



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           |           |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           | 2024/25   |
| Subject (*)              | Genomics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        | Code                      | 614522006 |
| Study programme          | Mestrado Universitario en Bioinformática para Ciencias da Saúde                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           |           |
| Descriptors              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           |           |
| Cycle                    | Period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Year   | Type                      | Credits   |
| Official Master's Degree | 1st four-month period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | First  | Optional                  | 6         |
| Language                 | Spanish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |                           |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                           |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           |           |
| Department               | Biología                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |                           |           |
| Coordinador              | Vila Taboada, Marta                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | E-mail | marta.vila.taboada@udc.es |           |
| Lecturers                | Becerra Fernandez, Manuel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | E-mail | manuel.becerra@udc.es     |           |
|                          | Cerdan Villanueva, Maria Esperanza                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        | esper.cerdan@udc.es       |           |
|                          | Vila Taboada, Marta                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        | marta.vila.taboada@udc.es |           |
|                          | Vizoso Vázquez, Ángel José                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        | a.vizoso@udc.es           |           |
| Web                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |                           |           |
| General description      | <p>Genomics has many subdisciplines. According to the NIH, Genomics is the study of all of a person's genes (the genome), including interactions of those genes with each other and with the person's environment. However, Genomics also deals with the genomes of other organisms as well as their evolution. Genomics includes knowledge procuded by Genetics, Molecular Biology, Biochemistry, Computer Science, Statistics, Maths, Physics and so on.</p> <p>Classic Genetics used to start with a mutant and then search for the gene or genes responsible for that particular phenotype. By contrast, Genomics aims at predicting the function of genes from their sequence and/or their interaction with other genes.</p> <p>OMIC sciences (Genomics, Proteomics, Metabolomics) are top science at the moment, particularly because of bioinformatics and the new DNA-sequencing technologies.</p> |        |                           |           |

## Study programme competences / results

| Code | Study programme competences / results                                                                                                                                                                          |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A8   | CE8 - Understanding the basis of the information of the hereditary material, its transmission, analysis and evolution                                                                                          |
| A9   | CE9 ? To understand the benefits and the problems associated with the sequencing and the use of biological sequences, as well as knowing the structures and techniques for their processing                    |
| B1   | CB6 - Own and understand knowledge that can provide a base or opportunity to be original in the development and/or application of ideas, often in a context of research                                        |
| B2   | CB7 - Students should know how to apply the acquired knowledge and ability to problem solving in new environments or little known within broad (or multidisciplinary) contexts related to their field of study |
| B5   | CB10 - Students should possess learning skills that allow them to continue studying in a way that will largely be self-directed or autonomous.                                                                 |
| B6   | CG1 -Search for and select the useful information needed to solve complex problems, driving fluently bibliographical sources for the field                                                                     |
| B7   | CG2 - Maintain and extend well-founded theoretical approaches to enable the introduction and exploitation of new and advanced technologies                                                                     |
| B8   | CG3 - Be able to work in a team, especially of interdisciplinary nature                                                                                                                                        |
| C1   | CT1 - Express oneself correctly, both orally writing, in the official languages of the autonomous community                                                                                                    |
| C2   | CT2 - Dominate the expression and understanding of oral and written form of a foreign language                                                                                                                 |
| C3   | CT3 - Use the basic tools of the information technology and communications (ICT) necessary for the exercise of their profession and lifelong learning                                                          |
| C7   | CT7 ? To maintain and establish strategies for scientific updating as a criterion for professional improvement.                                                                                                |
| C8   | CT8 - Rating the importance that has the research, innovation and technological development in the socio-economic and cultural progress of society                                                             |



| Learning outcomes                                                                                                                          |  |                                       |            |            |
|--------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------|------------|------------|
| Learning outcomes                                                                                                                          |  | Study programme competences / results |            |            |
| Knowledge about the molecular tools used in genomics                                                                                       |  | AJ8<br>AJ9                            |            |            |
| Knowledge about structural, functional and evolutionary genomics                                                                           |  | AJ8                                   | BJ1<br>BJ2 | CJ8        |
| To set up experiments and analyse and interpret data using DNA microarrays and RNAseq                                                      |  |                                       | BJ6<br>BJ7 | CJ2<br>CJ3 |
| Knowledge about the mechanisms involved in the evolution of genomes and the molecular and bioinformatic tools used in that kind of studies |  |                                       | BJ5<br>BJ8 | CJ1<br>CJ7 |

| Contents                                          |                                                                                                                                                                             |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                             | Sub-topic                                                                                                                                                                   |
| Introduction: from Molecular Genetics to Genomics | Molecular markers<br>Applications of recombinant DNA technologies<br>PCR and real-time quantitative PCR<br>Sanger sequencing<br>DNA editing techniques                      |
| The Human Genome Project                          | Approaches for whole genome sequencing                                                                                                                                      |
| Next Generation Sequencing (NGS)                  | Platforms<br>Paired-end libraries<br>Data files                                                                                                                             |
| Whole genome sequencing                           | Annotation<br>Comparative genomics                                                                                                                                          |
| Metagenomics                                      | Metabarcoding                                                                                                                                                               |
| Clinical Genomics                                 | Amplicon-seq<br>Panel-seq<br>Exome-seq<br>Pharmacogenomics                                                                                                                  |
| Single Nucleotide Polymorphisms (SNPs)            | Genome wide association studies (GWAS)<br>Digital genetic testing                                                                                                           |
| Functional Genomics                               | Transcriptome analysis: microarrays and RNAseq                                                                                                                              |
| Hands on                                          | Introduction to the Integrative Genomics Viewer (IGV)<br>Solving exercises using GALAXY<br>Gene expression analysis using GALAXY<br>Pharmacogenomic analysis using PHARMGKB |

