INTERIM DRAFT REPORT OF THE 2007-08 COUNCIL OF FACULTIES
TASK FORCE ON PHARMACEUTICAL SCIENCES AND RESEARCH EDUCATION

TASK FORCE MEMBERS

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CHARGES

1. Assess the degree to which basic pharmaceutical science education in the professional degree program has been compromised or diluted.
2. Make specific recommendations regarding the balance of basic pharmaceutical science knowledge acquisition and the development of scientific reasoning.
3. Make specific recommendations regarding the balance of clinical science instruction and the development of clinical reasoning.
4. Propose an early curriculum solution beyond didactic instruction to ensure students understand the principles of research inquiry.
5. Consider and make recommendations regarding how early research emphasis in the professional degree program may stimulate interest in dual degree tracks to develop clinical scientists.
6. Disseminate findings and recommendations through one or more publications in appropriate professional journals.

Upon the appointment of the Task Force, Sandy Zito and Stephen Cutler met by telephone to discuss the charges and establish a plan for addressing them. It was decided that the charges would be divided among the Task Force Members with either 'Sandy' or Stephen providing oversight.

Charge 1: *Assess the degree to which basic pharmaceutical science education in the professional degree program has been compromised or diluted.*

Team: Eman Atef, Ph.D., Massachusetts College of Pharmacy – Boston, Sudip Das, Ph.D., Butler University College of Pharmacy and Health Sciences and Robert Riggs, Samford University.

Brief Summary:

To prepare this report, an electronic survey (Appendix A) was conducted to identify whether the basic pharmaceutical sciences education in the professional degree program has been compromised or diluted following the switch to the entry-level PharmD degree. The survey was sent to the chairs of pharmaceutical sciences departments in US pharmacy schools/colleges. The questionnaire was divided into demographic questions, questions on where the major modifications of the basic sciences education components were implemented into the program, and questions on the changes in the number of credit hours of didactic teaching and/or labs. In addition, the curriculum of each US school/college of pharmacy was examined by the committee to catalog the number of credit hours devoted to basic and clinical sciences. Finally, the committee audited the past six years of the AACP Roster in order to quantitate the number of faculty in various disciplines employed in US pharmacy schools/colleges. These three instruments were used to address Charge 1 of the Task Force.

From the electronic survey more than half of the department chairs (54%) believe that the pharmaceutical sciences courses have been compromised. The chairs noted a general trend in which there seemed to be less emphasis in the offering of basic science courses. This in turn could impact the scientific background of the students graduating with pharmacy degrees. Along this vein, many of the chairs noted there is declining appreciation by students for topics in the pharmaceutical sciences. Most respondents identified medicinal chemistry and mathematics (calculations) courses as being compromised the most of the pharmaceutical sciences, followed by the topics of pharmacology and pharmaceutics, respectively. Interestingly, this trend is also noted in a survey of the AACP rosters from 2002-present. There has been an increase in the number of pharmacy schools during this period from 88 (full, associate, and affiliate) to 106 (according to ACPE), representing an increase of 19%. The number of basic science faculty teaching medicinal chemistry has increased 14%, pharmacology has increased 14%, and pharmaceutics has increased 12%, while the number of pharmacy practice faculty has increased 29%.

Our task force confirms 15-years of previous reports and articles warning of the declining status of both pharmaceutical sciences education and laboratory research education. [1-4] Based on the studies reported in this section as well as the collective experience of this Task Force, we strongly support the need to maintain an appropriate number of basic science courses, and that current levels are not further reduced. Furthermore, it is imperative that courses in the basic sciences be taught by suitably educated PhD faculty.

Background:

The following historical points and current realities served to frame our task:

- The proportion of content hours in pharmaceutical sciences decreased following the implementation of the entry level Doctor of Pharmacy degree.
- The proportion of schools with large pharmaceutical science research programs has decreased due to many reasons including the number of new schools that have opened in recent years and decreased grant-based funding opportunities.

