| Teaching Guide | | | | |
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| Identifying Data | | | | 2018/19 |
| Subject (*) | Plant Systematics: Phanerogamia | | Code | 610G02025 |
| Study programme | Grao en Bioloxía | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Graduate | 2nd four-month period | Third | Obligatory | 6 |
| Language | SpanishGalician | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Bioloxía | | | |
| Coordinador | Pimentel Pereira, Manuel | E-mail | m.pimentel@udc.es | |
| Lecturers | Pimentel Pereira, Manuel<br>Sahuquillo Balbuena, Elvira | E-mail | m.pimentel@udc.es<br>elvira.sahuquillob@udc.es | |
| Web | | | | |
| General description | We will integrate information on the morphology, anatomy, reproductive biology and ecology of Spermatophytes in order to understand the processes that led to their evolutionary origin and current diversity. We will also study some of the most ecologically and economically important seed plant families in temperate areas of the Northern Hemisphere, and the plant formations where they most commonly appear (forests, shrublands, grasslands and marginal habitats). By the end of the course you will have a thorough understanding of the evolution of seed plants and you will be able to identify specimens belonging to the main plant families growing in NW Iberian Peninsula. The knowledge acquired during this course is useful in many different professional fields such as teaching, scientific research, environmental assessment, agriculture, etnobotany, etc. | | | |

| Study programme competences | |
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| Code | Study programme competences |
| A1 | Recoñecer distintos niveis de organización nos sistemas vivos. |
| A2 | Identificar organismos. |
| A4 | Obter, manexar, conservar e observar especímenes. |
| A6 | Catalogar, avaliar e xestionar recursos naturais. |
| A7 | Reconstruír as relacións filogenéticas entre unidades operacionales e pór a proba hipóteses evolutivas. |
| A9 | Identificar e utilizar bioindicadores. |
| A11 | Identificar e analizar material de orixe biolóxica e as súas anomalías. |
| A19 | Analizar e interpretar o comportamento dous seres vivos. |
| A20 | Muestrear, caracterizar e manexar poboacións e comunidades. |
| A22 | Describir, analizar, avaliar e planificar o medio físico. |
| A23 | Avaliar o impacto ambiental. Diagnosticar e solucionar problemas ambientais. |
| A26 | Deseñar experimentos, obter información e interpretar os resultados. |
| A27 | Dirixir, redactar e executar proxectos en Bioloxía. |
| A29 | Impartir coñecementos de Bioloxía. |
| A30 | Manexar adecuadamente instrumentación científica. |
| A31 | Desenvolverse con seguridade nun laboratorio. |
| A32 | Desenvolverse con seguridade no traballo de campo. |
| B1 | Aprender a aprender. |
| B2 | Resolver problemas de forma efectiva. |
| B3 | Aplicar un pensamento crítico, lóxico e creativo. |
| B5 | Traballar en colaboración. |
| B8 | Sintetizar a información. |
| B9 | Formarse unha opinión propia. |
| B10 | Exercer a crítica científica. |

| Learning outcomes | | | |
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| Learning outcomes | Study programme competences | | |
| -Understand the taxonomic arrangement of seed plants that mirrors the evolutionary relationships among the different plant groups. | A1<br>A2 | B1<br>B2<br>B3<br>B8<br>B10 | |
| -Learn how to manage the different sources of information available (bibliography, internet, etc) in an adequate and critical manner. | A22<br>A27 | B8<br>B10 | |
| Understand the life cycles of the different groups of Spermatophytes, as well as the links among them and with their precursors. | A1<br>A2 | B1<br>B2<br>B3<br>B8 | |
| Understand the evolutionary processes that have led to the current diversity of Spermatophytes. | A1<br>A2<br>A7<br>A19 | B3<br>B9 | |
| -Acquire observation, description and identification skills focused on the seed plants, particularly on those groups that are more ecologically and economically important. | A1<br>A2<br>A4<br>A6<br>A9<br>A11<br>A20<br>A30<br>A31<br>A32 | B2<br>B3<br>B5 | |
| -Learn the basic methods to study seed plant species and communities in the field and in the laboratory. | A2<br>A4<br>A6<br>A11<br>A20<br>A23<br>A26 | B2<br>B3<br>B5<br>B8 | |
| -Encourage the students to learn and research more on the diversity of seed plants, especially those groups that grow around them and are important in NW Iberian Península. | A29<br>A31<br>A32 | B1<br>B2<br>B3<br>B8 | |

| Contents | |
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| Topic | Sub-topic |

