Course Title
Molecular and Cellular Biology

Course Description:
This is a one-semester course that explores modern molecular and cellular biology. Students will investigate transmission genetics, biomolecule structure and function, control of the cell cycle, cellular signaling pathways, cancer, and emerging genetic and molecular techniques.

Instructor(s):
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Office: B203

Meeting Room: A202
Meeting Days & Time: varying per instructor

Text(s) / Materials:
There are no textbooks for this course. Various and assorted reading will be provided to concur with topics. Students will be instructed to use internet sources as appropriate for individual topics.

Essential Content:
This course will have three major content foci. The first will address the transmission of information in the biological system. Included in this focus is a detailed treatment of DNA replication, transcription and translation. The second focus examines the molecular control of the eukaryotic cell cycle. The third focus highlights signal transduction pathways in the cell to direct important cell functions. All of these units will come together as we examine cell cycle control, cell differentiation, and their relationship to organismal function and diseases such as cancer.

Concurrent with and complementing course discussion, laboratory activities will be used to help students understand the concepts encountered in discussion. Students will engage in modern day molecular biology lab work. In this way, students will develop a sense of the field as it is practiced currently.

In addition to the above course work, students will engage in individual and group research activities and writing to examine the molecular controls of cancer. Students, through practice and instruction will improve their communication through writing.

SSLs and Outcomes:
The Molecular and Cellular Biology course represents an integration of a variety of topics in Biology and an extension of many concepts from Scientific Inquiries – Biology. This course focuses on the complex subject of the molecular control of cell functions. Understanding of information and processes, as described in IMSA Science Standards E1, E3, and F2 through F4 (see below) will support and extend student learning.

E. Students studying science at IMSA demonstrate understanding of cellular structure and function by:

E.1 explaining how organelles perform essential functions in the cell. [IL-12.A.4a][NSES-C]
E.3 describing cellular reproduction. [IL-12.A.4a][NSES-C]

F. Students studying science at IMSA demonstrate understanding of the explanatory power of evolution and its genetic basis by:

F.2 understanding the evidence of evolution. [IL-12.A.3c; 12.A.4c; 12.B.5b][NSES-C]
F.3 examining patterns by which traits are passed on through generations. [IL-12.A.5b][NSES-C]
F.4 exploring the molecular basis of heredity. [IL-12.A.4a][NSES-C]

A major theme in this course is to have students work with course knowledge gained in the context of cancer biology. In this way, students will employ creative applications of their knowledge and develop critical and scientific habits in thinking about novel situations. This will be accomplished primarily through the writing of a research paper. Standards of Significant Learning most appropriately meaningful to this work are:

SSLs and Outcomes

I. Developing the Tools of Thought
A. Develop automaticity in skills, concepts, and processes that support and enable complex thought. This is done through lab observations, correctly manipulating DNA, data collection, analysis, and using lab equipment properly.
B. Construct questions which further understanding, forge connections, and deepen meaning. This is done by analyzing data to draw conclusion and relate it to the concept.
C. *Precisely observe phenomena and accurately record findings.* This is done through laboratory observations, data collection and analysis.
D. *Evaluate the soundness and relevance of information and reasoning.*
This is done by drawing conclusions from laboratory and other data.

II. Thinking About Thinking
A. *Identify unexamined cultural, historical, and personal assumptions and misconceptions that impede and skew inquiry*. This is done by examining models for the pathways of gene expression.
B. *Find and analyze ambiguities inherent within any set of textual, social, physical, or theoretical circumstances*. Gene expression is studied.

III. Extending and Integrating Thought
A. *Use appropriate technologies as extensions of the mind*. This is done by the use of computers and lab equipment.
B. *Recognize, pursue, and explain substantive connections within and among areas of*

knowledge. This is done by making historical connections to scientists and connections among various topics within biology.
C. *Recreate the beautiful conceptions that give coherence to structures of thought*. This is done through analyzing and learning about molecular structures, such as DNA, recpetors, and biomolecules, and how structures affect the properties of molecules and living organisms.

