Math 202 Project
The purpose of this project is to illustrate how classroom topics are used in the real world by people in various fields. You are to choose one project from below. Notice that each project has two components: one that extends the mathematical ideas we discussed in class to applied problems and another that allows you to further explore your chosen topic and see what current mathematical tools are being used by scientists today. Your report is due at the beginning of class on Monday, April 6th. You may work through the math in groups, but each individual should write their separate reports.

Project Description 1 - Numerical integration and pendulums
Part 1 Complete Exercise 5 under "Chapter 7 Making Connections" on page 559 in the textbook. In addition to using *Mathematica* to approximate the period in part (b), also use Simpson's Rule with 8 subintervals and compare your work with *Mathematica's* approximation.

Part 2 Choose either numerical integration or pendulums as a topic and write a 1-2 page summary on how this topic is used in real world applications. Be sure to include at least two scholarly articles in your work.

Project Description 2 - Allee effect and mathematical modeling
Part 1
One model for population growth assumes that the rate of growth dP/dt is proportional to the product of the following quantities: the population P, the difference between the population and the "critical population" m, and the difference between the "carrying capacity" M and the population. Suppose that a population has a critical population of m=50 and a carrying capacity of M=200. Take the constant of proportionality k=0.000025.

(a) Construct a first-order differential equation for the population growth.

(b) Draw a direction field for this differential equation.

(c) Trace solutions with initial populations P(0)=40, 100, and 250 (Use NDSolve).

(d) Find the equilibrium solutions to this differential equation by setting dP/dt = 0. Use techniques from Calculus I to determine when the population will increase and when it will decrease. Use this information to comment on the long term behavior of solutions to this differential equation.

Part 2 Find a mathematical model in a scholarly article that uses first order differential equations. Write a 1-2 page summary on this article, including a summary of the analysis done on the differential equations and the real world implications of the mathematical model.