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| Lectures. Part I. Plant Evolution | Unit 1 - Alternating life cycles in the green lineage: From mosses to seed plants.<br>Unit 2 - The megasporangium, the ovule and the seed. Homologies across the different alternating life cycles.<br>Unit 3 - Taxonomy of land plants with alternating life cycle. The concept of plant species. Morphological taxonomy and phylogeny.<br>Unit 4 - Palaeoecology of the earliest land plants. Rhynie and the fossil forest of Gilboa. Main floristic transitions between the Palaeozoic, Mesozoic and Cenozoic.<br>Unit 5 ? Biological innovations of Gymnosperms and Angiosperms. Bases of seed plant biodiversity.<br>Unit 6 - Plan Evolution Mechanisms. Reticulate evolution. Asexual reproduction, hybridization and polyploidization. Self-pollination and cryptic speciation. |
| Lectures. Part II. Pollination and dispersal | Unit 7 ? Pollination. Mutualism and parasitism in pollination. Pollination systems and plant biodiversity.<br>Unit 8 ? Pollination in Gymnosperms. Adaptations to anemophyly in Gymnosperms and alternate pollination systems. Diversity of Gymnosperms. The Anthophyta theory.<br>Unit 9 ? Angiosperms and their pollination. Totally or partially anemophylous Angiosperms. Salicaceae, Fagaceae and Betulaceae.<br>Unit 10 ? Zoophyly in angiosperms. Adaptations to zoophyly in some plant families common in NW Iberian Peninsula. Asteraceae, Ericaceae, Fabaceae, Lamiaceae and Rosaceae.<br>Unit 11 ? Other mechanisms of pollen dispersal. Marine angiosperms.<br>Unit 12 ? Dispersal in Gymnosperms and Angiosperms. Adaptations to anemochory and zoochory. |
| Lectures. Part III. Agriculture | Unit 13 ? Agriculture: Growing and domesticating. Domestication syndromes. Bottlenecks, selection, hybridization and polyploidization.<br>Unit 14 ? The grasses and their domestication processes. The domestication of wheat and rice. Domestication in other economically important families: Solanaceae, Brassicaceae and Apiaceae. |
| Lectures. Part IV. Biogeography | Unit 15 ? Floristic kingdoms. Phytochorology: distribution areas. Potential vegetation and vegetation series. Endemic, rare, threatened and invasive plants. |
| Seminars (2 hours) | Seminar 1: Gymnosperms: compared analysis of their life cycles. Basic concepts on Gymnosperms. The students will take a test on the diversity and characteristics of Gymnosperms.<br>Seminar 2: Angiosperms: study of their life cycle. Compared analysis of the life cycles of angiosperms, gymnosperms and heterosporous ferns. The students will take a test on the life cycles of angiosperms, gymnosperms and heterosporous ferns<br>Seminar 3: Angiosperms. Compared analysis among the most important families in herbaceous, shrubby and forest plant communities in NW Iberian Peninsula.<br>Seminar 4: Angiosperms. Study of economically important plant families. Analysis of plant groups adapted to extreme environments. Biogeography and plant conservation. |
| Fieldwork | Seed plant diversity in Galicia. We will observe plant diversity in areas that are especially important due to their endemicity, the rarity of their flora, etc. |

