GreatHearts Irving

Physics Remote Learning Packet

May 4-8, 2020

Course: 11 Physics
Teacher: Miss Weisse natalie.weisse@greatheartsirving.org
Resource: *Miss Weisse's Own Physics Textbook* — new pages found at the end of this packet

Weekly Plan:

Monday, May 4
- ☐ Read & Understand Notes on *Unit 8 Part 3 – Hooke's Law Background* (pages 51-54)
- ☐ Complete Pre-Lab Observations
- ☐ Prepare Your "Lab Book" Entry

Tuesday, May 5
- ☐ Take Data
- ☐ Create 4 Graphs
- ☐ Complete the Calculations and Analysis of All Four Graphs
- ☐ Email Miss Weisse with Questions

Wednesday, May 6
- ☐ Area Under the Curve Calculations for All Four Graphs
- ☐ Explanation of the Physical Significance of the Area Under the Curve
- ☐ Write Lab Conclusion
- ☐ Email Miss Weisse with Questions and to Ask for *Unit 8 Part 4* of *Miss Weisse's Own Physics Textbook*

Thursday, May 7
- ☐ Read & Understand Notes on *Unit 8 Part 4 - Hooke's Law & Elastic Energy* Notes
- ☐ Complete Unit 8 Worksheet 2 #1-4
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Friday, May 8
- ☐ Attend Office Hours at 9:30am!
- ☐ Review *Unit 8 Part 4 - Hooke's Law & Elastic Energy* Notes (pages 55-57)
- ☐ Complete Unit 8 Worksheet 2 #5-7
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

____
Student Signature

I affirm that, to the best of my knowledge, my child completed this work independently

____
Parent Signature

Monday, May 4

➔ Read & Understand Notes on *Unit 8 Part 3 – Hooke's Law Background* (pages 51-54)

➔ Complete Pre-Lab Observations

- ◆ Watch the short, two-minute video (https://safeYouTube.net/w/wMh8), observe the image of four spring scales below, and image the behavior of springs or rubber bands to answer the following three familiar questions on a sheet of paper, or on a google doc, to be turned in.

    - *What do you see?*
    - *What can you measure?*
    - *What can you change?*

  **As you observe the four spring scales, describe both the motion and behavior of the springs as they move *and* the difference between the four springs.

- Prepare Your "Lab Book" Entry **on a piece of paper**. *This assignment cannot be completed online.*
    - Write the Purpose of the lab (can be found in Unit 8 – Part 3... if you don't already know)
    - List your Independent Variable (length of spring), Dependent Variable (force of spring), and Constants (determine these yourself).

      *** Are our variable in your list of things we can measure and change?!
    - Create four data charts like the example chart below.

      NOTE! Extension is the length the spring stretched when a force is applied, not the total length of the spring. To calculate this, subtract the length at 0 Newtons force from each measure length.

      Extension = Current Length – Length @ 0 Newton Force

Green Scale			
Force (N)	**Length (cm)**	**Extension (cm)**	**Extension (m)**

Tuesday, May 5

- Take data using the images found at the end of this packet, after the textbook.
    - Don't forget our precision measurement rules! You should write a measurement that has one more decimal place than the ruler marks. So each of your measurements should have *2 decimal places*. Also, to take good data, zoom in on your screen to ~200%, then use a piece of paper to create a line between the bottom of the spring and the ruler markings.
- Create four graphs from your four sets of data. Each graph should take up *at least* ⅓ - ½ of the page.
- Complete the calculations and analysis for each of the four graphs

  As a reminder –
    - The calculations include the slope, the y-intercept, and the 5% rule for the y-intercept if your value is not zero.
    - The analysis includes what the slope tells us (focus on units!) and what the y-intercept tells us.

- Some helpful reminders are found on page 54 of *Miss Weisse's Own Physics Textbook*

Wednesday, May 6

- Now that you have an equation that describes the relationship between force exerted by the spring and the extension of the spring, it is time to relate this information to *ENERGY.* If you recall from our study of motion 1st semester, we found new, important physical properties by calculating the Area Under the Curve (AUC) of the velocity versus time graph and acceleration vs. time graph. We can do the same thing here with our spring force versus length graph. ***Calculate the AUC for all four graphs.***

- Explain the physics significance of the Area Under the Curve. ***What physical quantity does this measurement give us? Use the units to help puzzle it out.***

- Write a Lab Conclusion.

    - Restate the problem and summarize how the data was taken.
    - State the relationship between the two variables, explain what the slope means, and state what the y-intercept tells us.
    - Compare the four different springs, giving numerical data.
    - Explain what the area under the curve tells us.
    - If your data has problems, provide possible explanations.
    - Provide an answer to the original problem.

    ***Today's work can be done on the same piece of paper as Tuesday's lab work.

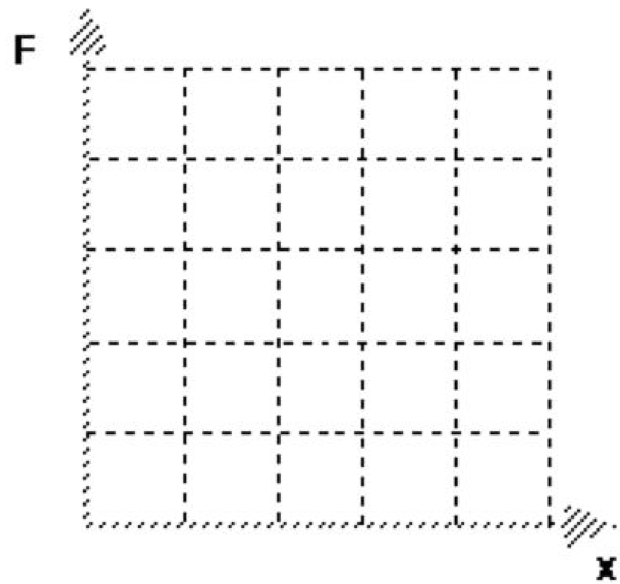
- Email Miss Weisse with Questions and to Ask for *Unit 8 Part 4* of *Miss Weisse's Own Physics Textbook*

Thursday, May 7

- ➔ If you have not done so yet, turn in your lab and request *Unit 8 Part 4* from Miss Weisse via Email!
- ➔ Read & Understand Notes on *Unit 8 Part 4 - Hooke's Law & Elastic Energy*
- ➔ On a sheet of paper with a full heading, complete Unit 8 Worksheet 2 #1-4

Energy Storage and Transfer Model Worksheet 2 (part #1-4):
Hooke's Law and Elastic Energy

Directions: Suppose one lab group found that F = 1000 N/m (Δx). Construct a graphical representation of force vs. displacement. (Hint: make the maximum displacement 0.25 m.)

