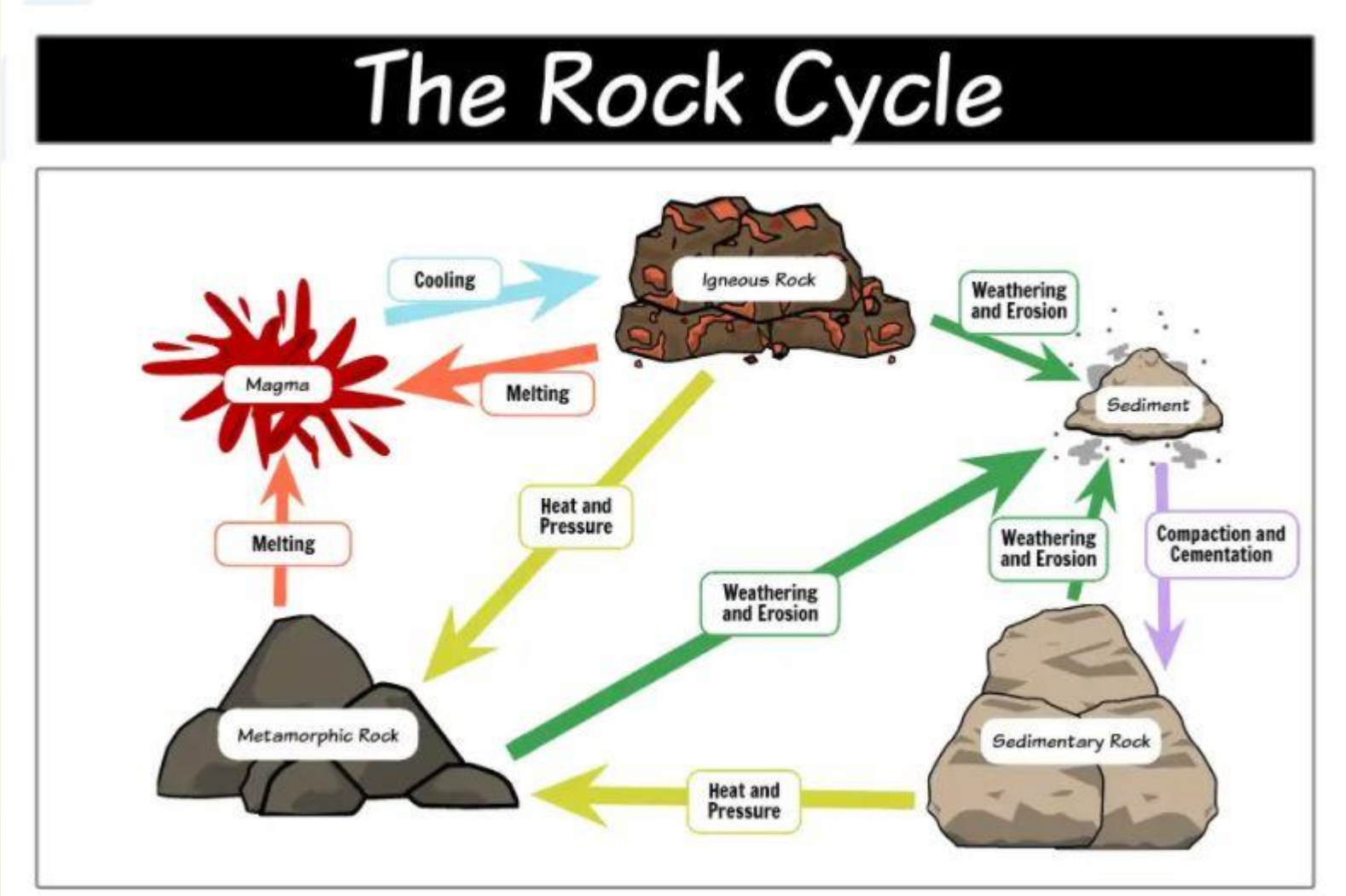
2022 Science Bowl



Hello Science teachers! So glad to have all of you on-board! Thank you for taking the time to help our young students participate in Science Bowl.

I'm Patti Mason, a retired chemistry and physics teacher who has been writing for this contest for many years.

We cycle through four disciplines with the contest and experiment:

Physics/Engineering
Biology
Chemistry
Earth/Atmospheric Science.

This year we're looking at Earth Science, and in particular the Rock Cycle.

I have more details on the experiment portion of the contest at the end of this presentation. But right now I want to narrow down the topic.

Students need to know the following:

1. What the Rock Cycle diagram represents
2. The three types of rock – igneous, sedimentary, and metamorphic
3. Steps showing the conditions required for one rock to change into another
4. Simple examples of each rock:
   Igneous: pegmatite, basalt, granite, obsidian, pumice
   Sedimentary: sandstone, shale, limestone
   Metamorphic: slate, quartzite, marble
5. How each type of rock is formed
6. Relationship between volcanoes and the rock cycle

Definitions of terms:

Erosion	Deposition	Weathering
Compaction	Cementation	Melting
Heating	Pressurization	

Extrusive and intrusive rocks

Pressure and Area

Math Calculations:

Percentage change will be covered in experiment section

How to do pressure calculations

How to add the pressure of the atmosphere (14.7 pounds per square inch) to applied pressure

Reading Passage:

There will be a reading passage related to a volcano which will be part of the Individual Round of the contest. The passage will be released to coaches shortly before the contest window, and will also be embedded in the Individual contest window.

