second and third types of T cells are **helper cells** and **suppressor cells**. The helper T cells activate the B-cells and cytolytic Ts while the suppressor T cells moderate the B-cells and other T-cells. These three types of lymphocytes produce proteins collectively known as **lymphokines**. The latest research shows that these lymphokines play a central role in the immune system and may even promise treatment for immune deficiency diseases such as AIDS. AIDS victims have less than half the required number of lymphocytes per milliliter of blood, with a very low number of helper T cells and a relative overabundance of suppressor Ts. Many victims come down with pneumocystis pneumonia and Kaposi's sarcoma much as do immunosuppressed transplant patients. We now have direct evidence that this mysterious AIDS disorder is transmitted by the blood and has a long incubation period. It is feared that the infectious agent, if there is one, is no longer present when the full-blown symptoms of AIDS become observable. This fact would explain why it has eluded the best and brightest in the medical field up to this time. A treatment for AIDS, however, may be in the offing with the lymphokine research being done in the U.S. and Japan. Interleukin II, one of the lymphokines elaborated by the T cells stimulates production of T cells that produce a B cell Growth Factor (BCGF) that eventually leads to antibody production. **In vitro** tests show that interleukin-2 improved the function of T cells from AIDS patients. At Sloan-Kettering Memorial Institute it was found that patients treated with interleukin-2 showed an increase in the number of helper T cells. With the cloning of the gene for interleukin-2, large quantities of purified interleukin-2 may become available for further testing.

Another line of research, that of production of monoclonal antibodies, has provided the medical profession with new tools for diagnostic screening, immunotherapy, anyntigen purification, and basic research in biochemistry and immunology. Let us hope we are watching the sunrise of a new day in our battle against infectious diseases.

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**The Inquiry Approach to Teaching Non-Majors Biology**

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One of the most difficult courses to teach among a biology department's offerings is the general biology course for non-majors. In some departments the non-majors and majors are combined into a single course; other departments try to keep the two separate. The latter alternative sometimes results in a "watered-down" version of the majors' course. A third possibility is that the non-majors course might over-emphasize human anatomy and physiology or systematics and phylogeny.

At Rockhurst College we have an introductory course for majors and a separate course
(BL 15, Biology of the Contemporary Scene) for non-majors to satisfy the general lab science requirement. Two of our department members, Dr. George O'Connor and myself, with considerable input from other department members, recently decided to examine BL 15 and, if necessary, revise the course contents and method of delivery. The results of our study included new course objectives, a different lecture format, a student study guide, a different exam format, and a different emphasis in lab.

For our course objectives we decided that we wanted the students to be exposed to the nature of science and to the use of the scientific method as a means of acquiring knowledge. We wanted the students to learn to both ask questions and then answer these questions using their own observations and deductive abilities. Because most non-majors, after completing a course of this nature, rapidly forget the biological terms normally covered during the semester, and because many students are intimidated by the new vocabulary which is normally presented in this type of course, our revised course attempts to reduce the number of scientific terms to those which are absolutely essential in a discussion of principal biological concepts. These terms are then used repeatedly throughout the course so that they might become part of the student's working vocabulary. This allows the student to concentrate more on the concepts than on the vocabulary. Finally, we wanted our students to observe, first hand, the use of the "scientific method" as a formal means of solving problems.

We next selected what we considered to be the main concepts in biology. These included: science and the scientific method, general chemistry and cell physiology, life, cell theory, organisms, biological inheritance, evolution, homeostasis, ecosystems, and behavior. We also decided on the basic principles involved in each concept with the understanding that the illustrations for these principles would be left to the discretion of the individual instructors.

We decided to utilize an inquiry-type format. Our intention was that students would respond to questions prepared by the instructor. In practice, these questions attempt to direct the students' thoughts in such a way that they, in essence, teach themselves basic ideas. Personally, I found developing questions for this type of format to be very difficult, and I frequently slipped back into the didactic style. To counteract this tendency I designed flow diagrams which consist of a series of questions with suggested general responses. These flow diagrams, which can be quite flexible, help me to stay with the inquiry format and also help me visualize the direction in which class discussion is heading.

Obviously, this inquiry format will work only if students are prepared to participate. To encourage this participation, students are given daily three to five minute quizzes over material they will be discussing in class. These quizzes are primarily objective. About five to ten percent of the student's grade is based also on actual participation in class discussion.

In addition to the final, three major lecture exams are given during the separate lab period. Different lab sections meeting at the same time take the same exam, regardless of which lecture section they are in. This arrangement means that the exams must be somewhat general to allow for individual instructor differences in presenting the material. It also means that the instructors must communicate with each other frequently with regard to lecture discussion content and vocabulary. This cooperation is accomplished by having the instructors sit in on each others classes and by weekly (or even more frequent) meetings. Although some questions on the exams are objective and rely primarily on memorization of terms, most of the questions are more indirect and require the student to utilize the material covered in their lecture discussion to "solve" the answers to the questions. The
contents of the problems or questions are often over material not discussed directly in class or in the text. Instead the students try to relate the questions to the appropriate model discussed in class. For instance, a problem might consist of a description of a physiology experiment. The student would read the description and then identify observations, questions, hypotheses, variables, controls and standards and state the significance of the results in relation to the hypothesis. Neither this specific experiment nor the subject matter of the experiment will have been presented in lecture or in the text, but other experiments will have been discussed as models.

