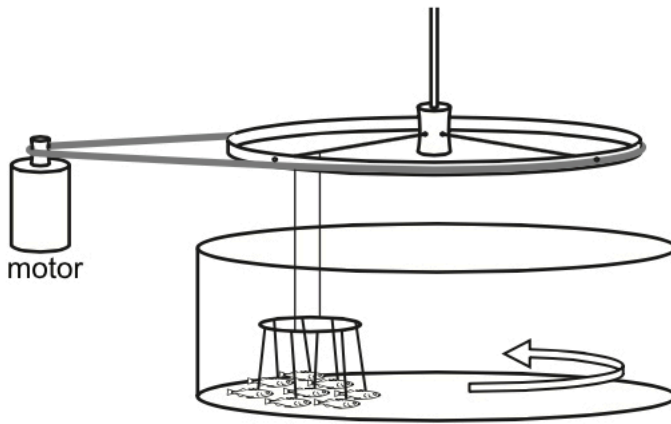


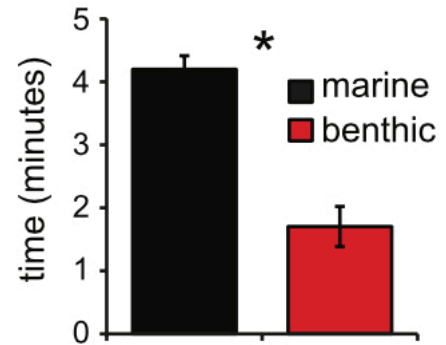


Data Points  
**Schooling Behavior of Stickleback Fish  
from Different Habitats**

**A**



**B**



**Caption:** An artificial fish school model (Panel A) was used to test the schooling behavior of threespine stickleback fish (*Gasterosteus aculeatus*). The model consisted of eight stickleback casts attached to a bicycle wheel that was rotated by a motor. As the wheel turned inside a tank, the model fish “swam” around in a “school.” Panel B shows the mean time (in minutes) that real marine (black bars) and freshwater benthic (red bars) stickleback fish introduced into the tank spent schooling with the model fish. The bars represent the means  $\pm 1$  standard error of the mean (SEM). The asterisk represents a significant difference between the two groups.

## BACKGROUND INFORMATION

A team of scientists studied the schooling behavior of threespine stickleback fish (*Gasterosteus aculeatus*) by experimentally testing how individual fish responded to an artificial fish school model. Schooling is a social behavior of fish, in which they congregate in groups as they swim and synchronize their position, direction, and speed. Schooling can be beneficial in making it less likely for individual fish to be caught by predators and increasing the likelihood of finding food. However, there are also costs associated with schooling such as competition for resources among fish in a school, so if predation is low or fish have other means to escape predators, schooling may not be beneficial. Stickleback fish of the same species can live in very distinct habitats: an open-water marine habitat versus a highly vegetated freshwater benthic habitat. The benthic zone is the area of water closest to the sediment and may be vegetated if sunlight reaches the sediment. Observations of fish in the wild suggested that marine stickleback fish have a strong tendency to school, whereas freshwater benthic stickleback fish are less likely to do so. To test these differences experimentally and to also determine whether schooling is an inherited or learned behavior, the researchers raised marine and freshwater benthic stickleback fish under laboratory conditions—in other words, without the opportunity to learn how to school from their parents. They then placed individual fish in a tank containing an artificial model school (Panel A in the figure). Following a short acclimation period to the tank, the artificial school



Data Points

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model was turned on and the introduced fish was observed for 5 minutes, measuring the time it spent schooling with the moving artificial school. Experimental trials were conducted with 19 marine stickleback fish and 20 freshwater benthic stickleback fish. The graph in the figure above (Panel B) shows the average time spent schooling by marine stickleback fish (black bars) and freshwater benthic stickleback fish (red bars).