

ASSESSING PREBACCALAUREATE HUMAN PHYSIOLOGY COURSES

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Two surveys were conducted between 1994 and 1996. The purpose of the initial survey was to obtain demographic information about prebaccalaureate human physiology courses. Of the 117 responding physiology departments, 50% offered human physiology at the prebaccalaureate level to 14,185 students during the 1994–1995 academic year. The mean was 245 students per year (± 30 SE). Class size was limited by 44% of the respondents. Prebaccalaureate human physiology was offered as a separate course from anatomy by 93% of the departments. Sixty-one percent scheduled the course once a year. The purpose of the second survey was to determine how physiology departments evaluated prebaccalaureate physiology courses and faculty. All responding departments utilized student feedback; 38% of the departments included physiology chair review, 38% peer review, and 9% allied health faculty review. Twenty-eight percent of allied health programs evaluated the course. Results indicated that, whereas a significant number of undergraduate students are enrolled in prebaccalaureate physiology courses annually, those courses appear to lack formal, consistent formative evaluation.

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Key words: undergraduate; allied health student; teaching effectiveness; formative evaluation

The physiology department at the University of North Dakota School of Medicine and Health Sciences offers a prebaccalaureate (undergraduate) human physiology course for the allied health, premedicine, and physical education students. The prebaccalaureate human physiology course was offered in both the fall and spring semesters to a total of 240 students per year. However, by 1992, the number of students requesting enrollment increased significantly. The physiology department did not have the resources available to teach 50–60 additional students per semester. This increased demand delayed the students' enrollment in the course, postponed admission to their selected programs, and increased the number of semesters necessary for graduation.

A search of the literature was undertaken to determine whether other physiology departments had encountered increased demand and what methods were suggested to modify enrollment practices. Before 1994, no organized demographic information regarding prebaccalaureate human physiology courses was available. The physiology department faculty thus determined that the 1994 survey would be a cost-effective method of obtaining information about how similar physiology departments managed enrollment, the frequency of course offerings, service to respective student populations, the number of credit hours allotted, whether laboratory experiences were included, and how the course was evaluated (see APPENDIX A).

The purpose of the 1996 survey was to ascertain current criteria by which physiology departments evaluate undergraduate human physiology courses and instructors. It was hoped that this shared information would assist the physiology faculty in developing criteria specific to the assessment of teaching effectiveness (see APPENDIX B).

METHODS

In May 1994, a questionnaire was mailed, along with a cover letter explaining the questionnaire, to the 158 department chairs, and to physiology department chairs, of schools of medicine in those universities in the United States and Canada that offer a baccalaureate degree in physiology. A current listing of the department chairs of schools of medicine and the 1988 *Institutions Awarding Academic Degrees with a Major in Physiology* (1) were used to as a mailing list. Those physiology departments that did not respond were sent another copy of the same questionnaire in October 1994.

In March 1996, a questionnaire was mailed, along with a cover letter explaining the questionnaire, to 50 physiology department chairs who had been identified from the initial survey and from correspondence. Physiology departments within schools of medicine that offer prebaccalaureate human physiology courses were chosen exclusively for the 1996 study. The physiology department chairs who did not respond were sent a second copy of the same questionnaire in October 1996.

Descriptive statistics were used to analyze data from the 1994 and 1996 surveys.

RESULTS

Of the 158 physiology departments sent surveys in 1994, 117 responded, and 32 of 50 responded to the 1996 survey. In the 1994 survey, 50% of the responding departments offered human physiology at the baccalaureate level. Of these respondents, 39 were medical school physiology departments and 20 were institutions offering a baccalaureate degree in physiology. A total of 14,185 students per year were enrolled in those 59 institutions in the 1994–1995 academic year. The number of students enrolled ranged from 8

