ISC 1105: Semester One

Subject	Topic	# lect	Chapter	# pages	Total
Biology (12 lect)	Diversity of Life	1	Raven 1	15	100
	Population Dynamics • Resource allocation, exponential growth • Resource limitation, logistic growth • Age-structured populations, life-history • Human demography	4	Raven 55	20	
	Community Ecology • Competition, ecological niche • Predation • Natural resource management	4	Raven 56	20	
	Ecosystems • Nutrient cycling & energy flow • Biodiversity	2	Raven 57	22	
	Conservation Biology	1	Raven 59	23	
Chemistry (11 lect)	Atoms & Molecules • Laws of definite & multiple proportions • Dalton, Cannizzaro & Avogadro	1	Zumdahl 2	8	210
	Stoichiometry • The mole • Percent composition • Balancing chemical equations • Stoichiometric calculations	2	Zumdahl 3	40	
	Types of Reactions • Aqueous solutions • Acid-base reactions • Oxidation-reduction reactions	2	Zumdahl 4	40	
	Kinetics • First- and second-order reactions • Non-elementary reactions • Enzyme-catalyzed reactions	3	Zumdahl 15	37	
	Equilibrium • Law of mass action • Le Chatelier's principle	1	Zumdahl 6	35	
	Acids & Bases • pH • Strong and weak acids; bases	1	Zumdahl 7	20	
	Aqueous Equilibria • Buffer solutions • Titration curves	1	Zumdahl 8	30	

Physics (15 lect)	Concepts of motion	1	Knight 1	30	350
	Vectors and coordinate systems	1	Knight 3	25	
	Kinematics in 1d and 2d	2	Knight 2, 4	65	
	Force and motion	1	Knight 5	20	
	Newton's third law	1	Knight 7	25	
	Dynamics in 1d and 2d	2	Knight 6, 8	60	
	Impulse and momentum	1	Knight 9	25	
	Energy	2	Knight 10	30	
	Work	1	Knight 11	30	
	Rotation of rigid bodies	2	Knight 12	40	
	Biomechanics	1			
Math (16 lect)	Discrete-time Dynamical Systems • Variables, functions, units, dimensions • Updating functions • Cobwebbing • Stable and unstable equilibria • Exponential growth	3	Adler 1	90	375
	Limits & Derivatives • Rate of change • Continuity • Rules of differentiation • Second derivative • Exponential and log functions • Chain rule	3	Adler 2	90	
	Applications of Derivatives • Discrete dynamical systems • Maxima and minima • Limiting behavior & leading behavior	3	Adler 3	75	
	Integrals and Applications • Differential equations and antiderivatives • Rules of integration • Riemann sums • Fundamental theorem of calculus • Applications of integrals • Infinite limits of integration	4	Adler 4	60	
	Autonomous Differential Equations	3	Adler 5	60	
5 periods	Intro, reviews, tests, etc.				
59	Total # 75 min periods				

ISC 1106: Semester Two

Subject	Topic	# lect	Chapter	# pages	Total
Biology (22 lect)	Mendelian Genetics • Traits, phenotypes, genotypes • Monohybrid & dihybrid crosses • Dominant & recessive traits • Chi-square test	4	Raven 12	18	165
	Chromosomal Theory of Inheritance • Meiosis • Sex determination	1	Raven 13	17	
	Population Genetics • Hardy-Weinberg equilibrium • Five agents of evolution • Natural selection	3	Raven 20	20	
	Evolutionary Biology • Evidences for evolution • Evolutionary clocks	2	Raven 21	20	
	Origin of Species • Biological species concept • Natural selection & reproductive isolation • Genetic drift	2	Raven 22	20	
	DNA: Structure and Function • The double helix • DNA replication	2	Raven 14	20	
	Proteins: Structure and Function • Amino acids & peptide bond • Primary, secondary, tertiary structure • Enzyme action	3	Raven 3	10	
	Hemoglobin & sickle-cell anemia (optional)	1			
	Biotechnology • Recombinant DNA • PCR • Applications	2	Raven 17	20	
	Genomics • Sequencing genomes • Sequence comparisons • Applications	2	Raven 18	20	
Chemistry (19 lect)	Gases • Ideal gas law • Kinetic theory	1	Zumdahl 5	20	210
	Energy, Enthalpy & Thermochemistry • Heat, work and internal energy	2	Zumdahl 9	45	