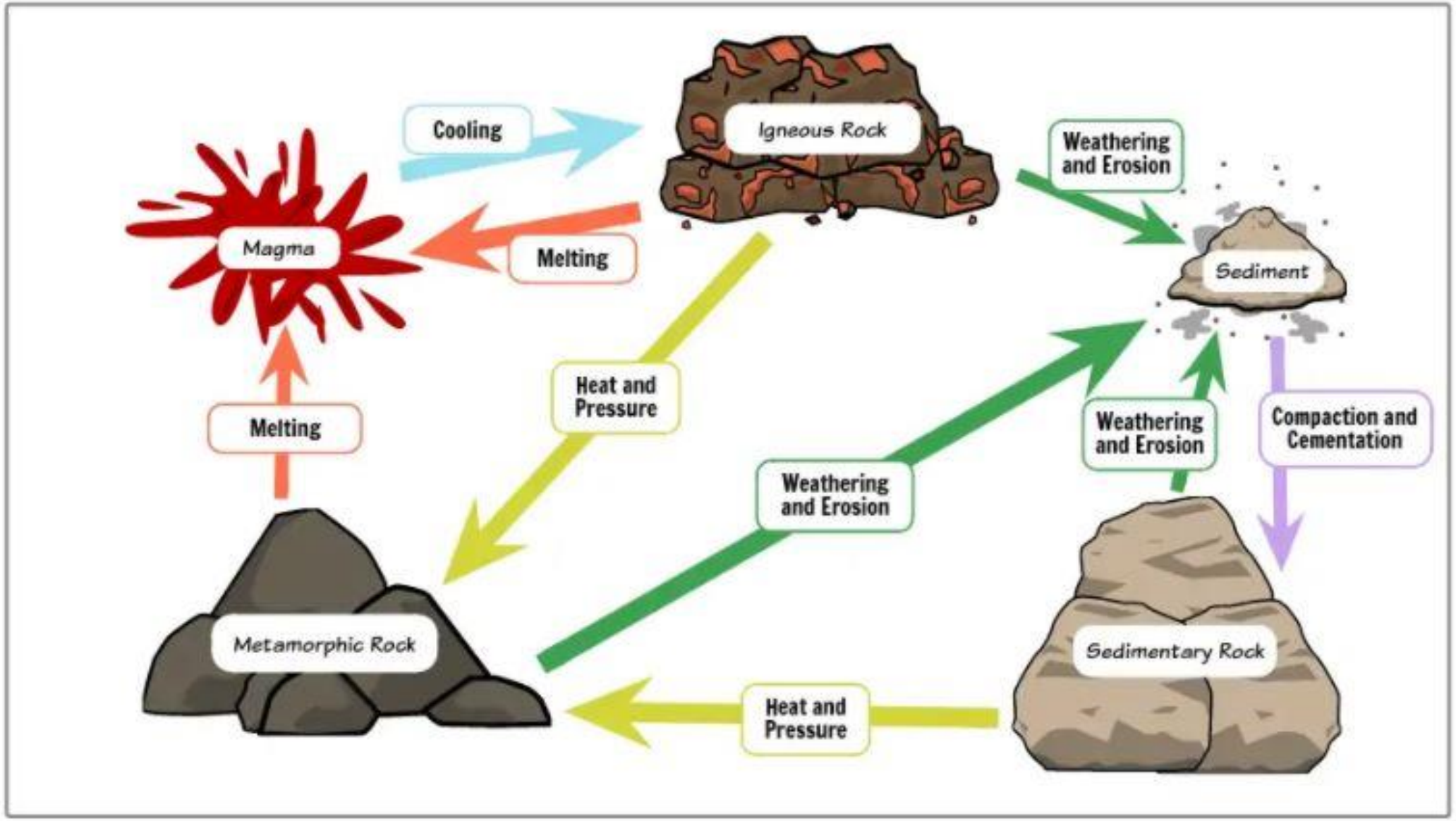
Resources:

They are too abundant to list here. Begin with a 7th grade Indiana science textbook. A high school earth science book will probably have too much information.

There are a multitude of websites for elementary age students – just type in Rock Cycle for Kids or Rock Cycle quizzes

The practice questions are very typical of the kinds of questions on the three test rounds.

The Rock Cycle



THE ROCK CYCLE:

Just as in the past, students have learned about the Water Cycle, so too will they learn about the Rock Cycle, in which one type of rock is transformed into another type of rock through various processes involving

Erosion, Weathering, Compaction, Cementation, Melting, Heating and ***Pressurization.***

The types of rocks in the cycle are

Igneous,
Sedimentary, and
Metamorphic.

Sedimentary

Igneous

Two-Part Experiment

Part 1: will allow students to explore how sedimentary rocks are formed under pressure and quantitatively measure how much compression can be achieved over a period of time.

IMPORTANT: This portion will require at least two weeks of observation, so start early.

Part 2: will allow students to compare properties of two types of igneous rocks which have varying densities using egg whites.

This part of the experiment can be done in a short period of time.

Part One

In this part of the activity, students will use slices of wheat and white bread to create layers which are meant to represent different layers of sediment deposited by rivers or streams over a long period of time. The bread will be alternately stacked, and pressure applied using textbooks over a period of time. Students may alter the design of the experiment (after doing the one with 5 slices of each bread) by using more slices, or more pressure etc.