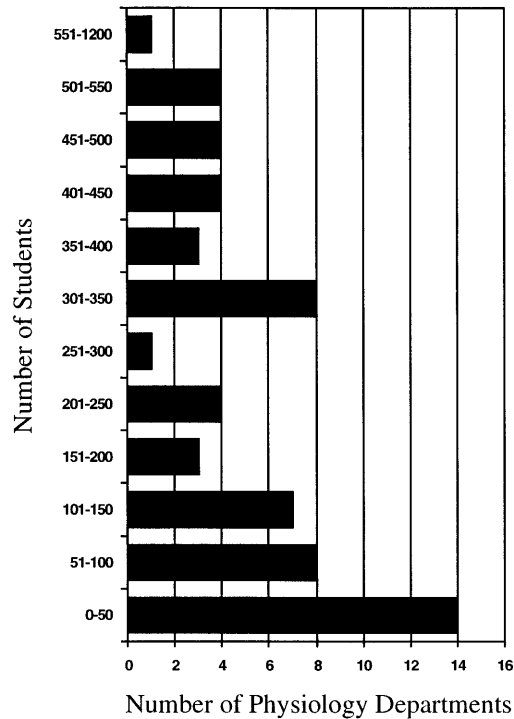


FIG. 1. Number of physiology students enrolled during 1994–1995 academic year. A total of 14,185 students were enrolled in prebaccalaureate human physiology by the responding 59 physiology departments. The majority of physiology departments (38%) enrolled ≤100 students per year, whereas 9% (5 departments) taught >500 students per year. The mean was 245 ± 30 (± SE) students.

to 1,200 students per year (Fig. 1). The mean was 245 students per year (± 30 SE).

Prebaccalaureate human physiology was offered as a specific course, separate from anatomy, by 93% of the physiology departments. Twelve percent offered both a combined and a separate course, and seven percent offered only a combined anatomy and physiology course. The frequency with which the prebaccalaureate human physiology course was offered varied from once a year to more than three times a year. Sixty-one percent offered the course once a year, twenty-four percent twice a year, and fifteen percent three or more times per year. Class size was limited by 44% of the physiology departments. The majority of physiology departments limited enrollment to <200 students, giving priority to allied health students. The methods used to limit enrollment are listed in Table 1.

TABLE 1
Methods of limiting enrollment in prebaccalaureate human physiology during 1994–1995 academic year

No. of Students	Priority to Allied Health Majors	Registrar (Class Level)	Academic Performance	Space Limitation	Quota System	Other	Total
0–50	3					1	4
51–100	3			1			4
101–150	2						2
151–200	3			1			4
201–250						1	1
251–300	2						2
301–350		1			1		2
351–400	1		1				2
401–450							0
451–500			1				1
501–550	1						1
551–600							0
601–650		1					1
651–700		1					1
701		1					1
<i>n</i>	15	4	2	2	1	2	26

The number of credits awarded for the prebaccalaureate human physiology course ranged from three to five semester credit hours and from six to ten quarter credit hours. The majority of departments awarded four or five semester credit hours for the course as shown in Table 2.

Twenty-three physiology departments offered a laboratory component; eighteen included credit for a laboratory component in the total course credits, and five offered the laboratory as a separate course. Live animal experiments, video demonstrations, computer-assisted instructions, and computer simulations were used to explain physiological concepts in the laboratory. These results are presented in Fig. 2.

Only six of the departments charged the students a laboratory fee, ranging from \$10 to \$30. The number of allied health programs requiring a laboratory compo-

nent is shown in Table 3. Physical therapy, nursing, and occupational therapy programs required that a laboratory component be included with the course more often than other programs.

TABLE 2
Credit hours offered for prebaccalaureate human physiology during 1994–1995 academic year

Credit Hours	Physiology Departments	
	No.	%
3 (Semester)	13	22
4 (Semester)	20	34
5 (Semester)	17*	34
6 (Quarter)	1	29
8 (Quarter)	2*	2
10 (Quarter)	2	3
No response	4	7

*Credit hour for laboratory included.

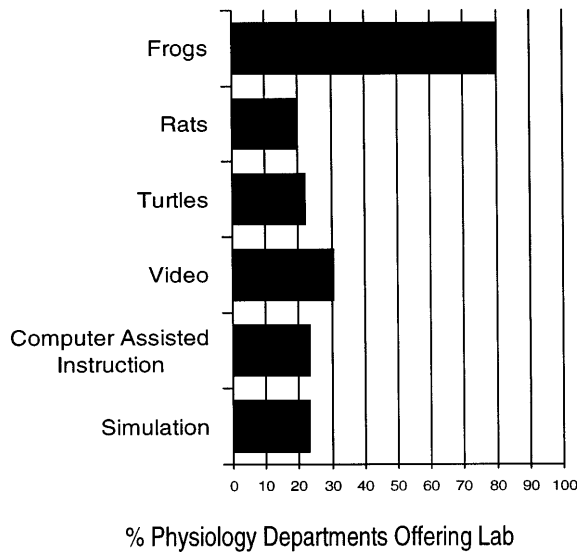


FIG. 2.

