



## Teaching Guide

| Teaching Guide      |                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                             |           |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------|-----------|
| Identifying Data    |                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                             | 2022/23   |
| Subject (*)         | Cytogenetics                                                                                                                                                                                                                                                                                                                                                                                   |        | Code                                                                        | 610G02022 |
| Study programme     | Grao en Bioloxía                                                                                                                                                                                                                                                                                                                                                                               |        |                                                                             |           |
| Descriptors         |                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                             |           |
| Cycle               | Period                                                                                                                                                                                                                                                                                                                                                                                         | Year   | Type                                                                        | Credits   |
| Graduate            | 1st four-month period                                                                                                                                                                                                                                                                                                                                                                          | Fourth | Optional                                                                    | 6         |
| Language            | Spanish                                                                                                                                                                                                                                                                                                                                                                                        |        |                                                                             |           |
| Teaching method     | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                   |        |                                                                             |           |
| Prerequisites       |                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                             |           |
| Department          | Bioloxía                                                                                                                                                                                                                                                                                                                                                                                       |        |                                                                             |           |
| Coordinador         | Gonzalez Tizon, Ana Maria                                                                                                                                                                                                                                                                                                                                                                      | E-mail | ana.gonzalez.tizon@udc.es                                                   |           |
| Lecturers           | Gonzalez Tizon, Ana Maria<br>Mallo Seijas, Natalia<br>Martinez Lage, Andres                                                                                                                                                                                                                                                                                                                    | E-mail | ana.gonzalez.tizon@udc.es<br>natalia.mallo@udc.es<br>andres.martinez@udc.es |           |
| Web                 |                                                                                                                                                                                                                                                                                                                                                                                                |        |                                                                             |           |
| General description | This is a course focusing on the study of eukaryotic chromosome from the structural, functional and evolutionary perspective. In this area seek to improve the knowledge acquired in the molecular genetics and genetic materials. Special emphasis on the organization of the genetic material and their implications in the evolution of genomes, their variation and handling will be done. |        |                                                                             |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                                                                                            |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | Recoñecer distintos niveis de organización nos sistemas vivos.                                                                                                                                                                                         |
| A2   | Identificar organismos.                                                                                                                                                                                                                                |
| A11  | Identificar e analizar material de orixe biolóxica e as súas anomalías.                                                                                                                                                                                |
| A16  | Realizar cultivos celulares e de tecidos.                                                                                                                                                                                                              |
| A26  | Deseñar experimentos, obter información e interpretar os resultados.                                                                                                                                                                                   |
| A29  | Impartir coñecementos de Bioloxía.                                                                                                                                                                                                                     |
| A30  | Manexar adecuadamente instrumentación científica.                                                                                                                                                                                                      |
| A31  | Desenvolverse con seguridade nun laboratorio.                                                                                                                                                                                                          |
| B1   | Aprender a aprender.                                                                                                                                                                                                                                   |
| B2   | Resolver problemas de forma efectiva.                                                                                                                                                                                                                  |
| B3   | Aplicar un pensamento crítico, lóxico e creativo.                                                                                                                                                                                                      |
| B4   | Traballar de forma autónoma con iniciativa.                                                                                                                                                                                                            |
| B5   | Traballar en colaboración.                                                                                                                                                                                                                             |
| B6   | Organizar e planificar o traballo.                                                                                                                                                                                                                     |
| B7   | Comunicarse de maneira efectiva nunha contorna de traballo.                                                                                                                                                                                            |
| B8   | Sintetizar a información.                                                                                                                                                                                                                              |
| B9   | Formarse unha opinión propia.                                                                                                                                                                                                                          |
| B10  | Exercer a crítica científica.                                                                                                                                                                                                                          |
| B11  | Debater en público.                                                                                                                                                                                                                                    |
| B13  | Comportarse con ética e responsabilidade social como cidadán e como profesional.                                                                                                                                                                       |
| C1   | Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.                                                                                                                                               |
| C2   | Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.                                                                                                                                                                    |
| C3   | Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.                                                                        |
| C4   | Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común. |
| C6   | Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.                                                                                                                      |



|    |                                                                                                                                               |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------|
| C7 | Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.                                                              |
| C8 | Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade. |

