Modelling band formation in *Chara* species

B.Sc. project in Applied Mathematics - Mathematical Biology (Applied Analysis)

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The multicellular freshwater algae of the *Chara* species (see Figure 1A) is a model system that is used in studying the electrophysiology in plants. These pond weeds have very long internodium cells: a length of 3 to 5 cm for a single cell is quite common. Therefore, these cells are well accessible for micro electrode measurements. If such intermodium cells (with nodium cells at each end) are placed in a container with 'band formation solution' BFS, a medium that contains among others phenol red (a pH indictor) and the weak acid $Ca(HCO_3)_2$, bands of high and low acidity (pH) are formed, indicated by the colouring of phenol red (see Figure 1B). This process is known as '*band formation*'.

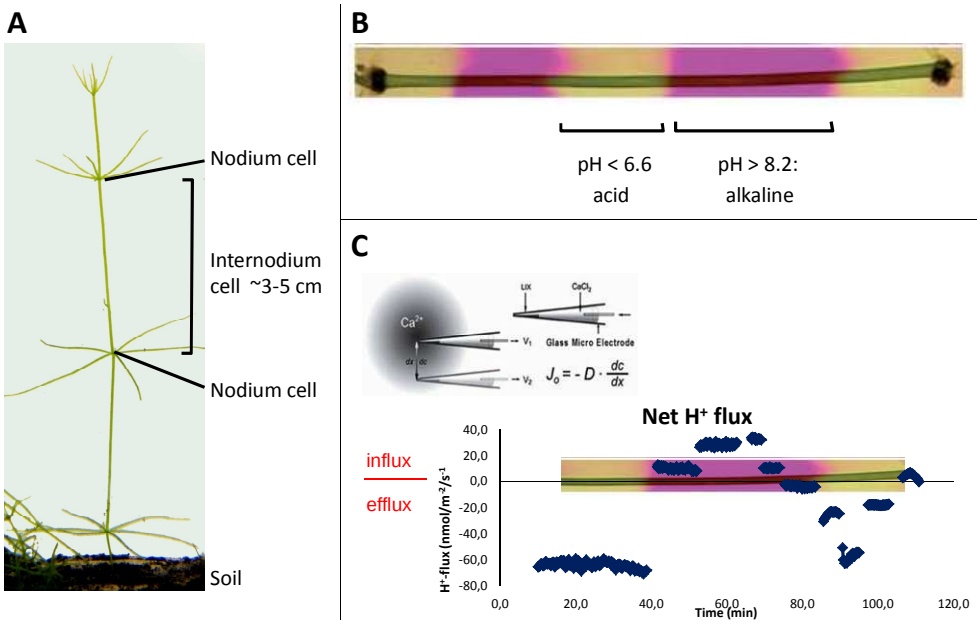

Figure 1.: (A) *A specimen of Chara corallina where the location of nodium and intermodium cells is indicated. (B) Band formation when an internodum cell and its two neighbouring nodium cells are placed in a container with band formation solution. (C) Proton flux through the cell membrane can be measured using the vibrating probe method. (experimental data provided by Suyun Zhang (IBL)).*

The goal of this B.Sc. project is to develop models for band formation together with the experimental biologists of the Plant BioDynamics Laboratory (PBDL) at the Institute of Biology Leiden (IBL), simulate these models, e.g. in Matlab or COMSOL Multiphysics, analyse their behavior theoretically and validate the model predictions thus obtained with experimental data from PBDL.

You will learn about the mathematical theory of '*Turing patterns*'. These are stable spatial patterns that occur in particular systems of partial differential equations (reaction-diffusion equations) and that have been successful in providing an explanation for e.g. patterns on animal skins. We shall investigate whether band formation is a Turing pattern too. On the biological side you will be co-supervised by Suyun Zhang (IBL), who is conduction biological research on band formation at PBDL, and will provide experimental data. The proposed project can be combined well with the course 'Mathematical Biology: The virtual cell' provided by dr. Sander Hille, which discusses e.g. aspects of electrophysiology and mathematical modeling of ion exchange through biomembranes.

A detailed presentation of this project cannot be given in the last week of January, unfortunately. ***Please contact the lecturer by email if you are interested and want further information.***