SUBJECT:	**STRUCTURE AND FUNCTION OF THE DIGESTIVE AND ENDOCRINE SYSTEMS, METABOLISM AND NUTRITION**					
CREDITS:	Total:	**13**	Theory:	**6.5**	Practical:	**6.5**

SPECIFIC OBJECTIVES

As the end of the course, the student should be able to:

- Understand and explain:
  - Microscopic structure of the different organs that make up the digestive system.
  - The participation of the digestive system in homeostasis and in the mechanisms that coordinate the functions of the digestive system.
  - The motor and secretory functions of the digestive system; regulation and cellular mechanisms involved.
  - The digestion process and absorption of food; regulation and cellular mechanisms involved.
- Identify and analyze microscopic preparations of the different organs of the digestive system.
- Analyze the results of functional examinations of the digestive system.
- Understand and explain:
  - The general organization of metabolic processes.
  - The metabolism of saccharides, lipids and proteins and the particular metabolic characteristics of different tissue types.
  - Metabolic interrelations between different tissue types.
  - The metabolic functions of the liver in homeostasis.
- Analyze the results of metabolic tests with clinical applications.
- Understand and explain:
  - The general organization of the hormone system.
  - The characteristics of cells involved in diffuse hormone secretion and, in particular, the diffuse neuroendocrine system.
  - The general structural characteristics of endocrine glands and the specific structural characteristics of the pancreas, suprarenals, thyroid, parathyroid, hypophysis and the hypothalamo-hypophyseal system.
  - The molecular structure of the different hormones.
  - The processes involved in the production, transport and metabolization and regulation of different hormones.
  - The physiological effects of different hormones and the action mechanisms involved.
- Identify and analyze histological preparations of the different endocrine glands.
- Analyze the results of functional examinations of the endocrine system.
- Know and explain:
  - The composition and functions of the different components of foods.
  - The determining factors of the caloric balance in the body.
  - The mechanisms that regulate the ingestion of foods.
  - The functions of nutrition and its relations with metabolic homeostasis.
- Obtain current information relevant to the different contents of the subject.
- Carry out detailed, independent research into the various topics covered in the course.
- Correctly relate the knowledge acquired on the various subject areas in oral, written and graphic work.

The specific learning objectives will be outlined topic by topic in the course *Teaching Guide* which will be distributed to students at the end of the first semester.

PROGRAMME

I. DIGESTIVE SYSTEM

1.1. Importance and functional significance of the digestive system in homeostasis.

Nutrient contribution: motor functions, secretory functions, digestion and absorption. Excretory functions. Defence functions.

HISTOLOGICAL ASPECTS

2.1 The oral cavity.

Histological organization of the lips and cheeks. The tongue: mucous and lingual papillae. Taste receptors: histophysiology.

2.2 The teeth.

Dental nomenclature. Histological structure of the teeth: dentine, enamel and cement. Soft parts of the tooth: dental pulp, peridontal membrane and gum. Alveolar bone. Odontogenesis.

2.3 Saliva glands.

General structure. Characteristics of the parotid, submaxillary and sublingual glands. Minor saliva glands in the buccal mucosa.

2.4 Pharynx and oesophagus.

The pharynx. Amygdala. General structure of the digestive tube: layers; vascularization; lymph vessels; lymphoid tissue; innervation. Suspensory folds. Histological structure of the oesophagus: oesophageal glands. Vascularization and innervation of the oesophagus. Histogenesis of the oesophagus.

2.5 The stomach.

Arrangement and morphology of the stomach layers. The heart and fundus regions: superficial epithelium and fundal glands. Mucosa cells, parietal cells and principal cells. Distribution of endocrine cells. Cardiac region: cardiac glands. Pylorus region: pyloric glands. Histogenesis of the stomach. Cell renewal and regeneration of the stomach.

2.6 The exocrine pancreas.

Concept and general structure of the pancreas. The exocrine pancreas: cytology of acinose and centreacinose cells. System of ducts. Histogenesis and regeneration of the pancreas.

