American Institute of Biological Sciences

"A Review of Biological Instructional Materials for Secondary Schools"

M. Patricia Morse and
the AIBS Review Team

Funded by the David and Lucile
Packard Foundation

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Executive Summary

The American Institute of Biological Sciences (AIBS) has undertaken a review of ten textbooks that are currently used in year-long courses in the biological sciences in secondary schools. The goal is to:

- Provide information - a snapshot of the year 2000 - to those in school districts who choose instructional materials to make informed decisions that help teachers provide ALL students with standards-based learning environments for biological literacy.

A nine-person review team, of scientists, teachers, and science educators reviewed ten programs of biology instructional materials with publication dates from 1997-2000. The team developed a review instrument for the evaluation based on the *National Science Education Standards*. Three of the life science content standards for grades 9 to 12--Evolution, Interdependence Of Organisms, and Molecular Genetics--along with the "Other Content Standards," and the "Pedagogical and Other Considerations" were used as criteria and the results are presented.

Instructional Materials are grouped into three categories:

1) "Traditional" instructional materials that do not particularly respond to the standards but simply focus on new content and new options at each printing,
2) "Innovative" instructional materials that are specifically designed to meet all of the *National Science Education Standards*, and
3) "Mixed" instructional materials that come from the traditional background, including updating and adding of content, but have responded to some or all of the pedagogy and other standards in presentation.

Results indicate:

- For the most part, the content is accurate and up-to-date, but the way the materials are presented for teaching leaves room for vast improvement.
- Most books are too large, too encyclopedic, and leave too much responsibility on the teachers to determine how to use them to meet the standards.

The AIBS study was conducted at the University of Washington in Seattle, with funding from the David and Lucile Packard Foundation.

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Special and heartfelt thanks go to Wayne Carley and Jan Tuomi who advised our deliberations, and Ingrith Deyrup-Olsen who evaluated our full team meetings. Their wise council kept us all on task. Thanks also go to Doug Young (University of Washington) who kept our electronic communications current and Kristin Enoch (UW-Friday Harbor Laboratories)our meeting recorder, Darlene Robbins (AIBS) for editing and Marilyn Maury, (formerly of AIBS) who helped facilitate several meetings. Many of the textbook publishers provided us with textbooks, allowing one set of materials to be incorporated into the Deyrup-Olsen Resource Room at the University of Washington. We are grateful for their help and generosity. Finally, we acknowledge Richard O'Grady (Executive Director of AIBS) who provided continual support for our efforts.

We are particularly indebted to the David and Lucile Packard Foundation for their support. One of the Committee members, (Morse) was privileged to be with David Packard several weeks before he passed away at a national Sigma Xi, The Scientific Research Society Meeting. His excitement about what would be made available to ALL children via the new technologies was clearly on his mind; we hope to have served his vision in some small way. Finally, we extend our thanks to the three Packard Foundation program representatives who guided the grant, Kenneth Ford, Jaleh Daie and Helen Doyle.

Abstract

The American Institute of Biological Sciences (AIBS) in collaboration with the University of Washington in Seattle, with funding from the David and Lucile Packard Foundation, has undertaken a review of textbooks that are currently used in year-long courses in the biological sciences in secondary schools. A nine-person review team, of scientists, teachers and science educators, reviewed ten programs of biology instructional materials with publication dates from 1997-2000. The team developed a review instrument for the evaluation based on the *National Science Education Standards* (NSES). Three of the life science content standards for grades 9-12, Evolution, Interdependence Of Organisms and Molecular Genetics along with the "Other Content Standards," and the "Pedagogical and Other Considerations" were used as criteria and the results are presented. Books are grouped into three categories: 1) "Traditional" instructional materials that do not particularly respond to the standards but simply focus on new content and new options at each printing, 2)"Innovative" instructional materials that are specifically designed to meet all of the *National Science Education Standards*, and 3) "Mixed" instructional materials that come from the traditional background, including updating and adding of content, but have responded to some or all of the pedagogy and other standards in presentation. The goal is to provide information for those who choose instructional materials in biology in the nation's secondary classrooms to make informed decisions that are based on the *National Science Education Standards*. Ultimately this review is to help teachers provide ALL high school students with standards-based learning environments for the students to become literate in the biological sciences.

A. Introduction

There is widespread concern in this country about the state of mathematics, science and technology education. Cries of alarm have been raised by educators, scientists, politicians, and parents about the preparation of American students for full and meaningful participation in our global, technology-driven society. These concerns about our youth's future as scientists, innovators, policymakers, scientifically literate citizens has manifested itself in many educational "reform" efforts, in research in teaching and learning and most prominently, in a broadly based national effort to establish standards for scientific literacy applicable to ALL students. There are numerous building blocks to form this vision and one of those is the instructional materials that are available for the teachers in the classrooms of our nations schools.

There is a need for quality materials to be available and utilized in secondary schools to teach the biological sciences. This review has been undertaken to assess ten widely used sets of materials (textbooks and the associated materials – CD-ROM, videos, Teacher's Guides, other resources) that are currently available on the market. The philosophy of this review was determined by members of the review team who individually have been involved in varying capacities in activities related to education and research in the biological sciences. The review occurs at a time when the focus is on:

- the recognition that biology is for ALL students
- new biological research and resulting innovative applications
- the recognition of student needs and learning patterns as determined by research on learning
- the explosion of instructional technologies and new ways to present materials in the classroom
- the development of standards, both at the national level and within the states for biological literacy.

The tradition for many years in the United States has been that the majority of high school students take a full year of biology in the 10th grade. The instructional materials for this course were hardbound textbooks, often accompanied by laboratory manuals that too often contained largely "cook-book" exercises, guidelines for dissections of pickled prepared specimens, and presented few opportunities for inquiry-based science. Assignments might be given to read a certain number of pages, and the teacher would quiz the students the next day on their memorization of the numerous facts

(often highlighted in the text). Emphasis was often on marching through the phyla, memorizing parts of the body and testing by filling in the blanks. Fortunately for some students, there have always been a number of highly motivated teachers who were able to engage the students in active learning, adapt and develop their own innovative and meaningful materials, utilize community resources and incorporate rich field experiences into the curriculum.

During the 1960's and early 1970's, just after the launch of Sputnik, the US national response was to put more resources into the teaching of science in the secondary schools so that more students would become professional scientists. It was during that period that the Education and Human Resources Directorate of the National Science Foundation funded the development of science instructional materials, and several new biology textbooks came on the market. For example the Biological Science Curriculum Study (BSCS) produced a series of general biology books in the green (ecology), blue (biochemical) and yellow (comprehensive) versions. The country took seriously the business of sending students (especially white males) on to college to become professional scientists.

In the 1990's, and even more so as we move on toward the next millennium, a new philosophy of reform is taking center stage in molding K-12 science experiences. According to this philosophy, all students are entitled to the opportunity to understand what science is about and to be science literate;) when they leave secondary schools (NAS, 1990; Moore, 1995; BSCS, 1993). Grassroots efforts, by science educators, scientists and master teachers with a long-term vision of science opportunities for ALL students, have resulted in several very important documents that form a framework for the explosion of current efforts. These documents are based on research about how students learn, and on the evolving realization that for satisfactory and effective lives, all students should experience the learning environment that leads to science literacy. The first works are from the American Association for the Advancement of Science, "Project 2061." As part of a long-term plan for science literacy, AAAS published *Science for All Americans* (AAAS, 1989) and *Benchmarks for Science Literacy* (AAAS, 1993). These documents are a framework of conceptual understandings in science disciplines, including life sciences, for science literacy and for all students. These are tools for educators to use in formulating their own curricula, and AAAS Project 2061 continues to remain on the forefront in facilitating science education reform, including developing valid and reliable methods for evaluating the quality of curriculum materials (see <attp://www.project2061.org> for further information). The second document, "*National Science Education Standards* (NSES)," is published by the National Research Council of

the National Academy of Sciences (NAS, 1995). This framework was reviewed and accepted by a large number of scientists, educators and teachers around the country (see http://www.nap.edu for on line documents). The NSES document goes beyond content and includes the needs for professional development of teachers, the best practices based on what research tells us of how students learn, the needs for coordinated assessments, and the need for schools and systems (states and national) to coordinate their practices. These documents present a framework for the textbooks and other materials to meet the current needs of teachers to teach for science literacy for all students. States (49 out of 50) have followed this trend with standards of their own, and publishers and curriculum developers are scrambling to keep up with the changes.

The response to these national and state standards is very exciting and at the same time overwhelming to the teachers and others who make decisions on choosing instructional materials. Materials now being developed bring simulations, software, telecommunications, Internet resources and biological visualizations (from the cell to the planet!) into the classroom. Along with this is a change in the way the teachers are using the materials. There is a tendency to move from just a lecture format to an encouragement of student-centered activities (Texley and Wild, 1996; Olson and Loucks-Horsley, 2000). Teachers act more as facilitators, providing rich opportunities for students to engage in learning through experimentation and activities that reflect real life events and offer pathways to construct their own understanding of how "scientists do science." These changes do not slight the basic concepts. On the contrary, they lead the students to engagement in problem solving, in learning the facts to substantiate their conclusions and to seek further understanding about the world around them, learning science as science is done.

We are entering a new millennium in which biological research promises vast new knowledge at the molecular, cellular and environmental levels with new applications in health and biotechnology. It is imperative that we prepare our future citizens with the best materials available! Although that preparation involves teachers at the center, adequate learning environments, good assessment practices, adequate resources and exemplary instructional materials that reflect the standards are an important pieces of the puzzle (NAS,1999b).

At present the application of new ideas and materials to the textbooks being produced is far too random and restricted. The ways "textbooks" are chosen differ from state to state, and in many cases, differ even within an individual state! Leaving aside some political considerations peculiar to biology (i.e., whether, and how, evolution or

human reproduction should be included), other daunting problems exist. What do we mean by quality? What are the most effective materials? How are instructional materials chosen? How do publishers fit into the equation? If a book is the most popular and the best advertised, does this mean that it is the best? Is there evidence of enhanced learning from the use of technology-based materials? What are the costs of the materials? Do the materials have teacher guides to help use the materials effectively? Are the materials attractively presented so that they are meaningful to diverse student populations? And perhaps even more encompassing of the above questions, do the materials reflect the Benchmarks for Science Literacy and the *National Science Education Standards*? Therefore one must ask, for whom are the materials designed and what will the student know and be able to do as a result of using these instructional materials? Publishers are interested in "keeping up" with the standards movements, and have begun to address these concerns in their revisions. How do the revisions and the new materials just coming out compare with one another? Where does a teacher or administrator or parent turn for guidance in selection of instructional materials?

It is these and related problems that we begin to address in this review. This is a guide, a "consumer report" of the state of ten programs of biological curriculum materials available at this time. It would be ideal if this guide carried a "good housekeeping seal of approval" or could state that one set of materials is the very best. However, more appropriately, a guide should give the strengths and weaknesses in the various year-curriculum materials based on the quality and up-to date nature of the biology, teaching strategies and the quality of support for the teacher in the classroom. It is not the case of "the best" or "the worst" but rather of development of a series of characterizations to give a basis for selecting what is most appropriate for a particular school in a particular state. We base this review on the *National Science Education Standards* (NAS, 1995) as interpreted by the reviewers.

One other area of concern, as we review extant materials, is developed in the recent TIMSS (Third International Math and Science Survey) Report. Data from the results suggest that "more is less." As the biology knowledge base has expanded due to research in the various traditional biological disciplines (consider the numerous new findings in area such as genetics, microbiology, immunology, cell and molecular structure and function, and neurobiology) the biology curriculum has become "overstuffed " with concepts and facts. Data from the TIMMS report indicate that the US leads, way beyond all other countries tested, in the number of concepts covered in a particular science discipline, and that this leads to curricula that are a "mile wide and an inch deep" (Schmidt *et al*., 1997). The question must be asked, is the idea that "more is

less" valid? In covering so many concepts in a year course, do our teachers sacrifice depth of understanding of fewer concepts in favor of superficial understanding of too many concepts? Which type of learning fosters retention by the students? What role do the instructional materials play in the outcome? These considerations are part of the review and discussed in the results.

A careful consideration of specific content within the instructional materials of a program along with the instructional strategies was central to this review process. Of particular importance was the identification of factual errors and visual misconceptions. Of equal concern was poor writing, lack of up-to-date materials and materials presented totally out of context to the students' world, materials with little chance of engaging student interest. Finally, if the materials were not presented in a way that encourages teacher engagement, either in adapting local resources or guiding the teacher in the facilitation of teaching in the most up to date ways, the materials were not considered to fully meet the needs of today's students. In this review, expert biology teachers, practicing scientists (representing research in cellular, organismic and ecological aspects of biology) and science educators (science instruction supervisors, science teacher educators, curriculum writers etc.) were engaged in the process of review.

B. Review Instrument and Review Process

The review instrument (Appendix 1) was formulated by the review team and primarily based on the *National Science Education Standards* (NAS, 1995). Other review documents that were utilized as resources by the team included, *the Review of Instructional Materials for Middle School Science* (NSF, 1997), *Benchmarks for Science Literacy, Project 2061* (AAAS, 1993), Roseman, Kesidou and Stern (1997), and the Spokane, Washington School District 7-12 Materials Evaluation form (Stowell, 1997). After considerable discussion and revision, the instrument was constructed and in most cases, reflected the *National Science Education Standards* (NSES) (NAS, 1995).

Three NSES life science content areas were selected for review by the team: 1. Biological Evolution (BE A-E), 2. Molecular Genetics (MG A-D), and 3. Interdependence of Organisms (BI A-E) (Appendix 1). These three content areas were examined in each of the ten publisher's texts and associated program materials for the presence of the standard, for scientific accuracy and if the information was up to date. So in one reading of evolution this area was considered by the individual reviewer under the

NSES criteria of Other Content Standards (OCS 1-5) and Pedagogy and Other Considerations (POC 1-5) (see the Review Instrument used in Appendix 1).

For each of the ten sets of materials (see list of those reviewed in Appendix 2), two reviews were undertaken for each life science content area and thus six separate reviews were compiled for each book (Appendix 3). Therefore, the OCS standards and the POC standards were completed for each content area twice, and for each of the individual programs or textbooks, 6 times. At intervals over a year, after the team members had reviewed groups of two and three textbooks, the entire team came together to discuss the results. At the conclusion, the review team revisited all of the results to recalibrate and look for any inconsistencies in their process. The scale of the review was based on scores of 0.5 increments to 5, with the descriptive terms, 1 - Poor, 2 - Inadequate, 3 - Adequate, 4 - Excellent, 5 - Exemplary as responding to the Standards (NSES) recorded within the review instrument. Additional trends and comments from the group discussions are included in the review results. The review process is documented in Appendix 3.

The components in each instructional program are numerous, and for our purposes, we will refer to these full-year instructional materials as the ten "textbooks." These are listed in Appendix 2. Many of the student textbook covers have animal pictures associated with the covers of the materials. These shortened names are familiar to many biology teachers and are listed in Appendix 2 ("Elephant," "Wolf," "Owl," "Eagle," etc.). Textbooks reviewed were found at the National Association of Biology Teachers Meetings. They represent textbooks that were tracked down by the review team principal investigator. The availability of texts to review was found to be a difficult hurdle to overcome. However, several of the publishers responded with materials immediately; others presented some challenges to secure materials. Our final choice does not represent all the materials that are on the market; resources limited the number we were able to include in the review, and they tended to represent those that were accessible from the responsive publishers and their representatives.

We present the general findings followed by the actual review results that includes a section on each book with scores and comments. The discussion follows and is based on graphing and comparing the data.

C. General Findings

1. While all of the authors/publishers have made significant efforts and have had considerable success in bringing all or most of the content standards into their recent editions, they had varying levels of success in making the generally acceptable content accessible to teachers and students.

2. The sense of the review team was that most of the textbooks simply added more material to what was already present, making the books ponderous, making the essential aspects of the standards difficult to access, and presenting the teachers with an enormous burden. They are also extremely heavy textbooks for students or teachers to carry.

3. After reviewing the texts and accompanying materials (ratings and comments follow in Section D), the review team found that the topics of importance in biology are well represented in nine of the ten textbooks reviewed. However, the team found that much more attention is needed in creating environments that foster learning, meeting the "other content standards" and "pedagogy" standards of the NSES.

4. At the completion of the ratings and comments for all of the texts, the review team concluded that nine of the examined texts fell into three categories:

- "Traditional" – these books are heavy and often rich in content. All of the NSES life science content standards can be found there, but there is little explicit linking of the text material to the NSES standards and minimal attention is paid to the framework of the standards that would improve the learning environment.
- "Innovative" – these books reflect the intent of the authors to provide reflection on the nature of science and the learning of science in a social context. The instructional design is innovative. The authors address the standards explicitly both in content and in their inquiry-based approach to the learning of science. These materials are rich in teacher guidance.
- "Mixed" – These books are built on the traditional presentation of content, but have considered the NSES standards in their recent editions and have incorporated instructional design that reflect the NSES framework.

5. As the review process progressed, the team became increasingly convinced that the authors/publishers have a responsibility for not only guaranteeing that the Standards "Content" is present somewhere in the text, but that it is accessible, extractable and

coherent. The materials were reviewed from the point of view of the teacher who is expected to understand all of the content, know the best pedagogical practices, and to guide themselves and their students through the vast amounts of materials. The burden on the teachers is great.

6. Probably the greatest challenge in biology as in other areas of science is to assure fair assessment of student learning. The assessments in all of the formats (standards-based assessments considered here in contrast to the newer "high stakes" assessments) reflect and help us to understand the way children learn. Many of the textbooks need attention to this area to create better learning environments.

D. Review Results

The review results are presented in order of those materials that were found by the review team to be more responsive to the *National Science Education Standards* to those materials found to be less responsive using the review instrument in Appendix 1. As noted earlier, the books reviewed are listed in Appendix 2 and the process used by the review group summarized in Appendix 3.

I. Title: *Biology: A Human Approach*
Authors: Biological Sciences Curriculum Study
Publisher: Kendall/Hunt Publishing Company
Date: 1st Edition, 1997

Components: Student Edition (hard cover); Teachers Guide; Teacher's Resource Book, Videodisc Package, Computer simulations (2-Mac and Dos compatible

Philosophy and Design: *Biology: A Human Approach*, is a program for 9th and 10th grade students that uses a constructivist instructional model, the BSCS 5-E model of learning - Engage, Explore, Explain, Elaborate and Evaluate. The materials are written to de-emphasize vocabulary and emphasize conceptual learning. Each unit has a human perspective and the activities engage students in the learning process. The materials are organized under six unifying themes: 1. Evolution: Patterns & Products of Change in Living Systems, 2. Homeostasis: Maintaining Dynamic Equilibrium in Living Systems, 3. Energy Matter and Organization: Relationships in Living Systems, 4. Continuity: Reproduction and Inheritance in Living systems, 5 Development: Growth and

Differentiation in Living Systems, and 6. Ecology: Interaction and Interdependence in Living Systems.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 4.0	BI-A 3.5	MG-A 4.5
BE-B 4.0	BI-B 4.0	MG-B 4.0
BE-C 4.0	BI-C 4.0	MG-C 4.0
BE-D 4.0	BI-D 4.0	MG-D 4.0
BE-E 4.0	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.5	OCS-1 4.0	OCS-1 4.5
OSC-2 4.0	OCS-2 4.0	OCS-2 4.5
OSC-3 3.0	OCS-3 4.0	OCS-3 4.0
OSC-4 4.0	OCS-4 4.0	OCS-4 4.0
OSC-5 4.0	OCS-5 4.0	OCS-5 4.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**
POC-1 4.5	POC-1 4.5	POC-1 4.0
POC-2 4.0	POC-2 3.5	POC-2 4.0
POC-3 4.0	POC-3 4.0	POC-3 4.0
POC-4 3.5	POC-4 4.0	POC-4 4.0
POC-5 3.5	POC-5 4.0	POC-5 4.0

Evolution: Evolution is a major theme from the beginning of the book and there are particularly good sections on cultural evolution and continental drift. The amount of active learning was considered to be exceptionally high, with many thought-provoking questions about evolution posed for students. There is a lack of diagnostic tools in this section to assess prior knowledge. It was noted that more practice of the 5E method of instruction by the teachers, which is well developed in the Teacher's Resource Guide, seems necessary for good implementation. The level of reading and writing needed in the course is relatively high. There are no strategies in the teachers' resource book for coping with English as a second language, special education, or children of lower ability.