	• Calorimetry • Standard enthalpies				
	Entropy & Free Energy • Reversible and irreversible reactions • Wrev and free energy • Free energy calculations	3	Zumdahl 10	50	
	Organic and Biochemistry • Alkanes, alkenes, alkynes • Aromatic hydrocarbons • Carbonyl chemistry • Polymers • Proteins, carbohydrates	4	Zumdahl 21	40	
	Biochemistry • Organic oxidation series • Reaction mechanisms	5			
	Bonding • Ionic and covalent bonds • Lewis structures • VSEPR and molecular shapes • Introduction to molecular orbitals	4	Zumdahl 13	55	
Physics (11 lect)	Gravitation	1	Knight 13	20	165
	Oscillations	2	Knight 14	30	
	Temperature and ideal gases	2	Knight 16	25	
	Work, heat, and the First Law of Thermodynamics	2	Knight 17	30	
	The micro/macro connection	2	Knight 18	25	
	Heat engines and refrigerators	2	Knight 19	35	
Math (2 lect)	Trigonometric functions • Frequency, amplitude, phase • Derivatives and integrals	2	Adler 1.8, 2.10	20	20
5 periods	Intro, reviews, tests, etc.				
59	Total # 75 min periods				

ISC 2105: Semester Three

Subject	Topic	# lect	Chapter	# pages	Total
Biology (22 lect)	Energy and Metabolism • ATP • Enzymes • Overview of metabolism	2	Raven 6	12	145
	Oxidation of Sugar, Protein & Fat • Glycolysis • Krebs cycle • Electron transport chain • Oxidative phosphorylation • Catabolism of proteins and fats	5	Raven 7	23	
	Photosynthesis • Photosystems • Light reactions • Dark reactions • Photorespiration • C4 photosynthesis • Evolution of metabolism & photosynthesis	4	Raven 8	20	
	Membranes • Structure and function • Facilitated diffusion • Membrane potential (Donnan equil) • Active transport mechanisms • Action potentials	4	Raven 5	15	
	Nerve Impulses & Synapses	1	Raven 43 Adler 5.8	10 5	
	Control of Gene Expression • Lac operon • Trp operon • Regulatory mechanisms in eukaryotes • Protein degradation	4	Raven 15 Raven 16	25 20	
	Cell Signalling • Ligands and receptors • Receptor kinases • G-protein coupled receptors	2	Raven 9	15	
Chemistry (5 lect)	Electrochemistry • Galvanic cells • Standard reduction potential • Electrical work, Nernst equation	3	Zumdahl 11	15	40
	Properties of Solutions • Thermodynamics	2	Zumdahl 17	25	

	• Colligative properties				
Physics (20 lect)	Traveling waves and superposition	3	Knight 20, 21	60	375
	Electric charges and forces	1	Knight 25	30	
	Electric field	1	Knight 26	30	
	Gauss's Law	1	Knight 27	30	
	Electric potential, capacitance	3	Knight 28, 29	60	
	Current and resistance	1	Knight 30	25	
	Fundamentals of circuits	2	Knight 31	25	
	Magnetic field	2	Knight 32	35	
	Electromagnetic induction	2	Knight 33	35	
	Electromagnetic fields and waves	2	Knight 34	25	
	AC circuits	2	Knight 35	20	
Math/Stat (6 lect)	Linear Algebra • Vectors • Matrices • Determinants • Eigenvalues and eigenvectors • Problem based applications	6	Math Emporium or ISC Notes	--	
6 periods	Intro, reviews, tests, etc.				
59	Total # 75 min periods				

ISC 2106: Semester Four

Subject	Topic	# lect	Chapter	# pages	Total
Biology (11 lect)	Development • Cell differentiation • Nuclear reprogramming • Early embryonic development • Fruit fly segmentation genes • Morphogen gradients • Evolution of development	4	Raven 19 Raven 25	20 10	
	Cell Cycle Control • G1, S, G2, M; checkpoints • Cyclin-dependent kinases • Cancer	3	Raven 10	20	
	Immune System (optional) • Innate immunity • Adaptive immunity • Antigens and antibodies • Pathogens	2	Raven 51	25	
	Stochastic Gene Expression • RNA fluctuations • Protein fluctuations	2			
Chemistry (7 lect)	Atomic Theory • Electrons, protons, neutrons • Bohr atom • Wave mechanics • Schrodinger's equation for H atom • Quantum numbers • Aufbau principle	1	Zumdahl 12	35	80
	Covalent Bonding • Molecular orbitals • Spectroscopy	2	Zumdahl 14	45	
	Diffusion • Fick's laws • Reaction-diffusion equation • Applications	4			
Math/Stat (12 lect)	Statistics and Probability Theory • Probability, conditional prob, Bayes Thm • Prob density functions (PDFs), CDFs • Random variables, expectation • Descriptive statistics, variance	6	Adler 6.3-6.9	80	145
	Binomial and Normal Distributions • Binomial distribution	4	Adler 7.4-7.5,	20 20	