2.7 The small intestine.

General layered structure of the small intestine. Structural specializations of mucous: intestinal villi and Crypts of Lieberkuhn. Cytology of the intestinal epithelium: enterocytes, calciform cells, Paneth cells, endocrine cells. Histological structure of the layers: *muscularis mucosae*, submucosal, muscular, serosal. Vascularization of the small intestine: Lymph vessels and lymphoid tissue. Innervation of the intestine: submucosal and myenteric folds. Regional differences in the small intestine.

2.8 The liver, biliary passages and biliary vesicle.

Morphology of the liver. Histological organization of the liver: The hepatic lobe. Blood circulation in the lobe: hepatic sinusoids. The hepatocyte: ultrastructure and function. Segmentation in the hepatic lobe. Connective tissue. Blood vascularization. Lymph vessels. Liver innervation. Hepatic regeneration. Intrahepatic bile ducts. Extrahepatic bile ducts. The biliary vesicle: histological structure. The choledocoduodenal junction: histological structure. Histogenesis of the liver and biliary pathways:

2.9 Histological structure of the large intestine.

Histological structure of: cecum, appendix, colon, rectum. The anorectal junction. Vascularization of the large intestine: Lymphoid tissue of the large intestine. Innervation of the large intestine: Histogenesis of the intestines. Cell renewal and regeneration.

COORDINATION OF DIGESTIVE SYSTEM FUNCTIONS

3.1 Mechanisms of synchronization of digestive system functions.

Enteric nervous system and vegetative nervous system. Endocrine and paracrine systems.

MOTOR FUNCTIONS

4.1 Mastication and deglution.

Functions of mastication. Regulation of mastication. Deglution mechanism. Oral, pharyngeal and oesophageal phases of deglution. Control of deglution; mechanisms involved.

4.2 Motor functions of the stomach.

Motility of the proximal stomach and distal stomach. Movements of the empty stomach and full stomach. Control of gastric motility. Regulation of gastric evacuation; mechanisms involved.

4.3 Motor functions of the small intestine.

Objectives of the motor activities in the small intestine. Types of movement. Control of intestinal motility; nervous and humoral mechanisms involved, reflexes.

4.4 Motor functions of the large intestine.

Objectives of the motor activities in the large intestine. Types of movement. Regulation mechanisms. Reflexes, defecation reflex.

4.5 Vomiting.

Functional significance of vomiting. Motor activities involved. Induction mechanisms.

SECRETORY FUNCTIONS

5.1 Saliva secretion.

Composition of saliva; organic and inorganic components. Functions of saliva. Mechanisms of saliva secretion. Regulation of saliva secretion; nervous and hormonal factors and mechanisms involved.

5.2 Gastric secretion.

Composition of gastric secretion; organic and inorganic components. Functions of gastric secretion. Mechanisms for production and secretion of HCI. Regulation of gastric secretion; nervous and hormonal phases and mechanisms involved.

5.3 Pancreatic secretion.

Composition of pancreatic secretion; organic and inorganic components. Functions of pancreatic secretion. Mechanisms involved in pancreatic secretion. Regulation of pancreatic secretion; nervous and hormonal phases and mechanisms involved.

5.4 Bile secretion.

Composition of bile secretion; organic and inorganic components. Functions of bile secretion. Enterohepatic circulation. Functions of the biliary vesicle. Mechanisms involved in bile secretion. Regulation of bile secretion; factors and mechanisms involved. Regulation of evacuation of the biliary vesicle. Excretion of bile pigments.

5.5 Intestinal secretion.

Composition of intestinal secretion. Functions of intestinal secretion. Mechanisms involved in intestinal secretion. Regulation of intestinal secretion; nervous and hormonal mechanisms involved.

INTESTINAL ABSORPTION

6.1 Absorption of water, inorganic compounds and vitamins.

General mechanisms of intestinal absorption. Absorption of water. Absorption of sodium, potassium, magnesium, chlorine, bicarbonate and phosphates. Absorption of iron and copper. Absorption of vitamins.

6.2 Digestion and absorption of saccharides.

Enzymes involved in digestion of saccharides; amylase, bacterial cellulases, oligosaccharidases, phosphatases. Stages in the digestion of saccharides. Absorption of monosaccharides; stages and mechanisms involved.