Interdependence of Organisms: This section was seen as an outstanding section if delivered by the teachers as designed. The essays are a necessary part of the program and a high level of competence in the teacher is needed. The content follows *the National Science Education Standards*. The activities themselves do not always present complete content coverage, but are excellent specific examples. The essays do build the important generalizations. The 5E instructional model provides rich inquiry opportunities, and is activity-oriented, well paced, and with experimental inquiry opportunities for students in each chapter. Science and humanities connections are pervasive throughout the text. Treatment of ecological issues is serious and pro-active and not just filled with doom and gloom! On the negative side, safety issues are seen as overly cautious. They may give students the impression nature is dirty, dangerous, unhealthy (e.g., students are advised to wash their hands after setting up a simple aquarium, not to handle any organisms on field trips outdoors, use goggles and wash hands after handling yeast). Treatment of energy flow in ecosystems seems rather simplistic. Some concern was voiced that one topic, e.g. ozone, is used to represent a global issue and students might not be able to expand the concepts to other environmental topics. However, in balance, this topic is well developed as a capstone, providing a hypothetical situation in which students grasp the complexity of thinking about any environmental topic. Under science and technology, no mention is made of satellite photography, and there is a minimal use of Internet for data, or opportunities to link scientists and classrooms. The reviewers felt there was not enough field-work included for an ecology unit. Again, it was noted that the text does not stand on its own; it requires a teacher trained in constructivist theory to facilitate the program, and the essays at the back are essential.

Molecular Genetics: The content standards are well met in these materials. The design is to move from macroscopic to microscopic to molecular, and the results clearly follow this design. The materials engage the students, each chapter beginning with a practical

application for students which follows the model of inquiry teaching, and moves to journal writing. Students seek out most of the information in the essay portion of the book as they construct their knowledge through the activities. The laser disc expands the information. Again, it was noted that there is very good articulation with *the National Science Education Standards*. The materials clearly lead students to design their own experiments and construct their own knowledge. The shaping and refinement of the knowledge is enhanced by strategic questions within the activity. This was particularly clear in the activity to model DNA function. The videodisc provides additional information as the students remodel their model of DNA. Historical perspectives are included with a presentation of a progression of knowledge from those of Mendel to the pending new evidence. A strong presentation is the concept that ideas we develop are subject to change pending new evidence and are open to skepticism. The historic sidebars are frequent, pertinent and written for students. The active learning is particularly strong in this text, allowing sub-populations of students to learn; thus the learner is involved, not only in just the science they think is of interest to them, but they are exposed to and actively become involved in much more. Every unit begins with activities that result in questions that students use to build their knowledge. This successful presentation differentiates this text from most others.

General Comments: The ratings are high for this program. The text weaves the six unifying themes into two sub-themes of "Science as Inquiry" and "Science and Humanity." Science as Inquiry refers both to the discovery (constructivist) process by which information is obtained and evaluated, and the changing body of knowledge that characterizes scientific understanding. The Science and Humanity sub-theme makes the study of biology more relevant by incorporating the critical elements of human culture, the history of science, the place of ethics, ethical analysis and decision making in today's controversial science world. Not only do the authors say they are going to do this, but they carry out the connections between the various themes. The breadth of the essays and the depth of content included in each essay allow this text to be used both as a builder of mainstream concepts and as entrance for individual learners to advanced levels of biology. The information is seen as not downloaded on the student, but rather constructed through activities in a clearly defined 5E model learning cycle. This cycle and the constructivist approach allow students already having an interest, as well as students not bringing an interest, an equal opportunity for understanding.

Of particular note is that the program is supported by rich teacher resource materials that are especially important to guide the teaching of the course. For example, "strategies for guiding learners" discusses common student misconceptions that limit

understanding. Also provided are flow charts for each chapter as well as unit overviews that provide teachers with goal statements for content, inquiry, technical connections and human perspectives. These materials model the process of inquiry, and help move the teacher and students through constructed activities in stages of complexity. There are a series of essays at the back of the text that act as resources for the inquiries, journal writing and other activities. Once again, note that the essays need to be read! This is not the traditional text with bold words; on the contrary, the materials develop concepts through a constructivist approach. The text is not designed to stand-alone; all of the materials are essential for the entire program. This book is clearly linked to NSES, not only in the content, but also in the pedagogy, professional development and implementation suggestions. It is clear that the Teacher Support guide is excellent, but that to use the materials requires changes in teaching techniques; this may not be popular with all teachers. The review team found the ratings were consistent in all three content areas discussed. There is a high complexity of issues that are engaging, and the human factor throughout the materials is a "plus" for interesting the students

II. Title: *Biology: The Web of Life*
Authors: Marilyn Lisowski and Eric Strauss
Publisher: Addison Wesley Longman, Inc/Scott Foresman-Addison Wesley
Date: 2nd Edition, 2000 ("Wolf")

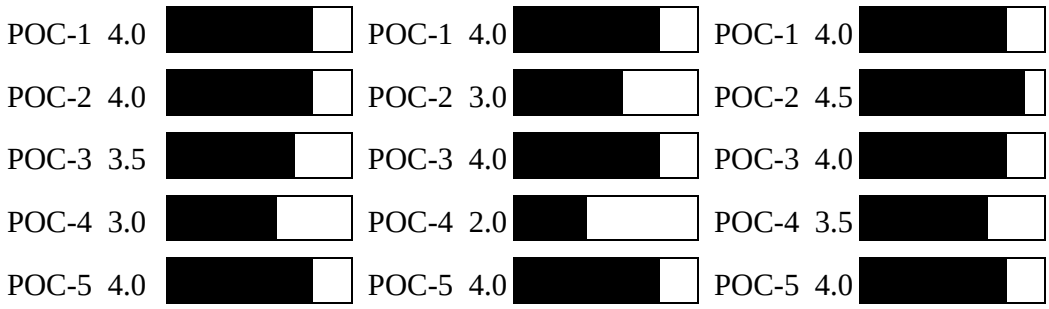
Program Components: Student Edition Textbook, Teacher's Edition Textbook., Laboratory Manual, Teacher's Resource Package, Overhead Transparency Package, Animated Biological Concepts Videodisc Worksheets, Interactive Biology Simulations Worksheets, Videos (Biology alive! Series), Videodiscs (2 disc set- animated biological Concepts Videodiscs), CD-ROMS (Test-Works, Interactive Biological Simulations, Teacher's Resource Planner, Biologia: Complete Spanish Translation of Text) Internet Sites (bioSURF, The Biology Place)

Philosophy and Design: This program is developed to give teachers numerous options for teaching biology. The program includes student-oriented features and a varied pedagogical format to accommodate all student learning styles. The comprehensive content is organized for flexibility. The fundamental principles are clearly identified and connected. The multitude of activities (5 minute to whole class periods) is intended to develop varied learning and laboratory skills. Technology options include videos, videodiscs, CD-ROMs, and a Web site. A three-step instructional design learning cycle of Engage, Teach and Assess is used. The text begins with a chapter on the Study of

Life. This chapter includes “the big ideas” around what is life, and how scientists study the natural world. From there the book is organized around 9 units with 38 inclusive chapters. The units are: 1) The Basis of Life; 2) Genetics, 3) Change and Diversity; 4) Monerans, Protists, and Fungi; 5) Plants; 6) Invertebrate Animals; 7) Vertebrate Animals; 8) Human Biology; and, 9) Organisms and the Environment. The Teacher’s Edition further breaks down the chapters into Core, Standard, and Extended curriculum units, allowing teachers to modify their coverage by pacing materials according to students’ abilities. The Teaching Resource Package with Planning Software is included within the Teacher’s Edition of the textbook on a CD-ROM.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 4.0	BI-A 4.0	MG-A 4.0
BE-B 4.0	BI-B 4.0	MG-B 4.0
BE-C 4.0	BI-C 4.0	MG-C 4.0
BE-D 4.0	BI-D 4.0	MG-D 4.0
BE-E 4.0	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.0	OCS-1 3.0	OCS-1 4.5
OSC-2 3.5	OCS-2 2.5	OCS-2 3.5
OSC-3 2.0	OCS-3 2.0	OCS-3 4.0
OSC-4 4.0	OCS-4 3.5	OCS-4 3.5
OSC-5 4.0	OCS-5 4.0	OCS-5 4.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**



Evolution: The content presentation in evolution is thorough and there are superb pictures and illustrations. The illustrations do an excellent job of teaching by themselves and the authors have used original and valuable ways of presenting information. Evolution is brought into focus throughout the text, as well as in three specific chapters. Science as inquiry is not as imaginative as one would hope for in evolution. The coverage of history and the nature of science are excellent, as the authors bring in controversy and the concept that ideas are subject to change. There is an excellent chapter on human evolution. The concepts of evolution are well developed to allow students the opportunity for depth of understanding. There are good resources (CD-ROM as well as within the textbook) for assessment. Equity is well done including a complete Spanish language translation of the text. The Teacher's Edition has numerous notes on clarifying misconceptions, short labs, class activities and meeting all diverse needs of the gifted, at risk and LEP (Limited English Proficiency) students. The design elements, "engage, teach and assess" hints flow thorough the unit with many useful ideas for the teachers.

Interdependence of Organisms: The content surrounding this section has some missing parts. The authors claim there are references to ecology throughout the text, but it does not live up to that claim. The book relegates ecology to the end. Only two pages are devoted to human population and there is almost nothing about human consumption of resources. Environmental issues are glossed over without much depth, with much time spent on very upbeat presentations of some environmental "success stories." The text is well written, inviting and with good visual support. Science as inquiry is very guided, and only at the end do students have some opportunity to design their own experiments. There are not many chances to do field studies. There are lots of opportunities for writing activities and cooperative class activities. In addressing depth of understanding, the ecology section does not go far enough in helping students understand the complexity

of issues; that is, there are no opportunities for debates or position papers. The assessment has excellent critical thinking questions. Helpful materials are presented for implementation, but there does not appear to be enough time allotted in the program to teach this unit successfully.

Molecular Genetics: The information relating to genetics content standards is present, accurate, and current. It is presented in historical context and is "concept-driven." The materials are rich in biotechnology information and experiences. The Unit 2 Review Manual (Fundamentals of Genetics) supports the teacher in adding or clarifying many of the major concepts. The format is effective to build a depth of understanding. Each activity starts with "the Big Idea", the major concepts, vocabulary and then provides exercises and enrichment activities and links to more information. The materials are strong in guided inquiry, and building critical thinking and all of this is embedded in the text. There is little opportunity to design experiments.

General Comments: This is a very attractive text, well-illustrated, and organized, unit by unit, chapter by chapter for teaching/learning experiences. Each chapter in a unit starts with an engaging feature often dealing with pre- and misconceptions. This is followed by the "Lab Zone," - some discovery activities. Each section starts with "THE BIG IDEA!" and ends with Checkpoints and a Chapter Review that reviews the Big Ideas, helps develop concept maps, and provides Internet links. This attractive organization should enhance discovery-based learning, using many of what are now considered "best practices." This is a working textbook, not a library or supplementary resource. Some of the limited text materials are supplemented by the Teachers' Review Manuals and by the active Internet links provided. This is a new book (copyright, 2000, 2nd edition) but there are not explicit links to or acknowledgement of the national standards as are provided in some recent texts. These definitely would be helpful to the teachers as they struggle to bring together state and national frameworks.

III. Title: *Biology: A Community Context*

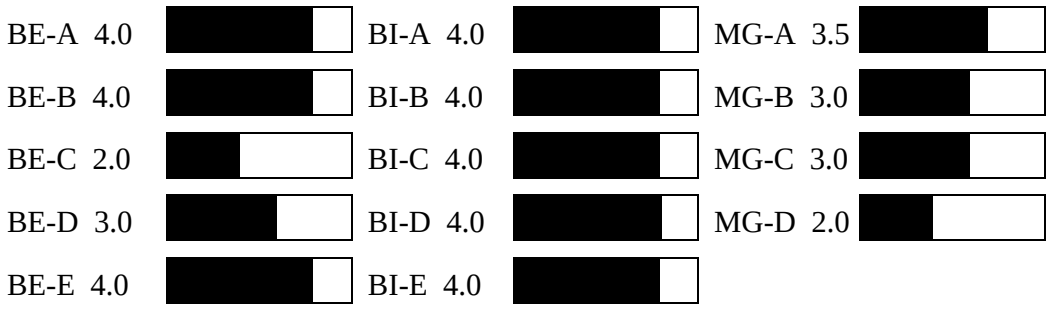
Authors: William H. Leonard and John E. Penick
Publisher: South-Western Publisher An International Thompson Publishing Company
Date: 1st Edition, 1998

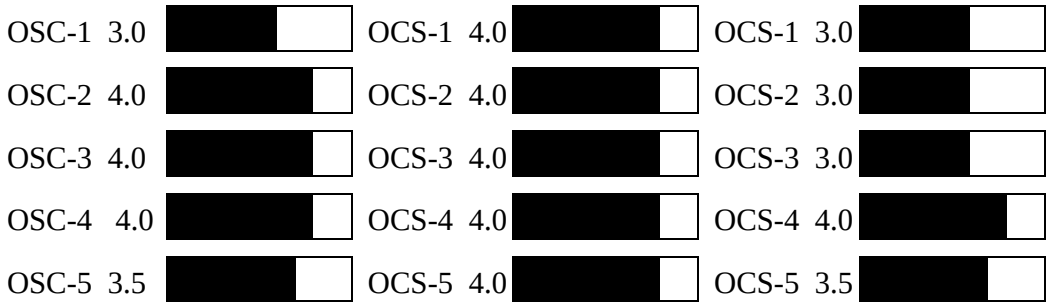
Components: Student Text Book, Teacher's Guide, Instructional Resource, CNN Video Update for Biology: A Community Context, Student Resource, The MicroExam Test Generator (Dos and Mac versions), BioLog.

Philosophy and Design: This is an active learning program for 10th grade biology students. The goals as stated are to create a rich stimulating classroom in which students are motivated to learn and interact safe from rejection and ridicule, and ideas are encouraged and nourished. The student textbook is divided into eight units, four of which are essential, and the first three must be sequential. The other four are optional. Each unit begins with a video that raises questions and dilemmas based on real world situations. This is followed by a series of guided inquiries that are carefully sequenced, followed by a Conference that provides a way for all students to "catch up" with each other. Keeping notes in a BioLog is central to the individual activities. The design of each unit is similar and reinforces the curriculum goals for students in the classroom, that is, development of knowledge, personal characteristics, attitudes and actions. The instructional strategy is described as inquiry-oriented, requiring the teacher to create a classroom climate in which students work both together and alone, often making decisions as to how and what they will learn. This is meant to reflect the tentative nature of science knowledge and promotes the idea that all such knowledge is learned in a social context. The Student Resource, a supplement to the text, has 45 essays about key topics and controversies in biology and they serve as a resource for the Conferences, Congresses, and Forums in the curriculum. This is described as a uniquely distinct set of materials that provides a consistent approach of community-oriented activities for the biology students in a highly interactive environment.

Review Results:

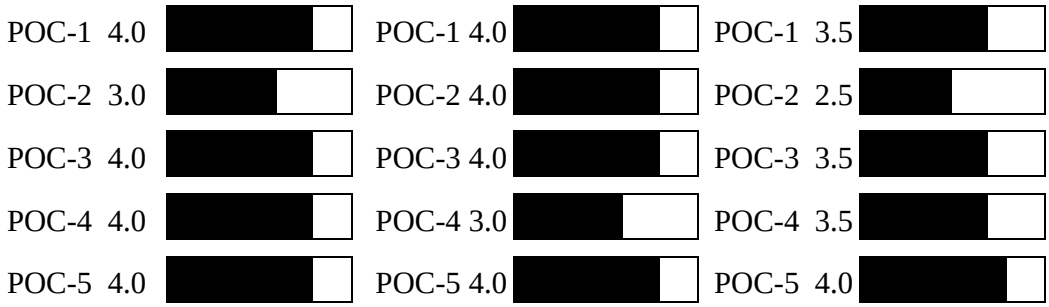
EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		





PEDAGOGY AND OTHER CONSIDERATIONS (POC)

BE **BI** **MG**



Evolution: The content is there, but not well covered in all cases. The philosophy of less is more is operating and the obvious strength is the involvement of the students in all aspects of the activities. The student reading is not required, and evolution is woven through the entire program, not in any distinct sections. This means it is also too disjointed for good understanding. It relies on the teacher and student to make sense of the scattered information. The history of evolution is there in content, but it is noted that pedagogy of teaching evolution needs to be present as well. The teaching is very different from the usual teaching techniques, and teachers will have to change in order to be effective and create the learning environment called for by the authors in the Teacher's Guide.

Interdependence of Organisms: The content standards in this section are particularly well met. An example is cycling matter in the community that is emphasized under a number of different topics. The examples of organisms used are numerous and geographically distributed in diverse habitats. Many of the topics are repeatedly reinforced through many of the units. The materials that apply to global issues such as global warming, ozone depletion and acid rain come across in an unforced effective way

under numerous topics related to these potentially depressing concepts. The materials were written by more than 55 biologists, science educators and high school biology teachers, and field-tested by 65 teachers in 17 states. This seems to be well reflected in the excellent coverage of the high school concepts, and in the resulting materials designed for heterogeneous classes. There is an emphasis on positive as well as negative human activities, and the language is non-emotional, and non-judgmental in nature. This is a major strength of the text. There are many examples of inquiry, although there is a weakness in not having outdoor field studies. Mathematics is included as well as technology with an abundance of Internet references for gathering important data for the students' work. Global Information Systems (GIS) is not mentioned. The exercises are thought provoking and critical thinking exercises. To quote the text, "…is designed to have students doing hands-on activities about 75% of the time;" that goal seems to have been met. The social and personal perspectives are strong in the entire design. The conference, Congress and Forum sections in each unit amply allow students opportunities to express and discuss ideas with their teacher and their peers. They visit the Internet connections in these activities. This leads them to realize the humanness of science. Guided inquiries emphasize the nature of science, and there are 31 guided inquiries and 31 extended inquiries in the ecology units alone! The teacher is richly supported in all aspects of instruction and at the same time given options as to the depth pursued in any unit. This strategy must make the materials attractive to a great diversity of teachers and students in terms of experience and ability. A major strength of the materials is the development of a limited number of fundamental biological concepts. The materials are carefully organized and students are not overwhelmed by an encyclopedic textbook. Assessments are varied; the unit tests are multiple choice, but all others involve extraordinary amounts of writing. It was noted that even though the curriculum is overwhelmingly student-directed, a great deal of energy and organization is required by the teacher to keep students on track. The materials reflect a diverse ethnic group of students engaged cooperatively. The materials have many role models for all students portrayed as workers in science careers.

