SCHOOL OF MEDICINE

SAN RAFFAELE INTERNATIONAL MD PROGRAM

Academic Year 2010/2011

Semester 1

- Medical Humanities
- Statistics and Bioinformatics
- Chemistry and Biochemistry
- Basic Life Support

Semester 2

- Medical Physcis
- Genetics & Developmental Biology
- Cell & Molecular Biology

MEDICAL HUMANITIES

Course Chair: Michael John michael.john@unisr.it

Credits: 1st Semester 2010-11 Total credits: 9
Total hours: 110

Aim: To help students understand that patients are people, and not just a mass of molecules, who have not only an illness, but are also suffering fear and anguish. Doctors must therefore strive to empathize with individuals and not simply distribute medication and drugs to faceless and nameless numbers.

Scientific sector – discipline code: L/LIN-12, M-FIL/03, MED/02
Total number of credits: 9
Number of lecture and seminar hours: 110
Number of hours for tutorials: 12

Discussion and active student participation will be paramount to the overall success of the course.
Course objectives:
In today's frenetic, high-tech world, where medicine is evidence based and focuses on specialties of all possible kinds, doctors generally have little time to ponder the multifaceted problems of their patients. Indeed, there are innumerable horror stories told by sick people that stem from the uncaring attitudes and the lack of sensitivity shown by many health professionals. Yet medicine should be seen as a caring profession that requires doctors not only to provide valid clinical assistance but, above all, to empathize with patients and their families when they are at their most vulnerable and in need of understanding.
Nowadays, medical school students are encouraged to interact with patients virtually from the beginning of their training and an increasing amount of emphasis is being placed on the teaching of social sciences, ethics and communication skills to help create a new kind of doctor. One way of doing this is by introducing the study of the *Medical Humanities* (literature, music, visual arts, psychology, sociology, philosophy, ethics, history, language, religion etc.) into the medical curriculum. These subjects require imagination, close observation and understanding, which are all fundamental characteristics of a successful and caring doctor.
How otherwise might a 20-year-old medical or nursing student learn about the complexities of the human condition? How would they be able to understand the reactions and feelings of someone with a terminal illness or a crippling disability, let alone a parent who has just lost a child? They certainly will not learn these skills from standard clinical textbooks, where the words fear and anguish do not appear in the index. Yet fear and anguish are at the very center of how a patient faces up to and lives with an illness.

At the end of this course, students will have a greater understanding of:

- *empathy and patient-centered communication*
- *team work and the ability to interact with colleagues and other health professionals*
- *linguistics and use of language*
- *truth-telling and the delivery of bad news*
- *withdrawal of treatment*
- *euthanasia and assisted suicide*
- *treatment of violence and abuse*
- *ethical and legal problems linked to medical errors*
- *ethics committees*
- *conflict of interest and relationship with industries*
- *chronic illness*
- *old age, death and bereavement*
- *cross-cultural conflicts*
- *alternative and complementary health practices*
- *religion and spirituality*
- *ethical problems linked to stem cells, organ donation and transplantation*
- *re-pro ethics and new reproductive technologies*
- *history of medicine and medical education*

Prof Michael John – course coordinator
Prof. William Cooke
Prof. Roberta De Monticelli
Prof. Roberto Mordacci
Prof. Giuseppe Pantaleo
Pro.f Andrea Sereni
Prof. Simon Tiberi

AREA 1: DOCTOR-PATIENT COMMUNICATION

MICHAEL JOHN - Coordinator (20 hours)

Title: Doctors and patients in literature and at the movies	
1	Introduction to Doctor-Patient Communication
2	Movie: The Doctor (Director - Randa Haines)
3	Reading: The Diving Bell and the Butterfly (Jean Dominique Bauby)
4	Movie: The Diving Bell and the Butterfly (Director - Julian Schnabel) *in French with English subtitles*
5	Reading: Awakenings (Oliver Sacks)
6	Movie: Awakenings (Director - Penny Marshall)
7	Reading: Gesundheit (Patch Adams with Maureen Mylander)
8	Movie: Patch Adams (Director - Tom Shadyac)
9	Reading: One Flew Over the Cuckoo's Nest (Ken Kesey)
10	Movie: One Flew Over the Cuckoo's Nest (Milos Forman)

SIMON TIBERI (20 hours)
This course will focus on three main areas:

1. Introduce concepts of visual literacy to the medical curriculum and it's usefulness in clinical medicine.
2. Development of empathy, through role plays, creative writing and discussions.

Title: Developing observation and empathy- the lost art of medicine	
1	Introduction to Medicine today, is it an art or science? What does it take to be a doctor. (Prof. G.Pozza)
2	Introduction to visual literacy - methods used in describing art
3	Example to deep looking - guided visit to an art gallery
4	Example to deep looking - focus on facial and body expressions
5	Example to deep looking - practical examples in groups
6	How to integrate visual literacy into clinical medicine
7	Developing empathy through poetry ,short stories and creative writing
8	Final presentation

WILLIAM COOKE (10 hours)

Title: Can the pen be mightier than the scalpel?	
1	Why, How and What Doctors Write
2	Deductive Communication, from Roman Oratory to Quentin Tarantino
3	Mindset: (i) Writing is Writing, (ii) No Place for Narcissism, (iii) Content Expertise is not Enough
4	The Science of Science Writing: Five Golden Rules for Reader-Friendly prose
5	Clarity in the expression of Who (subject/actor) does What (verb/action). Practice and Peer Review

Materials consist in a pdf file + "The Science of Science Writing",
Gopen and Swan, American Scientist, Volume 78, 1990, a copy of which will be made available on intranet.

ROBERTA DE MONTICELLI (10 hours)

Title: Outlines of a phenomenology of the doctor-patient relationship

1. Personal identity: theories of the self
2. The layers of the emotional life
3. The ways of empathy
4. Confidence and Suspicion
5. Dante's *Inferno*: Phenomenology of a strange passion

References:

Rudder Baker L. 2000, *Persons and Bodies – A Constitution View*, Cambridge Studies in Philosophy

Gallagher, S., Zahavi, D., 2008, *The Phenomenological Mind – An introduction to Philosophy of Mind and Cognitive Science*, Routledge

Ratcliffe, M. 2008. *Feelings of Being: Phenomenology, Psychiatry and the Sense of Reality*. Oxford University Press, International Perspectives in Philosophy and Psychiatry series.

