The Workshop Project Newsletter

PROGRESSIONS:
PEER-LED TEAM LEARNING

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PEER-LED TEAM LEARNING INTRODUCTORY BIOLOGY ABSTRACTS FOR MODULES

Module 1: Chemistry of Life

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Abstract
Living systems obey chemical and physical laws. This module focuses on chemical principles that are necessary for understanding life processes. For example, energy transformations in the cell occur by the formation and breaking of chemical bonds. These chemical reactions result in the reorganization of sub-atomic particles. The pre-workshop activities focus on terminology and symbols in biochemistry. In the workshop students are engaged in a variety of activities that develop their understanding of molecular structure, chemical bonding, water chemistry, pH, and chemical reactions that are important to life. Students practice converting symbols into diagrams of atoms and molecules, use concept maps to study relationships, and solve problems in pairs and small groups. A team competition is also included. Post-workshop problems are not included.

Module 2: Biological Molecules

Joseph Griswold,[+] Dean Stetler,* and Michael Gaines°
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Abstract
Living things build medium to large-sized **organic molecules** constructed of a carbon skeleton to which are attached other atoms, especially hydrogen, oxygen and nitrogen. These include familiar names like **carbohydrates**, **lipids** (including fats and steroids), and **proteins**. These larger molecules are organized into cell parts (ex., Phospholipids in cell membranes), carry information (ex., DNA in genes), and control the rate of chemical reactions in the cells (ex., enzymes). A working knowledge of these organic molecules is essential for mastering biology. The pre-workshop activities in this module focus on terminology, drawing and interpreting structural formulae, identifying functional groups, and basic structure of the major classes of biological molecules. At the beginning of the workshop, a "bingo" game is used to review the important concepts from the pre-work-shop. Students do drawings of simple molecules using a round-robin approach, and then pairs of students convert word descriptions into drawings of more complex molecules. Finally students engage in pair problem-solving on a series of questions that are presented to their peers for discussion. Post-workshop problems are not included.

Module 3: Cell Structure and Function

Diane Baronas-Lowell, Ph.D.*, Kim Van Vliet, MS, & Dean Stetler, Ph.D.+**
(*Florida Atlantic University; **University of Florida, +University of Kansas)

Abstract
The cell is the simplest organization of molecules that show the properties of life. Cells are highly diverse in their sizes and structures, reflecting their evolutionary history and specialized functions. In some simpler living things, a single cell is the entire organism, performing all the life functions. In multicellular organisms, cells tend to be more specialized, with each cell type organized for its function, while depending on different cells to do the rest. In this module the goal is to learn the important structural components of cells and how these units work together in carrying out life processes. In the pre-workshop, students learn important terminology, begin to relate cell structure to function and learn to interpret diagrams of cells. The workshop begins with a game of *Jeopardy* that reviews important topics like techniques for studying cells, cell structure and function and cell borders and junctions. Next, in pair problem-solving, students develop ways of representing different kinds of cells, organelles, and other cell structures in ways that clarify function. Small group projects follow that challenge students to develop cell analogies as a means of learning connections and understanding the "big picture" of cell function. The final activities focus on the critical processes of endosymbiosis, secretion and signal transduction. The post-workshop includes questions at several levels ranging from multiple choice to case studies.

Module 4: Cell Membranes & Transport

Dean Stetler* and Joseph Griswold+
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Abstract
The chemical environment inside living cells differs markedly from the environment outside the cell. **Cell membranes** regulate the ongoing exchange between the intracellular and extra-cellular environments, making it possible for cells to get vital raw materials (examples: oxygen, sugars, amino acids), rid themselves of wastes (examples: carbon dioxide, urea), and maintain a healthy electrical balance (membrane potential). This module enables students to gain a deeper understanding of cell membrane structure and the processes of **transport** that move molecules in and out of cells, especially **diffusion** and **osmosis**. Pre-workshop activities focus on terminology, membrane structure, and the concept of gradients. In the Workshop, an opening round-robin challenges student to draw part of a cell membrane and answer questions so that a big picture emerges of the organization and function. Next students use pair problem-solving to address a series of transport problems from real life situations. In a section on osmosis and diffusion, students diagram cells and the extracellular environment with different solute concentrations and then determine what molecular movements will occur across the cell membrane. Post-workshop problems are not included.