| Learning outcomes                                                                                                                                                                                                                                    |     |                             |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------------|----|
| Learning outcomes                                                                                                                                                                                                                                    |     | Study programme competences |    |
| Deepen your knowledge of the organization of hereditary material with an evolutionary approach through the study of chromosomes and their variations.                                                                                                | A1  | B1                          | C1 |
|                                                                                                                                                                                                                                                      | A11 | B2                          | C2 |
|                                                                                                                                                                                                                                                      | A16 | B3                          | C3 |
|                                                                                                                                                                                                                                                      | A26 | B4                          | C4 |
|                                                                                                                                                                                                                                                      | A30 | B5                          | C6 |
|                                                                                                                                                                                                                                                      | A31 | B6                          | C7 |
|                                                                                                                                                                                                                                                      |     | B7                          | C8 |
|                                                                                                                                                                                                                                                      |     | B8                          |    |
|                                                                                                                                                                                                                                                      |     | B9                          |    |
|                                                                                                                                                                                                                                                      |     | B10                         |    |
|                                                                                                                                                                                                                                                      |     | B11                         |    |
| To understand the fundamentals involve when learning about chromosome and familiar with the basic methodology employed for the study of chromosomes.<br>Tools for cytogenetics.                                                                      | A1  | B1                          | C1 |
|                                                                                                                                                                                                                                                      | A2  | B2                          | C2 |
|                                                                                                                                                                                                                                                      | A11 | B3                          | C3 |
|                                                                                                                                                                                                                                                      | A16 | B5                          | C4 |
|                                                                                                                                                                                                                                                      | A30 | B6                          | C6 |
|                                                                                                                                                                                                                                                      | A31 | B11                         | C7 |
|                                                                                                                                                                                                                                                      |     | B13                         | C8 |
| Search and use of different literature and databases that allow carrying out the scientific approach to a topic related to chromosomes sources, organization, function and evolution.<br>Management information sources of interest in cytogenetics. | A29 | B3                          | C1 |
|                                                                                                                                                                                                                                                      |     | B8                          | C2 |
|                                                                                                                                                                                                                                                      |     | B9                          | C3 |
|                                                                                                                                                                                                                                                      |     | B10                         | C4 |
|                                                                                                                                                                                                                                                      |     | B13                         | C6 |
|                                                                                                                                                                                                                                                      |     |                             | C7 |
|                                                                                                                                                                                                                                                      |     |                             | C8 |

| Contents                                                         |                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                            | Sub-topic                                                                                                                                                                                                                                                           |
| Topic 1. Organization and structure of the eukaryotic chromosome | O DNA no cromosoma: DNA de copia única, DNA moderadamente repetitivo, DNA altamente repetitivo, secuencias esenciais: CEN, TEL e ARS.<br>A proteínas cromosómicas: histonas e non histonas. Tipos, modificacións e funcións.                                        |
| Topic 2. From chromatin to metaphase chromosome                  | Organización da cromatina en interfase: o nucleosoma, a fibra fundamental, os bucles e as SARs.<br>Os territorios cromosómicos.<br>Organización do cromosoma en metafase: condensinas e andamio de proteínas non histónicas.<br>Tipos de cromatina.<br>O cariotipo. |
| Topic 3. The longitudinal differentiation of chromosomes         | O bandeo de cromosomas. Tipos de bandas.<br>Significado estrutural e funcional das bandas.<br>As isocoras.                                                                                                                                                          |



|                                                         |                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic 4. Chromosome replication and transcription       | Ciclo celular e replicación.<br>Replicación da cromatina e acoplamento das histonas.<br>A transcripción da fibra de cromatina: eucromatina e heterocromatina.<br>Os cromosomas plumosos e os cromosomas politénicos.                                                                                                                                      |
| Topic 5. Mitosis and changes in cell division           | Características principais da mitosis<br>Intercambio entre cromátidas<br>Control da separación de cromátidas irmáns                                                                                                                                                                                                                                       |
| Topic 6. Meiosis and changes of chromosome behaviour    | Características principais da meiosis<br>Complexos sinaptonémicos<br>Recombinación e nódulos de recombinación<br>Os quiasmas: frecuencia e distribución<br>Segregación cromosómica e cromatídica                                                                                                                                                          |
| Topic 7. Chromosome sex determination                   | Sistemas cromosómicos de determinación do sexo<br>A haplodiploidía.<br>Heterocromatinización e sexo.<br>Orixen dos cromosomas sexuais                                                                                                                                                                                                                     |
| Topic 8. Structural chromosome changes                  | Delecions: clases e orixen. Consecuencias xenéticas<br>Duplicacions: clases, orixen, consecuencias e relevancia no proceso evolutivo.<br>Inversions: clases, orixen, comportamento meiótico, consecuencias e relevancia no proceso evolutivo.<br>Translocacions: clases, orixen, comportamento meiótico, consecuencias e relevancia no proceso evolutivo. |
| Topic 9. Poliploidy, haplodiploidy and aneuploidy       | Orixen, identificación, tipos, comportamento meiótico, consecuencias, e importancia evolutiva.<br>Os cromosomas B<br>Amplificación xénica                                                                                                                                                                                                                 |
| Topic 10. Methodologies and development of technologies | Hibridación in situ fluorescente.<br>Cariotipos espectrales.<br>Citometría de fluxo.<br>Microdissección e microclonación de cromosomas ou bandas cromosómicas.                                                                                                                                                                                            |
| Laboratory practices                                    | 1. Cultivos celulares e obtención de cromosomas metafásicos<br>2. Inducción de bandas cromosómicas e estudo da actividade NOR<br>3. Elaboración de cariotipos                                                                                                                                                                                             |

