

## Faculty of Science and Engineering

**Profile report:** Functional Genetics and Genomics, Functionele Genetica en Genomica

- Discipline: Life Sciences, Biology, functional genetics in Eukaryotes
- Level: Tenure-track assistant professor with education profile
- Fte: 1,0 fte

### 1. Scientific discipline

Genetics is a fundamental discipline in the Life Sciences and Biology, and indispensable for understanding how organismal traits are shaped and inherited. Genomics is the modern study of genomes, and comprises coding and non-coding DNA and RNA sequences that affect traits of organisms. Functional genetics and genomics aim at uncovering the genetic pathways of organismal traits, the so-called genotype to phenotype map.

This position will predominantly focus on strengthening the understanding of the genetic pathways of organismal traits in various courses in the Biology Bachelor and in the Ecology & Evolution Master, as well as other Master programs. The appointed candidate's research should preferably support current research lines in the Groningen Institute for Evolutionary Life Sciences on Genetics and Genomics.

### 2. Vacancy

This position is opened by the Board of the Faculty (PT/gl/21/00266) and will be embedded in the institute Groningen Institute for Evolutionary Life Sciences (GELIFES). The criteria and conditions pertaining to the position are described in the document [‘Assistant professor with an education profile’](#).

### 3. Selection committee (BAC)

- Prof.dr Rampal Etienne (Scientific Director GELIFES)
- Prof.dr Theo Elzenga (Education Director GELIFES; Chair)
- Prof.dr Leo Beukeboom (Director Erasmus Mundus Master in Evolutionary Biology)
- Prof.dr Bregje Wertheim (Program Director Master Ecology and Evolution)
- Prof.dr Jean-Christophe Billeter (Program Director Master Behavioural and Cognitive Neurosciences)
- Vacancy (*external member*)
- student member. t.b.d.

Advisors: Linda Bosveld Verburg (HR), Per Palsboll (Professor Marine Evolution and Conservation)

### 4. Area of expertise

Genetics is a traditional and core field of Biology, as well as an essential discipline in the Medical and Life Sciences. Knowledge of genetics is indispensable for many aspects of human society, including health and diseases, food supply (plant and animal breeding) and nature conservation (e.g. adaptation to climate change). Mendelian genetic principles are central to our understanding of how organismal traits are shaped, can be altered by selective and non-selective processes, and how (mal)adaptations and diseases come about. Quantitative genetics focuses on the organismal and population level and studies complex traits with a polygenic basis, which includes most traits that are important for

fitness. Population genetics has been central in the study of allele frequencies at the population level and forms the basis to evolutionary biology. Genomics is a more recent and still rapidly growing field of molecular genetics, that is being integrated in all other studies of biology and life sciences.

A central challenge in biology is the reconstruction of the genotype to phenotype map. This requires functional genetics, the elucidation of single gene functions and their interactions with other genes. Various innovative technologies exist for this, both at the level of individual genes, and at the genomic, transcriptomic and proteomic level. Novel techniques for discovery of genes and testing their function (e.g. RNA interference, CRISPR-Cas gene-editing) now enables the study of genetic pathways of phenotypic traits in non-model organisms. The genomics revolution expands this towards uncovering the genetic architecture of multiple and complex traits. There are also important applied aspects of functional genetics and genomics, such as elucidating the genetic basis of economically important traits for breeding (e.g., seed yield, milk production) and for health and disease.

Functional Genetics & Genomics is a rapidly evolving field as novel approaches and methodology are continuously being developed. We can now investigate genetic function at both the single gene level as well as at the whole genomic level. This requires (knowledge of) sophisticated molecular techniques associated with gene detection, expression and manipulation (editing and knockdown) as well as analyses of large data sets. The involvement of a functional genetics and genomics expert in the teaching programs is highly needed to create coherence between genetic and genomic aspects in introductory courses and field-specific applications across different biological specializations. A broad range of students need training in these techniques, not just those in the field of medical and molecular genetics, but also in ecology and evolution, as well as behavioural and neurosciences. In addition, expertise is needed to provide advanced-level education in functional, evolutionary genetics and genomics, for students who decide to specialize in this discipline. All of these initiatives require a high commitment to education, educational innovation and didactic skill development.

## **5. Embedding: institute (and expertise group)**

The Groningen Institute for Evolutionary Life Sciences (GELIFES) aims to enhance the understanding of adaptive processes and the maladaptive consequences of their limitations, across all levels of biological organization (from molecules and genes to individuals and ecosystems), to inform the society and contribute solutions to societal problems. The institute has tight connections with the Faculty of Medical Sciences (FMS) and University Medical Centre Groningen (UMCG). It coordinates master programs in evolution and ecology as well as in medical and behavioural neurobiology.

GELIFES is organized in a non-hierarchical manner, and staff associate with one (or more) informal expertise groups. The tenure-track assistant professor is free to choose their expertise group. GELIFES currently has six expertise groups, each consisting of several professors and assistant professors with their groups: *Genomics Research in Ecology & Evolution in Nature* (GREEN), *Theoretical Research in Evolutionary Life Sciences* (TRES), *Evolutionary Genetics, Development and Behaviour* (EGDB), *Behavioural and Physiological Ecology* (BPE), *Conservation Ecology* (CONSECO) and *Neurobiology*.