6.3 Digestion and absorption of lipids.

Enzymes involved in the digestion of lipids: lipases, carboxylester lipase, phospholipases. Stages in the digestion of lipids. Absorption of the products of lipid digestion; stages and mechanisms involved.

6.4 Digestion and absorption of proteins.

Enzymes involved in the digestion of proteins: endopeptidases, exopeptidases and epithelial cell membrane peptidases. Stages in the digestion of proteins. Absorption of the products of protein digestion; stages and mechanisms involved. Absorption of native proteins.

II. METABOLISM.

1.1 Metabolic pathways and metabolism.

Metabolic functions. Metabolic specialization and interdependence of the different tissue types and organs. Types of metabolic pathways. Control of flow along metabolic pathways. Supracellular regulation and control of metabolism.

1.2 Study of metabolism.

Acellular systems. Cell tissues and systems. Isolated organs and organisms.

METABOLISM OF GLYCIDS

2.1 Distribution of absorbed saccharides. Oxidative pathways in monosaccharides.

Distribution of monosaccharides in different organs and tissues. Mechanisms and control of monosaccharide transport into cells. Phosphorylation and dephosphorylation of monosaccharides; enzymes and regulation mechanisms. Glycolysis and respiration; stages, reactions, balance and regulation. Pentose pathway, stages, reactions, balance and regulation.

2.2 Functions of the liver in saccharide metabolism.

Participation of the liver in glycaemia control; metabolic pathways involved. Oxidative pathways (anaerobic glycosis, respiration and pentose pathway); stages, reactions, balance and regulation. Glyconeogenesis; precursors, stages, reactions, balance and regulation. Coordinated control of glycolysis and glyconeogenesis. Composition and characteristics of glycogen granules. Glycogenesis; stages, reactions, balance and regulation. Glycogenolysis; stages, reactions, balance and regulation. Coordinated control of glycogen synthesis and degradation. Synthesis of the derivatives of monosaccharides; glucuronic acid. Lipid synthesis using saccharides.

2.3 Metabolism of saccharides in muscle tissue.

Oxidation of monosaccharides; control and adaptation of states of contraction and rest. Glycogen synthesis and degradation; regulation mechanisms. Particular characteristics of glycidic metabolism in cardiac muscle.

2.4 Metabolism of saccharides in other tissue types.

Relative importance of the different oxidative pathways; control mechanisms. Renal glyconeogenesis; precursors and regulation. Synthesis of lactose in mammary tissue; regulation.

2.5 Tissue interrelations in glycidic metabolism.

Glucose and lactate flow between tissues in different physiological situations. Integrated glycemic control.

METABOLISM OF LIPIDS

3.1 Distribution of absorbed lipids. Oxidative pathways of fatty acids.

Blood transport of absorbed lipids; lipoproteins and plasma proteins. Composition and structure of chylomicra. Metabolism of chylomicra; processes involved and control mechanisms. Transport of plasma lipids into cells. Mitochondrial and peroxisomal β-oxidation; stages, reactions, balance and regulation. α-oxidation and ω-oxidation.

3.2 Functions of the liver in the metabolism of lipids.

Oxidation of fatty acids. Oxidative pathways of fatty acids; varieties, stages, reactions, balance and regulation. Ketogenesis; significance, stages, reactions and regulation. Synthesis of fatty acids; precursors, pathways, stages, reactions, balance and regulation. Coordinated control of the synthesis and degradation of fatty acids. Synthesis and degradation of triacylglycerols; stages, reactions, balance and regulation. Synthesis of cholesterol; precursors, stages, reactions, balance and regulation. Catabolism of cholesterol; metabolism of biliary acids.

3.3 Functions of adipose tissue in lipid metabolism.

Functions of adipose tissue an energy deposit; characteristics of triacylglycerols as reserve material. Lipogenesis; particular characteristics and regulation mechanisms. Lipolysis; stages, reactions, balance and regulation. Coordinated control of tricylglycerol synthesis and degradation. Metabolic functions of brown adipose tissue.

