

1096-A0-59

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Phytoplankton motion in the ocean, at the scale of individual cells, involves the interaction of passive and actuated elastic structures with a surrounding fluid - a common theme in biological fluid dynamics. We present recent modeling results that shed light on the active swimming of dinoflagellates, as well as the passive motion of diatoms in shear flows . These diatoms may form chains or bear spines. In addition to examining how the flexibility and geometry of the diatoms affect their rotational dynamics, we will discuss how laboratory experiments and computational simulations are being calibrated in an effort to characterize the elastic properties of different species of chain-forming diatoms. (Received June 30, 2013)