*Math Activities that include student choices:*
*Making some of the CCSSm practices a little more engaging*

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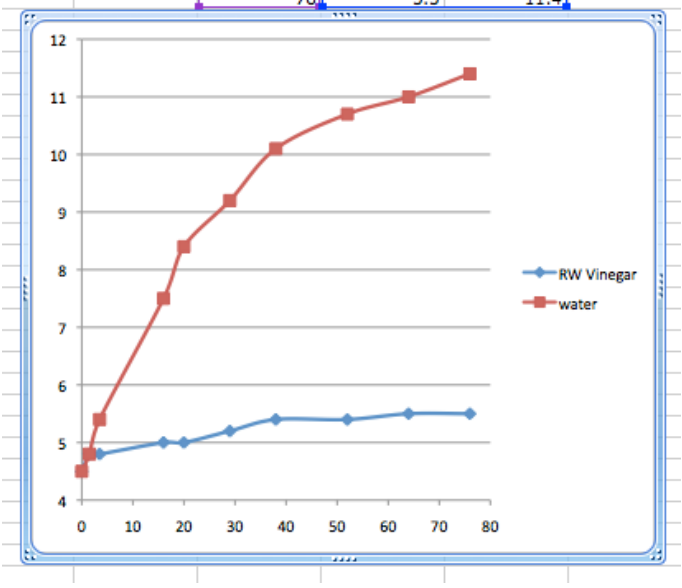
# 1. Grow Beasts

**Focus**: measurement, data analysis, CCSSm Practice #4: Model with Mathematics.
NGSS Science & Engineering Practice #3: Planning and carrying out investigations.
**Materials**: Grow Beasts, bowls or ziplock bags, rulers

The grow beast is a small, inexpensive, readily available toy that, when placed in water, absorbs it and thus "grows" over the course of several days, then gradually shrinks to more or less its original size when removed from the water. Some are dinosaurs but others are bugs, sea creatures, lizards and just about everything else that can be molded from this special substance, a superabsorbent hydrophilic (water-loving) polymer. This is like the stuff you will find if you slice open a disposable diaper. Its key feature is that it absorbs liquid. In a diaper it is formulated so as to do this very quickly. In a grow beast the process takes days. They do this in water. They do it in milk. They do it in coffee. They'll do it in root beer if you give them a chance. But in each of these liquids they grow and shrink at different rates. That's part of make them so worthwhile in a math or science classroom. Students can predict, measure, record, analyze, predict again with new data, etc. and all in a context – watching a dinosaur "grow" that is engaging and fun.

| hours elapsed | RW Vinegar | water |
|---|---|---|
| 0 | 4.5 | 4.5 |
| 1.5 | 4.8 | 4.8 |
| 3.5 | 4.8 | 5.4 |
| 16 | 5 | 7.5 |
| 20 | 5 | 8.4 |
| 29 | 5.2 | 9.2 |
| 38 | 5.4 | 10.1 |
| 52 | 5.4 | 10.7 |
| 64 | 5.5 | 11 |
| 76 | 5.5 | 11.4 |




You can get grow beasts from a number of places including "Loose in the Lab." (http://looseinthelabscience.com/dinosaur-gro-beasts/ )

Contact me if you want more information about these things or how to use them in a classroom.

# 2. Doll Proportions

**Focus**: proportional reasoning, CCSSm Practice #2 : Reason abstractly and quantitatively.
**Materials**: dolls and tape measures


Give students a look at the dolls and ask if there's anything not quite human about them. Students will say that the head is too big, the arms are too short, the feet are too small, etc. But are they? Help students see that they can use mathematics to compare the dolls to humans. For example, they might find the ratio of a doll's arm length to its body length (height). Then the same measurements can be taken for students working with the dolls. The ratio will likely be different. If you can get other sorts of dolls you will find that some have more and some have less typically human ratios.

# 3. Bungee Barbie

**Focus**: Seeing patterns in data. Constructing understanding of linear data and their graphs with attention to slope. CCSSm Practice #2: Reason abstractly and quantitatively, and #4: Model with mathematics.


**Materials**: Barbie / Ken (or similar) dolls, rubber bands and measuring devices such as tape measures.

The objective of this activity is for teams of students to create a mathematical model / equation relating the distance Barbie will fall to the number of rubber bands making up a bungee cord. Students use the model to predict the number of rubber bands needed to perform the bungee jump from a specific height.