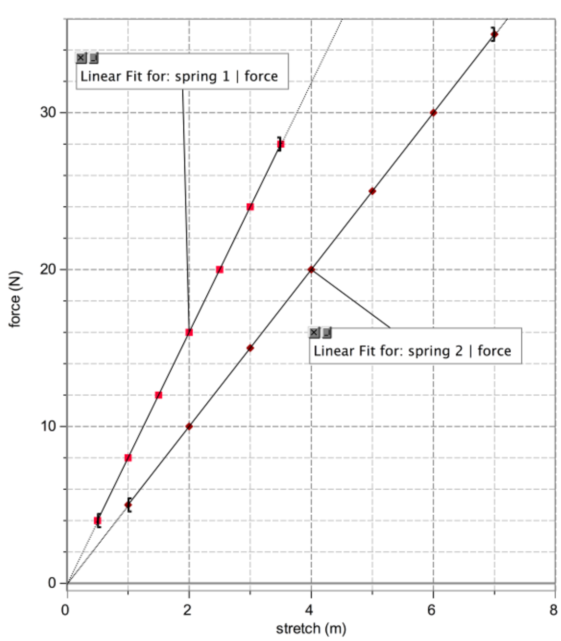


1. Graphically determine the amount of energy stored while stretching the spring described above from x = 0 to x = 10. cm.

2. Graphically determine the amount of energy stored while stretching the spring described above from x = 15 to x = 25 cm.

Directions: The graph below was made from data collected during an investigation of the relationship between the amounts two different springs stretched when different forces were applied.

3. Determine the spring constant for each spring.



4. For each spring, compare:

a. the amount of force required to stretch the spring 3.0 m.

b. the E_{el} stored in each spring when stretched 3.0m.

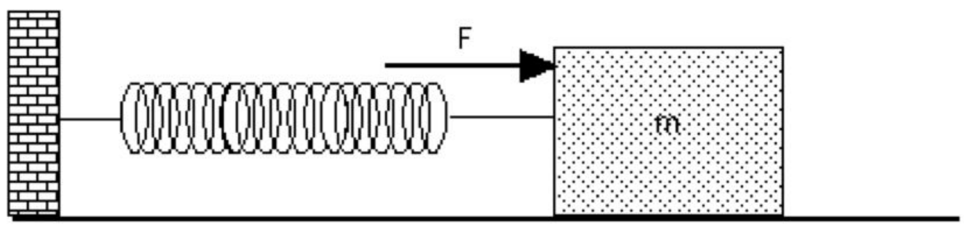
Friday, May 8

- ➔ Attend Office Hours at 9:30am! I want to talk to you and help you!
- ➔ Review *Unit 8 Part 4 - Hooke's Law & Elastic Energy* Notes
- ➔ On a sheet of paper with a full heading, complete Unit 8 Worksheet 2 #5-7

Energy Storage and Transfer Model Worksheet 2 (#5-7):
Hooke's Law and Elastic Energy

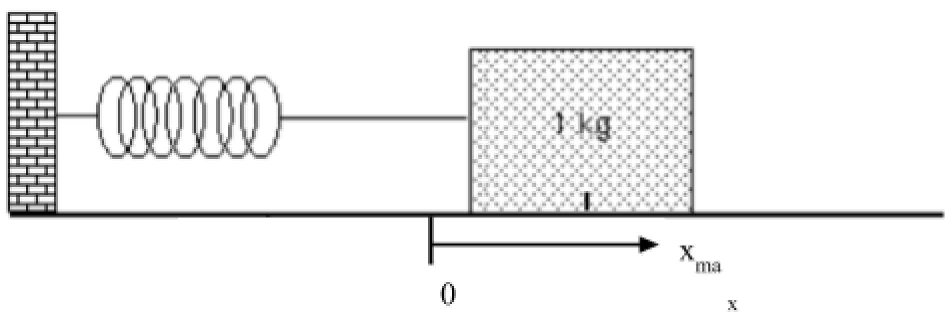
5. Determine the amount that spring 2 needs to be stretched in order to store 24 joules of energy.

6. The spring below has a spring constant of 10. N/m. If the block is pulled 0.30 m horizontally to the



right, and held motionless, what force does the spring exert on the block? Sketch a force diagram for the mass as you hold it still. (Assume a frictionless surface.)

7. The spring below has a spring constant of 20. N/m. The μ_s between the box and the surface is 0.40.



a. The box is pushed to the right, then released. Draw a force diagram for the box above when the spring is stretched, yet the box is stationary.

b. What is the maximum distance that the spring can be stretched from equilibrium before the box begins to slide back?

c. Do pie chart analysis for this situation, when the spring is stretched beyond its maximum (from part b above) so it slides back, and then the box oscillates back and forth until it comes to a stop. Assume your system includes the spring, box, and table top.

Unit 8

Part 3 - Hooke's Law Background

Many of the problems we did last week had to do with elastic energy. Elastic energy is found in things that can regain their shape after being deformed by some force. Obvious examples of this are the a stretched rubberband, a trampoline when someone jumps on it, or a wind-up toy's mechanism when it gets wound up.

But, in fact, the elastic properties of matter are involved in many physical phenomena. When matter is deformed (compressed, twisted, stretched, etc) and the deforming forces are sufficiently small, the material will return to its original shape when the deforming forces are removed. Steel wires, concrete columns, metal beams and rods, and other material objects can also undergo elastic deformations, but they are often too small for us to see. For many materials, it is approximately true that when the material is stretched or compressed, the resisting or restoring force that tends to return the material to its original shape is related to the amount of the deformation but points in the opposite direction opposite to the stretch or compression — Newton's Third Law! So the more force that is applied to a spring, the more the spring stretches, causing the spring to apply a larger force.

