

REVIEW OF THE BIOLOGICAL SCIENCES, 1991

Committee

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RESEARCH

To: Chancellor Donna Shalala

From: John Hearn

On behalf of the committee that you appointed to review the Biological Sciences at our University, I enclose our report.

Our central thesis is that UW-Madison is very strong in the Biological Sciences overall, but this strength is far from uniform. Rapid and in some cases radical action is required if we are to improve our position and to compete. Without these actions we cannot sustain our position and we will decline.

Improved strategic planning, continued review of strengths and weaknesses in research, teaching and administration, movement of resources to support excellence, and a strong team approach to multidisciplinary programs are necessary for our future success. We have a lot to be proud of but there is no room for complacency.

In carrying out our review, we have amassed a considerable amount of data, opinions from faculty in two rounds of consultation, reports and strategic plans from our and other Universities. This material, together with the minutes of our meetings and other relevant notes, will be presented as a reference annex. We propose that this annex be used for internal managerial purposes by those who you ask to consider implementation of our report. This annex will not be circulated as part of the report.

CURRENT STATUS

The Committee's evaluation of biological research was not intended to determine quality in an absolute sense, but instead looked for significant changes in how well the biological sciences at the UW-Madison rank in comparison to other institutions of higher education.

The question then arises: to which other institutions should we compare ourselves? The members of the Review Committee strongly believe that the University of Wisconsin-Madison ought to compare itself with institutions conducting the very highest level of scientific work, and not with a list confined to the Big Ten or to land grant universities in the Midwest. The Committee realized that an exhaustive analysis of comparable rankings over the last 10-20 years with respect to such indicators as federal funding for research, support from private foundations or opinions from various national polls would not be possible. Nor would statistics on certain types of extramural funding, such as NIH, Markey or Searle awards necessarily be applicable to all areas of the biological sciences. We therefore chose 5 measurements which we considered fairly representative of how well the biological sciences at UW-Madison are doing in (1) competing with other institutions for extramural funding and (2) in the perceptions of rankings with other institutions by outside biologists. These measurements are:

(i) ranking of universities in total funds from the National Science Foundation.

(ii) ranking of the University of Wisconsin-Madison in research funds from the U.S. Department of Agriculture.

(iii) ranking of the UW-Madison as a whole and of the Medical School alone in total annual research funds received from

the National Institutes of Health over a span of 20 years. This information was provided by N.I.H.

(iv) number of investigators at the University of Wisconsin-Madison who have been supported by three major private funding groups, the Searle Scholars program, the Markey Trust and the Howard Hughes Medical Institute.

(v) the perception of outside biologists who are members of the National Academy of Sciences regarding the status of the biological sciences at the University of Wisconsin-Madison 10-15 years ago versus the present. (See table.)

The results of this brief statistical survey of rankings can be summarized as follows:

(i) The University of Wisconsin-Madison has consistently ranked among the top three universities as a recipient of NSF funds in biology over the past 15 years:

1976: 3rd 1981: 2nd 1986: 2nd 1991: 3rd

These funds came from grants through NSF funded programs in biotic systems and resources, cellular biosciences, molecular biosciences, neurosciences and the division of instrumentation and resources.

(ii) The College of Agricultural and Life Sciences (CALS) at the University of Wisconsin-Madison is consistently ranked No. 1 in the nation. CALS national ranks in USDA competitive grants:

<i>per capita</i>	1986: 1st	1990: 1st
<i>total</i>	1986: 2nd	1990: 2nd

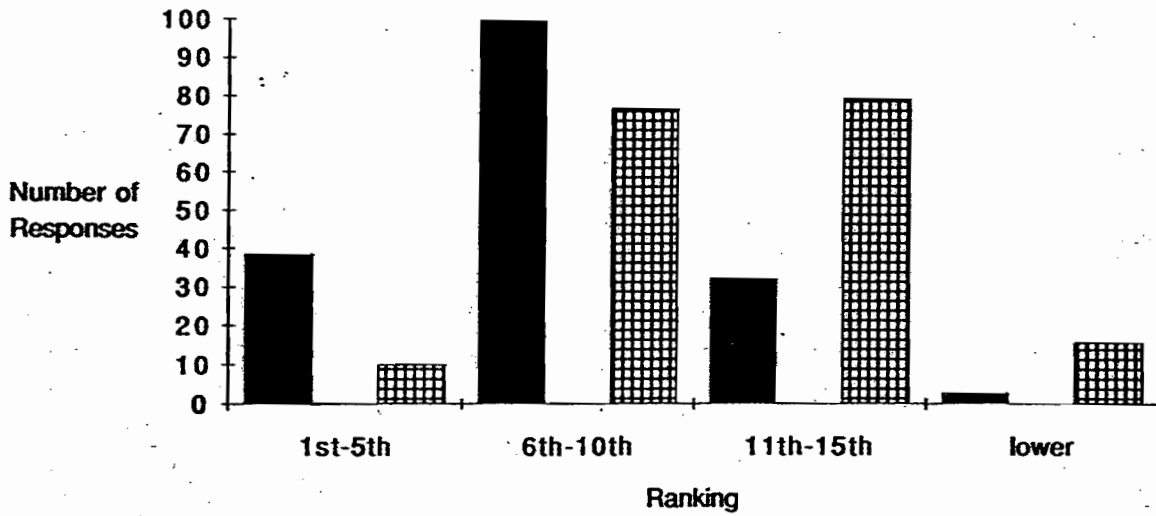
and in Competitive Federal Research funding:

<i>per capita</i>	1986: 1st	1990: 1st
<i>total</i>	1986: 2nd	1990: 2nd

(iii) The rank of the University of Wisconsin-Madison for total NIH funds received by institutions of higher education in the U.S.:

1970	1975	1980	1985	1990
6	10	12	12	15

Comparison of perceptions of NAS members on UW-Madison standing 10-15 years ago versus the present.



