# The Biological Problem

## Second heading

### Third heading

#### Forth Heading

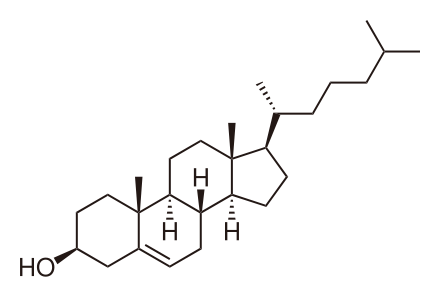
The first biological problem presented in this paper involves the modeling of the endocytosis of Low Density Lipoprotein(LDL). The model is broken down into several smaller parts. The amount of receptors with a quantified amount of LDL is modeled, as well as the subsequent breakdown of these receptors, the recycling of some amount of the receptors, and the rate of new receptor production. This problem is expanded and generalized to the case where LDL particles are added at a constant rate to the extracellular medium, which is the more likely situation *in vivo*. For each model, steady states and pseudo steady states are calculated from the differential equations.

1. **Summary of the computations**

A system of seven equations is used to summarize the interactions and the dynamics of LDL cholesterol and receptors. These seven equations illustrate the rates of change in the concentration of free pits, the concentration of occupied pits, the concentration of bound LDL, the concentration of the internal store of receptors, the concentration of the intracellular and extracellular LDL, and the concentration of the cholesterol derived from intracellular LDL.

The seven differential equations summarize the aspects that we are interested to model.

From these differential equations it is possible to solve for the steady states in the system, and make predictions for systems which are in different experimental conditions as the ones which are being modeled here.



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*Equations and Constants*

|  |  |  |
| --- | --- | --- |
|  | Description | Value |
|  | Concentration of pits free of LDL divided by the initial concentration of pits. | Function of time |
|  | Rate of return of internal pits to the surface | 0.006345 |
|  | Concentration of pits in the internal store divided by the initial concentration of pits | Function of time |
|  | Rate of LDL binding | 0.000459 |
|  | Number of receptors in a pit | 200 |
|  | Concentration of LDL particles in the extracellular medium divided by the initial concentration of extracellular LDL | Function of time |
|  | Rate of internalization of empty pits | 0.003564 |
|  | Concentration of pits containing LDL divided by the initial concentration of pits | Function of time |
|  | Concentration of bound LDL divided by the initial concentration of pits | Function of time |
|  | Rate of production of new pits | 0.0006345 |
|  | Concentration of intracellular LDL derived cholesterol divided by the ideal cholesterol concentration | Function of time |
|  | Cholesterol dependence of pit production | 2.3 |
|  | Fraction of internalized pits which are recycled | 0.7 |
|  | Volume ratio of extracellular to cellular media | 15000 |
|  | Rate of LDL delivery, set to 0 because in the experiment LDL is not delivered in a steady rate. | 0 |
|  | Ratio of pits to LDL particles at t = 0 | 0.0155 |
|  | Concentration of LDL particles in the intracellular medium divided by the initial concentration of extracellular LDL | Function of time |
|  | Rate of conversion of LDL to cholesterol | 0.00011745 |
|  | Cholesterol content per LDL particle | 0.0015 |
|  | Rate of cholesterol regulation | 0.0019359 |

**References**

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