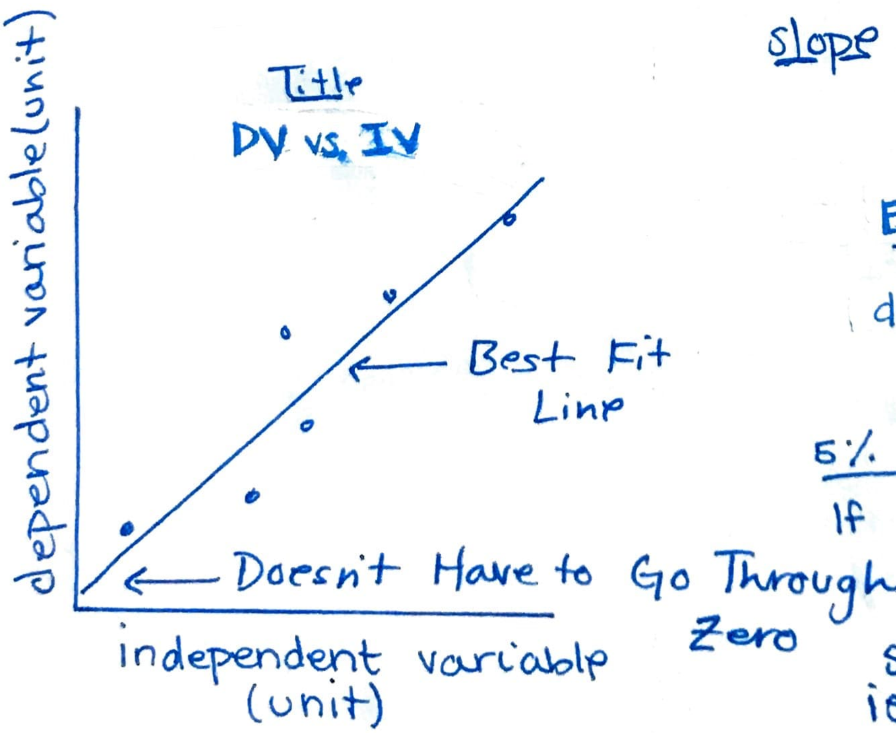
The English physicist, Robert Hooke, recorded the relationship between a spring and a mass attached vertically to the spring (so the gravitational force on the mass is pulling down on the spring). This idealized behavior of matter is called HOOKE'S LAW. In the following lab, you will determine the relationship between the force used to deform (stretch) a spring and the amount that the spring has been attached. Unlike Hooke's original labs, we are using spring scales laid horizontally on a surface. The spring scale shows a gradient of forces along the column that houses the scale. As one end of the scale is pulled (with the other end in place), a force is exerted on the spring so that it extends in length and pulls back with equal force. As you pull you feel the spring pulling back. Think about what happens if you just release the spring after pulling it – what happens and what causes what happens?

THE POST-LAB SECTION OF *Miss Weisse's Own Physics Textbook* WILL BE MADE AVAILABLE TO YOU AFTER YOU TURN IN YOUR LAB.

Helpful Reminders

MEASUREMENT	EQUATION(S)	UNIT(S)	VARIABLE	UNIT BREAKDOWN
speed/velocity	$=\frac{\Delta x}{\Delta t}$	meter/second	m/s	na
acceleration	$=\frac{\Delta v}{t}$	meter/second²	$\frac{m}{s^2}$	$\frac{\Delta v}{t} \Rightarrow \frac{(\frac{m}{s})}{s} = \frac{m}{s \cdot s} = \frac{m}{s^2}$
force	$= m \cdot \vec{a}$	Newton	N	$m \cdot a = kg \cdot (\frac{m}{s^2}) = \frac{kg \cdot m}{s^2}$
momentum	$= m \cdot \vec{v}$	kilogram· meter per second	$\frac{kg \cdot m}{s}$	$m \cdot v = kg(\frac{m}{s}) = \frac{kg \cdot m}{s}$
energy	$= F \cdot d$ (one of many equations)	Joule	J	$= F \cdot d = N \cdot m = \frac{kg \cdot m}{s^2} \cdot m = \frac{kg \cdot m^2}{s^2}$

