Seven Pillars of Biology Literacy: A Proposal for What Secondary School Teachers Might Teach & What College Instructors Should Reinforce

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Recently, while serving on a panel at a state science-teacher conference, I was asked to describe what secondary school biology teachers should do to best prepare students for college. This seemed a particularly intriguing question, because in a former life I taught middle and high school biology and I now teach biology courses for majors and nonmajors at a large state university. I also quickly recognized that I couldn’t fully address this important issue quickly, thus, I am very pleased to have the opportunity to do so here. Of course, this is not a definitive list but rather a conversation-starter for me – and, hopefully, for ABT readers.

Immediately, I had more questions than answers! What is this work we call biology? How should educators tell the story of life? What are the major milestones in biological discovery that expanded our knowledge of life on Earth? What role, if any, should the grand narrative of the formation of the universe and complexity play in biology education? What does it mean to be human? Students need content, but they also require skills and even opportunities to change preexisting attitudes. They need the practice in thinking critically while exploring ways to contribute outside disciplinary boundaries. Clearly, future change preexisting attitudes. They need the practice in thinking critically while exploring ways to contribute outside disciplinary boundaries. Clearly, future citizens – biologists and non-biologists alike – must become adept at making connections among seemingly disparate pieces of information, transdisciplinary concepts, and questions, as well as be able to understand and evaluate evidence.

So, with this background in mind, here are some initial personal proposals about how secondary biology teachers might prepare students for life and for higher levels of biology learning:

1. Cultivate and instill a sense of wonder and appreciation for the natural world. E. O. Wilson referred to this as “biophilia,” which suggests that we all have an affinity or natural attraction for life. Fostering a love and wonder toward nature can occur if we include outdoor experiences so that students can touch, feel, and experience nature.

2. Make the point that all living systems are interconnected, highlighting the complementarity of organisms and the environment. To borrow the words of Thomas Berry, a cultural historian and geologist, life on Earth “is a unity, an interacting and genetically-related community of beings bound together in an inseparable relationship in space and time.”

3. Help students see how Earth processes and human activity are mutually intertwined. As Berry writes, “the unity of Earth is especially clear: each being of the planet is profoundly implicated in the existence and functioning of every other being of the planet.”

4. Instill an appreciation for why knowledge of the Evolutionary Epic matters and how it relates to our understanding of life on Earth both past and present. Every fossil tells a story, and every geological period can fill volumes of our shared ancestral history. The evolutionary epic is rich with extraordinary tales that are awe-inspiring. It is a story that is no less crucial to our current identity. In both the changes of the past few centuries of conventional history and the origin and dynamic transformation of species, it speaks to our heritage in our own tiny corner of the universe. It allows us to reflect on our role in the chapter that is currently being written.

5. Help students understand what it means to be human and how our humanity is linked to all living things. Humans have a common ancestor at many levels, from the shrew-like creatures that escaped the dinosaurs to fish and even further back to microscopic single cells. We share roughly 30% of our DNA with a banana, a reality that is both sobering and profound. People who see history in a limited fashion – as only what has happened to humans in the past 5000 years – will likely have their views appropriately shaken when they observe the evolutionary epic of life for the past 3.5 billion years.

6. Focus instruction on the nature of science and the history of our understanding of key biological concepts. One way of knowing or understanding our world is through the biological sciences. Scientists were able to describe and explain the general principles or mechanisms involved in everyday observed natural phenomena through observation, experimentation, and collection of empirical evidence.

7. Enable learners to appreciate the flow of energy (photosynthesis and cellular metabolism). Energy is a unifying concept in biology and sets the foundation for a variety of science concepts within the earth and physical sciences as well. Energy provides the foundation for chemical reactions in various metabolic pathways and enables organisms to maintain their natural systems, to grow and reproduce.

In a world of human-induced climate change and the continuing loss of biodiversity, all educators must be judged primarily by whether or not we inhibit, ignore, or foster student understanding, appreciation, and even wonder at a “human–Earth” relationship that demonstrates the interconnectedness of all life. This view contrasts with typical views of biology as a fact-oriented description of natural phenomena. However, seeing biological science as a way of knowing that embraces and integrates various scientific themes will reveal to students the interconnectedness of the life sciences while still revealing the fascinating phenomena that comprise the dynamic discipline of biology. Let me conclude by saying that I do not expect all to agree with the choices I have offered here, so let’s see this as a conversation-starter. What knowledge and experiences do you think biology learning experiences should offer?

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