Module 7: DNA, RNA and Proteins

Joseph G. Griswold*
(City College of New York- Biology)

Abstract
The goal of this workshop is to master the basics of three processes: **DNA replication**, the synthesis of RNA (ribonucleic acid) by **transcription**, and the building of proteins through **translation.** These three processes are bound by a **universal genetic code** that is common to most

living things. In the Pre-workshop students build mastery of the terminology, use symbols to learn about the organization of nucleotides, and review the basics of DNA replication, transcription and translation. In the Workshop students begin working in small groups to review answers to selected pre-workshop questions. Pairs of students then work to correct "scholarly definitions" that contain factual errors, and share their analysis in round robin format with the rest of the group. In solving the short problems that follow, pairs or small groups practice representing processes of information transfer in different ways. In longer problems small groups work on diagramming DNA-RNA-protein relationships as dictated by the genetic code. Finally, a round robin or small group approach is used to create concept maps that relate concepts students have studied throughout the workshop. A full set of Post-workshop problems plus internet links for additional study are included.
Thanks to Kim VanVliet of the University of Florida for supplying internet links and reviewing an early draft of this module.

Module 8: Scientific Discovery in Biology

Michael Gaines, Beth Gaydos, and Joseph Griswold+**
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Abstract

Biology is the scientific study of life. To understand Biology, students need to become familiar with the process by which biologists gather and test their information about the living world—how they answer ***scientific questions***. In this module students work collaboratively to practice developing questions, formulating hypotheses, making predictions, and then designing investigations with dependent and independent variables plus a variety of controls. Finally, they will analyze the descriptions of scientific investigations done by others to identify key elements that were studied earlier.

Workshop activities include round robins, pair problem solving, team competitions, and jigsaw approaches with challenge questions at the end. Pre- and post-workshop activities are included. Estimated time: two hours.

Module 9: The Life Cycle of Eukaryotic Cells

Joseph G. Griswold, Ph.D*
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Abstract

Eukaryotic cells (with membrane-bound nuclei) reproduce themselves and have a **life cycle** that includes "birth", maturation and reproduction, and cell death. The objective of this module is to understand facets of cell division, **mitosis** and **cytokinesis**, as components of the cell life cycle. The pre-workshop enables students to master the terminology describing genetic material in the cell, and to learn how it can be represented diagrammatically in prophase and interphase cells. Vocabulary related to mitosis is also introduced, along with concepts relating to the control of division. The Workshop begins with small group critiques of solutions to the pre-workshop problems. Then in a round robin format, students review events in the cell life cycle devising flow charts and completing diagrams and tables. A two-team competition challenges students to correct "scholarly definitions" in a timed format and then critique work by the opposing team. In a round robin using diagrams, students interpret figures depicting phases of mitosis in animal and plant cells, and answer questions about relationships that are illustrated. Pair problem-solving is used as students develop concept maps for small and larger concept "families." The final activities have students integrating what they have learned and relating the process of cell division to important control factors. Five post workshop activities allow students to practice applying knowledge they have gained on the topic of cell division and its control.

Module 10: Meiosis and Gametogenesis

Joseph G. Griswold, Ph.D.
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Abstract
To produce a new individual (a **zygote**, initially) with **2N** chromosomes, an egg and sperm each contribute half the total, or **N**, when fertilization occurs. Both sperm and eggs, called **gametes**, develop from body cells in which the full 2N chromosomes are present. Special cell divisions, which reduce the number of chromosomes in half make up a process called **meiosis**. Cells that have completed meiosis then differentiate to become gametes. The objective of this laboratory is to learn how meiosis produces eggs and sperm to carry genetic information from one generation to the next. The Pre-Workshop includes sections that enable students to develop (or check) their understanding of the genetic material of the cell and the divisions of meiosis. Interpreting diagrams, reviewing vocabulary and making drawings are all included. In the Workshop, leaders begin by coordinating a jigsaw in which pairs of students review and critique answers to selected pre-workshop problems. In the second activity, student pairs must take a word problem and convert it into a cell diagram showing genetic material of the cell. In the next two activities students use paper models (provided) to do simulations of mitosis and meiosis, and then present their results in a jigsaw format. An integrative follow up has students comparing mitosis and meiosis using tables and a multiple matching format. In a subsequent activity, students apply their knowledge in learning about the special features of **spermatogenesis** vs. **oogenesis**. The final activity addresses the subsequent steps of fertilization and cleavage. A full post-workshop is provided.