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| Laboratory sessions | Lab session 1. Phylogenetic analysis. Build a small phylogenetic tree of cultivated and wild wheats.<br>Lab session 2. Gymnosperms diversity. Identification, structure and comparative analysis of female cones from Subclass Ginkgoidae and Pinoideae (Families Taxaceae, Pinaceae, Cupressaceae -including Taxodiaceae-).<br>Lab session 3. Classification of fruits. Flowers, Inflorescences and Fruits.<br>Lab session 4. Angiosperms diversity I. Forest trees. F. Fagaceae, Betulaceae, Salicaceae, Oleaceae, Adoxaceae/Caprifoliaceae. Identification, structure and analysis of pollination and/or dispersal.<br>Lab session 5. Angiosperm diversity II. Shrubs. F. Fabaceae, Ericaceae, Cistaceae, Rosaceae, Lamiaceae. Identification, structure and analysis of pollination and/or dispersal.<br>Lab session 6. Angiosperm diversity III. Herbs (Rosidae, eu-dicots). F. Apiaceae, Caryophyllaceae, Asteraceae, Euphorbiaceae, Primulaceae. Identification, structure and analysis of pollination and/or dispersal.<br>Lab session 7. Angiosperm diversity IV. Herbs (Lilianae, monocots). Asphodelaceae, Poaceae, Juncaceae, Alliaceae, Iridaceae. Identification, structure and analysis of pollination and/or dispersal. |
| Learning-service | The students will acquire some of the skills programmed in the course through collaborative research work with NGOs. This activity is organised as alternative to the Projects described below. |
| Projects | Two projects will be carried out. Both projects will focus on the study of different morphological, biological and evolutionary traits of the spermatophytes. Special attention will be paid to plant diversity in NW Iberian Peninsula.<br>This task is organised as alternative to the learning-service described above. |

| Planning | | | | |
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| Methodologies / tests | Competencies | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | A1 A7 A11 A19 B1 B2 B3 B8 B9 B10 | 21 | 46.5 | 67.5 |
| Seminar | A7 A9 B1 B2 B3 B8 B9 B10 | 7 | 11.5 | 18.5 |
| Laboratory practice | A2 A4 A6 A9 A11 A30 A31 B1 B3 B5 | 14 | 7 | 21 |
| Field trip | A1 A2 A9 A19 A20 A23 A32 B1 B2 | 7 | 0 | 7 |
| Supervised projects | A22 A23 A26 A27 A29 A32 B3 B8 | 0 | 17 | 17 |
| Case study | A22 A23 A26 A27 A29 A32 B3 B8 | 0 | 17 | 17 |
| Personalized attention | | 2 | 0 | 2 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | | |

| Methodologies | |
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| Methodologies | Description |
| Guest lecture / keynote speech | All basic concepts and ideas will be explained during the 50 minutes-long lectures. Lessons have been planned so students can acquire the required knowledge gradually. The teachers will use power point presentations that will be available in the moodle platform. Attendance is not compulsory, but it is strongly recommended. |

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| Seminar | Seminars are intended to reinforce the knowledge acquired during lectures. All basic concepts will be revised during seminars using different exercises, mostly tests and ?mute-diagrams? representing the life cycles of the different plant groups under study. Attendance and participation in seminars are compulsory. |
| Laboratory practice | The students will analyse and manipulate different representatives of some of the families studied during lectures. In the laboratory sessions, the students will use identification keys and floras to identify the plants brought by the teachers. They will also analyse the different characters that highlight the adaptation of the specimens to the environments ?and ecosystems- where they grow. |
| Field trip | A one day-long field trip guided by the teachers will take place towards the end of the semester. During the field trip, representatives of some of the families studied in lectures will be observed, together with the environments where they grow. Additionally, we will visit some of the areas of Galicia where the level of endemicity is higher, and we will analyse the mechanisms that have led to such endemicity. Attendance to the excursion is voluntary. |
| Supervised projects | This acivity has been designed within a learning-service framework. Here we combine students' academic activities with collaboration with environmentalist NGOs involved in plant conservation in Galicia.<br>The students will choose between this learnig-service program or the more traditional Case studies explained below. The number of hours of personal work is identical in both activities (34 hours). |
| Case study | The students will apply the knowledge acquired during lectures and laboratory sessions in two different projects (phylogenetic and floristic). Detailed instructions on how to carry out the projects will be given during seminars, and further guidance will be given through tutorial sessions with the lecturers.<br><br>The students will choose between the learnig-service (supervised projects) program or these more traditional case studies. The number of hours of personal work is identical in both activities (34 hours). |

| Personalized attention | |
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| **Methodologies** | **Description** |
| Laboratory practice<br>Field trip<br>Seminar<br>Case study<br>Guest lecture / keynote speech<br>Supervised projects | All students are welcome to consult the teachers any doubt that might arise from the different activities included in the course. |