3.4. Metabolism of lipids in other tissue types.

Oxidation of fatty acids, glycerol and ketonic bodies; tissular characteristics. Functions of glycerol, fatty acids ad cholesterol as biosynthetic precursors.

3.5. Tissue interrelations in lipid metabolism.

Composition and structure of VLDL, LDL and HDL. Functions of VLDL, LDL and HDL. Metabolization of VLDL, LDL and HDL. Flow of fatty acids, glycerol, ketonic bodies and lipoproteins between tissues in different biological situations.

METABOLISM OF AMINO ACIDS AND PROTEINS

4.1 Distribution of absorbed amino acids.

Distribution of amino acids in different organs and tissues. Mechanisms and control of amino acid transport into cells.

4.2 Cellular metabolism of amino acids and proteins.

Function of amino acids as protein precursors; regulating factors. Functions of amino acids as precursors of other compounds; tissular characteristics. Degradation of cellular proteins; processes involved. Regulating factors of protein exchange. Catabolism of amino acids; pathways, stages and reactions involved. Decarboxylation deamination, transamination and transdeamination reactions. Oxygenase-catalyzed reactions. Other reactions involved in the catabolism of amino acids. Metabolic destination of the carbonate skeleton of amino acids; glycogenic amino acids and ketogenic amino acids. Nitrogen and protein sulphur removal pathways. Balance and regulation of amino acid degradation.

4.3 Functions of the liver and kidney in the metabolism of amino acids and proteins.

Protein nitrogen transport to the liver and kidney; reactions and processes involved. Urea cycle; precursors, stages, reactions, balance and regulation. Renal elimination of protein nitrogen; reactions and processes involved. Products of the elimination of non-protein nitrogen; pathways involved. Hepatic metabolism of bile pigments. Functions of the liver in the metabolism of plasmic proteins; regulatory factors.

4.4 Tissue interrelations in protein metabolism.

Flow of amino acids and metabolites for protein nitrogen transport in different physiological situations.

III. ENCOCRINE SYSTEM

1.1 Hormonal control.

Functions of the hormone system in homeostasis. Chemical nature of hormones. Cellular effects of hormones; stages in the mechanism of hormone action with membrane receptors and intracellular receptors. Synthesis, secretion, blood transport, inactivation and degradation of hormones. Functional exploration and experimental study of the endocrine system.

1.2 Endocrine glands.

General characteristics of endocrine cells and glands.

DIFFUSE HORMONE SECRETION

2.1 Diffuse endocrine system.

Concept. Methods for the detection of diffuse endocrine cells. Structure and ultrastructure of diffuse endocrine cells. Embryological origin of diffuse endocrine cells. Histophysiology of the diffuse endocrine system.

2.2 Eicosanoids.

Molecular characteristics of prostaglandins, thromboxanes and leukotrienes. Producer cells and target cells. Biosynthesis and secretion. Mechanisms of action.

2.3 Cytokines and growth factors.

Diffuse peptide secretion hormones. Producer cells and target cells. Molecular characteristics of cytokines and growth factors. Biosynthesis and secretion. Mechanisms of action.

PANCREATIC HORMONES

3.1 The endocrine pancreas.

Structure of Islets of Langerhans. Structure of islet cells. Vascularization and innervation of islets. Histogenesis and regeneration of the pancreas.

3.2 Molecular structure.

Insulin, glycogen, amylin, somastostatin, pancreatic polypeptide. Precursor molecules.

3.3 Production, transport and metabolization.

Biosynthesis and secretion of pancreatic hormones; stages, processes and control mechanisms. Plasma transport. Tissues and processes involved in degradation.

3.4 Physiological effects. Mechanisms of action.

Tissues and target cells. Effects on metabolism of saccharides, lipids and proteins. Non-metabolic effects. Mechanisms of action; receptors, actions on gene expression, extranuclear actions.

SUPRARENAL HORMONES

4.1 The suprarenal gland.

Structure. Embryological origin. Microscopic structure of the adrenal cortex; layers. Microscopic structure of the suprarenal medulla. Blood and lymph vascularization of suprarenals. Histophysiology of the supra-

renal cortex. Innervation of the suprarenal gland. Histophysiology of the suprarenal medulla. Cell renewal and regeneration of the suprarenal cortex. Paraganglia.

