

S'more Info, Please

1st Grade



Background:

My family likes to make s'mores in our fire pit. When it's too cold and we just have to have a s'more, we'll make one in the microwave. The marshmallow gets so huge and that's the best part for me! That got me wondering: do some of the other properties of the marshmallow—like its weight—change when I heat it? What about if I heat the marshmallows for different amounts of time?

Testable Question:

How do the temperature, weight, and size of a marshmallow change when you heat it?

Prediction:

I expect that the more time the marshmallow spends in the microwave, the hotter it will be, the bigger it will get, and the more it will weigh.

Procedure:

1. Using a kitchen scale, weigh the marshmallow (in grams)
2. Using a food thermometer, take the internal temperature of the marshmallow (in degrees Fahrenheit)
3. Using a ruler, measure the diameter and height of the marshmallow (in centimeters)*
4. Heat the marshmallow in the microwave for a specific amount of time
5. Measure the diameter and height of the marshmallow after heating
6. Weigh the marshmallow after heating
7. Measure the internal temperature of the marshmallow after heating
8. Repeat steps 1-7 for a good sample size of marshmallows and heating for different amounts of time
9. Graph the data collected to see if my hypothesis is true

*Mid-experiment procedure change:

Since the marshmallow blows up in the microwave and then immediately starts to shrink when it comes out, it's hard to measure. Instead of pulling out the marshmallow and measuring it with a ruler, I measured it compared to an apple while it was in the microwave, right at the end of the heat time. I used the same apple for every trial (7cm diameter 6cm height). The marshmallows are 3cm diameter and 2cm height (about 1/3 the size of the apple).

Constant Conditions:

Independent Variable: The ONE thing I changed

- I varied the amount of time I heated the marshmallow in the microwave.

Dependent Variable: What I'm measuring or observing

- The temperature (degrees Fahrenheit), size (centimeters), and weight (grams) of the marshmallow.

Constant Conditions: What I'm keeping the same every time

- As best as possible, I used marshmallows of the same size and temperature to begin each trial round. I realize that there may be some variability in the marshmallows that is outside of my control and could affect the results.

