CONTENIDOS DEL CURSO Y BIBLIOGRAFÍA

El curso será impartido en inglés y español dependiendo del docente a cargo. En este programa los títulos de cada tema se indican en español y los contenidos en inglés a modo de referencia.

A. CONTENIDOS GENERALES

I. Morfología floral y taxonomía - *Louis Ronse de Craene (LRDC)*

1. Introduction to flower morphology
- Definition of flowers
- Floral organ identity
- Accessory structures
- Fruits

2. Description of floral structures
- Floral formulae
- Floral diagrams

3. Structural changes in flowers
- Phyllotaxis: spirals and whorls
- Merism
- Symmetry change
- Homeosis
- Floral tubes and hypanthia

4. Increased complexity and reduction
- Polyandry and polygyny
- Staminodes and stamen loss
- Pseudomonomery
- Organ loss and shifts of organs
- Reversals

5. Identifying major groups of plants with floral characters
- APG classification
- Characterization of major clades of flowering plants

6. Major evolutionary trends in angiosperms
- Changes in the floral ontogeny
- Convergent and parallel evolution
- Pseudanthia
- Petal evolution in the Pentapetalae

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Leins P, Erbar C (2010) Flower and fruit. Morphology, ontogeny, phylogeny, function and ecology. Stuttgart, Schweizerbart Scienc Publishers.
Ronse De Craene LP (2010) Floral diagrams. An aid to understanding floral morphology and evolution. Cambridge, Cambridge University Press.
Ronse De Craene L.P., Iwamoto A., Bull-Hereñu K., Dos Santos P., Luna-Castro J. and Farrar (2014). Understanding the structure of flowers – the wonderful tool of floral formulae: a response to Prenner & al. Taxon 63: 1103-1111.
Ronse De Craene L.P. (2016). Meristic changes in flowering plants: how flowers play with numbers. Flora 221: 22-37.

II. Biología de la polinización y la reproducción - *Regine Claßen-Bockhoff (RCB)*

1. Flowers as functional units
- Introduction to pollination biology
- Pollination and fertilisation
- Pollination by animals (zoophily), wind and water
- Flower-pollinator interaction: attraction, reward and deceipt
- Reproductive units: flowers, pseudanthia and inflorecences
- Floral syndromes and co-evolution
- Attracting animals
- Diversity of pollinators' bodies and cognitive capacities
- Scent, colour, shape

2. Flower rewards and deception
- Pollen
- Nectar and nectaries
- Fatty oils
- Parfumes
- Egg deposition place
- Mimicry
- Traps
- Sexual deception

3. Flower- pollinator interactions
- Floral syndromes
- Pollinator groups
- Selected pollination mechanisms

4. Beyond flowers - the plant as a reproductive unit
- Introduction to reproduction biology
- Fitness
- Flower arrangement in space: basic inflorescence types

Phenology, flowering sequence and floral display
Perfect flowers and sex separation: monoecy, dioecy
Reproductive systems
Breeding systems: autogamy, geitonogamy, xenogamy
Promotion of outcrossing: herkogamy, dichogamy

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Leins P, Erbar C. 2010. Flower and fruit. Morphology, Ontogeny, Phylogeny, Function and Ecology. Schweizerbart, Stuttgart
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Richards AJ. 1997. Plant Breeding Systems. 2nd edit. London: Chapman & Hall.
Vogel S. 1954. Blütenbiologische Typen als Elemente der Sippengliederung. Jena: Fischer. (English translation 2002: Floral-biological syndromes as elements of diversity within tribes in the flora of South Africa. Shaker, Aachen).
Wester P, Lunau L. 2017. Plant-pollinator communication. Advances in Botanical Research 82: 225-257 https://doi.org/10.1016/bs.abr.2016.10.004

III. Anatomía floral - *Paulette I. Naulin (PIN)*

1. Flower evolutive context
Flower ontogenetic origin
Tissue of sterile whorls (sepals and petals)

2. Tissue of fertile whorls (androecium and gynoecium)
Relationship between flower and fruit tissues

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Dickson, W. C. 2000. Integrative plant anatomy. San Diego. HP Harcourt.
Gurevitch, J., Scheiner, S. M., & Fox, G. A. 2006. The ecology of plants. Sinauer associates incorporated.
Raven, P. H., Evert, R. F., & Eichhorn, S. E. 2013. Biology of plants. W. H. Freeman and Company.
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Taiz, L., & Zeiger, E. 2010. Plant Physiology. Sinauer associates incorporated.

