**Diatom acclimation to elevated CO2 via cAMP signalling and coordinated gene expression**

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Burning fossil fuels and land-use change have accelerated CO2 emissions to the atmosphere by a factor ∼100 above natural levels. About a third of anthropogenic emissions have been absorbed by the oceans increasing dissolved CO2 and reducing Ph. Despite these changes, CO2 concentrations in surface waters remain below half-saturation for most forms of ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco), the central enzyme used to fix carbon. Consequently, marine phytoplankton, including diatoms, rely on carbon concentrating mechanisms (CCMs) to ensure adequate delivery of CO2 to the Rubisco active site, minimizing the competitive fixation of oxygen. The required bicarbonate transporters and carbonic anhydrases of these CCMs concentrate CO2 against a gradient, which is energetically costly. Downregulation of CCMs as part of acclimation to elevated CO2 should result in energy savings to the diatom cell and metabolic rearrangement. Here we use nitrate-limited chemostats to simulate *in situ* nutrient limitationwhile precisely controlling cell biomass and CO2, allowing us to identify potential signaling pathways triggered either by an abrupt transition to increased CO2, as might occur during coastal upwelling, or at steady-state exposure to elevated CO2, including 800 µatm predicted for the year 2100.

**1. Highlight in the text and then check off the terms that you find in this section:**

\_\_\_\_\_ anthropogenic \_\_\_\_\_ active site \_\_\_\_\_ downregulation

\_\_\_\_\_ Rubisco \_\_\_\_\_ fixation \_\_\_\_\_gradient

\_\_\_\_\_chemostats \_\_\_\_\_ bicarbonate transporters \_\_\_\_\_CCMs

\_\_\_\_\_ steady-state \_\_\_\_\_acclimation \_\_\_\_\_carbonic anhydrases

**2. Use a science dictionary (text or online) for help in defining these terms.**  Be prepared to help your group make meaning of these terms by taking notes for each word.

anthropogenic-

active site-

downregulation-

rubisco-

fixation-

gradient-

chemostats-

bicarbonate transporters-

CCMs-

steady state-

acclimation-

carbonic anhydrases-

3. Why are CCMs important to diatoms?

4. Why would downregulation of CCMs result in energy savings?

5. Make a prediction: how will diatoms such as *Thalassiosira pseudonana* respond to high

 levels of CO2 (climate change)?