Exploiting key competences in Biology, Engineering and Computer Science, Mathematics, Physics available in Trento
Capturing the increasing need for researchers/experts able to:

- transform the enormous amount of biological information ("big data") into knowledge
- gain quantitative insight into the behaviour of biological systems by means of bio-mathematical and bio-physical models

**SPOTLIGHT ON BIOINFORMATICS**

**Biology goes digital**

A new species of biologist is beginning to thrive in the niche created by recent genomic and computational advances.
The Department of Cellular, Computational and Integrative Biology

CANCER BIOLOGY & GENOMICS

CELL & MOLECULAR BIOLOGY

MICROBIOLOGY & SYNTHETIC BIOLOGY

NEUROBIOLOGY & DEVELOPMENT

ADVANCED IMAGING
HIGH THROUGHPUT SCREENING & MICROARRAY
BIO-ANALYTICAL MASS SPECTROMETRY
PROTEIN SCIENCE
LAB MANAGEMENT TEAM

CONCEPTS

Higher education
Research center
Independent PIs
Core facilities
Molecular basis of diseases
Computational Biology
Biomedicine
Core facilities
Biotechnology

Research & Innovation

Cell Analysis & Separation
Next Generation Sequencing
Model Organism
Bioinformatics
Grant Support
Physics Department

Fundamental and applied fields of study

- Experimental Gravitation
- Biophysics and Biosignals
- Bio-organic Chemistry
- Communication of Physical Sciences
- Atomic and Molecular Physics
- IdEA (Hydrogen, Energy, Environment)
- Structure and dynamics of complex systems
- Nanoscience
- Theoretical and computational physics

Partner institutions

[Logos of TIFPA, Consiglio Nazionale delle Ricerche, BEC, ECT*]
The Department of Information Engineering and Computer Science (DISI)

Founded in January 2002 as a dynamic and qualified response to the ever-increasing, leading-edge competency demands in the field of ICT, drawing from a productive fabric at the local, national and international level.
Mathematics Department

- Analytic and Algebraic Geometry
- Calculus of Variations and Geometric Measure Theory
- Dynamical Systems and Control Theory
- Lie Algebras, Groups, Cryptography and Codes
- Mathematical Logic and Theoretical Computer Science
- Mathematical Physics and Geometrical Methods in Physics
- Nonlinear Partial Differential Equations
- Numerical Approximation of Partial Differential Equations
- Stochastic Processes

- Laboratory of Didactics and Communications of Mathematics
- Laboratory of Industrial Mathematics and Cryptography
- Laboratory of Mathematical and Computational Biology

CIRM
CENTRO INTERNAZIONALE PER LA RICERCA MATEMATICA

INdAM
Istituto Nazionale di Alta Matematica

Trento Institute for Fundamental Physics and Applications
Admission

First level University Degree in:
✓ Biotechnology
✓ Biological Sciences
✓ Science and agro-food technologies
✓ Pharmaceutical and Technological Sciences
✓ Chemical and Technological Sciences
✓ Physical and Technological Sciences
✓ Mathematical Sciences
✓ Information Sciences and Technology
✓ Information Engineering

...plus

basic knowledge and skills in computer science, mathematics, physics, chemistry and biology

+ English B1

Three different tracks based on educational background

BIOTECHNOLOGICAL TRACK

PHYSICAL TRACK

COMPUTATIONAL TRACK

BIOCOMPUTATIONAL TRACK*

*to be activated
Courses

- **Mandatory Courses:** to allow students from different educational paths to harmonize their background (24 CFU/ECTS) and to acquire specific competencies (24 CFU/ECTS)

- **Elective courses:** to focus on selected biotechnological or computational topics (36 CFU/ECTS)

- **Free choice courses:** among courses offered by the UniTN Departments (12 CFU/ECTS)

- **Language,** English B2 or higher (3 CFU/ECS)

- **Traineeship** within the University of Trento organizations involved in the Master Degree, by other Italian or European Universities, or in industries operating in the biotechnology, bioinformatics and computational area (6 CFU/ECTS)

- **Thesis** (usually related to the traineeship activity; 15 CFU/ECTS)