Solid = 10-15 years ago. Pattern = present.

n = 193

Among the institutions of higher education which have superseded UW-Madison are: Duke University, University of California-San Diego, University of Minnesota, University of Michigan, Washington University, University of California-San Francisco.

The rank of the University of Wisconsin Medical School for total NIH funds received by medical schools in the U.S.:

1970	1975	1980	1985	1990
16	16	21	25	27

Among the U.S. medical schools which have superseded the University of Wisconsin School of Medicine are: Case-Western Reserve University, University of Southern California, University of Iowa, University of Texas Southwest, University of Alabama, Vanderbilt University, University of Rochester, University of North Carolina, Baylor University.

(v) Data on perceived rankings by members of the National Academy of Sciences. (See chart.)

Summary: These data show that the University of Wisconsin-Madison is maintaining its positions of excellence in agriculture and several NSF funded programs, but is declining in national position and excellence in many areas of biology as perceived by National Academy of Science biologists. A significant loss is occurring in its national standing in health and basic biology research as indicated by declining NIH funding. The UW-Madison was largely ineffective in attracting support from the Markey Trust and Hughes Institute.

Therefore, to prevent further decline in its strengths and to elevate the quality of research in the biological sciences at Wisconsin to the highest standards, the Biological Sciences Review Committee recommends the following strategies for improvement.

RECOMMENDATIONS

1. Strategic Planning

Recommendation. We propose that a new Strategic Planning Committee, elected by faculty, be established to help initiate new programs, upgrade existing programs, regularly oversee reviews of strengths and weaknesses and play a role in allocating resources across the biological sciences.

Rationale. Despite the strengths of individual scientists, departments and programs, we believe that the biological sciences as a whole are losing ground because no mechanism exists for central planning. In an era of declining extramural support for research, it is imperative to set priorities and provide future directions for biology.

(i) Because no central planning exists to coordinate faculty hiring, hiring in the biological sciences addresses the needs of individual departments and schools but cannot shape the future direction of biology at UW-Madison as a whole. Interdisciplinary programs and centers, though lacking in conventional resources such as

Relative number of awards received for Searle Scholars, Markey Fellows, and Howard Hughes Investigators

	Searle Scholars		Markey Fellows	Howard Hughes
	'81-'85	'86-'9	'85-'90	Medical Institute Investigators
Harvard University	8	6	11	17 ('75)
Stanford University	5	2	6	12 ('87)
UC-San Francisco	3	9	10	14 ('81)
Yale University	5	3	4	15 ('82)
MIT	2	4	5	7 ('81)
UC-Berkeley	2	2	7	4 ('87)
Johns Hopkins University	3	2	4	11 ('76)
California Inst. Tech.	2	4	3	3 ('89)
UC-San Diego	4	1	3	3 ('85)
Washington University	2	0	5	9 ('76)
UW-Madison	0	3	0	1 ('90)
Rockefeller Institute	1	0	2	9 ('86)

adequate line budgets or space, play a major role in attracting high quality students and faculty, but lack the authority to re-assign essential faculty themselves. Because departmental hiring is usually directed toward departmental needs, not those of a broadly based field some of the most exciting and highly visible areas of biology cannot grow in a coherent direction. UW-Madison has therefore "missed the boat" in organizing the coherent development of this campus of rapidly growing, important areas of modern biology, such as neuroscience, cell biology, immunology and developmental biology.

(ii) Because no central planning exists for pursuit of external funding, at present most initiatives for external funding come from individual investigators. No coordinated central mechanism exists for aggressively pursuing outside funds for new instruction or multiuser facilities for interdisciplinary groups. UW-Madison has therefore missed out in getting prestigious federal and private awards not only for individual faculty, such as Hughes investigatorships, but also in getting large money awards for new buildings for biology, such as those from Markey.

(iii) Because no central planning exists to set priorities in the biological sciences, there is virtually no mechanism to phase out weak programs. This campus cannot support every biological program, department or center that now exists. If strong programs are to thrive, then weak or nonviable programs must be scaled back, phased out, or strengthened by merger. At present, no systematic plan exists for regular evaluation of programs in the biological sciences through which such priorities can be set.

Solution and Implementation. To address the problems arising from the lack of central direction in the biological sciences, we propose the immediate creation of a Strategic Planning Committee for biology which, through its Chairperson, will make recommendations directly to the Chancellor for the improvement of the state of biology at UW-Madison now and in the future. The Committee will be composed of about 10 eminent scientists representing cell, molecular, organismal, ecological/environmental and applied areas of biology. We suggest that candidates initially be nominated by active members of the National Academy of Sciences, with input from the faculty and then elected by the biology faculty at large for an initial 3-year term.

How will the Strategic Committee function to improve biology?