Gallagher, S. & Schmicking, 2010, *Handbook of Phenomenology and Cognitive Science*. D. Springer.

Goldie, P. 2010, *Oxford Handbook of Philosophy of Emotion*. Oxford University Press.

Straus, E., 1966, *Phenomenological Psychology*, Tavistock, London

De Monticelli, R., 2006 *The Feeling of Values: for a Phenomenological Theory of Affectivity*, in: Bagnara, S., Crampton Smith, G., *Theories and Practice in Interaction Design*, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp. 57-76

De Monticelli, R., (2007) *The Phenomenological Revolution*, Proceedings of the XXVII IHSRC, "Encyclopaideia", 22, July-December, pp. 9-30

De Monticelli, R. (2000) *Dante's Inferno: Phenomenology of a Strange Passion*, "Psychopathology" 2000, 33 182-190

Suggested reading:

1. Gallagher-Zahavi 2008, chapters 7 (The embodied mind); 8 (Action and agency); 9 (How we know others)
2. Dante, Inferno, Canti VII-VIII, (any English translation, for ex. *The Divine Comedy*, transl,. by Allen Mandelbaum, with an Introduction buy E.Montale, New York, Everyman's Library, 199

GIUSEPPE PANTALEO (10 hours)

Title: Psychological aspects of social interaction in health-related contexts

1. Unique individuals or interchangeable group members? *Social identification, self-categorization* and the shape of social interaction
2. The intensity of positive/negative *emotions* and *motivations* in health-related and broader societal contexts
3. 'Intensity' issues in compliance, health, and risky behaviors – the paradoxical role of *deterrents*
4. Perspective-taking and (mis-)communication: *Self-symbolizing* and the neglect of others' perspectives
5. *'Physical/biological orienting'* vs. '*multiple psychological perspectives'*
6. *Consistency needs* in doctor-patient communication
7. *Static* vs. *dynamic* thinking: Cognitive and motivational factors underlying doctor-patient communication
8. From "empathic resonance" to "empathic perspective-taking": The evolution of empathy
9. "Multiple perspectives" and the complexities of the human condition: fear, anxiety, and anguish as instigators of the *orienting* response
10. Beyond the Age of Empathy?

Articles and reading materials will be made available to the students at the beginning of each lesson.

AREA 2: BIOETHICS

MORDACCI ROBERTO (10 hours + 12 hours practicals)
Introductory course on Bioethics

Prof. Roberto Mordacci.
Tutors: Alex Grossini, Michele Loi

Mon 10/1, 11-13
Lecture I – *An Introduction to Bioethics*
- The meaning of the term
- The origins
- The main areas
- The main teories

Wed 12/1, 9-11
Tutorials: analytical reading and discussion of
- M.P. Battin, *Bioethics*, in R.G. Frey, C.H. Wellman (eds.), *A Companion to Applied Ethics*, Blackwell, Oxford 2003, pp. 295-312

Wed 26/1, 9-13
Tutorials: vision and discussion of a movie of bioethical interest (with tutors and teacher)
GATTACA, by Andrew Niccol, USA 1997
Readings: D.W. Brock, *Genetic Engineering,* in R.G. Frey, C.H. Wellman (eds.), *A Companion to Applied Ethics*, cit., pp. 356-368

Mon 31/1, 9-11
Lecture II – *The Beginning of Life*
- The moral status of human embryos
- Medically assisted procreation
- The issue of abortion

Mon 31/1, 11-13
Tutorials: analytical reading and discussion of
- J. Finnis, *Abortion and Health Care Ethics*, in H. Kuhse, P. Singer (eds.), *Bioethics. An Anthology*, Blackwell, Oxford 1999, pp. 13-20
- M. Tooley, *Abortion and Infanticide*, ivi, pp. 21-35

Tue 1/2, 9-11
Lecture III – *The End of Life*
- The definition of death
- Euthanasia and assisted suicide

Tue 1/2, 11-13
Tutorials: analytical reading and discussion of
- G. Grisez, J.M. Boyle Jr., *The Morality of Killing. A Traditional view*, in H. Kuhse, P. Singer (eds.), *Bioethics. An Anthology*, cit., pp. 211-214
- J. Rachels, *Active and Passive Euthanasia*, ivi, pp. 227-230

Wed 2/2 9-11
Lecture IV- *Research Ethics*
- The ethics of biomedical research
- Informed consent and ethics committees
- New frontiers: neuroethics

Wed 2/2 11-13
Tutorials: analytical reading and discussion of
- A. Damasio, *Neuroscience and Ethics: Intersections*, The American Journal of Bioethics, 7(1), 3-7, (2007)

Fri 4/2 9-11
Lecture V – *Genetics and Justice*
- The ethics of genetics
- Playing God, future persons and nature
- Enhancement and justice
- General conclusions

All the books are already available at San Raffaele Library
Useful Websites: http://moraliaontheweb.com
http://theimmoralist.wordpress.com

AREA 3: LOGIC OF DISCOVERY

ADNREA SERENI (20 hours)
Epistemology

This course aims to introduce selected fundamental issues in epistemology, theory of knowledge and philosophy of science. Topics are chosen on the basis of their historical and philosophical relevance, and all feature important connections with medical thinking.

Lecture I – Fundamental issues in epistemology
Wed. 10/11, 9-13 (4h.)

- Kinds and Sources of knowledge
- Knowing-how and knowing-that
- What is knowledge? Definitions and problems.
- What is justification? Theories of justification.
- Epistemology and science:
  - foundationalism, naturalized epistemology, experimental philosophy

Lecture II – Forms of reasoning
Wed. 17/11, 9-13 (4h.)

- deductive reasoning
- inductive reasoning
  - problem of induction
- abductive reasoning
  - inference to the best explanation
- critical thinking and decision making

Lecture III – Realism, anti-realism, and empiricism
Thur. 18/11, 11-13 (2h.)

- fundamental issues and differences
- reductionism vs anti-reductionism
- relation empirical evidence / theory
  - realistic mechanical model of body
  - realistic and anti-realistic conceptions of diseases

Lecture IV – Mind/body problem
Frid. 19/11, 11-13 (2h.)