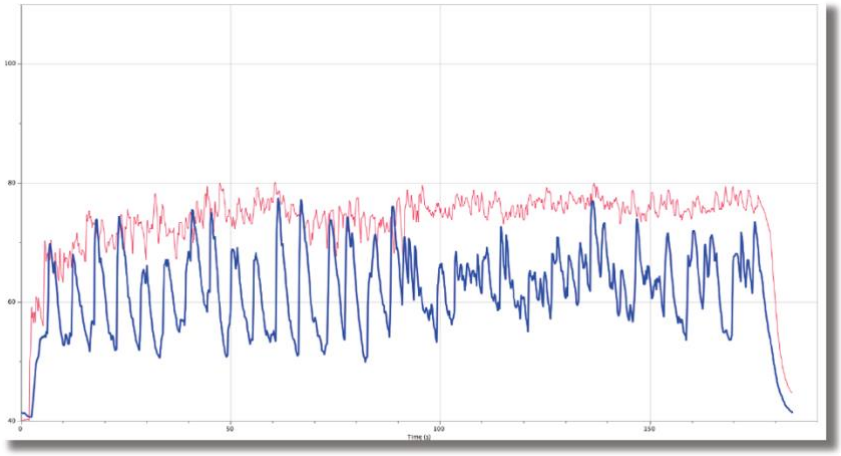
I let teams choose a doll or bring one of their own. I attach the first rubber band to the doll's ankles. All the rest of the bands will be attached from this beginning so it needs to be secure. I give them five more bands and a tape measure and task them with finding out how much further the doll will fall with the addition of each new rubber band. If they are on the right track, and can demonstrate their understanding of the pattern in the data, I give them five more rubber bands. With these and some more time to experiment they are charged with making an accurate prediction about how many bands will be needed for a jump from a given height, say from a second story landing or balcony. They have to be able to explain their reasoning.

When all the groups have convinced me that they have a rational, mathematically sound prediction and know how many bands will be needed to give Barbie the thrill of her little plastic life, I give them the bands they think they need and we go to the predetermined jump site to test their predictions. This is a popular activity and you can find it all over the web, e.g., https://www.youtube.com/watch?v=ISZ_U23_JIQ

# 4. Graphing Music

**Focus**: Understanding meaning conveyed in a graph ("volume" vs time) with attention to slope and averages. CCSSm Practice #2: Reason abstractly and quantitatively, and #4: Model with mathematics.
**Materials**: Sound Probe (e.g., http://www.vernier.com/products/sensors/sound-level-probes/slm-bta/ ), a means to play music, students' songs.

When you have a sound probe, the one linked above or some other, you can use it to sense the volume of ambient sound (in decibels) and see this graphed against time. You can then analyze these graphs for all sorts of characteristics such as average level across a given interval, rate of change, trends in loudness, etc. When students apply these analyses to the traces left by songs they care about their level of engagement is high. Here is a graph for two songs on one set of axes. The more rhythmic of the two is "Uncloudy Day" by the Staple Singers. The more chaotic looking trace was left by "Honkey Tonk Woman" by the Rolling Stones. Time is on the x-axis (~ 3 min. total) and volume is on the y-axis.



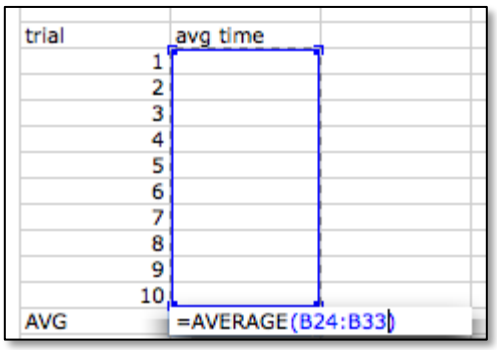
Note: The meter can be used as a stand-alone device in which case measurements are read from the LCD screen on the device, or it can be connected to a computer (requires the Go-Link) or TI Graphing Calculator.

# 5. *Sheep Dash* from the BBC

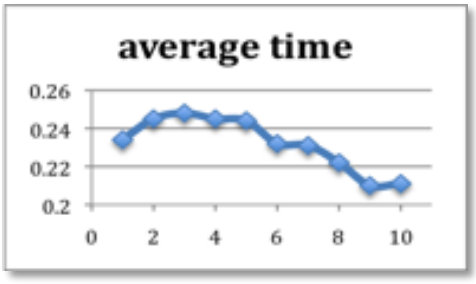
**Focus**: trends in data (CCSSm S.ID.C.7 and 8) CCSSm Practice #3: Construct viable arguments and critique the reasoning of others, and #4: Model with mathematics.
**Materials**: Access to the Website: http://www.bbc.co.uk/science/humanbody/sleep/sheep/

This is a highly engaging (?) way to generate lots of data through measurement of your reaction times. Go to the site and play the game a few times.