- There are a growing number of new schools of pharmacy that in general have neither the resources nor the prestige to develop strong pharmaceutical education and laboratory research education programs.
- There has been a decrease in the number of new PhD pharmaceutical scientists, especially those having pharmacy backgrounds.
- In the past six years, the percent increase in the number of pharmacy schools is greater than the percent increase in faculty teaching in the basic sciences.
- The NABPLEX exam moved away from examining basic science knowledge to a more practiced-based exam.

Charge:
Our unified subcommittee was charged with comparing the past and present quantity and quality of pharmaceutical science courses in pharmacy curricula.

Recommendation:
1. The ACPE standards Appendix B should be used as a starting point for AACP to develop quantitative requirements for all of the pharmaceutical sciences. Once defined, AACP should petition ACPE to modify Appendix B with the number of hours required for specific basic science courses.
2. Each school must ensure the number of courses offered in the basic sciences is not reduced from its current level.
3. Courses in the basic sciences must be taught by suitably educated PhD faculty.
4. Schools are encouraged to develop a knowledge-based examination that all students must pass in order to progress from year to year *or* progress from the didactic part of the curriculum to the experiential portion. An alternative course of action would be to have a minimum GPA that students must achieve in the didactic portion of the curriculum before progressing to the experiential section.

Discussion:
Our studies show that since the implementation of the entry level Pharm D degree, there has been a decrease in the quantity and quality of pharmaceutical science courses offered in a number of schools of pharmacy. This is, in part, due to the change in education practices where the desire is to produce a more clinically oriented practitioner, or technician. In one report used for this study, it is suggested that we may have reached a saturation point of over training and under educating our students. [5] In that report, it is noted that preparing students for practice experience doesn't necessary translate into intellectual and thoughtful development. This, in turn, may result in a reduced ability of the graduate to anticipate and adapt to change. Exposure to the basic sciences and research in general is one of the differences between a pharmacist and other health care practitioners. In order for one to be an expert in medication use, it is imperative that the individual have a solid scientific foundation in the basic pharmaceutical sciences. It is through a deep understanding of the chemical properties of pharmaceuticals and their interactions with various biological systems, that one becomes a truly great practitioner.

The development of a clinical practitioner with the skills sets to understand the chemistry, biochemistry, pharmacology, and other basic sciences requires that their education be met by PhD faculty with backgrounds in the respective disciplines. This formally trained teacher has a

unique ability to educate students with a better understanding of how the biological and chemical processes relate to pharmacy. The employment of a PhD faculty, within a specific scientific discipline, ensures a student receives in-depth knowledge about the subject matter.

Charge 2: *Make specific recommendations regarding the balance of basic pharmaceutical science knowledge acquisition and the development of scientific reasoning.*

Team: Kem Kruger, PharmD, PhD, University of Wyoming School of Pharmacy, and Richard Maskiewicz, PhD, Loma Linda University School of Pharmacy

Charge 3: *Make specific recommendations regarding the balance of clinical science instruction and the development of clinical reasoning.*

Team: Marie Chisholm-Burns, PharmD, MPH, FCCP, FASHP, University of Arizona College of Pharmacy, and Allison Bell, PharmD/PhD 3rd Year Student, Mercer University College of Pharmacy

Please note: because charges 2 and 3 mirror each other, the teams assigned to these charges have combined their efforts to submit this joint report.

Brief Summary:

To prepare this report, the literature and the PharmD curricula of several U.S. Colleges/Schools of Pharmacy are being examined. Based on our collective experience as Pharmacy faculty and students, we have come to the following conclusion to date: *although we feel that all curricula should provide opportunities for students to develop and fine-tune scientific and clinical reasoning skills, it is difficult to generically make specific recommendations regarding the target amount or balance of pharmaceutical science knowledge acquisition, clinical science instruction, and scientific/ clinical reasoning (i.e., critical thinking skills), as each curriculum should take into account some institutional flexibility.*

Furthermore, we strongly support that PharmD programs should have a mixture of both scientific and clinical reasoning, pharmaceutical science knowledge acquisition, and clinical science instruction. We also support that there should be greater pedagogical emphasis on activities that challenge students to apply what they learn rather than straight traditional or rote lecture. In addition, good practitioners must be able to apply knowledge, and Bloom's Taxonomy states that the development of intellectual skills progresses through six categories: *knowledge* (the acquisition of facts or concepts), *comprehension* (understanding the meaning of facts or concepts), *application* (using facts/concepts in new situations), *analysis* (breaking down concepts into basic components), *synthesis* (building patterns from essential elements or basic components), and *evaluation* (making judgments about concepts; please refer to the following website for more information on Bloom's Taxonomy: http://www.nwlink.com/~donclark/hrd/bloom.html. Thus, our recommendations will address both the passive (e.g., *knowledge*) and active (e.g., *application*) aspects of learning.

