



Environmental Signaling (ES-101)

From Phenomena to Mechanisms

Overall Course Objectives

Concept Knowledge

Students will be able to:

- Identify the parts and hormones of the endocrine system, and explain their inter-related functions
- Discuss pathological responses, differentiate them from normal states, and to weigh potential avenues for pharmacological treatment
- Describe cases of endocrine disruption, and identify their probable causes and mechanisms, and design investigations that could distinguish the true causes
- Describe natural products known to influence the endocrine system, and analyze the potential of these products for pharmaceutical interventions
- Identify the important structural features of steroid hormones, and explain the differences between chemical structure of endogenous, synthetic, and natural estrogen mimics
- Explain how the classical and fast-signaling pathway for estrogen signaling work.
- Explain the basics of epigenetics and how estrogen and other agents imprint genes.

Skills- Students will be able to:

- Read case studies, identify, investigate, and evaluate possible explanations for them.
Interpret and weigh evidence about research methods.
- Write explanations understandable to intelligent non-specialists, which synthesize original research results and cite scientific literature.
- Use current technology to convey and display information.

Students will be introduced to the concepts, phenomena and mechanisms of endocrine disruption through case studies and research articles. They will learn of the effects of endocrine disruption in wildlife and humans, and be introduced to the nutraceutical and pharmaceutical uses of natural estrogenic molecules.

The course will model the scientific method, leading to students to grapple with unexpected phenomena (e.g. pigs with disrupted reproduction, male frogs with ovaries, a generation of young women with a high rate of a rare cancer) and asked to hypothesize, investigate, and test alternative hypotheses. In this way it will prepare them for further work as scientists, and assist them in developing the important skills needed to evaluate information and communicate their ideas, using available technology to accomplish this.

Assessments of student progress

Class discussions will allow us to evaluate student progress towards objectives. Weekly assignments will include cases for students to read, investigate, and answer questions about. There will also be occasional reading assignments based upon research or review papers. This will allow us to evaluate student progress towards the objectives.

Formal Assessment

- Students will, as a group, come up with definitions to share online in a weblog the following terms: endocrine system; hormone; endocrine disruption; phytoestrogen; mycoestrogen; nuclear receptor; epigenetic.
- Students will, in small groups, explain how chemicals in the environment, either natural or synthetic, can influence the body's signaling and result in positive or harmful effects (or both). They will publish these explanations in a weblog.
- Students will, in small groups, design experiments that will examine the causes and mechanisms of endocrine disruption. They will publish descriptions of these investigations, and the reasoning behind them, in a weblog.
- Students will, individually, publish in a weblog a brief commentary (500-1000 words) with references, on a subject within the range of topics we cover. The commentary will provide a novel synthesis of or insight into previous research, or suggest a novel research approach or program to answer important questions.

Topic	Details
Case 1: Strange Happenings	Students examine some strange phenomena with people and animals around the world. They discuss what these events might have in common, and work to define endocrine disruption, phytoestrogen, describe how the endocrine system works, and how the idea of endocrine disruption developed.
Case 2: The Case of the Cross-Dressing Carp	Students watch a video about endocrine disruption and surface water contamination.
Case 3: DES: Endocrine Disruption Begins	Students learn about the discovery of DES's effects on the daughters of the women who took it, investigate how it was used in livestock, and read about government regulation of pharmaceutical chemicals
Case 4: Gloom and Doom	Students combine what they learned the previous sessions with news of human diseases from around the world. They critically examine the evidence that humans are being affected by endocrine disruption.
Case 5: The Mortician's Mystery	How do endocrine signals, which flow through the whole body in the circulatory system, affect only some tissues? Using a famous case Students learn about Nuclear Receptors, fast and classical estrogen signaling mechanisms, and turn and around and explain them in their writing assignments.
Case 6: Shape Matters	Students look at several "estrogenic" molecules using biochemical model kits to compare and look for similarities. An expert on biochemical structures to help us out, giving more details on the structure of both ligand and receptor. Students report the results of their investigations in their writing assignments.
Case 7: Contraceptive Encounters	Students investigate the basis of pharmacological interventions for contraception, either writing or acting out scenarios between doctors and patients.
Case 8: Marked for Disease	Students examine data suggesting that environmental exposure of a female can affect her daughters and grand-daughters. They will look for a mechanism to explain how this might work, and report about epigenetics in their writing assignments.
Case 9: Precocious Puberty	Students examine cases of precocious puberty, reversible and non-reversible results of chemical exposure to evaluate the importance of timing and development in endocrine disruption. They summarize and explain what they learn in writing assignments.
Case 10: Messing with Synthesis	Students examine the patterns of biosynthesis in steroidogenesis, and at the special positions of aromatase, and at how one enzyme can have multiple roles in the pathways.
Case 11: Why is Everything Estrogenic?	Students examine cases of estrogenic chemicals from all sorts of taxa, and cross-functional chemicals that are anti-fungal and estrogenic. With expert help they take a phylogenetic view of estrogenicity. They write about what they learned in assignments