- monism vs dualism
- reductionism and emergentism
- behaviourism
- functionalism
- biological vs phenomenical: the problems of qualia and consciousness
  - patient as a body and patient as a person

Lecture V – Explanation

Wed. 24/11, 9-11 (2h.)

- what is explanation?
- covering laws model (and problems)
- causal explanation
  - empiricism and causation
- medical causation

Lecture VI – Q&A

Wed. 25/11, 11-13 (2h.)
Questions on lectures I-V with class answers
Open question-time
Class exercises
Selection of topics for group-work

Lecture VII/VIII – Group-work

Thur. 9-12, 11-13 / 14-16
Group presentation with class discussion
Approximatel8 slots each group, 5 persons per group, 25 minutes each group (15 mins. presentation and 10 mins. discussion)

Readings

The course's reading-list will consist of lecture-notes and book-chapters. Chapters will be selected among the following text-books:

I. Johansson, N. Lynöe, *Medicine & philosophy: a twenty-first century introduction*, Ontos Verlag, 2008

Ladyman, J., Understanding philosophy of Science, Routledge, 2002; italian translation *Filosofia della scienza*, Carocci, Roma, 2007.

Okasha, S., *Philosophy of Science. A very Short Introduction*, Oxford University Press, Oxford-New York, 2002; Marcum, J. A., *An Introductory Philosophy of Medicine – Humanizing Modern Medicine*, Springer, 2008

Morton, A., *A guide Through the Theory of Knowledge*, Blackwell, Ofxord, 2003.

Moser, P., *Oxford Handbook of Epistemology*, Oxford Univerity Press, Oxford, 2002.

Wulff H.R., Pedersen S. A., Rosenberg R., *Philosophy of Medicine*, Blackwell, 1990;

Additionaly, many wepages from the Stanford encyclopedia of Philosophy might be of help: http://plato.stanford.edu.

COMPULSORY READING MATERIAL FOR MEDICAL HUMANITIES

Prof. Michael John

1. The Diving Bell and the Butterfly – ISBN - 1-85702-794-9 Jean-Dominique Bauby
2. One Flew Over the Cuckoo's Nest Ken Kesey
3. Awakenings – ISBN - 0-330-32091-2 Oliver Sacks
4. Gesundheit Patch Adams with Maureen

Prof. Roberta De Monticelli

The Phenomenological Mind- An introduction to philosophy of Mind and Cognitive Science, 2008 Mylander Gallagher S. Zahavi D.

Prof. Andrea Sereni

Philosophy of Science. A very Short Introduction, Oxford University Press, Oxford-New York, 2002 R.A. Epistemology, Wiley-Blackwell, Oxford, 2006 Okasha, S Fumerto

Conditions and notes

Notes: Attendance of all lessons, seminars and tutorials is COMPULSORY and an electronic register will be kept. For unavoidable absences (e. g. illness) follow the procedure indicated on the Student Intranet on Attendance Requests.

STATISTICS AND BIOINFORMATICS

Course Chair: Clelia Di Serio diserio.clelia@hsr.it

Credits: 1st Semester 2010-11 Total credits: 6
Total hours: 112

Teacher: Prof. Clelia Di Serio

Teaching Assistant (TA): Chiara Brombin, Ph.D

Course Description

The course presents fundamental concepts in applied probability, exploratory data analysis, experimental design, statistical inference, focusing on probability and analysis of one and two samples. Fundamentals in informatics, data management and basic data analysis are also provided in the course. Topics are described in detail in the timetable.

Course Objectives

The goal of this course is to equip medical students with core applied statistical concepts and methods:

1) The course will refresh the mathematical, computational, statistical and probability background that students will need to take the course.

2) The course will introduce students to the display and communication of statistical data by means of descriptive statistics for univariate and bivariate variables.

3) Students will learn to recognize the experimental design to understand different types of studies arising in public health studies.

4) Students will learn to read epidemiological papers and interpret the statistical analyses.

5) Students will learn to understand basics in probabilities (Bayes theorem) to interpret screening tests and main topics in experimental design (e.g., studies type definition, sources of bias, etc..)

6) Students will learn to evaluate correlation, calculate regression coefficients and interpret confidence intervals for population means and proportions in order to build a hypothesis systems one and two tails;

7) Students will learn to perform a two-sample t-test and interpret the results; calculate a 95% confidence interval for the difference in population means and proportions

8) The course will also cover Analysis of Variance (ANOVA)

During the course lessons in information technology will be held in computer room. Excel and SPSS statistical software will be used for computer applications of theoretical issues.

Readings

Main material**:**

- Textbook: Biostatistics. Basic Concepts and Methodology for the Health Sciences (9^{th} edition). Author: Wayne W. Daniel. WILEY
- Supplementary Online Material.

Additional material (one of the following):

- **Discovering Statistics Using SPSS (Introducing Statistical Methods),** 3rd edition, by Andy P. Field (2009)- Sage Publications
- **SPSS Survival Manual: A step by step guide to data analysis using SPSS,** 4th edition, by Julie Pallant (2010)-Allen & Unwin
- **SPSS Programming and Data Management, 4th Edition,** by Raynald Levesque; SPSS Inc.

Homework

Each lecture topic will be accompanied by a homework assignment. Homework completion will contribute to the final mark.

Prerequisites

Calculus and a moderate level of mathematical literacy are prerequisites for this class (set theory, concept of function, linear function, logarithm, exponential, concept of derivative and integral). Students are required to have good knowledge of Office package (Excel in particular). Upon entering the course, students are expected to have basic skills in Excel (e.g. reading in data, creating new variables, merging data sets, case selection, sub-setting, sorting, stratification, etc.).