| Planning                        |                                                                          |                      |                               |             |
|---------------------------------|--------------------------------------------------------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests           | Competencies                                                             | Ordinary class hours | Student's personal work hours | Total hours |
| Guest lecture / keynote speech  | A1 A2 A11 B2 B3 B6<br>B8 B9 B10                                          | 21                   | 52.5                          | 73.5        |
| Laboratory practice             | A11 A16 A26 A29<br>A30 A31 B1 B3 B4 B5<br>B7 B13 C1 C2 C3 C4<br>C6 C7 C8 | 14                   | 28                            | 42          |
| Mixed objective/subjective test | A11 B2 B3 B8                                                             | 1.5                  | 0                             | 1.5         |
| Workbook                        | B1 B3 B5 B6 B9 B10                                                       | 0                    | 6                             | 6           |
| Practical test:                 | A11 A16 A26 A30<br>A31 B1 B2 B7 B8 C1<br>C3                              | 1                    | 0                             | 1           |
| Oral presentation               | B1 B2 B3 B5 B8 B9<br>B10 B11                                             | 5                    | 17                            | 22          |



|                                                                                                                                 |  |   |   |   |
|---------------------------------------------------------------------------------------------------------------------------------|--|---|---|---|
| Personalized attention                                                                                                          |  | 4 | 0 | 4 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. |  |   |   |   |

| Methodologies                   |                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                   | Description                                                                                                                                                                                                                                                                                                                                                                                                       |
| Guest lecture / keynote speech  | Nas clases maxistras o profesor explicará os contidos fundamentais de cada tema do programa e sinalará as actividades asociadas a este. Estas incluírán a consulta de bibliografía, a resolución de boletíns de cuestións e problemas, ou a elaboración dun traballo que o alumno deberá elaborar en grupo ou individualmente.                                                                                    |
| Laboratory practice             | Laboratory practices related to the development of chromosomes and karyotypes were developed. It will be know the cell cultures, making the karyotype and develop some method of chromosome banding.                                                                                                                                                                                                              |
| Mixed objective/subjective test | A proba mixta consistirá en preguntas curtas ou de tipo test e resolución de problemas.                                                                                                                                                                                                                                                                                                                           |
| Workbook                        | O alumno leerá un ou dos artigos científicos para ampliar e profundizar nos contidos tratados no temario, e que exporán na presentación oral.                                                                                                                                                                                                                                                                     |
| Practical test:                 | Se valorará os coñecementos adquiridos durante as prácticas de laboratorio.                                                                                                                                                                                                                                                                                                                                       |
| Oral presentation               | Consistirá na exposición oral de un ou dos artigos científicos, acompañada de una presentación en power point, que posteriormente aloxaráse na plataforma Moodle da materia, para a súa consulta de cara a completar ou ampliar contidos da materia. A exposición será de un máximo de 10-12 minutos. Esta actividade realizarase por parellas. Ambos membros do grupo deben repartirse a exposición do traballo. |

| Personalized attention                                                                                    |                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies                                                                                             | Description                                                                                                                                                                                                                                                                           |
| Guest lecture / keynote speech<br>Oral presentation<br>Workbook<br>Laboratory practice<br>Practical test: | Throughout the course, the teacher will be available during the hours of interactive lectures, group tutorials / small group and individual tutoring for answering questions, guiding the development of seminars / group work and all matters related to the organization of matter. |