Background:

The following historical points and current realities served to frame our task:

- The proportion of content hours in pharmaceutical sciences decreased following the implementation of the entry level Doctor of Pharmacy degree.
- The proportion of schools with large pharmaceutical science research programs has decreased due to many reasons including the number of new schools that have opened in recent years and decreased grant-based funding opportunities. Thus, teaching assistants are not available to assist with educational activities in all programs. Funding cuts and curricular changes have also decreased educational laboratory availability, resulting in fewer Ph.D.'s graduating in the fields most directly applicable to pharmacy instruction and new drug product development.
- Fewer pharmacy students are going into graduate programs in the basic pharmaceutical sciences (other than pharmacology) following the implementation of the entry level Doctor of Pharmacy degree. As a result, the proportion of non-pharmacist faculty will increase in the basic sciences. Additionally, it is difficult to recruit faculty in certain disciplines such as pharmaceutics so the likelihood increases that instructors in a given area might not have a research background in the area.
- Pharmacy graduates, the product of our educational system, should have good critical thinking skills. Pharmacists who are good critical thinkers typically have a solid knowledge base and strong scientific and clinical reasoning skills.
- Knowledge acquisition and scientific and clinical reasoning are not mutually exclusive; in fact, they are two alternating educational states and are synergistic. Knowledge acquisition traditionally comes first, and is often fulfilled by the traditional lecture format. However, after knowledge acquisition, it is beneficial for the student to have *application* opportunities of the pharmaceutical and clinical sciences that go beyond traditional lecture. These applications should create situations where critical thinking occurs. These situations may be formal (e.g. research experience or homework/in-class activities such as solving technical problems such as deriving, combining, and interpreting equations, determining physical/biological significance of mathematical relationships, and determining therapeutic significance of physical/biological processes) or spontaneous teaching moments that happen in the classroom or laboratory.
- Critical thinking activities and teaching moments enhance and encourage knowledge acquisition. Once students begin to think critically they realize they need additional knowledge. The more knowledge they gain the more they can think about things differently – it is an evolutionary process. Unfortunately, because of the evolutionary process, it is difficult to prescribe a specific balance in knowledge acquisition and scientific/clinical reasoning to meet the needs of each school. The necessary mix of formal and informal critical thinking exercises vary from class to class and school to school depending on the school's recruitment pool and mission.

Charge:

Our unified subcommittee was charged with looking at the balance between pharmaceutical science knowledge acquisition, clinical instruction, and the development of scientific and clinical reasoning skills.

Recommendations:

1. Each school independently or in conjunction with AACP should assess students' knowledge acquisition and critical thinking abilities to determine if students' knowledge acquisition and scientific/clinical reasoning skills are adequate. If problems are identified, then the balance of knowledge acquisition and opportunities to enhance scientific/clinical reasoning skills should be addressed within the individual curriculum based on the schools resources.
2. Curricula should be modified to incorporate active learning strategies designed to enhance scientific and clinical reasoning skills as well as knowledge acquisition, synthesis and retention.
    a. Examples of structural changes include:
        i. Teaching pharmaceutical and clinical science courses in integrated form with case discussions. In this scenario related Pharmacology, Medicinal Chemistry, Pharmacotherapeutics, Pharmaceutics and Pharmacokinetics principles would be taught in tandem. For example, a module on beta-blockers would be taught in Medicinal Chemistry, Pharmacology, Pharmacotherapeutics, and Pharmacokinetics during the same one-week time period. Then, adding a Case Discussion class to incorporate the various aspects of beta-blockers presented in each of the courses in case applications (See Appendix B for an example).
        ii. Developing a pharmacy skills lab which incorporates and applies the principles from clinical and pharmaceutical science courses.
        iii. Developing additional laboratory or applied research courses.
        iv. Combining clinical and pharmaceutical science courses into integrated multidiscipline courses.
        v. Implementing case studies/active learning through problem-based learning (PBL).
    b. Examples of course modifications include:
        i. Weaving case discussions throughout pharmaceutical science (Pharmaceutics, Pharmacology, Medicinal Chemistry, and the Social and Administrative Sciences) and clinical science (Pharmacotherapeutics and Pharmacokinetics) courses.