Laboratory techniques used to explain physiological concepts during 1994–1995 academic year. Of the responding 59 physiology departments, 23 (39%) offered a laboratory component with the prebaccalaureate human physiology course. In 18 physiology courses, frogs were used to explain physiological concepts, in 6 courses rats were used and in 5 courses turtles were used. In 7 physiology courses, animal video demonstrations of physiological concepts were used, in 5 courses computer simulation was used, and in 5 courses computer-assisted information was used.

Demographics from the 1996 survey revealed that 85% of the physiology departments offered human physiology at the junior/senior class level, and 31% offered both lower and upper class-level physiology courses (Table 4). Whereas the majority of physiology

TABLE 3
Number of prebaccalaureate allied health programs requiring a human physiology laboratory component during 1994–1995 academic year

Programs	<i>n</i>
Physical therapy	14
Nursing	12
Occupational therapy	11
Athletic training	9
Clinical laboratory science	8
Dietetics	8
Premedicine	2
Physical education	2
Radiology	1
X-ray	1
Other	2

TABLE 4
Courses offered in prebaccalaureate human physiology during 1995–1996 academic year

Characteristic	Physiology Departments	
	No.	%
Physiology course level		
Freshman/sophomore	15	47
Junior/senior	27	85
Both levels	10	31
No. of physiology courses offered		
1	17	53
2	5	16
3	6	19
4	2	6
>20	2	6
Types of physiology courses offered		
Human physiology	17	53
Exercise physiology	11	34
Biophysics	2	6
Specific organ systems	2	6

departments offered only one undergraduate physiology course, other departments offered exercise physiology and specific organ systems courses.

Of the responding physiology departments, 86% critiqued the course. The majority solicited student ratings, whereas only 12% included more than one assessment tool to evaluate the course. The methods used by the physiology departments to evaluate teaching effectiveness are presented in Table 5. Student ratings, physiology chair, peer, and allied health program reviews were methods utilized by the physiology departments surveyed. Thirty-one percent of the physiology departments exclusively used the student ratings to assess teaching effectiveness.

The second survey also included criteria to evaluate teaching strategies. In addition to lecture, clinical applications, laboratory experiences, computer-based multimedia instructional materials, and assigned problems or homework were methods utilized. The amount of student contact time for each of these methods ranged from 1 to 8%. These results are presented in Fig. 3.

Methods of assessing student achievement in the course are listed in Fig. 4. All physiology departments assessed student learning by multiple-choice exams, whereas other methods of assessment accounted for 1–7% of the student's total grade.

TABLE 5
Evaluation of teaching effectiveness during 1995–1996 academic year

Method	Physiology Departments	
	No.	%
Mechanism		
Student evaluation	32	100
Individual student comments	30	94
Course-stimulated critical thinking	12	38
Physiology department chair/affiliated dean		
Yearly evaluation	13	41
Course content evaluation	9	28
Physiological concepts evaluation	4	12
Peer/colleague review		
Physiology department faculty	12	38
Allied health faculty	3	9
Allied health programs		
Student success in program	8	25
National accreditation approval	9	28
Course content evaluation	5	16
Physiological concept evaluation	4	12
Syllabus	8	25

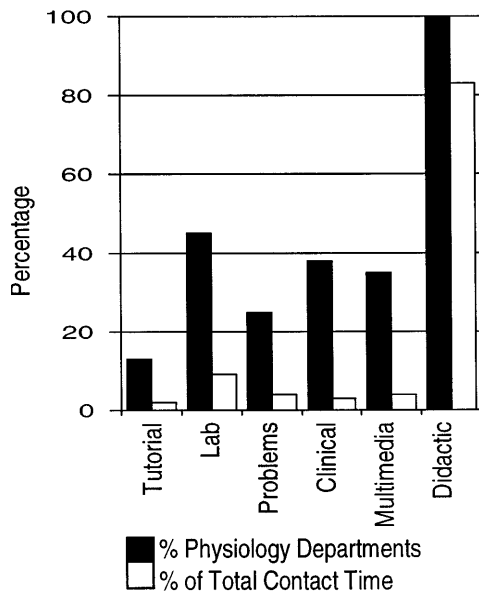


FIG. 3.

