Thinking About Biology

The Fundamentals of Scientific Research: An Introductory Laboratory Manual is a laboratory manual geared towards first semester undergraduates enrolled in general biology courses focusing on cell biology. This laboratory curriculum centers on studying a single organism throughout the entire semester – Serratia marcescens, or S. marcescens, a bacterium unique in its production of the red pigment prodigiosin. The manual separates the laboratory course into two separate modules. The first module familiarizes students with the organism and lab equipment by performing growth curves, Lowry protein assays, quantifying prodigiosin and ATP production, and by performing complementation studies to understand the biochemical pathway responsible for prodigiosin production. Students learn to use Microsoft Excel to prepare and present data in graphical format, and how to calculate their data into meaningful numbers that can be compared across experiments. The second module requires that the students employ UV mutagenesis to generate hyper-pigmented mutants of S. marcescens for further characterization. Students use experimental data and protocols learned in the first module to help them develop their own hypotheses, experimental protocols, and to analyze their own data. Before each lab, students are required to answer questions designed to probe their understanding of required pre-laboratory reading materials. Questions also guide the students through the development of hypotheses and predictions. Following each laboratory, students then answer a series of post-laboratory questions to guide them through the presentation and analysis of their data, and how to place their data into the context of primary literature. Students are also asked to review their initial hypotheses and predictions to determine if their conclusions are supportive. A formal laboratory report is also to be completed after each module, in a format similar to that of primary scientific literature. The Fundamentals of Scientific Research: An Introductory Laboratory Manual is an invaluable resource to undergraduates majoring in the life sciences.

Chaired by K Wüthrich (Nobel Laureate in Chemistry, 2002) and co-chaired by B Weckhuysen, this by-invitation-only conference has gathered 39 participants — who are leaders in the field of computational modeling and its applications in Chemistry, Material Sciences and Biology. Highlights of the Conference Proceedings are short, prepared statements by all the participants and the records of lively discussions on the current and future perspectives in the field of computational modeling, from chemistry to materials to biology.

Note: This text is the instructor’s version. For student use, order Handelsman et al: Biology Brought to Life Lab Manual (0-07-282374-7). Biology Brought to Life is a unique guide for helping instructors promote active learning in the biology classroom. This manual provides practical advice and detailed instructions for implementing open-ended experiments, cooperative learning, and exercises that enhance learning skills in large or small introductory biology courses. Its methods are designed to excite students about science, to foster analytical and critical thinking skills, and to reach a broad group of students with diverse learning styles. Biology Brought to Life features eleven open-ended experiments that illustrate fundamental principles of biology and teach students how to apply the scientific method to investigation of biological problems. The Instructor's Version also presents general principles for using cooperative learning and specific examples of how to apply those principles in a biology course. The materials are intended for majors and nonmajors biology courses and for biology instructors looking for ways to incorporate inquiry-based, active learning and microbiological examples into their courses.

Biologists often study living systems in light of their having evolved, of their being the products of various processes of heredity, adaptation, ancestry, and so on. In their investigations, then, biologists think comparatively: they situate lineages into models of those evolutionary processes, comparing their targets with ancestral relatives and with analogous evolutionary outcomes. This element characterizes this mode of investigation - 'comparative thinking' - and puts it to work in understanding why biological science takes the shape it does. Importantly, comparative thinking is local: what we can do with knowledge of a lineage is limited by the evolutionary processes into which it fits. In light of this analysis, the Element examines the experimental study of animal cognition, and macroevolutionary investigation of the 'shape of life', demonstrating the importance of comparative thinking in understanding both the power and limitations of biological knowledge.

