Main Topic	Measurement
Subtopic	Graphing
Learning Level	High
Technology Level	High
Activity Type	Student

Description: Graph four different physical relationships, taking measurements for each. Find the equation of each line.

Required Equipment	Computer with Excel or other graphing application, Spring Set/3, Hooked Masses, Meter sticks, Boyle's Law apparatus, several identical weights or books, D-Cell holder, D-Cell battery, 2 alligator wires, mini bulb, mini bulb holder, light sensor, 7 wood blocks.
Optional Equipment	

Educational Objectives

- Investigate and interpret four different graphical results from experiments.

Concept Overview

Station #1 investigates the relationship between force and displacement of a stretched spring. Students will discover a direct linear relationship, with an equation of the form $y = mx + b$.

Station #2 uses an object falling at constant velocity toward a motion sensor. Students graph distance above the ground vs. time and find a negative linear relationship. The equation is y=mx+b, and m is negative.

Station #3 relates light intensity to distance from the source. The graph shows an inverse-square relationship, with an equation $y = 1/x^2$.

Station #4 uses staggered, stacked blocks to result in a simple parabolic graph, where $y = x^2$.

Lab Tips

Station #1: You may assign different springs to different groups, so that the class can see that the general shape of the graph is the same for different springs.

Station #2: Students need to be familiar with how to use the motion sensor. The data they will collect is simple and quick to capture.

Station #3 is best done in a darker part of the room, to avoid extraneous light entering the sensor.

Station #4 can be done with simple 12-18-inch long identical pieces of 2x4 lumber or 7 copies of the same book.

This lab was contributed by Dwight "Buzz" Putnam, Whitesboro High School, Marcy, NY.

Picture of a Lab Name: _____

Class: _____

Goal:

Investigate different graphical results.

Materials:

Computer with Excel or other graphing application, Spring Set/3, Hooked Masses, Meter sticks, Motion Sensor, Coffee Filter, D-Cell holder, D-Cell battery, 2 alligator wires, mini bulb, mini bulb holder, light sensor, 7 wood blocks.

Procedure & Requirements

1. You will take data from **4 different Stations**.
2. For **EACH** Station, **FOR FULL CREDIT, YOU MUST**…
   - Complete the data table.
   - Plot the data on **Excel**.
   - Use "**scatterplot**", **label axes**, insert an appropriate **Trendline** AND include an **equation** for your data.

*** REMEMBER! THE TRENDLINE SHOULD BE THE "BEST FIT" SHAPE!**

- Answer the questions for **EACH** station.
- **Each lab partner MUST create their own graphs & answer questions!**

Station #1 - *Mass suspended from a Spring → "Hooke's Law"*

1. Using the masses on the lab table, you & your partner will **measure** and record the position of the **bottom of the spring** as masses are added to it.
2. Be certain to measure the position of the spring with **NO** masses on it. This will be the **ZERO POSITION**.
3. Continue to add masses on to the spring and measure the **ELONGATION** of the spring in each instance.
4. Complete the Data Table & plot a graph of **Mass [x-axis] vs. Elongation**.

Mass [gms]	Elongation [cm]
200	
500	
700	
1000	
1200	
1500	

Station #1/Graph Questions

A. Describe ***in words*** the relationship between mass & spring elongation.

B. Using Excel and the generated **equation** of the plotted, what is the **slope** of the graph?

C. What is the **equation** for the graph?

Picture of a Lab Name: _____

Class: _____

Station #2 – *"The Coffee Filter Drop"*

1. Using the **Motion Detector**, click **"collect"** and wait for the sound of the detector before you drop the filter.
2. **Drop the filter** ~2-3 meters directly in-line above the detector until it falls onto it.
3. **Select** the portion of the graph that is **LINEAR** and **type the highlighted data** into your data table. [You can make the graph later.]
4. Plot a graph of **Distance [Position] vs. Time [x-axis]** on Excel.

Distance [m]	**Time [seconds]**

Station #2/Graph Questions

a. What is the **equation** for the graph?

b. Using Excel and the generated **equation** of the plotted line, what is the **slope** of the graph?

c. Using Excel and the generated **equation** of the plotted line, what is the **Velocity** of the coffee filter?

Station #3 – *Intensity of Light vs. Distance from the Source*

1. Hook the alligator clips to the battery so that the bulb turns on.
2. Set the end of the probe at the **0cm** mark.
3. Move the probe to the **2cm mark** and take your **Light Intensity reading**.
4. Continue to take readings every **2cm**.
5. Complete the data table
6. Plot a graph of **Source Distance [x-axis] vs. Light Intensity.**

Source Distance [cm]	Intensity [lux]
0.5	
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	

Station #3/Graph Questions

D. Describe ***in words*** the relationship between **Intensity & Distance** from the source.

E. What is the **equation** for the graph?

Station #4 – *Maximum Span "Stack O' Stuff"*

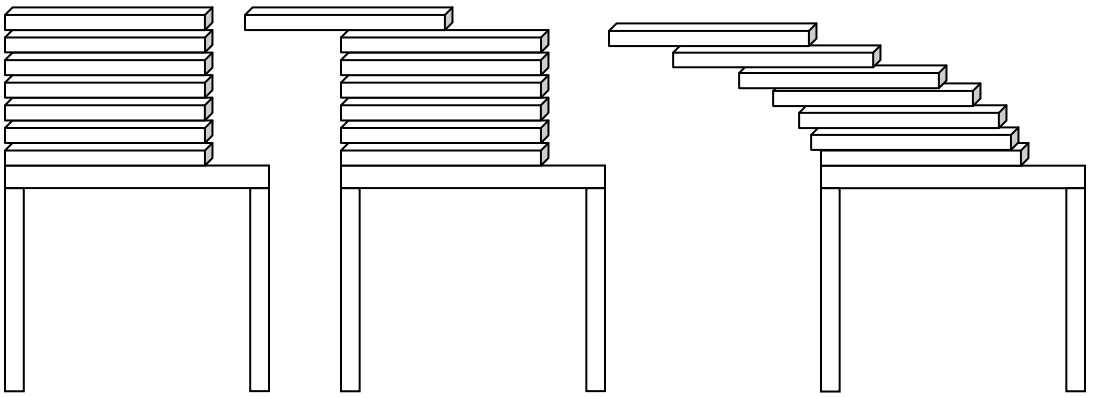
1. Using the blocks/books provided in the Physics room, stack **7 blocks/books DIRECTLY ON TOP OF EACH OTHER AT THE EDGE OF THE TABLE.** [**see diagram next page**]
2. Beginning with the **top block/book**, push the **top** block/book out **as far as it will go** without falling.
3. Next, push the next book beneath the top one as far out as possible until the top two are ***just barely balanced***.
4. Continue this process until all 7 are balanced over the edge of the lab table and the final diagram is achieved.
5. Complete the Data Table.
6. Plot a graph of **Book/Block # [x-axis] vs. Distance.**
7. ***Distance is measured from the Block/Book edge to the Block/Book beneath it!***

Book/Block #	Distance [cm]
Block/Book #1 [Distance of bottom book/block from the edge of the lab table]	**0cm**
Block/Book #2	
Block/Book #3	
Block/Book #4	
Block/Book #5	
Block/Book #6	
Block/Book #7	

Picture of a Lab

Name: _____

Class: _____



Step #1 Stack Book/Blocks	Step #2 Move top book #7 as far out as possible.	Step #3 Books should look like this when correctly placed.

Station #4/Graph Questions

A. Describe ***in words*** the relationship between book # & distance.

B. What is the **equation** for the graph?