EQUIPMENT / SUPPLIES:

Loaf of wheat bread (sandwich type). Cheapest brand you can find – Aldi's, Kroger…don't use Pepperidge Farms!

Loaf of white bread (sandwich type).

Wax paper (not Saran Wrap or Cling Wrap). Parchment paper will do, but is more expensive.

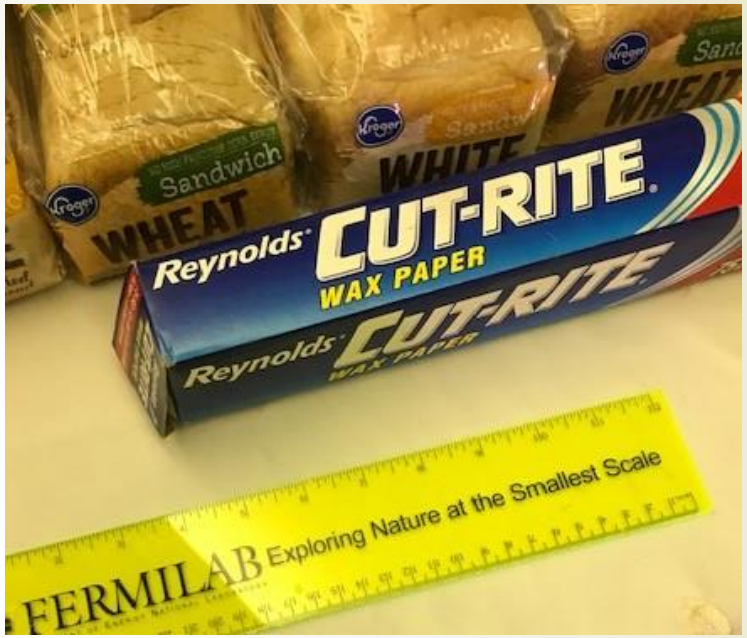
Ruler / meter stick

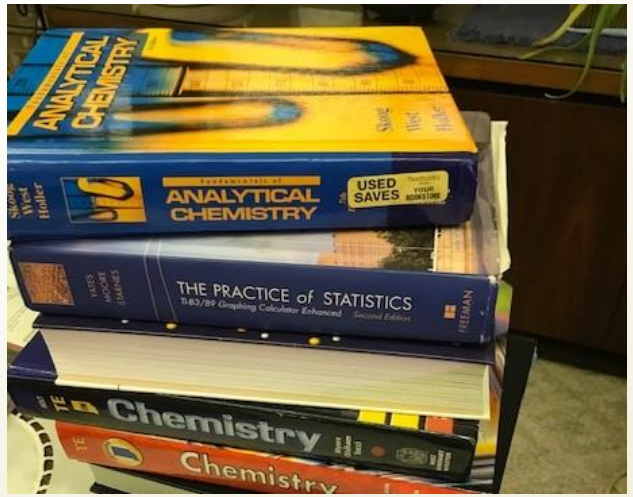
Digital bathroom scale

Textbooks of same size and weight

Knife or kitchen shears to trim off crusts

EQUIPMENT / SUPPLIES:





Directions:

1. Trim the crust off 5 slices of white bread.
2. Trim the crust off 5 slices of wheat bread.
3. Place a sheet of wax paper on a counter, table or floor where it can remain undisturbed.
4. Stack alternating layers of wheat and white bread on the wax paper.
5. When all pieces of bread (10 in this case) have been put in the stack, measure the height in centimeters. Record this height.
6. Make a hypothesis of how much the bread will compress during this experiment.
7. Place a second piece of wax paper on the top of the stack of bread.

8. Determine the weight of the books placed on the bread. This can be done by standing on a digital bathroom scale, with and without the books. Most digital scales are not sensitive enough to measure less than 15 pounds, so this way works. If you have a laboratory scale that can measure the weight of one textbook, you can convert that into pounds for the students and then multiply by the number of books. Most lab scales do not measure over a kilogram. The conversion is 2.2 pounds per kilogram, since one pound is 454 grams.

9. Place several large books on top of the stack of bread. It may require some assistance to remain in place, undisturbed.

10. Leave the book covered bread alone for a week.

11. At the end of the week, remove the books and top layer of wax paper.

12. Measure the height of the stack after one week.

13. Record both before and after measurements.

Directions continued:

14. Determine the percentage of compression of the bread. For example, if the stack was 25 cm tall initially, and after a week it was 13 cm tall, the amount of compression was 12 cm. The percentage compression was 12/25 = 0.48 x 100 or 48% compression. The amount left is 13/25 = 52% of the initial height.