4.2 Molecular structure.

Catecholamines. Glucocorticoids. Mineral corticoids.

4.3 Production, transport and metabolization of catecholamines.

Biosynthesis and secretion of catecholamines; precursors, reactions and control mechanisms. Catecholamine plasma membrane transport. Tissues and processes involved in degradation of catecholamines.

4.4 Physiological effects of catecholamines. Mechanisms of action.

Tissues and target cells of catecholamines. Catecholamine effects on metabolism. Non-metabolic effects of catecholamines. Participation of catecholamines in stress response. Action mechanisms of catecholamines; receptors, molecular actions.

4.5 Production, transport and metabolization of corticoids.

Biosynthesis and secretion of corticoids; precursors, essential intermediaries, reaction types involved and control mechanisms. Plasma transport of corticoids; transport proteins. Inactivation and degradation of corticoids; formation and excretion of the 17 ketosteroids.

4.6 Physiological effects of corticoids. Mechanisms of action.

Tissues and target cells in corticoids. Effects of corticoids on metabolism and the hydrosaline balance. Non-metabolic effects of corticoids; systemic effects. Participation of corticoids in immunity, inflammatory and stress responses. Action mechanisms of corticoids; receptors, nuclear and extranuclear actions.

THYROID HORMONES

5.1 The thyroid gland.

Embryological origin. Histological structure. Ultrastructure of follicle cells. Histochemistry and histophysiology of thyroid follicles. Factors that modify the histology of the thyroid gland. Parafollicular cells or C cells of the thyroid gland; embryological origin and microscopic structure. Histophysiology of parafollicular cells.

5.2 Molecular structure.

Molecular characteristics of thyroid hormones.

5.3 Production, transport and metabolization.

Synthesis, storage and secretion of thyroid hormones; stages, processes and control mechanisms. Plasma transport of thyroid hormones; transport proteins. Inactivation and degradation of thyroid hormones; tissues and processes involved.

5.4 Physiological effects. Mechanisms of action.

Tissues and target cells. Effects on metabolism of saccharides, lipids and proteins. Effects on oxygen consumption, basal temperature and basal metabolism. Systemic effects; central nervous system and circulatory apparatus. Effects on growth and development. Mechanisms of action; receptors, nuclear and extranuclear actions.

REGULATORY HORMONES OF PHOSPHOCALCIC METABOLISM

6.1 The parathyroid glands.

Structure and embryological origin. Ultrastructure of parathyroid gland cells.

6.2 Parathyroid hormone. Molecular characteristics.

6.3 Production, transport and metabolization of parathyroid hormone.

Biosynthesis and secretion; stages, processes and control mechanisms. Plasma transport. Inactivation and degradation.

6.4 Physiological effects of parathyroid hormone.
Effects on phosphocalcic metabolism in bones, kidneys and the digestive apparatus. Mechanisms of action

6.5 Calcitonin.
Molecular characteristics

6.6 Production, transport and metabolization of calcitonin.
Biosynthesis and secretion; stages, processes and control mechanisms. Plasma transport. Inactivation and degradation

6.7 Physiological effects of calcitonin
Effects on phosphocalcic metabolism in bones, kidneys and the digestive apparatus. Mechanisms of action

6.8 Active compounds derived from D vitamins.
Structural characteristics of D vitamins. Structural characteristics of the derivatives of D vitamins with hormone action; dihydroxyvitamin-D_3

6.9 Production, transport and metabolization of hormones derived from D vitamins.
Conversion of D vitamins into hormone action derivatives; tissues involved, stages and regulatory factors. Plasma transport; transport proteins. Inactivation and degradation.

6.10 Physiological effects of hormones derived from D vitamins.
Effects on phosphocalcic metabolism in bones, kidneys and the digestive apparatus. Mechanisms of action.