Teaching methods during 1995–1996 academic year. In the second survey, all 32 physiology departments utilized the lecture format for presentation of physiological concepts for a total of 81% of student contact time. Nine departments used lectures as the only method of delivery. Of all departments, 38% applied information to clinical situations, 34% incorporated computer-based multimedia instructional materials, and 25% assigned homework.

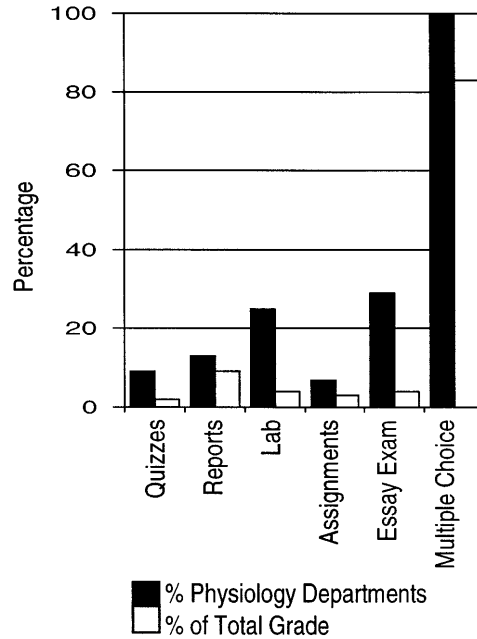


FIG. 4.

Student performance assessment during 1995–1996 academic year. All responding physiology departments assessed student learning by multiple-choice exams for an average of 85% of the total grade. Of all departments, 59% evaluated students' performance based solely on multiple-choice exams, whereas others included assessment methods such as essay exams, assigned problems, in-depth reports, or quizzes. However, these methods used to assess achievement contributed negligibly to the total percentage of the final grade in the course.

DISCUSSION

In the 1994–1995 academic year, 14,185 students were enrolled in prebaccalaureate human physiology courses. Considering this impressive number of students enrolled each year, it is apparent that faculty teaching in these curricula represent a important role models (18). The quality of these instructors' teaching may significantly affect the career choices of many of these students (18).

Almost all of the physiology departments offered prebaccalaureate human physiology as a separate course from anatomy. Sixty-one percent scheduled the physiology course once a year, and sixty-three percent awarded four to five credit semester hours for the course. Thirty-nine percent of the courses offered a laboratory component; the majority used live animals to demonstrate physiological concepts. Only

22% of the departments utilized computer-assisted instruction and video demonstrations.

In addition, the second survey found that 100% of the physiology departments utilized the didactic lecture format for 81% of total student contact time. The incorporation of active learning opportunities into the lecture format, when teaching strategies can be modified, has been reported in the literature (2, 12–14, 16). One question is why physiology teachers are not incorporating other teaching modalities into their courses. Is a lack of formative (improving faculty teaching) evaluation a factor? Self-reflection, student achievement, student ratings, and chair and peer reviews are recommended by teaching strategists to be included in formative evaluations (2, 3, 5, 7, 8, 17, 19).

The use of self-evaluation is as important an aspect in teaching as scholarship (4). John Dewey's description of reflective inquiry not only applies to students' critical thinking processes but also to assess whether the instructor's classroom actions reflect his or her epistemology (6, 7). Developing alternative actions and then monitoring change within the classroom must be an important part of self-evaluation if teachers are to grow/develop in the profession of teaching (3, 5, 19).

Assessment of student learning is a fundamental parameter utilized to evaluate teaching effectiveness. Multiple-choice examinations provided 85% of each student's total grade; however, not all students equally demonstrate competency by multiple-choice examination (2, 9, 11, 15). Because of the increasingly diverse student population, alternative student assessments may include essay examinations, term papers, homework, laboratory experiences, and cooperative learning. However, we do not currently appreciate the degree to which student assessment is being utilized by other disciplines in course evaluation. The limited inclusion of other methods of evaluation of student achievement shows a lack of instructional awareness of the changing enrollment characteristics of undergraduate students.