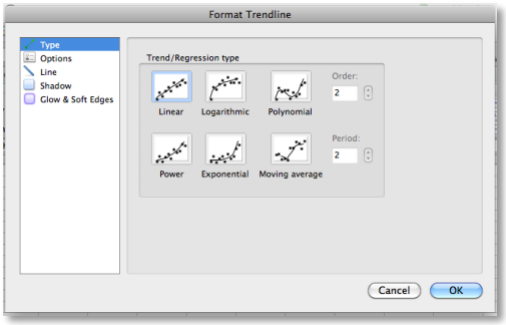
Set up a spreadsheet to hold the data: For now, try 10 rows, 2 columns => 10 sets of 5 trials.



Generate and enter your data then highlight the appropriate range of cells and make an X-Y (scatter) plot. Click on the plot (line) itself to select all of the points simultaneously then go to the Chart menu to select "Add Trendline…" This will give you a "Format Trendline" dialog box that allows you to do just that. Using the "options" button you can add the trend line's equation so that you can consider the slope of the line (assuming a linear trend line…._).




In the end you will have a chart like this. (see below) Note that you can set it up so that the chart is created and the trend line and equation are adjusted <u>as the data are added</u>. Does the trend line tell you anything about how fast you will be after 20 trials? How about 200??




<u>Activity Outline:</u>

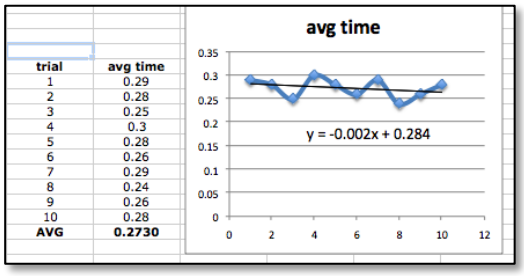
15 min. Gather "baseline" data.

10 min. Do something … to see if it will affect your reaction times (e.g., drink a Mountain Dew or run around the building or meditate or…).

10 min. Gather new data in your altered state.

10 min Analyze the differences between the data sets.

15 min Return to class and discuss how you know what you know.




| trial | avg time |
|---|---|
| 1 | 0.29 |
| 2 | 0.28 |
| 3 | 0.25 |
| 4 | 0.3 |
| 5 | 0.28 |
| 6 | 0.26 |
| 7 | 0.29 |
| 8 | 0.24 |
| 9 | 0.26 |
| 10 | 0.28 |
| **AVG** | **0.2730** |

# 6. Forecast Verification … or not

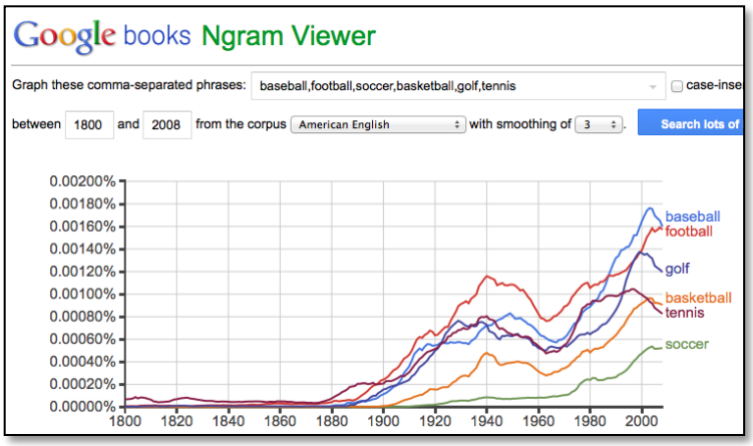
**Focus**: Using data to verify or support a hypothesis and measure a trend in the data. CCSSm Practice #1: Make sense of problems and persevere in solving them.

