GHENT UNIVERSITY

FUNCTIONAL BIOLOGY

OVERVIEW

WHAT

Functional Biology is a research field in Biology that focuses on **how life works** at the level of the **individual organism**. In the major program 'Functional Biology' you study the **functioning** of microbes, plants and animals throughout their life cycle as well as how they **interact with the environment**.

WHY

Knowledge of the complex details on how organisms work, their possibilities, flexibility, and constraints is of importance in many branches such as nature conservation, agriculture, and medicine.

HOW

Core courses

- **Development:** How can a fertilized egg develop into an entire multicellular organism and how is this process shaped by evolution?
- **Physiological Regulation:** How do cells communicate and work in concert to create a fully functional individual?
- **Functional Abiotic Interactions:** How does an organism respond to a changing environment?
- **Functional Biotic Interactions:** How do organisms interact with each other?

In-Depth courses

Provide further detail on these topics or focus on related matter (e.g. aging, brain function, immunology, molecular biology, methods and tools).

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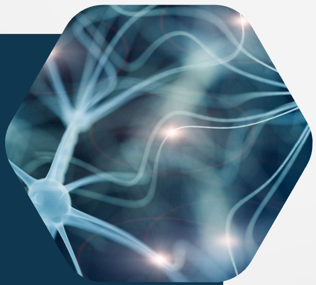
Evo-Devo: how evolution shaped the developmental process

The Functional Biology major explores Evolutionary Developmental Biology (Evo-Devo) in plants and animals, focusing on how genetic and developmental processes drive diversity in body plans, structures, and adaptations.
Animal Evo-Devo examines how morphological diversity arises through gene expression, despite limited genetic variability. Key concepts include developmental constraints, modularity, the role of Hox genes, and homologous pathways shaping vertebrate organs.
Plant Evo-Devo addresses plant resilience to climate change, evolution of photosynthesis and focuses on advanced reproductive strategies. It emphasizes genetic and morphological adaptations allowing plants to survive terrestrial environments and also focuses on human-driven evolution via domestication.
These courses equip students interested in genetics, biodiversity, and evolutionary biology with key insights into the genetic underpinnings of development and adaptation.

Physiological Regulation: how cells communicate to play the symphony of multicellular life



Multicellular organisms maintain stability and efficiently respond to environmental stimuli. To that purpose, animals use nervous and endocrine systems. These are featured in the course Physiological Regulation in Animals, which discusses mechanisms like neurophysiology, hormone signaling, and homeostasis. Topics range from neural transmission and sensory perception to higher brain functions, with practical insights gained through lab excursions and research presentations. The Physiological Regulation in Plants course investigates regulatory networks governing growth based on internal signals (e.g., hormones) and environmental cues (e.g., light). These courses offer the students essential insights into physiological adaptations crucial to biology, health sciences, and sustainable agriculture.

Functional interactions: how organisms respond to a changing environment

The Functional Biology major explores how organisms interact with their environments—both living and non-living—through physiological, molecular, and evolutionary mechanisms.
Courses on Functional Abiotic Interactions examine how bacteria, plants, and animals adapt to extreme and fluctuating abiotic factors, such as temperature, light, and chemical stress.
Plant Biotic Interactions and Host-Parasite Interactions focus on organismal interactions, covering mutualistic and pathogenic relationships, from bacterial quorum sensing to plant and animal immunity.
The Global Change Physiology course integrates ecology and physiology to explore organismal responses to global challenges, such as climate change and pollution. These studies are vital for predicting environmental impacts on ecosystems and aiding biodiversity conservation and ecological sustainability efforts, helping to mitigate future environmental change effects.

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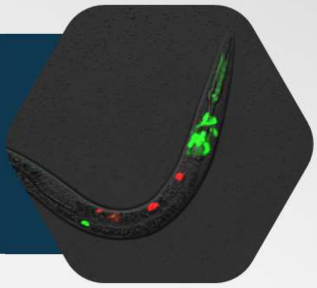
RESEARCH IN THE PICTURE

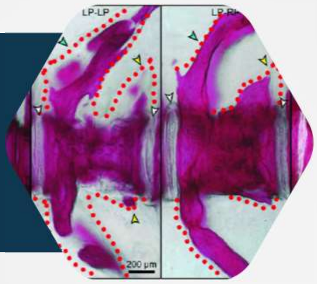
The function of *C. elegans* globins

Globins are an ancient protein family found across bacteria, archaea, and eukaryotes. In the nematode *Caenorhabditis elegans*, 34 globins were identified, many expressed in neurons and likely involved in signaling. We found that GLB-12, a membrane-bound globin, regulates worm reproduction by generating superoxide and hydrogen peroxide signals in the gonad. Its neuronal function remains unclear. Currently other globins are under investigation.



Development and plasticity of the fish skeleton

Our research explores the development, plasticity, and remodeling of skeletal tissues, particularly bone, cartilage, and teeth in teleost fish, the most diverse vertebrate group. We study these processes in a comparative developmental and evolutionary context, focusing on continuous tooth replacement. The group's research also contributes to biomedical studies and works to prevent skeletal malformations in farmed fish.



Unravelling host-symbiont interactions

We use arthropod models, specifically herbivorous insects and mites, to address important questions in the broader fields of speciation, herbivory, and symbiosis. Within these research fields, we dissect the molecular-genetic basis of key complex traits, including hybrid defects, xenobiotic detoxification, and symbiont-mediated cytoplasmic incompatibility. We integrate methodologies from field, population, and theoretical biology with those from cytology, genomics, and genetics.

Rooting for stronger crops

The root system of *Arabidopsis thaliana* is an excellent model to study the relationship between cell cycle regulation and growth and development. Understanding this offers a great potential for altering root architecture and water uptake, allowing to design plants to survive under dryer conditions.

Plant biofortification

As the global population is projected to exceed 11 billion by 2100, food security faces significant challenges, particularly due to climate change, which can reduce crop yields by 20-40%. This disproportionately affects underdeveloped regions and the poorest populations. The Laboratory of Functional Plant Biology focuses on sustainable plant production, studying plant growth, stress control, and biofortification to combat micronutrient deficiencies and improve food security.