**Lab: How do Phones Charge? (Revisited)**

**Motivation:** Revisiting the same problem done earlier in the semester now that we can find a better equation to model the data. Show students an everyday application of logistic models.

**Objectives:** Students will be able to find the equation of a logistic equation to model data.

**Materials:** Data from the “How do Phones Charge?” lab. If you do not have this data still, complete Activity 1, if you do have the data, start with Activity 2.

**Activity 1:**

Use your data from the previous time you worked with this example. If you lost your data or did not do the last problem, follow the steps below and use the Data Collecting Table to record your data.

Start with a cell-phone or tablet that is completely out of battery. Yes, that means you must kill your battery in your phone or tablet. To gather your data, charge your phone and record the percentage of battery you have at equal time intervals until your phone is fully charged. Note: Your phone should be on (to see the percentage) but for accurate data, you should refrain from using your phone until all the data is collected.

**Activity 2:**

Use two of your first few data points to create an exponential model for the percent charge of the phone/tablet, $f(t)=Ae^{kt}$, where $t$ is the number of minutes after charging has begun.

**Activity 3:**

1. Use your exponential model to predict the percent charge of the battery at the following times:
	1. 5.5 minutes after charging began
	2. 13 minutes after charging began.
2. Use your exponential model to determine how long it will take for your battery to be 75% charged.
3. Does your data truly follow an exponential curve? Why or why not?

**Activity 4:**

A logistic growth model is used to model populations where the growth is constrained by variable resources. That is, the growth is restricted to a certain amount, $d$.

Logistic Growth Model: $f\left(t\right)=\frac{d}{1+ke^{-ct}}$ where $c, d, k$ are positive constants.

**Activity 3:**

1. Is there a restriction to the amount that the phone/tablet battery can be charged? If so, this value would be the value of $d$.
2. Does charging your phone/tablet follow a logistic growth model? Why or why not?
3. Use two of your data points to create a logistic growth model to represent the percent charge after $t$ minutes of charging. You will use these data points to create a system of equations to solve for $k$ and $c$.
4. Use this model to predict the percent charge of the battery at the following times:
	1. 5.5 minutes after charging began
	2. 13 minutes after charging began.
5. Use your exponential model to determine how long it will take for your battery to be 75% charged.