Two recent papers (and an associated Viewpoint) in the American Journal of Pharmaceutical Education highlight the need for pharmacy students to increase their competence in both "basic pharmaceutical science" and "scientific reasoning". [6-8] Recommendations towards development of additional "critical thinking skills" by offering integrated, multi-discipline 2nd and 3rd year course "modules or blocks", each entailing active learning through group discussions and projects, will strengthen the pharmacotherapeutic competence of both student and practicing Doctors of Pharmacy. The ability of these course blocks to concurrently reinforce the students retention of basic pharmaceutical science knowledge and to employ scientific reasoning as part of critical thinking skills, however remains to be determined.

3. Schools should try to incorporate case discussions/applications and other active learning activities (realizing you can learn facts and concepts though application activities as well as through traditional lecture) with traditional lecture.

***Discussion*:**

Traditionally, enhancement of both knowledge acquisition and development of scientific reasoning skills is achieved by (a) the solving of technical problems (such as deriving, combining, and interpreting equations, determining physical/biological significance of mathematical relationships, and determining therapeutic significance of physical/biological processes) offered as homework, and (b) research experience. The lack of adequate numbers of teaching assistants to grade homework assignments (especially at smaller/newer Schools of Pharmacy) makes this approach difficult. Similar limitations at smaller and/or newer Schools limit the amount of research-based coursework that can be offered. One alternative may be to offer students problem solving exercises within the basic pharmaceutical sciences courses as extra credit, where individuals interested in future teaching or research could acquire additional knowledge and develop additional academically relevant skills.

Development of additional competence in <u>both</u> basic pharmaceutical science knowledge and scientific reasoning may in the future become an even more acute need, especially for PharmD students considering an academic career track. The reason for this is the continued decline in the number of PhD's graduating from Schools of Pharmacy with degrees in core pharmaceutical sciences (other than pharmacology), further reducing the availability of non-PharmD faculty. Suggestions continue to be made that faculty needs may in the future have to be met by hiring Ph.D.'s graduating from departments/programs outside of pharmacy schools, the thought being that "on the job training" within the pharmacy school will be employed for the chemists, biochemists, biologists, etc. being hired as lecturers and researchers in a given pharmaceutical science field. Additional exposure of non-pharmacy PhD faculty to the field of pharmacy education may be accomplished by encouraging them to attend AACP meetings.

<u>Charge 4</u>: *Propose an early curriculum solution beyond didactic instruction to ensure students understand the principles of research inquiry.*

Team: Nathan Shankar, Ph.D., University of Oklahoma College of Pharmacy and Chandradhar Dwivedi, Ph.D., South Dakota State University College of Pharmacy.

Brief Summary:

To prepare the report on this charge data was gathered using Task Force Members experiences at our respective institutions and with feedback from colleagues at select peer institutions. We were able to conclude that it would not be too difficult to incorporate experiences in students' education that would expose them to principles of research inquiry. In addition, we strongly support that PharmD programs provide these experiences in their instruction. This would allow for the development of practitioners with skills that follows Bloom's Taxonomy (as stated above in Charge 2 and 3).

Charge:

Our subcommittee was charged with proposing an early curriculum solution that ensures students understand the principles of research inquiry.

Recommendations:

It was determined that the following opportunities should be made available to students, which would facilitate their understanding of research inquiry principles.