Molecular Genetics: The book's community approach is innovative, exciting and unique in organizing biology around a number of socially important issues related to student interest. The authors' designation of some units as "optional" creates a problem in implementation as seen by the reviewers. If units 1,2 3 and 8 are the essence as stated by the authors and presented in sequence, and units 4,5, 6 and 7, (considered as optional in the Teacher Guide), are omitted, the scores would be different in the review of molecular genetics. The standard concepts in molecular genetics are either absent or poorly addressed unless all units are used. There is a need for better editing. Genetics seems

scattered in its presentation under several topics. The learning is active and exciting, but few activities follow the scientific methods of approach. Science as inquiry is present with evidence and asking of questions, but there is a limited amount of science in the way scientists do it. The visualizations, graphics and pictures engage students of varying backgrounds and point of view and are excellent. The depth of understanding for molecular genetics is not very good. Obvious genetic connections are often left out. For example, in the discussions about taxonomy and natural selection, genetics does not seem to play a role!

General Comments: This book might be termed "less" because it is selective in the areas covered. However, those areas chosen are well addressed and are treated with appropriate detail. The depth of understanding relative to concept development in ecology is excellent, although the other areas do not have that depth. There is concern that if all sections were not included in a particular class, the basic concepts of major areas, for instance genetics, would not be covered appropriately. Other major strengths of the program are the student activities that orient and involve them in their own learning, and the clear relationship of content to the experiences and interest of students. Science is shown as important to people from all walks of life and good for ALL students. One of the strongest points is in the way equity is portrayed throughout the materials, and the authors are to be congratulated for this presentation.

IV Title: *Biology: The Living Science*
Authors: Kenneth R. Miller and Joe Levine
Publisher, Prentice Hall
Date: 1998 ("Lioness")

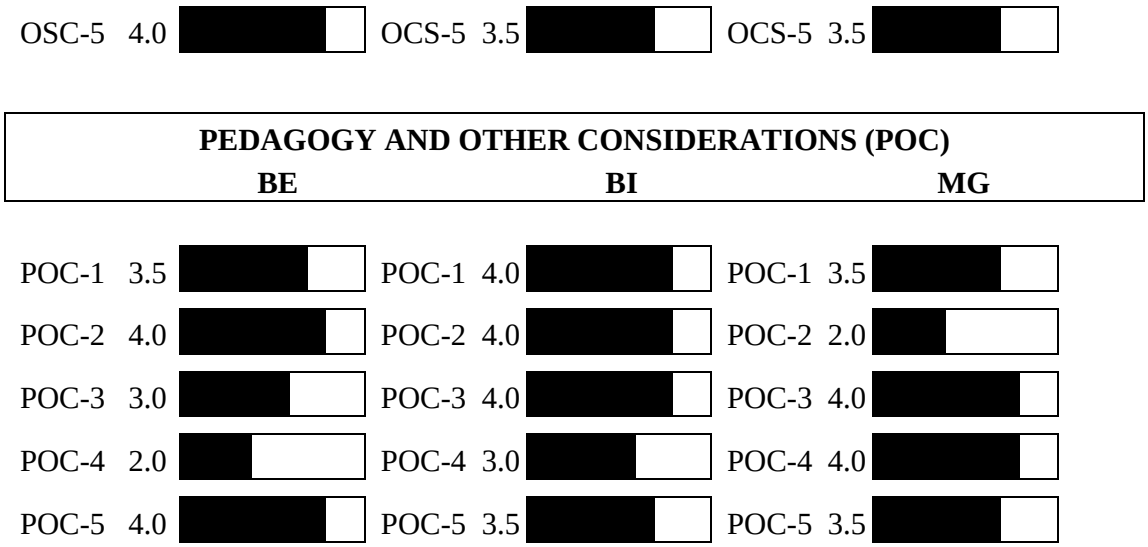
Components: Student textbook edition, Teacher's textbook edition, Teaching Resources, Laboratory Manual, Laboratory Manual-Annotated Teacher's Edition, BioLog, BioLog Teacher's Edition, Transparencies, Technology Components that includes, BioVue Videodiscs, The Digital From CD ROM, CyberEd – 12 CD-ROM Series, The Mayo Clinic CD-ROM (The Total Heart, Family Health), Computer Test Bank with Dial a Test.

Design and Philosophy: This textbook represents a new approach to motivation and content, and the program is designed to involve every student. It is described as a lively presentation with manageable content and characterized by interactive learning. The

program offers instructional “pathways” to help manage curriculum for diverse student needs. Other characteristics are: 1) BioJournal, for students to connect their own thought and observations, 2) Connections, that feature new discoveries and present issues in biology that students face today and in the future, 3) Career Track, to explore careers; Mimi Labs, hands on experiences, 4) Problem Solving, that encourage students to explore a range of real-life situations and apply critical thinking to arrive at meaningful solutions, 5) Laboratory Investigations, where students design experiments, and 6) Integration Features, to show connections of biology within an interdisciplinary context. The first four units cover the basic six biology concepts: Characteristics of Living Things, Cell Biology, Genetics, Evolution and Natural Selection, Biodiversity, and Ecology. This program comes in a series of hardcover books: a single volume (Units 1-8), the Core Course (Units 1-5), Unit 6, From Bacteria to Plants, Unit 7 Animals, and Unit 8 The Human Body. Unit 5 is an overview of all the phyla from bacteria to humans. Units 6,7 and 8 are more detailed discussions of bacteria, plants, animals and the human body. The instructional design is a four step plan, Engage, Explore, Teach, Assess.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 4.0	BI-A 3.5	MG-A 3.5
BE-B 4.0	BI-B 4.0	MG-B 2.5
BE-C 4.0	BI-C 4.0	MG-C 3.0
BE-D 4.0	BI-D 4.0	MG-D 3.0
BE-E 4.0	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 4.0	OCS-1 4.0	OCS-1 3.0
OSC-2 4.0	OCS-2 3.5	OCS-2 2.0
OSC-3 2.5	OCS-3 3.0	OCS-3 2.5
OSC-4 3.0	OCS-4 3.5	OCS-4 4.0



Evolution: This book is very well written and illustrated. The flow through the chapters is excellent. In the evolution section, the relationships of the molecular and species levels are particularly well presented. The biodiversity coverage includes scientific evidence, unification of molecules with species, measurements of biodiversity and cites the contemporary scientists, Eisner and Wilson, leading researchers in the area. The unifying concept of evolution is particularly well addressed in a clear, unambiguous way. Darwin comes across as a scientist doing science as a human endeavor. The history of science in this section is particularly well done. Inquiry is addressed in the problem solving Mini Labs. The students use Internet data on biodiversity in an excellent experiment. The assessments are well done creating an active environment for students with words such as, "reviewing, expanding, extending, applying."

Interdependence of Organisms: The "Core Course" includes Units 1-5 of which Ecology is the 4th and is given approximately as many pages as the other 4 units. This is a welcome change, and perhaps recognition, that ecology is now a significant topic. (Typically, it is relegated to the last chapter with the implication that it is the least necessary of all the biological disciplines and can be left undone if time runs out). For the most part the science is accurate, although there is an error about plants not releasing carbon dioxide. There are some outdoor activities included. Student inquiry is woven into the materials in greenhouse effect and habitat and population change. There is an admirable section on major concerns relative to the biological and environmental implications of continued human exponential population growth. Technology is nicely woven in as well. All the major topics of concern are addressed in detail with familiar and varied examples. Each chapter has Ecology Notes sections in the Teacher's Edition,

which integrate ecology with all the other disciplines. There is clearly stated concise and relevant teacher support in the Teacher Edition of the text. There are some imaginative science inquiries, and students participate in the design in both short term and long-term experiments. There are plenty of opportunities to both do and understand inquiry although most of them are teacher-guided rather than student-generated. A lot of responsibility is put on the teacher to lead actively in the discussions leading up to the investigations, rather than arising from a student's reading of the text. Not a lot of emphasis is given to open student discussions where personal opinion is solicited A bit more emphasis on student peer discussion and/or debate might greatly help many students fully understand what is happening on the earth at the present time. The instructional materials explicitly focus on equity issues, and are well sprinkled with references to minorities. There are regular "Teacher Support, Managing Classroom Diversity" boxes. Rachel Carson is not mentioned with DDT, but is in the Unit 8 on the human body! There are lots of good suggestions for future career paths, but the text might feature more pictures of currently working scientists from different groups.

Molecular Genetics: This section has a good history of the science leading to the discovery of DNA's structure. There are some disappointing diagrams, specifically of DNA replication that show polymerization going in the same direction on both strands and the bases all of equal length, and a very fuzzy geometry in the graphic at the hydrogen bonding site. Yet the vast majority of graphics are reflective of an intentional move toward a friendly, accurate and up to date approach. There are some concepts in regard to gene regulation that might be better developed, as could areas on protein synthesis. There is some evidence of connecting concepts of genetics with evolution, but less accounts on steps from protein synthesis to cell type. Although inquiry was present in the chapter, it appeared more as snippets at various locations in the unit. There are some opportunities to read about technology, especially relative to selective breeding, molecular experimentation techniques of restriction enzymes, transformation, transgenic animals and plants, diagnostic approaches for human disease and the human genome. There are no opportunities to apply understanding of technology. The science in personal and social perspectives and the history and nature of science standards are exceptionally well done in this section. There is some difficulty in having a logical progression for developing conceptual understanding. None of the major content areas are clear, present and accurate in every category. The text hits on one or two areas very clearly and the rest are not present, have to be deduced, or are left hanging for five chapters. Yet there are a number of well-done summarizing statements, concept maps, well crafted review questions, and sections to expand on learning. The assessments are presented in a complete package, beginning with a focus piece in the chapter introduction and

checkpoints at the end of each short concept. Also, every section assessment has areas requiring critical thinking. The implementation materials are adequate. The lesson plans include the instructional design of the learning cycle and it is laid out for each chapter.

General Comments: The authors set out to present engaging materials for all students and appear to have succeeded in doing so. The materials are well supported for teachers. The organization of the units allows flexibility while meeting the majority of the content standards.

V. Title: *Insights In Biology*

Author: Education Development Center Development Team, Jacqueline Miller, PI
Publisher: Kendall/Hunt Publishing Company
Date: 1998

Components: 5 modules, each with a Teacher Guide and Student Manual. 1) The Matter of Life, 2) Blueprints of Infection, 3) Different Stages Through the Ages, 4) Traits and Fates, and 5) What on Earth?, and an Implementation Guide.

Philosophy and Design: This introductory biology course for 9th or 10th grades is designed as an inquiry –based curriculum for all students. The educational experience provides traditional discipline-specific concepts with an emphasis on presenting concepts in depth and in context, develops conceptual connections through a story line that is relevant to students' lives, and uses inquiry-based activities that focus on process and thinking skills. These skills include problem solving, writing, and thinking skills and are meant to help students become active learners. Another goal is to provide support to teachers in developing these new instructional strategies and pedagogical approaches that are interactive, inquiry-based, hands-on, and that develop science process and thinking skills. The design incorporates flexibility to meet the belief that students have a variety of learning experiences, and each should be afforded an opportunity to ask and answer meaningful, thoughtful and challenging questions about themselves and their world. The design provides the teacher with assessment options that inform instruction and measure student concept and skill development, includes the development of new technologies and uses of models and manipulatives, and provides options for sequencing the modules to meet the needs of the students. The content is correlated with the AAAS *Benchmarks for Science Literacy* and *National Science Education Standards.*

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 3.0	BI-A 3.5	MG-A 4.0
BE-B 3.0	BI-B 3.0	MG-B 4.0
BE-C 3.0	BI-C 3.5	MG-C 4.0
BE-D 2.0	BI-D 4.0	MG-D 4.0
BE-E 2.0	BI-E 3.5	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.0	OCS-1 4.0	OCS-1 4.0
OSC-2 4.5	OCS-2 3.0	OCS-2 4.0
OSC-3 1.0	OCS-3 2.5	OCS-3 2.5
OSC-4 4.0	OCS-4 3.5	OCS-4 4.0
OSC-5 2.5	OCS-5 3.0	OCS-5 5.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**
POC-1 4.5	POC-1 4.0	POC-1 4.0
POC-2 3.0	POC-2 3.5	POC-2 3.0
POC-3 4.0	POC-3 4.0	POC-3 4.0
POC-4 4.0	POC-4 4.0	POC-4 4.0
POC-5 2.5	POC-5 3.0	POC-5 4.0

Evolution: Evolution is considered mostly in the modules, *What on Earth* and *Fates and Traits.* The authors present a program that is built on "less is more" and is therefore a very different program than most textbooks. There are five modules, but it is stated that

only four might be used in a full year. This presents a problem as to how evolution would be covered, and would have to be carefully considered by the teachers. The content presented is excellent but it is spotty in its coverage. Teachers may need to supply additional information. At times the level of reading varies, and the quality is uneven. The concepts of descent with modification are weak, and no human evolution is included. There is little on technology in this section. The presentation of science as inquiry is excellent, and this instructional design approach is considered exemplary.

Interdependence of Organisms: For this section, most of the content is found in the module "What on Earth." The Teacher's Guide and Student Manual go hand-in-hand, and the Student Manual is not meant to be used alone but is integrated closely with background reading in the Guide. The emphasis is on hands-on learning experiences followed by analysis questions that force the students to make their own connections. This approach is opposed to traditional textbook readings that generally contain vast amounts of information. Most of the concepts are well covered although a real omission concerns the treatment of human population growth, a serious environmental issue that is relegated to an optional activity in the Teacher's Guide and not mentioned in the Student Manual. Although the module is rich with hands-on activities, the authors do not always provide the opportunities to develop the abilities to do scientific inquiry and less so, the understandings about scientific inquiry. The unit is rich with instructions for a long-term project, an experimental investigation of a local environment, and the Teacher's Guide includes information on such Internet resources as the GLOBE program and Tapestry grants. There is a great deal of dependence on the teacher's initiative and ability to organize these efforts. Although technology is mentioned in regard to models in reintroducing wolves into Yellowstone National Park, students are not given hands-on experience with computers. There is excellent treatment of science in personal and social perspectives and good treatment of important historical events. However, again, students are not given the opportunities to look at actual data or develop an understanding of the quantitative nature of environmental science. While students are encouraged to offer their personal views on the Florida Everglades Project, they are not asked to consider the kind of evidence scientists use to argue environmental actions. Depth of understanding, is emphasized and the students are given introductory and final questionnaires that emphasize a holistic understanding of significant ecological topics covered. There is an excellent "Extending Ideas" section using biogeochemical cycles. The Teacher's Guide, an essential element, is excellent and provides the teacher with all the tools to implement the program. The student manual is not a traditional textbook; it contains only the essential information for each of the 7 learning experiences, is user friendly and contains clear procedures. No specific instructions are included in the Teacher's Guide for

teaching special populations of students. However, the format of Insights is very "hands-on," inclusive of many different learning styles and generally well paced.

Molecular Genetics: This content was found in the *Traits and Fates* and *Blueprints of Infection* modules. The content standards are well met within an innovative teaching context. Concepts are well stated and then backed up with context in the Student Manual and with hands-on activities. Some drawings would benefit from a higher resolution and less simplistic explanations. Overall strengths in molecular genetics are the presentation in an innovative context for learning, the inquiry approach, engaging nature of the material and the activity-rich environment. The case studies are a great selection of readings and include careers. There is a consistent use of history and the nature of science, and in this section, it was considered exemplary. There is strength in the diversity of experiences presented. The assessment is consistent with the inquiry approach, and a variety of methods are used. Equity issues in this section were seen as a non-issue as it allows for engagement for all kids.

General Comments: The modular units of *Insights* with the five Student Manuals and the Teacher's Guides provide a well-paced and pedagogically excellent approach. The program delivers a hands-on approach to the subject matter with the teacher as facilitator. The committee noted that the program has the potential of not covering all topics if all the modules are not included during the year. The materials are considered very innovative, and well supported with implementation materials for schools and for teachers. The module approach is a welcome change from the heavy books!