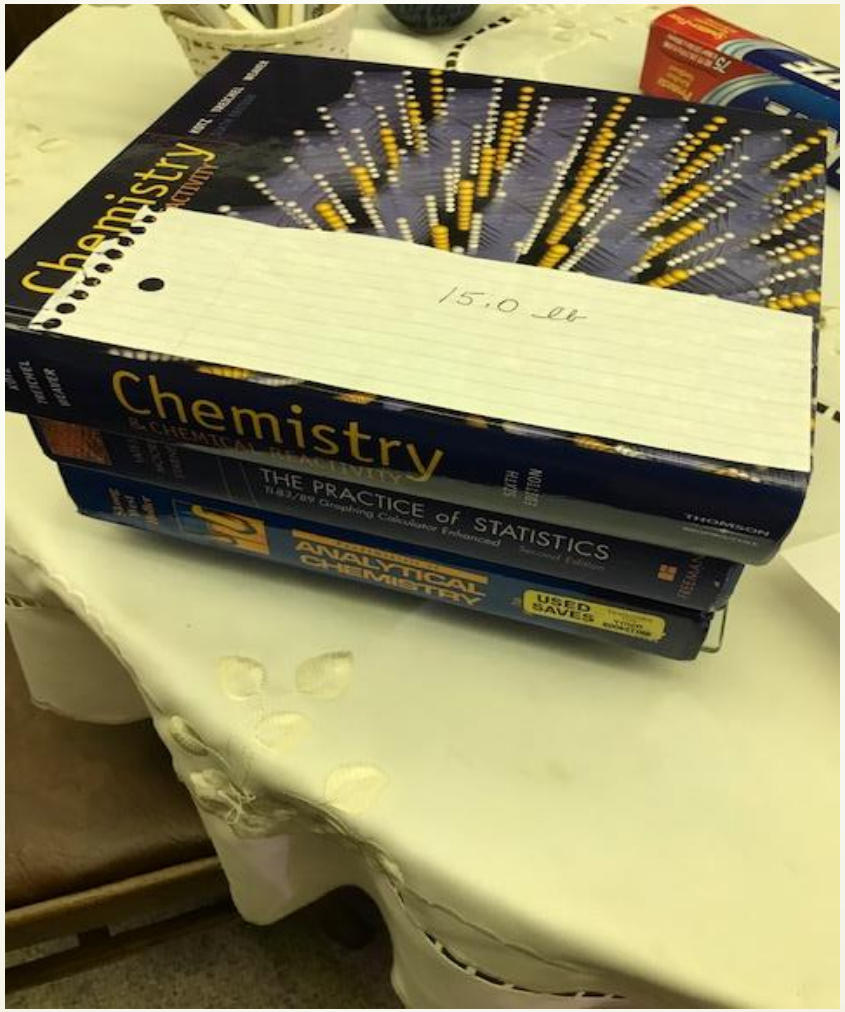
15. Add several more books to the stack and leave them for several more days.

16. Re-measure the height of the stack of bread and compare the measurements to the previous two measurements.

Trimmed stacks of bread

Measuring initial height of stack

Books on stack at beginning



Questions to consider:

1. Why was it important to trim off the crusts before making the stack?

2. Will you get the same amount of compression if the stack was taller?

3. Will you get the same amount of compression if more books were used?

4. Will the percentage of compression be the same if the stack was taller?

5. Will the percentage of compression be the same if more books were used?

6. How does the activity demonstrate how sedimentary rocks are formed?

Discussion of Pressure calculations:

It is important to be able to look at how much pressure is being applied to the bread when the books are added to the top of the stack.

Pressure is defined as Force per unit area—that is a push or a pull (in this case a push) over the area of the slice of bread. The bread measured 8.0 cm by 8.5 cm. Converting to inches, that is 3.150 in x 3.346 in, which gives an area of 10.5 square inches.

EXAMPLE: If you have textbooks with a total weight of 15 pounds placed on a stack of bread with an area of the stack of 10.5 square inches, the pressure will be 15 pounds/ 10.5 square inches or 1.43 pounds per square inch due to the books. Now, the air around us also is exerting a pressure on everything. It may not seem like it to us, but the air exerts a pressure of 14.7 pounds per square inch on everything around us, including us. So in addition to the weight of the books on the stack of bread, we need to add 14.7 pounds per square inch on to the total, so for our 15 pounds of books, the total would be 1.43 + 14.7 or 16.13 pounds per square inch on the stack of bread.

If students put the same amount of pressure on a taller stack, the pressure will still be the same, and they could expect that the compression would be less. That is part of the experiment—to learn if that is the case. Or to take the same size stacks of bread slices and put different amounts of pressure on them by using different numbers of books. I think it is very important to be able to get a quantitative measurement of both the pressure and the amount of compression and percentages.

Part 2:

In this part of the activity, students will use egg whites to look at the difference between pumice and obsidian rocks. Both obsidian and pumice are made from the same igneous rock material and considered glassy rocks.

Pumice is a froth of igneous rock that has so many gas bubbles in it that it can float on water. A sample of pumice is about 90% air. **Obsidian** is a volcanic glass that flows out of the ground as lava.

Pumice

Egg Whites

Obsidian

EQUIPMENT / SUPPLIES:

Six eggs (egg whites can also be purchased separately – this may be preferable since you don't waste the yolks)

Hand mixer

Two bowls

Spatula

Measuring cup or 2 graduated cylinders (250 mL)

Directions:

1. Measure equal amounts of egg whites into two separate bowls. Record the amount.

2. Whip the egg whites in one bowl until they form peaks when the beaters are lifted out of the bowl.

3. Using the spatula, scrape the whipped egg whites into the cylinder and measure the amount.

4. Compare the amounts of whipped egg whites and un-whipped egg whites.

5. Calculate the percentage increase in volume.

My Results:

Data Table Part 1

Number of slices	Initial Height, cm	Height after 8 days, cm	Height after 11 days, cm	# pounds applied	Area of slice, sq inches
10	12.1 cm	2.05	1.4	15.0 pounds	10.5
16	18.2 cm	2.1	2.1	12.2	10.5
10	11.6 cm	1.5	1.3	11.6	10.5

Calculations table:

