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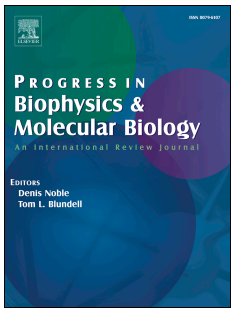

Achilles and the tortoise: Some caveats to mathematical modeling in biology

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ACHILLES AND THE TORTOISE

Some Caveats to Mathematical Modeling in Biology

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Abstract

Mathematical modeling has recently become a much-lauded enterprise, and many funding agencies seek to prioritize this endeavor. However, there are certain dangers associated with mathematical modeling, and knowledge of these pitfalls should also be part of a biologist's training in this set of techniques. (1) Mathematical models are limited by known science; (2) Mathematical models can tell what *can* happen, but not what *did* happen; (3) A model does not have to conform to reality, even if it is logically consistent; (4) Models abstract from reality, and sometimes what they eliminate is critically important; (5) Mathematics can present a Platonic ideal to which biologically organized matter strives, rather than a trial-and-error bumbling through evolutionary processes. This "Unity of Science" approach, which sees biology as the lowest physical science and mathematics as the highest science, is part of a Western belief system, often called the Great Chain of Being (or *Scala Natura*), that sees knowledge emerge as one passes from biology to chemistry to physics to mathematics, in an ascending progression of reason being purification from matter. This is also an informal model for the emergence of new life. There are now other informal models for integrating development and evolution, but each has its limitations.

Keywords: Mathematical modeling; evolution; development; epigenetic landscape; dialectics