CHEMISTRY AND BIOCHEMISTRY

Course Chair: Massimo Degano degano.massimo@hsr.it

Credits: 1st Semester 2010-11 Total credits: 12

Type of subject: Traditional medical discipline
Field: General discipline for the preparation of a doctor: Structure, function and metabolism of molecules of medical interest.
Scientific sector – discipline code: BIO/13- BIO/10
Total number of credits: 12
Number of lecture hours: 106
Number of hours for Seminars/Practicals: 12
Number of hours for Tests and exams: None
Number of hours for Individual study: 156

Course objectives:
The Chemistry and Basic Biochemistry course is one of fundamental importance, in which students are presented with the notions of the chemical and biochemical mechanisms necessary to understand the regulation of biological processes of the cell and of the organism.
This course covers classical molecular and cellular biochemistry, cellular physiology, and molecular genetics. Metabolic interrelationships as they occur in the individual will be stressed and related to disturbances in disease states.
The knowledge and understandings provided by the course constitute the foundations for the following semesters both for the molecular analysis of physiological processes and those of pathogenetic mechanisms in disease. The specific field of Chemistry and Basic Biochemistry will focus on the principles of general and organic chemistry with a description of the fundamental chemical reactions for the understanding of biological processes, the structure and function of organic molecules that constitute the building blocks of living matter, and the analysis and structure and function of principle biological polymers, with particular emphasis on the processes of catalytic enzymes.

At the conclusion of this course, students should be able to:

- Solve problems in diagnosis and treatment of human disease by application of biochemical principles.
- Use primary medical and scientific literature as a resource for learning and problem-solving.
- Define, describe and contrast functions of genes and macromolecules in normal and pathologic contexts.
- Define and describe systemic metabolic biochemistry in terms of genes and molecules.
- Deduce therapeutic mechanisms from established molecular mechanisms.
- Interpret new medical discoveries in terms of fundamental principles of biochemistry
- Explain the molecular basis of diseases that affect cellular function or development.

The course is a prerequisite for:
Foundation for “Cellular and Molecular Biology” and “Genetics and developmental Biology”.
Prof. Massimo Degano (MD) – Coordinator - 40 hours
Prof. Mauro Freccero (MF) – 40 hours
Prof. Angelo Corti (AC) – 20 hours

No.	Theme	Lecturer
1	Introduction to the course. Chemistry and biochemistry in human physiology	MD
2	Atomic Structure. Electron Configuration and the Aufbau Principle. Atomic and Molecular Orbitals. Chemical Bonding - Covalent, Ionic and Metallic Bonds.	MF
3	Intermolecular Forces - Dipole-Dipole Forces, Hydrogen Bond, London Forces. Periodic System of Elements. Trends in the Periodic Table. Nomenclature of Inorganic Compounds. Characterization of sp-, d- and f-Elements and their Compounds.	MF
4	Classification of Chemical Reactions. Chemical Thermodynamics -the Laws of Thermodynamics, Enthalpy, Entropy, Free Energy. Spontaneity of Chemical Change. Chemical Equilibrium. Equilibrium Constant. Le Chatelier´s Principle.	MF
5	Chemical Kinetics. Reaction Rates and Factors that Influence them. Activation Energy and the Activated Complex. Catalysts and Mechanism of their Effect.	MF
6	Solutions and their Properties. Solubility, Concentration of Solutions. Solutions of Electrolytes, Ionization Constant. Activity (effective concentration). Acids and Bases. The Dissociation of Water. The pH Scale. Salts, Hydrolysis of Salts, Solubility Product. Buffers, Characterization, pH, Capacity. Buffers of the Blood.	MF
7	Oxidation-Reduction Processes. Hydrogen and Oxygen in these Processes. Standard Reduction Potentials. Osmosis. Osmotic Pressure. Colligative properties. Importance in Medicine.	MF
8	Scope of Organic Chemistry. Formulas, Naming and Classification of Organic Compounds. Resonance, delocalization, conjugation, and aromaticity	MF
9	Hydrocarbons and their Derivatives. Alkanes, Alkenes, Alkynes, Cycloalkanes.	MF
10	Alcohols	MF
11	Ethers, epoxides, and sulfides	MF
12	Amines	MF
13	Ketones and aldehydes	MF
14	Carboxylic acids, esters, amides	MF
15	Amino Acids and their Properties. Important Peptides.	AC
16	Lactones, lactames and antibiotics	MF
17	Phosphoric acids, inorganic and organic phosphates	MF
18	Aromatic compounds	MF
19	Alpha substitution and condensation of enols and enolate ions	MF
20	Synthetic reactions in bioorganic chemistry	MF
21	Proteins - Amino Acid Composition, Conformation of Proteins -	AC
22	Monosaccharides - Classification, Configuration, Optical Activity, Anomers, Epimers. The Haworth Formulas. Reactions of Monosaccharides. Glycosidic Linkage, Reducing and non-Reducing Disaccharides. Polysaccharides and Glycosaminoglycans, Composition, Properties.	MF
23	Types of Bonds and Interactions. Physical and Chemical Properties. Classification of Proteins.	AC
24	Carbohydrates.	MF

25	Myoglobin and Hemoglobin	AC
26	Lipids and Steroids. Classification, Structure, Properties, Chemical Reactions.	MD
27	Enzymatic catalysis	AC
28	Introduction to the cell, compartments and cellular biochemistry.	MD
29	Cell membranes. Introduction to metabolism.	MD
30	Enzyme regulation	AC
31	Overview of Intermediary Metabolism. Biological Oxidation and Bioenergetics. The Respiratory Chain and its Components. The Mechanism of Oxidative Phosphorylation. Oxygenases and Hydroperoxidases. Free Radicals.	MD
32	The Citric Acid Cycle and its Regulation. The Pyruvate Dehydrogenase Complex.	MD
33	Protein folding	AC
34	Metabolism of Carbohydrates - Metabolism of Glucose and its Regulation. The Pentose Phosphate Pathway. Other Pathways of Hexose Metabolism. Gluconeogenesis. Metabolism of Glycogen and its Regulation. Metabolism of Glycosaminoglycans.	MD
35	Protein purification and characterization	AC
36	Antibodies	AC
37	Metabolism of Lipids and Steroids - Digestion, Resorption and Transport. Lipoproteins and their Metabolism. Biosynthesis and Degradation of Saturated and Unsaturated Fatty Acids. Ketogenesis. Eicosanoids. Metabolism of Acylglycerols and Sphingolipids. Metabolism of Cholesterol. Biosynthesis of Bile Acids and Steroid Hormones.	MD
38	Metabolism of Proteins and Amino Acids -Digestion, Resorption and Transport. Transamination, Oxidative Deamination and Decarboxylation of Amino Acids. Catabolism of the Carbon Skeleton of Amino Acids. Ammonia Formation and its Removal. Biogenic Amines.	MD
39	Nucleosides, Nucleotides and Nucleic Acids. DNA and RNA structure and properties. DNA sequencing.	MD
40	Metabolism of Pyrimidine and Purine Nucleotides.	MD
41	Protein Synthesis.	MD
42	Metabolism of Porphyrins and Bile Pigments. Biosynthesis of Heme and Hemoglobin and their Catabolism. Jaundice.	MD
43	Components of the Blood. Water and Ions Metabolism. Acid-Base Balance. The Lungs and the Kidney in Acid-Base Balance. Disorders of Acid-Base Balance.	MD
44	Metabolism of Erythrocytes. Haemostasis and Blood Clotting.	MD
45	Contractile and Structural Proteins. Mechanism of Muscle Contraction and its Energy Supply.	MD
46	Metabolism of Connective Tissue. Connective Tissue Proteins, Proteoglycans. Process of Mineralization.	MD
47	Metabolism of Adipose Tissue.	MD
48	Metabolism of Liver.	MD
49	Receptors. Hormones.	MD
50	Extracellular and Intracellular Communication. Second Messengers, Protein Kinases.	MD