**Materials**: Access to long range forecasts (cell phones generally have a weather app)

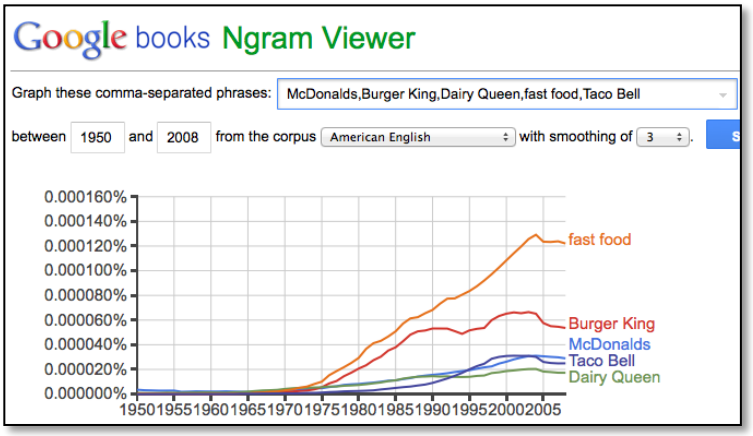

Weather forecasters often make temperature forecasts for today, tomorrow, (a "one-day" forecast) the next day (a "two-day" forecast), the one after that, etc. often up to a week or ten days out. Are these forecasts accurate? How can we quantify this? What if we kept track of the forecasts for one-day, two-day, three-day etc. up to the ten-day forecast and then kept track of how well they verified. That is, how far the actual reading was from that which was forecast. Intuitively, it seems as though the short-term forecasts ought to be more accurate than the long-term forecasts but is that the case? Set up a spreadsheet to hold and make calculations with forecast data and find out. This makes a nice long-term project, taking at least ten days to complete and allowing for new data calculations every day.

# 7. Ngram Viewer (Google)

**Focus**: Understanding data and data representations CCSSm Practice #5: Use appropriate tools strategically.
**Materials**: Access to the Website: https://books.google.com/ngrams

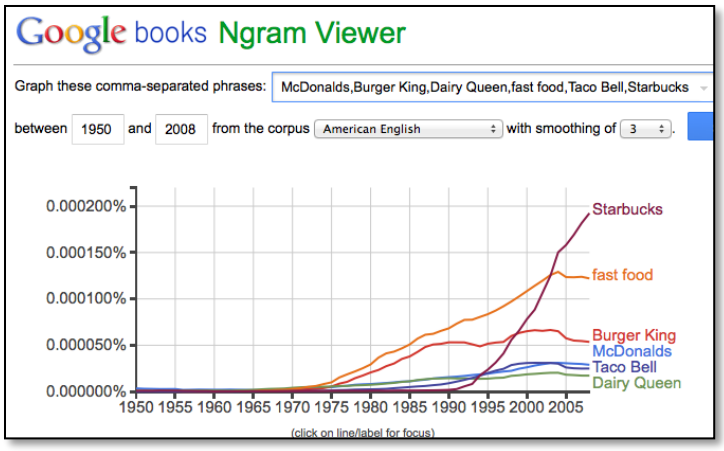



Google's Ngram Viewer takes advantage of the fact that Google has been scanning books for years now and they have accumulated quite a database. That database can be accessed and queried in some simple and not so simple ways. For instance, I can ask for the frequency with which the words baseball, football, soccer, golf and tennis have occurred in books they have scanned. The default is to query English language books published between 1800 and 2000 but if I wished to do so I could look at, for example the results for books in Chinese between 1966 and 1976, or Italian from 1750-1820, etc.




How about "fast food," "McDonalds," "Burger King," "Dairy Queen" and "Taco Bell"?

What happens if we add "Starbucks" to the search?




Notice that the scale on the y-axis had to change. Notice also that .000200% is not a very big number. (What does it mean exactly?) If we search for "the," during the same period, it is relatively steady at about 4.5% which means it's about 22,500 times more often than "Starbucks" at its peak.

Students can use this website to search for terms that interest them. Teachers can use that interest as a springboard to work on getting them involved in examination of graphs, the significance of scale and representations of data in general.

# 8. Wolfram Alpha

**Focus**: Quantification, analysis and representation of quantity (which is pretty much "math.") CCSSm Practice #4: Model with mathematics.
**Materials**: Access to the Website: http://www.wolframalpha.com/

Wolfram Alpha has become quite an extraordinary site for quantifying, analyzing and representing life. You get a strong hint of this as soon as you open their homepage. You can explore via the links there but here are a few specific paths that will demonstrate some of the quantifying power and potential of this site:

On the front page, click on the first link, "Mathematics."
Click on the addition example (125+375), at the top of the list. Simple but interesting… Go back to "Mathematics." Then click on the "Plotting and Graphics" example. Go back. Then enter something of your own, for example, $x^2 - 4x + 24 = 45$. It will solve it, and more….
Now go back out to the beginning and type in your name. LOTS of information.
Try searching for your birth date. E.g., "June xx, 19xx."

Now try the name of the city where you were born and your birth date. E.g., "Spokane, May 12, 1958." …. So much quantification! So many opportunities to let students choose their own context for the generation of numbers for analysis!

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