from a point source also spreads out according to the inverse square law.

4. b)

The sun and moon both pull on the Earth and our oceans, but at times they pull in different directions and from different sides. We get the highest tides when they are working together (new and full moon and the lowest tides when they are working against each other (first- and third- quarter moons) The reason the moon has a greater influence on the tides is that the difference between when the moon is closest to us (perigee) and when the moon is farthest from us (apogee) in its elliptical orbit is greater than the difference between when we are closest to the sun (perihelion, summer in the Northern Hemisphere) and when we are furthest from the sun (aphelion, winter in the Northern Hemisphere).

5. b)

Your mass does not change just because you go into space. However, you also cannot escape gravity. The sensation of weightlessness is caused when you lack a support force, and this happens when you are in free-fall (orbit). You can experience this in theme park rides when you are falling at the same rate as the seat beneath you, yet you do not experience the force of your weight pushing into the seat or the force of the seat pushing back.

6. c)

According to Galileo's inertia, an object in motion tends to stay in motion at a constant velocity (same speed and same direction, a straight-line motion), until acted upon by some influence. Newton realized that the influence that caused the moon's path to curve must be the force due to Earth's gravity.

7. c)

The mass of an object and the distance between an object and another object both affect the force due to gravity on both objects, but the force is more strongly dependent on the distance, because it is squared in the equation. The weight of an object does not affect the gravity on it; gravity affects the weight of an object Weight equals mass times the acceleration due to gravity.

8. b)

This is another application of Newton's Universal Law of Gravity. When an object is thrown at or near the Earth's surface, it may experience zero velocity in the vertical direction, depending on if the object is thrown at an angle above the horizontal or not, but at every point in the object's path gravity is a constant g.

9. c)

Here is a quantitative application of Newton's Universal Law of Gravity. Since the radius is squared, increasing the radius 3 times weakens the force due to gravity by a factor of 9.