(i) The strategic committee will oversee 15% of all new positions as they become vacant in the biological sciences, which at present would be 5-6 positions per year. Based on their own evaluation and the proposals of deans, departments, centers and programs, the committee will recommend to the Chancellor which areas of biology need recruitment of new faculty, and which departments or centers might be candidates for the best homes for these recruits. This would encourage deans and departments interested in capturing these positions to consider recruiting beyond mere departmental needs. Even with responsibility for only 15% of new positions, the strategic committee would be able to direct the campus in a coherent fashion into important new areas of biology. The strategic committee would be able to strengthen those interdisciplinary programs with a strong research base by recommending that at least partial FTEs be awarded directly to them. New faculty will still need departmental tenure homes, but joint appointments between departments and programs could be arranged through the appropriate deans and chairs.

(ii) The strategic committee will seize initiatives for funding opportunities by bringing together appropriate groups for multiuser facility awards. The committee can act as a strong nominating body for individual faculty enrichment awards, especially when departments or programs fail to take advantage of such opportunities. The Strategic Planning Committee will also play a role in planning priorities for new buildings for biology.

(iii) The strategic committee will organize regular critical outside reviews of all departments, centers and programs. To reduce costs, units covering similar areas of biology might be reviewed together. These outside reviews will be used to make recommendations about how best to strengthen these organizations. In some cases mergers could be recommended. In others, programs may need to be phased out. It is understood that these decisions would respect faculty tenure rights.

External review committees will be selected by the Biology Divisional Committee. The appropriate deans will identify units in greatest need of immediate evaluation. All units will be evaluated within the first 5 years and then less often (perhaps 7-10 years) depending on need. This will replace the current review process. Reviews will be submitted to the dean and the Strategic Planning Committee, which will oversee implementation of the review committee's recommendations. It is essential that high quality outside reviewers be selected and that their recommendations be taken seriously.

2. Modern Biological Research Facilities

Recommendation. We recommend a major initiative to provide modern biological research facilities on the UW-Madison Campus. This is essential for initiating recommendations for strategic planning described in 1.

First, we recommend construction of a major interdisciplinary biological research facility. This building will house faculty members in emerging disciplines that cross both departmental and college lines and will provide flexible space that allows multidisciplinary groups to get together. It will also serve to announce the commitment by Wisconsin to support modern biological research. This strong statement of commitment is critical to the recruitment of the highest caliber faculty and students to this university.

Second, we recommend that a 10-year plan for the construction, renovation and centralization of biological facilities be developed and put into effect. These im-

proved facilities will permit biological scientists to remain competitive in this period of tremendous technical advances. Included in this plan will be the review of shared services facilities on campus to decide whether to expand, maintain, consolidate or close individual units.

Rationale. The University of Wisconsin is facing a decline in the quality and quantity of biological research space. Our biological buildings have not kept pace with the needs of modern programs of research and strict new regulatory codes. Not only has the University of Wisconsin failed to modernize its biological research facilities, but in addition other institutions have confronted this situation head-on with the construction of new buildings and the renovation of existing space to modern standards. As a result, our competitiveness in recruiting the best faculty and students plus our ability to attract federal and private research funds have been diminished. The University of Wisconsin-Madison campus badly needs shared resources for expensive, state of the art equipment and a mechanism to reduce or close facilities when the service provided is no longer in high demand. The Strategic Planning Committee will be well positioned to advise on the needs for shared services and facilities.

Implementation

(i) Construction of an interdisciplinary biological sciences research building should begin as soon as possible. This facility should be located in proximity to the existing basic biological sciences in the Henry Mall area, and should house laboratories for approximately 50 faculty from a broad range of fields within biology, rather than being devoted to specific departments. This building will help to provide new funding opportunities for interdisciplinary groups and will serve as an incubator for emerging programs in biology.

(ii) A 10-year plan for the construction and renovation of central facilities should be developed to coordinate the biological sciences. First, we recommend that planning begin immediately and that construction and/or reallocation of space be set to begin within 2 years. Second, we recommend that this plan be put into effect within 10 years. Third, we recommend that facilities be planned to bring together groups with similar research and teaching missions. For example, central facilities for Environmental Studies, Plant Sciences or Neurosciences might consolidate some of the smaller units that now exist on campus in these expanding disciplines and

provide a focal point for coordinated research. Fourth, the UW-Madison needs a mechanism to close or reduce facilities when the service offered is no longer in high demand. The Strategic Planning Committee will play a role in guiding these decisions. Resources from scaled down or closed facilities could then be used to fund new initiatives.

(iii) **Current space must be utilized more efficiently.** In some cases, when space is under used or poorly organized, this will require reallocation of current space.

(iv) **The University of Wisconsin-Madison should be developed as a center for biological conferences, similar to that at Cold Spring Harbor on Long Island.** We envision week long conferences that are held every year in Madison. Each conference might attract 500-1000 biological scientists. In the short term, all this project would require is an increase in support staff for the current conference organization plus a major effort in public relations. In the long term, new facilities might be considered.

The development of Madison as a major center for biological conferences would greatly facilitate recruiting efforts in attracting postdoctoral fellows and new faculty. On the coasts, there is a general perception of the Midwest as a flat place filled by corn fields. People tend to fly over it when possible. This perception could be changed dramatically if thousands of scientists were exposed to Madison each year.