VI. Title: *Modern Biology*

Authors: "Built on past editions with staff and contributing writers"
Publisher: Holt, Rinehart and Winston
Date: 1999 ("Owl")

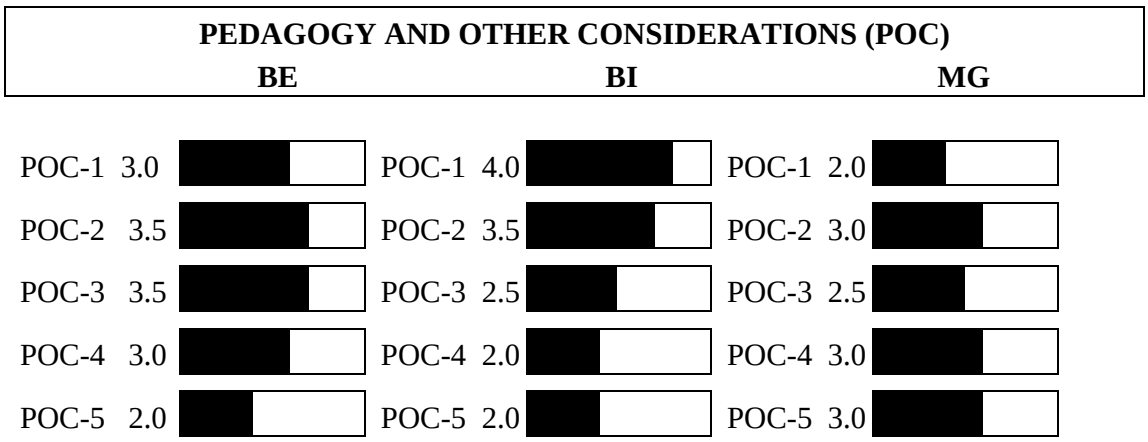
Components: Holt BioSources Lab Program (5 laboratory manuals); The Holt BioSources Teaching Resources CD-ROM; Holt Biology Videodiscs, Interactive Explorations in Biology

Philosophy and Design: The intent is to provide comprehensive coverage of biological concepts and topics, meet the needs of parents and the community leaders who ask for more rigorous courses of study, and revise materials according to national standards to help students achieve science literacy. The 53 chapters of the content subjects are

organized around 10 units on 1080 pages: 1) Biological Principles, 2) Cells, 3) Genetics, 4) Evolution, 5) Ecology, 6) Microorganisms, 7) Plants, 8) Invertebrates, 9) Vertebrates and 10) Human Biology. Design elements of the book include, Features (Research Notes, Literature and Life, Great Discoveries), Chapter Investigations (scientific methods and data-collecting techniques used by biologists to ask questions and form conclusions), and Interactive Explorations (using CD-ROM for students to manipulate variables, collect data and draw conclusions about biological phenomena). The materials are organized around 6 flexible plans that utilize different parts of the units and allows teachers to meet the needs of individual students and classes: 1) Basic Course, 2) Cell Biology Emphasis, 3) Ecology Emphasis, 4) Zoology Emphasis, 5) Botany Emphasis and 6) Human Biology Emphasis. It is stated that the multiple authors and staff have most recently revised this 37 year old book in accordance with the recommendations of the *AAAS Benchmarks for Science Literacy* and *National Science Education Standards*.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 4.0	BI-A 4.0	MG-A 4.0
BE-B 4.0	BI-B 4.0	MG-B 4.0
BE-C 4.0	BI-C 4.0	MG-C 4.0
BE-D 4.0	BI-D 4.0	MG-D 4.0
BE-E 4.0	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.5	OCS-1 3.0	OCS-1 3.0
OSC-2 3.0	OCS-2 3.5	OCS-2 2.0
OSC-3 2.5	OCS-3 3.0	OCS-3 3.0
OSC-4 2.0	OCS-4 3.0	OCS-4 2.0
OSC-5 4.0	OCS-5 3.0	OCS-5 4.0



Evolution: The evolution content is present, accurate and current. The materials are well presented. The historic portions are particularly captivating to the read. The evolution theme is strong in each of the six plans suggested to cover the material with different biological emphases. Subject areas that are particularly well covered are Darwin, the Burgess shale, additions to the finch studies of Darwin by Grant and Grant, and there is a compelling discussion about relating the theory of evolution to the theory of gravity and the theory of the cell. In the other content areas, there are wonderful connections with geological history, and connecting anthropology with the Leakys' investigations and other homonid evolution research. The concepts are fundamental and comprehensive, but too much is presented. It feels like a college level understanding of evolution and more geared to the implementers (teachers) than to those students who will read the textbook. This is particularly true when cladistics comes into the discussion. Science as scientists do it is a marginal activity and not too often addressed. The Burgess Shales are presented without scientists with the exception that a good account is given of Professor Gould. The investigations are inquiry-oriented and in one case, data is included for use by the students. The role of technology in studies about evolution is not brought up. Also, science in personal and social perspectives is not covered except for one reference to peoples in Ecuador. The history of science is well presented, with a bit less on the nature of science. Relative to active learning, there is little to engage different groups of students. The depth of understanding is present, and there are helpful planning guides for the teachers. So, if these are followed, the students should have excellent coverage. There is a logical progression, but the presentation is overly fact laden. There are some excellent questions to bring together the concepts at the end, but there are still the parrot-like multiple choice questions as well. Many of the teacher hints are very interesting. There is also an excellent approach of bringing back concepts where the molecular

findings fit into the developments in our understanding of evolution, and this includes a molecular clock! Still, one wonders if this is appropriate for high school biology. Self-assessments are available at the end of each chapter, and the answers given for the teacher edition. The investigations carry some excellent questions, and they are pretty tough! There do not seem to be hints on how to score these, nor are there any portfolio-type suggestions. In conclusion, this is a strong unit. The most negative part is the immense size and overwhelming knowledge within the book's covers. It would be daunting to a teacher, and there is no real explanation of what level of expertise, professional development or help would be needed to implement this book in a geographically large area.

Interdependence of Organisms: The topic is well covered in unit 5 (Ecology) although the vocabulary and terminology are excessive. Connections are frequently made with evolution and other areas in the text. Especially noteworthy are the Eco-connections in other areas of the text that reinforce connections of ecology to other topics in biology. In-text-labs help students understand concepts, but provide limited opportunities to do scientific inquiry. There are a few exceptions (last in text-lab), but the best inquiry experiences are found in BioSources (supplemental lab program). These are excellent, but time consuming and it seems unlikely they would be used. Technology is covered in BioSources but again, as supplementary materials, they are not part of the budgeted time for ecology. Science in personal and social perspectives is partially addressed, with some excellent coverage of the effects of human populations on the environment. There is a limited discussion of the bioethics of various ecological issues. Active learning is an important consideration and is well addressed in ecology. The text is well organized for student understanding, and the chapter design helps students see the overview of concepts and their relative importance. The Teacher's Edition provides lots of interesting notes that help students develop depth of understanding. The assessments in general focus too much on vocabulary and fact testing. The critical thinking questions are excellent. The Teacher's Edition is very supportive for teaching ecology. The time factor however, is a major difficulty. Time that is suggested for minimal coverage of the ecology unit (Ch.19 –23) is approximately 6-8 weeks. This included in-text-lab activities, but does NOT include BioSources lab activities. This would require an additional 4-6 weeks. The ecology unit is approximately 10% of the entire text. The entire text is too large and teachers are given no guidance about prioritizing units. This sets up a frustrating situation for teachers, and is counterproductive to the sensible coverage of life science as outlined by the *National Science Education Standards*.

Molecular Genetics: The information relating to genetics content standards is present, accurate (with several minor ambiguities on diagrams), and current. It is presented in excellent historical context. However, it is very detailed, and may require more background than that of the general population of 9th and 10th graders. The presentation will require considerable teacher intervention to help students get the big concepts from this didactic fact-laden text. The science as inquiry is the weakest aspect with little opportunity for inquiry using the experiments in the text. The supplemental materials help this, but there would be difficulty in fitting them all in. There is a good section on technology in genetics, but few opportunities to use it. There are many issues raised that relate science in personal and social perspectives; however, there are no real opportunities to engage students in developing, defending or communicating ideas. The history and philosophy areas are well embedded in the text and this is a strong point. Active learning is somewhat addressed, but is not inquiry. One must still sift through an enormous body of facts and narrative. Activities seem to be observational and model building. This is a didactic, authoritative text that develops concepts logically. However, it does not challenge the students to develop hypotheses, inquire, or assess prior knowledge and beliefs.

General Comments: This is a very attractive book, well illustrated and well written. The content is covered. However, it is very long. There is a strong development of concepts and rich connections through the text. However, the text does not lend itself to inquiry, unless teachers specifically utilize BioSources. The time frame for coverage does not seem reasonable for the teachers.

VII Title: *Biology: Principles and Explorations*

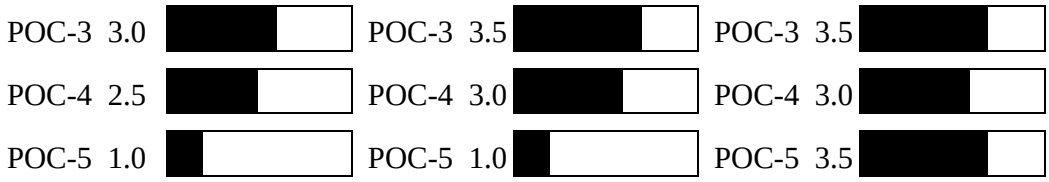
Authors: Johnson, George B and Raven, Peter H.
Publishers: Holt, Rinehart and Winston
Date: 1998 ("Turtle")

Components: Student Edition Textbook, Annotated Teacher's Edition, Study Guide with Answer Key, Student Study Guide, Chapter Tests with Answer Key, Holt Biology Videodiscs Teacher's Correlation Guide

Philosophy and Design: The authors note there has been a revolution in biology and as a consequence, textbooks are too long, and curriculum is packed with too much information to teach comfortably in the time available. They turn to teaching the ideas of

biology and do so based on four recommendations: 1) adopt a higher quality standard, 2) focus on principles rather than information, 3) develop flexible curricula, 4) use technology. Inquiry-based laboratories are included with each chapter and they emphasize group work, the process of science and the use of technology. The materials also offer "BioSources," a package of supplementary materials that can act as extensive resources for the teachers and for students. The Holt Biology Videodiscs include barcodes and descriptors correlated specifically to this textbook. There are block scheduling support materials as well as extensive teacher hints in the Teacher's Edition.

EVOLUTION (BE)	INDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 4.0	BI-A 4.0	MG-A 3.0
BE-B 4.5	BI-B 4.0	MG-B 3.5
BE-C 3.5	BI-C 4.0	MG-C 3.0
BE-D 4.5	BI-D 4.0	MG-D 3.0
BE-E 4.0	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.0	OCS-1 3.5	OCS-1 2.5
OSC-2 3.5	OCS-2 3.0	OCS-2 2.5
OSC-3 2.5	OCS-3 2.0	OCS-3 3.5
OSC-4 2.5	OCS-4 4.0	OCS-4 3.0
OSC-5 4.0	OCS-5 2.5	OCS-5 4.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**
POC-1 2.0	POC-1 2.0	POC-1 2.5
POC-2 3.5	POC-2 3.5	POC-2 3.0



Evolution: There is an exemplary treatment of content concepts of some facets of evolution, especially relative to plants, populations and sexual reproduction. The active learning is dependent on the use of Holt resource materials, and does not pervade the text. The materials appear to be highly dependent on a dynamic teacher. The most difficult area is that of equity. The pictures carry undesirable overtones in this content area; an example is the representations of African *Homo erectus* as naked and European Neanderthal representation clothed.. There is also is an example of a reference to Peking rather than Beijing.

Interdependence of Organisms: The content in this section was found to be accurate and well chosen with appropriate depth for all high school students. Major misconceptions that sometimes interfere with student learning were addressed and corrected. The illustrations were clear, well chosen and with clear captions. Human population growth was recognized as the Earth's "core problem." There is a comprehensive coverage of earth's major environmental problems. There is little evidence of appreciation that every person on earth must actively respond to "ecology." The text reads in a somewhat impersonal academic perspective as if all students automatically are fascinated with the natural world. Science as inquiry is pervasive throughout the unit, and the investigations utilize living animals; they are considered relevant, realistic and satisfactory. The text has an appearance of exclusion of woman; in almost all cases (with the exception of Ann Ehrlich) men are the cited "scientists." The use of Biosources, a generic Holt supplement, is not implicit, but would improve the approach in the use of these materials.

Molecular Genetics: This is an attractive, well illustrated and linked to useful supplemental materials. There are useful questions at the end of the chapter that provide depth of understanding. The writing in this section is interesting overall. While the goal is to have a limited number of concepts, the major concepts are not clearly stated and reiterated. The concepts tend to be masked by too much detail. There is lots of vocabulary. Under social perspectives, the viewpoints presented seem one-sided; perhaps opposing views could have been included. There is little opportunity for inquiry within

the textbook. There are good examples on the history and nature of science. There are lots of concept maps used to connect materials.

General Comments: This is a very well written book that is encyclopedic in its inclusions of detail. Some of the sections are done very well, especially the sections on plant evolution and population concerns. The writing is very descriptive and although the content concepts are present and accurate in the areas reviewed, there is a general lack of inquiry present in the text leaving the teacher in a position to utilize supplemental resources to provide such opportunities for the students. The area most in need of attention is the ways that multicultural groups of people are not represented in the book. It will be difficult for various groups of students, especially females, to relate to biological sciences as relative to their own lives.

VIII. Title: *BSCS Biology: An Ecological Approach*

Authors: BSCS Biological Sciences Curriculum Study
Publisher: Kendall/Hunt Publishing Company
Date: 8th edition, 1998.

Components: Student Text, Teacher's Edition, Teacher's Resource Book, Student Study Guide, Student Study Guide-Teacher's Edition, Micro Test Computer Test bank (Mac and Dos), Test Item File Manual.

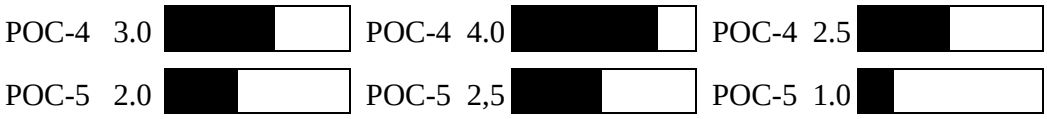
Philosophy and Design:

The Green Version is a program for 1st year high school biology students. The design of the materials is student-centered, with an active learning approach and experienced-based instructional activities including laboratory investigations, projects, illustrations, interactive readings, and inquiry discussions. Twenty four chapters are built around five ecological themes: 1) The World of Life: the Biosphere, 2) Continuity in the Biosphere, 3) Diversity and Adaptation in the Biosphere, 4) Functioning Organisms in the Biosphere, and 5) Patterns in the Biosphere. More activities are included than can be done in the year, leaving choice up to the teacher. Three principles from research in cognitive psychology support the instructional hypotheses utilized in these materials: 1. learners benefit most from concrete learning experiences prior to trying to understand abstract science concepts, 2 learners must reconstruct knowledge as if it were entirely new to them, and 3. learners attempt to build onto their existing cognitive framework. The student study guide is designed to enhance students in communication skills,

science skills and general cognitive skills. A computer Test Bank of mostly multiple choice and some essay questions, with a manual to organize the materials by chapter, difficulty level and biology concepts, is provided. Because there is more than can be done in any one year, the materials can be organized (with 70% overlap) into three different schedules emphasizing 1) Ecology, 2) Physiology and Cellular, and 3) Diversity and Evolution.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 3.0	BI-A 4.0	MG-A 2.5
BE-B 3.0	BI-B 4.0	MG-B 3.0
BE-C 3.0	BI-C 4.0	MG-C 3.0
BE-D 4.0	BI-D 4.0	MG-D 3.0
BE-E 4.0	BI-E 4.5	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 3.5	OCS-1 4.0	OCS-1 3.0
OSC-2 2.0	OCS-2 4.5	OCS-2 2.0
OSC-3 1.0	OCS-3 3.5	OCS-3 3.0
OSC-4 3.5	OCS-4 4.0	OCS-4 3.0
OSC-5 3.0	OCS-5 4.0	OCS-5 4.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**
POC-1 2.0	POC-1 2.5	POC-1 2.0
POC-2 3.0	POC-2 4.0	POC-2 3.0
POC-3 3.0	POC-3 3.5	POC-3 3.0



Evolution: The content is addressed in all areas and there are good connections with other disciplines (mathematics and geology). There are missed opportunities, such as more information on Darwin's finches. There are no real opportunities for student research. The labs are rather cookbook in nature. The role of technology, for example in carbon dating, is not addressed. The applications and problems at the end of the chapters are very good. The test bank questions are at too low a cognitive level and there are too many multiple-choice questions. There is a tendency to assess numerous facts. There are few opportunities for portfolio or performance testing. It is also noted that in the evolution chapter, the pictures are somewhat boring and not very diverse. In fact, the pictures in the book are downsized from the last volume, and seem to have lost a good deal of appeal for the reader. There is little mentioned in dealing with diverse students under such categories as "English as a second language", disabilities or low abilities.

Interdependence of Organisms: There is excellent coverage of content in the ecological areas, and this topic is the theme throughout the book. However, there is still too much content. Examples were viewed as too numerous and each was covered in depth, resulting in advanced reading requirements for students. *Biology: An Ecological Approach* was particularly strong in the use of inquiry in the materials. Starting with Chapter 1 inquiry is included as an integral portion consisting of outstanding and unique inquiries with plenty of field and laboratory experiences. One reviewer noted that there was far too much chemistry and presented too fast for the average student. Technology received good coverage and the human culture associated with population growth was well explained. There was less opportunity for students to actually use educational technologies, and there was no reliance on resources from the Internet. Students do engage in bio-ethical decision making, and important environmental problems such as global warming and population growth are well covered. It might even be better if there had been more encouragement for students to take personal actions on environmental issues. There is a good review of the history of agriculture. The book still seems very ambitious in terms of content that is presented. The equity issues need attention. There was a tendency for whiteness to dominate the illustrations, and it was mentioned "even a white sheep!" In summary, this section was seen as an excellent, well thought out treatment of the subject matter and was reviewed as above average in all categories in this content area of interdependence of organisms.

Molecular Genetics: The content is addressed in all of the areas. In the DNA structure presentation, the interest level is pretty low, and some of the diagrams have misleading information. In reviewing the molecular genetics standard, the main unifying theme in the textbook, continuity, is not really present in this section. The definition of mutation is incorrect and there is no discussion of germ line and somatic mutation. Through historical experiments presented, students can develop understandings about scientific inquiry, but there is little student inquiry. Science and technology and social perspectives are well addressed. The historical examples are excellent. Some opportunities for active learning exist, but it is noted that the essays in the Teacher's Resource are somewhat boring, and not engaging! There is not much discussion of change of ideas over time. Overall, the unit on inheritance seems like an add-on, as if the authors did not think it is related to the overall theme of the book. No attempt is made to use the understanding of the molecular mechanisms of inheritance to explain biodiversity and evolution.

General Comments: There is a strong continuity of inquiry philosophy throughout the BSCS version of an ecological approach to the study of biology, and content and pedagogy match well with the various standards. However, this book, in the 8th edition, is still much more like the traditional fact-driven textbook. It is in need of updating, especially in responding to multiple ways of learning and equity issues. An approach using a particular theme like ecology seems to be appropriate, but the review group thought more attention should be given to make sure even coverage is given to the major standards content areas as they are connected to the ecological theme.

IX. Title: *Biology*

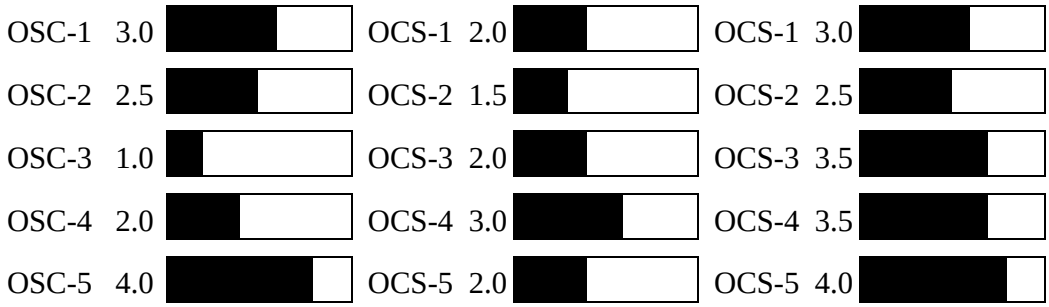
Authors: Kenneth R. Miller and Joe Levine
Publisher: Prentice Hall
Date: 5th Edition, 2000 ("Elephant")

Components: Student Edition Textbook; Annotated Teacher's Edition; Laboratory Manual, Student Edition; Laboratory Manual, Annotated Teacher's Edition; Teaching Resources; Study Guide, Student Edition; Study Guide, Annotated Teacher's Edition; Classroom Manager; Assessment Resources with Dial-A-Test (with CD-ROM) Transparencies with Teachers Guide; Biotechnology Workbook; Biotechnology Workbook Solutions Manual; BioVue Videodiscs; Biology Success Kit, Level I; Biology Success Kit, Level II; Mastering the Main Ideas: Overhead Teaching Support; Got It! Videotapes

Philosophy and Design: .The philosophical approach in this biology program is to stress conceptual development and provide insight into the thinking processes behind scientific discovery. The program reflects an evolutionary approach as a unifying theme. It is designed as a complete comprehensive program, presented in an academically solid and friendly manner. Auxiliary materials augment the program and enhance the learning experience. The program is designed to help students recognize the critical importance of scientific developments in today's and tomorrow's world, and develop an appreciation of the basic concepts in biology. The program offers a balance between textual and investigative material with flexibility to suit individual teaching styles and classroom needs. The textbook presents relevant and recent facts that are used to build science concepts. Opportunities are provided for the full development of science skills through laboratory investigations, problem solving features, and critical and creative thinking questions at the end of every chapter. There are 10 units, each with a series of chapters, 49 total in the book, and a total of 1149 pages in the student text. The ten units are, 1) The World of Life, 2) Cells: The Basic Unit of Life, 3) Continuity of Life, 4) Diversity of Life, 5) Life on Earth: Bacteria, Protists and Fungi, 6) Life on Earth: Plants, 7) Life on Earth: Invertebrate Animals, 8) Life on Earth: Vertebrate Animals, and 9) Human Biology. The program is organized to allow teachers to choose which chapters to teach, and in which order to teach them.