| Assessment | | | |
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| **Methodologies** | **Competencies** | **Description** | **Qualification** |
| Laboratory practice | A2 A4 A6 A9 A11 A30 A31 B1 B3 B5 | The students will have to answer a written test per each laboratory session. Tests will be handed over at the end of each session. Once all the laboratory sessions are over, all students will have to take a visu exam. Each student will have to recognise 10 species from a list of 75 that will be given to the students at the beginning of the semester. The list includes some of the most common species in the NW Iberian Peninsula.<br><br>The following competencies will be assessed:<br>-A2, A4, A6, A9, A11, A30, A31, B1, B3, B5 | 15 |
| Field trip | A1 A2 A9 A19 A20 A23 A32 B1 B2 | Attendance and participation will be valued<br><br>The following competencies will be assessed:<br>-A1, A2, A9, A19, A20, A23, A32, B1, B2 | 1 |

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| Seminar | A7 A9 B1 B2 B3 B8 B9 B10 | Attendance and participation will be valued<br><br>The following competencies will be assessed:<br>A7, A9, B1, B2, B3, B8, B9, B10 | 1 |
| Case study | A22 A23 A26 A27 A29 A32 B3 B8 | The quality, originality and clarity of the projects will be considered in the final grade.<br><br>This activity and the supervised projects (aka learning service; explained above) are mutually exclusive. The result obtained in this task represents 34% of the final grade.<br><br>The following competencies will be assessed:<br>-A23, A27, A29, A32, B3, B8 | 17 |
| Guest lecture / keynote speech | A1 A7 A11 A19 B1 B2 B3 B8 B9 B10 | All students will have to take a written exam that will include multiple choice questions, short answer questions and essay questions.<br><br>The following competencies will be assessed:<br>-A1, A7, A11, A19, B1, B2, B3, B8, B9, B10 | 49 |
| Supervised projects | A22 A23 A26 A27 A29 A32 B3 B8 | This activity and the case studies (explained below) are mutually exclusive. The result obtained in this task represents 34% of the final grade. Reports will be graded based on quality and usefulness. The staff of the NGOs involved in the activity will be heard regarding the correction of the report.<br><br>The following competencies will be assessed:<br>-A23, A27, A29, A32, B3, B8 | 17 |

**Assessment comments**

All students will have two chances for passing the course. To use the first chance, the students will need to participate in at least 70% of the activities. Also, the students will need to get at least 4,0 out of ten points in the written exam, the laboratory sessions (including the visu test) and the projects (case study and learning service) for these parts to be considered for the final grade. To pass the course, students will need an average grade of 5.0.
In order to be qualified as "not present" the students should not participate in activities that account for more than 30% of the final qualification.
In the second chance students will need to improve their grades in the different parts (written exam, visu exam and projects) until they earn a 5.0. Parts graded with less than 4.0 will always have to be repeated. In this second chance, the visu exam will include 15 plants from the list.
Qualifications obtained in the different activities (projects, laboratory, etc) will NOT be kept from one year to the next.
Part-time students or students who participate in equality and diversity support programs are welcome to participate in this subject. The teachers will adapt the different compulsory activities in order to enable these students to fulfill the aims of the course.