1. Exposure to the research performed by faculty members either through attendance at a specially organized Research Awareness Program, seminars or through participation in a specific mentored research project.
2. Availability of a research elective (Independent Study, Research Problems, etc.).
3. Attendance at research seminars presented by distinguished faculty and invitees to the college or campus.
4. Participations and recognitions at college/campus Research Day.
5. Structured Summer Research Programs with stipends.
6. Collaboration with student organizations and graduate students.
7. Early exposure to dual-degree programs such as PharmD/MS and PharmD/PhD.

Charge 5: *Consider and make recommendations regarding how early research emphasis in the professional degree program may stimulate interest in dual degree tracks to develop clinical scientists.*

Team: Chris Destache, PharmD, Creighton University School of Pharmacy and Health Professions, Edward Roche, PhD, University of Nebraska Medical Center College of Pharmacy, Allison Bell PharmD/PhD 3rd Year Student, Mercer University College of Pharmacy.

Brief Summary:

In May 2006, a survey was sent out to members of AACP and reported by Murphy, *et al*.[6] The content of the manuscript, which was published in the *American Journal of Pharmaceutical Education*, was used to address this particular charge of the Task Force.

Murphy et al. surveyed 88 colleges and schools of pharmacy [6], identified from *The Roster of Faculty and Professional Staff* of the American Association of Colleges of Pharmacy.[9] Their survey was sent to Deans of the institutions or to another appropriate person within their school/college for participation. The questionnaire requested information in four areas including formal research-related coursework, required student research experiences, other research-related courses, and perceptions of student-conducted research. The results of this survey showed an 88% response rate. Most colleges required some coursework in statistics (91%) and drug information/literature evaluation (94%), while 53% of the schools/colleges surveyed required research methods.

Required research experiences were used at 25% of pharmacy schools/colleges. An additional 45 colleges (57%) offered elective research experiences. Also, 14 colleges did not provide any

research opportunities. Of the 20 colleges that required some form of a research project, 12 (60%) also offered elective research opportunities. Colleges offering an elective research experience were more likely to be public, while those requiring some form of research experience were more likely to be private.

A total of 15% (20) of colleges/schools of pharmacy required students to conduct the component of a complete research project. These included development of a research proposal and/or submission to an institutional review board (IRB), collection and analysis of the data, and preparation of a written report and/or present/defend their findings at the college level or beyond. Seven of the 20 required all components of this process, 3 required all but a written report but did require presentation of the results. One required all but a presentation and one required all but IRB submission and presentation of results. The remaining 8 programs required some form of project, 4 required only a written proposal, 2 required a proposal and IRB document preparation, and 2 required a written proposal and presentation of the proposal.

Of interest, the number of students enrolled was not related to whether the college required a complete project nor had elective research experiences. Twelve (60%) utilized a letter grading system for this and 7 utilized a pass/fail system. College faculty members (80%) served as project advisors for most required student research experiences. However, 10 (50%) colleges also used external faculty members (i.e. preceptors) or non-college faculty members within the university.

A wide variety of required data collection and analysis were commonly allowed to collect data from chart reviews, surveys, databases, interviews, clinical measures, laboratory procedures, and direct observation. Most respondents (94%) indicated that they had made no changes in student research experiences in the last 5 years. Of note, 2 colleges/schools eliminated required projects due to increasing class size and faculty opposition (1 changed from a research requirement to an elective) and five respondents indicated that their colleges were considering implementation of a required research project.

Few students take advantage of elective student research experiences. Seventy-eight percent with elective experiences estimated that less than 10% of students participated in these opportunities.

The benefits of required research projects (regardless of whether the colleges required them) according to the respondents (n=18) is related to the opportunity for increased learning, improved critical thinking skills, and improved ability to use the literature. Philosophical responses were the second most common comment. These include the belief that those who graduate with a doctorate should have some understanding of research and the foundations of evidence-based medicine. Preparation for postgraduate training and to become future faculty members was also a large component of the responses.

Disadvantages of required research projects identified by 19 respondents was the issue of resources, lack of faculty time for mentoring, lack of space in the curriculum for a student project, and faculty members inadequately trained to mentor student research. Five respondents

were in opposition to requiring a research project and stated that this training should be research for graduate programs.

Summary:

It appears from this recently reported survey that the amount of elective research opportunities that are being offered to Doctor of Pharmacy students is adequate, yet students are not taking advantage of this opportunity.