Suggested textbooks (choose 1 or 2 from this list)
Timberlake – General, Organic, & Biological Chemistry. Pearson ed., ISBN 0-8053-8914-8
Lehninger – Principles of Biochemistry ISBN 071677108X
Stryer – Biochemistry ISBN: 0-7167-8724-5
Voet & Voet – Biochemistry. Wiley eds. ISBN 0-471-58651-X

San Raffaele International MD Program
Vita-Salute San Raffaele University
A.Y 2010.2011

MEDICAL PHYSICS

Course Coordinator:
Prof. Michele Arneodo: arneodo@to.infn.it
Collaborator
Prof. Monika Grothe: grothe@mail.cern.ch

SDS: FIS/07 – MED/36
Credits: 5
Lectures: 50 hours
Practicals: 10 hours

The course covers the basic principles of Physics, with emphasis on subjects useful for understanding biological phenomena and biomedical instrumentation. Problem sessions are foreseen.

Prerequisites
Basic mathematics. Knowledge of calculus is not required.

Course Syllabus

Mathematical review
Cartesian coordinates, functions and their graphical representation. Linear and logarithmic scales. Significant figures. Scientific notation. Vectors and operations with them: sum, difference, scalar and vector product.

Physics quantities and their measurement
Units. Statistical and systematic uncertainties.

Mechanics
Velocity, acceleration. Uniform straight motion. Constant-acceleration motion. Falling objects. Motion in two and three dimensions. Circular motion: angular and tangential velocity, centripetal acceleration; uniform circular motion.

Force, mass, Newton's laws; inertial and non-inertial reference frames. Gravitational forces. Friction.

Work, kinetic and potential energy. Total mechanical energy and its conservation. Conservative forces, dissipative forces. Power. Impulse and linear momentum. Momentum conservation; collisions.

Simple harmonic motion; pendulums and springs. Elastic forces, elastic potential energy. Damped and forced oscillations; resonance.

Torque; couples. Equilibrium of rigid bodies. Levers. Centre of gravity. Stability.

Motion of the centre of mass; Newton's law for particle systems. Motion of rigid bodies: angular speed and acceleration. Moment of inertia. Angular momentum and its conservation.

Elasticity. Stress and strain. Young's modulus; Poisson's modulus; shear modulus; bending. Elastic limit, ultimate strength.

Fluids
Archimedes' principle. Flow rate. Equation of continuity. Conservation of energy and Bernoulli's equation. Viscosity; Hagen-Poiseuille's law; flow resistance; Stokes' law; sedimentation velocity; turbulent flow; Reynolds number.

Ideal gases; equation of state; kinetic theory. Real gases. Vapours and gases. Saturated vapour.

Diffusion, diffusion coefficient, Fick's law. Surface tension; laws of Laplace and Jurin.

Thermodynamics
The first principle of thermodynamics. Specific heat capacity, heat capacity. Heat capacity of an ideal gas at constant pressure or constant volume. Metabolic rate. Second principle of thermodynamics; reversible and irreversible processes; entropy; thermodynamic cycles, Carnot's cycle, efficiency.

Electricity and Magnetism
Electric charge, Coulomb's law, electric field, electrostatic potential energy, potential; electron volt. Relation between field and potential difference. Electric dipole: field lines and behaviour in an electric field.

Conductors and insulators. Polarisation of a dielectric. Electric capacity; capacitor; effect of a dielectric. Relative dielectric constant. Energy stored in a capacitor. Capacitors in series and parallel.

Electric current. Drift velocity of the charge carriers. Electric resistance; resistivity. Ohm's law. Resistors in series and parallel. Electrical circuits. Power in electrical circuits, Joule's law. Ohmic and non-ohmic conductors; the diode.

Direct and alternating current circuits.

Effects of current through the human body. Grounding.

Magnetic field. Lorentz's force; force on a current-carrying wire. Biot-Savart law. Field generated by a wire, field generated by a circular current loop. Solenoid. Magnetic dipoles; magnetic dipole moment; behaviour of a magnetic dipole in a magnetic field. Ferromagnetic materials, permanent magnets.

Magnetic field flux. Faraday's law. Electric generators, transformers.

Cathode ray tube. Linac, cyclotron, synchrotron.

Nuclear magnetic resonance.

Periodic waves. Wave velocity; period and wavelength. Longitudinal and transverse waves. Fourier analysis. Electromagnetic waves. Antennas. Quantisation of energy in electromagnetic waves: the photon.

Generation of X rays: Bremsstrahlung and characteristic lines.

Sound Waves
Nature of sound. Intensity of sound waves. Intensity level; decibels. Doppler effect. Ultrasounds. Reflection and absorption of ultrasounds. Principles of sonography and Doppler sonography.

Geometrical Optics
Refraction index. Reflection, refraction, Snell's law. Total internal reflection. Lenses. Lensmaker equation; thin-lens formula. Accommodation; near and far points.

Modern Physics, Nuclear Physics
The main concepts of special relativity. The main concepts of quantum mechanics (energy quantisation). Atomic structure; transitions between atomic orbitals.

