Name: _____ _____ Date: _____

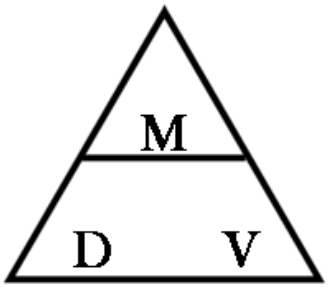
Density for Chocoholics 

Introductory Paragraph: Density is the term used to describe the relationship between the mass of an object and its volume. **Under constant conditions of temperature and pressure, the density of any substance is always constant. Altering the temperature and/or pressure of a system will also alter the density of any substance.** The density of most any substance can be determined by measuring its mass and volume and using the following equation:

Density Equation:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} \quad \text{or} \quad D = \frac{M}{V}$$

or



Objective: You will be able to calculate the densities of various sized pieces of chocolate and recognize that density is one of the most important properties of matter.

Complete the following vocabulary:

Mass:

Weight:

Volume:

Procedure (DO NOT eat the candy until your mass and volume measurements have been completed and recorded on the report sheet on page 5):

IMPORTANT: Record **ALL** measurements in the report sheet!

Procedure A: What is the Density of a Hershey's Chocolate bar?

1. Unwrap your candy bar without breaking it. It is very important that it remain in one piece for the beginning of the activity.

2. Using the triple-beam balance, determine the mass of the candy bar (diagram 1). For sanitary purposes place the candy bar wrapper between the chocolate bar and the balance pan.

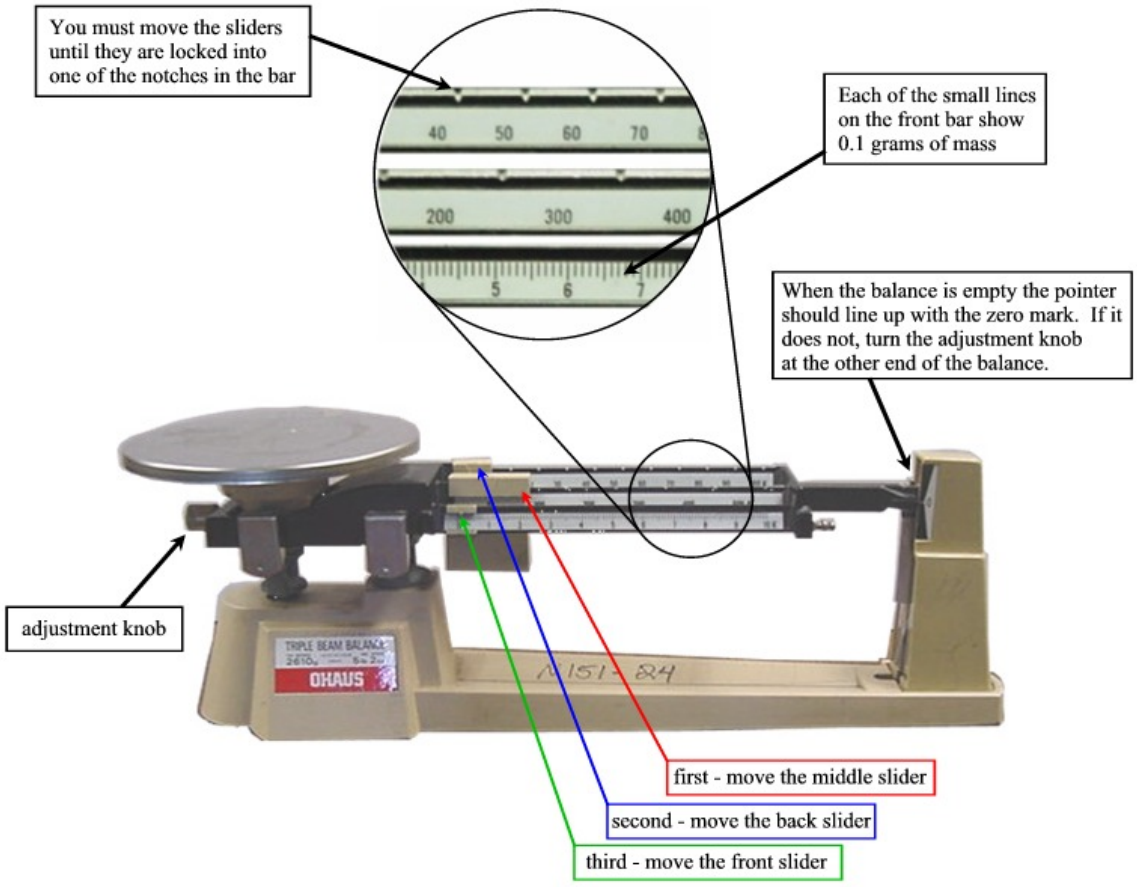


Diagram1: How to use the triple-beam balance.