All physiology departments in the second survey utilized anonymous student ratings as a measure of appraising teaching effectiveness, which corresponds to almost universal usage in the university setting in the United States (5, 19). Limited involvement by

physiology department chairs, peers, and allied health programs is troubling. Students lack the background to provide the evaluative information that the chair, colleagues, and allied health programs can provide. Another limitation is that few students have developed the ability to assess their metacognitive skills, a student's self-awareness about himself or herself as a learner and awareness about strategies that can be used to accomplish academic goals (3, 10). Despite the fact that educational strategists recommend a multifaceted approach for improving teaching in the classroom, only one study has previously addressed evaluation of medical school physiology teaching (4).

CONCLUSIONS

The data presented here highlight the importance of renewed focus on prebaccalaureate physiology education and, furthermore, justify the potential formation of a prebaccalaureate committee within the American Physiological Society that would plan research/pedagogical sessions aimed at those physiologists most involved in undergraduate education. Additional joint seminars with the Human Anatomy and Physiology Society members is also recommended.

Formative evaluation of prebaccalaureate physiology teaching is encouraged. Increased physiology department chair, peer review, self-evaluation, allied health faculty, and program involvement may increase teaching effectiveness and facilitate professional development.

APPENDIX A

University of North Dakota School of Medicine and Health Sciences Physiology Survey

1. Do you offer a human physiology course at the prebaccalaureate level? How often is it offered?
2. Number of credit hours: ____
3. Is it combined with anatomy? ____ yes ____ no
4. At what level of difficulty is the course offered?
____ freshman ____ sophomore ____ junior
5. How many students are enrolled in the course per year?
6. Do you limit the size of the class?
7. If so, how do you determine which student to admit? ____ Quota system (% from each major requiring the course) ____ Average combined academic performance for each major ____ Priority system based upon those students admitted to a major program ____ Limited to specific major only ____ Level of credits earned ____ Other

8. Is a laboratory offered with the class? If yes, is the lab: ___ required ___ optional
9. If optional, is it required for any of the following majors? ___ Athletic training ___ Dietetics ___ Nursing ___ Clinical laboratory science ___ Pre-medicine ___ Occupational therapy ___ Physical therapy ___ Other
10. Is a laboratory fee charged? If yes, how much: ___
11. Is the lab fee charged: ___ student ___ department major
12. Do any of the experiments involve live animals?
13. If yes: ___ frogs ___ turtles ___ rats ___ dogs ___ rabbits ___ other
14. If no, are audiovisual materials and/or computer simulations used as an alternative? If yes, please list.
15. How is the content of the class evaluated? Please comment.

APPENDIX B

University of North Dakota School of Medicine and Health Sciences Physiology Survey

Number of different prebaccalaureate human physiology courses offered per year

Class level(s) for each of the prebaccalaureate human physiology course(s) offered (*specify for each course*)

- ___ Upper level (*junior/senior*)
- ___ Lower level (*freshman/sophomore*)

1. How is each prebaccalaureate physiology course evaluated?
 - Student (*anonymous*) evaluations during the course offering? ___ yes ___ no
 - If yes, answer the next question; if no, go to question 2.*
 - Are the student evaluations in a computerized format? ___ yes ___ no
 - Does it include a section for individual comments? ___ yes ___ no
 - Does it include an evaluation of critical thinking? ___ yes ___ no
 - If no, how is student evaluation of the course's approach to complex thinking processes evaluated?*
2. Yearly evaluation by the Physiology Department chair? ___ yes ___ no
 - If yes, answer the next question. If no, go to question 3.*
 - Does the Physiology chair evaluate course content? ___ yes ___ no
 - Is an evaluation of the presentation of physiological concepts in lecture evaluated? ___ yes ___ no
 - Are the method(s) of presentation evaluated? ___ yes ___ no
3. Is the course evaluated by peer review? ___ yes ___ no
 - If yes, answer the next question. If no, go to question 4.*
 - Is the peer review completed by faculty in the Physiology Department? ___ yes ___ no
 - Is the peer review completed by faculty from Biomedical Science Departments in Medical Schools that offer prebaccalaureate human physiology courses? ___ yes ___ no
 - Comments: _____

Is the peer review completed by allied health faculty that have agreed to participate in the evaluation process? ___ yes ___ no

4. Do allied health faculty for the programs that require the course evaluate the course? ___ yes ___ no
 - If yes, answer the next question. If no, go to question 5.*
 - This evaluation is performed: (*check all that apply*)
 - ___ by allied health faculty assessment of student learning of concepts necessary to perform successfully in their program's courses
 - ___ by reaccreditation approval by the program's national accreditation evaluation
 - ___ by allied health faculty evaluation of the course content
 - ___ by allied health faculty evaluation of the presentation of physiological concepts
 - ___ by allied health faculty evaluation of the syllabus
 - Comments: _____