Structure of the atomic nucleus. Stable and unstable nuclei. Alpha, beta and gamma decays. Activity; law of radioactive decay. The physics principles of PET.

Interaction of radiation with matter
Interaction of charged particles with matter: the Bethe-Bloch equation; the case of electrons and positrons. Interaction of X and gamma rays with matter: photoelectric effect, Compton effect, pair production. Biological effects of radiation; dose. Applications to imaging.

COURSEBOOKS:

- **General Physics 2nd Edition,**
  Morton Sternheim, Joseph Kane
  ED. Wiley & Sons

- **Physics 3rd Edition,**
  Morton Sternheim, Joseph Kane
  ED. Wiley & Sons

- **Fundamentals of Physics Extended, 9th Edition** (or preceding editions),
  David Halliday, Robert Resnick, Jearl Walker
  ED. Wiley & Sons

CELL AND MOLECULAR BIOLOGY

Course Coordinator:
- **Prof. Roberto Sitia *RS*: sitia.roberto@hsr.it**

Collaborators:
- **Prof. Marco Bianchi *MEB* *bianchi.marco@hsr.it***
- **Prof. Fulvio Mavilio *FM* *mavilio.fulvio@hsr.it***
- **Prof. Eelco Van Anken *EVA* *vananken.eelco@hsr.it***
- **Prof. Simone Cenci *SC* *cenci.simone@hsr.it***

Tutors:
- **Dr. Josè Garcia Manteiga garciamanteiga.josemanuel@hsr.it**
- **Dr. Isaline Rowe rowe.isaline@hsr.it**
- **Dr. Céline Schaeffer schaeffer.celine@hsr.it**
- **Dr. Emilie Venereau venereau.emilie@hsr.it**

SDS: BIO/11, BIO/13 , INF/01
Credits: 11
Lectures: 88 total hours
Practicals: 60 total hours

- **RS 1 (Tuesday, 15/03/11 h. 9-11)**

Introduction to the Course of Molecular and Cell Biology

Structure of the Course, a voyage between Systematic teaching and Problem Based Learning
-what are genes and how they work (MB)
-genetic and epigenetic mechanisms (MB)
-what are cells (RS, EvA)
-how cells divide (MB, SC)
-how cells die (SC)
-how cells know where they are and where to go (RS, EvA)
-how they interact with the environment (EvA, SC, MB, FB, RS)
-how cells differentiate (MB)
-molecular bases of disease (MB, EvA, RS)

What is life?
Where do we come from?

Introduction to our cells
Membranes, cytoskeleton, organelles.

- **RS 2 with Tiziana Anelli (Tuesday, 15/03/11 h. 14-16)**

Intracellular transport and cell movements

Microtubules, microfilaments, molecular motors
Polarity
Axonal transport
Cytoskeleton
Muscular contraction
Cilia and flagella
Microvilli

- **RS 3 with Monica Fabbri (Wednesday, 16/03/11 h. 9-11)**

Cytoskeleton and adhesion molecules

Adhesion molecules
Integrins
Tissue organization

RS 4 (Monday, 21/03/11 h. 9-11)

Evolution, Darwin and the adaptable cell structure

Prokaryotes, eukaryotes, multicellular organisms.
The evolution of specialized tissues.
Homeostasis.

- **RS 5 (Tuesday, 22/03/11 h. 9-11)**

Intracellular transport

Three main mechanisms of macromolecular transport:
-To and from the nucleus
-Membrane translocation
-Vesicular transport

Exo, endo, pino, phagocytosis
Transcytosis
Mechanisms of cell polarity

- **RS 6 (Wednesday, 23/03/11 h. 9-11)**

Cell compartmentalization

Specific signals target macromolecules to different organelles.

- **RS 7 (Thursday, 24/03/11 h. 14-16)**

Protein folding, the second genetic code

Anfinsen's demonstration of the central dogma
Chaperones and protein evolution

- **RS 8 (Monday, 28/03/11 h. 9-11)**

Protein degradation

Proteasomes, lysosomes and autophagy

- **RS 9 (Tuesday, 29/03/11 h. 9-11)**

Protein quality control and homeostasis

Stress responses in development and disease

- **RS 10 (Wednesday, 30/03/11 h. 9-11)**

Proteostasis as a signal and pathogenetic mechanism.

Mechanisms of proteotoxicity.
Molecular and cellular aging

- **RS 11 (Thursday, 31/803/11 h.14-16)**

Conformational diseases

Prions, Amyloidoses, Alzheimer & Parkinson.

- **RS12 with Domenico Cianflone (Tuesday, 05/04/11 h. 14-16)**

Where is biomedicine going?

A DNA-driven world. Craig Venter's lecture
The mystery of non-coding DNA

- **MEB 1 (Tuesday, 29/03/11 h. 14-16)**

Nuclear structure

Nuclear membrane and lamins. Nuclear pores and transport

- **MEB 2 (Wednesday, 06/04/11 h. 9-11)**

An example of transcriptional regulation.

The NF-kB system

- **MEB 3 (Thursday, 07/04/11 h. 14-16)**

Chromatin and gene expression 1

Nucleosomes. Histones and histone variants. Histone post-translational modifications, and enzymes that effect them.

- **MEB 4 (Monday, 11/04/11 h. 9-11)**

Chromatin and gene expression 2

Hetechromatin an euchromatin. How nucleosome position and histone modifications affect gene expression

- **MEB 5 (Tuesday, 12/04/11 h, 9-11)**

microRNAs, RNA interference, and transcription

miRNA, siRNA, heterocromatin and centromeres

- **FB 1 (Monday, 04/04/11 h. 9-11)**

Transcriptional Regulation of gene expression

Transcription factors, inducible and constitutive. Subnuclear structure and transcription factories. Does RNA polymerase goes to the gene or does the gene go to the polymerase?

- **FB 2 (Tuesday, 05/04/11 h. 9-11)**

Regulation of transcription by signaling mechanisms

- **FB 3 (Monday, 18/04/11 h. 9-11)**

Stem cells

- **FB 4 (Tuesday, 19/04/11 h. 9-11)**

Stem cells and cancer

- **FB 5 (Wednesday, 20/04/11 h. 9-11)**

Regulating loops

- **EvA 1 (Tuesday, 22/03/11 h. 14-16)**

Membrane Structure
Architecture, composition, membrane proteins .