IV. Expressing and Evaluating Constructs
A. *Construct and support judgments based on evidence.* This is done by laboratory exploration, and constructing new knowledge from data through forming conclusions and making generalizations.
B. *Write and speak with power, economy, and elegance.* This is done through lab work, written answers to questions, and demonstrating understanding through leading and participating in discussions.
C. *Identify and characterize the composing elements of dynamic and organic wholes, structures, and systems.* This is done by relating molecular structure to function.
D. *Develop an aesthetic awareness and capability.* This is done by drawing attention to links between current content and the world around them.

V. Thinking and Acting With Others
B. *Make reasoned decisions which reflect ethical standards, and act in accordance with those decisions.* This is done by not manipulating data to fit conclusions and preventing plagiarism in all work.

This course is designed to have a significant laboratory component, and it will support student growth in the science and inquiry skills as defined IMSA Science Standards, A1 through A9 (written as refinements of pertinent SSLs).

A. Students studying science at IMSA engage in the process of scientific inquiry by:

A.1 applying the skills of observation (describe, compare, and contrast characteristics; identify parameters, precisely observe phenomena). [IL-11.A.5a][NSES-A]
A.2 designing and planning investigations and constructing questions which further understanding, forge connections, and deepen meaning. [IL-11.A.5b][NSES-A]
A.3 carrying out investigations that develop skills, concepts, and processes that support and enable complex thought. [IL-11.A.5c][NSES-A]
A.4 using appropriate technologies to collect, analyze and present information. [IL-11.A.5c][NSES-A]
A.5 accurately recording findings. [IL-11.A.5c][NSES-A]
A.6 analyzing data to find ambiguities inherent within any set of textual, social, physical, or theoretical circumstances. [IL-11.A.5d][NSES-A]
A.7 employing scientific reasoning to evaluate the soundness and relevance of information. [IL-11.A.5e][NSES-A]
A.8 constructing and supporting judgments based on evidence. [IL-

11.A.5e][NSES-A]
A.9 sharing results by communicating orally, in writing, and through display with power, economy, and elegance. [IL-11.A.5e][NSES-A]

Instructional Design and Approach:
Instructional design will change as is appropriate for daily topics. Instructor lectures, student presentations, small and large group discussions, and problem solving will all be employed where deemed most effective. As the material explored in this course is visual in nature, a heavy reliance on computer visuals.

Application and extension of course learning to causes of cancer will be accomplished through group presentations, exams, and an end of semester forum where students will be the "expert" about their cancer and will share their knowledge with classmates.

The laboratory activities are designed to provide insight into the field of molecular biology and cell functions and will be guided. Laboratory activities later in the semester will be more open-ended to provide students with more personal ownership.

Student Expectations:
Students encounter the material and concepts of this course through selected readings or from problem-centered activities created by the instructor. These activities require students to construct understanding as they strive to answer focusing questions. Class discussions are integral to answer these questions. The teacher guides students to forge the solutions to problems through debate and discussion. Students play an important part in disseminating information to other students informally in discussions and in formal presentations. In conducting laboratory experiments, students will enter the lab with an understanding the important topics as well as the laboratory procedures. These include fundamental and current applications in biotechnology.

The students will 1) complete all assigned readings, 2) participate in each class discussion session by asking or answering questions or sharing relevant comments, 3) submit written reports for selected activities or experiments, 4) complete all assigned work within specified deadlines, 5) follow all safety procedures and guidelines, and 6) arrive to class on time prepared for each day's activities.

Assessment Practices, Procedures, and Processes:
Each student's performance and learning in this course will be measured by assessing the following: 1) the extent to which students contributed to class discussions; 2) the quality of written assignments; 3) the scores on exams; and 4) the quality of formal presentations. Assessed assignments will focus on gauging student learning with respect to both content standards and the IMSA Standards for Significant Learning (SSLs). Periodically, content-based formative assessments will be conducted to determine further pedagogical choices.

Because nature is a continually evolving field, we cannot always predict the kind of new information that students will bring or how long it will take to cover specific topics. Therefore, we do not publish a calendar. However, we do have a specific order in which we cover the information, as presented below.

1. Transcriptional Control and modifications
2. Signal Transduction and the cell cycle
3. Replication & DNA sequencing
4. Recombination & Inheritance
5. Stem Cell Development & Epigenetics