# slices	Height difference, 8 days	% change in height	Height diff, 11 days	% change in height	Pressure, lb/in^2
10	10.05 cm	83.1%	10.7 cm	88.4%	16.1
16	16.1 cm	88.5%	16.1 cm	88.5%	15.9
10	10.1 cm	87.1%	10.3cm	88.8%	15.8

PSI calculation:

Area of bread slice: 8.0 cm x 8.5 cm = 68 cm^2

Convert to sq inches 1 sq inch = 6.4516 cm^2

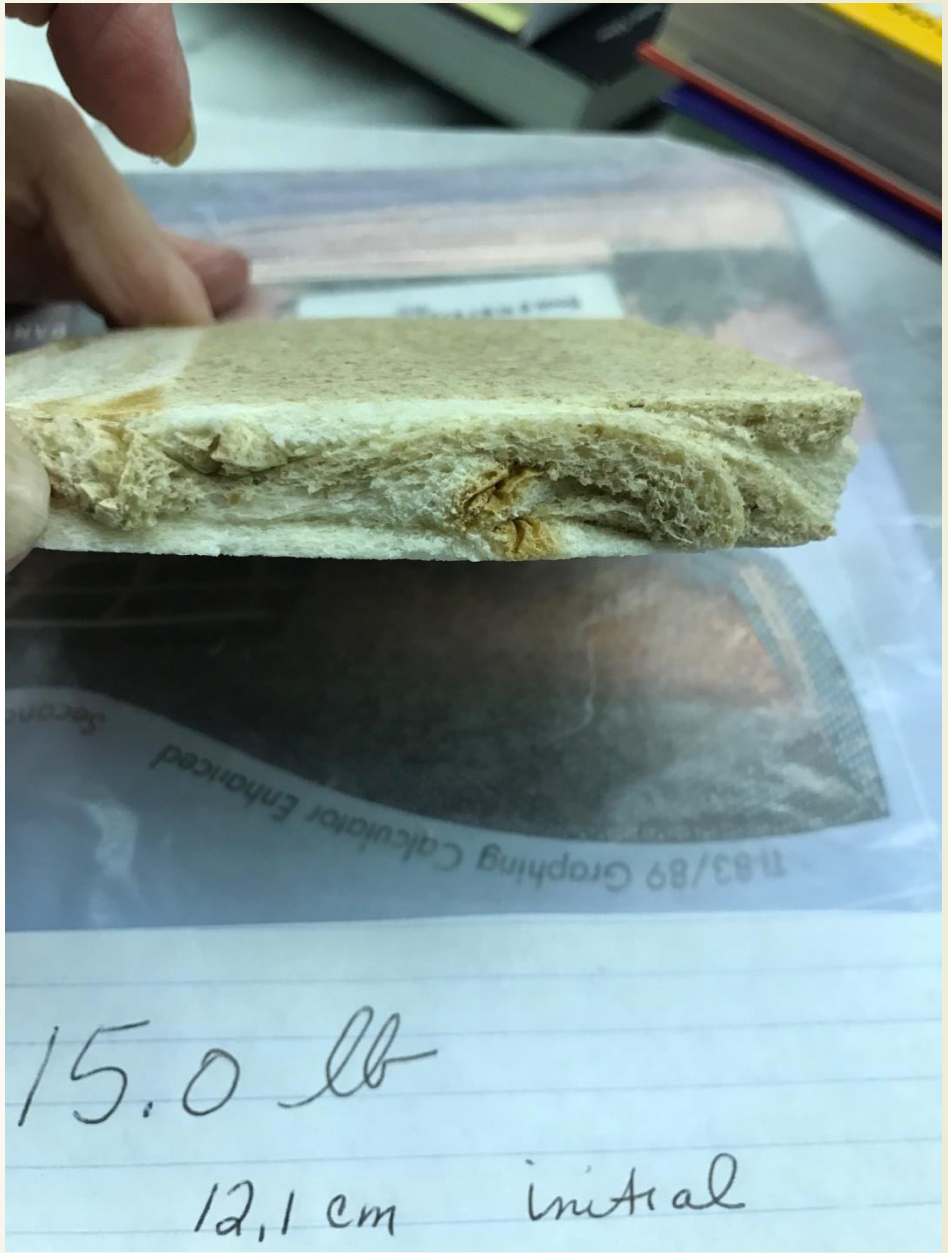
