Objective: The goal of this activity is to determine the speed of a tennis ball and acceleration of a tennis ball due to gravity.

Problem: Will a tennis ball dropped from 2 m take twice as long to reach the surface as a tennis ball dropped from 1 m?

Hypothesis: If __________________________________________, then __________________________________________ because __________________________________________.

Materials: Stop watch · Meter stick · Tennis ball · Digital video camera (optional) · Balance

Design Experiment/Procedure and Data Tables:

This part will be done on the following blank piece of paper and placed after this page before the conclusion questions

How would the materials be used to measure how long it takes the ball to travel different distances as gravity acts on it, determine the speed, determine the mass and weight of the ball and calculate acceleration? Design a procedure with at least 5 steps and draw the set-up of your experiment including labels and measurements in meters. You will also need to design a data table or multiple data tables to record measurements for at least 3 trials at 2m and at least 3 trials at 1m, time, speed, acceleration of a tennis ball due to gravity, mass, and weight. Remember to include a row for the averages at the bottom of the tables except for mass and weight. You may use digital video to record the ball’s motion.

*Since the ball is in motion and human reaction time varies, the time should be recorded to the nearest whole second. Also, the exact height may vary a bit since it will be held by hand and released. So it will not be recorded with greater accuracy than a whole number.

Useful Formulas & Units: *If mass is measured in grams, it must be converted to kilograms.

On Earth, acceleration due to gravity is 9.8 m/s²

\[ F = m \times a \]

Weight = \[ m \times a \text{ (acceleration due to gravity on Earth)} = 9.8 \text{ m/s}^2 \] = ____________ N

\[ A = f/m \]

Average Speed = \[ D/T \] = _____ m/s

acceleration of an object dropped from rest \[ a = 2d/t^2 \],
**Procedure:** (Number each step)

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**Data:** (You can use the back of this paper if you need more room. Use a ruler.)
Conclusion Questions:

1. How did the average speed of a tennis ball dropped a short distance compare to the average speed of a tennis ball dropped a long distance (use data)? How does Newton's second law of motion explain this result?
   
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2. Imagine that a tennis ball is dropped from a tall building. If it falls 5 meters in the first 1 second after it is dropped, will it fall 5 meters, more than 5 meters, or less than 5 meters in the next second? What can you predict about how far it will fall in the second after that? (Assume that the only force acting on the ball is gravity.) Explain your answer.
   
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3. To calculate the acceleration of an object dropped from rest, you can use the equation \( a = 2d/t^2 \). How does the calculated acceleration of the tennis ball in your investigation compare to the true acceleration due to gravity (use both accelerations)?
   
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4. What factors might have affected the accuracy of your measurements and/or variables might not have been controlled?
   
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5. What would happen to the weight of objects if they were on the moon or on other planets in the solar system?
   
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6. What would happen to the mass of objects if they were on the moon or on other planets in the solar system?
   
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7. Write a Conclusion Statement.
   
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