Argument Driven Inquiry Instructional Model
(Adapted from Argument-Driven Inquiry in Biology: Lab Investigations for Grades 9–12, NSTA 2014)

The objective of the ADI instructional model is to help teachers make lab instruction more meaningful for students and enable students to learn more inside the school science laboratory by encouraging and facilitating students presenting to their peers; responding to questions; and then writing, evaluating, and revising reports as part of each lab. These lab investigations allow students to develop the disciplinary-based literacy skills outlined in the State Standards for English language arts.

Three Dimensions of the NGSS framework:

Life Sciences Core Ideas:
- From molecules to organisms: Structures and processes
- Ecosystems: Interactions, energy, and dynamics
- Heredity: Inheritance and variation of traits
- Biological evolution: Unity and diversity

Crosscutting Concepts:
- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function • Stability and change

Scientific Practices:
- Asking questions
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information
Stage 1: Identify the task and the guiding question. Hold a “tool talk”
- Small groups of students then …

Stage 2: Design a method and collect data
- Groups then …

Stage 3: Analyze data and develop a tentative argument
- Each group then shares its argument during an …

Stage 4: Argumentation session
- Collect additional data or reanalyze the collected data
- If needed, groups can …
- The teacher then leads an …

Stage 5: Explicit and reflective discussion
- Individual students then …

Stage 6: Write an investigation report
- The report then goes through a …

Stage 7: Double-blind group peer review
- Each student then …

Stage 8: Revises and submits his or her report
Biology District Pacing Guide Activity

What is the most effective way to teach the information required in the Biology 1 course?

We will begin with Stage 3 of ADI, and use teacher experience in teaching Biology 1 according to its course description with the use of labs and hands-on activities as Stages 1 and 2.

This is the current CER supporting the District Pacing Guides

Claim

The most effective way to teach the information required in the Biology 1 course is by teaching from a Macro- to Micro- perspective.

The current District Pacing Guide follows a Macro to Micro approach, starting with Ecology and finishing with Macromolecules, an abstract and difficult concept. Embedded throughout the curriculum there is spiraled approach to teaching the Micro-concepts (Macromolecules, Cellular structure and function) – see Biology Year at a Glance.

The outline of the course is as follows:

- ECOLOGY (How do interactions among organisms impact the changing environment?)
- EVOLUTION (How do scientists think life began and continues to change on Earth?)
- CLASSIFICATION (Why do scientists classify living things the way they do?)
- HUMAN BODY (How are human body systems different?)
- REPRODUCTION (How do organisms grow and reproduce?)
- GENETICS (How do inherited traits lead to variations?)
- MOLECULAR GENETICS (How does your genetic code determine an organism’s physical appearance?)
- BIOCHEMISTRY (What are the basic building blocks)
- FACTORS THAT AFFECT HUMAN HEALTH (After EOC)

Evidence

Students in middle school learn about biology in 6th and 7th grade, and have a review of Biology before the FCAT in 8th grade. Students in 9th grade take the Physical Science course, which is formatted to address Physics in the first semester and Chemistry in the second semester. Middle school students are well versed in concepts of Ecology and general understanding of the structure and functions of cells, but lack a depth of understanding in these concepts.

Students exposed to Ecology at the beginning of the course are able to draw on their prior knowledge and relate to concrete concepts. This allows students to build on their conceptual understanding and tackle on more difficult abstract concepts.

The Biology 1 course has very specific standards/benchmarks that are specified by the Item Specifications Guide. To date, I have not seen any school take the Micro to Macro approach; instead teachers prefer to follow the textbook, which addresses Ecology starting in Chapter 3. What we have seen with schools that perform well in the Biology EOC, is that they all teach the entire Biology curriculum with an extreme focus on fidelity to the NGSSS benchmarks.
Data:
Percentage of students scoring 3 and above on Biology EOC

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>54</td>
<td>56</td>
<td>On</td>
</tr>
<tr>
<td>B</td>
<td>96</td>
<td>99</td>
<td>On</td>
</tr>
<tr>
<td>C</td>
<td>55</td>
<td>47</td>
<td>Off</td>
</tr>
<tr>
<td>D</td>
<td>55</td>
<td>30</td>
<td>Off</td>
</tr>
</tbody>
</table>

Justification/Reasoning
The current District Biology Pacing guide is organized and presented to maximize on the knowledge of incoming 9th graders who would have recently finished Physical Science, specifically Chemistry being taught in the second quarter of the Physical Science course, and who have certain knowledge in Biology from Middle School, specifically 6th and 7th grade.

Since students would have had minimal exposure to Biology content during the comprehensive science 3 (8th grade) and Physical Science (9th), it was determined that starting with a concept that was familiar and easier to grasp (Ecology), it would be easier on the student and would encourage more engagement and confidence in learning Biological content.

Discussions from the field have shown that some schools are not following the pacing guide and instead follow the pacing of the textbook that jumps back and forth from Micro to Macro Biology, probably not a method that allows the student to build up its content knowledge in a formative, sequential way.

The concern with this approach is the emphasis on the Macromolecules (Micro) being taught at the beginning of the course. Macromolecules can end up taking a large portion of the necessary instructional time, usually at the expense of other concepts. When examining the construction of the Biology 1 EOC using the Content Focus document it is shown that questions related to Macromolecules (as described in the Item Specs) total only 3 points out of the 56 total points (see attached Biology 1 Content Focus document)

Teaching the course with fidelity requires teachers not to focus that heavily on this one concept alone (see attached Biology 1 Test Item Specifications Guide, pg. 78; Learning Goals Biology, pg. 35; and the Biology Reporting Categories, pg. 3).

For Homework (follow up assignment)

Develop a tentative argument with your Biology teachers (Stage 3)

Prepare a presentation for the Argumentation Session (next ICAD meeting)
  • Stage 5

Stage 6 will occur after we “all” present and discuss and a summary is shared with everyone.

This will lead to Stage 7 and Stage 8, which will be probably be done through a survey