

Team Project #2 - M&M's

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The Conversation

Jack was sitting at his kitchen table, eating a bowl of Cheerio's, and reading the latest issue of [1] *Science News* when Diane came down for breakfast. Pouring herself a cup of coffee Diane asked "What's so interesting that I don't even get a "good morning" ?"

"It's this Science News article about M&M's." Jack replied, "These guys at Princeton, Cornell, and North Carolina showed how M&M's packed randomly actually pack together as well as ordered spheres."

"M&M's!" exclaimed Diane., "Sounds like a good candidate for a Golden Fleece award. I bet these guy's were using taxpayer money to buy those M&M's! Boy, that's right up there with that tequila fish study!"

"Hold on a minute Diane. It also says here that this study has implications for materials science and other important things."

"I'll bet." said Diane.

"Well anyway" muttered Jack, "I think it's kind of neat. Actually, look at this, it says here that they not only used real M&M's, but also did computer simulations of M&M packing."

"Huh, I wonder how they did that." said Diane, "I remember reading that *Shrek* used a lot of computer graphics and a lot of math. I wonder if that's related."

"Could be." said Jack, "In my Calc class we've been drawing these neat pictures with this thing called *Maple*. I'll bet I could use that to draw an M&M."

"Yea, that's neat." replied Diane, "But, I bet they had to do more than that. I mean, how did they get the size right? How would you make your picture the same as a real M&M?"

"Good question. They give some other references here [2, 3], I bet I could use the information in these articles to make my picture accurate."

"Maybe." said Diane, "But I think you'd still need to measure a real M&M. But, if you got it right, that would be cool! You could figure out the volume of an M&M and then use that info to figure out how many M&M's this jar could hold."

"Hey, then we could win one of those bean-guessing contests!" said Jack. "There's a question for you, I wonder if jelly-beans pack better?"

"Or Reese's Pieces." said Diane.

"Aren't they the same shape as M&M's?" asked Jack.

"Oh yeah." replied Diane.

"Here's another crazy idea. In my Calc class we looked at the curve you get when you intersect a cylinder and a sphere. It looked like the stitches on a baseball. I wonder what you'd get if you intersected an M&M with a cylinder?"

“Yea! Now, imagine you’re an ant walking along that curve, how far do you have to walk to get back to where you start?” asked Diane.

“Hey, that’s a neat question Diane! Do you have any M&M’s?”

“I’m going back to bed now.” replied Diane.

Questions for Discussion

- Jack and Diane raised many interesting questions. List them. Flesh them out and make them precise.
- Diane mentioned a container of M&M’s. This container will be available in class. What measurements do you need of the container to compute the number of M&M’s in the container? Take these measurements. What measurements of an individual M&M do you need? Take these measurements. (The team who computes the number of M&M’s most closely using their model of a single M&M plus information from the article’s mentioned by Jack not only gets a good grade, but gets to take home the container!)
- Where can you find the articles Jack mentioned? Find them, distribute copies to your group, and read them. How does the information in the articles help you address the questions raised by Jack and Diane?

Your Task

Your job is to write a report answering the questions raised by Jack and Diane. The format of your report should be that of a scientific paper. You should use the MS Word template from the American Journal of Physics to define your style. Your report should include an abstract, an introduction, an experimental section (if applicable), a theory section, and a discussion section. You should cite references as appropriate. To get a sense of the appropriate style (grammar, voice, etc.) for a scientific paper, I suggest you read the references below. In particular, focus on [3]. In your abstract, you must include your prediction *based on your theoretical calculation of M&M volume and the packing information from the references* of the number of M&M’s in the container shown in class. The correct number will be revealed on April 14th, the due date for this assignment. If you wish, you may hand in a first draft of your report on April 12th. I will read it and suggest revisions. Making these revisions will substantially improve your grade (in most instances).

References

- [1] Science News, “Candy Science: M&M’s pack more tightly than spheres”, v. 165, 7 (2004).
- [2] Science, “Packing in the Spheres”, v. 303, (2004).
- [3] Science, “Improving the Density of Jammed Disordered Packings Using Ellipsoids”, v. 303 (2004).