Therefore in sq inches it is 10.5 in^2

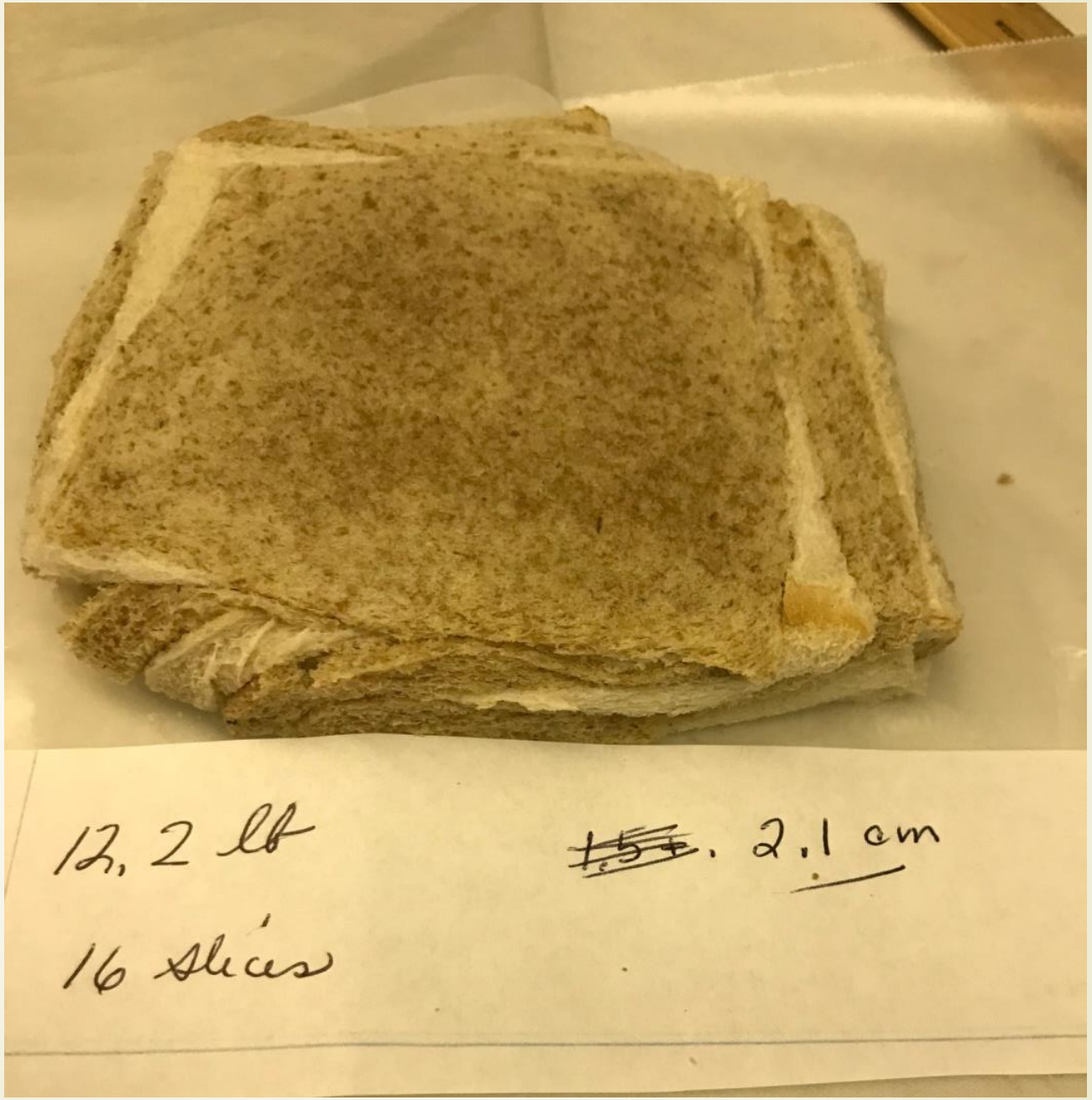
Sample #1 15.0 lb/10.5in^2= 1.43 lb/in^2; but atmosphere exerts 14.7 lb/in^2 on everything including the books pressing down on the bread, so the total pressure is 16.1 lb/in2^2

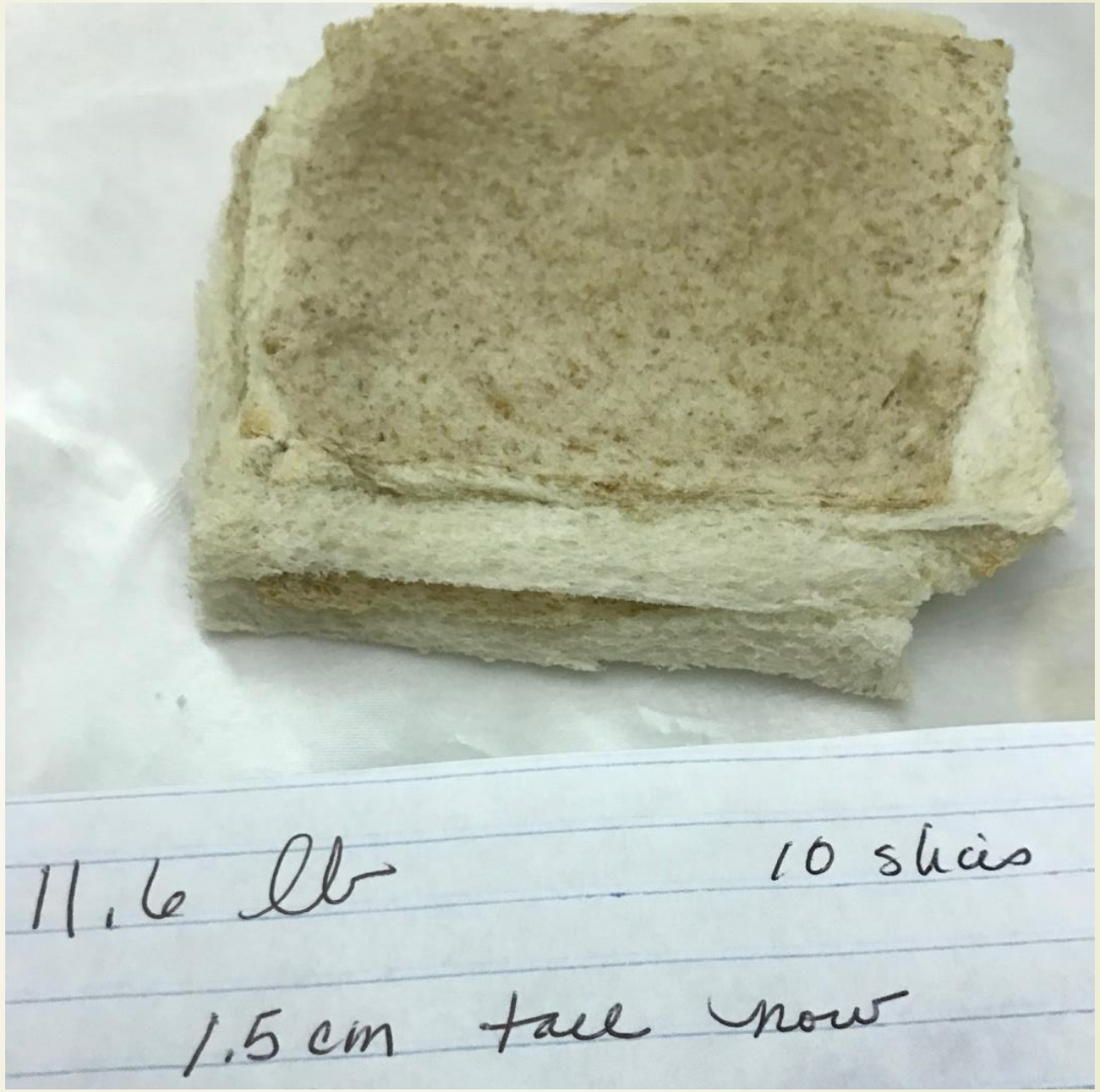
Sample #2
12.2 lb/10.5 in^2 = 1.16 lb/in^2 then add 14.7 = 15.9 lb/in^2

