Welcome to the RCN-UBE Biochemistry and Molecular Biology Workshop

Moravian College
3 March 2012

American Society for Biochemistry & Molecular Biology
Supported by NSF
Goals of This Afternoon’s Workshop

1. Rewrite core concepts into sentences (45 min.)

2. Unpackage learning objectives from core concepts. (90 min.)

3. Identify underlying concepts from chemistry, physics, and math that support these learning objectives. (45 min.)
What Do Our Students Need to Know?

Chemistry
Provides the methods and molecular perspective

Biochemistry
Molecular Biology
Provides the relevance
Provides physical models

Mathematics

Physics

\[ M = \frac{2RT \ln \frac{\nu_1}{\nu_2}}{\omega^2(1-\nu)(\nu_1^2-\nu_2^2)} \]
Biochemistry Working Core Concepts

From workshops across the nation, and from small working groups last year, four (4) core concepts have emerged.

These core concepts will occupy us in various ways for the rest of the afternoon.

First we need to create working groups of about four people each.
Forming Groups

- If you are a biochemist/chemist, add 400
- If you are a molecular biologist/biologist, add 200
- Your class size is usually >50, add 200
- Your class size is usually <50, add 100
- If you are Female, add 100
- If you are Male, add 50
- Total number of years you have taught
- Sum the seven digits of your office Phone Number
- GRAND TOTAL (Your Number)

- When you have calculated Your Number, line up in numerical order. Count off by 8's.
Four Working Core Concepts

1. Energy: Fundamental Nature, Utilization and Flow (Groups 1 & 5)

2. Core Concepts in Biochemistry and Molecular Biology are Based on: (Groups 2 & 6)
   a. Objective Measurement
   b. Quantitative Analysis
   c. Critical Interpretation

3. Macromolecular Structure, Function, Regulation, and Storage (Groups 3 & 7)

4. Transformation and Transfer of Information (Groups 4 & 8)
All core concepts rely on:

1. Evolution
2. Skills
3. Foundational concepts from other disciplines
Input and Feedback from Biochemistry Educators on Working Core Concepts (45 minutes)

Each group transform your assigned core concept into a complete sentence (or two) that would succinctly capture its meaning.

When your group has settled on a sentence, type it into the PowerPoint presentation.
Reporting Out I

Share sentences with larger group.

1. Energy:
   a. Group 1: Biochemical systems harvest, store, and use energy to do mechanical work and drive chemical transformations.
   b. Group 5: The basis of life is the making and breaking of chemical bonds in order to do useful work, during which energy is conserved.

2. Measurement & Analysis:
   a. Group 2: A biochemist will, based on the scientific method, critically interpret information derived from quantitative analysis that is informed by objective measurements from rationally designed experiments. *
   b. * this sentence does not represent a core biochemical concept from biochemistry.
   c. Group 6: The core concepts of biochemistry and molecular biology are built on the fundamental principles of chemistry, math and physics, utilizing the scientific method applied in a biological context.
Share sentences with larger group.

1. Macromolecules:
   a. Group 3: The chemical and physical properties of a biological macromolecule are a direct result of its three-dimensional structure; regulation of this function occurs as the three-dimensional structure is altered.
   b. Group 7: Function, regulation, and compartmentalization (storage) of macromolecules are determined by their 3-D structures.

2. Information:
   a. Group 4: Information in biological systems is transformed and transferred through molecular interactions and changes.
   b. Group 8: The ways in which systems respond to external stimuli.
Unpackaging Core Concepts (1.5 hours)

Working in your groups, write 10 or less learning objectives for your assigned core concept. These would be the 10 most important learning objectives for this core concept.

These learning objectives should embrace the breadth of that core concept.

Use Blooms Taxonomy (handed out) to choose appropriate verbs for the cognitive levels of the objectives.
# Bloom’s Taxonomy

<table>
<thead>
<tr>
<th>Level</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Count, Define, Describe, Draw, Find, Identify, Label, List, Match, Name, Quote, <strong>Recall</strong>, Recite, Sequence, Tell, Write</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Conclude, Demonstrate, Discuss, Explain, Generalize, <strong>Identify</strong>, Illustrate, Interpret, Paraphrase, Predict, Report, Restate, Review, Summarize, Tell</td>
</tr>
<tr>
<td>Application</td>
<td>Apply, Change, Choose, Compute, Dramatize, Interview, Prepare, Produce, Role-play, Select, Show, Transfer, Use,</td>
</tr>
<tr>
<td>Analysis</td>
<td>Analyze, Characterize, Classify, Compare, Contrast, Debate, Deduce, Diagram, Differentiate, Discriminate, Distinguish, Examine, Outline, Relate, Research, <strong>Separate</strong>,</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Compose, Construct, <strong>Create</strong>, Design, Develop, Integrate, Invent, Make, Organize, Perform, Plan, Produce, Propose, Rewrite</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Appraise, Argue, Assess, Choose, Conclude, Critic, Decide, Evaluate, <strong>Judge</strong>, Justify, Predict, Prioritize, Prove, Rank, Rate, Select,</td>
</tr>
</tbody>
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[www.teach-nology.com](http://www.teach-nology.com)

Promoting Concept Driven Teaching Strategies in BMB through Concept Assessments
Bloom’s Taxonomy

Evaluation
- Making decisions and supporting views; requires understanding of values.

Synthesis
- Combining information to form a unique product; requires creativity and originality.

Analysis
- Identifying components; determining arrangement, logic, and semantics.

Application
- Using information to solve problems; transferring abstract or theoretical ideas to practical situations. Identifying connections and relationships and how they apply.

Comprehension
- Restating in your own words; paraphrasing, summarizing, translating.

Knowledge
- Memorizing verbatim information. Being able to remember, but not necessarily fully understanding the material.
Identify foundational concepts from Chemistry, Physics, and Math (45 min)

Working in your group, consider your core concept and relate it to foundational concepts from chemistry, physics, and math. Select the appropriate ones for the learning objectives that you developed. If there are additional foundational concepts, please identify them.

i.e. What do students need to know and use from prerequisite courses to understand your core BMB concepts?
Future Direction of the Project

Change wording of core concepts in biochemistry and molecular biology from nation-wide workshops.

Compile objectives developed at these workshops for each core concept.

Identify foundational concepts from chemistry, physics, and math.
Sharing

Core concepts, objectives, and concepts from chemistry, physics and math will be shared with the national community at:


Next Year: Workshops will focus on developing a variety of assessment tools to help faculty see whether students understand the core concepts and learning objectives.
Assessment

• Was today’s program worthwhile for you?
  – If so, in what ways? What will you take away?
  – If not, what would have made it better for you?

• Suggestions for future activities dependent or independent of the ASBMB initiative.
  – How could ASBMB serve you?
  – Forming Undergraduate ASBMB Affiliates (UAN)?
  – Northeast/Mid-Atlantic Regional Consortium

Promoting Concept Driven Teaching Strategies in BMB through Concept Assessments
Thank you

Thank you for your time and effort in developing these national biochemistry and molecular biology core concepts and learning objectives!