The amount of required research experience in schools/colleges of pharmacy is limited due to lack of both curricular-time and faculty support.

The schools/colleges of pharmacy that do not provide research experiences may be limiting student experiences in pharmaceutical education.

Recommendations:

1. Colleges and schools of pharmacy should explore elective course development to introduce students to research in pharmaceutical and clinical sciences.
2. Colleges and schools of pharmacy should explore ways to encourage students to participate in elective research courses and experiences.
3. Colleges and schools of pharmacy should explore incentive mechanisms to encourage faculty to participate as mentors in research oriented elective courses and.
4. Deans of colleges and schools of pharmacy should explore ways to fund students in summer research projects, or provide travel grants for students to attend a regional or national research meeting to present their research results.

Charge 6: *Disseminate findings and recommendations through one or more publications in appropriate professional journals.*

Team: All Members of the Task Force

As the Task Force enters into the final stages of their charges, a white paper or other type of publication for the dissemination of our findings will be completed.

References:

1. K. Skau. Pharmacy is a Science-based Profession. *Am. J. Pharm. Ed*., 2007, 71(1), 11.

2. C.T. Ueda. Chair Report for the Research and Graduate Affairs Committee. *Am. J. Pharm. Ed*., 1993, 57, 25S-29S.

3. K.S. Winans and S. Madhavan. Some factors influencing undergraduate pharmacy students' perceptions of and attitudes toward research related activities. *Am. J. Pharm. Ed*., 1992, 56, 29-35.

4. M.C. Nahata. Clinical Research in the Pharmacy Academy. *Am. J. Pharm. Ed*., 2002, 66, 84-85).

5. A.P. Lemberger. The pharmaceutical sciences as academic disciplines. *Drug. Intell. Clin. Pharm*.,1988, 22, 807-812.

6. J. Murphy, M. Slack, K. Boesen and D. Kirking. Research-related Coursework and Research Experiences in Doctor of Pharmacy Programs. *Am. Jour. Pharm. Ed*., 71(6), 2007, Article 113.

7. V. Roche. Improving Pharmacy Students Understanding of Long-term Retention of Acid-Base Chemistry. *Am. Jour. Pharm. Ed*., 71(6), 2007, Article 122.

8. F. Ascione. Viewpoint: Research Requirement for PharmD Students. *Am. Jour. Pharm. Ed*., 71(6), 2007, Article 115.

9. AACP Roster of Faculty and Professional Staff 2005/2006. Alexandria, VA. American Association of Colleges of Pharmacy.

Appendix A: Survey to Assess Basic Science Education

Survey of Chairs of Basic Science Departments of Schools/Colleges of Pharmacy to assess whether the pharmaceutical sciences courses have been compromised or diluted.

1. Your affiliation was founded
    a. 1-10
    b. 10-20
    c. 20-30
    d. More than 30 years

2. Number of years of experience you have in teaching pharmaceutical sciences courses in a pharmacy institution
    a. 1-10
    b. 10-20
    c. 20-30
    d. More than 30 years

3. The number of students enrolled in your program
    a. Less than a 100 students
    b. 100-200 students
    c. 200-300 students
    d. More than 300 students

4. Do you believe the pharmaceutical sciences courses have been compromised?
   YES NO

5. When was the last major curricular change implemented in your institution?
   a. 1-10 years
   b. 10-20 years
   c. 20-30 years
   d. I don't remember any changes since I joined the school.

6. How many credit hours of DIDACTIC courses do you have in the following disciplines in your institution? Only consider the professional curriculum.
   a. Pharmacology/Biological sciences
   b. Medicinal Chemistry
   c. Pharmaceutics/Pharmacokinetics (including clinical pharmacokinetics)

7. Ideally, how many credit hours of DIDACTIC courses do you believe you should have in the following disciplines in your institution? Consider professional curriculum only.
   a. Pharmacology/Biological sciences
   b. Medicinal Chemistry
   c. Pharmaceutics/Pharmacokinetics (including clinical pharmacokinetics)

