6 Compartment Model Modification
BE-382, Winter '08-'09, Dr. C. S. Tritt
Due on something a ballerina would wear.

Imagine that a new version of the drug, Compound Y, described in the “Solving Overall Balance Equations” has been developed. The new drug is called compound Z and is very similar to Compound Y. The only difference between the two drugs is that Compound Z is much more fat soluble that Compound Y. This results in the need to modify the existing compartmental model and implement the modified model in Matlab.

Compound Z is so fat soluble that its equilibrium concentration in fat cells is 5.0 times that of normal cells and body fluids. That is, a concentration of 2.00 mg/l of Compound Z in the plasma will be in equilibrium with an average concentration of 10.0 mg/l in the fat cells.

As a result of this increased solubility, the typical tissue cells compartment in the old model must be split into two compartments in the new model. One will represent lean tissue cells and the other will represent fat cells. Both of these compartments are in contact with and only with the lymph and tissue fluid compartment. The following values illustrate the situation.

| Quanty | Old Tissue Cells | New Lean Cells | New Fat Cells |
|---|---|---|---|
| Volume (l) | 14.8 | 10.3 | 4.5 |
| Area*U (1/s) | 0.0075 | 0.0055 | 0.0035 |

There is no breakdown of Compound Z in the fat cells, so mass balance equation for them is:

$$V_{fc}\ \frac{dC_{fc}}{dt} = A_{fc}\left(C_{tf} - \frac{C_{fc}}{RS_{fc}}\right)$$

where $RS_{fc}$ is the relative solubility of the drug in the fat cells, i.e., 5.0.

Otherwise, all the volumes and kinetic parameters are the same in the two models.

Your assignment is to develop and implement this new model (you may modify the existing model program that can be downloaded from the course website, zipped into one file called *compartmodel.zip*). Use your model to find the bolus size necessary to produce a maximum concentration in lean tissue cells of 200 mg/l (as a test of your new program, over an 8 hour interval and with a bolus of 10.0 grams my program this gave a maximum concentration in the lean tissue cells of about 255.9 mg/l).

Turn in your .m files and a plot showing the drug concentrations in each compartment as function of time (with concentrations between 0 and 400 mg/l and times from 0 to 6 hours). Also turn in a 1 page memo explaining how you modified to program and stating how you think the modification of the drug will affect its usefulness.