An administration for conference organization already exists, but is extremely small. Conferences leaving Cold Spring Harbor due to the exorbitant cost and limited size of their facility could be attracted here. In addition, other conferences that have no permanent home might be attracted to the idea of coming to one place each year. If these efforts were successful, both the staff and space assigned to conference organization would need to be increased.

3. Faculty Recruitment and Retention

Recommendation. Recruitment and retention of the highest caliber faculty must be made a top priority. Without this as a central goal, the biological sciences at UW-Madison cannot remain competitive.

Rationale. In order for the UW-Madison to live up to its perceived world class status in biological research, it must attract and retain a highly visible and outstanding faculty. To accomplish this goal Wisconsin must provide an environment that allows those faculty to succeed. We must reward excellence before our stars entertain thoughts about leaving. Outstanding faculty need to be recognized early in their careers and rewarded appropriately.

When a university reacts only to outside offers it is often too late. Last minute counter-offers cannot be expected to create loyalty or make up for years of underappreciation.

Implementation

(i) **Attractive facilities, adequate salaries, and generous start-up funds must be provided by the units and graduate dean in order for UW-Madison to be successful in hiring the best faculty.** Competitive start-up packages should be the highest priority for WARF funds.

(ii) **Approximately 30 endowed professorships yielding \$50,000 or more per year should be solicited for the biological sciences and provided for outstanding faculty.**

(iii) **New laboratories through the addition of facilities described elsewhere in this report must be provided for our most productive and innovative biologists.** For example, a pool of funds from overhead could be retained for such renovations.

(iv) **A sabbatical program should be made available to all faculty including those in the biological sciences.** Such programs are widely available at other universities, and improve faculty competitiveness for research funds, as well as contributing to improved teaching and morale. Faculty who are no longer making an effective contribution to research or teaching should be permitted the option of early retirement, which, in such cases could be encouraged by an improvement in retirement benefits.

(v) **Better public relations with the state legislature should be initiated by the University with respect to the accomplishments of biological scientists at UW-Madison.** In setting the pay plan for UW faculty, the state legislature is strongly influenced by perceptions of what the faculty accomplishes. They should be made aware of the large amounts of outside funds generated by

our faculty and the economic benefits to the state accruing from biological research. The Legislature should also be disabused of the notion that the typical work load of faculty consists of only a few hours a week. (See #13).

(vi) **The administration should review the service units of the University (i.e., buildings and grounds, purchasing, financial administration, safety agencies, etc.) with the aim of contributing to the real goals of the University (i.e., excellence in teaching and research).** Often, bureaucracy is very discouraging to faculty and students, who perceive service units as a hindering rather than enabling their research efforts. An increase in local support staff is needed, ranging from equipment service and repair to secretarial services. We suggest that the University invest more money for this purpose.

4. Recruitment and Training of Graduate Students

Recommendation. (i) The ancillary costs of training graduate students must be reduced by changing the formulas for calculating tuition and fringe benefits and granting state residency. (ii) All programs should decrease the average time required to complete the Ph.D. (iii) A central, integrated biology graduate student recruitment program should be developed. (iv) The minor requirement for the Ph.D. should be dropped.

Rationale. Training programs in biology at UW-Madison are among the best in the nation and compete fiercely for the highest quality students. The attraction of such students is the key to the quality and competitiveness of biological research at UW-Madison and is crucial to faculty recruitment and retention. We must there-

fore offer competitive stipends in addition to high quality training. Until emergency measures were enacted this past year, a significant percentage of students were dissuaded by UW's low stipends. Faculty have used precious external grant resources to raise stipends. The cost of training graduate students at UW-Madison appears to exceed that at most peer institutions and will become a disincentive to graduate training. The formulas for calculating tuition and fringe benefits should be reviewed to eliminate this apparent discrepancy.

The average time to complete a Ph.D. has increased 30-50% over the last 20 years. The minor requirement contributes

to the increase in time for graduate work. Shortening the time for completion of the Ph.D. will help to improve the competitiveness of our training programs.

Finally, the number and variety of biology training programs at UW-Madison are bewildering to many prospective students and there is a significant duplication of effort involved in admissions and recruitment.

Implementation

(i) **Tuition, fringe benefit and overhead costs must be capped** at a reasonable rate, regardless of stipend level. State residency status should be granted after 1 year of study in order to lower tuition costs.

(ii) **The average time to Ph.D. completion must be reduced.** While individual needs and different research areas may require a range of training periods, a 4-6 year time period for the Ph.D. is a realistic goal, and would enhance our competitiveness.

(iii) **The minor requirement should be dropped.** This will reduce the time to the Ph.D.

(iv) **Promotional literature, centralized recruitment and streamlined admission procedures** will aid all programs in attracting a greater percentage of high caliber students. The trend among our competitors is toward streamlined admissions.

5. Financial Resources

Recommendation. The financial resources necessary for recruiting and retaining the "best and the brightest" and providing them with first rate facilities must be generated not only by aggressive pursuit of external funding opportunities as already stated in this report but also by: (1) creation of more and larger industrial research collaborations; (2) a substantial commitment of state funds; (3) reallocation of existing University resources to capitalize on current strengths and to capture new opportunities; and (4) expansion of the patenting and licensing activity of the University and its agents.

Rationale. Successful competition for future funds will require far greater coordination and activism of the biological faculty and more meaningful leadership from the administration. Many of the recommendations below are aimed at enabling the biological research community to become even more self-supporting through industrial consortia and greater intellectual property revenues, in addition to external grants.

