Biology Taught to Engineers

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Dear Editor,

Thank you again for a stimulating May/June issue of EMBS Magazine. And, again, your excellent editorial entitled “Have You Invented Anything Lately ?” has prompted me to respond.

Engineering involves an amalgam of scientific knowledge with creative activities to move beyond either factual knowledge or artistry in order to produce solutions to problems important to humankind. Although not all biomedical engineers invent equipment, they should all have the capacity to do so.

There are at least two characteristics of the engineering mind that are crucial to the ability of engineers to create desired products and processes. The first you mentioned in your editorial – the ability to calculate necessary parameter values. This, of course, enables the engineer to predict success for her/his design and avoids the need for a long and costly trial-and-error process that only perhaps leads to a successful design.

The other necessary ingredient is the ability to understand how things work. This ability involves vision, conceptualization, and mental connections. An engineer must know how something is supposed to work before she/he can quantitatively analyze the prospective design.

This, then, leads to your comments on the Biology for Engineers course. If you ask most engineering faulty members how a course in biology for engineers should differ from a biology course for scientists, then most would likely answer as you did in your editorial. They would say that biology for engineers must take a quantitative approach that is not included in the course for scientists.

This answer may be partly correct, but ignores the fact that engineers need to know how things work, and why they are as they are, before they break out their calculators. It is a mistake, I believe, to base a course on biology for engineers on a quantitative foundation before the essential concepts of biological workings are full comprehended. It has been my experience that engineering students are too quick to plug numbers into equations to chug out answers before they completely understand the reason for why they are using this set of equations rather than another set. It has also been my experience that I have occasionally attended research paper presentations by bioengineers who completely miss basic biological concepts and spend inordinate amounts of time and effort trying to solve technical problems without hope of solution. In both of these cases, quantitative information was available, but basic conceptual understanding was lacking.

Thus, I believe that a biology for engineers course must present biology as a set of concepts that work together. The laws of physics, chemistry, mathematics, and engineering sciences are relevant, just as are the unique uses to which they are put in

living things. And, to make this clear, a biology for engineers course should deal with the entire realm of biology, not just human biology, because there are principles to be learned from microbes and plants as well as from humans and animals.

This approach to biology for engineers is not common, to say the least, but I believe strongly that it is the proper approach. By the time you see this, my *Biology for Engineers* textbook should have appeared in published form. Take a look at it, and see what you think.

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