# Internship proposal for a student in second year of MSc
# Physiology and biochemistry of diatoms
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***Place and supervisor* :**
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**Keywords** : marine microalgae, metal toxicity, metabolism

The proposal enters in the frame of the project "Metabolic conversion in marine microalgae: setup of a cellular model (C3MarMo)", funded by the Region Basse-Normandie (France). This includes a student stipend of 436 € per month.

**Metabolic conversion: an answer of microalgae to stress.** Thanks to photosynthesis, microalgae produce carbohydrates from $CO_2$, water and light. When microalgae are stressed, the metabolic activity is reoriented toward the production of secondary metabolites (Lemoine & Schoefs, 2010, Photosynthesis Res 106, 155). For instance, the diatom *Chaetoceros gracilis* accumulate lipids under a high light stress (Mortensen et al., 1988, J Exp Mar Biol Ecol 122, 173). The metabolic conversion is important from the ecological and economic point of views because many of the secondary metabolites present high added-values (Mimouni et al., 2012, Current Pharmaceutical Biotech, In press).

**Metal imbalance disturbs metabolism.** The activities of human societies lead to an increase of metals in the environment. The tolerance of microalgae to the variations of metal amounts differs according to the species, some being tolerant while others are not (Wang & Wang, 2009, Aquat Toxicol 95, 99). The sensitivity varies with the kind of metal. For example, concentrations in cadmium higher than 1.2 µg/L have negative impacts on the development of microalgae (http://envlit.ifremer.fr/region/basse_normandie/qualite/contaminants_chimiques/cadmium_cd). Such negative impacts are linked to requirement of metals for numerous metabolic reactions , the latter being disturbed when metals are present in too large amounts the functionning of cells (Solymosi & Bertrand, 2011, Agronomy Sust Developm. 32, 245 ; Ngyuen-Deroche et al., The Scientific World Journal, Article ID 982957, 15 pages). For instance, the presence of cadmium in the diatom *Phaeodactylum tricornutum* slows down its growth. Moreover, the presence of cadmium interferes with a protective mechanism against damages of high light intensities (xanthophyll cycle) (Bertrand et al., 2001, FEBS Lett 508, 153). If the physiological effects of heavy metals are more and more illustrated (Solymosi & Bertrand 2010, in *Handbook of Plant & Crop Stress* (Pessarakli M ed), Taylor & Francis/CRC Press, 675), the precise targets of these pollutants remain often undetermined, preventing the building of a cellular model allowing to predict the actions of metals. In order to obtain the missing information, several tools are available: (i) the genome of different diatoms, accessible on public data banks (http://genome.jgi-psf.org/), (ii) proteomics that allows the determination of the qualitative and quantitative variations of proteins from cells cultivated in different conditions (Aloui et al., 2011, BMC Plant Biology, 11, 75).

**The project** should lead to a better understanding of the mechanisms of action of cadmium on a marine diatom, *Phaeodactylum tricornutum*. Recently sequenced, it is a convenient study model. The two following points will be primarily treated:

**a.** The use of bioinformatics in order to rebuild the metabolic pathways affected by an excess of cadmium.

**b.** The physiological comparison of *P. tricornutum* cultivated in a non polluted and a cadmium-polluted medium: measurements of oxygen emission (oxygen probe) and fluorescence emission (PAM), quantification of pigments (UPLC) and proteins (Bradford).

Therefore, a student with a deep knowledge of metabolism and photosynthesis are welcome. An experience with pigment, protein and/or oxygen evolution quantification constitutes an advantage.