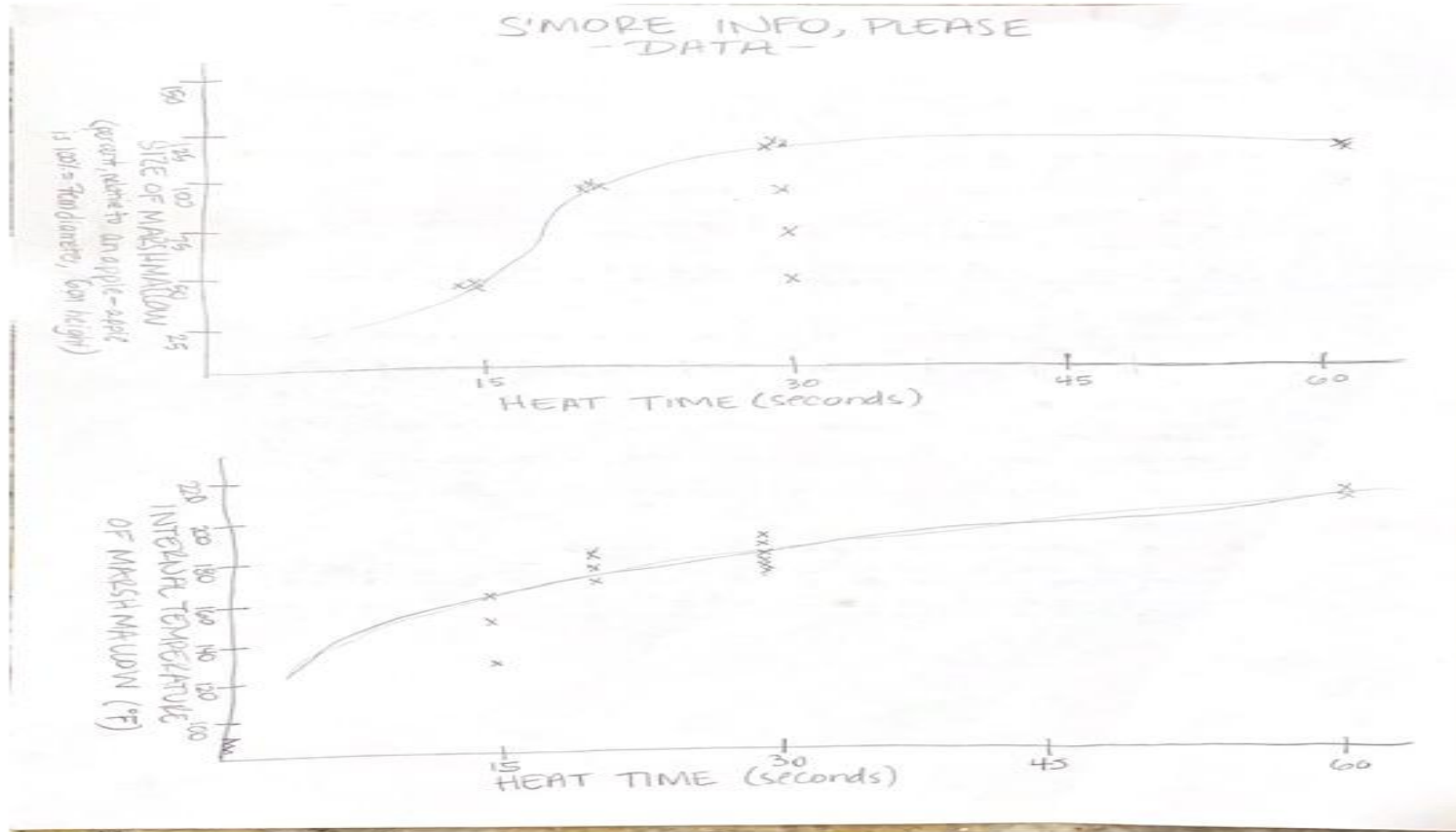
Data and Trials:



Data and Trials (continued):

Trial #	Heat Time (seconds)	Internal Temperature (°F)		Size (relative to apple)	
		Before	After	Before	After
1	15	72	133	33%	50%
2	15	72	156	33%	50%
3	15	71	163	33%	50%
4	20	70	174	33%	100%
5	20	71	168	33%	100%
6	20	73	182	33%	100%
7	30	67	181	33%	125%
8	30	76	188	33%	50%
9	30	76	190	33%	75%
10	30	71	180	33%	100%
11	30	71	178	33%	125%
12	30	72	185	33%	125%
13	60	72	211	33%	125%
14	60	72	215	33%	125%

Data and Trials (continued):



Conclusion:

After doing several tests and graphing them, I found out that my hypothesis is partially true. As I increase the duration of heat on the marshmallow...

✓ ...the internal temperature of the marshmallow goes up as well

✓ ...the size of the marshmallow also increases

✗ ...the weight doesn't change at all!

💡 BUT (this is something I didn't expect) the size of the marshmallow seems to have a limit – the size doesn't change much after 60 seconds

Reflection:






I thought the weight would change and it didn't! I learned that something can get bigger (volume) even while the weight (mass) doesn't change. That makes sense, volume is like the amount of room it takes up and mass is how heavy it is. The heat wouldn't really add anything to the marshmallow.



This experiment sparked some research about the chemical properties of marshmallows and the effect of heat (the reason for the increase in volume). I'm eager to learn even more about the effects of heat/temperature change...asking these kinds of questions is how things like light bulbs are invented!

Reflection (continued):

There were a few things that probably affected my results. Next time, I would try to control these variables a little more for more accurate results.

-  The starting temperature of the plate should be the same for each trial
-  All the marshmallows should be from the same package (I used two different packages)
-  The ending measurement of the marshmallow should be more precise, if possible
(not based on an apple!)