**Total** 120 CFU/ECTS
## Educational offer

<table>
<thead>
<tr>
<th>I year</th>
<th>II year</th>
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</thead>
<tbody>
<tr>
<td><strong>I semester</strong></td>
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<tr>
<td><strong>Courses</strong></td>
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<tr>
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</tr>
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<td>Quantum Physics</td>
<td>Statistical Models</td>
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<tr>
<td>Quantum Chemistry</td>
<td>Stochastic Processes</td>
</tr>
</tbody>
</table>

Courses are mostly composed by two integrated modules (6 CFU/ECTS each)
Biotechnological track: electives (36 CFU)

I year

I semester
- Mol. Basis of Cell Structure & Function
- Cellular & Molecular Dynamics
- Organic & Biological Chemistry
- Experim & Computational Biochemistry
- Biostatistics & Probability
- Biostatistical Computing
- Scientific Programming
- Algorithms & Data Structures
- Quantum Physics
- Quantum Chemistry

II semester
- Computational Human Genomics
- Computational Microbial Genomics
- Genetic & Metabolic Engineering
- Tissue Engineering
- Network-based Data Analysis
- Network Modeling & Simulation
- Algorithms for Bioinformatics
- Bioinformatic Resources
- Non-equilibrium statistical physics
- Multi-scale methods in soft matter

II year

I semester
- Mathematical Modeling in Biology
- Spatio-temporal Models in Cell & Tissue Biology
- Physical Modeling of Biomolecules
- Computer Simulation of Biomolecules
- Machine Learning
- Biological Data Mining
- Economics & Management
- Biotechnology Regulations
- Statistical Models
- Stochastic Processes
### Computational track: mandatory

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- **Cellular & Molecular Dynamics**
- **Organic & Biological Chemistry**
- **Experim & Computational Biochemistry**
- **Biostatistics & Probability**
- **Biostatistical Computing**
- **Scientific Programming**
- **Algorithms & Data Structures**
- **Quantum Physics**
- **Quantum Chemistry**

#### II semester
- **Computational Human Genomics**
- **Computational Microbial Genomics**
- **Genetic & Metabolic Engineering**
- **Tissue Engineering**
- **Network-based Data Analysis**
- **Network Modeling & Simulation**
- **Algorithms for Bioinformatics**
- **Bioinformatic Resources**
- **Non-equilibrium statistical physics**
- **Multi-scale methods in soft matter**

#### II year
- **Mathematical Modeling in Biology**
- **Spatio-temporal Models in Cell & Tissue Biology**
- **Physical Modeling of Biomolecules**
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- **Machine Learning**
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**CIBIO**

**DFis**

**DMat**

**DISI**

**Other**
### Physical track: mandatory

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**II year**

**I semester**
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- Spatio-temporal Models in Cell & Tissue Biology
- Physical Modeling of Biomolecules
- Computer Simulation of Biomolecules
- Machine Learning
- Biological Data Mining
- Economics & Management
- Biotechnology Regulations
- Statistical Models
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## Biocomputational track*: mandatory

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- Mathematical Modeling in Biology
- Spatio-temporal Models in Cell & Tissue Biology
- Physical Modeling of Biomolecules
- Computer Simulation of Biomolecules
- Knowledge and Data Integration
- Economics & Management
- Biotechnology Regulations
- Statistical Models
- Stochastic Processes

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Other
**Suggested free choice courses (12 CFU):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>High Throughput Technology</td>
<td>6</td>
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<tr>
<td>Genomics and Drug Discovery</td>
<td>6</td>
</tr>
<tr>
<td>Knowledge and Data Integration</td>
<td>6</td>
</tr>
<tr>
<td>Digital signal processing</td>
<td>6</td>
</tr>
<tr>
<td>Computational Physics</td>
<td>6</td>
</tr>
<tr>
<td>Statistics of Stochastic Processes</td>
<td>6</td>
</tr>
<tr>
<td>Bayesian Statistics</td>
<td>6</td>
</tr>
<tr>
<td>Ultrasound Technologies for Medical Applications</td>
<td>6</td>
</tr>
<tr>
<td>Fundamentals of Image and Video Processing</td>
<td>6</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2019/2020</td>
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<td>---------------</td>
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<tr>
<td>Faculties:</td>
<td>All faculties</td>
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<tr>
<td><strong>Course:</strong></td>
<td><strong>[LM] Quantitative and Computational Biology - 0521H</strong></td>
</tr>
<tr>
<td>SSD:</td>
<td>Tutti i settori</td>
</tr>
<tr>
<td>working language</td>
<td>Tutte le lingue</td>
</tr>
</tbody>
</table>