Will this method give you an accurate mass measurement for the candy bar? If not, what should you do?

3. Record the mass of the whole Hershey Bar in proper location of the report sheet. Label your units to the nearest tenth of a gram.

4. Find the volume of the whole Hershey Bar using a metric ruler and the equation for the volume of a rectangular solid: $v = \mathbf{l} \times \mathbf{w} \times \mathbf{h}$. Where v = volume, l = length, w = width, and h = height.

5. Record the volume of the whole bar in the proper location of the report sheet. Label the units to the nearest tenth of a cm^3.

6. Calculate the density of the whole Hershey Bar using the density equation at the top of page 1 and your data from steps 2 and 5.

7. Record the density of the whole Hershey Bar in the proper location of the report sheet. Use the proper units and label them to the nearest tenth.

8. Carefully break the whole Hershey Bar along the center indentation (diagram 2).

Diagram 2: Hershey Bar broken along center indentation.

9. Use a paper clip to scratch an "A" onto the back of one half and a "B" onto the back of the other half.

10. Based on the density measurement of the whole bar (your initial observation), predict (infer) what the density might be for the half bar labeled "A".

11. Record your prediction for the half bar in the report sheet, to the nearest tenth.

12. Calculate the density for half "A" of the Hershey Bar using procedures 2 through 5 from above.

13. Record your answer in the report sheet to the nearest tenth.

14. Carefully break half “A” along its center indentation (diagram 3) so that you now have 2 quarters of the original bar.

Diagram 3: Hershey Bar broken along indentation.

15. Using the end of the paper clip, label one of the quarters “1” and the other “2”.

16. Based on the density measurements of the whole bar and the half labeled “A”, predict what the density might be for the quarter labeled “1”.

17. Record your prediction in the report sheet to the nearest tenth.

18. Calculate the density for quarter “1” using procedures 2 through 5.

19. Record your answer in the proper location of the report sheet. Label your answer to the nearest tenth.

20. Carefully break quarter “1” into thirds along the indentations (see diagram 4).

Diagram 4: Bar broken along indentation.

21. Using the paper clip, label the top piece of chocolate bar with an “a”, the center third with a “b” and the last third with a “c”.

22. Based on the density measurements for the whole bar, the half labeled “A”, and the quarter labeled “1”, predict what the density might be for the small piece (third) labeled “a”.

23. Record your prediction in the proper location of the report sheet. Record your answer to the nearest tenth.

24. Calculate the density of the small piece of the Hershey Bar using procedures 2 through 5.

25. Record your answer in the proper location of the report sheet to the nearest tenth.

Report Sheet

	Mass (g)	Volume (cm^3)	Density
Whole Bar			
Prediction for Half-Bar	XXXX	XXXX	
Half-Bar measurements			
Prediction for Quarter Bar	XXXX	XXXX	
Quarter Bar measurements			
Prediction for Small Piece	XXXX	XXXX	
Small Piece measurements			

Questions:

1. How does the density of the whole Hershey Bar compare to the density of the half-bar?

2. How does the density of the half-bar compare to the density of the small piece?

3. Do your data concur with the introductory paragraph back on page 1.

4. If your data concurs with the introduction then go on to question #5, if not describe why not.

5. What effect does the shape and/or size of a Hershey Bar have on its density?

6. How does the density of the melted (liquid) chocolate compare to the density of the solid Bar?

7. Based on this activity, describe what happens to the density of any substance when the size and/or the shape is changed.

Procedure B: How do the Densities of Different Chocolates Compare?

Calculate the densities of one small piece of Cadbury chocolate and one small piece of Nestlé's Chocolate.

	Mass (g)	Volume (cm^3)	Density
Cadbury Piece			
Nestlé's Piece			

8. How do the densities of these chocolates compare to each other and to the density of the Hershey's chocolate?

Conclusion:

Describe the effects of changing shape and changing size with the density of any substance.

Teacher Notes:

* The chocolate pieces should have very straight edges. Not a problem with the Hershey pieces but when I cut up the Cadbury and Nestles pieces I had to work a little at keeping the pieces square.

* Melt chocolate in a microwave for 30 or so seconds or use a double boiler/crock pot. DO NOT melt chocolate in a beaker on a hotplate.

* Use paper or Styrofoam cups for the melted chocolate.