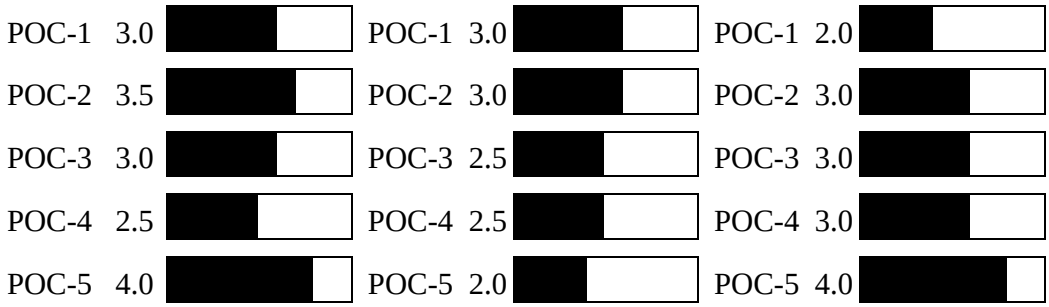
Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 3.5	BI-A 4.0	MG-A 3.0
BE-B 4.0	BI-B 4.0	MG-B 2.5
BE-C 3.0	BI-C 4.0	MG-C 4.0
BE-D 4.0	BI-D 4.0	MG-D 4.0
BE-E 2.5	BI-E 4.0	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**



PEDAGOGY AND OTHER CONSIDERATIONS (POC)

BE **BI** **MG**



Evolution: The authors use evolution as a unifying theme and the content in the book is very rich. The evolution sections have a good collection of biology reference material on the topic's covered. The level of reading would be difficult for many students; it seems appropriate for 12+ grade students. The biological classification is hung up on a march through the kingdoms, and does not show a very good relationship to evolution. The labs tend to be "cook-book" and rarely stimulate higher-order skills. The Web address in the text is a plus and if updated regularly, could facilitate addressing current issues. In the opinion of the reviewers, the book would not prepare a student for a standards-based examination.

Interdependence of Organisms: The text represents a very traditional treatment of Interdependence of Organisms. Ecological concepts are well sequenced, up-to-date and interesting. Teacher's Edition has good suggestions for teaching and plenty of interesting background information. Other chapters throughout the text have Ecology Notes which tie ideas together. The Student Edition is well organized with focus questions, journal activities, lab investigations and quick labs. Supplemental teaching materials provide plenty of alternative activities (Hands-On Activities, Lab Manual, Ecology Investigations, Biological Case Studies). There is a Web site link to EPA, and project

GLOBE, but no references as to how scientists gather data and the importance of the communication system for gathering data. Human population growth is treated well. However, this is not an innovative treatment of ecology. Its main emphasis is on factual information and rather dry descriptions of ecological concepts. Students are not invited into environmental concerns with stories about real scientists and in depth looks at a few select issues. Parts of the text reads like a sermon (e.g., p. 1052 "we must … is evident seven times on one page alone) and ends with a statement from one of the authors on the importance of environmental protection laws which seems almost flippant. There is little historical development. There is a section on DDT, but no significant naturalists such as Rachel Carson, are mentioned. Nowhere in the ecology unit is there opportunity for student debate, discussion or serious examination of the complexity of any one issue. Students are not given the opportunities to engage in ethical dilemmas. Another serious criticism is the lack of real inquiry experiences for students. Teacher's Edition follows lab recipe book investigations with suggestions that students design their own experiments, but no guidance on scientific inquiry as it relates to ecological research design is provided. Lab investigations themselves are not interesting explorations of ecological techniques or problems. Students are not encouraged to get involved in local concerns. Finally, 73 pages are devoted to Unit 10 and it is the last unit in a large heavy text of 1077 pages. It is an overwhelming book, filled with much too much factual information – it is an encyclopedia! It is too condensed with too much vocabulary, too many facts and descriptions and too few in depth stories about real people, events and concerns that would make ecology come alive for students. What is clear in this section is that the content standards are "present and accurate" but that the pedagogy and other content considerations are not well addressed.

Molecular Genetics: The book is written in a very "personalized manner. The authors add chatty and casual comments at the beginning and end of each unit, engaging the students in the authors' thinking and directing them to other materials, including the authors' Web sites. One reviewer noted that the book might engage "concrete visualizers" but not auditory learners and those who learn by logical progression and analysis. Metaphoric writing such as "tRNA acts like a tiny beacon for amino acids…." may enchant visualizers but not those who do not visualize molecules in these terms. There are also some overstatements. For example, "Mendels's work was rediscovered in 1990…." However, there is an excellent discussion of Mendel's work. The content is presented in a didactic, linear organization with little reference to overarching concepts. One feels somewhat lost in excessive detail and the book does not seem to be at the best level of organizing information for student understanding. Science as inquiry is addressed in discussions and classical experiments, but few opportunities for students to

design, experiment, etc. are included. Science and technology and science in personal and social perspectives are well addressed, but again, no opportunities for students to participate in activities are included. There are numerous demonstrations, but little to actively engage the students. Equity issues are very well presented in the sections on genetics. The text alone meets many but not all of the goals of pedagogy standards. There are excellent links to the history and philosophy of science, and good examples of experiments and the interpretations and controversies associated with them.

General Comments: This is an attractive well-illustrated up-to-date book just ready for release in its present revision (5th edition). While it has been revised since the publication of the *National Science Education Standards* and AAAS Benchmarks, it does not appear to be written with those in mind. A strength of this book is the way the main ideas and concepts are put forward at the beginning and end of each unit, linking the unit to previous units and ideas.

X.Title: ***Essentials of Biology: Concepts and Communication***
Authors: Pignatiello, J., R. F. Siggens, Jr., F DiChiappari and J. Madama
Publisher: Holt, Rinehart and Winston, (Harcourt Brace & Company)
Date: 1998 ("Eagle")

Components: Student edition (paper), Teachers edition, Testing program, Holt Biology videodiscs, Audio CD Program.

Philosophy and Design: This is a program specifically designed to build biological literacy among students from varied cultural and linguistic backgrounds. The book uses "sheltered English," - translated to mean simple and friendly language that is concrete, enrichment with video images, an audio program and hands-on activities. The materials are specifically designed for students whose primary language is not English, for students who have learning disabilities and students who have poor reading skills. The book is organized into 35 chapters of about 3-4 pages each. Subjects move through cells, energy, genetics, evolution, behavior, into the plant and animal kingdoms, ending with the various systems of the human body.

Review Results:

EVOLUTION (BE)	INTERDEPENDENCE OF ORGANISMS (BI)	MOLECULAR GENETICS (MG)
CONTENT: PRESENT AND ACCURATE (See Appendix 1)		
BE-A 2.0	BI-A 1.0	MG-A 4.0
BE-B 2.0	BI-B 1.0	MG-B 2.0
BE-C 2.0	BI-C 0.5	MG-C 4.0
BE-D 2.0	BI-D 0.5	MG-D 2.0
BE-E 2.0	BI-E 0.5	
OTHER CONTENT STANDARDS (OCS)		
BE	**BI**	**MG**
OSC-1 1.0	OCS-1 0.5	OCS-1 1.0
OSC-2 1.5	OCS-2 0.5	OCS-2 0.5
OSC-3 1.5	OCS-3 0.0	OCS-3 2.0
OSC-4 0.0	OCS-4 0.5	OCS-4 1.5
OSC-5 1.5	OCS-5 0.0	OCS-5 1.0
PEDAGOGY AND OTHER CONSIDERATIONS (POC)		
BE	**BI**	**MG**
POC-1 2.0	POC-1 0.0	POC-1 1.0
POC-2 2.0	POC-2 0.0	POC-2 2.5
POC-3 2.0	POC-3 0.0	POC-3 2.5
POC-4 3.5	POC-4 1.0	POC-4 2.0
POC-5 2.0	POC-5 0.5	POC-5 2.5

Evolution: There is a lack of depth in the evolution content presentation, and a very shallow development of any of the concepts. There is little connection with the nature of science or how science is done. The materials may be developmentally appropriate for beginning ESL (English as a Second Language) students, but there is little content and no

opportunities for development of critical thinking skills. Depth of understanding does not seem possible, although revisiting of a limited set of concepts is not only endless, but also rather boring. The text represents an attempt at creating an interesting book for ESL students, and the theory in the Teacher's Guide is right on target for ESL principles. The actual text falls short of the promise of the Teacher's Guide. The text, student activities and assessments are on a very low cognitive level. Beginning ESL students might find the materials interesting, and the activities marginally challenging, but all others would find little challenge in this set of materials as it relates to understanding the concepts of evolution.

Interdependence of Organisms: There is absolute minimal content that is oversimplified, imprecise and not engaging for any category of reader. The materials do not meet the needs of high school students. There is no science as inquiry, and areas such as technology, and the history and nature of science are not addressed. The active learning is not at the high school level and the depth of understanding is not much beyond elementary school. The fuzzy, newsprint-quality illustrations, uninformative captions make this a rather cheap appearing book. There is inadequate coverage of human influences on the environment of population growth and its significance. There is information about English as a second language and the learning disabled, but these materials are not seen in the ecology section to be engaging for any groups of students. The reviewers felt this textbook was not interesting, engaging or effective for anyone, student or teacher.

Molecular Genetics: Information is present in some cases, but is very simplistic in its presentation, - sometimes to the point of inaccuracy. It does not seem developmentally appropriate for high school students. There is no inquiry, and many lost opportunities! There is little discussion of societal and ethical issues related to molecular biology.

General Comments: This book was reviewed, because it specifically states it is a Biology Text for English as a Second Language and Learning Disabled Students. Our question was, does it live up to its own objectives? It is low priced, with little color (this was intended). The inclusion of audio-tapes is a definite plus for a helpful environment for students to learn English. However, the reviewers felt that the outcome was more of a language course book, not one that would create an environment to help high school students learn biology.

E. Discussion

In light of the general findings and the presentation of the details associated with each textbook, the numerical data is presented in a series of graphs for comparisons. Figures 1-7 summarize our scores and the trends are discussed below. Comparisons are made among 1) three of the life science content standards as listed in the NSES for grades 9-12, Biological Evolution, Interdependence of Organisms and Molecular Genetics, 2) Other Content Standards (OCS), and 3) Pedagogical and Other Considerations (POC) (Figs. 1,2,3 & 4). Finally, nine of the textbooks are discussed in three instructional materials categories, "Traditional" (Fig. 5), "Innovative" (Fig. 6), and "Mixed" (Fig. 7). One textbook, *Essentials of Biology: Concepts and Communication* -"Eagle" was written specifically for students with English as a second language and is considered separately.

In figure 1, summary scores are graphed for each textbook and results represented in the range from the textbook found by the reviewers to be most responsive to the *National Science Education Standards*, *Biology: A Human Approach* to the least responsive textbook, *Essentials of Biology: Concepts and Communication* ("Eagle"). Several trends can be noted. With the exception of the "Eagle" textbook, units considered were all clustered between 2.9 and 3.8, that is from close to Adequate (3) toward Excellent (4). None were considered overall to be in the Exemplary (5) range, although some individual ratings within the original data were at the 4.5 scale of response. The review team was surprised by how bunched together the data was in the final analysis. The biology textbooks are full of biology! With few exceptions, the materials are presented in an attractive way, are scientifically correct, are up to date, are supported with numerous illustrations, and have an overwhelming amount of materials to augment whatever lessons are evolved by the teacher. That being said, it can also be reported that the materials are overwhelming in coverage, the books are so heavy and cumbersome that it is difficult to imagine the teacher or the students carrying them any distances or using them every day in a manner necessary (like reading them!) to cover so much material. Yet this has been the traditional approach to our biology textbooks - adding on facts and new discoveries, leaving nothing out. The factual presentations are laboriously elaborate. Research is showing that memorization is not the route to deep understanding and life long learning (NAS, 1999a,b), and this mold, inherent in many of the programs, needs to be broken. One assumes that this traditional approach has been successful for some students in the past, but the call for learning outcomes for all students, the call for literacy beyond memorization, the call for understanding just what

biology is all about - biology as a way of knowing about the natural world, addressing biological problems in the future and connecting biology to every students' everyday lives cannot not be answered with this traditional approach. And it is the signs of breaking out of this mold that are present in the materials we reviewed that indicate developers and publishers are responding to the responsibility of needed change. The break comes when attention is given to the other standards and this was seen in varying degrees. This review committee did not address how teachers use these materials, the amount of professional development needed for effective implementation nor did we address resources available or actual learning in the classrooms. Our reviews were only concerned with the instructional materials and how they measured up to the National Science Education Standards.

If we look more loosely at the three areas of the standards reviewed some other trends emerge (Fig. 2). With the exceptions of *Insights, Biology: A Community Context* and *Biology: A Human Approach*, it is noted that Life Science Content areas average scores (BE, BI, MG) are higher than the Other Content Standards (OCS) and Pedagogy and Other Considerations (OCS) scores. These three texts have innovative designs that were developed with particular attention to the framework of the NSES. We also point out that *Biology: the Web of Life* ("Wolf") has scored much higher than others in the OCS and POC standards, demonstrating that in this more traditional approach, more consistent attention to all of the NSES can be achieved.

As noted earlier, Life Science content standards (Fig. 3) chosen to be evaluated by the review team were Evolution (BE), Interdependence of Organisms (BI) and Molecular Genetics (MG) and the details of these standards can be seen in the review instrument in Appendix 1. Reasons for these choices are multiple. There is some perception in the science community that evolution is not covered in textbooks. This is often reinforced by messages from the media. With the recognition of the centrality of the theme of evolution in the biological sciences (NAS, 1998), this content standard was considered an essential component. Understanding the differences and the relationships between molecular and organismic diversity, as well as comprehending the nature of evidence in this cohesive theme were considered by the review team to be central to biological literacy. The Interdependence of Organisms topic includes concepts associated with ecology, conservation, global environment and the interactions among all living organisms as well as their interactions with the physical environment. Two textbooks utilize these concepts as organizing themes, *Biology: an Ecological Approach* and *Biology: A Community Context.* The latter book is especially designed to engage students in community problems, many of which relate to these concepts. Molecular genetics

concepts are critical for high school students to understand as they are faced with an explosion of knowledge related to such topics in medicine, agriculture and everyday life activities.

The team noted that although there was some variation in response within each textbook evaluation, evolution was found to be present and accurate in almost all of the books reviewed. In several books, evolution was woven though the text materials and into many activities. A particularly excellent content presentation of plant evolution was found in the "Turtle" book (*Biology: Principles & Explorations*). The basic criteria in this section were presence of the content relative to the standards and accuracy of the materials presented. Details of the review team discussions are found in the results section. It was noted that textbooks such as *Biology: A Community Context* and *Insights In Biology*, instructional materials that are written with a theme-oriented approach and a constant pedagogical design, score lower in some of the life science content categories. In figure 3, we compare the life science content areas (BE, BI, and MG) and find in all but the "Eagle" instructional materials that the scores relatively close together, indicating a consistency in presence, accuracy and up-to-date materials. However, when one looks at the pedagogical and other considerations, and the attention given to the other content standards, scores are lower (Fig. 4). It is here that the historical context of the encyclopedic books appears to be reflected in the responses to the NSES. And it is this lagging attention to these other areas that needs to be addressed. The research on how students learn (NAS, 1999a) refers to the original research base that formed the background during the establishment of the *National Science Education Standards*. With curriculum materials, professional development for teachers and school resources (NAS, 1999b) that reflect this environment for learning, students will have a better chance to become biologically literate. The review team acknowledged that there is a gradient of change in place. Topics of importance in biology are well represented, but much more attention is needed by those who create the instructional materials, whether from the beginning or in revisions of materials, toward creating environments that foster learning.

This trend of responses has led the review team to consider the reviewed textbooks in three categories, "Traditional," "Innovative" and "Mixed" instructional materials. We have not included the "Eagle" (*Essentials of Biology*) instructional materials in this data, as the scores are not competitive in the discussion. Although the materials were written with a specific audience in mind (English as a second language) it is the opinion of the review team that the materials are inadequate to help students achieve biological literacy and should not be used in biology courses.

Three textbooks are included in the category of "Traditional" Instructional Materials *Biology: Principles & Explorations*, *Biology: An Ecological Approach*, and *Biology* (Fig. 5). All of these books are considered content heavy by the review team. That does not mean that the content is not interesting, or that they are not well written. What it often means is that the publishers seem to have increased the scientific facts and concepts in the book, including most everything that is new, without addressing how these materials respond to the NSES. There are new suggestions in the teacher editions that are opportunities to do active learning or to know a very new fact, but the overall impression is that it is business as usual, using what seems to have worked in the past, without reflection through attention to the framework of the standards that would improve the learning environment. New editions may need radical new approaches to allow these textbooks to remain competitive.

Three programs were included in the "Innovative" Instructional Materials group (Fig. 6), *Biology*: *A Community Context, Biology: A Human Approach* and *Insights In Biology*. All three of these programs have explicit designs that are followed through the entire program. *Biology: A Community Context* is a distinct set of materials that provides a consistent approach of community-oriented activities for the biology students in a highly interactive learning environment. The content might be termed "less" because of the focused nature of the selected areas covered. The materials were viewed as reflecting the intent of the authors, to provide a reflection of the nature of science and learning that science in a social context. The essays and controversies in biology that serve as the resources for students to form conferences, congresses and forums, provides a new approach for a learning environment. There is lots of support for the teachers in undertaking this program. A second innovative set of materials is the only truly modular unit reviewed, *Insights In Biology*. Reviewers agreed that the five modular units provide a well paced program that was pedagogically excellent and delivers a hands-on approach to biology, with the teacher as a facilitator. The materials are well supported with implementation materials relative to teachers, schools, and the connections to the standards. A third innovative program is the *Biology: A Human Approach*. Utilizing the well known BSCS (Biological Sciences Curriculum Study) 5-E model of instruction, this program was reviewed as having the closest response to the *National Science Education Standards*. Inquiry is at the center of this constructivist approach to learning, and the materials are well supported by teacher resources and guidance. All three of these programs have innovative ideas that were evolved in response to the *National Science Education Standards* in their developmental phase.

