### Module Descriptions

**Module One:** Aster Hybridization—Students investigate the process of speciation and develop field biology research skills in the context of studying a hybrid aster population on the campus of Calvin College.

**Module Two:** Fish Phylogenetics—Students use morphological and genomic strategies to study relationships with the Salmonidae family represented in the Great Lakes, to construct phylogenetic trees, and to explore how these tools are used for wildlife conservation.

**Module Three:** Hominid Evolution—Students distinguish between evolutionary adaptation and social development by examining skull replicas of hominids and modern primates and by investigating human gender differences in behaviors and sexual selection.

### Development Strategy

- **Course Development:**
  - Team of instructors, PIs, and undergraduate students brainstorm module topics.
  - Students optimize lab procedures and draft lab manual using a "hybrid" design strategy (Figure 1).

- **Implementation:**
  - Fall 2013 semester
  - External evaluations and revisions

### Alignment with Vision and Change Core Competencies

<table>
<thead>
<tr>
<th>Vision and Change Core Competencies</th>
<th>Scientific Process</th>
<th>Quantitative Reasoning</th>
<th>Modeling &amp; Simulation</th>
<th>Interdisciplinary Science</th>
<th>Collaboration &amp; Writing</th>
<th>Societal Connections</th>
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<tbody>
<tr>
<td><strong>One</strong></td>
<td>Generating and testing hypotheses based on plant phenotypes</td>
<td>Making statistical and graphical comparisons of aster populations in RStudio</td>
<td>Using the Calvin College GIS Tree Inventory Map as a tool for identifying trees</td>
<td>Forming connections between biology and statistics while graphing plant traits</td>
<td>Utilizing aster specimens from the University of Michigan Herbarium</td>
<td>Learning about local plants and trees</td>
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<td><strong>Two</strong></td>
<td>Using phylgetic techniques (DNA sequencing and morphology) to make conclusive judgments about the interrelatedness of the Salmonidae family found in the Great Lakes</td>
<td>Computing differences in DNA sequences to show relatedness of using maximum parsimony and bootstrapping to construct phylogenetic trees</td>
<td>Working with introductory simulations of phylogenetics to understand maximum parsimony</td>
<td>Incorporating statistics into DNA analysis</td>
<td>Conducting dilutions introduced in chemistry</td>
<td>Discussing biodiversity in its greater social context</td>
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<td><strong>Three</strong></td>
<td>Defining parameters for use in measuring skulls and computing differences in skull indices in order to judge relatedness of extinct hominid species and extinct great apes</td>
<td>Measuring skulls and computing differences in skull indices in order to judge relatedness of extinct hominid species and extinct great apes</td>
<td>Using statistical tests to determine the significance of gender differences</td>
<td>Utilizing skull replicas in order to model human evolution</td>
<td>Comparing techniques used in psychological research to those used in non-human biological research</td>
<td>Writing a formal scientific lab report</td>
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### Assessment Plan

- Critical Thinking Assessment Test (CAT)
- Assessment questions and "CAT analogs"
- Pre- and Post-assessments
- Student research notebooks, research reports, and other artifacts
- Informal assessments: daily assignments SALG (Student Assessment of Learning Gains) survey
- Comparison to previous lab manual

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- Local fishing charters for donations of tissues from fish caught in Lake Michigan