Answers to Beginner Modeling Exercises

System Dynamics In Education Project
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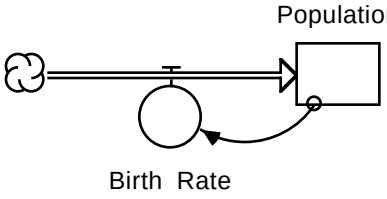
Remember that importance of these exercises is to begin to see stocks and flows in the world around you. Do not get discouraged if your answers differ from those presented here. Examine the answer given, think through your answer again, and continue. Through the spiral approach within Road Maps, every concept and skill will be revisited in more detail further in your studies.

1. A) For each variable that might be either a stock or flow, depending on what system and perspective one has in mind, both answers are given. Keep in mind that a diagram reveals many of the hypotheses made about the system. Notice these hypotheses and think them through, but do not be concerned if your answers are not an exact match of what is given here.

UNITS

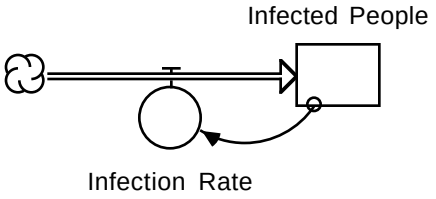
Population --> stock Population --> people
Birth Rate --> people/year



UNITS

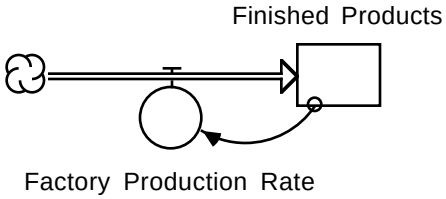
Infected people --> stock

Inf. People --> people
Infection rate --> people/month



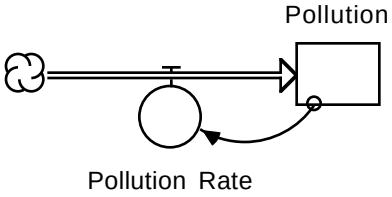
Factory production --> flow

Finished Prod. --> widgets
Prod. rate --> widgets/day



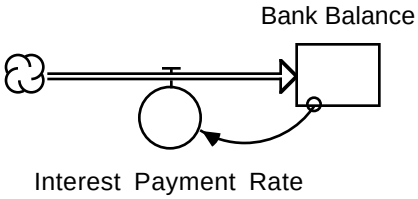
Pollution --> stock

Pollution --> pollutant amount
Pollution rate --> pollutants/month



Interest --> flow

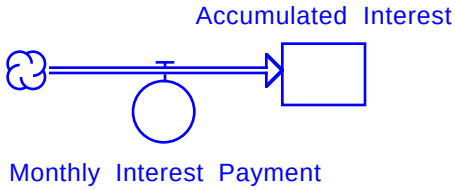
Bank Balance --> money
Interest pymt. --> money/month



UNITS

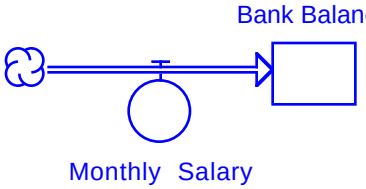
Interest --> stock

Accum. Interest --> money
Interest pymt. --> money/month



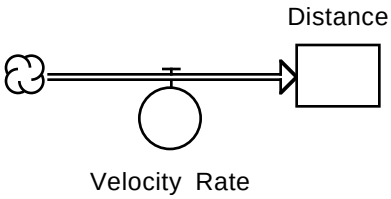
Salary --> flow

Bank Balance --> money
Salary --> money/month



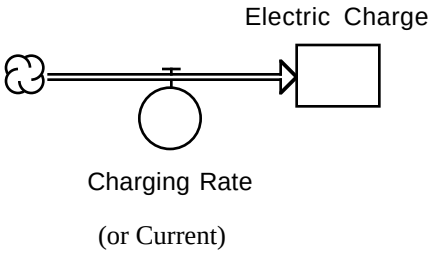
Distance --> stock

Distance --> miles
Velocity rate --> miles/hour



Electric charge --> stock

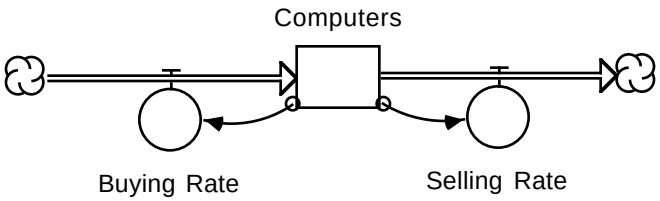
Electric Charge --> coulombs
Charging rate --> amperes
(Current is equivalent to Charging rate)



