Computational Science Program for Ohio Community and Technical Colleges

Draft Competencies for Introduction to Computational Biology
March 2008

Competency/Descriptors
Explain the role of computational science in biology **Descriptors:** Introduce the importance of computational science in biology Introduce the history and application of computational science in biology – give specific examples (e.g., Bird Flu pandemic, SARS, oil spills, drug resistance and development, protein modeling, etc.) Introduce the terminology associated with the field Discuss future trends and potential issues (e.g. bioethics) in the field
Demonstrate the use of database search engines and information retrieval methods **Descriptors:** Reinforce the use of NCBI databases (e.g., OMIM, Books, GenBank, etc.) Reinforce retrieval of research literature (e.g., PubMed) Illustrate the use of a specific database with a biological example (e.g., inherited disease, etc.) Reinforce biological concepts and terminology (e.g., transcription, translation, mutations, etc.)
Demonstrate sequence analyses **Descriptors:** Introduce computational concepts and terminology associated with sequence analyses and manipulation (e.g., BLAST, ClustalW, etc.) Reinforce biological concepts and terminology associated with sequence analyses and manipulation (e.g., amino acid translates into protein, etc.) Search and align a simple pair-wise sequence (e.g., microbial drug resistance, etc.) Introduce sequence analysis techniques (e.g., PAM scoring matrix)
Demonstrate basic phylogenetic tree construction, manipulation and analysis **Descriptors:** Introduce computational concepts/methods and terminology associated with phylogenetic trees (e.g., maximum parsimony, etc.) Reinforce biological concepts and terminology associated with phylogenetic trees (e.g., evolution, mutation, etc.) Compare new results with original data
Discuss basic protein structure and function **Descriptors:** Reinforce biological/chemical concepts (e.g., primary, secondary, tertiary, hydrophobicity) and terminology associated with proteins (e.g., amino acid translates into

protein, etc)
Introduce the basics of computational science in modeling protein structure (e.g., NCBI Cn3D viewer – using a selected plant amino acid sequence, translate data into protein sequence, then visualize 3D structure of protein sequence)
Reinforce the structure/function relationship (e.g., explain or illustrate that structural differences may lead to functional differences)
Introduce the basics of computational science in modeling protein function (e.g., growing industrial areas such as drug discovery)

Discuss the fields of proteomics and genomics
Descriptors:
Define the terminology associated with the fields of proteomics and genomics
Define tools (e.g., databases, such as MIT, NCBI and EXCEL) and basic approaches used in proteomics and genomics (e.g., DNA Microarrays, cluster analysis and visualization of data)
Using selected microarray data, construct a XY scatterplot, fit data to a straight line, analyze data for outliers
Discuss interpretation of results

Introduce field of computational biomodeling
Descriptors:
Define and discuss the terminology/concepts associated with the field of biomodeling (e.g., biological systems such as immunology, organs systems, cell function, etc.) and ecological systems modeling (e.g., predator/prey, global warming, etc.)
Illustrate the use of a biomodel by doing a research project

- Select a model
- Learn to manipulate the model
- Predict outcome of action
- Gather data generated by model
- Analyze data
- Interpret results
- Demonstrate working model
- Report results in written format