Assignment 7: Due 6 October 2016

I. Thinking about the World: An Introduction to Modeling

Consider each of these observations about some part of the world. What constraints do the words impose? What assumptions could you make consistent with the statements? How would you build a *model* that would allow you to explore the effects of different assumptions about the details or structure of your models?

1. In a community of infertile immortals, some healthy individuals who come in contact with infected people get sick and then some infected people recover never to get sick again.

2. Some immortal rabbits have immortal bunnies.

3. Some immortal rabbits have bunnies, some of which survive to become immortal rabbits.

4. An enclosed field can only support a finite number of immortal rabbits, some of which have bunnies.

5. Money in a tax-free economy earns interest.

6. Some rabbits have bunnies while some rabbits die.

7. Immortal rabbits, some of which have bunnies, compete for limited resources in an enclosed field, with the losers vanishing from the field never to compete or have bunnies again.

8. In a closed economic community, some immortal students who are mentored by employed immortals become workers; some workers retire never to work or study again.

9. The government taxes your interest-earning savings.

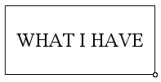
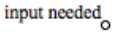
10. You just can 't get ahead: as your interest-earning savings grow, the government takes more of your money so you can never exceed some fixed maximum balance.

11. Some rabbits have bunnies while wolves eat some of the rabbits. Some well-fed wolves have pups, while some wolves die of starvation.

12. Starting with initial amounts of A, B, and C compounds, some of A reacts with B at some rate to create more B. Some of B creates more C at a certain rate.

For each of the above examples:

a) Express the model as one or more (coupled) differential equations.
b) Express the model as a system diagram using the 4 elements discussed in class:

what you have	a quantity represented with a **box** or container shape, sometimes called a stock or reservoir.	
how something changes per unit of time	a **rate** of change represented with a pipe flowing into or out of a box, sometimes called a flow or pipe. Notice the valve image in the middle, which indicates that the actual number flowing through this pipe can be set.	
what you know	a **variable** or constant input to the model represented with a circle or text.	
what depends on what	A dependency **arrow** or connector from one component to another that can be read as, "I need to know _____ in order to calculate what I am pointing to."	

II. Thinking about YOUR World

What "stories" could be added to the list above to illustrate modeling in your discipline?

III. What is like What?

Look at the modeling ideas from I and II. Determine which are similar in their structure – for example, money in a tax-free economy and immortal rabbits could both be thought of as "the more we have the more we get." What other similarities can you find?