As in Lecture 10.4a we’ll begin with information about how something is changing (rate of change = first derivative) and use that information to derive an equation to describe an amount.

Today’s examples are medical-biological scenarios.

Example A: One injection of 10 mg of a medication is given to a patient. The amount of the drug in the bloodstream decreases by 8% per hour. a) Set up and solve a differential equation that is satisfied by $P(t)$, the amount of the medication in the bloodstream of the patient. b) Estimate the amount of the drug in the bloodstream after 24 hours (to the nearest tenth).  

**answers:** $P = 10e^{-0.08t}$, $\approx 1.5$ mg

Example B: An anti-coagulant is introduced intravenously at a rate of 0.5 mg per hour. On a continuous basis 2% of the drug in the bloodstream is absorbed into the body. a) Set up and solve a differential equation that is satisfied by $y(t)$, the amount of anti-coagulant the bloodstream of the patient. b) Determine the equilibrium amount of the anti-coagulant in the bloodstream of the patient.  

**answer:** $y = 25 + Ce^{-0.02t}$, 25 mg
Example C. Radon, when dispersed in the atmosphere is harmless, but when allowed to concentrate in a closed space becomes a serious risk. A 1000 ft\(^3\) room has a radon level of 500 pCi (pico curies) per ft\(^3\). A ventilation system is installed which brings in 100 ft\(^3\) of outside air containing 4 pCi per ft\(^3\). An equal volume of air leaves the room. Assuming the air mixes thoroughly, determine how soon the radon level will fall to 112 pCi per ft\(^3\), the safe level set by the EPA.

(Note that \(y\) is defined as “amount of radon in a 1000 ft\(^3\) room”, so that the initial condition of “500 pCi per ft\(^3\)” translates to “when \(t = 0, y = 500,000\)."

Answers: general solution is \(y = 4000 + Ce^{-0.1t}\); particular solution is \(y = 4000 + 496000e^{-0.1t}\); exact time is \(t = -10 \ln \left( \frac{27}{124} \right)\) hours; approximate time is \(t \approx 15.2\) hours.
One of the text practice exercises involves using Newton’s Law of Cooling (see Lecture 10.2 Example A) to determine time of death.