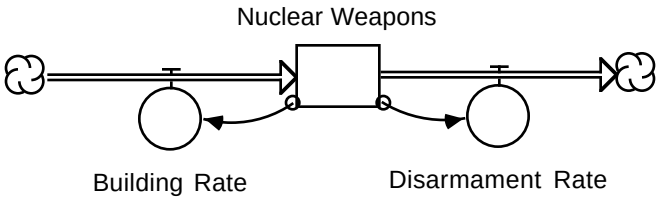
B) As in Part A, there may be many different flows for each of the stocks, but only a few flows have been presented here. A different answer is not wrong. Examine the answers and make sure you understand the essence of the stock and flow identification process.

UNITS

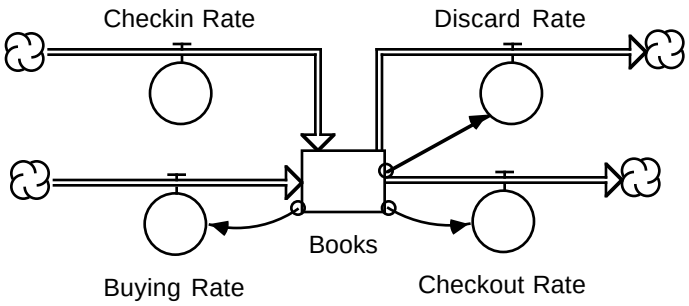
Computers -> Computers
Buy/Sell Rate -> Computers/day



Weapons -> Warheads
Bld./Disarm Rate -> Warheads/month

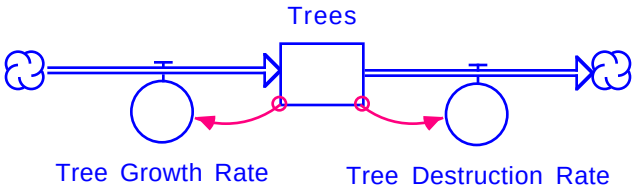


Books -> Books
All Rates -> Books/day

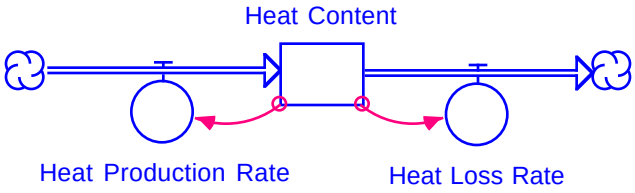


UNITS

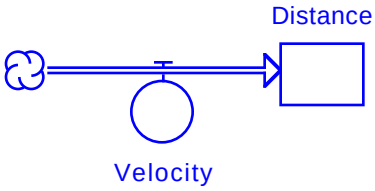
Trees -> Trees
Grow/Dest. Rate -> Trees/year



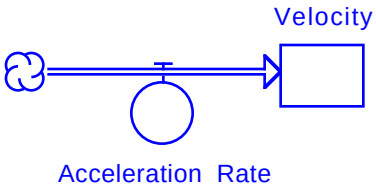
Heat Content -> Calories
Prod./Loss Rate -> Calories/hour



