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Care and Use of Invertebrates in the classroom (on the cheap)

Invertebrates are an excellent addition to undergraduate classrooms, providing learning opportunities in behavior, ecology, genetics, and many other areas of life science. Many of these benefits are best realized from extended cultures of organisms, but scientists and teachers often do not know how to keep invertebrate animals alive, healthy and exhibiting normal behavior for an extended period. Extended culture lowers costs so that instructors do not need to collect or order new animals every term and permits longer experiments and activities in the classroom. We explain basic husbandry techniques for a variety of invertebrates including marine, freshwater, and terrestrial animals and provide instructions for proper disposal or preservation of cultures. Additionally, we outline helpful tips such as keeping slugs from turning into mush; fruit fly food recipes; feeding jellyfish; exploring local ponds, vacant lots, supermarkets, and more. We give simple lesson plans for invertebrate activities that go beyond supplier's information sheets. Examples include: keeping jellyfish alive without a special tank, examining the radula from a marine snail, observing courtship behaviors and learning in fruit flies, trail following in a variety of invertebrates, tube ventilation in marine worms, and more. Our advice is drawn from a combined fifty years of trial and error. Instructors without previous experience in extended cultures can keep invertebrates in their classrooms and teaching labs with these effective protocols. We encourage others to add to this store of practical advice.

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Mechanical Models of Suction Feeding

Suction feeders generate a flow of water into their mouth with a rapid and highly coordinated movement of multiple muscle and skeletal elements in the jaw. Successful prey capture is dependent on the fluid flow and the predator is able to control and modulate aspects of the fluid flow through skeletal mechanics. Hydrodynamic forces primarily cause the forces resisting skeletal movement and associated mouth opening. A model of the skeletal mechanics and their relation to fluid mechanics is key to a full understanding of suction feeding performance. Despite this obvious relationship between the musculoskeletal movement and generated fluid flow, functional models of the feeding within the fish are relatively simple and not generally not complete or predictive of suction performance. This talk summarizes the recent history, current state, and potential future of mechanical models of suction feeding. This includes: 1) Heuristic explanations of musculoskeletal mechanics, 2) Application of mechanical advantage from levers and four bar linkages to predict jaw opening speed, 3) Suction Index as a model to predict pressure based on musculoskeletal morphology, 4) Numerical modeling of multiple skeletal and muscle models, and 5) the potential utility of physical models of suction feeding.

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Population genomics of rapid adaptation in Fundulus heteroclitus exposed to power station thermal effluents

Temperature is one of the most important environmental parameters affecting an organism's physiology, yet our understanding of evolutionary adaptation to rapidly changing environmental temperature is still incomplete. This study utilizes genotyping−by−sequencing derived genetic markers to examine genetic structure and adaptation among natural fish populations exposed to thermal effluents near power generating stations. Thermal effluents impact nearby estuaries and can raise mean water temperature by 1−3°C. Using a combination of outlier scan and population genetic structure clustering approaches, this study reveals substantial population structure among exposed and unexposed populations of the estuarine fish, *Fundulus heteroclitus*, that is most parsimoniously explained by evolution by natural selection. Replicate populations across different thermal effluents demonstrate both unique and shared adaptive responses. Further analysis provides insight into whether selection has acted on *de novo* mutation or the standing genetic variation among the populations recently adapted to increased temperature.

30.4 DE MEYER, J.*; IDE, C.; BELPAIRE, C.; GOEMANS, G.; ADRIAENS, D.; University Ghent, Belgium, Research Institute for Nature and Forest (INBO), Belgium, Research Institute for Nature and Forest (INBO), Belgium; *jendmeye.demeyer@ugent.be*

The search for the onset of head shape bimodality in European eel (Anguilla anguilla)

The life cycle of the European eel (*Anguilla anguilla*) remained a mystery until the 20th century, when Schmidt discovered that the Sargasso Sea was its spawning area. However, many aspects of the eel's life cycle remain poorly understood. Among these is the bimodal distribution in head shape, with broad− and narrowheaded phenotypes reported in the yellow eel stage. Although this has been linked to dietary preferences of the yellow eels, very little is known about why, how and when this dimorphism arises during their ontogeny. To find out whether this dimorphism indeed appears in relation to trophic niche segregation, we examined head shape variation at an earlier ontogenetic stage, the glass eel stage, as at this stage, eels are considered to be non−feeding. Head shape was studied in glass eels from the Yser river mouth, the Leopold Canal and from the rivers Severn, Trent and Parret by both taking measurements (head width/head length) and using an outline analysis. Our results show that there's already considerable variation in broadness and bluntness of the head at the glass eel stage, but no unambiguous support for head shape dimorphism was found. However, as variation in head width/head length ratios in non−feeding glass eels shows a similar range as in feeding yellow eels, head shape in European eel might be at least partially determined through other mechanisms than trophic segregation.