

## **North Shore Science League Event Description**

*Submitted by Dan Franklin-Marblehead High School on 1/11/05*

### **Modeling Neurochemistry as a Dynamic System**

Neurochemistry is a key science of the 21<sup>st</sup> century with many applications in medicine and engineering. Systems are often difficult to understand because they are complex and formed of many interconnected and independent elements. Models are used to simplify systems and help make sense of existing data from scientific studies as well as predict data that can be expected in light of the model. Key components of a system model for neurochemistry-- causal link, negative and positive feedback loops, and emergent properties—can be found in the seminal work of Norbert Wiener, Donald Hebb, Alan Hodgkin, Andrew Huxley and Stephen Grossberg among others. As a system embedded in neural modeling, neurochemistry is connected with psychological, neuropsychological and biochemical sciences.

The first part of the event will focus on what we are trying to model. Students will answer several questions about neurons and how they work. A word bank will be provided from which each team will complete a ‘fill-in-the-blank’ exercise.

The second part of the event will involve interpreting pictures and diagrams related to neurons and neural activity.

The third part of the event will involve interpreting mathematical models that can simulate neural excitation, inhibition and overall system behavior. These models are based on Volterra-Lotka models which have been used to describe cooperation and competition in a variety of systems: population biology of predators and prey, ecology, psychophysiology (vision and working memory) and developmental biology.

In preparation, students can reference both specialized and general textbooks on neurochemistry and neural modeling as well as works by the authors cited above.

No reference material, computers or calculators will be permitted during the event.