| Planning                                                                                                                        |                               |                                      |                               |             |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests                                                                                                           | Competencies / Results        | Teaching hours (in-person & virtual) | Student's personal work hours | Total hours |
| ICT practicals                                                                                                                  | B2 B5 B8 C3                   | 21                                   | 42                            | 63          |
| Mixed objective/subjective test                                                                                                 | A8 A9 B2 C1 C2 C3             | 2                                    | 8                             | 10          |
| Guest lecture / keynote speech                                                                                                  | A8 A9 B1 B6 B7 C1<br>C2 C7 C8 | 21                                   | 52.5                          | 73.5        |
| Personalized attention                                                                                                          |                               | 3.5                                  | 0                             | 3.5         |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |                               |                                      |                               |             |

| Methodologies |
|---------------|
|---------------|



| Methodologies                   | Description                                                                                                                                                                                                                                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ICT practicals                  | Hands on: students solve exercises using their own laptop.                                                                                                                                                                                             |
| Mixed objective/subjective test | Assessment of the learning process. Tests may include multiple choice questions, problem solving and computer exercises. Instructors will decide whether scheduling a separate test for the computer exercises depending on the progress of the group. |
| Guest lecture / keynote speech  | Each instructor will explain the basic contents of each topic interacting as much as possible with the students.                                                                                                                                       |

| Personalized attention |                                                                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies          | Description                                                                                                                                                                                                                                              |
| ICT practicals         | The instructors will carefully supervise the student's work during the hands-on sessions.<br>In the event of having officially certified "part-time" students, the instructors will take the appropriate measures so that their scores are not affected. |

| Assessment                     |                               |                                                                                                                                                                                                                                                               |               |
|--------------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                  | Competencies / Results        | Description                                                                                                                                                                                                                                                   | Qualification |
| Guest lecture / keynote speech | A8 A9 B1 B6 B7 C1<br>C2 C7 C8 | In order to pass the subject, all students will have to take a multiple choice test and/or short-answer questionnaire.                                                                                                                                        | 70            |
| ICT practicals                 | B2 B5 B8 C3                   | All students will have to submit several reports following the guidelines provided by each instructor. In these reports, students will answer questions and/or solve exercises using their own computer and the software introduced during the computer labs. | 30            |

| Assessment comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p>Students scoring at least 50 (out of 100) points but not reaching the minimum thresholds (ICT practicals: 15 out of 30 points; Objective test; 28 out of 70 points) will be awarded a 4.5 (out of 10) score. When resitting, they can choose to take both parts or only the failed one.</p> <p>Evaluation criteria and methodology will be same for the first and second opportunities, except for mark "A with distinction" which will only be awarded to outstanding students passing the subject in the first opportunity.</p> <p>Students will be scored as "ABSENT" (Non presentado) only when not involved in any of the assessed activities.</p> <p>In the case of exceptional circumstances, lecturers may assist the student to improve his/her learning process and/or catch up on missed work/assessments. The student is responsible for liaising with his/her lecturer to organise this assistance by e.g. applying for: an extended deadline to present his/her work or taking an exam in a different date. The coordinator can request evidence about the reason for such an application.</p> <p>In the event of having officially certified "part-time" students, the instructors will take the appropriate measures so that their scores are not affected.</p> <p>All aspects related to ?academic dispensation?, ?dedication to study?, ?permanence? and ?academic fraud? will be governed in accordance with the current academic regulations of the UDC.</p> |

| Sources of information |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic                  | <ul style="list-style-type: none"> <li>- Robison PN, Piro RM, Jäger M (2018). Computational Exome and Genome Analysis. CRC Press, Taylor &amp; Francis Group</li> <li>- Kulkarni S, Pfeifer J (2015). Clinical Genomics. A guide to Clinical NGS. Academic Press, Elsevier</li> <li>- Brown TA (2018). Genomes4. Garland Science, Taylor &amp; Francis Group</li> <li>- Pevsner J (2015). Bioinformatics and Functional Genomics. Wiley Blackwell</li> </ul> |
| Complementary          |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Recommendations |
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| Subjects that it is recommended to have taken before                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Introduction to molecular biology/614522004<br>Genetics and molecular evolution/614522005                                                                                                                                                                                                                                                |
| Subjects that are recommended to be taken simultaneously                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                          |
| Subjects that continue the syllabus                                                                                                                                                                                                                                                                                                      |
| Fundamentals of bioinformatics/614522008                                                                                                                                                                                                                                                                                                 |
| Other comments                                                                                                                                                                                                                                                                                                                           |
| Do not take this course unless your level of English is B1 or higher. According to the UDC regulations for the 2023/24 academic year, if the subject does not have at least five students enrolled, it will be taught on a tutorial basis. This means that only the hours included in the teaching staff's POD will be taught in person. |

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.