$$\text{slope} = m = \frac{\Delta(DV)}{\Delta(IV)}$$



Equation of a Line

$$dv = m(iv) + b$$

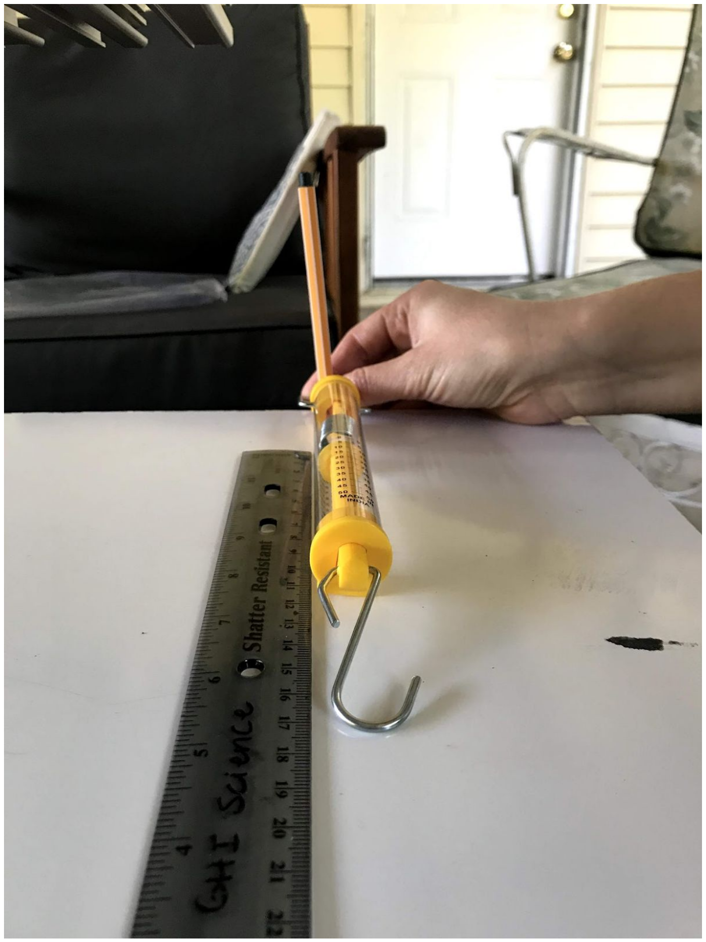
5% Rule

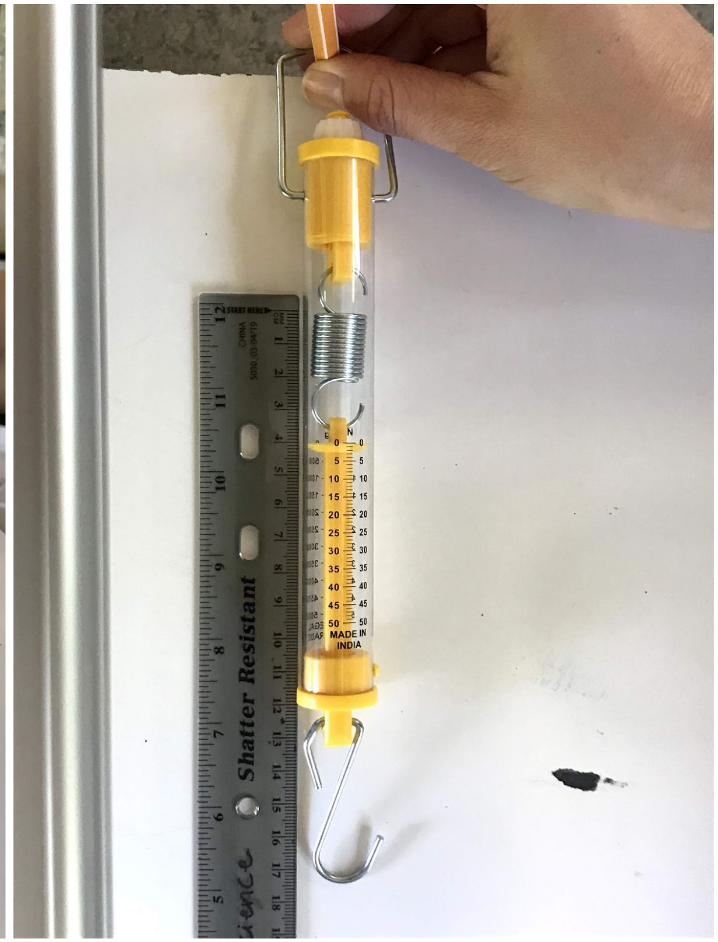
If $b < (.05)(\text{max-dv value})$ then we can say the y-intercept is negligable.

SET UP

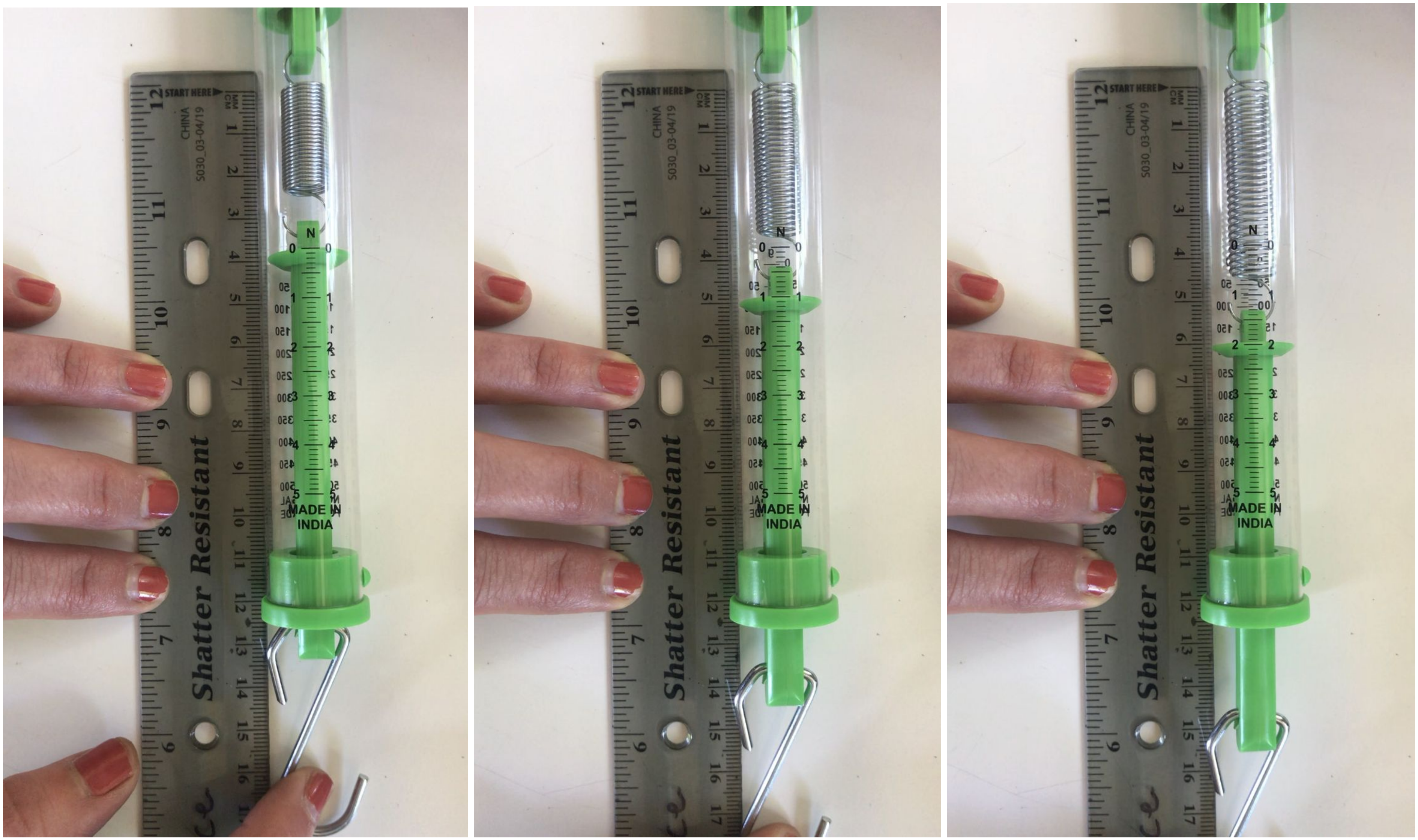
***********************to make your measurements you will want to zoom in on your computer screen (~200%)**********************

FROM THE FRONT: The spring scale is being anchored in place with a pen perpendicular to the board, so the whole scale cannot be pulled forward when the hook is pulled forward to extend the spring.	**FROM THE TOP:** Again, the spring scale is anchored by the pen and the top of the spring is aligned with the zero mark of the ruler. The ruler remains stationary throughout the measurements.