Subtle-body practices are found particularly in Indian, Indo-Tibetan and East Asian societies, but have become increasingly familiar in Western societies, especially through the various healing and yogic techniques and exercises associated with them. This book explores subtle-body practices from a variety of perspectives, and includes both studies of these practices in Asian and Western contexts. The book discusses how subtle-body practices assume a quasi-material level of human existence that is intermediate between conventional concepts of body and mind. Often, this level is conceived of in terms of an invisible structure of channels, associated with the human body, through which flows of quasi-material substance take place. Contributors look at how subtle-body concepts form the basic explanatory structure for a wide range of practices. These include forms of healing, modes of exercise and martial arts as well as religious practices aimed at the refinement and transformation of the human mindbody complex. By highlighting how subtle-body practices of many kinds have been introduced into Western societies in recent years, the book explores the possibilities for new models of understanding which these concepts open up. It is a useful contribution to studies on Asian Religion and Philosophy.

Baum and Smith, both professors evolutionary biology and researchers in the field of systematics, present this highly accessible introduction to phylogenetics and its importance in modern biology. Ever since Darwin, the evolutionary histories of organisms have been portrayed in the form of branching trees or "phylogenies." However, the broad significance of the phylogenetic trees has come to be appreciated only quite recently. Phylogenetics has myriad applications in biology, from discovering the features present in ancestral organisms, to finding the sources of invasive species and infectious diseases, to identifying our closest living (and extinct) hominid relatives. Taking a conceptual approach, Tree Thinking introduces readers to the interpretation of phylogenetic trees, how these trees can be reconstructed, and how they can be used to answer biological questions. Examples and vivid metaphors are incorporated throughout, and each chapter concludes with a set of problems, valuable for both students and teachers. Tree Thinking is must-have textbook for any student seeking a solid foundation in this fundamental area of evolutionary biology.

This inexpensive supplemental guide offers insights not only into what biologists think, but how they think, by discussing the nature of scientific thinking and the primary thinking

patterns that biologists use to generate and test alternative hypotheses.

Atheists assert that the natural world has no meaning or purpose. Dr Denis Alexander, Emeritus Director of The Faraday Institute for Science and Religion at St. Edmunds College, Cambridge, draws a different conclusion. Not only do recent evolutionary biological data appear inconsistent with the claim that the world is purposeless, but the Christian doctrine of creation has provided and continues to provide both context and stimulus for the study of the natural world. Christians started biology! However, is a belief in an omnipotent, benign Creator consistent with a world of pain and suffering? From a lifetime's study in the biological sciences, Denis Alexander believes that whilst the cost of existence is extremely high, it can nonetheless be squared with the idea of a God of love whose ultimate purposes for humankind render that cost more comprehensible.

Thinking about Biology is intended for biology students who are interested in reflecting on the wider contexts of their studies. This 2003 book encourages students to see that biology does not deliver certainties; it discusses how biological ideas become established facts; it uses history to examine how ideas change, and to show that the biological facts that form the basis of a biology course are likely to change too. Each chapter is based on biological topics, and examines them for their philosophical, social and political implications. Topics covered include the role of natural selection in evolution, the history of ideas about fertilisation and inheritance, vivisection, and reductionism. Genetically modified foods, xenotransplantation, eugenics, and genetic testing are some of the controversial subjects discussed. Thinking About Biology should be essential reading for all college students already taking a biology course, and for those contemplating such a course in the future.

This book discusses the emergence of life, the development of the individual, and the study of the interaction between individuals and species. It gives the student of theoretical biology some idea of the flavor of current research in the field.

The American Association for the Advancement of Science's report on Vision and Change in Undergraduate Biology Education suggests that instructors "can no longer rely solely on trying to cover a syllabus packed with topics" but rather should "introduce fewer concepts but present them in greater depth." They further suggest that the principles embodied in a set of core concepts and competencies should be the basis for all undergraduate biology courses, including those designed for nonmajors. The theme of Tools for Critical Thinking in Biology will be the first and most fundamental of these competencies: the ability to apply the process of science. Biology courses and curricula must engage students in how scientific inquiry is conducted, including evaluating and interpreting scientific explanations of the natural world. The book uses diverse examples to illustrate how experiments work, how hypotheses can be tested by systematic and comparative observations when experiments aren't possible, how models are useful in science, and how sound decisions can be based on the weight of evidence even when uncertainty remains. These are fundamental issues in the process of science that are important for everyone to understand, whether they pursue careers in science or not. Where other introductory biology textbooks are organized scientific concepts, Tools for Critical Thinking in Biology will instead show how methods can be used to test hypotheses in fields as different as ecology and medicine, using contemporary case studies. The book will provide students with a deeper understanding of the strengths and weaknesses of such methods for answering new questions, and will thereby change the way they think about the fundamentals of biology.