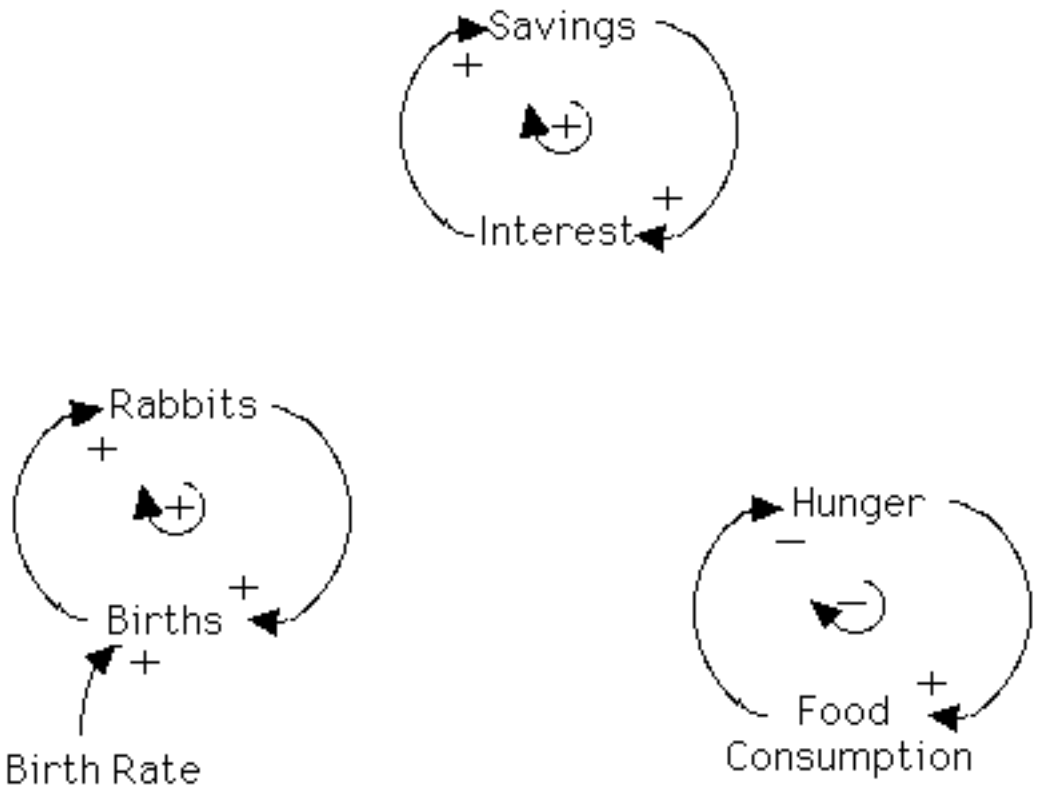
Distance -> Miles
Velocity -> Miles/Hour

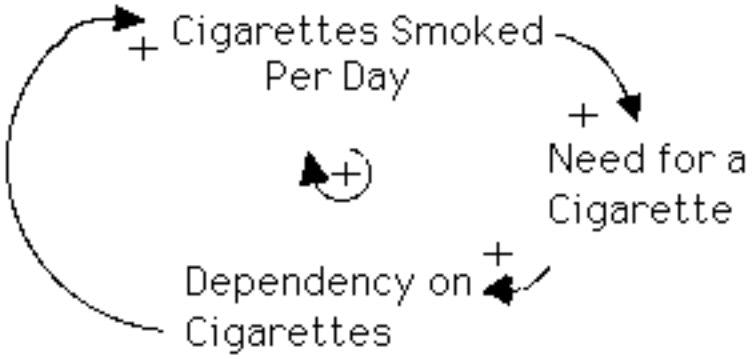


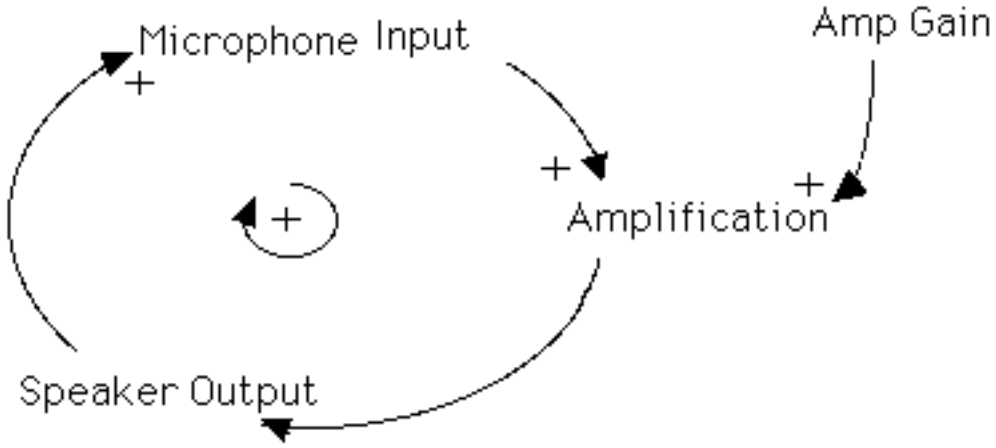
Velocity -> Miles/Hour
Acceleration Rate -> Miles/Hour/Hour