| Assessment                      |                                                                          |                                                                                                                                                                                                                                                                                          |               |
|---------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies                                                             | Description                                                                                                                                                                                                                                                                              | Qualification |
| Mixed objective/subjective test | A11 B2 B3 B8                                                             | Avaliarase mediante unha proba obxectiva os coñecementos adquiridos durante as clases expositivas e as clases en grupo interactivo.                                                                                                                                                      | 40            |
| Oral presentation               | B1 B2 B3 B5 B8 B9<br>B10 B11                                             | Avaliarase a exposición oral e a presentación en power point do traballo realizado polo alumno tendo en conta a capacidade para extraer o máis relevante dos artigos científicos empregados, a capacidade de traballar en grupo, a expresión oral e corporal, e a capacidade de síntese. | 25            |
| Laboratory practice             | A11 A16 A26 A29<br>A30 A31 B1 B3 B4 B5<br>B7 B13 C1 C2 C3 C4<br>C6 C7 C8 | Take into account the interest to learn techniques on chromosomes, skill in the laboratory experiments ability to solve chromosomes and the attitude and ability to function in the laboratory.                                                                                          | 20            |
| Practical test:                 | A11 A16 A26 A30<br>A31 B1 B2 B7 B8 C1<br>C3                              | Se valorará os coñecementos adquiridos durante as prácticas de laboratorio.                                                                                                                                                                                                              | 15            |

| Assessment comments |
|---------------------|
|---------------------|



Laboratory practices are mandatory.

To pass the subject, the student must obtain at least 50% of the score assigned to the mixed test and another 50% of that of the laboratory practices. It will be considered NOT PRESENTED when the student has not participated in more than 20% of the scheduled assessable activities. This criterion applies to the January call. In the July call, to obtain the grade NOT PRESENTED, it will be enough to not appear for the objective tests (theory and practical exams).

For the evaluation of the July call, the student, in addition to the theory and practical exams, must present the bulletins of solved problems and the power point presentation of the oral presentation. In the event that these last two activities were already evaluated in the January call, the grade obtained will remain for July.

For students with part-time dedication and exemption from attendance, the teacher will adopt the measures that he deems appropriate to avoid damaging her grade (flexibility in the delivery dates of the assessable activities). Instead of the oral presentation, these students will make a 2-3 page summary that must be delivered in pdf to the teacher for evaluation.

The fraudulent performance of tests or assessment activities will directly imply the application of current regulations in the UDC.

## Sources of information

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Pierce BA (2008). Genetics, a conceptual approach. New York, Freeman</li> <li>- Klug WS, Cummings MR (2011). Essentials of Genetics. San Francisco, Pearson</li> <li>- Pierce BA (2011). Fundamentos de Genética, conceptos y relaciones. Buenos Aires, Médica Panamericana</li> </ul> <p>Nesta materia, os profesores recomendarán artigos científicos de revisión, publicados recentemente, para que o alumnado dispoña de bibliografía e referencias actuais sobre cada un dos temas da materia. Os artigos estarán aloxados na plataforma moodle dende o primeiro día de clase.</p> |
| <b>Complementary</b> | <br />                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Recommendations

### Subjects that it is recommended to have taken before

Biology: Basic Levels of Organisation of Life I (Cells)/610G02007

Genetics/610G02019

Molecular Genetics/610G02020

### Subjects that are recommended to be taken simultaneously

### Subjects that continue the syllabus

### Other comments

Attendance at the master classes enables the treatment of doubts or questions that may arise in the course of the explanations, facilitating the understanding of the topics. The study must contemplate the habitual consultation of at least the recommended bibliography. Study and group work favors understanding and develops a critical spirit. Doubts and difficulties raised by any aspect of the subject must be resolved as soon as possible, raising them in face-to-face classes or attending individualized tutorials. Given that part of the recommended bibliography for this subject is in English, it is advisable to have knowledge of this language, at least at the level of comprehension of written texts. Green Campus Program Green Campus Program of the Faculty of Sciences To help achieve a sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Sciences (2020)", the documentary works carried out in this matter: to. They will be requested mainly in virtual format and computer support. b. If done on paper: - Plastics will not be used- They will be printed on both sides.- Recycled paper will be used- Drafts will be avoided.

(\*)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.