Insert the name (even partial) of the professor you want to search

**Professor:**

Insert the name (even partial) of the teaching activity you want to search
BSc in Bio, Comp Sci, Math, Phys

- Mandatory
- Electives
- Free choice
- Language

Traineeship
Thesis

Mandatory Electives
Free choice
Language

BIOTECHNOLOGICAL TRACK

COMPUTATIONAL TRACK

PHYSICAL TRACK

BIOCOMPUTATIONAL TRACK*

international.unitn.it/mqcb
# Professional profiles at outcome

## BIOTECHNOLOGIST
- Skills in experimental techniques and instrumentation and deep understanding of cellular and molecular processes
- Skills in dedicated software for laboratory equipment and raw data management
- Effective interaction both with laboratory personnel and analysts and ability to integrate workflows

## BIOINFORMATICIAN
- Development of software and computational tools for biological data analysis
- Skills in complex databases, web resources and in cluster- or cloud-based computational solutions
- Building and maintaining workflows and pipelines for raw biomolecular data analysis and integration

## COMPUTATIONAL BIOLOGIST
- Development of analytical methods for large-scale data (genomics, proteomics, metabolomics) and molecular interaction models
- Identification, development and test of computational methods for the discovery of active ligands and for drug development
- Design of in silico experiments to test data-driven hypotheses and interpretation of result

## DATA AND SYSTEMS BIOLOGY ANALYST
- Skills in biostatistics for experimental design and advanced analysis of clinical and molecular data
- Curation of high-dimensional data for the representation of biological knowledge by integrated systems and biological networks
- Analysis of complex biological data derived from whole-cell measurements
EXPLORING LINKS BETWEEN GERMLINE VARIANTS AND ABERRATIONS IN ONCOGENIC SIGNALING PATHWAYS

ANALYSIS OF CO-OCCURRENCE OF BINDING SITES FOR THE STEROID HORMONE RECEPTORS AND C/EBP FAMILY MEMBERS TRANSCRIPTION FACTORS WITHIN REGULATORY ELEMENTS

Extraction of drug-related signatures exploiting RNASeq data from brain cortex of schizophrenia patients

Modelling microbial motion: the case of Chlamydomonas Reinhardti

NEURAL NETWORK-BASED PREDICTION OF GLOBAL PROPERTIES OF BIOLOGICALLY RELEVANT POLYMERS

Folding of Topologically Complex Proteins Via Multi-Scale Models

BIOCHEMICAL BASED ARCHITECTURES FOR COMPUTING SYSTEMS

FULL ATOMISTIC MODEL OF PRION STRUCTURE AND CONVERSION
Multiple opportunities for internships
Master of Science in Quantitative and Computational Biology

The Master of Science in Quantitative and Computational Biology is a multidisciplinary degree that formally integrates quantitative sciences and applied biology.

The course - entirely taught in English - is designed to capture the increasing need for researchers and experts able to transform the enormous amount of biological information ("big data") into knowledge and to gain quantitative insight into the behaviour of biological systems by means of bio-mathematical and bio-physical models.

Key target areas include pharmacogenomics, biotechnology, food science, and precision medicine, which represent applied research fields where the growing availability of multidimensional data demands high interdisciplinarity.

The course is designed to train experts in biotechnology, computational biology, bioinformatics and biological data and systems biology analysis, who will have the opportunity to learn in a multidisciplinary context, interacting with students with different experiences.

Strong emphasis will be given to quantitative and computational aspects, with a focus on tools to analyze, model and understand biological systems and phenomena.

Teaching activities include lectures, laboratory courses and seminars. The master of science thesis will be carried out during the second semester of the last year.

Students will have the chance to carry out research projects within the University of Trento organizations involved in the Master Degree, by other Italian or European Universities, or in industries operating in the biotechnology, bioinformatics and computational areas.

https://offertaformativa.unitn.it/en/lm/quantitative-and-computational-biology