Because this format often represents a new approach for the students, Dr. George O'Connor and myself prepared a study guide with the help of a local KCRCHE (Kansas City Regional Colleges of Higher Education) grant. Students are required to purchase this study guide at cost from a local printing establishment at the beginning of the semester. The guide explains the course format and objectives and gives a brief introduction, complete with working vocabulary and preparatory discussion questions, for each of the ten main concepts.

Finally, our lab sequence helps to emphasize the scientific method and the nature of science. Although some of the labs might be thought of as traditional, the emphasis is on scientific thinking. The first lab emphasizes observation and the difference between observations and inferences. We have the students "observe" a "black box" and attempt to formulate an hypothesis concerning the nature of the contents. Then we have them observe an orange. Next, the students learn how to use the microscope, but the microscope, but the emphasis is not on the microscope per se but rather on how tools can extend the limits of one's observation capabilities. This concept is reinforced by a lab on cells, which not only illustrates material covered in the lecture discussion, but also shows them a practical application of the microscope. Other labs teach quantitative skills, including graphic and tabular data presentation. Finally, a series of labs illustrates the process of hypothesis formation and testing. Included in these experimental design labs are uses of controls and standards.

We plan to continue revising the study guide and discussion questions and will be evaluating the students' reactions to the lecture and lab formats. Preliminary evaluations suggest that students are generally in favor of this type of biology course, but there is some confusion as well as some reservations stemming in part from the fact that this is a novel experience for many students and not what they might have experienced in high school biology. We also have the problem of dealing with students who have very diverse majors. We are hoping that by emphasizing biology as a science and science as one way of thinking and problem-solving, we can help more students see why science is important in their lives, regardless of major.
(Editor's Note: The following is an example of a quiz question used in this course)

In a factory many departments and pieces of machinery must work in harmony in order to produce a specific product. A similar requirement is also true of the organelles and other components of a living cell. Column A below lists several aspects of a manufacturing plant. Column B lists organelles and other cellular components. Based on function, match the cellular components from column B with their factory counterparts in column A:

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>45. janitorial staff (clean-up)</td>
<td>A. mitochondria</td>
</tr>
<tr>
<td>46. manufacturing machine</td>
<td>B. nucleic acids (DNA)</td>
</tr>
<tr>
<td>47. conveyor belt</td>
<td>C. ribosomes</td>
</tr>
<tr>
<td>48. power plant</td>
<td>D. proteins</td>
</tr>
<tr>
<td>49. packaging/shipping dept.</td>
<td>E. lysosomes</td>
</tr>
<tr>
<td>50. manager</td>
<td>F. fats</td>
</tr>
<tr>
<td>51. energy for immediate use (i.e., electric)</td>
<td>G. Golgi apparatus</td>
</tr>
<tr>
<td>52. energy reserve (i.e., fuel oil)</td>
<td>H. endoplasmic reticulum</td>
</tr>
<tr>
<td>53. spare parts for machines, etc.</td>
<td>I. nucleus</td>
</tr>
<tr>
<td>54. blue prints for factory</td>
<td>J. carbohydrates</td>
</tr>
</tbody>
</table>

CREATIONISM OR EVOLUTION?

By Robert H. Buchholz, Professor of Biology, Monmouth College

The main criticisms of evolution raised by creationists are these: (1) the age of the earth is far too short for evolution to have occurred; (2) there are no transitional forms between major groups of organisms; (3) the fossil record does not show an increase in complexity of organisms when one compares later strata with earlier; (4) the Second Law of Thermodynamics denounces evolutionary trends from simple to complex and (5) the theory of evolution, like creationism, is metaphysics, not science; hence equal time should be allotted to creationism. Let us deal with each of these points.

(1) The determination of the age of sedimentary rocks by the radioactive decay of various chemical elements gives evidence that the age of the solar system, including our earth, could be 4.6 billion years. This would be ample time for evolution to have occurred.

(3) Biological evolution hypothesizes that, over the course of time, there are changes in populations of such magnitude that one recognizes descendants as different from ancestors. Transitional forms such as the Archaeopteryx (primitive bird) have been found. This is a fossil with characteristics of both reptiles and birds. The vertebrates (animals with backbones) are the best test case for tracing evolution since they have bones and teeth that fossilize well. There are numerous intermediate fossil forms linking the main types of vertebrates. The transition from reptiles to early mammals is well documented.

(3) Evolution implies a general trend from simple to complex structure. Early fossil records show only invertebrates (animals without a backbone). In later rock strata there is the appearance of fish-like organisms. Still later come the amphibians and reptiles and finally the birds and mammals. As a part of life genes mutate and recombine and as a consequence the individuals of a species come to differ from one another. Gradually the better adapted will survive and become increasingly different from their ancestors, and we will recognize that evolution has occurred.