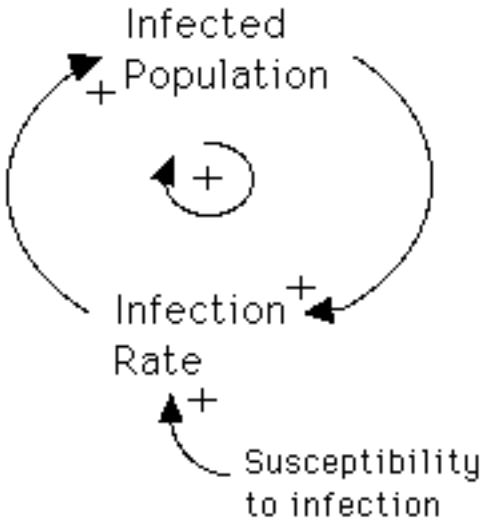


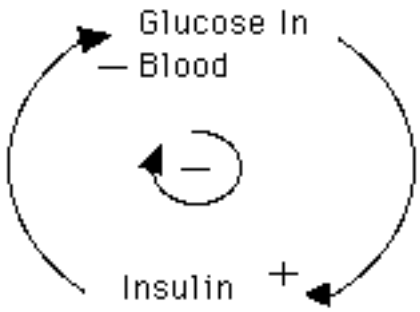
2) (A)

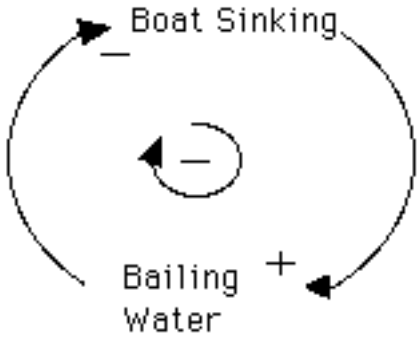

Savings
+
+
Interest
Rabbits
+
+
Births
+
Birth Rate
Hunger
−
+
Food
Consumption
Gravitational
Acceleration
Velocity of
Falling Object
+
−
Air Resistance
+

