Why Biomedical Engineers Should Study Biology

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Is it a waste of time for biomedical engineering students to study biology? A lot of BME educators seem to think so. In their opinions, physiology is sufficient; biomedical engineers should be thoroughly familiar with physiological processes of the human body, but there is little need for biological knowledge if it has no direct relevance to human physiology.

I can agree in part with these educators. There certainly is a lot of material taught in traditional biology courses for which it is hard to see relevance. After all, who needs to know about the ecosystem of an ocean reef, or the relationships among various segmented worms, or how plants convert sunlight energy and carbon dioxide into sugars? Having to spend time learning these seemingly irrelevant pieces of information, at the expense of not learning other, more pertinent facts, can be an unnecessary extravagance when there is only so much material that can fit into an already overcrowded undergraduate curriculum.

If the only thing that biomedical engineers did was to build cardiac defibrillators or MRI imaging systems, then these educators would be correct – taking biology would be a waste of time. However, the field of biomedical engineering is expanding rapidly into new applications hardly ever dreamt of several years ago. So called "personalized medicine" requires new DNA tests, detection of specific biomarkers requires knowledge about enzymes and biochemistry, neural engineering requires familiarity with emotions and personality, and holistic approaches require comprehension of ecological interactions. One cannot fully understand the full nature of these and other interrelated biological tendencies by taking only human physiology. There are some biological principles more basic than those found in a physiology course, and these can be learned in the right biology course.

The problem with many biology courses is that they are taught by biologists for biology students. These courses are taught largely the way they were taken as students by those now teaching them (of course the material has changed, but the paradigm remains largely the same). And that is fine, for biology students.

But engineers, not just biomedical engineers, but all engineers, need to know about biological principles in the same ways that they know about transport process principles, mechanical principles, electrical principles, or biomaterials principles. These principles form the concepts basic to engineering applications, and, when dealing with anything biological, it is good to know the likely outcomes for an idea before one spends much time or effort developing it.

Hence, the biology course that biomedical engineers should take is not the same biology course usually offered at the university. Rather, this course should emphasize basic biological principles, at all hierarchical levels, with an eye toward ultimate applications in engineering designs. The biomedical engineer should take from this course an appreciation for how

biological systems work together. Developed correctly, this could be just as much an engineering science course as statics or heat transfer.

Certain biological principles are important to know about: competition, cooperation, optimization, communication, energy transformations, adaptation, and environmental interactions among them. Further, because biomedical engineers deal with whole human beings, some human psychology should be included. This course, similar to other courses taken at the undergraduate level, can present enough of the subject matter to be a useful terminal course, or could be an introductory course to subsequent courses taken later on. Certainly, such a course would make human physiology easier to teach and understand if taken after biology.

Every educational institution that I know has a list of required general education courses or categories to help round out a student's education and contribute to their worth as educated citizens. These courses have been derided by some as a waste of time. However, they add to student perspective, and are often appreciated more with time as careers progress. The general biology course that gives understanding of the biological world around us can give the same basic perspective that persists throughout an entire career.

What is the most desirable outcome of a biomedical engineering design? Certainly that design should include effectiveness, efficiency, biocompatible materials, acceptable operational features, easy installation, and a host of others. But one desirable feature is that it would work cooperatively with the intended biological system (usually human, including associated microbiome) rather than imposing upon that system. A good course in biology could help biomedical engineering students achieve better designs and realize more successful careers.