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

LETTERS

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Consistent with our data, mounting evidencesuggests that diatoms sense a change in external CO2 concentrations, in part, through cAMP signaling. We observed that cAMP metabolism genes were upregulated at steady-state elevated CO2, including a phosphodiesterase (which degrades cAMP by hydrolysis) and two membrane-bound cyclases that enhance production of cAMP. This indicates a change in cAMP metabolism at steady-state elevated CO2, potentially altering how signals are propagated in cAMP-responsive pathways. A functioning diatom CCM must transport bicarbonate into the plastid to the stroma, where it is converted to CO2 by a carbonic anhydrase. The CCM sub-cluster contains genes encoding plastid-localized membrane proteins, including proteins homologous to a family of gated anion-selective channelspermeable to bicarbonate.These plastid-targeted proteins provide a feasible mechanism for bicarbonate transport to the stroma. Once inside the plastid, bicarbonate can be converted to CO2. Another feature of an efficient diatom CCM is active transport of bicarbonate from the external environment to the cell interior; the SLC4-2 bicarbonate transporter is the most likely candidate, as it is distantly related to a transporter demonstrated to serve this role in the diatom *P. tricornutum*, and the gene encoding this transporter was significantly downregulated at steady-state high CO2.

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

\_\_\_\_\_upregulation \_\_\_\_\_ downregulation \_\_\_\_\_ transcription factors

\_\_\_\_\_ metabolic/metabolism \_\_\_\_\_ propagated \_\_\_\_\_ cAMP

\_\_\_\_\_ plastid \_\_\_\_\_active transport \_\_\_\_\_ steady-state

\_\_\_\_\_ stroma \_\_\_\_\_CCM \_\_\_\_\_ gated anion-selective channels

**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.

upregulation-

downregulation-

transcription factors-

metabolic/metabolism-

propagated-

cAMP-

plastid-

active transport-

steady state-

stroma-

CCM-

gated anion-selective channels-

3. What roll do you think cAMP has?

4. Why does the diatom move bicarbonate into the stroma (plastid)?

5. What clue tells you the diatom must expend energy to move the bicarbonate into the stroma?

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

levels of CO2 (climate change)?