6.11 Other regulatory hormones of phosphocalcic metabolism.
Glucocorticoids, estrogens, androgens, growth hormone.

6.12 Regulation of the plasma level in regulatory hormones of phosphocalcic metabolism.
Regulatory factors and mechanisms involved.

6.13 Functional exploration of the parathyroid gland and phosphocalcic metabolism

HYPOTHALAMOHYPOPHYSEAL HORMONES

7.1 Hypophysis; adenohypophysis.
Hypophysis; general arrangement, divisions and subdivisions. Embryological origin of the different parts of the hypophysis. Vascularization and innervation of the hypophysis. The adenohypophysis: histological structure of the *pars distalis*, *pars tubelaris* and *pars intermedia* . Cytology of adenohypophyseal cells. Histogenesis of the adenophypophysis. Histophysiology of the adenophypophysis.

7.2 The hypothalamohypophyseal system and neurohypophysis.
Relations between the hypothalamus and the adenohypophysis; the hypophyseal portal system. Hypothalamic control of the release of hypophyseal hormones. Relations between the hypothalamus and the neurohypophysis. The hypothalamohypophyseal tract. Histological structure of the neurohypophysis. Histophysiology of the neurohypophysis.

7.3 Structural characteristics of adenohypophyseal hormones and hypothalamic regulatory factors.
Adenohypophyseal hormones; ACTH, TSH, FSH, LH, GH, MSH, LPH, PRL. Hypothalamic release and inhibition factors.

7.4 Production, transport and metabolization of adenohypophyseal hormones.
Biosynthesis and secretion of adenohypophyseal hormones and hypothalamic regulatory factors; stages, processes and control mechanisms. Plasma transport of adenohypophyseal hormones. Tissues and processes involved in degradation of adenohypophyseal hormones.

7.5 Physiological effects of adenohypophyseal hormones. Mechanisms of action.
Target tissues and organs of stimulatory or trophic adenohypophyseal hormones. Physiological effects of adenohypophyseal hormones. Mechanism of action of trophic hormones. Target tissues and cells of

growth hormone. Metabolic effects of growth hormone. Effects of growth hormone on cell and tissue growth. Mechanisms of action of growth hormone.

7.6 Somatomedins.
Structural characteristics. Production, transport and metabolization. Physiological effects. Mechanisms of action.

7.7 Structural characteristics of neurohypophyseal hormones.
Vasopressin (ADH), oxytocin.

7.8 Production, transport and metabolization of neurohypophyseal hormones.
Biosynthesis and secretion; stages, processes and control mechanisms. Plasma transport; neurophysins. Tissues and processes involved in degradation.

7.9 Physiological effects of neurohypophyseal hormones.
Target tissues and organs. Physiological effects. Mechanisms of action.

IV. METABOLIC HOMEOSTASIS AND NUTRITION

1. Composition and functions of foods.
Functions of the different components of foods; carbohydrates, lipids, proteins, vitamins, minerals and trace elements. Carbohydrate, lipid and protein content of the different types of foods.

2. Nutrition and caloric balance.
Caloric expenditure; determining factors. Calorific value of foods. Caloric balance.

3. Nutrition and metabolic homeostasis.
Metabolic interrelations between different tissues and organs in the phases of consumption (absorption) and hunger (postabsorption), in situation of motor rest and activity; substrate flow and hormonal control. Metabolic adaptations during fasting. Metabolic adaptations in situacions dínjúria. Contribution of nutrients in different physiological and physiopathological situations. General dietary recommendations.

4. Regulation of food ingestion.
Neural centres involved in the regulation of food ingestion. Mechanisms and factors that regulate food ingestion.

LEARNING RESOURCES AND TEACHING METHODOLOGIES

Theory classes
The theory credits are studied in groups of no more than 80 students and are based on oral explanations and presentations. Graphic information (photographs, diagrams or graphs) is presented using slides or transparencies. Students will generally be given a paper copy of this information.

The theory classes are intended to:

- Provide a general overview of the topics covered, intended to give the student a conceptual structure of the subject into which knowledge from other sources can easily be fitted.
- Clarify certain aspects of the course that are particularly difficult for students to understand. This may be due to their inherent complexity, their links with other subject areas or simply because they have not been satisfactorily explained in the sources available.
- Introduce new aspects that are not present in text books or that need to be brought up to date. These aspects will be analyzed and placed correctly into the overall context of the subject.