Implementation. We recommend:

(i) **Creation of more and larger industrial research collaborations.** We strongly support the development of industrial consortia such as those created through the UW-Madison Biotechnology Center. These consortia, however, are relatively small and more creative programs will be necessary to attract industrial support of greater research dollars. These joint ven-

tures are appropriate activities for the University-Industry Research (UIR) Program; however, this office does not currently have the resources to establish such consortia. Therefore, we further recommend:

a. **A complete overhaul of the biology-related activities of the UIR program** by developing it into a professional marketing organization, complete with the legal, financial and personnel resources necessary to organize and promote faculty initiatives of interest to industry and to aggressively seek out potential industrial research partnerships with major agricultural, biomedical and pharmaceutical firms.

b. **Increased legal and technical assistance from the University offices** concerned with industrial research agreements. Most individual faculty have no experience in dealing with industry. This can create a reluctance to explore industrial collaborations. The University should clarify further the channels and procedures for establishing collaborations.

(ii) **A substantial commitment of state funds to modernize the UW-Madison campus biological research facilities** is necessary to attract external funds and a high caliber of faculty and students (see Facilities). While some external building funds will be raised, for example, as the matching component to the WISTAR plan, the largest burden appropriately falls to the State.

(iii) **Reallocation of a portion of new WARF funds derived from new biological inventions directly to the strategic development of biology.** It is likely that the biological sciences at UW-Madison are going to generate an increasing number of patentable discoveries. We propose that, to further encourage invention by faculty, the fruits of this expansion be applied to further developments in biology. This can be accomplished by a slight modification in the current distribution formula for WARF monies, i.e., that the current 65% general / 15% department / 20% inventor royalty formula be changed to 50% general / 15% department / 20% inventor / 15% strategic development of biology. These development funds should be held in a special account by the Graduate

School and disbursed under guidance and advice from the Strategic Planning Committee.

(iv) **Expansion of the patenting and licensing activity of the University and its agent.** The University's patent agent, the Wisconsin Alumni Research Foundation (WARF) is one of the most successful and well-established organizations of its kind. However, WARF could be doing more to take advantage of the large and productive research base of the University. Specifically, the decision-making process at WARF which seeks to determine whether an invention 1) is patentable; 2) is defensible and 3) could be expected to provide a reasonable return is too stringent. It is difficult to forecast accurately the potential value of a biological patent over its 17 year life, as evidenced by the forfeiture of millions of dollars by the Medical Research Council in England because it failed to capitalize on the discovery of monoclonal antibody technology. To prevent such potential losses we propose that:

a. The University strongly urge WARF to consider filing all patent applications on the basis of patentability and enforceability alone.

b. The University develop a second intellectual property management system to assist with all patenting, licensing and intellectual property matters outside of WARF's scope or in which WARF declines to take an interest.

TEACHING AND TRAINING

CURRENT STATUS

The national and international standing of the biological sciences at the University of Wisconsin-Madison depends heavily on excellence in research. However, quality in teaching and training is also a major factor in our reputation. Without the attraction of talented students into the biological sciences where will the next generation of biologists come from?

It was not possible to evaluate the status of teaching by statistical ranking. However, exit polls reveal that 86% of undergraduates are happy with their courses. They state that the quality of the teaching is good but that access to courses is an ongoing problem. Intense discussion by the Review Committee with input from outside faculty led to recurring opinions about how to strengthen the status of undergraduate teaching:

Undergraduate teaching is not sufficiently rewarded in hiring, promotion and salary decisions. At present faculty teaching loads are uneven, which demoralizes faculty who do more than their fair share. Faculty may get little credit from their home departments for interdisciplinary teaching, which does not encourage development of new courses in emerging interdisciplinary areas of biology. Further, faculty supervision of undergraduate research, organization of seminars and student mentoring need to be recognized and rewarded.

Introductory courses for majors and non-majors in the biological sciences are inadequately staffed by faculty and TA's. This has led to courses that are simply too large to allow adequate student-faculty contact. More participation by faculty, with proper credit given, in team taught introductory courses would reduce class size, and increased funding for TA positions would provide more course sections. Moreover, better coordination among colleges and departments would set more uniform quality standards across campus and eliminate wasteful redundancy in course offerings.

There are insufficient laboratory and research opportunities for undergraduates. There was concern at the alarming erosion of support for laboratory and field

courses, which has led to deterioration or outright cancellation of laboratories. Even Biocore, which is perceived as a model course for undergraduate biology majors, has suffered from inadequate staffing and supplying for its laboratories. The Review Committee also perceived a need to make undergraduate research experiences more widely available to the top biology majors.

RECOMMENDATIONS

6. Strong Introductory Courses in Biology

Recommendation. A strong introductory course sequence for biology majors should be established. These courses should include laboratory and field work.

Rationale. The content of the current introductory courses is not consistent for all potential biology majors. There is also some course redundancy among schools and colleges. In addition, limited resources have diminished the quality and availability of laboratory experience.

Implementation. A strong introductory course sequence of 2 semesters with 5 credits per semester including laboratory work for all science and biology majors should be given in the sophomore year. The content would cover basic principles and follow a logical progression from molecules to ecosystems and ethics.

We propose that:

(i) The course comprise lecture sections of approximately 150 to 300 students, and laboratory sections of no more than 25 students per lab.