The authors describe mostly in non-technical language the development of a new scientific paradigm based on nonlinear deterministic dynamics and fractal geometry. The concepts from these two mathematical disciplines are interwoven with data from the physical, social and life sciences. In this way rather sophisticated mathematical concepts are made accessible through experimental data from various disciplines, and the formalism is relegated to appendices. It is shown that the complexity of natural and social phenomena invariably lead to inverse power law distributions, both in terms of probabilities and spectra. This book tries to show how to think differently about familiar phenomena, such as why the bell-shape curve ought not to be used in teaching or in the characterization of such complex phenomena as intelligence. Contents:Lure of Modern ScienceLinear Spaces and Geometry in Natural PhilosophyNoise in Natural PhilosophySelf-Similarity, Fractals and MeasurementsMaps and DynamicsDynamics in Fractal Dimensions Readership: Students of biology, physics and the social sciences. keywords:Scaling;Time Series;Nonlinear Dynamics;Chaos;Fractal Processes;Fractal Dimensions;Nonlinear Maps;Modeling;Complexity“Like a review article, topics are chosen to reflect scholarly importance, and every idea and concept is well documented with ample references to the literature. Like a trade book, the book does not require extensive background in physics and has a style that makes it hard to put down … The book, in fact, is the among the best introductions for the newcomer to the area of 'statistical thinking' that I have seen … I recommend this book to undergraduates and beginning graduate students who want to get a concrete impression of what many statistical mechanicians are actually doing today.”Journal of Statistical Physics “It provides the reader with a good grounding in nonlinear science and, at the same time, a superb critique of the traditional natural science approaches that often dominate our thinking.”Complexity and Chaos in Nursing

How can educators bridge the gap between "big" ideas about teaching students to think and educational practice? This book addresses this question by a unique combination of theory, field experience and elaborate educational research. Its basic idea is to look at science instruction with regard to two sets of explicit goals: one set refers to teaching science concepts and the second set refers to teaching higher order thinking. This book tells about how thinking can be taught not only in the rare and unique conditions that are so typical of affluent experimental educational projects but also in the less privileged but much more common conditions of educational practice that most schools have to endure. It provides empirical evidence showing that students from all academic levels actually improve their thinking and their scientific knowledge following the thinking curricula, and

discusses specific means for teaching higher order thinking to students with low academic achievements. The second part of the book addresses issues that pertain to teachers' professional development and to their knowledge and beliefs regarding the teaching of higher order thinking. This book is intended for a very large audience: researchers (including graduate students), curricular designers, practicing and pre-service teachers, college students, teacher educators and those interested in educational reform. Although the book is primarily about the development of thinking in science classrooms, most of it chapters may be of interest to educators from all disciplines.

This book describes the latest advances in systems biology in four plant-based marine ecosystems: seaweeds, seagrasses, microalgae, and corals. Marine organisms that inhabit the oceanic environment experience a diverse range of environmental fluctuations, anthropogenic stress, and threats from invasive species and pathogens. System biology integrates physiology, genomics, transcriptomics, proteomics, and metabolomics into numerical models and is emerging as an important approach to elucidate the functional adaptations of marine organisms to adverse environmental conditions. This book focuses on how ecophysiology, omics platforms, their integration (a systems biology perspective), and next generation sequencing tools are being used to address the stress response of marine seaweeds, seagrasses, corals, marine microbe diversity, and micro- and macroalgae/corals-bacterial interactions to global climate change and anthropogenic activities. The contents of the book are of special interest to graduate and postgraduate marine biology students and marine biology researchers, particularly those interested in marine ecology, stress physiology of marine macrophytes/corals/phytoplankton, and environmental microbiology. This book would also be of interest to marine engineers engaged in the management and conservation of our valuable marine resources.

