Applied Rates of Change

Goal: • Can use derivative rules to find appropriate rate of change for the context of the problem. • Can use chain rule fluently to find rate of change with respect to time.
Terminology: • Differential Equation

In your groups you need to make up 3 stories that relate one unit to another. I want to see a reasonable graph that describes the scenario and then an equation that could describe the graph. To help you choose your units we have a handy chart that will tell you what relation you should be looking at.

Birthday Month	Unit	Birthday Month	Unit	Birthday Month	Unit
January	Volume (m^3)	May	Cost ($)	September	Humidity (%)
February	Volume (L)	June	Memory (MB)	October	Population (people)
March	Temperature (^oC)	July	Force (N)	November	Charge (C - Coulomb)
April	Pressure (atm)	August	Mass (kg)	December	Light Intensity (cd – candela)

Scenario #1 Person 1 vs. time

Description:	Graph:
Equation:	Differential Equation:

Scenario #1 Person 2 vs. Any unit that is not time

Description:	Graph:

Equation:	Differential Equations:

Example: Concentration is measure in amount of substance per unit volume. Imagine we start with a empty glass and add water at some variable rate and add sugar crystals at some other rate.

(a) Write an equation to model the concentration
(b) make a differential equation with respect to time
(c) make a differential equation with respect to amount of sugar

Practice Problems: 3.3: # 1-6, 8, 9
3.4: 1-6 are okay. Don't worry about remembering the vocab though

 3.3 # 7

In Class Evidence

3. If a tank holds 1000L of water, which takes an hour to drain from the bottom of the tank then the volume of water remaining in the tank after t minutes is

$$V = 1000\left(1 - \frac{t^2}{60}\right)$$

Find the rate at which water is flowing out of the tank after 10 minutes.

4. The mass in kg of the part of a wire that lies between its left endpoint and a point x is

$$M = \sqrt{x}$$

a. Find an approximate value for the average density from $x = 1$ to $x = 1.1$m

b. Find the density when $x = 1$m

6. The population of a bacteria colony after t hours is

$$n = 1000 + 180t + 25t^2 + 3t^3$$

Find the growth rate after 3 hours

7. A substance at constant temperature will have a relationship between volume and pressure. The isothermal compressibility is

$$\beta = -\frac{1}{V} \cdot \frac{dV}{dP}$$

And measures how fast the volume changes as pressure changes (dV/dP)per unit volume ($1/V$). The volume of a sample in cubic meters at 25°C is related to the pressure in kilopascals by

$$V = \frac{5.3}{P}$$

Find the compressibility when pressure is 40 kPa