	• Normal distribution • Random walk and diffusion		7.8-7.9		
	Other Distributions • Geometric distribution • Exponential distribution • Poisson distribution	2	Adler 7.6-7.7	25	
Physics (12 lect)	Quantization	1	Knight 38	30	210
	Matter waves	1	Knight 39	20	
	Quantum Mechanics	1	Knight 40	35	
	Atomic physics	1	Knight 41	30	
	Wave optics	3	Knight 22	30	
	Ray optics	2	Knight 23	40	
	Optical instruments	1	Knight 24	25	
	Topics in Biophysics	2			
(12 lect)	Student Presentation	12			
5 periods	Intro, reviews, tests, etc.				
59	Total # 75 min periods				

Summary

Subject	# lect (%)	Textbook	# ch	# pages/total #
Biology	67 (28%)	Raven, Johnson, etc., Biology	26	480/1280 = 38%
Chemistry	42 (18%)	Zumdahl & DeCoste, Chemical Principles	16	540/1080 = 50%
Physics	58 (25%)	Knight, Physics for Scientists and Engineers	38	1180/1280 = 92%
Math/Stat	36 (15%)	Adler, Modeling the Dynamics of Life	8	600/800 = 75%
Other	33 (14%)	Intros, tests, reviews, student present'ns		
Total:	236 (100%)			

Notes to Students:

Biology: ISC covers the same chapters in Raven as "Principles of Biology" except for Plant Biology (Chapters 30, 31, 36-41) and Animal Biology (Chapters 42, 44-50, 52, 53). To gain exposure to these aspects of biology, ISC students majoring in Biological Sciences or Microbiology are expected to co-enroll in BIOL 1106 (3C) in parallel with ISC 1106 (8C). Furthermore, ISC students majoring in Biological Sciences should plan to enroll in BIOL 2804 (Ecology) and BIOL 2004 (Genetics) during their sophomore year and to put off enrollment in BIOL 2104 (Cell & Molecular) and BIOL 2704 (Evolutionary Biol) until their junior year. Students planning to major in Microbiology should take BIOL 2604 (General Microbiology) in the spring semester of their sophomore year. ISC students majoring in biology, biochemistry or other life sciences should take organic chemistry (CHEM 2535-36 + lab) in their sophomore year.

Chemistry: ISC covers the same chapters in Zumdahl as CHEM 1055-56 except chapters 16, 18, 19. ISC students seeking a B.A. in Chemistry will have to pick up this information on their own, as needed for advanced courses.

Physics: ISC covers most of the material in "Foundations of Physics". However, physics majors will not get "electricity and magnetism" in the ISC until year two—not in time for a sophomore level course taken by all Physics majors that has introductory E&M as a prerequisite. Physics majors in ISC are therefore required to take the second semester of University Physics (PHYS 2306) as a pass/fail special course.

Mathematics and Statistics: ISC covers elementary linear algebra (MATH 1114) and calculus (MATH 1205-06). Students who take all four semesters of ISC will be given equivalence for these math courses, as may be required by any major in the College of Science. If ISC students need equivalence for MATH 1225-26, then they must co-enroll for a one-credit math-supplement course (ISC 2984) in parallel with ISC 1105, and they must enroll in MATH 1226, preferably in the second semester of their freshman year. The ISC does not provide equivalence for any statistics requirements, e.g., biological statistics (STAT 3615).

General: Although ISC students do not receive instruction in all the material covered in the standard curriculum, they are exposed to important scientific material that is not covered in the standard curriculum. And they are trained in interdisciplinary thinking across the physical, chemical, biological and mathematical sciences. In addition, they gain experience in team science, critical thinking, oral and written presentation and other skills that are not taught in the standard curriculum at the freshman-sophomore level.

Notes to Faculty:

ISC faculty are expected to teach the subject matter listed for each semester of the master syllabus, so that teachers of later semesters will have reliable expectations of the material ISC students have already seen. For any given semester, the instructors may decide on the sequence in which the topics are presented, depending on how they plan to integrate the subject matter. However, they should coordinate the lecture material with the syllabus of the ISC laboratory for that semester. Within each discipline the specific number of lectures assigned to each topic in the master syllabus is only a suggestion based on past experience. Individual instructors may vary the emphasis placed on each topic and the issues raised as illustrations of "integrated" scientific problems. The overall emphasis given to each discipline in each semester, however, should not deviate greatly from the guidelines in the master syllabus, except by permission from the director of the ISC.

Faculty are encouraged to personalize the course with examples taken from their own teaching and research interests, especially examples that illustrate the interplay of different scientific points of view. Faculty are encouraged to make the best case studies available to teachers who follow after in the form of lecture notes, problem sets, handouts, etc.