

Using Visual Python Programming Language to Model Physical Systems

Overview

The importance of computer literacy for our students can not be overstated. Most of my students however, see computers only as: gaming devices, word processors and windows to the world (i.e. U-Tube, My-Space). The overall purpose of this unit is to show students how scientists use computers and, in particular computer programming to investigate and build models the natural world. The work being done by Dr. Banu Ozkan and Dr. Arjan van der Vaart at the Center for Biological Physics at Arizona State University will be used as a paradigm example for this unit. The CBP work involves: English (writing grant proposals), biology, chemistry, physics, mathematics and computer science so, it clearly demonstrates the integrated nature of modern scientific research.

Instructional Goals

- 1. Connections: Students will be able to identify and explain the integrated nature of modern scientific research:**
 - English (writing grant proposals), biology, chemistry, physics, mathematics and computer science.
- 2. Programming: At the conclusion of this unit students will be able to:**
 - Explain what a computer is and how a computer works.
 - Describe what a computer program is.
 - Identify the 4 main types of computing Languages.
 - Machine
 - ASCII
 - Assembler
 - High Level – Basic, C, Fortran, Lisp, Pascal, Java
 - Scripting – JavaScript, Python
 - Explain how computer languages differ.
 - Describe how Scripting languages work.
- 3. Writing a simple program VPython. At the end of this unit students will be able to:**
 - Write a program
- 4. How do scientists use computer programming to model natural phenomenon in order to investigate that phenomenon?**

Note: Specific timetables have been avoided in this document, since school schedules vary and each class/teacher combination will explore the concepts in the activities and discussions at different paces. It is intended that the discovery process will be driven by the students' interest and curiosity.

In this unit students come to recognize that computer programs can be a valuable tool in modeling and understanding physical systems. Students will write computer program simulations using the mathematical models developed experimentally in class.

Instructional Notes

Instead of beginning with a paradigm lab, the first activities review basic properties of proteins. Instructional materials have been placed in a PowerPoint presentation to accompany this short unit. We will also make use of a web-site, Introduction to Computer Science using Java 1.4 version, July 2003 Bradley Kjell, Central Connecticut State University - <http://chortle.ccsu.edu/CS151/cs151java.html>

PowerPoint Presentation (or instruction)

- Complete presentation and discussion of general information on protein: function, structure, configuration and folding. (Power Point)
- Chapters 1 – 4 in Introduction to Computer Science using Java 1.4 <http://chortle.ccsu.edu/CS151/cs151java.html>
- Introduction to programming languages

Activity 1

- Programming in VPython
 - See notebook
 - Introduction to VPython @ http://vpython.org/VPython_Intro.pdf
 - Students will work through introduction
 - Students will create a program for a ball bouncing inside a box.

Activity 2

- Assessment
 - Write a 1 page reflection answering the following question.

How do scientists use computer programming to model natural phenomenon in order to investigate that phenomenon?