Module 11: Mendelian Genetics 1

Joseph G. Griswold, Ph.D.
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Abstract
In sexually reproducing animals, genetic information is passed from the parents to offspring by means of **haploid gametes** (egg and sperm) that, in most organisms, unite to form a **diploid zygote**. The zygote receives half of its chromosomes from one parent and half from the other. The alleles that the parents pass on determine not only the **genotype** of the offspring, but also its observable traits -- its **phenotype**. This is the first of two workshop modules that help student learn the patterns of hereditary transmission. In the Pre-Workshop a groundwork of terminology, concepts, and genetic problem solving skills is established for later problem-solving that ensures students will do the subsequent work with solid conceptual understanding. In the Workshop, students collaborate in pairs initially to hone problem-solving skills working on problem segments. In a section on crosses with simple **dominance**, a combination of round robin questions on concepts and pair problem solving and full problems are used, with students presenting solutions to their peers in the workshop. The third activity addresses **incomplete** and **codominance** through a team competition, and the subsequent activity deals with codominance and **multiple alleles** in pair problem solving. A full post-workshop includes concept mapping and problem-solving.

Module 12: Mendelian Genetics 2

Joseph G. Griswold, Ph.D.* and David L. Wilson, Ph.D.+
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Abstract
Patterns of inheritance are often much more complex than those encountered in genetics Module 11. Mammals, birds, plants like garden peas, and insects have thousands of different genes in their genomes. Frequently scientists wish to study inheritance patterns for two or more genes simultaneously. The loci of these genes may be linked or not. And most complex organisms have separate **sex chromosomes,** as distinguished from the others that are called **autosomes**. Genes located on sex chromosomes (**sex-linked**) have some special patterns of expression. The Pre-Workshop has three activities that help students master the basics of dihybrid crosses, linkage, and and sex-linkage by building on concepts mastered in the prior genetics module (Module 11). In the Workshop, pairs of students each get a different problem on dihybrid crosses that they solve and present to the rest of the group. The comparison between linked genes and those assorting independently is investigated in the second activity by pairs who contribute to a jigsaw the reveals important patterns and concepts. The third activity involves solving genetics problems with a "twist." Students must identify problem types and clues that led them to their conclusions. Problems vary in level of difficulty from straightforward dihybrid crosses to pedigree analyses. Activity 4 on linked genes and Gene Mapping takes students step-by-step through the concepts and analysis process in determining the location of gene loci. Activity 5 is an optional section that challenges student pairs or small groups to do more complex problems that require the application of principles learned earlier. A full post-workshop with concept reviews, problems and resources for further exploration on the internet is provided.
**Special thanks to Kim Van Vliet of the University of Florida who provided internet links for further exploration at the end of this module.*

Module 15: Nerve Local Potentials and Action Potentials

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Abstract
A *neuron* is a single cell that is specialized to transmit electric signals (called impulses) from one part of the body to another. A *nerve* is actually made up of many individual neurons bundled together. To understand how signals travel from a receptor in the skin to the central nervous system (CNS) or from the CNS to a muscle, we build on the membrane transport concepts learned earlier related to local and action potentials. Now students will add information about where in the neuron they occur, and how one thing leads to another to cause nerve conduction. The pre-workshop focuses on vocabulary development and learning the important anatomical features of neuron through interpretations of diagrams. The Workshop begins with a Jeopardy game the checks students' understanding of concepts related to neural anatomy, local potentials, action potentials and membrane polarization changes. A small group activity follows in which students analyze the results of ion movement to predict what will happen to membrane potential. The third activity has students graphing membrane potentials from word problems. In a short activity that follows, students investigate the relationship between local membrane potentials and action potentials. The problems on poisons and anesthetics in the final activity challenge students to apply what they have learned to analyze mechanisms of responses to these compounds by the neurons and neural circuits. Post-workshop problems are not included.