Seminars
There are different types of seminars with specific objectives:

- Methodological; aimed at providing the knowledge and guidelines required to carry out the practical laboratory tasks and functional exploration sessions.
- Applied; for applying the knowledge gained to problem solving exercises.
- To cover in more detail areas of particular scientific or clinical interest.
- On research material; aimed at the presentation and discussion of a current or classic study of particular relevance or significance.
- To present bibliographical research projects and occasional "experimental" studies carried out individually or in small groups.
- To solve difficulties and doubts.

Practical activities

Practical credits will studied in groups of approximately 20 students.

Practical microscope work

Aimed at the identification and interpretation of histological preparations.

- Digestive: microscopic observation of sections of saliva glands, oesophagus, stomach, small intestine, large intestine, liver and biliary vesicle.
- Endocrine. Microscopic observation of sections of pancreas, adrenal gland, thyroid, parathyroid, hypophysis and diffuse endocrine system.

Experimental laboratory practice

For carrying out activities on protocol preparation, instrument handling, observation and collection of data, analysis of results, deduction of conclusions and presentation of results.

- Digestive:
  - Starch hydrolysis with α-amylases
  - Action of pancreatic lipase; effect of bile salts
  - Action of chymotrypsin; activation of chymotrypsinogen by trypsin
- Metabolism:
  - Study of pyruvate-kinase, phosphoglycerate mutase and lactate dehydrogenase isoenzymes

Computer-based activities

Aimed at:

- Interactive analysis of the solution to complex problems using graphic representations of the parameters involved.
- Viewing and modifying the development of simulated processes that are too complex for laboratory practice.

Visits to Biochemical Analysis and Functional Exploration Laboratories

Intended to introduce students to commonly used diagnostic methodologies and techniques.

Bibliographical tasks

Performed individually or in small groups. These are intended to encourage students to develop bibliographical research skills and to produce written essays and oral presentations.

Tutorials

Students will have the chance to discuss issues arising from the course individually with teachers during their tutorial hours.

LEARNING REQUIREMENTS

Knowledge

- Principles of thermodynamics and bioenergetics
- Properties of water and aqueous solutions
- Structure and properties of different groups of biomolecules (saccharides, lipids, proteins and nucleotides)
  - Structural characteristics and functions of enzymes.
  - Composition, structural and functional characteristics of cell membranes.
  - Composition, structural and functional characteristics of intercellular compartments.
  - Molecules, structures and processes involved in cell motility
  - Molecules, structures and process involved in the maintenance, expression and replication of genetic information
  - Molecules, structures and process involved in cell communication and signal transduction
  - Structures and processes involved in the cell cycle, proliferation and cell death
  - Structural and functional characteristics of epithelial, connective, adipose, cartilaginous, muscle and nerve tissue

Procedures

- Use documentation from various sources to acquire, deepen and broaden knowledge related to the relevant subject areas:
  - Gather, select and process information with critical reasoning
  - Identify and consult the different sources of information available in libraries and information systems

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  - Understand the content of written and spoken information and messages
  - Summarize and schematize information from written and spoken sources

- Be able to relay information relevant to the subject areas
  - Produce coherent and linguistically correct written work, using computers where applicable.
  - Prepare oral presentations and express them correctly, using the appropriate terminology
  - Produce diagrams, graphs and guides as tools for expressing ideas, in both oral and written work

- Carry out laboratory work in the correct manner
  - Correctly follow the steps outlined in guides to practical laboratory work
  - Collect data from laboratory work and organize them in diagrams, tables or graphs
  - Analyze the data from laboratory work to draw conclusions
  - Prepare written reports on the laboratory work carried out
  - Maintain a thorough and honest approach to obtaining, processing and presenting experimental data
  - Observe laboratory safety regulations
  - Use volumetric materials
  - Prepare solutions
  - Prepare buffer solutions
  - Determine the pH of a solution
  - Use optic microscopes to observe histological preparations