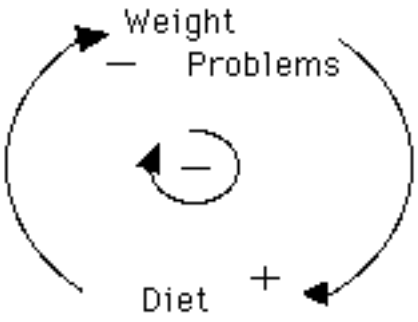

Cigarettes Smoked Per Day
Need for a Cigarette
Dependency on Cigarettes

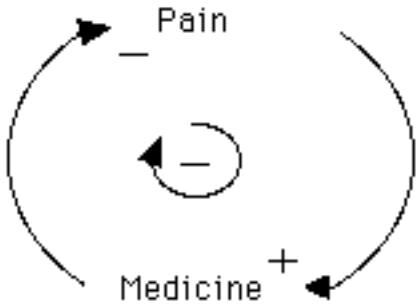

Microphone Input
Amp Gain
Amplification
Speaker Output

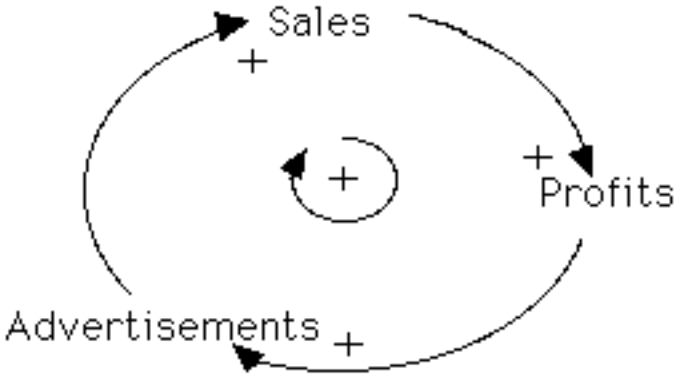

Infected Population
Infection Rate
Susceptibility to infection

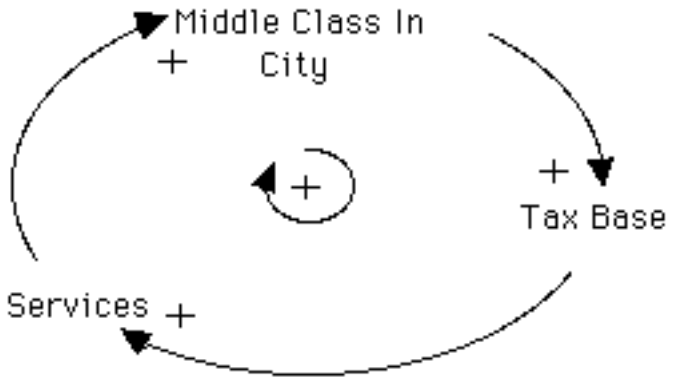

Glucose In
Blood
Insulin


Boat Sinking
Bailing
Water

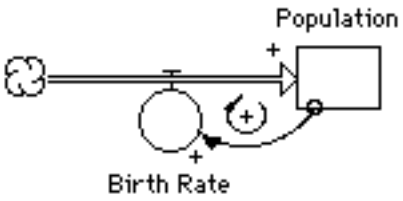

Weight
Problems
Diet

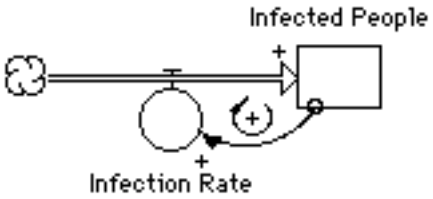

Pain
Medicine

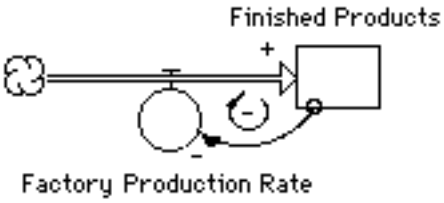

Sales
Profits
Advertisements

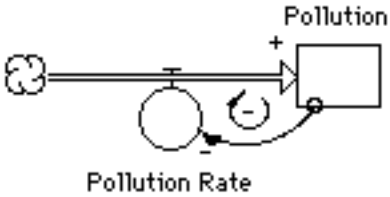


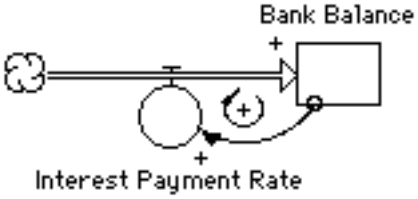
(B) For the following answers, remember that, for each system modeled, certain hypothesis about how variables interact have been made. Notice what each diagram implies about the relationships between the variables, but do not discount different answers as being wrong. Think through your answer again, to check for consistency, and then move on.

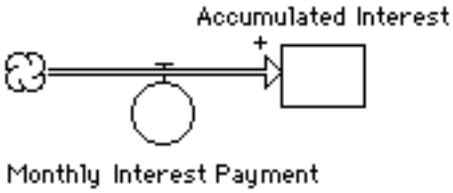


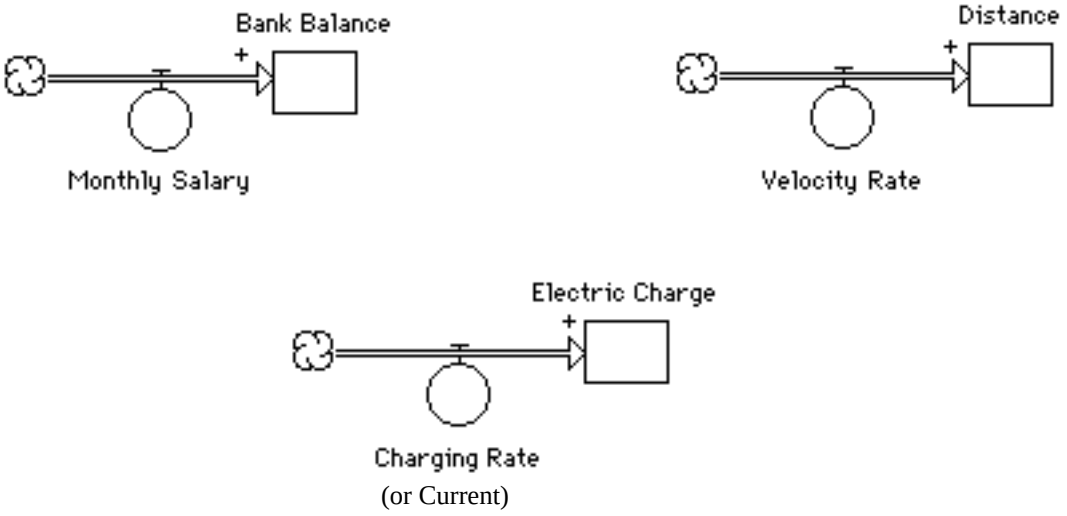












(C) Refer to the stock and flow diagrams in number one part A or in number 2 part B for the answers to the three systems you chose. In STELLA this is known as laying out the plumbing. This step often solidifies mental models to some extent, and leads into the formulation of explicit equations for the system. Although the formulation of equations for the three systems you chose is not a formal exercise here, it may prove to be useful and challenging to tackle some of these equations on your own.