8. How many credit hours of LABORATORY courses do you have in the following disciplines in your institution? Consider professional curriculum only. Consider a three hour lab per week corresponding to one credit for your calculation if the lab credits are considered ZERO in your institution.
   a. Pharmacology/Biological sciences
   b. Medicinal Chemistry
   c. Pharmaceutics/Pharmacokinetics (including clinical pharmacokinetics)

9. Ideally, how many credit hours of LABORATORY courses do you believe you should have in the following disciplines in your institution? Consider professional curriculum only. Consider a three hour lab per week corresponding to one credit for your calculation if the lab credits are considered ZERO in your institution.
   a. Pharmacology/Biological sciences
   b. Medicinal Chemistry
   c. Pharmaceutics/Pharmacokinetics (including clinical pharmacokinetics)

10. In your institution, what do you think are the major areas the pharmaceutical sciences courses deficient? What would be the impact of this deficiency on the skill and knowledge of the pharmacy graduates?

11. Did the number of graduate students in the following fields increase, decrease or remain unchanged?
    a. Pharmacology/Biological sciences
    b. Medicinal Chemistry

c. Pharmaceutics/Pharmacokinetics

12. Do you have a general comment?

Appendix B: A Case Example

One method for introducing more active learning into pharmaceutical and clinical sciences classrooms is found in the attached theoretical PharmD curriculum (see Table below). In this program, 2nd year students have Pharmacology for 4 hours and Medicinal Chemistry for 3 hours during the 1st semester, as well as a weekly Case Discussions (Pharm 822) course that incorporates principles of both Pharmacology and Medicinal Chemistry. An example of source material for case discussions: Currie BL, Roche VF, Zito SW. *Medicinal Chemistry Case Study Workbook*. Williams & Wilkins; 1996. During the 2nd semester of the 2nd year and the 1st and 2nd semesters of the 3rd year, students have Pharmacotherapeutics for 6 hours. Each week in Pharmacotherapeutics, 2 to 3 hours of class time is devoted to active learning activities such as case discussions. Additionally, 3rd year students have Pharmacokinetics for 4 hours during their 1st semester. During that semester, they also have a weekly Pharmacokinetics Discussion course (Pharm 808a) which is more of an applications course (involving case discussions and clinical debates) that incorporates principles of Pharmacokinetics. Similarly, during the 2nd semester of the 3rd year, students have a Clinical Pharmacokinetics course and a weekly Pharmacokinetics Discussion course to apply knowledge acquired in Clinical Pharmacokinetics.

Example of a PharmD Program Employing Active Learning

Second Professional Year

First Semester (16 units)

Course	Units
Pharm 822 - Case Discussions	1
Pharm 845 - Medication Use in Health Care Systems	3
Pharm 861B - Research Design Considerations	2
Medc 837A - Medicinal Chemistry	3
Pcol 871A - Pharmacology	4
Pcol 836A - Chemotherapy of Infectious Diseases	3

Second Semester (19 units)

Course	Units
Pharm 861C - Drug Info., Literature Evaluation	2
Pharm 875A - Pharmacotherapeutics	6
Medc 837B - Medicinal Chemistry	2
Pcol 871C - Pharmacology	3
Tox 874 - Clinical Toxicology	2

Pharm 812A - Non-Prescription Medications and Devices	2
Electives	2

Summer Second Professional Year (optional)

Course	Units*
Required Rotations (optional at this point in the curriculum)	5-10
Pharm 803A - Community Pharmacy Practice	
Pharm 803B - Institutional Pharmacy Practice	

Third Professional Year

First Semester (17 units)

Course	Units
Pharm 895B - Prep. for Rotations	1
Pharm 875B - Pharmacotherapeutics	6
Pharm 807 - Pharmacokinetics	4
Pharm 808A - Pharmacokinetics Discussion	1
Pharm 842 - Prof. Practice Mgmt.	3
Electives	2

Second Semester (16 units)

Course	Units
Pharm 875C - Pharmacotherapeutics	6
Pharm 843 - Pharmacy Laws/Ethics	2
Pharm 885 - Clinical Pharmacokinetics	3
Pharm 808B - Pharmacokinetics Discussion	1
Pharm 862 - Writing a Proposal for a Scientific Study	2
Electives	2