Part 1. Balloon Activity

NOTE: Do this activity outside. There is a possibility you might get wet.
Purpose: To illustrate the “critical speed” concept of gravitational force.

Materials:
String, Water Balloon, Water

Critical Speed: The minimum speed required for a satellite to be in a circular stable orbit.

Directions:
1) Put water into the balloon about ¾ of the way full. Tie off the balloon.
2) Attach a string of 80 cm in length to the balloon.
3) Sling the balloon on the string around your head
4) Adjust the speed to see what happens when you let go.
5) Adjust the length of the string attached to the balloon (shorten by 20 cm several times).

Answer These Questions BASES ON YOUR OBSERVATIONS!!!!:
1) Look at the balloon’s shape as it spins around the person. Compare it to the balloon at rest. What is different regarding the shape of the balloon?

2) Adjust the speed of the orbiting balloon around your head. What happens to the shape of the balloon as the speed of orbit increases?

3) Adjust the length of the string by allowing the string, shortening it by about 20 cm at a time. STOP the motion and then start again with a shorter length. What happens to the shape of the balloon?
4) How does changing the length of the string adjust the period and speed of the balloon’s orbit? Do you have to increase or decrease the speed of orbit just to keep the balloon from hitting your head? Count out the time for a rotation when it is short and long and see what the difference is. What happens to the tension in the string as the string gets shorter?

5) Identify the general patterns of what you see. How does the critical speed change with shortening the string?

Part II: The Moons and Tides

A. First read this website on tides: [http://home.hiwaay.net/~krcool/Astro/moon/moontides/](http://home.hiwaay.net/~krcool/Astro/moon/moontides/)
Answer this question in your own words: Why are ocean tides so different everywhere? (Use more space if needed.)

B. Launch the Gravity and Tides Labs simulation at: [http://aspire.cosmic-ray.org/](http://aspire.cosmic-ray.org/)
Scroll down to the lesson titled “Tides” and click it. Launch the FLASH lab and click on “Student Version.” (The Teacher version isn’t any different so don’t try it – it is cluttered up with not very helpful explanations.)

Do all four Gravity and Tide activities IN ORDER. Answer the following questions. Use more space if needed.
1. What is the speed the Earth needs to have to achieve a circular orbit around the sun (critical speed)?

2. What happens to the Earth if its speed is less or more than this critical speed?

3. Why doesn’t the Earth move in toward the Sun? That is, why doesn’t the Earth spiral into the Sun?

4. Why is the moon more influential on the Earth’s tides than the Sun?

5. What would happen if there were two moons orbiting the Earth? How would the tides daily tides change? What would be the tides at A, B, C, D for each diagram. Label them H for high, M for medium, and L for low.

C. Tide Level Observer: do the observing for both the 24hr period and the 29 day period. You do NOT need to print out your data. Plot your data by hand on the charts below and answer the questions.
1) Look at the graph to answer the following:
   a. What day(s) are the tides the highest?

   b. What phase of the moon does this correspond to?

   c. What day(s) are the tides the lowest?

   d. What phase of the moon does this correspond to?
1) Explain (2-3 sentences) the relationship between the number of tides per day and a 24-hour day.

2) What must be responsible for the pattern of tides that you see?
   a. The moon orbits the Earth once each day.
   b. The Earth spins on its own axis once each day.

3) Hypothesize what would happen if the earth stopped spinning on its own axis. Which of the following would occur? (More than one answer is possible.)
   a. The pattern of tides would remain the same.
   b. There would be no tides.
   c. The temperature of the ocean would change.
   d. Circulation of ocean waters would decrease.