Gravity and Staying in Orbit
The Rope and Ball Activity

Isaac Newton's 1st Law of Motion: An object at rest tends to stay at rest. An object in motion tends to stay in motion in a straight line. While an object is in motion, it will change direction or speed only if acted upon by an outside force.

Isaac Newton's 2nd Law of Motion: the acceleration of an object is dependent upon the force acting upon the object and the mass of the object.

Centripetal Force: moving or tending to move toward a center.

Velocity: The speed of something in a given direction

Directions:

1. Everyone on the team:
    a. Orbit the rope above your head.
        i. With the ball only a foot out, try to keep the ball the same distance, for a few seconds, without it moving farther out.
        ii. While the ball is orbiting, try to move the ball out about a foot keeping it the same distance for a few seconds.
        iii. While the ball is orbiting, try to move the ball out about another foot then keeping it the same distance for a few seconds.
        iv. Keep doing this until the ball can't go out any further.
2. Take turns swinging the rope at different lengths for one minute. Count the number of orbits it makes at that length. Mark the table below.

	Length of the Rope in inches	Number of Orbits Per Minute	The Speed of the Orbiting Ball compared to the last	Amount of Force to Orbit the Ball from the last level
1.	6			
2.	12			
3.	18			
4.	24			
5.	30			
6.	36			

3. Answer the questions on the next page.

Questions about the Rope and Ball Activity

Part I: Answers for question one.

1. What did you find out about force with the orbit of the ball when it stayed the same length while orbiting?

The force doesn't change to keep it in orbit.

2. What did you find out about force with the orbit of the ball to take it farther out into orbit?

More force was needed to be added to make the ball go out farther.

3. What did you find out about force with the orbit of the ball when the ball was farther out while the ball was orbiting at the next length?

The force went back to no change to keep the ball in orbit.

Part II: Answers for question two.

4. What does the length of the rope have to do with the number of orbits?

As the rope gets longer and farther from the center, the number of the orbits gets less.

5. Why do you think length of the rope has something to do with the number of orbits?

The longer the rope is the farther the ball is away from the center and it will take more distance for the ball to go around a full orbit.

6. What does the length of the rope have to do with the velocity of the ball?

With the ball farther out, the velocity slows down.

7. Why do you think length of the rope has something to do with the velocity of the ball?

The farther the ball is out away from the center, the ball has to slow down because the pull of the rope would go out farther if it sped up. It has to stay slow to stay in the orbit.

8. What does the length of the rope have to do with the force for the ball to orbit?

The longer the rope is out away from the center, there is less force.

9. Why do you think length of the rope has something to do with the force for the ball to orbit?

The longer the rope is away from the center, the pull of the rope is less and the orbit has to slow down so it doesn't go out farther.

10. Looking at real world ideas, what makes moons and planets stay in orbit.

    a. ***When the moon is close to Earth, the pull of gravity is so strong that it has to go faster not to be pulled into Earth.***

    b. ***When the moon is going faster, it will go around Earth faster and have more orbits.***

    c. ***When the moon is farther away from Earth, the pull of gravity is less so it needs to go slower not to go off out into space.***

    d. ***When the moon is going slower, it will go around Earth slower and have less orbits.***

11. Draw a model of what is happening in space that keeps planets and moon in orbit on the backside of the first paper.