(ii) Faculty, TAs and senior undergraduates be recruited from across the campus to participate in these laboratories. Feedback from involved faculty suggests that a 4 year commitment is necessary. Although each team might develop its own particular 'flavor' to the course, the same general principles and concepts in biology would be covered. This course would require as many as 12-18 faculty per year and 14 TAs per semester, and would necessitate broader faculty participation in undergraduate teaching which we view as a highly desirable goal. This recommendation would also involve many more graduate students in under-

graduate teaching, which is an important part of graduate training.

(iii) The Vice Chancellor for Academic Affairs with the Divisional Committee and the Deans will develop a mechanism, with the assistance of the Center for Biology Education, to recruit faculty, develop the courses and allocate the necessary resources. Participation in teaching competes for faculty research time and it is therefore extremely important that outstanding teachers be rewarded for excellence in teaching. Laboratory improvement funds should be sought through outside agencies such as NSF, NIH and DOE.

(iv) The 2 semester introductory sequence could be an alternative route to Biocore for biology majors. Biocore, which could be the honors course for biologists, should continue as is with its current enrollment.

7. Flexibility for Biology Majors

Recommendation. Biology majors should have the flexibility to broaden their scope beyond department boundaries, to include emerging interdisciplinary fields in the biological sciences.

Rationale. Many of the new rapidly emerging areas of biology are interdisciplinary and students wishing to "major" in such a field may find it difficult to meet the requirements of all the involved departments and colleges. We therefore propose a move toward interdepartmental majors that would allow students more flexibility in meeting such requirements, and in tailoring a curriculum toward individual designs.

Implementation. Students should have the option to design their own major in consultation with advisors, developing a 2-3 year course plan on the basis of the introductory course. We propose that after a general introductory sequence, each track in areas of biology such as for example ecology, plant physiology, developmental biology, neuroscience, and cell and molecular biology would have 3-5 core courses.

Students should balance the learning of important facts with critical thinking and an experimental approach to biology. Lab and field courses can be especially useful for this. Further, students who play a more active part in designing their course of study will be more inclined to think critically.

8. Effective Advice and Mentorship

Recommendation. All students in biology should have effective advice and mentorship by their second or third semester at the latest.

Rationale. On a very large campus, it is possible for some students to flounder or miss opportunities, through the lack of information and direction.

Implementation. We recommend strongly that every student be matched with an advisor.

The current program of mentorship for minority students should therefore be endorsed and expanded to cover all of our student body. Appropriate credit should be given to faculty for student advising.

In addition, a biological sciences database should be established which lists the options for courses and also the essential details of faculty and their research and training interests.

9. Research Experience for Undergraduates

Recommendation. The top biology majors should be encouraged to work on a research project in a faculty laboratory toward the end of their undergraduate careers.

Rationale. A major strength on the Madison campus is the access that undergraduates have to research laboratories, which is a considerable attraction for the best students and should be marketed more actively in student recruitment.

Implementation. To ensure that our best majors have an opportunity for research, the Center for Biology Education (CBE) will act as brokers to coordinate faculty sponsors and biology majors.

10. Biology for Non-Science Majors

Recommendation. All non-science majors should be instructed in the fundamental principles of biology at molecular, cellular, organismal and ecology/environmental levels.

Rationale. Several colleges and departments currently offer courses in biology for non-science majors with uneven content. These courses are uneven in quality.

Implementation. The CBE should coordinate the establishment of a conceptual framework of the topics to be covered in biological science courses for non-science majors. Such courses should include what is relevant in the biological sciences to the lives of citizens. In order for balance in general science to be offered, coordination among the various natural sciences will be needed at the divisional level. Non-science majors should receive a minimum of 5 credits of biology including a laboratory, or equivalent such as field trips, etc. These courses would be part of a sequence that should also include the physical sciences.

ORGANIZATIONAL STRUCTURE

CURRENT STATUS

The first segment of this report describes how strategic planning could strengthen biology by allocating more resources to quality programs and phasing out or merging weaker ones. These efforts will help to achieve greater unity in the biological sciences and conserve precious resources. The advantage at UW-Madison is to have a diversity of schools and colleges on a single campus where they can share facilities, create joint appointments, and organize strong interdisciplinary programs.

On the other hand, the specialized needs of schools and colleges such as agriculture, medicine and veterinary medicine prohibits a radical restructuring of biology into a single college, along the lines of Berkeley's recent reorganization. Therefore, the Committee supports an evolutionary process in which the currently highly fragmented structure will be replaced by more unity. As a first step toward greater unity Botany and Zoology should be invited to join with CALS. Streamlining of administrative units and improved communication will also help in unifying the biological sciences. Above all, we should not lose sight of our unique opportunities for strong ties between the basic, applied and clinical biological sciences on a single campus.

RECOMMENDATIONS

11. Evolution toward a more unified structure for biology

Recommendation. The UW-Madison biological sciences, which currently involve more than 70 departments and over 40 centers, institutes and programs, should be integrated into a more unified structure.

Rationale. The Committee considered several possibilities for restructuring the organization of the biological sciences at UW-Madison. The current Model 1 (see diagram) represents the status quo, which was rejected as inadequate for future development of excellence in research and teaching. Two additional models (not illustrated) were also considered but ultimately rejected. In one of those models a Vice Chancellor for Biological Sciences was added to give a unified leadership across

the division. However, this structure also had the disadvantage of another tier of administration. The second of those models would incorporate into a single College of Life Sciences all biological science faculty with the exception of clinical scientists in the professional schools. This structure was rejected because, even though it would centralize the biological sciences into one college, it would also have the serious disadvantage of separating the clinical from the basic sciences in the professional schools.

