Goals

- Learn how to apply Newton’s law of universal gravitation to understand the orbits of objects.
- Develop a deeper understanding of how the properties of a planet affect the gravitational force it exerts on objects.
- Understand what is actually meant by the everyday term “weightlessness”.

Rubrics relevant for these activities: A5, A7, A9 (Rubrics attached at end of recitation)

Activities

1. Read carefully through Example 4.10 in section 4.5 of College Physics. Cover up the answer to the “Try it yourself” at the end of the example. Work through the “Try it yourself” completely. Note: The online version of the “try it yourself” is missing an equation. There should be a second one:

   \[ 40 m = 0 = (v_0 \cos 0^\circ)t \]

2. Astronaut Sally Ride floats in the space shuttle as it moves in a circular orbit around Earth. When she tries to stand on a bathroom scale she just floats above it and the scale reads zero.
   a. Is her weight zero? If not, explain why the scale reads zero. Use pictures and force diagrams to help you.
   b. Consider the statement “Astronauts in orbit are weightless.” Given what is meant by “weight”, does this commonly-spoken statement make sense? Explain your reasoning.

CHECKPOINT! Discuss your answer to the previous question with your TA/LA before moving on.

3. Imagine a satellite that orbits an Earth-like planet. This planet has no atmosphere so the satellite is able to orbit just above the planet’s surface. Determine the speed of this satellite. Start by drawing a force diagram for the satellite, then use Newton’s 2nd law.

4. Your friend says that if Earth were the only object interacting with the Moon, the Moon would fall onto the surface of Earth because the two objects attract each other gravitationally. Do you agree with them? Explain.

5. Use your understanding of gravitation to answer the following questions. DO NOT SIMPLY LOOK UP THE ANSWERS. But, feel free to look up any other physical data that you need.
   a. Determine the speed of Earth in its orbit around the sun.
   b. Determine the mass of the sun

Now that you have answered the questions, look up the answers online. If your answers are not consistent with what you find online, go back and revise your work.

6. Let’s say you were on the surface of the planet Saturn. Determine the ratio of the gravitational force exerted by Saturn on you, to the gravitational force exerted by Earth on you right now. Start by determining the value of the gravitational field at Saturn’s surface (DO NOT SIMPLY LOOK THIS UP. Calculate it.). Is the value of the ratio surprising? What did you expect the result to be? Explain the reasoning behind your expectation. Resolve the discrepancy between your expectation and your calculated result.

Rubrics

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<thead>
<tr>
<th>RUBRIC A: Ability to represent information in multiple ways</th>
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<tbody>
<tr>
<td>Scientific Ability</td>
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<td>Representations students can make</td>
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