5. How is the course content presented? (*check all that apply*)

___ didactic lecture	___ % of total contact time
___ clinical correlations	___ % of total contact time
___ computer assisted	___ % of total contact time
___ instructional material	___ % of total contact time
___ assigned questions/problems to hand in for grading	___ % of total contact time
___ lab experiments	___ % of total contact time
___ computer assisted tutorials and study materials	___ % of total contact time
6. How is student performance evaluated? (*check all that apply*)

___ multiple-choice exams	___ % of total grade
___ essay exams	___ % of total grade
___ assigned coursework	___ % of total grade
___ laboratory experiments	___ % of total grade
___ group presentations	___ % of total grade
___ in depth reports	___ % of total grade
___ drop quizzes	___ % of total grade
___ other (<i>please specify</i>)	___ % of total grade

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References

1. **American Physiology Society.** *Institutions Awarding Academic Degrees With a Major in Physiology.* Washington, DC: Am. Physiol. Soc., 1988.
2. **Angelo, T. A., and Cross, K. P.** *Classroom Assessment Techniques: A Handbook for College Teachers* (2nd ed.). San Francisco, CA: Jossey-Bass, 1993.
3. **Braskamp, L. A., and J. C. Ory.** *Assessing Faculty Work: Enhancing Individual Performance.* San Francisco, CA: Jossey-Bass, 1994.

4. **Carroll, R. G.** Professional development: a guide to the educator's portfolio. *Am. J. Physiol.* 271 (*Adv. Physiol. Educ.* 16): S10-S13, 1996.
5. **Centra, J. A.** *Reflective Faculty Evaluation: Enhancing Teaching and Determining Faculty Effectiveness*. San Francisco, CA: Jossey-Bass, 1993.
6. **Dewey, J.** *How We Think*. Lexington, MA: Heath, 1933.
7. **Dewey, J.** *Democracy and Education*. New York: Free Press, 1916.
8. **Glassick, C. E., M. T. Huber, and G. I. Maeroff.** *Scholarship Assessed: Evaluation of the Professional*. San Francisco, CA: Jossey-Bass, 1997.
9. **Jensen, M. S.** Cooperative quizzes in the anatomy and physiology laboratory: a description and evaluation. *Am. J. Physiol.* 271 (*Adv. Physiol. Educ.* 16): S48-S54, 1996.
10. **McKeachie, W. J.** *Teaching Tips: Strategies, Research and Theory for College and University Teachers* (9th ed.). Lexington, MA: Heath, 1994.
11. **Michael, J. A.** Teaching problem solving in small groups. *Ann. NY Acad. Sci.* 701: 37-38, 1993.
12. **Modell, H. I., and R. G. Carroll.** Promoting active learning in large groups. *Ann. NY Acad. Sci.* 701: 49-60, 1993.
13. **Modell, H. I., and J. A. Michael.** Promoting active learning in the life science classroom. Defining the issues. *Ann. NY Acad. Sci.* 701: 1-7, 1993.
14. **Richardson, D.** Using situational physiology in a didactic learning setting. *Am. J. Physiol.* 271 (*Adv. Physiol. Educ.* 16): S61-S67, 1996.
15. **Richardson, D., and B. Birge.** Teaching physiology by combined passive (pedagogical) and active (androgical) methods. *Am. J. Physiol.* 268 (*Adv. Physiol. Educ.* 13): S66-S74, 1995.
16. **Richardson, D. R., and R. G. Carroll.** (Editors.) Active learning in large class settings. *Am. J. Physiol.* 269 (*Adv. Physiol. Educ.* 14): S73-S79, 1995.
17. **Seldin, P.** *How Administrators Can Improve Teaching*. San Francisco, CA: Jossey-Bass, 1990.
18. **Vander, A. J.** The excitement and challenge of teaching physiology: shaping ourselves and the future. *Am. J. Physiol.* 267 (*Adv. Physiol. Educ.* 12): S2-S16, 1994.
19. **Weimer, M.** *Improving College Teaching: Strategies for Developing Instructional Effectiveness*. San Francisco, CA: Jossey-Bass, 1990.