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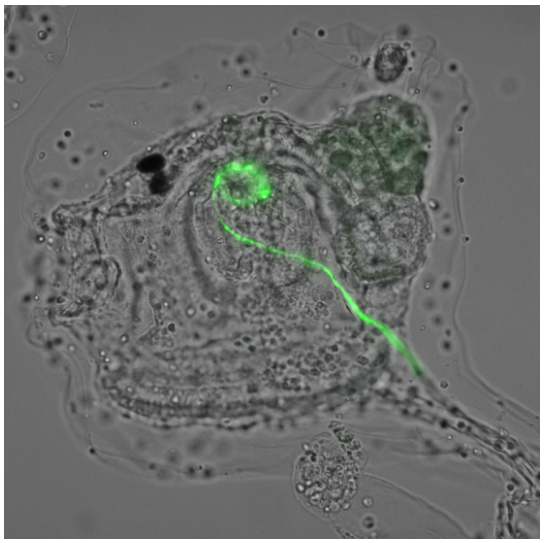
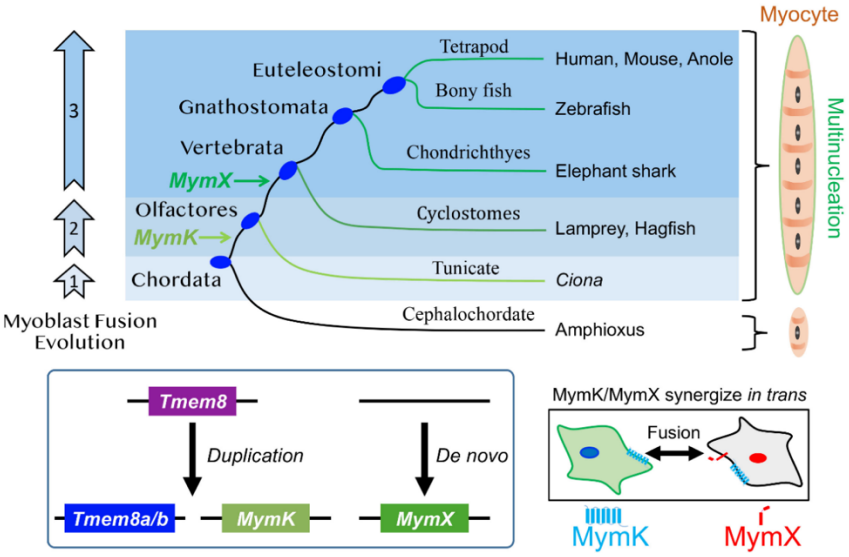
Evolution of a chordate-specific mechanism for myoblast fusion

講師：　Alberto Sunao (直) Stolfi 博士
（Georgia Institute of Technology, USA）
日時：　2022 年 7 月 8 日（金）9:00〜10:30
場所：　Teams（オンライン）



Vertebrate myoblast fusion allows for multinucleated muscle fibers to compound the size and strength of individual mononucleated cells, but the evolution of this important process is currently unknown. The phylum Chordata hosts closely related groups that span distinct myoblast fusion states: no fusion in cephalochordates, restricted fusion and multinucleation in tunicates, and extensive, obligatory fusion in vertebrates. To elucidate how these differences may have evolved, we studied the evolutionary origins and function of membrane-coalescing agents Myomaker and Myomixer in various groups of chordates. Here we report that Myomaker likely arose through gene duplication in the last common ancestor of tunicates and vertebrates, while Myomixer appears to have evolved de novo in early vertebrates. Functional tests revealed an unexpectedly complex evolutionary history of myoblast fusion in chordates. A pre-vertebrate phase of muscle multinucleation driven by Myomaker was followed by the later emergence of Myomixer that enables the highly efficient fusion system of vertebrates. Thus, our findings suggest an evolutionary model of chordate-specific fusogens and illustrate how new genes can shape the emergence of novel morphogenetic traits and mechanisms.



お問い合わせは理工学部・藤原滋樹（ tatataa@kochi-u.ac.jp ）まで