**Sources of information**

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|---|---|
| Basic | Contenidos teóricos: CARRIÓN, J.S. (2003). Evolución vegetal. DM editores. Murcia.DEVESA, J.A. & CARRIÓN, J.S. (2012).Las Plantas con Flor. Servicio de Publicaciones de la Universidad de Córdoba. Córdoba.FONT QUER, P. (1985). Diccionario de botánica . Labor, Barcelona. FRIIS, E.M.; CRANE, P. & PEDERSEN, K.R. (2011). Early flowers and angiosperm evolution. Cambridge University Press. Cambridge.GLOVER, B. (2007). Understanding flowers and flowering. An integrated approach. Oxford Biology. Oxford.GREGORY, T.R. (2008). Understanding evolutionary trees. Evolution: Education & Outreach 1: 121-137. JUDD, W.S.; CAMPBELL, C.H.; KELLOG, E.A.; STEVENS, P.F. & DONOGHUE, M.J. (2008). Plant Systematics. A phylogenetic approach. Sinauer Associates. Sunderland.MAUSETH, J.D. (2003). Botany. An introduction to Plant Biology. Jones & Bartlet. Sundbury.MORRIS, D.W.; MORRIS, M.Z. (2002). English-Spanish Dictionary of Plant Biology. Cambridge International Science Publishing. Cambridge. ROST, T.L.; BARBOUR, M.G.; STOCKING, C.R.; MURPHY, T.M. (2006). Plant Biology. Thomson Brooks/Cole. Belmont.SIMPSON, M.G. (2010). Plant Systematics. Elsevier. AmsterdamVARGAS, P.; ZARDOYA R. (2012). El árbol de la vida: sistemática y evolución de los seres vivos. Sinauer. Sunderland. Prácticas: AIZPURU,I.; ASEGINOLAZA, C.; URIBE-ECHEBERRÍA, P.M.; URRUTIA, P. & ZORRAKIN, I. (2000). Claves ilustradas de la Flora del País Vasco y territorios limítrofes . Servicio Central de Publicaciones del Gobierno Vasco. CASTROVIEJO, S. et al (2001) Claves de Flora Ibérica, vol. I . Real Jardín Botánico, Madrid. GARCÍA, X.R. (2008) Guía das plantas de Galicia . Xerais. GARCÍA ROLLÁN, M. 1996. Atlas clasificatorio de la Flora de España Peninsular y Balear . 2 Vols. Mundi Prensa, Madrid. LEMEY, P.; SALEMI, M. & VANDAMME, A.M. (2003). The phylogenetic handbook: a practical approach to phylogenetic analysis and hypothesis testing. Cambridge University Press. Cambridge. |
| Complementary | Teoría:IZCO, J.; BARRENO, E.; BRUGUÉS, M.; COSTA M.; DEVESA, J.; FERNÁNDEZ, F.; GALLARDO, T.; LLIMONA, X; SALVO, E; TALAVERA, S. & VALDÉS, B. (2004). Botánica. McGraw-Hill, Madrid.NABORS, M.W. (2005). Introducción a la Botánica. Pearson Educación. Madrid.RODRÍGUEZ IGLESIAS, F. (2005) Galicia Naturaleza. Botánica I. Hércules de Ediciones, S.A., A Coruña.SMITH, A.M.; COUPLAND, G.; DOLAN, L.; HARBERD, N.; JONES, J. et al. (2009). Plant Biology. Garland Science. New York.STRASBURGER, E., F. NOLL, H. SCHENCK & SCHIMPER A.F.W. (2004). Tratado de Botánica (actualizado por P. SITTE et al.) Omega, Barcelona.TAYLOR, T.N., TAYLOR, E.L., KRINGS, M. (2009). Paleobotany. Academic Press. Londres. Prácticas:BONNIER, G. & De LAYENS, G. (1993). Claves para la determinación de plantas vasculares. Omega, Barcelona.MANOBENS, R. Mª (1988) Botánica, instruccions per als recol-lectors de plantes: l'herbari. Preparació i documentació. Generalitat de Catalunya.MAYOR, M. & T.E. DÍAZ (2003) La flora Asturiana. Ayala, Oviedo. |

| Recommendations |
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| **Subjects that it is recommended to have taken before** |
| Biology: Basic Levels of Organisation of Life II (Tissues)/610G02008<br>Microscopic Organography/610G02009<br>Genetics/610G02019<br>Introduction to Botany: General Botany/610G02023<br>Plant Systematics: Cryptogamia/610G02024<br>Plant Physiology I/610G02027<br>Plant Physiology II/610G02028 |
| **Subjects that are recommended to be taken simultaneously** |
| Molecular Genetics/610G02020<br>Population Genetics and Evolution/610G02021<br>Applied Plant Physiology /610G02029 |
| **Subjects that continue the syllabus** |
| Botanical Geography: Geobotany/610G02026 |
| **Other comments** |

-Students should work regularly in the semester and they should use the recommended bibliography.-Biology students in their third year are generally very busy; they should try to finish their reports and activities as soon as possible.

-Students should communicate with the teachers regarding any doubts that might arise from the different activities of the course, especially the case studies and the learning service projects.