B. CONTENIDOS ESPECÍFICOS

IV. Dibujo botánico en el campo - *Joao Felipe Ginefra Toni (JT)*

The workshop invites the participant to develop observational skills and to recognize specific changes in floral structures over time. Botanists like Humboldt, Goethe and Martius also performed attentive and accurate drawings in the field during scientific journeys as an important tool for their research in plant morphology. The relevance of Anschauung (Seeing) in morphological studies will be discussed. As Goethe has already distinguished; there is a great difference between “seeing” and seeing. The former can only grasp static representations of living structures reduced into abstract explanations based on genetic and/or environmental

determinism. On the other hand, seeing in a Goethean morphological sense means, through direct and exact observation, to grasp in a dynamic or process- oriented way the unity that underlies the multiplicity of morphemes (unity in multiplicity), and by so doing, conversely, to see how such multiplicity originates out the whole or unity (multiplicity in unity). Therefore, focus will be given to species which have different developmental stages in the field, because such drawing exercise should be not only about representing a structure with lines on a paper but also about training cognitive skills such as exact sensorial imagination, memory and aesthetic appraisal in order to reconstruct as vividly as possible the developmental stages that a given plant goes through. Thus, by practicing botanical drawing we could learn in which sense our thinking becomes a mode of seeing and our seeing a way of thinking in the study of flowers.

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Ginefra Toni, J. F. (2018): On the origins and renaissance of Goethe's Morphology. Elemente der Naturwissenchaft 108:5-21.
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Holdrege, C. (2005): Doing Goethean science. Janus Head 8:27–52.
Ronse De Craene, L. P. (2010): Floral diagrams. An aid to understanding flower morphology and evolution. Cambridge

V. Bauplan floral en monocotiledóneas - *Akitoshi Iwamoto (AI)*

The floral Bauplan of monocots, pentacyclic flower are remarkably shared in monocots. But, the origin of floral Bauplan remains controversial. I will explan what is the floral Bauplan of monocots and discuss its origin using the results of studies on floral developments of both of basal monocots and basal angiosperms. I'll also refer to the results of our article of JPR about the floral development of Alismatales.

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Ronse De Craene L, Smets EF (1995) The androecium of monocotyledons. Monocotyledons Syst Evol 1:243–254
Akitoshi Iwamoto, Ayaka Nakamura, Shinichi Kurihara, Ayumi Ohtani and Louis P. Ronse De Craene (2018) Floral development of petaloid Alismatales as an insight into the origin of the trimerous Bauplan in the flower of the Monocots Jour Plant Res 131: 395–407

VI. Estructura floral en Sapindales del Neotrópico - *Juliana Hanna Leite El Ottra (JLO)*

-Current issues in the systematics of Sapindales
-Comparative floral structure of neotropical representatives of Rutaceae, Simaroubaceae and Meliaceae
-Floral sexuality in Meliaceae representatives: structural *vs* functional sex

-Evolutionary pattern of nectary bearing structures and floral architecture in Sapindales

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Bachelier JB, Endress PK. 2009. Comparative floral morphology and anatomy of Anacardiaceae and Burseraceae (Sapindales), with a special focus on gynoecium structure and evolution. *Botanical Journal of the Linnean Society* 159: 499–571.
Bachelier JB, Endress PK, Ronse de Craene, L. 2011. Comparative floral structure and development of Nitrariaceae (Sapindales) and systematic implications. In: Wanntorp L, Ronse de Craene L, eds. *Flowers on the tree of life.* Cambridge: Cambridge University Press, 181–217.
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VII. Morfología de inflorescencias - *Kester Bull-Hereñu (KBH)*

-General diversity of inflorescences
-Ramification patterns and sequences of blooming
-Floral units and maristem fractionation
-Ontogenetic perspective for an inflorescence classification

Bibliography

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VIII. Diversidad morfológica floral en *Croton* (Euphorbiaceae) - *Pakkapol Thaowetsuwan (PT)*

Croton L. is a non-cyathial Euphorbiacean mega-diverse genus possibly comprising about 1,200 species, globally present in tropical and subtropical regions (one species presence in Chile). Flowers of Croton have many interesting features, e.g., various forms of inflorescence, complex trichome types, diverse stamen forms and number in male flowers. Inflorescences of Croton and related genera are diverse ranging from determinate racemes to indeterminate racemes, thyrses and panicles. Stamen forms were found to be highly different among different genera but within Croton the inflexed stamen is the most abundant. Stamen number in Croton is highly fluctuating but the presence of 11 stamens is found to be the most common and possibly the ancestral character of the genus.

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IX. Adaptaciones florales – *Patricia dos Santos (PDS)*

-Eco-evolution of flowers
-From strategy to diversification
-Adaptations to the environment
-Resource allocation to reproduction
-Plant longevity
-Flowering phenology
-Adaptations to pollination
-Biotic vs abiotic pollination syndromes
-Adaptations to pollen limitation
-Case studies

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X. Integración floral y diversificación morfológica en *Schizanthus* - *Javiera Chinga (JC)*

-Mechanisms of floral integration: pollinator-mediated selection and developmental factors
-Changes of integration along ontogeny (ontogenetic integration)
-Growth dynamics along ontogeny (ontogenetic allometry)
-Changes in ontogenetic integration and ontogenetic allometry underlying morphological evolution in Schizanthus' flowers.

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