The structure favored by the Committee is Model 2 (see diagram) which we viewed as the first step in an evolution toward a more unified structure for biology. This model requires (i) the establishment of a Strategic Planning Committee for biology (See 1) and (ii) the addition of Botany and Zoology to CALS. The advantages of a Strategic Planning Committee for strengthening and unifying biology by emphasizing joint appointments, sharing of facilities and strong interdisciplinary programs have already been described in the first part of this report. The addition of Botany and Zoology to CALS would also have strong unifying effects. First it would place these departments in a college whose Dean has a stronger commitment to biology. Second it would put all undergraduate biology teaching in a single college where the curriculum could be more easily coordinated and teaching loads more equitably distributed. Third, in accordance with the goals of strategic planning, hiring in the biological sciences would be better coordi-

nated. The adoption of Model 2 was viewed not necessarily as an end point but instead as the beginning of an evolution toward more cohesiveness in the biological sciences.

Implementation. We strongly recommend the immediate adoption of model 2 which will add the departments of Botany and Zoology to CALS.

12. Reviews of Administration

Recommendation. External review of administrators and administrative procedures at Divisional, College and School levels should be carried out at 5 yearly intervals.

Rationale. Across departments, Schools and Colleges, there is a considerable variation in the numbers of administrators and a perceived unevenness in quality. In following the pattern of regular review of scientific activities, administrative excellence should also be included for review. The general perception in the many comments received by the Committee is that the overall FTE and resource allocation to administration is growing at the expense of faculty positions. A review would address such concerns. In addition, there may be opportunities for small departments to share administrative support, thereby reducing non-scientific and educational overheads. We support strongly the initiatives of many Deans to use only a minor percentage FTE of their associate and assistant appointees, so that in the long run these individuals are not divorced from their science and their departments.

Implementation. The Chancellor should develop regular reviews of administrative and business efficiency. The goal of these reviews should be to promote the closest possible teamwork between scientific, educational and administrative entities on campus.

13. Improved Information and Communication

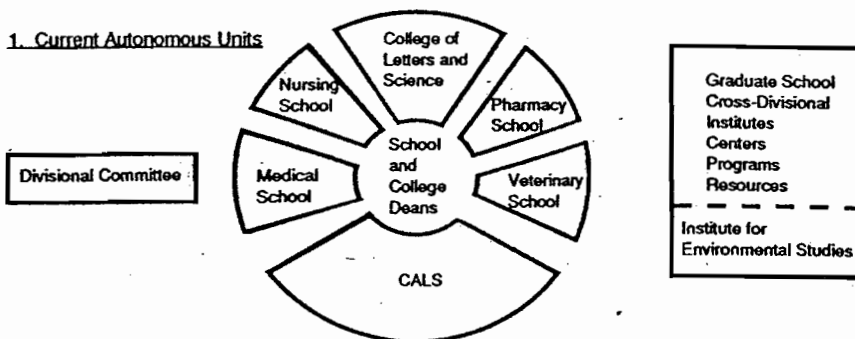
Internal Communications

Recommendation. The great strengths in the biological sciences, at individual and departmental levels, should be reflected in a simple database with on-line access for faculty and students. In addition, a simple

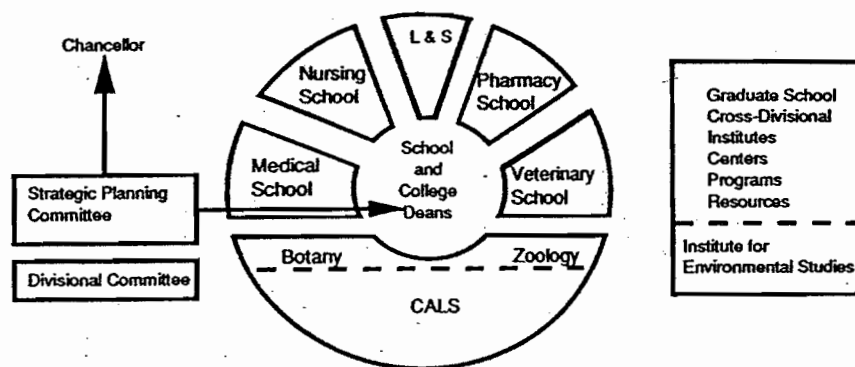
Organization of the Biological Sciences

Possible structures

1. Current Autonomous Units



2. Proposed Model 2



and unified literature should be developed and presented as a marketing document for these strengths in attracting faculty and students.

Rationale. The success of the biological sciences at UW-Madison has led to a multiplicity and complexity of individual units that can be baffling. We suggest that some relatively simple actions could overcome these problems and lead to better communication within the biological and allied sciences.

Implementation. A simple database should be created indicating (i) for each faculty member, a 200 word abstract of research projects, a brief listing of teaching and training activities, and the necessary personal details together with key words to enable simple access; (ii) for each department, center, institute or program, a simple, one page mission statement listing objectives and principle research and teaching activities, together with key personnel and key words for easy access. This

on-line database should encourage rapid availability of information and catalyze research and teaching interactions.