GREEN SPRING SCALE (VIDEO)

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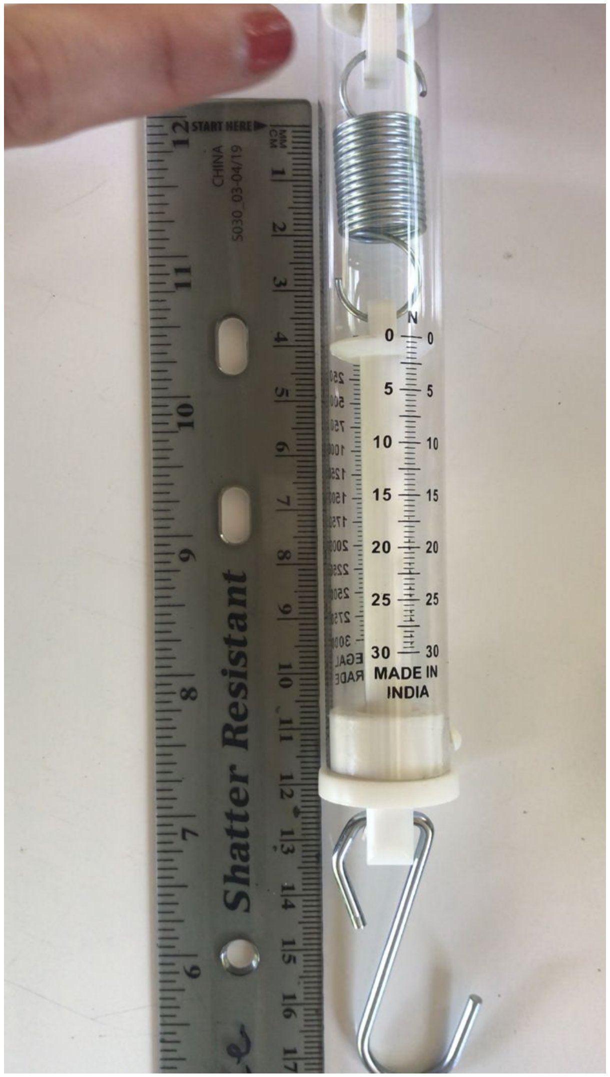
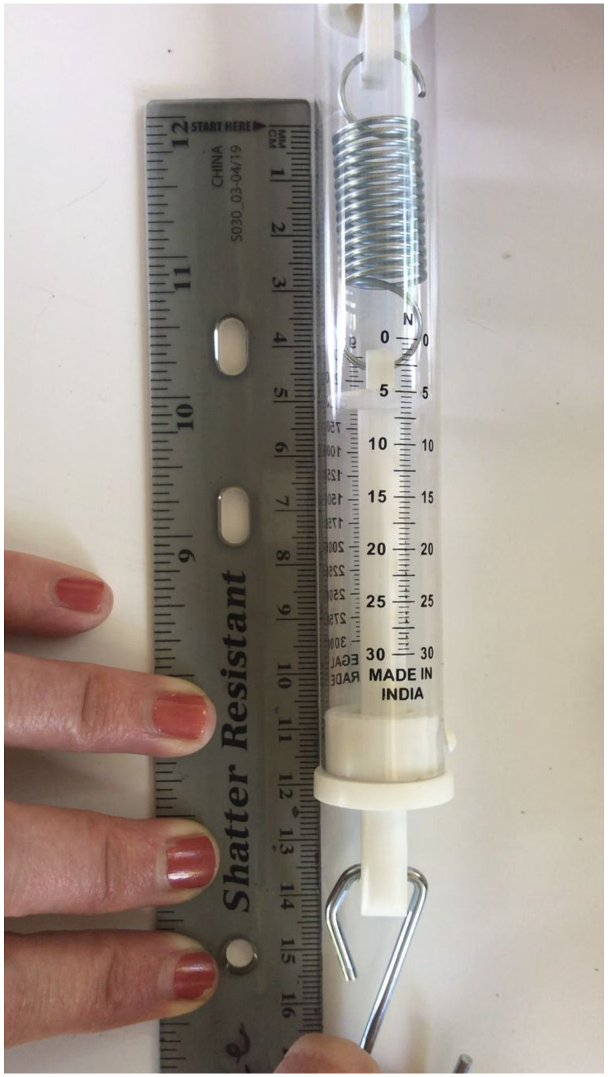
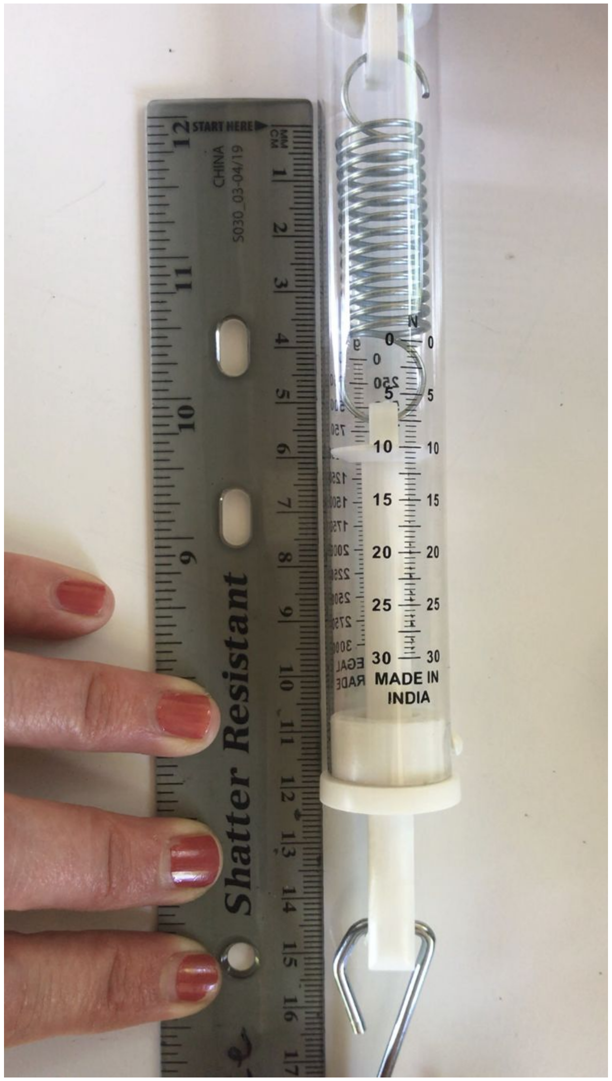
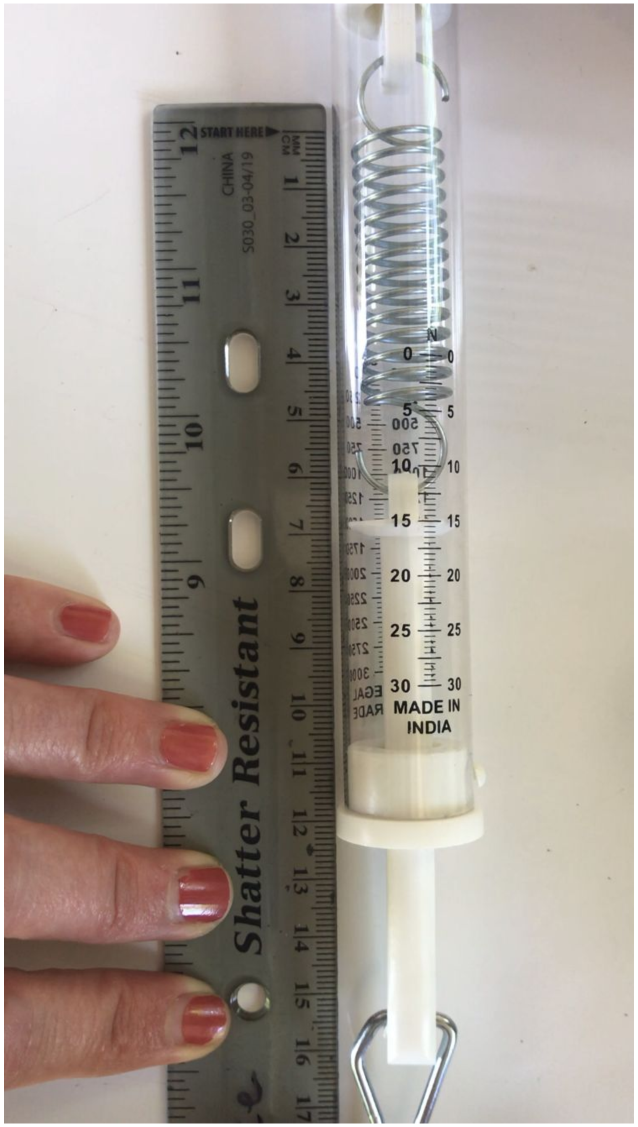
WHITE SPRING SCALE (VIDEO)