- **EvA 2 (Monday, 02/05/11 h. 9-11)**

Energy conversion I
Mitochondria

- **EvA 3 (Tuesday, 03/05/11 h. 9-11)**

Energy conversion II
Chloroplasts, genetics of mitochondria & plastids, evolution of electron transport chains.

- **EvA 4 (Tuesday, 03/05/11 h.14-16)**

Cell signaling I
Principles of cell communication

- **EvA 5 (Wednesday, 04/05/11 h. 9-11)**

Cell signaling II
G protein coupled cell surface receptors.

- **EvA 6 (Thursday, 06/05/11 h. 14-16)**

Cell signaling III
Enzyme coupled cell surface receptors.

- **EvA 7 (Monday, 09/05/11 h. 9-11)**

Cell signaling IV
Unfolded Protein Response, determining cell shape.

- **EvA 8 (Tuesday, 10/05/11 h. 9-11)**

Manipulating proteins & DNA I
Cloning, cDNA libraries, tagging, PCR.

- **EvA 9 (Tuesday, 10/05/11 h. 14-16)**

Studying gene function & expression I
Function prediction, genetic screens, tagged libraries, reporter genes.

- **EvA 10 (Wednesday, 11/05/11 h. 9-11)**

Studying gene function & expression II
Reverse genetics, knock-out libraries, RNAi, complementation, epistasis & EMAP, microarray.

- **EvA 11 (Thursday, 12/05/11 h. 14-16)**

Visualizing cells I
Standard microscopy techniques.

- **EvA 12 (Tuesday, 17/05/11 h. 9-11)**

Visualizing cells II
Advanced microscopy techniques

- **EvA 13 with Antonio Siccardi (Wednesday, 18/05/11 h. 9-11)**

A historical perspective
The Luria-Delbruck experiment .

- **SC 1 (Tuesday, 12/04/11 h. 14-16)**

Cell cycle 1
Phases and logics of the cell cycle. Experimental approaches. The Cell Cycle Control System. Engineering checkpoints. Significance of G phases. Molecular players: cyclins, cyclin-dependent kinases, Cdk inhibitors.

- **SC 02 (Wednesday, 13/04/11 h. 9-11)**

Cell cycle 2
Regulatory strategies: cyclic degradation, post-translational modofocations, de novo synthesis. Checkpoints in G1 and G2. Preventing DNA re-replication. Cdc25 and regulation of M-Cdk activity. Rb and E2F: the restriction point and the Skp2 autoinduction loop. The DNA damage checkpoints. p53 and p14/19ARF. Cancer as a cell cycle disease.

- **SC 03 (Thursday, 14/04/11 h. 14-16)**

Mitosis

Phases and mechanics. Cohesins and condensins. Centrosome, microtubules and the mitotic spindle. Role of motor proteins. Mechanisms of high-fidelity segregation: centromere and kinetochore. Mechanics of anaphase. Functions of chromokinesins. Cytokinesis. Drugs targeting mitosis and their clinical relevance.

- **SC 04 (Tuesday, 19/04/11 h. 14-16)**

Apoptosis - I

Functional significance: apoptosis vs. necrosis. Methods to study and monitor apoptosis. Functions in physiology and disease. Mechanisms: extrinsic vs. intrinsic apoptosis. Caspases: redundancy, efficiency, velocity. Death receptors and the Death-Inducing Signaling Complex (DISC). Mitochondria as signal integrators and death executors. The Apoptosome. Mitochondrial Outer Membrane Permeabilization (MOMP). The Bcl2 family: sensors/transducers, brakes, and effectors. Inhibitors of Apoptosis (IAPs)..

- **SC 05 (Tuesday, 17/05/11 h. 14-16)**

Apoptosis - II

Apoptosis and the integrated stress response. Stress specificity of BH3-onlies. The other functions of Bcl2 proteins: daily jobs of night killers. Mitochondria and ER cross-talk. ER calcium homeostasis and apoptosis. Regulation by the unfolded protein response and heat shock proteins. Proteotoxic apoptosis.

- **SC 06 (Monday, 23/05/11 h. 9-11)**

Apoptosis- III

Integrating Cell Cycle, Apoptosis, and Cancer. Apoptotic escapes from the cell cycle. Apoptosis from cytotoxic vs. genotoxic stress. Maladaptive thresholds: implications for cancer pathogenesis and therapy. Alternative forms of eukaryotic cell death: autophagy, paraptosis, pyroptosis. Autophagy in physiology and disease.

EvA 14 S1 Group 1 Tutor: Jose Garcia Manteiga
EvA 15 S2 Group 4 Tutor: TBN
RS 13 S3 Group 2 Tutor: Isaline Rowe
RS 14 S4 Group 3 Tutor: Celine Schaeffer

USMLE REQUIREMENTS

Biology of cells

• adaptive cell responses and cellular homeostasis
• intracellular accumulations
• mechanisms of injury and necrosis
• apoptosis
• mechanisms of dysregulation
- cell biology of cancer, including genetics of cancer
- general principles of invasion and metastasis, including cancer staging
• cell/tissue structure, regulation, and function, including cytoskeleton, organelles, glycolipids, channels, gap
junctions, extracellular matrix, and receptors

Molecular biology

• gene expression: DNA structure, replication, exchange, and epigenetics
• gene expression: transcription
• gene expression: translation, post-translational processing, modifications, and disposition of proteins
(degradation), including protein/glycoprotein synthesis, intra/extracellular sorting, and processes/functions
related to Golgi complex and rough endoplasmic reticulum
• structure and function of proteins and enzymes
• energy metabolism

COURSEBOOKS:

- Molecular Biology of the Cell
  Bruce Alberts, Alexander Johnson
  ED. Garland Science - ISBN: 978-0815341062
- Molecular Cell Biology
  Harvey Lodish, A. Berk, C. Kaiser….
  ED-W.H Freedom – ISBN: 978-0716776017
- Essential cell biology
  Alberts, Bray, et al. www.garlandscience.com/text**books**/081533480X.asp
- Cells
  Lewin, Cassimeris et al.
- Cell Biology
  Thomas Pollard, William Earnshaw
  ED.Saunders W.B ISBN: 978-1416022558
- Cell Biology
  Gerald Karp,
  ED. John Wiley & Sons Inc ISBN 978-0470505762

The above books contain all the essential notions, differing primarily in the style of presentation.

