The Marshmallow Hadron Collider

EXPERIMENT 50

Thinking about the speed of light is enough to give you a headache. Who in the world could possibly measure something traveling at 186,000 miles per *second*? Well, the surprising answer to that is "you."

Using a neat combination of arithmetic, a household appliance, and some yummy marshmallows, you can come to a pretty accurate measurement of the speed of light. It's all about the fact that light (the visible light we see) is just one part of a wider band of radiation, all traveling at the same speed. Microwaves are also part of that band . . . and that's where the marshmallows come in.

The distance between some zapped marshmallows will reveal the wavelength of the microwaves. Remember that we're working in meters, so the centimeter amount measures hundredths of a meter. And a label on the microwave will reveal the frequency (how often those waves vibrate each second). You can then use the calculator to tap in amounts for the following equation:

frequency x wavelength = velocity (or speed)

And remember: You can eat the experiment once you've done all the calculations.

MATERIALS

- MICROWAVE-SAFE DINNER PLATE
- MARSHMALLOWS
- MICROWAVE OVEN (WITHOUT A TURNTABLE, OR WITH TURNTABLE REMOVED)
- RULER (WITH CENTIMETER MARKS)
- CALCULATOR

TAKE CARE!

Don't get worried about the centimeters and meters if you're unfamiliar with them. If the amount you measure in step 4 is, say, 6 centimeters and you double it to get the wavelength, then you can write 12 centimeters in your calculation as 0.12.

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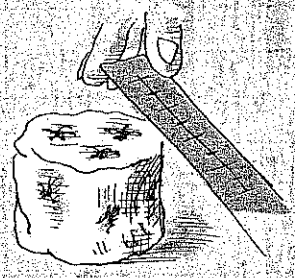
NOTE: Why, in this experiment, are we using metric units instead of the American system of measurement, which we've used throughout the book? Because that's the scientific convention. The fact is, when dealing with calculations of this magnitude, scientists realized that it was unworkable to have fractions of a 12th of something as a starting point. Sliding decimal points back and forth just proved to be easier, which is one major reason why metric is considered the language of science.

1. Set a single layer of marshmallows on the dinner plate.
2. Put the plate inside the microwave.
3. Turn the microwave to low heat for just long enough for some of the marshmallows to begin to melt.



4. Measure the distance—in centimeters—between the marshmallow melted spots. (There should be a similar measurement repeating itself: Double it to get the wavelength of the microwave radiation.)
5. Check the label on the microwave to see its frequency. It is usually written in MHz, which means "millions of times a second," so 2,400 MHz is "2,400 millions of times a second."
6. Now here comes the arithmetic: Get out your calculator.
7. Multiply the **frequency** (the MHz number with 6 zeros after it) by the **wavelength** you worked out in step 4. The result is the **speed,** which is how many meters per second the microwaves travel. That should be around the speed of light!
8. The official figure for the speed of light is 299,792,458 meters per second. See how close your figure is.