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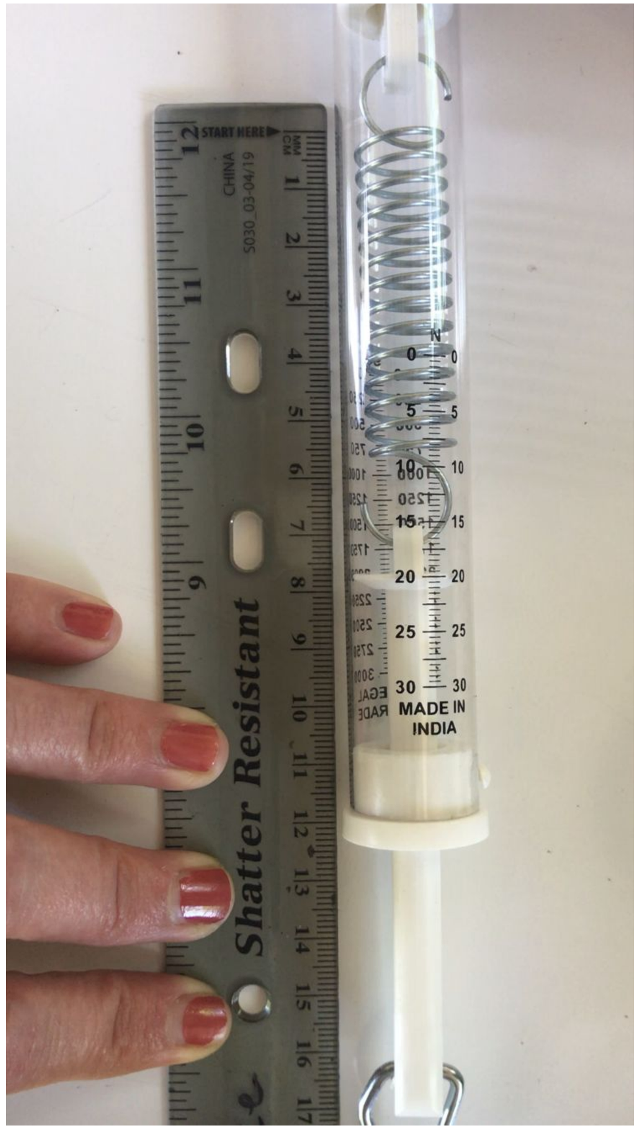
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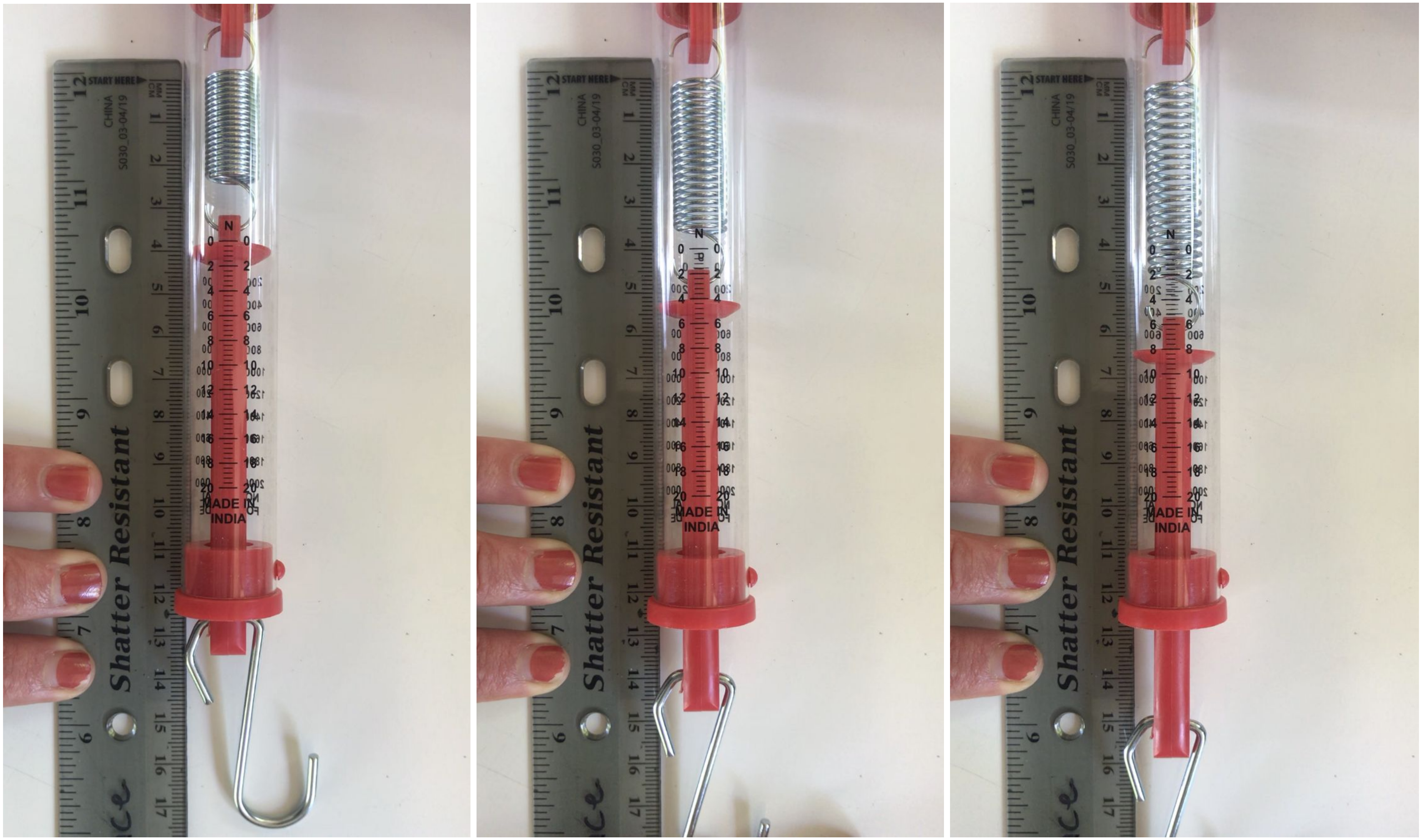
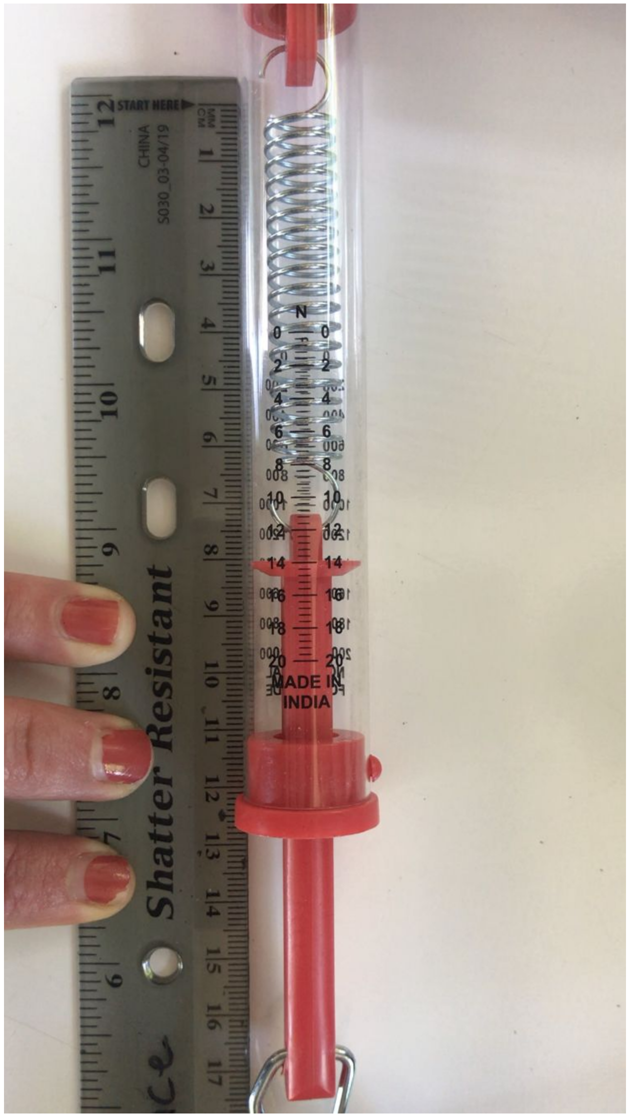
RED SPRING SCALE (VIDEO)