Suggested readings

We encourage our students to read on science, medicine and society. Below are a few tips.

M. Perutz. *Is science necessary?* and/or *I wish I made you angry before.*
Two lovely series of essays on science and scientists.

J. Diamond. *Germs, guns and steel.*
A brief summary of the last 13000 years of humans… Why did some civilisations prevail?

J. Monod *Chance and necessity.*
A Nobel Prize winner in Medicine tackles fundamental philosophical issues

J.D. Watson. *The double helix.*
Watson tells the story of how the structure of DNA was solved, with the pace of a crime fiction novel.

P. Medawar. *Advice to a young scientist.*
A few useful tips, should you decide to become a physician scientist. A thoroughly enjoyable book..

GENETICS AND DEVELOPMENTAL BIOLOGY

Course Coordinator:
- **Prof. Giorgio Casari: casari.giorgio@hsr.it**

Collaborators:
- **Prof. Giangiacomo Consalez: consalez.giangiacomo@hsr.it**
- **Prof. Luca Rampoldi: rampoldi.luca@hsr.it**

SDS: BIO /13 MED /03
Credits: 12
Lectures: 96 hours

Topics covered by the course

Mendelian and non-Mendelian genetics

1. Course introduction_ The Human Genome Project.
2. Mendelian Inheritance (I)_Definition of gene, locus, allele. The first Mendel's law.
3. Mendelian Inheritance (II)_The second and third Mendel's laws. Segregation and independent assortment.
4. Exceptions to Mendelian inheritance_Incomplete dominance, co-dominance. Penetrance and expressivity.
5. Exceptions to Mendelian inheritance_Sex-related effects. Pleiotropy. Pedigree design_2
6. Chromosomes/mitosis/meiosis_Chromosome structure (telomeres, centromere) and segregation during mitosis and meiosis. Crossing-over.
7. Chromosome structure_Chromatin structure and function. Histones and nucleosomes. Chromatin remodelling.
8. Recombination/mapping (I)_Molecular basis of recombination.
9. Recombination/mapping (II)_Recombination as a measure of genetic linkage. Mapping in bacteria and Drosophila.
10. Non-Mendelian inheritance (I)_Gene conversion. De-novo mutations. Mosaicism (X-inactivation).
11. Non-Mendelian inheritance (II)_Epigenetic control of gene expression. Imprinting.
12. Dynamic mutations (I)
13. Dynamic mutations (II)
14. Mitochondrial Inheritance
15. Chromosome mutations
16. Cytogenetics
17. CGH
18. DNA/RNA structure

19. Transcription/translation_Gene structure and transcription. The genetic code, structure of tRNA and ribosome.
20. Translation. Mechanisms of splicing
21. RNA interference_miRNA, siRNA, shRNA. Discovery and applications.
22. Point mutations and repair_Spontaneus and induced mutations. Repair of mutations and recombination.
23. Nonsense mediated decay
24. Complex mutations/polymorphisms/CNVs
25. Mutation detection techniques
26. Deep sequencing
27. Effect of mutations (gain/loss-of-function)_Gain-of-function and loss-of-function effect of mutations. Negative dominance.
28. Effect of mutations (ESE)
29. Genetic markers_DNA markers (microsatellites, SNPs). Genetic maps. Haplotype maps (the HaploMap project).
30. Genetic Mapping (I)_Linkage analysis in human pedigrees. LOD score calculation.
31. Genetic Mapping (II)_Linkage analysis in human pedigrees. Haplotype analysis.
32. Probability_Bayes' theorem, application for risk calculation in human pedigrees.
33. Examples of linkage/positional cloning
34. Examples of functional cloning
35. Quantitative Trait Loci
36. Population genetics_1
37. Population genetics_2
38. Molecular Evolution (I)
39. Non-parametric linkage analysis/association studies
40. Jolly

Embryology and developmental biology

This part of the course will cover the essentials of normal human development and of its main aberrations, providing information on some recognizable patterns of human malformation.

Topics covered by the course

General Embryology

- Gametogenesis: Conversion of Germ Cells into Male and female gametes,
- First Week of Development: ovulation to implantation
- Second Week of Development: Bilaminar Germ Disc
- Third Week of Development: Trilaminar, Germ Disc
- Third to Eighth weeks: The Embryonic Period
- Third Month to Birth: The Fetus and Placenta

Systems-based Embryology

- Skeletal System
- Muscular System
- Body Cavities,
- Cardiovascular System
- Respiratory System
- Digestive System
- Urogenital System
- Head and Neck
- Central Nervous System
- Ear and eye development
- Tegumentary System

USMLE REQUIREMENTS

Human development and genetics
• principles of pedigree analysis
- inheritance patterns
- occurrence and recurrence risk determination
• population genetics: Hardy-Weinberg law, founder effects, mutation-selection equilibrium
• principles of gene therapy
• genetic testing and counselling
• genetic mechanisms

COURSEBOOKS:

- **Langman's Medical Embryology / Edition11,**
  Thomas W.Sadler ,
  ED. Lippincott Williams & Wilkins
  ISBN: -13: 9780781790697

- **Human Molecular Genetics 3rd Edition,**
  Tom Strachan, Andrew Read
  ED: Garland Science - ISBN:0-8153-4184-9

MEDICAL HUMANITIES

Prof. Andrea Moro: andrea.moro@iusspavia.it

SDS: L-LIN/01
Credits: 1
Lectures: 10 total hours

Topics covered by the course

On the biological foundations of language: the linguistics perspective

1 &2. A short history of linguistics
3.The XX century: language(s), machines and children
4.The architecture of human language
5.Recursion or the specific differences with respect to other animals' codes
6.Grammar like a crystal: the universals of language (syntax)
7.Grammar like a crystal: the universal of language (semantics)
8.The brain and the mystery of impossible languages
9.Does the structure of the world influence the structure of language (and viceversa)?
10.Language, genetics and evolution

Coursebooks:

- The Generative Enterprise Rivisited, [selected parts]
  Noam Chompsky (2004) ,

- The Boundaries of Babel
  Andrea Moro (2010, paperback edition).
  [chapter 1 and 2]