A practical undergraduate textbook for maths-shy biology students showing how basic maths reveals important insights.

Evolution is the central unifying theme of biology. Yet today, more than a century and a half after Charles Darwin proposed the idea of evolution through natural selection, the topic is often relegated to a handful of chapters in textbooks and a few class sessions in introductory biology courses, if covered at all. In recent years, a movement has been gaining momentum that is aimed at radically changing this situation. On October 25-26, 2011, the Board on Life Sciences of the National Research Council and the National Academy of Sciences held a national convocation in Washington, DC, to explore the many issues associated with teaching evolution across the curriculum. Thinking Evolutionarily: Evolution Education Across the Life Sciences: Summary of a Convocation summarizes the goals, presentations, and discussions of the convocation. The goals were to articulate issues, showcase resources that are currently available or under development, and begin to develop a strategic plan for engaging all of the sectors represented at the convocation in future work to make evolution a central focus of all courses in the life sciences, and especially into introductory biology courses at the college and high school levels, though participants also discussed learning in earlier grades and life-long learning. Thinking Evolutionarily: Evolution Education Across the Life Sciences: Summary of a Convocation covers the broader issues associated with learning about the nature, processes, and limits of science, since understanding evolutionary science requires a more general appreciation of how science works. This report explains the major themes that recurred throughout the convocation, including the structure and content of curricula, the processes of teaching and learning about evolution, the tensions that can arise in the classroom, and the target audiences for evolution education.

[This book] presents the fundamental concepts of biology and develops students' critical thinking skills to apply these concepts ... [It introduces] the procedures of hypothesis formation, prediction, experimental design, and interpretation ... as the essential parts of scientific investigation ... [It covers] cell theory [and] focus[es] on energy, as well as the catalytic action of enzymes, and diffusion across cell membranes ... [It covers] the major physiological systems in organisms ... Primary emphasis is placed on the application of basic concepts such as diffusion, osmosis, energy capture and release, and the action of enzymes ... [This book] include[s] molecular biology and population genetics, as well as cell division and Mendelian inheritance ... [It finally] cover[s] the mechanisms of selection and speciation as well as the long range implications of evolution.-Pref.

Since its emergence over two decades ago, the construct of pedagogical content knowledge (PCK) has significantly impacted preservice and inservice teacher education, educational policy, and educational research. PCK has served to re-focus educators' attention on the important role of subject matter in educational practice and away from the more generic approach to teacher education that dominated the field prior to 1975. This ambitious text is the first of its kind to summarize the theory, research, and practice related to pedagogical content knowledge. The audience is provided with a functional understanding of the basic tenets of the construct as well as its applications to research on science teacher education and the development of science teacher education programs. The authors are prominent educators representing a variety of subject matter areas and K-12 grade levels. Although the focus of the text is science education, it should provide valuable reading for any individuals with interests in professional teacher education.

This book considers the complexities of human nature from a biological, psychological, and evolutionary standpoint and demonstrates how common modern behaviors can be traced back to early man. • Introduces evolutionary psychology through a thematic, chapter-based format • Explores one of the fastest-growing subfields in psychology today and presents contemporary debates that foster critical thinking skills • Showcases high-interest information through engaging sidebars • Defines unfamiliar terms and concepts • Includes a comprehensive bibliography for further study

Featuring a new approach to an undergraduate biology text, Tools for Critical Thinking in Biology emphasizes and is organized around methods and different ways of experimentation, rather than around biological topics. The result is a book that teaches new biology students to think critically about a wide range biological questions and subjects.

This laboratory manual gives a thorough introduction to basic techniques. It is the result of practical experience, with each protocol having been used extensively in undergraduate courses or tested in the authors laboratory. In addition to detailed protocols and practical notes, each technique includes an overview of its general importance, the time and expense involved in its application and a description of the theoretical mechanisms of each step. This enables users to design their own modifications or to adapt the method to different systems. Surzycki has been holding undergraduate courses and workshops for many years, during which time he has extensively modified and refined the techniques described here.