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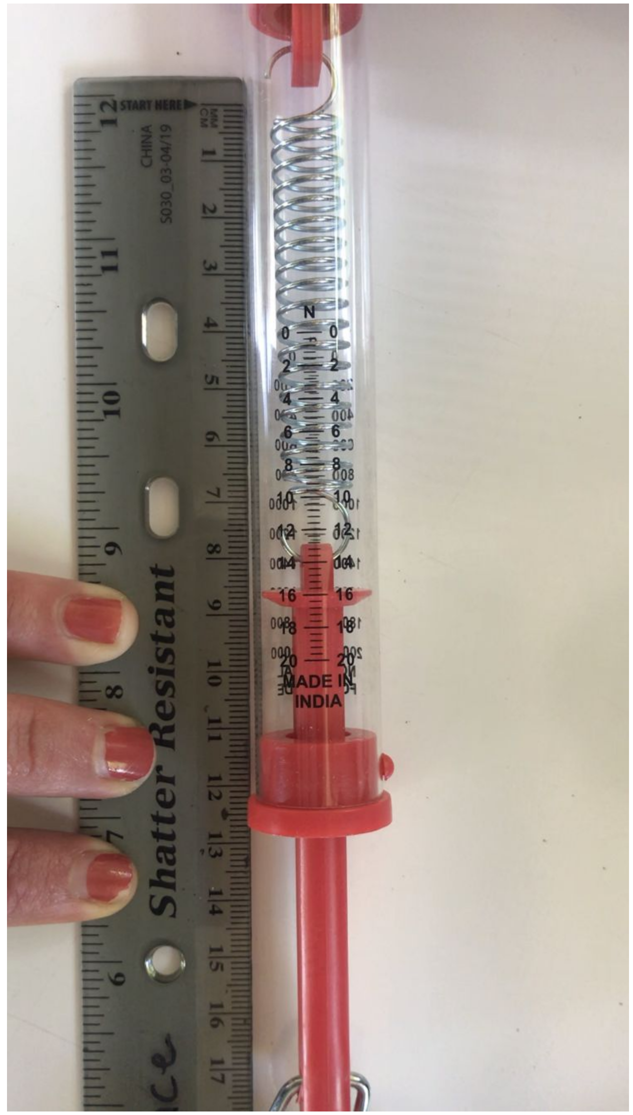
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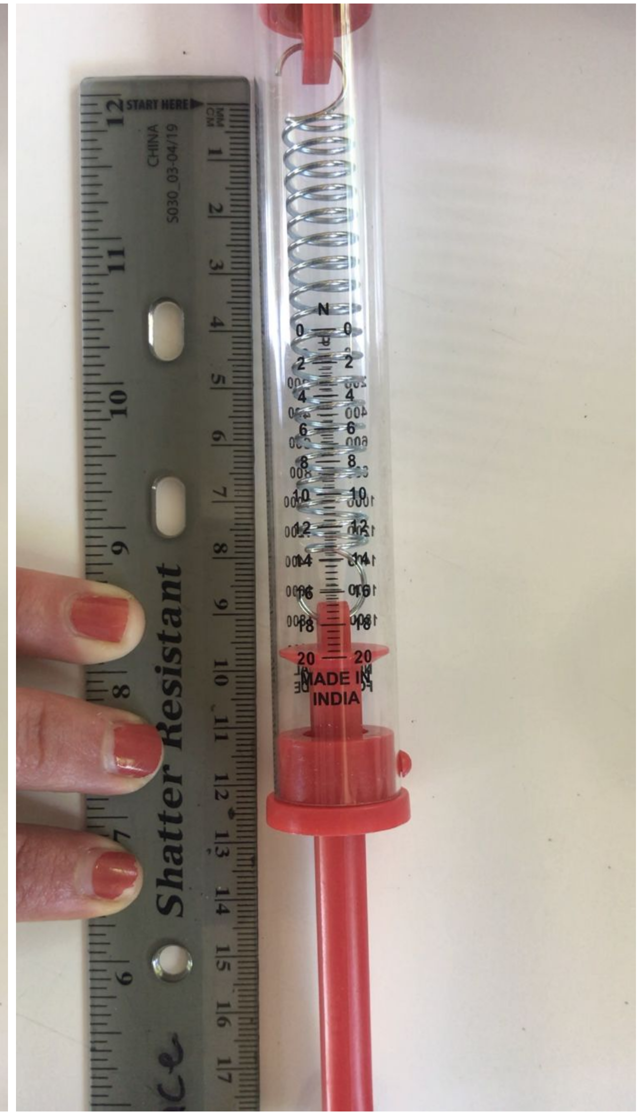
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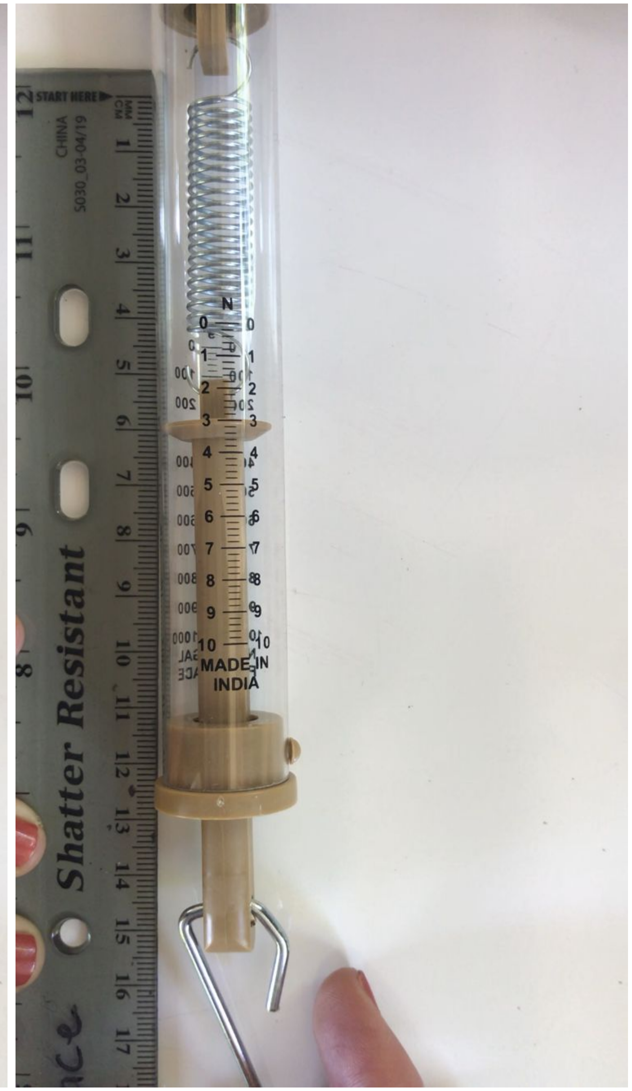
BROWN SPRING SCALE (VIDEO)

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