Three textbooks are included in the "Mixed Instructional Materials category (Fig. 7), *Biology: The Web of Life*, *Biology: The Living Science* and *Modern Biology*. These books are somewhat built on the traditional presentation of material, but have carefully considered the *National Science Education Standards* in their newest editions, and incorporated instructional design that reflect the NSES framework. For example, in *Biology: The Web of Life*, chapters have portions that deal well with pre- and misconceptions students might have about biology. Reviewers noted that this is a working textbook with active Internet links, and a feeling of design in each chapter. In *Biology: The living Science*, the authors have included diverse learning pathways for various students needs, and they are characterized innovative activities. This book is presented in smaller, hard cover units that allow for flexibility in presentation. *Modern Biology* is again, a very large and inclusive book, and the time factors to cover all the materials would be daunting to any teacher! The major part that adds to this unit is the BioSources laboratory exercises that are excellent, inquiry-based activities. However, if a teacher did not include these supplemental materials, the program would lack important parts in response to the NSES framework. All three of these "Mixed" approaches share the problem of being expansive in their coverage, and leaving the teachers to make many difficult decisions as to what should and should not be covered.

The results of this review are presented as a snapshot in the year 2000 of the response of ten currently available textbooks to the *National Science Education Standards*. While the results indicate the life science content materials are present and accurate and up-to-date, the other content standards, and pedagogical considerations leave room for vast improvement. Most books are just too large, still too encyclopedic and leave too much responsibility on the teachers to figure out how to use them. The resource materials supplied (often serving more than one program by a publisher) are vast, and the guidance to use them is not always helpful. It would seem that publishers and writers have often listened very carefully – to input from individual teachers, from scientists, from science educators and continued to add in what new is coming along, and updating the existing materials. This has sold the books, and that, in many cases, may just be the bottom line! They have provided new packages of resource materials, often with rich materials. For some teachers, this may work. For most, it will be difficult for them not to close the door of the classroom, and teach whatever feels most comfortable, after all, it would be impossible to cover the whole book!

At the same time, science literacy and how to reach it is being addressed and adopted by states who want to improve their citizens access to science. Forty nine out of fifty states have state standards that are very much based on AAAS Benchmarks and the

National Science Education Standards. Unfortunately, a quite different “high-stakes, standardized, test-based reform” movement, one that really does not mirror the so called “authentic standards-based reform” threatens to make the confusion in the classroom greater for our teachers (Thompson, 2001). It is the authentic standards that are central to this review, and to the efforts of teachers creating exemplary learning environments for all students. The review committee recognized that the *National Science Education Standards* are a framework, and that concepts can be taught through different designs. The textbooks that were in the innovative category clearly stated those designs. And clearly the *Biology the Web of Life*, the "Wolf" book, although still encyclopedic in size and traditional in the resource materials presentation, has followed a design pattern like the innovative texts, *Human Biology, Biology in the Community and Insights.* Other books do have partial changes in the approaches, leaving teachers to decide how to cover what topics in some predetermined rubrics.

One might ask where we are now? Evaluation of materials is called for and this result is one of several projects underway. This past year, a resource for selecting instructional materials was published (Singer and Tuomi, 1999) that will help all school districts in selecting materials, including biology instructional materials. This past summer (June 27th, 2000) the AAAS Project 2061 issued a press release (AAAS Project 2061, 2000) that stated the results of an evaluation of ten widely used and newly developed biology textbooks. None were given high ratings, although several were considered to have "promising activities." Interpretation of these results is not yet available, and thus cannot be discussed in absence of further details. However, AAAS Project 2061 has done innovative research on how teachers and developers might utilize new methods to create more responsive results.

It would seem that a new kind of responsibility is evolving, and change always seems like a risky area but the payoff for all children having the opportunity for biology literacy is great. That responsibility is in carefully designing the materials from the beginning with strong themes, strong attention to all of the standards, and infusing the design throughout the materials. The resources must specifically fit with the materials, with abundant help in the implementation of the programs. This is seen as examples for future directions in the innovative materials we reviewed.

The AIBS/Packard review team of teachers, scientists and science educators have created an instrument and process of review but we have only covered 10 of the nationally available books. There are others. We encourage others to consider similar sets of materials in the future. The publishers and developers will need more interactive

dialogue with reform-minded centers for teacher professional development. As noted in the National Academy's publication, *How People Learn, Bridging the Theory and Practice* (NAS, 1999b), quality instructional materials along with professional development and appropriate assessment must all play a role in creating the learning environments. Biology is of great interest to students, and it is our responsibility to create and choose user-friendly quality products for the nation's classrooms.

The results of the AIBS/Packard Review are very encouraging for the future in the biological sciences. The results emphasize that many steps have been taken by publishers, authors and editors of the biology textbooks that are in line with creating the learning environments to meet the goals for biological literacy. New collaborations and interactions among publishers, biologists, teacher professional development experts, academic pre-service professionals and assessment experts will undoubtedly characterize successful innovations in modifying and creating our instructional materials to meet the needs of literacy in the new decade of biology.

F. Literature Cited

AAAS, 1989. *Science for All Americans*. American Association for the Advancement of Science, Oxford Press, New York.

AAAS, 1993. *Benchmarks for Science Literacy,* Project 2061. American Association for the Advancement of Science. Oxford Press, New York.

BSCS, 1993. *Developing Biological Literacy: A Guide to Developing Secondary and Post-Secondary Biology Curricula*. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Moore, J. 1995. Cultural and Scientific Literacy. Molecular Biology of the Cell 6:1-6.

NAS, 1990. *Fulfilling the Promise: Biology Education in the Nation's Schools*. National Research Council, National Academy Press, Washington, DC.

NAS, 1995. *National Science Education Standards*. National Research Council. National Academy Press, Washington, DC.

NAS, 1998. *Teaching About Evolution and the Nature of Science*. National Academy Press, Washington, DC.

NAS, 1999a. Bransford, J., A. L. Brown and R. D. Cocking (Eds.). *How People Learn: Brain, Mind, Experience, and School*. National Research Council. National Academy Press, Washington, DC.

NAS, 1999b. Donovan, M. S., Bransford, J. D. and J. W. Pellegrino (Eds.). *How People Learn: Bridging Research and Practice.* National Research Council, National Academy Press, Washington, DC.

NSF, 1997. *Review of Instructional Materials for Middle School Science*. Division of Elementary, Secondary, and Informal Education. National Science Foundation, Arlington, VA.

Olson, S. and S. Loucks-Horsley (Eds.). 2000. *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. National Research Council, National Academy Press, Washington, DC.

Project 2061, 2000. Big Biology Books Fail to Convey Big Ideas, Reports: American Association for the Advancement of Science's Project 2061. Press release, AAAS, June 27, 2000. (http://project2061.aaas.org)

Roseman, J. E., Kesidou, S. and L. Stern. 1997. Identifying Curriculum Materials for Science Literacy. A Project 2061 Evaluation Tool. Based on a paper prepared for the colloquium "Using the *National Science Education Standards* to Guide the Evaluation, Selection, and Adaptation of Instructional Materials." National Research Council, November 10-12, 1996. (http://www.project2061.org)

Schmidt, W., C. McKnight and S. Raizen. 1997. *A Splintered Vision: An Investigation of U.S. Science and mathematics Education.* Kluwer Academic Publishers, The Netherlands.

Singer, M and J. Tuomi, (Eds). 1999. *Selecting Instructional Materials: a Guide for K-12 Science*. National Research Council. National Academy Press, Washington, DC.

Stowell, S. 1997. Spokane, Washington School District 7-12 Materials Evaluation form.

Texley, J. and A. Wild, (Eds.). *1996 NSTA Pathway to the Science Standards: High School Edition*. National Science Teachers Association

Thompson, Scott. 2001. The Authentic Standards Movement and its Evil Twin. On-Line article Kappan pp 358-362 January 2001. (http://www.pdkintl.org/kappan

G. Figure Legends and Figures

Figure 1. Summary of the averages for all evaluations of the ten textbooks reviewed based on the response to the *National Science Education Standards* moving from the more responsive units of instructional materials to the least responsive units.

Figure 2. Comparison of the averages of the 1) Life Science Content areas of Evolution (BE), Interdependence Of Organisms (BI) and Molecular Genetics (MG), 2) the Other Content Standards (OCS) and 3) the Pedagogy and Other Considerations (POC) for all ten textbooks.

Figure 3. Review scores for the ten textbooks in the Life Science Content topic areas, (Evolution, Interdependence of Organisms, and Molecular Genetics).

Figure 4. Comparison of the average scores for three areas of the *National Science Education Standards* that were reviewed within the Life Science Content Standards, Other Content Standards (OCS) and Pedagogical and Other Considerations (POC) in the ten textbooks reviewed.

Figure 5. Three units of materials that show a "traditional" approach to change in that they tend to increase the already heavy content, do not change the pedagogy in a substantive way, and respond unevenly to the other standards.

Figure 6. Three units of instructional materials that demonstrate "innovative" instructional design, often including specific pedagogical approach (such as inquiry) and, in some cases, involving less content. Note the high scores of *Biology: A Human Approach.*

Figure 7. Three units (including the textbooks and accompanying materials) showing "mixed" approaches in responses to the *National Science Education Standards* in the areas reviewed. Note the high scores of *Biology: The Web of Life* ("Wolf").

Figure 1. Summary Scores for 10 Textbooks Reviewed

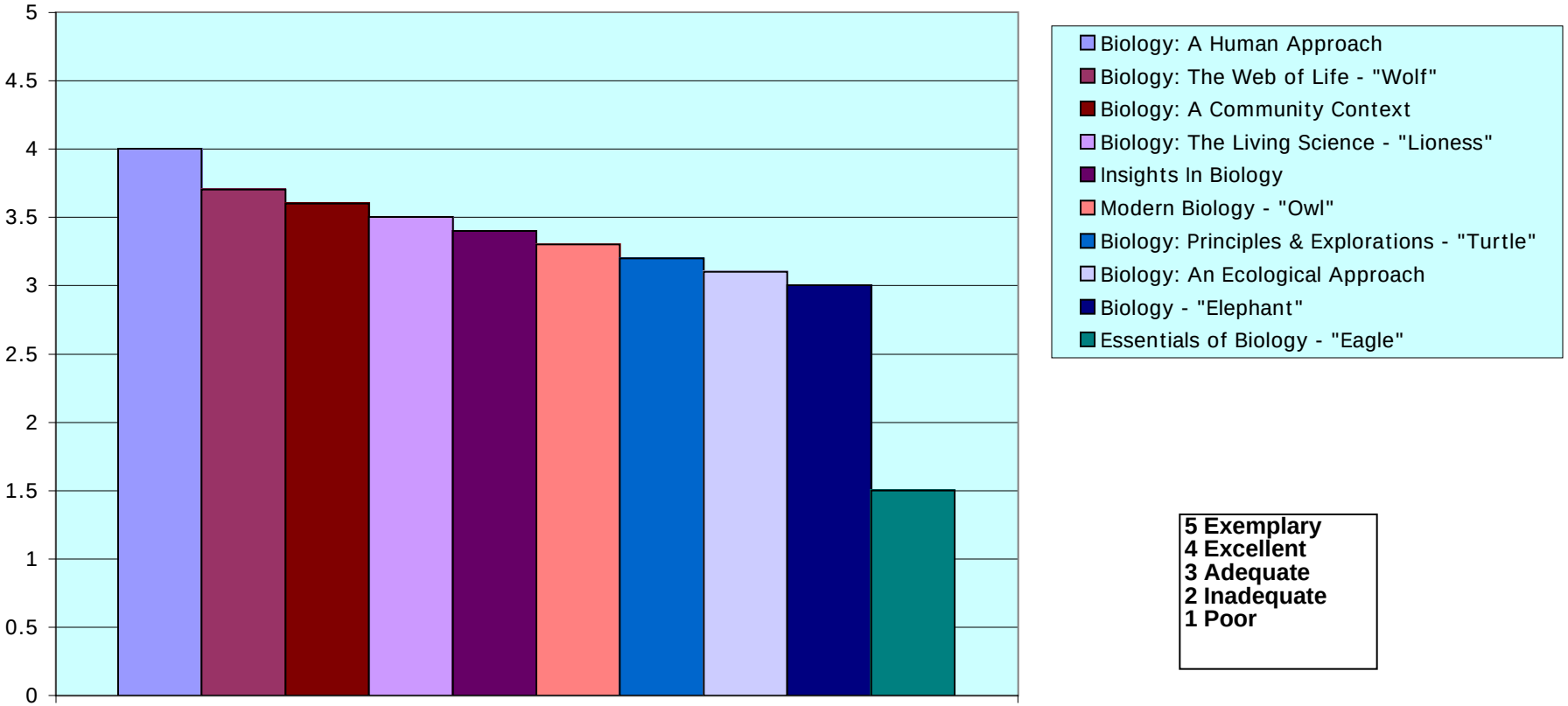
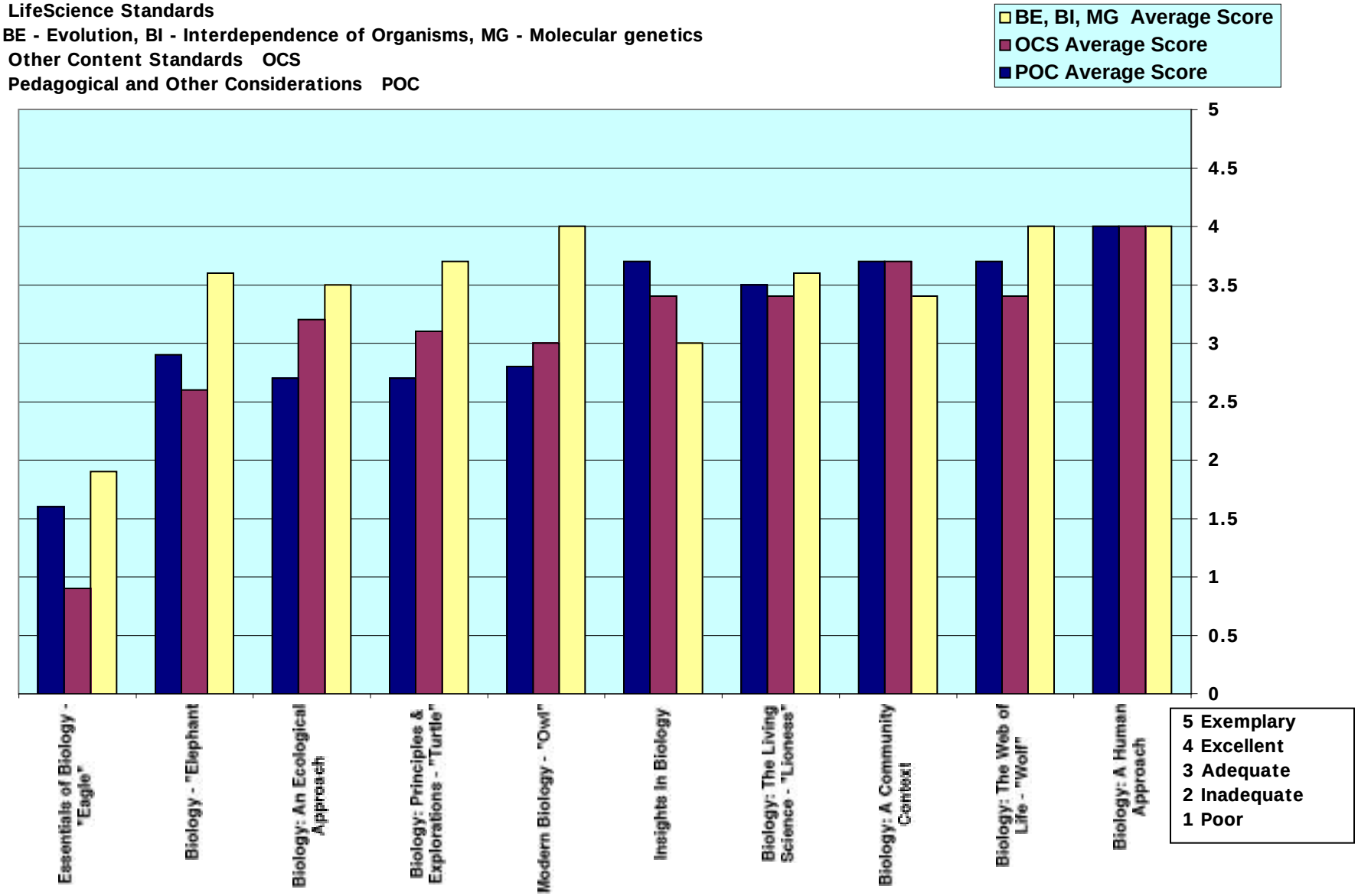


Figure 2. Comparison of Averages From Three Areas of Standards Evaluated

1. LifeScience Standards
   BE - Evolution, BI - Interdependence of Organisms, MG - Molecular genetics
2. Other Content Standards OCS
3. Pedagogical and Other Considerations POC



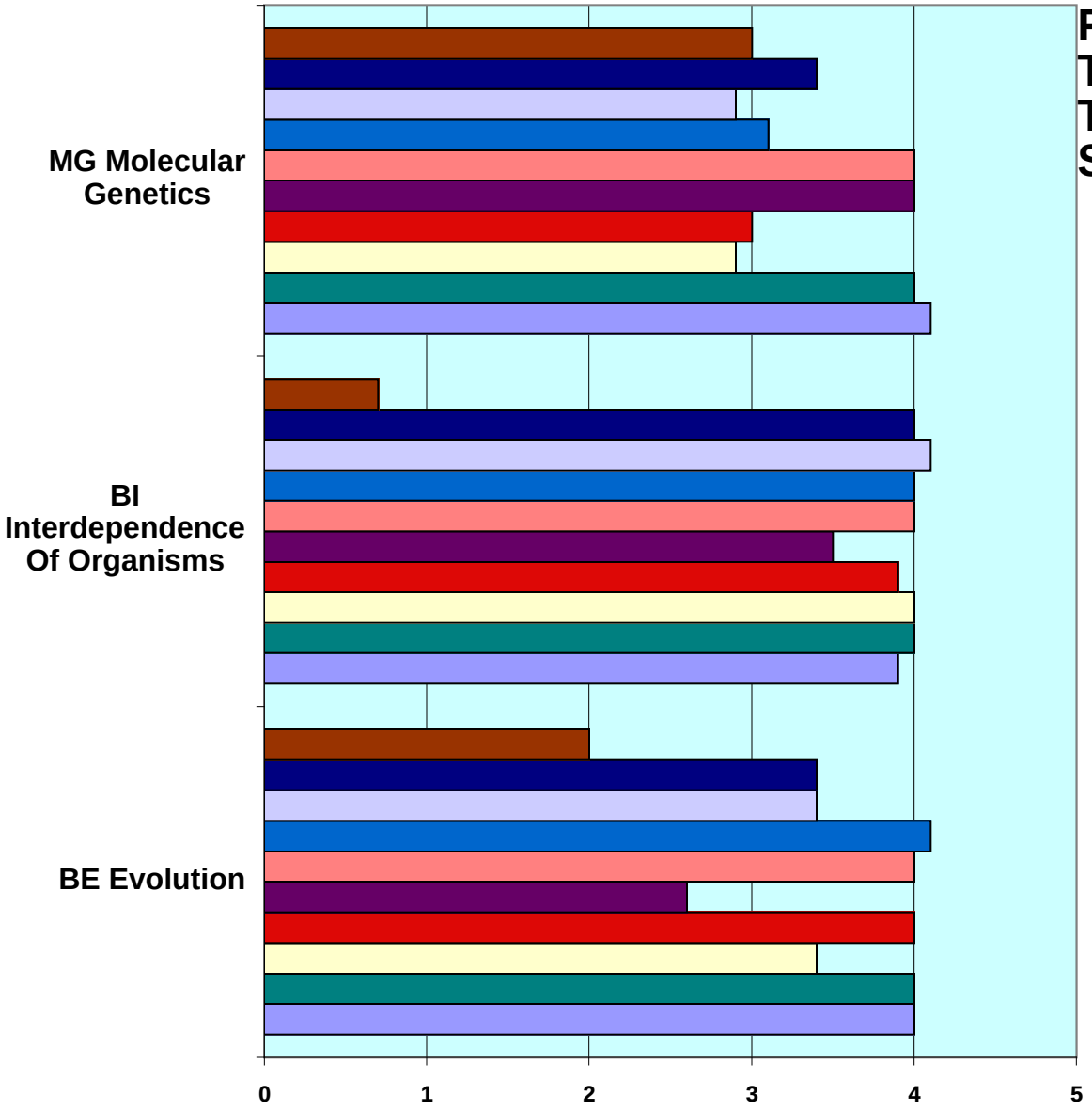


Figure 3. Comparison of Textbook Evaluations of Three Life Science Content Standards, BE, BI and MG