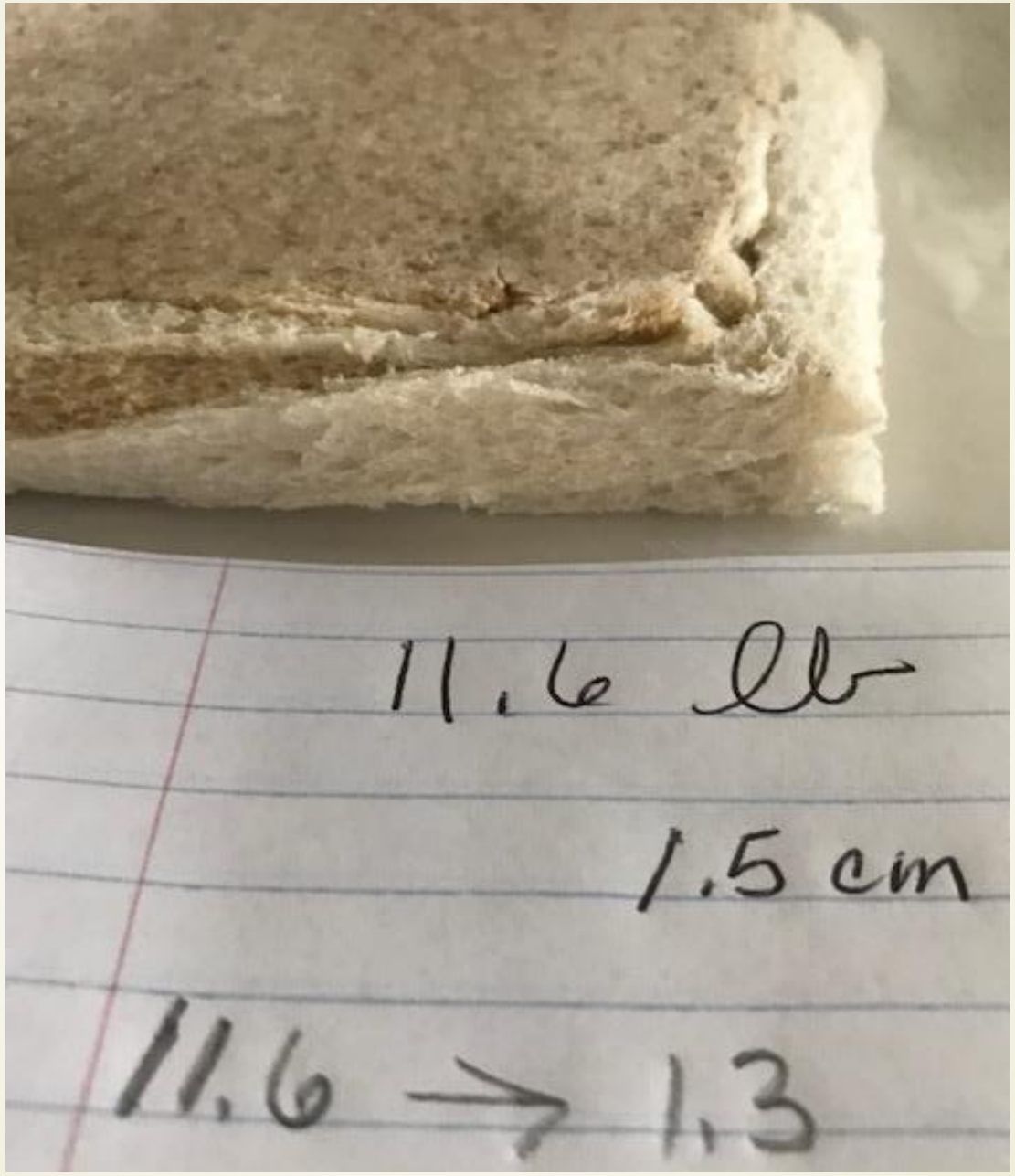
Sample #3 11.6 lb/10.5 in^2 = 1.10 lb/^{2} then add 14.7 = 15.8 lb/in^2

