

Physics m and m lab assignment



**ASSIGN
BUSTER**

Purpose: To practice direct and indirect measurement Introduction: Do you think you could measure the average thickness of a sample of M&Ms without directly measuring selected M&Ms? The answer is “ yes,” and in this activity you will make direct and indirect measurements of the thickness of M&Ms. You will compare the results and evaluate the reliability of each method of measurement. Be sure to view the tutorial on the proper use of the vernier caliper. Please re-visit the information on when to cite sources. Since a graduated cylinder is usually used for liquid measurement, students think they need to put water in the cylinder.

This is not true for this activity. The graduated cylinder will be kept clean and dryer this activity. It is also important to remember that in the metric system, one ml is the same volume as one cubic centimeter ($1 \text{ ml} = 1 \text{ cm}^3$).

M&MS Materials: none Pictures will be provided of the experiment. Materials used in obtaining the pictures are a bag of regular (NOT peanut) M&Ms (about 8 oz), plastic vernier caliper, and 100 ml plastic graduated cylinder.

Procedure: Start with a clean and dry 100 ml plastic graduated cylinder. Add M&Ms until the graduated cylinder is about $\frac{3}{4}$ full.

Gently tap the graduated cylinder to “ settle” the M&Ms. Read the volume of M&Ms in cm^3 and record the value in Data Table 1 . 2. “ Pour” the M&Ms onto a clean, dry table or other flat surface. Use your hands to gently push the M&Ms into a solid circular shape, not a ring. You want to minimize the spaces between M&Ms while making sure that the M&Ms are “ flat” on the surface. Now use the pictures of the vernier caliper to measure the diameter of the M&M “ circle. ” Record this value in Table 1. 3. Steps 1 and 2 are repeated using a different number of M&Ms. The thickness of three single

M&Ms selected at random from the sample are measured directly using the vernier caliper, which is precise to a thousandths of a centimeter (If you place an M&M on a surface, the thickness is a measurement from 5. Submit your work according to the directions at the bottom of the page. You will complete the tables as you answer the questions. Be sure to include the information in the Tables as requested below, so your instructor can check your calculations. Questions: When you performed Step 2 of the procedure, you actually made a cylinder of M&Ms.

The cylinder was rather “smashed,” and the height of the cylinder was the thickness of an M&M. Recall that the equation for the volume of a cylinder is $V = (\pi r^2)h$. A. Rearrange the equation for “h.” Show your work. B. Using the data from Table 1 and your equation, calculate the average thickness (height) of an M&M for each trial. Record your calculated values in Table 1. Hint: Students often forget that they must use the radius, and not the diameter, in the equation. Copy Table 1 into the assignment. C. You now have two values for the thickness of an M&M in Table 1.

Determine the average M&M thickness using these values and record your value in Table 3. D. You have just determined a value for the thickness of an M&M using the indirect method. What makes this method “indirect”? When Step 4 of the procedure was performed, a vernier caliper was used to measure the thickness of an M&M. A. Using the data from Table 2, calculate the average M&M thickness and record your value in Table 3. Copy Table 2 and Table 3 into the assignment. You have just determined a value for the thickness of an M&M using the direct method. What makes this method “direct”?