The Beauty and Power of Aligned Scientific Teaching Tools

Cheryl A. Sensibaugh

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Introduction
  • Scientific Teaching
  • Backward Design
  • Aligned Tools
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• Scientific Teaching
• Backward Design
• Aligned Tools

Example BMB Alignment Table

• Overall Learning Goal
• Specific Learning Objective
• Learning Assessment
• Learning Strategy
SCIENTIFIC TEACHING

Engaging in undergraduate education in a manner similar to conducting scientific research

**Research Goals**
- Specific Aims
- Evidence
- Experimental Methods

**Learning Goals**
- Specific Objectives
- Assessments
- Learning Strategies

“FORWARD DESIGN”

Step 1: Content List

Step 2: Write Exam

Step 3: What Learned?


**Introduction**

**Goals**

**Objectives**

**Assessments**

**Strategies**

**Summary**
### Overall Learning Goal
Students should understand…

<table>
<thead>
<tr>
<th>Learning Objectives</th>
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<th>Learning Strategies</th>
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<tbody>
<tr>
<td>Students should be able to (verb)…</td>
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BLOOM’S TAXONOMY OF EDUCATIONAL OBJECTIVES

Students should understand the core concept of macromolecular structure and function, including the nature of biological macromolecules, factors that impact structure, the relationship between structure and function, interactions, and regulation of function.
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Overall Learning Goal

Students should understand the core concept of macro-molecular structure, including the nature of biological macromolecules and factors that impact structure.
Students should be able to discuss the diversity and complexity of various biologically relevant macromolecules and macromolecular assemblies in terms of the basic repeating units of the polymer and the types of linkages between them.

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**Bloom’s 1-2**
compare and contrast

**Bloom’s 3-4**
sketch

**Bloom’s 5-6**
defend classifications of unfamiliar molecules
Overall Learning Goal

Students should understand the core concept of macromolecular structure, including the nature of biological macromolecules and factors that impact structure.

### Learning Objectives

- Students should be able to compare and contrast various biologically relevant macromolecules and macromolecular assemblies...
- Students should be able to sketch various biologically relevant macromolecules and macromolecular assemblies...
- Students should be able to defend classifications of unfamiliar, biologically relevant macromolecules and macromolecular assemblies...

... in terms of the basic repeating units of the polymer and the types of linkages between them.
**Overall Learning Goal**

Students should understand the core concept of macromolecular structure, including the nature of biological macromolecules and factors that impact structure.

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<td>T/F or Multiple choice (3 pts.)</td>
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<td>Students should be able to sketch various biologically relevant macromolecules and macromolecular assemblies…</td>
<td>Sketch a polymer (monomers – 2 pts.) (linkage – 1 pts.)</td>
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<td>Students should be able to defend classifications of unfamiliar, biologically relevant macromolecules and macromolecular assemblies…</td>
<td>Defend an evaluation (classify – 1 pt.) (defend – 2 pts.)</td>
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Overall Learning Goal
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<td>Students should be able to compare and contrast various biologically relevant macromolecules and macromolecular assemblies…</td>
<td>T/F or Multiple choice (3 pts.)</td>
<td>Pre-class Reading (1 participation pt.)</td>
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<tr>
<td>Students should be able to sketch various biologically relevant macromolecules and macromolecular assemblies…</td>
<td>Sketch a polymer (monomers – 2 pts.) (linkage – 1 pts.)</td>
<td>In-class Group Activity Table of biomolecules (5 participation pts.)</td>
</tr>
<tr>
<td>Students should be able to defend classifications of unfamiliar, biologically relevant macromolecules and macromolecular assemblies…</td>
<td>Defend an evaluation (classify – 1 pt.) (defend – 2 pts.)</td>
<td>Clicker Question 1 correct classification (2 participation pts.)</td>
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... in terms of the basic repeating units of the polymer and the types of linkages between them.
The Beauty
Direct support of desired learning outcomes

The Power
Evidence-based decisions:
• Curriculum review
• Course pedagogy
Overall Learning Goal
Students should understand...

the process of science, including:
• hypothesis generation
• experimental design
• data analysis, and
• data interpretation.

Overall Learning Goal
Students should understand the process of science, including hypothesis generation, experimental design, and data analysis and interpretation.

Learning Objectives

Given a hypothesis, students should be able to design an experiment, including explicitly specifying:

- appropriate experimental observations to be measured, and
- appropriate control samples.

**Overall Learning Goal**
Students should understand the process of science, including hypothesis generation, experimental design, and data analysis and interpretation.

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**Essay Question**
- Prompt contains given hypothesis
- Scoring rubrics with criteria and levels
Overall Learning Goal
Students should understand the process of science, including hypothesis generation, experimental design, and data analysis and interpretation.

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| Given a hypothesis, students should be able to design an experiment, including explicitly specifying the appropriate experimental observations to be measured, and appropriate control samples. | Essay Question | PBL Group Activity
- Submit designs
- Await data |
|                       |                      | Clicker
- Distracters are common errors |
**Overall Learning Goal**

Students should understand the process of science, including hypothesis generation, experimental design, and data analysis and interpretation.

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Given a hypothesis, students should be able to **design** an experiment, including explicitly specifying the appropriate experimental observations to be measured, and appropriate control samples.

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<th>TBD</th>
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