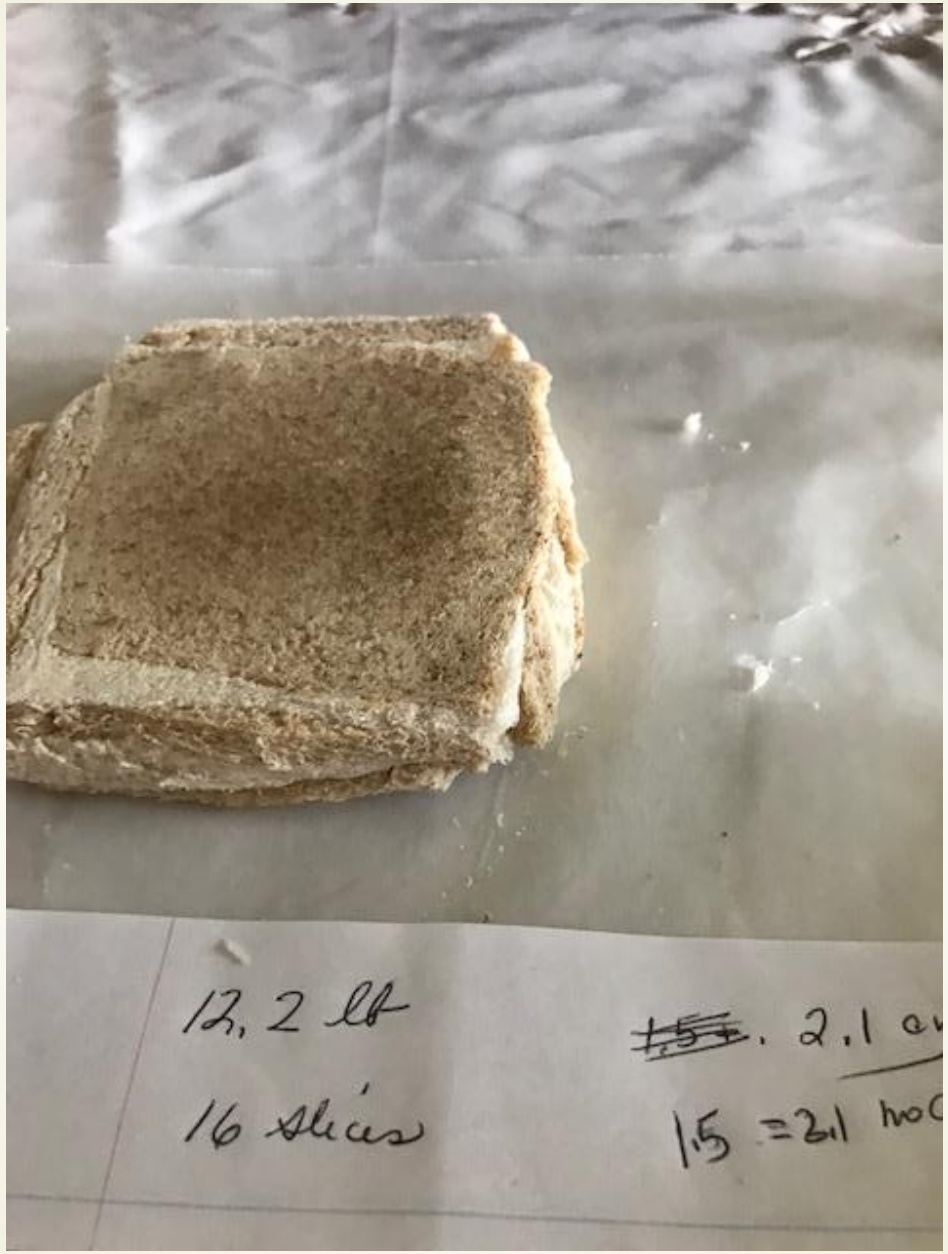
Pictures of the bread samples after they were under pressure for a period of time:




12.2 lb
~~1.5~~. 2.1 cm
16 slices


11.6 lb
10 slices
1.5 cm tall now


11.6 lb
1.5 cm
11.6 → 1.3


12, 2 lb
16 slices
2.1
1.5 = 3.1


12.1-1.4

Data Table Part II:

Initial volume egg whites	Final Volume egg whites

Calculate the percentage increase in volume by dividing the difference in volume by the initial volume of egg whites and multiplying by 100.

Follow up:

Watch the interesting story about Ivory Soap and why it floats:

http://www.todayifoundout.com/index.php/2015/03/truth-floating-soap/#:~:text=If%20anyone%20is%20curious%20about%20why%20Ivory%20soap,less%20dense%20than%20water%2C%20allowing%20it%20to%20float.

Questions to consider:

1. Why does pumice float and obsidian sink?

2. Which is more dense – pumice or obsidian?

3. If you have the same mass of pumice and obsidian (100 grams), will they both float or both sink? Explain.

4. If John's group used 135 mL of egg whites and Joe's group used 170 mL of egg whites, will they get the same results for
   a. Final volume? Explain
   b. Percentage increase in volume? Explain

For questions, contact me through Diane Abel, at dabel@iasp.org.

She will collate any questions and answers and see that all of you get the information.