- Essentials of Biology - "Eagle"
- Biology - "Elephant
- Biology: An Ecological Approach
- Biology: Principles & Explorations - "Turtle"
- Modern Biology - "Owl"
- Insights In Biology
- Biology: The Living Science - "Lioness"
- Biology: A Community Context
- Biology: The Web of Life - "Wolf"
- Biology: A Human Approach

5 Exemplary
4 Excellent
3 Adequate
2 Inadequate
1 Poor

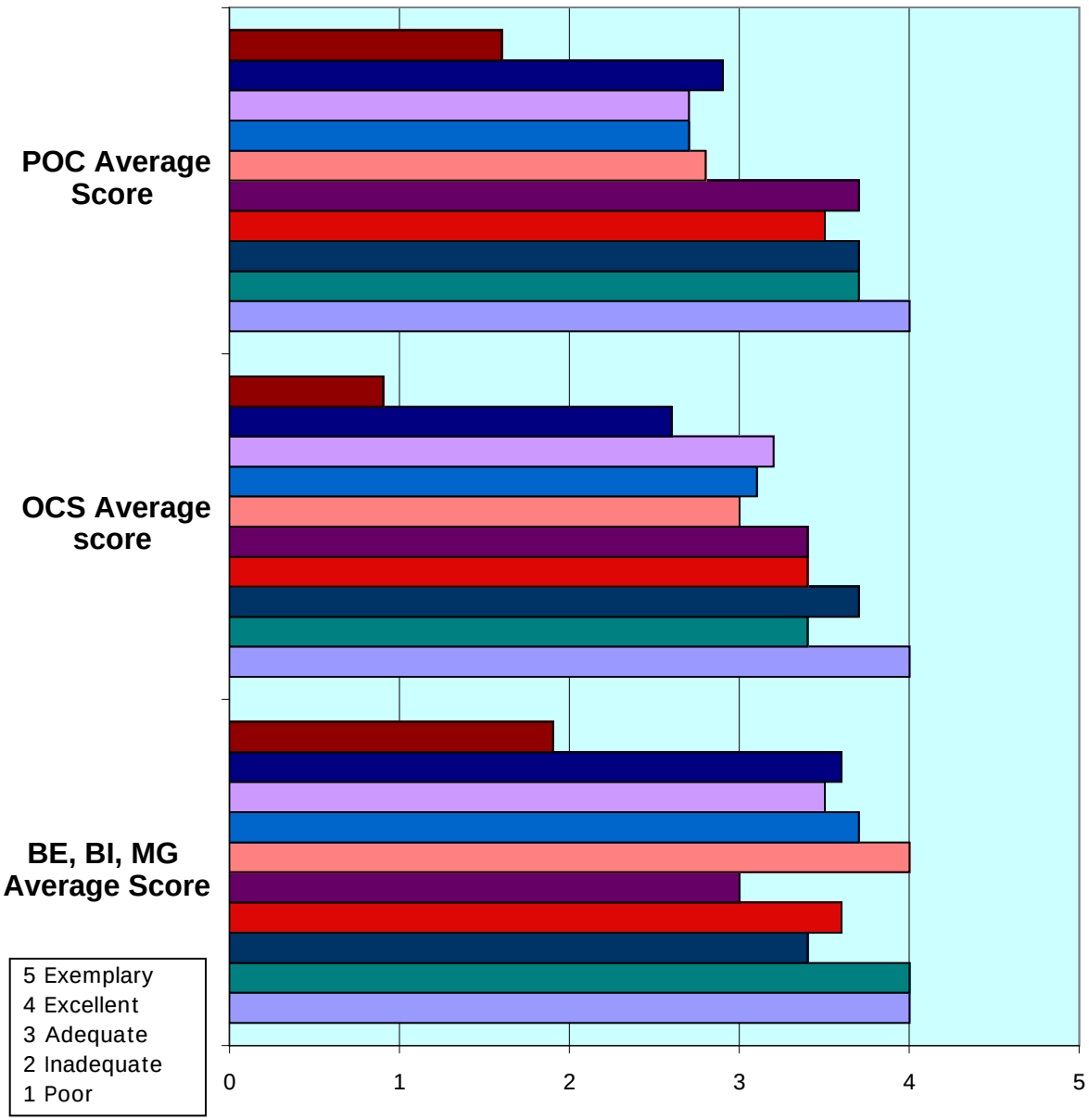


Figure 4. Comparison of Textbook Evaluations by Averages of Three Areas of Standards:

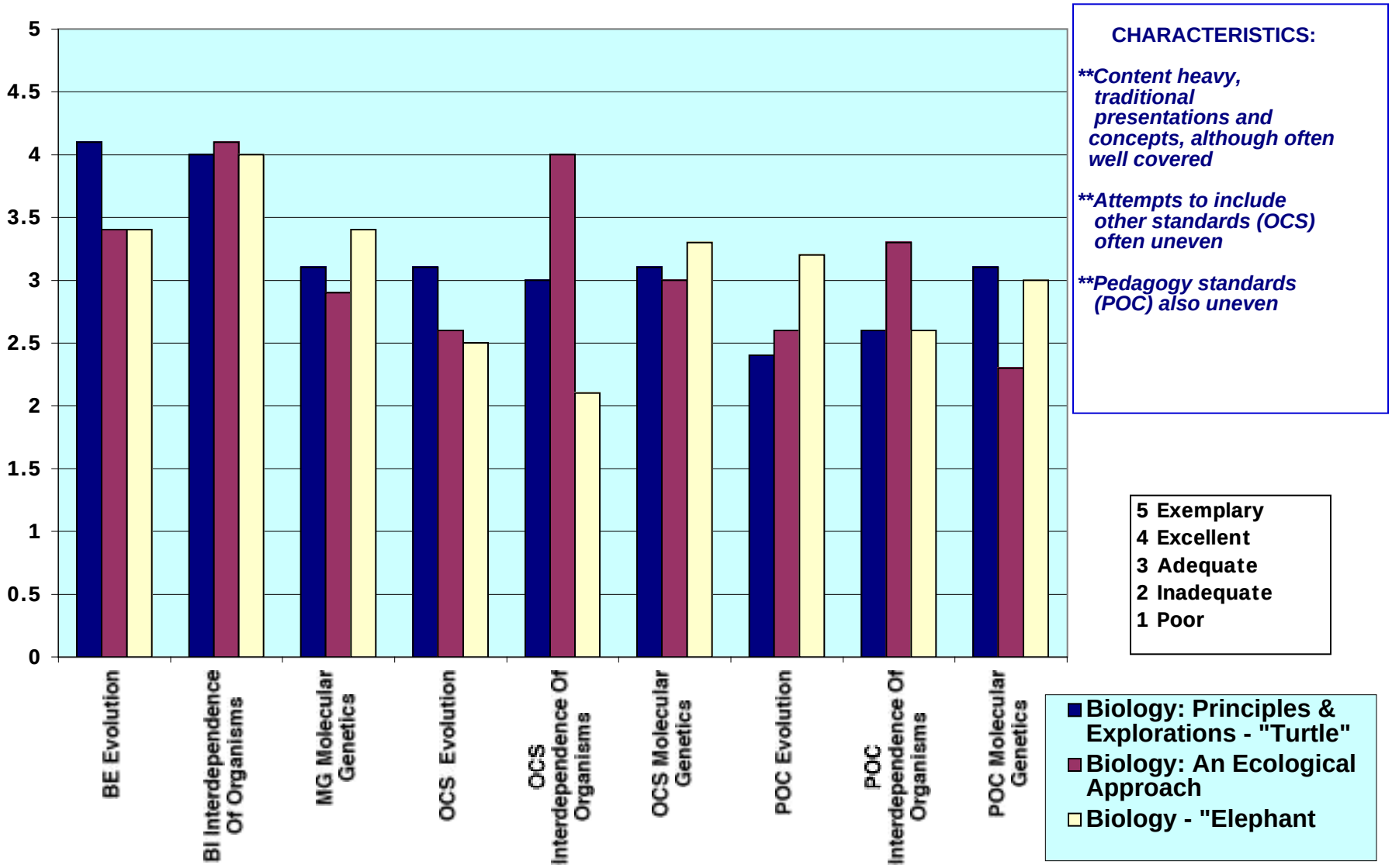
BE, BI, MG
Life Science Content Standards

OCS
Other Content Standards

POC
Pedagogical and Other Considerations

- Essentials of Biology - "Eagle"
- Biology - "Elephant
- Biology: An Ecological Approach
- Biology: Principles & Explorations - "Turtle"
- Modern Biology - "Owl"
- Insights In Biology
- Biology: The Living Science - "Lioness"
- Biology: A Community Context
- Biology: The Web of Life - "Wolf"
- Biology: A Human Approach

Figure 5. "Traditional" Instructional Materials



CHARACTERISTICS:

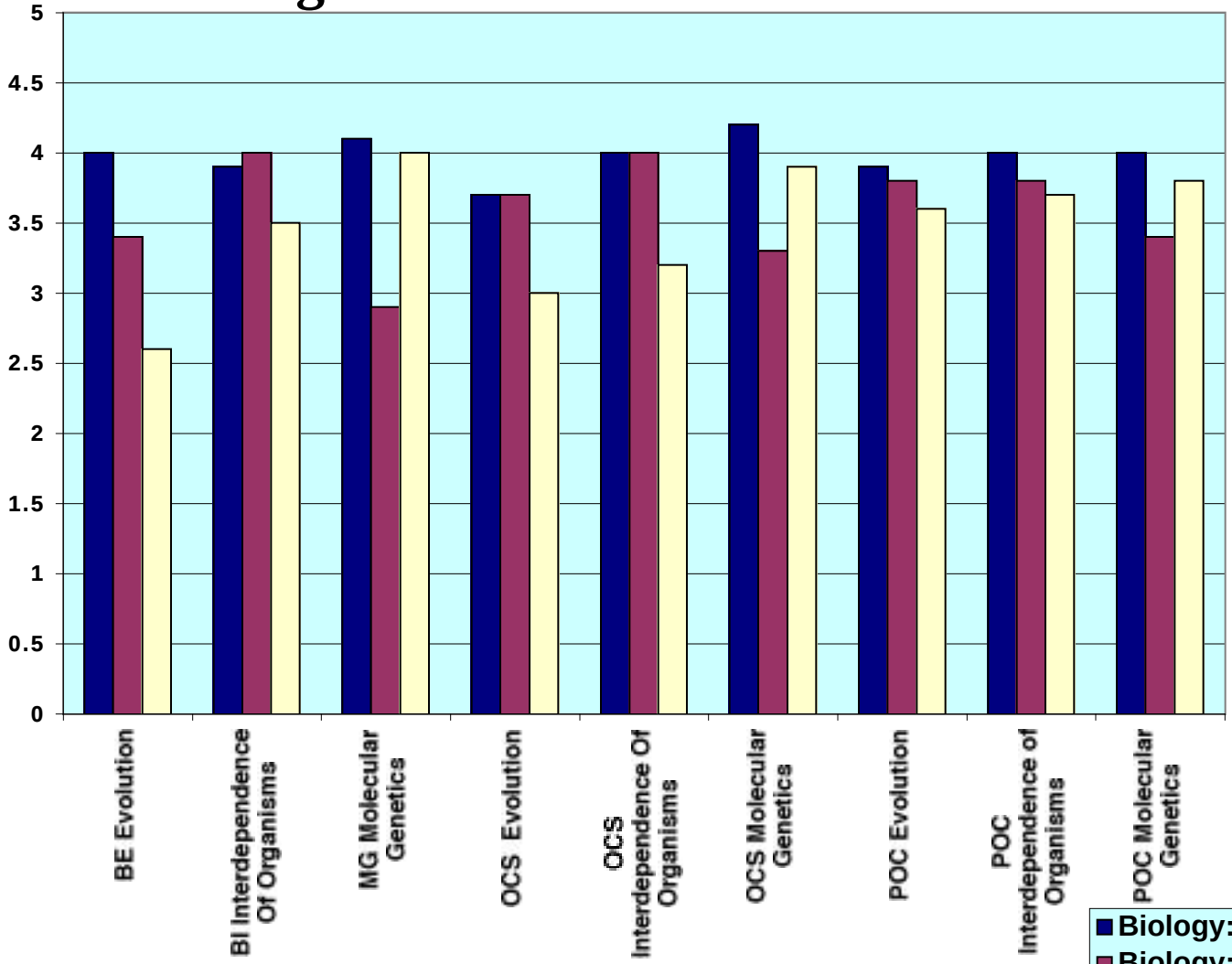
***Content heavy, traditional presentations and concepts, although often well covered*

***Attempts to include other standards (OCS) often uneven*

***Pedagogy standards (POC) also uneven*

5 Exemplary
4 Excellent
3 Adequate
2 Inadequate
1 Poor

Figure 6. "Innovative" Instructional Materials



CHARACTERISTICS:

***Evidence of positive responses to various aspects of the National Science Education Standards*

***Content present: often in mode of "less is more"*

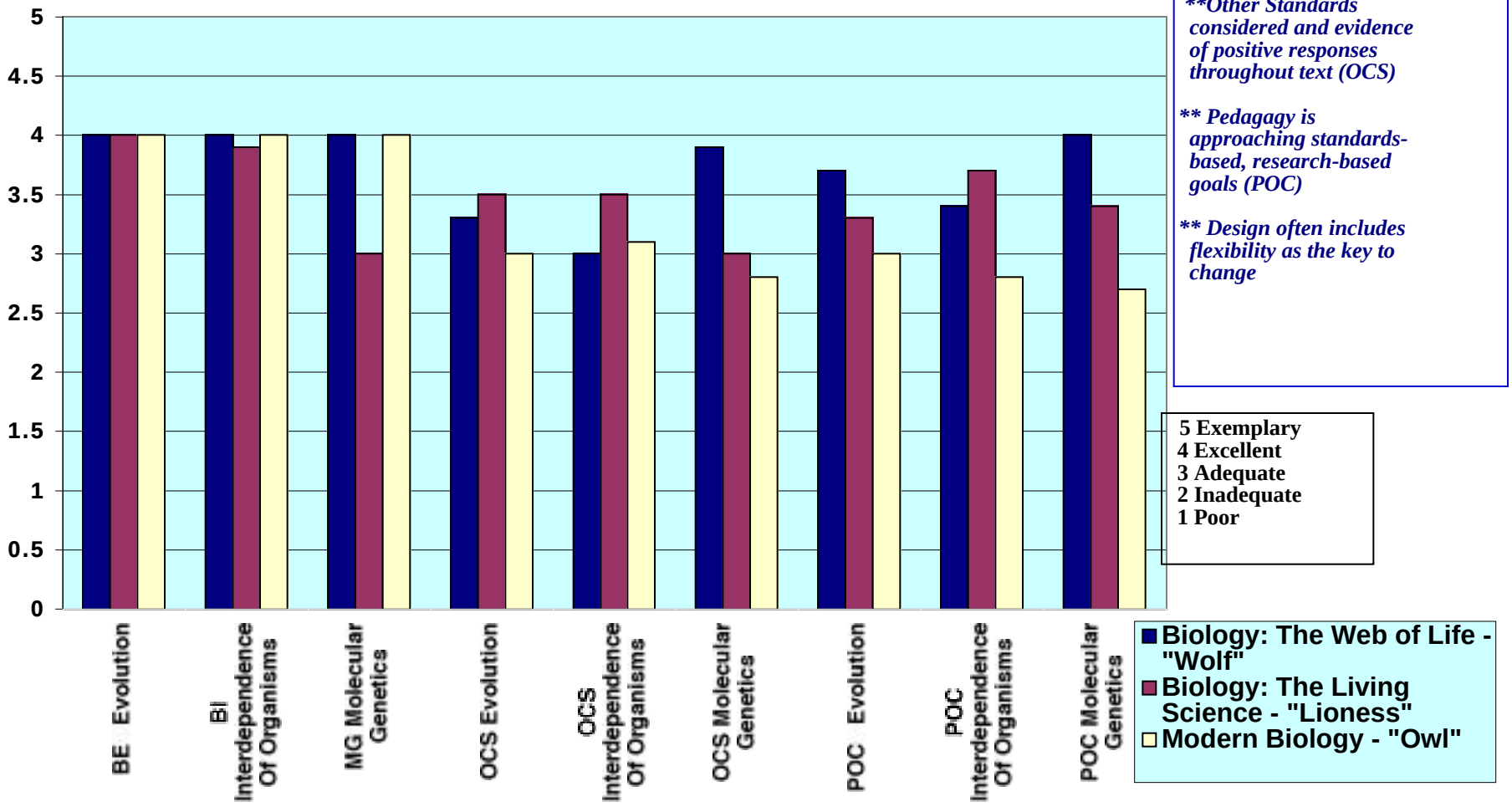
***Good attention to Other Content Standards (OCS)*

***Innovative approaches to Pedagogical considerations (POC)*

5 Exemplary
4 Excellent
3 Adequate
2 Inadequate
1Poor

- Biology: A Human Approach
- Biology: A Community Context
- Insights In Biology

Figure 7. "Mixed Approaches" Instructional Materials



CHARACTERISTICS

***Content Heavy*

***Other Standards considered and evidence of positive responses throughout text (OCS)*

*** Pedagagy is approaching standards-based, research-based goals (POC)*

*** Design often includes flexibility as the key to change*

5 Exemplary
4 Excellent
3 Adequate
2 Inadequate
1 Poor

Appendix 1
AIBS/PACKARD REVIEW INSTRUMENT

TEAM:
NAME of INSTRUCTIONAL MATERIALS:

NOTE Part 1: Each review of a Life Content Standard, (Evolution (BE), Interdependence of Organisms (BI) and Molecular Genetics (MG) included **Part II** Other Content Standards, and **Part III** Pedagogical and Other Considerations. Also, in the original instrument, after each bullet or content unit, the words: *Comments Current, Accurate and up-to-date* appeared and after each unit in the OCS and POC parts, *Comments* appeared. Repetition of Part II and III and the words above have been deleted from this abbreviated form. (see Appendix 3 for details of the process)

PART 1
Review of Biological Evolution
BIOLOGICAL EVOLUTION (BE) CONTENT STANDARD - UNITS BE-A - E

BE-A. Species evolve over time. Evolution is the consequences of the interactions of:

- Potential for species to increase in numbers
- Genetic variability due to mutation and recombination of genes
- Differences in survival-/or reproduction
- Finite supply of resources required for life
- Ensuring selection – variants that have high survival/reproductive success become more common over time

Rating of Biological Evolution Content Unit BE-A (0-5) _____

BE-B Diversity is the result of greater than 3.5 billion years of evolution

Rating of Biological Evolution Content Unit BE-B (0-5) _____

BE-C. Natural Selection and its consequences provide a scientific explanation for:

- The fossil record
- Adaptation
- Human evolution
- Evolution as it is happening right now – HIV, viruses, E. coli, Darwin's finches

Rating of Biological Evolution Content Unit BE-C (0-5) _____

BE-D. The millions of different species that live on earth today are related by descent from common ancestors

- **Rating of Biological Evolution Content Unit BE-D (0-5) _____**

BE-E. Biological Classifications are:

- Based on how organisms are related
- Hierarchical in nature, reflecting their evolutionary relationships
- Species is the most fundamental unit of classification and links to numbers in biodiversity
- **Rating of Biological Evolution Content Unit BE-E (0-5) _____**

SUMMARY Rating Standard BE (0-5) _____

Overall Strengths and weaknesses - items not discussed above.

