

SUBJECT:

# HUMAN REPRODUCTION AND DEVELOPMENT

CREDITS:

Total: **6**

Theory: **3**

Practical: **3**

## SPECIFIC OBJECTIVES

- Develop skills in spoken, written and graphic communication related to the course content through the creation and presentation of posters and participation in the discussion forum.
- Develop the habit of consulting the bibliography.
- Develop the ability to give precise definitions and to identify the most suitable definitions from a glossary of terms corresponding to the subject.
- Develop the ability to accurately present and interpret graphs relating functional parameters.
- Develop the ability to establish cause-effect relationships between functional parameters.
- Develop the ability to identify and analyze microscopic preparations of the different organs of the reproductive system.
- Develop regular work patterns through continuous assessment.
- Develop critical reading abilities through the discussion forum.

The objectives outlined here appear in part in the Medical Physiology Curriculum Objective Project and can be consulted at the following address: <http://www.the-aps.org/education/MedPhysObj/medcor.htm>

The specific learning objectives are included in the *Teaching Guide* to the subject which will be distributed at the end of the first semester of the course.

## PROGRAMME

### Theory

#### 1. The reproductive system. Advantages of sexual reproduction

Diploidy and genetic diversification. Possibility of improving the function of genes and forming new ones. Evolution of complex and versatile organisms.

#### 2. Physiology of sexual differentiation.

Genetic sex, gonadal sex and phenotypic sex. Germinal cells: origin and migration. Genes involved in the development of the gonads: WT1, SF1, DAX-1. Sex determination and sexual differentiation. Implications of the Y chromosome and Sry gene in sex determination. Factors responsible for the differentiation of extragonadal reproductive structures. Importance of dihydrotestosterone (DHT).

#### 3. Male reproductive structures: the testicle

Differentiation of the male reproductive system and its components. General structure of the testicle. The testicular lobe. The seminiferous tubules. The seminiferous epithelium. Germinal cells. The seminiferous epithelial cycle.

Structure of the sperm cell. Structure of Sertoli cells. Interstitial tissue: structure of Leydig cells. Blood and lymph vessels. Testicular innervation.

#### 4. Male reproductive structures: spermatogenic pathways and accessory glands

Excretory ducts of the testicle: straight tubules and *rete testis*. Extratesticular spermatogenic pathways: efferent ducts, epididymis, deferent duct and ejaculatory ducts. The accessory glands of the male genitalia: seminal vesicles. Bulbourethral glands. The penis: erectile tissue.

## 5. Puberty

Concept and age. Adrenarche. Factors involved in the onset of puberty. Activation of the hypothalamus-hypophysis axis. Changes in the composition of the body. Development of the gonads. Sex hormones and sequence of development of secondary sexual characteristics. The effect of mutations in gonadotrophic genes and/or their receptors on the physiology of reproduction.

## 6. Testicular function

Functional organization and location of the testicle. Proliferation, differentiation and functions of Leydig cells, Sertoli cells and peritubular cells. Interdependence between the different types of testicular cells. Paracrine control. Spermatogenesis and spermiogenesis. Gene expression during spermatogenesis. Importance of transcriptome in the process of spermatogenic differentiation.

Hormonal control of spermatogenesis: FSH, LH and testosterone. Testicular regulation of gonadotrophin production. Maturation and capacitation of sperm cells.

## 7. Androgens

Biosynthesis and secretion of androgens. Precursors. Transformation of testosterone into dihydrotestosterone and estrogens. Plasma transport: transport proteins. Inactivation and elimination. Physiological actions and action mechanism. Plasmatic levels. Androgen receptor.

## 8. Female reproductive structures: the ovary.

Disposition and general structure during sexual maturity. Oogenesis. Morphological evolution of ovarian follicles. Ovulation. Formation and morphological evolution of the corpus luteum. Study of the ovarian cycle and its modifications.

## 9. Female reproductive structures: the oviduct, uterus and vagina

General structure of the Fallopian tubes. Histological organization and modifications of the mucosa during the ovarian cycle. General structure of the uterus: myometrium and endometrium, histological changes during the phases of the menstrual cycle. The uterine neck: structure of the endocervix and exocervix. Cervical mucus.

Histological structure of the vagina. Exfoliative cytology of the vaginal epithelium. External genital organs.

## 10. Ovarian function

The ovarian cycle: follicular phase, ovulation and luteal phase. Recruitment, selection and dominance during the follicular phase. Interrelations between granulosa and internal theca cells. Onset of ovulation and anovulatory cycles. Formation, activity and regression of the corpus luteum. Proliferative, secretory, ischemic and menstrual phases of the endometrium. Plasma variations in estrogens, progesterone and gonadotrophic hormones during the menstrual cycle. Ovary-hypothalamus-hypophysis interrelations.

## 11. Ovarian hormones

Biosynthesis and secretion of estrogens and progesterone. Plasma transport: transport proteins. Metabolites and removal. Physiological actions and action mechanism. Estrogen and progesterone receptors.

## 12. Physiology of sexual response.

Neural, vascular and endocrine mechanisms.

## 13. Psychology of sexual response.

## 14. The mammary gland

General structure and histological organization. Glandular lobes and their cyclical and sexual modifications. Changes during gestation and lactation. Development and differentiation. Hormonal control: estrogens, progesterone, prolactin, insulin and glucocorticoids. Transcription of genes that encode milk proteins. Biosynthesis of lactose. Lactogenesis and lactation. Composition of milk. Regression of the mammary gland.

## 15. The placenta

Fertilization and the first developmental states of the human embryo. Implantation of the blastocyst. Formation of the placenta. Structural and ultrastructural characteristics of the placental villi: mesenchyme, cytotrophoblast and syncytiotrophoblast. Decidual modification of the endometrium. Placental circulation. The placental barrier. Structure of the umbilical chord.

Functions of the placenta. The placenta as an endocrine organ. Physiological importance of the production of progesterone, CG and CRH. Foeto-placental unit.

## 16. Menopause

Concept, age and mechanism. Hormonal fluctuations and changes. Physiological consequences. Menopause and aging.

### **17. Physiology of human development: foetus, infancy, childhood and adolescence**

Development and growth: determining factors. Stages of development. Foetus: hepatic function, cardiovascular function, respiratory function and endocrine functions. Infancy: respiratory and cardiocirculatory adaptations, temperature regulation and metabolism. Childhood: renal function and hydroelectrolytic balance; metabolism and nutrition; neurological, sensory and motor development. Physiology of adolescence.

### **18. Physiology of human development: pregnancy**

Endocrine functions. Cardiovascular and respiratory adaptations. Renal function. Hepatic function. Metabolism.

### **19. Physiology of human development: aging**

Average survival. Maximum longevity. Aging. Factors determining maximum longevity. Vegetative functions and regulatory functions during aging. Mechanisms involved in aging. Aging and functional independence.

### **20. Physiology of human development: death**

Cell death and death of the body. Accidental death and physiological death. Causes of death. The process of death. Difficulties in defining death.

## **Practical training**

1. Study of the sections of the hypothesis: trichromal Masson staining and hematoxylin-eosin staining.
2. Menstrual cycle (interactive programme).
3. Self-assessment of cases presented.

## **LEARNING RESOURCES AND TEACHING METHODOLOGIES**

To achieve these course objectives students must attend both theory and practical classes and participate actively in study groups.

Students will have access to a website (<http://www.fisiologia.net>) and discussion forum as complementary materials for a part of the programme.