The candidate will have access to GELIFES' excellent facilities for experimental research in genetics and genomics, including well-equipped molecular laboratories, plant and animal culturing facilities, SMT laboratories, fluorescent microscopes and IT facilities for large data processing.

## **6. Local and (inter)national position**

### Local:

Within FSE we teach the basics of prokaryotic and eukaryotic genetics in the Biology and Life Science & Technology program in collaboration with the Groningen Biomolecular Sciences and Biotechnological Institute (GBB). Our institute has strong links with the medical sciences at the UMCG as we educate medical biology students in genetics and genomics research. A hallmark of our educational profile is the integration of mechanistic (e.g., genetic and genomic) approaches with evolutionary approaches to understand adaptation .

### National:

GELIFES has a strong reputation in research and education in ecology, evolution, behaviour and neurobiology. GELIFES is the only life science institute in the Netherlands that specifically aims at integrating the study of physiological mechanisms with those of ecology and evolution. Many collaborations exist with other universities and research institutes in The Netherlands on a wide variety of topics, including the universities of Wageningen, Utrecht and Amsterdam and the Royal Dutch Academy Institutes Netherlands Institute for Ecological Research and the Netherlands Institute for Sea Research as well as the Naturalis Biodiversity Center.

### International:

There is no other institute in the Netherlands, and only very few in the world, that specifically aim at the integration of ecological and evolutionary approaches with neurobiology and physiology in the Life Sciences. Our international collaborations are too many to list but our research topics that are internationally very well recognized and relevant for the new staff member are among others the genetics and evolution of insect reproduction, the evolution and physiology of animal personalities, sociability and ageing, microbial genetics and ecology, evolutionary genomics, biological clocks, conservation genetics, maternal effects and theoretical biology.

## **7. Expected contributions to teaching**

The candidate will teach at all levels within the Life Sciences and Biology curriculum, with focus on the Bachelor level. They will teach basic principles of genetics and genomics, with strong emphasis on laboratory and computational education, as genetics & genomics research relies heavily on acquaintance of sophisticated experimental techniques, practical skills and analysis of large data sets. As the genetics and genomics are featuring all over the curricula for both BSc and MSc programs, coordination and alignment of teaching activities and maintaining good collaboration with colleagues that teach related fields such as bioinformatics, phylogenetics, evolutionary biology and behavioural genetics is an essential task for this position. The candidate will play a leading role in the development of the genetics and genomics education and is expected to develop new course materials, new courses and/or innovations in teaching in general. Another urgent innovation in teaching is the development of methods to train students to think and act in a multi-disciplinary manner, e.g. both from a proximate (mechanistic) and ultimate (evolutionary) perspective.

They will stay up to date with the latest developments in the fast-developing field of functional genetics and genomics, and integrate these in their teaching program. This includes the coordination and organization of bachelor research projects and ensuring that these projects are embedded in state-of-the-art research programs within GELIFES. This also entails the expansion of institute-driven student research projects into project-laboratories for education, a cross-organizational structure that spans the different majors (i.e., cross-curricular activities) of the BSc Biology. The candidate will apply for grants to further develop and apply novel teaching techniques.

Specifically, the candidate will be involved in the following (non-exhaustive list of) teaching activities, and improve the coherence between them

- Basic genetic principles (Mendelian, quantitative and population genetics)
- DNA, RNA and protein isolation techniques
- primer design, PCR techniques and optimization
- Sequence comparison and phylogenetic inference
- Sequencing methodologies, genome assembly and annotation, transcriptomic analyses
- Protein analysis methods
- RNA interference techniques
- Gene editing (CRISPR/Cas)

## **8. Expected contributions to research**

The new staff member is expected to associate with an existing research line of molecular and functional aspects of genetics applied to multicellular organisms within GELIFES. This embedding in a research program ensures that their teaching is fueled by modern research in the field and includes the translation of research activities into the teaching program (e.g., practicals) as well as instruction and (co)-supervision of Master and PhD students. The candidate is expected to support genetic and genomic approaches of other staff members in the institute, especially in the fields of life-history evolution, behavioural biology, phylogenetics, microbial ecology, theoretical biology, chronobiology, and neurobiology. They will have a clear affinity with functional genetic and genomic research with an empirical approach and evolutionary perspective.

GELIFES is known for its strong research in the field of functional genetics and genomics of insects. This includes ground breaking discoveries about the genetic basis of insect reproductive behaviour and sex determination, sociality and reproductive behaviour, biological clocks and immunity. This knowledge is increasingly applied to the expanding insect breeding industry by coordinating and participating in EU consortia (e.g., ITN on biocontrol, photoperiodism) and NWO-funded topical programs (e.g. NWO-Green, NWO-Closed Circles, NWO\_NWA Insectfeed). This is one potential research field with which the candidate may associate. Alternatives include the fields of individuality of personalities, neurological disorders and disease, and sleep, which is performed in rodents, birds, mammals or fish.

## **9. Expected contributions to the organization**

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. At the level of FSE, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees in the area of education. The candidate will participate

in relevant national and international organizations.