We recommend strongly that a simple, 20 page summary of the highlights of research and teaching in the Biological Division be prepared in a professionally presented, easy to read brochure in order to market the university's attractions to faculty, students, the press and public.

The Center for Biology Education could be asked to coordinate the management of the database. This should be kept simple, with each individual able to update his or her entry on an annual basis through on-line amendment. Where multi-system incompatibilities exist, transmission through e-mail for entry by the database manager could be considered. Future expansion of this capacity to other divisions may be advisable, at which point responsibility might be transferred to MACC.

External Communication

Recommendation. The University of Wisconsin-Madison should provide high impact, clear and simple briefing for state legislators, decision makers in government and industry, and citizens of the state regarding the contributions of the biological sciences.

Rationale. Recent press and public commentary on the research and teaching functions of our university suggest that better efforts are needed to communicate and market our skills in the biological sciences. Their vital industrial and economic contributions to Wisconsin and the nation must be made clear to legislators and decision makers.

Implementation. New public relations mechanisms such as regular campus tours for VIPs, a small annual scientific exhibition at the State Capitol, video or radio clips, should be initiated. We suggest that the Business School be consulted in improving our effectiveness in promoting the accomplishments of the biological sciences at UW-Madison.

ANNEX

Methods. The work of the committee was completed in six months from mid February to mid October 1991 with a break in July and August due to members commitments to research and scientific conferences. Three subcommittees were formed to consider (i) Research Development, (ii) Teaching, Training and Public Service, and (iii) Operational and Structural issues. The full committee met on an average every 2 weeks during the review. The first two months were spent in consultation with faculty, considerations of written and verbal evidence and the accumulation of background materials from our and other Universities. We formulated our recommendations with debate and discussion during the second two month period. These discussions continued through the preparation and refining of four drafts of our report during the last two months of our review. The second

draft was tested with invited comment and feedback from selected faculty. The first two drafts were written by the Chairman from materials produced by the subcommittees. The last two drafts were extensively rewritten and refined by Dr. Katherine Kalil, with continued feedback from committee members. Ms. Susan Carlson was responsible for analysis of data, coordination and infrastructural support of the committee's work.

Note. The mission of the review committee was to assess the current status and to recommend changes to meet the current and future needs of the Biological Sciences at UW-Madison. This report is therefore a diagnostic review with recommendations and suggestions for implementation.

The report completes the work of the committee and is the first stage of a three stage process. The second stage is a further widespread consultation with faculty and administration in considering the best approaches for implementation, which is the third stage.

In moving to implementation, time is not on our side. Many of our competitors have carried out similar reviews and restructured rapidly to focus on their strengths and to invest in the necessary infrastructure. The Biological Review committee looks for similar decisiveness and commitment from all concerned at our University in order to maintain and increase the competitiveness of the Biological Sciences at UW-Madison.

Acknowledgements. We thank the many individuals who have provided us with thoughtful and extensive advice during our deliberations. Without their commitment and support the work of the committee could not have been carried out.

Biological Review Committee Membership

Name; Department; Research Interest

Professor Seymour Abrahamson; Zoology and Environmental Studies, Health effects of radiation.

Professor Paul P. Carbone; Clinical Oncology, UW Clinical Cancer Center; Breast cancer, Cancer in the elderly.

Assistant Professor Sean B. Carroll; Molecular Biology/Genetics; Molecular biology of animal development.

Professor Roberto Coronado; Physiology; Molecular and cellular cardiovascular physiology.

Professor Hector DeLuca; Biochemistry, Nutritional Science; Molecular function of vitamins and hormones, metabolism of vitamins A and D.

Professor Thomas A. Duff; Neurosurgery; Biochemical mechanisms responsible for the development of cerebral vasospasm.

Professor Neal L. First; Meat and Animal Science; Reproductive physiology and developmental biology of agricultural animals.

Professor Linda K. Graham; Botany; Evolution of plants from green algae. Evolution of plant development processes. Physiological and community ecology of freshwater filamentous algae. Effects of herbicides on non-target phytoplankton.

Professor Carol A. Gross; Bacteriology; Heat shock response and heat shock proteins in *E. coli*.

Professor John P. Hearn; Physiology; Primate Research Center; Embryo-maternal cell signals at implantation. Reproductive success and gene flow in wild primate populations. Conservation biology of large mammals.

Professor Katherine Kalil; Anatomy; Growth and guidance of axons in the developing mammalian central nervous system.

Associate Professor Judith Kimble; Biochemistry, Lab of Molecular Biology; Genetics and biochemistry of developmental controls in the nematode *Caenorhabditis elegans*.

Professor Stanley J. Peloquin; Horticulture/Genetics; Plant breeding and plant genetics.

Professor M. Thomas Record; Biochemistry, Chemistry; Non-covalent interactions of proteins and nucleic acids in solutions.

Professor Daniel H. Rich; Pharmacy; Synthesis and mechanism of action of enzyme inhibitors. Development of new anti-AIDS drugs and immunosuppressive drugs.

Professor John Suttie; Biochemistry, Nutritional Science; Vitamin K action, clotting factor biosynthesis.

Professor Paul H. Williams; Plant Pathology; Genetics of plant-parasite interaction at the organismal and population level.

Associate Dean Thomas M. Yuill; Veterinary Medicine; Epizootiology of viral and other infectious diseases of wildlife and domestic animals.

Susan Carlson, Administrative Assistant