Review of Interdependence of Organisms

PART I. INTERDEPENDENCE OF ORGANISMS (BI) CONTENT STANDARD – UNITS BI-A-E

BI-A. Atoms and molecules on the earth cycle among the living and nonliving components of the biosphere

- Cycling of matter in the community (carbon, nitrogen, generating heat, exercise)

Rating Content Unit BI-A (0-5) _____

BI-B. Energy flows through ecosystems in one direction from photosynthetic organisms to herbivores to carnivores and decomposers.

- Begins with photosynthesis
- From producer to consumers
- Decomposers

Rating of Life Science Content Unit BI-B (0-5) _____

BI-C. Organisms both cooperate and compete in ecosystems

- interrelationships and interdependencies of these organisms may generate ecosystems that are stable for 100's or 1000's of years

Rating of Life Science Content Unit BI-C (0-5) _____

BI-D. Living organisms have the capacity to produce populations of infinite size but:

- Environments and resources are finite
- This fundamental tension has profound effects on the interactions between organisms
- Floods, disasters, habitat depletion contribute to the loss

Rating of Life Science Content Unit BI-D (0-5) _____

BI-E Human beings live within the world's ecosystems and modify it

- Population growth
- Technology
- Consumption
- Destruction of habitats through direct harvesting, pollution, atmospheric changes and other factors is threatening current global stability.
- If these factors not addressed it is possible that ecosystems will be irreversibly affected

Rating of Life Science Content Unit BI-E (0-5) _____

SUMMARY Rating Content Standard BI (0-5) _____

Overall Strengths and weaknesses - including items not discussed above.

Review of Molecular Genetics

PART I. MOLECULAR GENETICS CONTENT STANDARDS UNITS MG-A-D

MG-A. In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA molecules

- DNA is a log polymer (chain) made of four sub-units called nucleotides (adenine, guanine, cytosine and thymine) joined end to end. The DNA in cells normally exists as two strands wrapped around each other in a helical structure
- The chemical and structural properties of DNA explain how the genetic information is both encoded in genes (as a string of molecular letters) and replicated (by a templating mechanism).
- Each DNA molecule, associated with structural proteins, forms a single chromosome

Rating of Life Science Content Unit MG-A (0-5) _____

MG-B. The genetic information in DNA molecules provides instructions for assembling proteins

- A gene is a segment of a DNA molecule that codes for a protein
- The code in a gene is used to direct the joining of amino acids in a chain to form a protein. The amino acid chain folds into a complex structure determined by the order of the amino acids composing it, and the structure determines the function.
- The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. Different parts of the instructions are used in different types of cell, influenced by the cell's environment and past history.
- An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait.
- The characteristics of an organism are determined by a combination of genetic and environmental factors.

Rating of Life Science Content Unit MG- B (0-5) _____

MG-C. Most of the cells in a human contain two copies of 22 different chromosomes. In addition, a pair of chromosomes determines sex: a female contains two X chromosomes and a male contains one X and one Y chromosome.

- Transmission of genetic information to offspring occurs through egg and sperm cells that contain only one representative from each chromosome pair. An egg and sperm unite to form a new individual.
- The fact that the human body is formed from cells that contain two copies of each chromosome – and therefore two copies of each gene- explains many features of human heredity, such as how variations that are hidden in one generation can be expressed in the next.

Rating of Life Science Content Unit MG-C (0-5) _____

MG-D. Mutation and independent assortment of chromosomes provides for variation between generations and leads to diversity of species.

- Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, where as others can change cells and organisms.
- Only mutations in germ cells can create the variation that changes an organism's offspring.
- The sorting and reproduction of genes in sexual reproduction results in a great variety of possible gene combinations within the offspring of any two parents.
- The genetic variability of offspring due to mutation and recombination of genes is one component that contributes to the evolution of species.

Rating of Life Science Content Unit MG-D (0-5)_____

SUMMARY Rating Content Standard MG (0-5) _____

Overall Strengths and weaknesses - including items not discussed above.

PART II. OTHER CONTENT STANDARDS – OCS-1 – OCS-5

NOTE: PART II AND PART III WERE INDIVIDUALLY PART OF EACH READER' REVIEW OF THE LIFE CONTENT STANDARD ABOVE

OCS-1 Unifying Concepts and Processes: (p.115 NSES) This overarching standard provides broad unifying concepts and processes that complement the analytic more discipline-based perspectives presented in biology. The conceptual and procedural schemes in this standard provide students with productive and

insightful ways of thinking about and integrating a range of basic ideas that explain the natural and designed biological world.

CRITERIA - The concepts and processes:

- provide connections between and among traditional scientific disciplines
- are fundamental and comprehensive
- understandable and usable by people who will implement science program
- can be expressed and experienced in a developmentally appropriate manner for high school biology
- continuum of complexity from grades 5-8

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

OCS-2 Science as Inquiry (p.173-76 NSES) Instructional materials should provide opportunities for students to do scientific inquiry and understand scientific inquiry.

CRITERIA -

- identify questions and concepts about objects, organisms and events in the environment that guide investigations
- design and conduct scientific investigations
- use technology and mathematics to improve investigations and communications
- formulate and revise scientific explanations and models using logic and evidence
- recognize and analyze alternative explanations and models
- communicate and defend a scientific argument
- understandings about scientific inquiry

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

OCS-3 Science and Technology (p 190-91 NSES) Instructional materials should provide students the opportunity to develop abilities of technological design and understandings about science and technology

CRITERIA -

- understanding the role of technology in developing areas of biology
- designing activities around biological principles

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

OCS-4 Science in Personal and Social Perspectives (p191-199 NSES) Instructional materials should provide opportunities for students to understand local as well as global phenomena and challenges that occur on scales that vary from quite short (natural hazards) to very long (potential result of global changes).

CRITERIA - fundamental concepts and principles that relate to biology include:

- a series under personal and community health including hazards, disease, fitness, mood and behavior, eating patterns, family health needs, and sexuality.
- factors associated with population growth such as linear and exponential growth, resource use, birth rates and fertility rates, carrying capacity, and technology effects on capacity of the earth systems to support human beings.
- environmental quality especially the human effects that influence that quality and how environment is affected by natural and human-induced hazards

- science and technology in local, national and global challenges, especially as they relate to debates, land use and decisions about pollution and the effects of human activities on each other humans and other non-human organisms.

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

OCS-5 History and Nature of Science (p.200-201). Instructional materials should provide students the opportunity to develop understandings of science as a human endeavor, nature of scientific knowledge and historical perspectives.

CRITERIA - fundamental concepts and principles that relate to biology include:

- science as a human endeavor includes individual and team contributions. Scientists have ethical traditions that are influenced by societal, cultural and personal beliefs and ways of viewing the world - it is part of society!
- science differs from other ways of knowing through the use of empirical standards, logical arguments and skepticism as scientists strive for the best explanations about the natural world.
- scientific explanations require logic, respect for the rules of evidence, open to criticism, report methods and procedures and make knowledge public.
- all scientific ideas are subject to change, as new experimental and observational data becomes available.

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

SUMMARY Rating Standard OCS (0-5) _____

Overall Strengths and weaknesses - including items not discussed above.

PART III. PEDAGOGY AND OTHER CONSIDERATIONS

POC-1 Active Learning: Learning biology is something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many ways, and communicate their ideas with others (NSES p. 20). Some guiding questions are:

- Do the materials engage students in activities that help them connect the biological sciences to current issues and events at the personal, community and global levels?
- Are the instructional materials likely to be interesting, engaging and effective for ALL populations of students (e.g., gender, ethnicity, disability, rural, urban) (note we have a separate category for equity in the AIBS/Packard review)
- Do the materials provide students the opportunity for students to engage in scientific inquiry, to ask questions, propose hypotheses, gather data, manipulate and analyze data, develop arguments, consolidate and communicate their ideas for biological phenomena?
- Do the materials include information and guidance to assist the teacher in implementing lessons involving active learning (vignettes or scenarios, kinds of resources, support systems, professional development opportunities)?

0	**1**	**2**	**3**	**4**	**5**

Not addressed **Somewhat Addressed** **Well addressed**

Poor **Inadequate** **Adequate** **Excellent** **Exemplary**

POC-2 Depth of Understanding: Does the instructional material provide the student the opportunity to develop deep understanding of the biological concepts? Qualities to look for are:

- is there an overview of the concepts to be learned within the instructional materials?
- is there a concept map indicating the linkage between the concepts to be learned?
- does the material focus on the development of a limited number of fundamental biological concepts?
- Are there diagnostic tools available within the materials to determine necessary prior knowledge?
- Are opportunities embedded within the instructional materials to help students self assess and to probe their understanding? (Thought-provoking questions embedded with the instructional materials? Opportunities to monitor their understanding and to make predictions?)
- Does the material contain a logical progression for developing conceptual understanding?
- Is historical development of concepts present, including evidence for "the way that knowledge was arrived at?
- Does the material contain information that shows how science ideas change over time?
- Does the material revisit and summarize and provide closure to the intended learning concepts?
- Does the material provide opportunities for students to apply their understanding?

0 **1** **2** **3** **4** **5**

Not addressed **Somewhat Addressed** **Well addressed**

Poor **Inadequate** **Adequate** **Excellent** **Exemplary**

POC-3 Assessment: Instructional materials include classroom-based assessments and scoring guides that can be used to gather student achievement and performance data on important biological concepts and abilities (as defined in the NSES or Benchmarks)

- Is the primary purpose of the included assessments to provide feedback to the student, teacher, parent/guardian, and district administrators about student attainment of the intended biological learning targets?
- Are the biological learning targets to be attained and the performance standards associated with the assessments clear and explicit?
- Are there assessments included that can be used for diagnostic, formative, and summative purposes?
- Are the assessments deliberately designed to obtain data regarding student attainment of the intended biological concepts and abilities (this encompasses the ability to inquire and an understanding of biological concepts principles laws and theories)?
- Do the assessments include a variety of ways for students to demonstrate the acquisition of intended abilities and conceptual understanding (selected response, open response, extended response, performance demonstrations, written reports, interviews, portfolios, etc.)?
- Do the materials include assessments within lessons and advice for teachers about using the results to modify instruction?
- Are the assessments designed to provide valid, reliable, and fair data about student achievement and performance?

0 **1** **2** **3** **4** **5**

Not addressed **Somewhat Addressed** **Well addressed**

Poor **Inadequate** **Adequate** **Excellent** **Exemplary**

POC-4 Implementation and System Support: Implementation issues are critical in focusing schools and districts on strategies for aligning curriculum across the grades, providing professional development and

meaningful assessment, working with the community and parents, and evaluating the effectiveness of implementation of the particular instructional materials.

- Do the instructional materials include information and guidance to assist the teacher in implementing the lessons?
- Do the instructional materials provide information about the kind of resources and support system required to facilitate the district implementation of the required science materials?
- Do the instructional materials provide information about how to establish a safe science learning environment?
- Do the instructional materials provide information about the kind of professional development experiences needed by teachers to implement the materials?
- Do the materials provide guidance in how to link the materials with the district and state assessment frameworks and programs?
- Do the materials provide guidance and assistance for involving administrators, parents, and the community at large actively in supporting school science?
- Overall, are the materials usable by, realistic in expectations of, and supportive of teachers?

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

POC-5 Equity Issues: Instructional materials benefit from an explicitly focus on equity issues with suggestions for how teachers can gain access to needed materials and supplies and an understanding about complex but useful technologies for access for all. Often materials can address how to use heterogeneous student groups effectively and thereby accommodate various learning styles. Materials can reflect race and gender illustrations that allow materials to be more inclusive for a variety of student differences.

- Are the instructional materials likely to be interesting, engaging, and effective for females and for males?
- Are the instructional materials likely to be interesting, engaging, and effective for underrepresented and under served students (e.g., ethnic, urban, rural, with disabilities)?

0	**1**	**2**	**3**	**4**	**5**
Not addressed			**Somewhat Addressed**		**Well addressed**
	Poor	**Inadequate**	**Adequate**	**Excellent**	**Exemplary**

SUMMARY Rating Standard POC (0-5) _____

Overall Strengths and weaknesses - including items not discussed above.

Appendix 2: List of Biology Textbooks Reviewed

I. Title: *Biology: A Human Approach*
Authors: Biological Sciences Curriculum Study
Publisher: Kendall/Hunt Publishing Company
Date: 1st Edition, 1997

II. Title: *Biology: The Web of Life*
Authors: Marilyn Lisowski and Eric Strauss
Publisher: Addison Wesley Longman, Inc/Scott Foresman-Addison Wesley
Date: 2nd Edition, 2000 ("Wolf")

III. Title: *Biology: A Community Context*
Authors: William H. Leonard and John E. Penick
Publisher: South-Western Publisher An International Thompson Publishing Company
Date: 1st Edition, 1998

IV Title: *Biology: The Living Science*
Authors: Kenneth R. Miller and Joe Levine
Publisher, Prentice Hall
Date: 1998 ("Lioness")

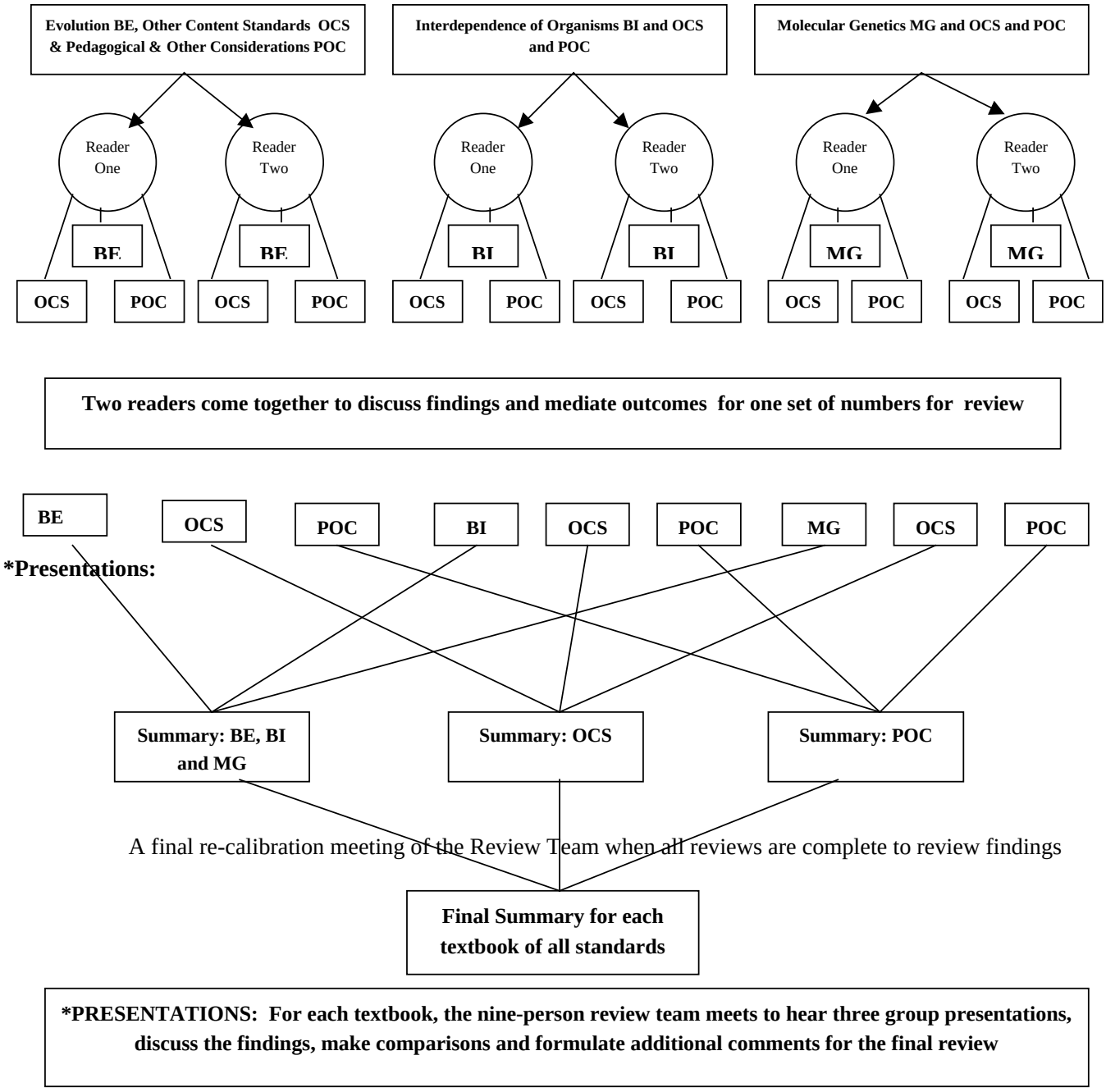
V. Title: *Insights In Biology*
Author: Education Development Center Development Team, Jacqueline Miller, PI
Publisher: Kendall/Hunt Publishing Company
Date: 1998

VI. Title: *Modern Biology*
Authors: "Built on past editions with staff and contributing writers"
Publisher: Holt, Rinehart and Winston
Date: 1999 (:Owl")

VII Title: *Biology: Principles and Explorations*
Authors: Johnson, George B and Raven, Peter H.
Publishers: Holt, Rinehart and Winston
Date: 1998 ("Turtle")

VIII. Title: *BSCS Biology: An Ecological Approach*
Authors: BSCS Biological Sciences Curriculum Study
Publisher: Kendall/Hunt Publishing Company
Date: 8th edition, 1998.

IX. Title: *Biology*
Authors: Kenneth R. Miller and Joe Levine
Publisher: Prentice Hall
Date: 5th Edition, 2000 ("Elephant")

X.Title: *Essentials of Biology: Concepts and Communication*
Authors: Pignatiello, J., R. F. Siggens, Jr., F DiChiappari and J. Madama
Publisher: Holt, Rinehart and Winston, (Harcourt Brace & Company)
Date: 1998 ("Eagle")

Appendix 3
Process for Review for Each of 10 Biology Instructional Materials