# Task Force on Redesign of the Preclerkship Curriculum: Status Report, December 2013

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## Appendix

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I. Executive Summary

No sooner had we completed a cycle of medical education reform in the middle of the previous decade than faculty task forces began to focus on better ways to teach and learn in an environment of generational changes in the way students engage, resulting in a mismatch between the way teachers teach and students learn. An important theme emphasized by the Task Force on Classroom Learning was that the development of long-term memory and the ability to summon information for problem solving should be a central tenet of the MD curriculum, and this requires linkage of new knowledge to prior learning and the placement of new knowledge in a conceptual framework that gives it meaning.

With these issues in mind, and given the wave of pedagogical innovation emerging at other medical schools, new medical schools, as well as Harvard and other universities, the Program in Medical Education (PME) leadership concluded that now is the ideal time to conduct a comprehensive review of the preclerkship curriculum—what we teach (what basic/population science content is required to prepare for clinical work); when we teach it (organizational framework); how we teach it (introduction of novel pedagogy that fosters critical thinking and that creates an interactive classroom environment, rather than passive transfer and cataloguing of information); who teaches (content experts versus pedagogy experts); where we teach (more flexible learning spaces to accommodate novel pedagogic principles); and how to assess both students and the changes we make. Hence, at the time of the PME annual medical education leadership retreat in June 2012, Harvard Medical School (HMS) launched a Task Force on Redesign of the Preclerkship Curriculum to address these considerations, to reflect profoundly on our education goals and mission, and to develop a new curriculum whose product is physicians who think and reason critically, that renews and reinforces the excitement of learning, and that inspires students.

The Task Force began meeting during academic year 2013 (AY13) and, during the first half of the year, generated a vision for a new approach to the preclerkship curriculum that would change the way we organize the curriculum, transform the way we engage students inside and outside the classroom, and realize our vision of a truly integrated curriculum based on innovative pedagogy. Beginning in February 2013 and continuing through the second half of AY13, a series of Task Force subcommittees translated, refined, and developed a more granular expression of that vision. These subcommittees focused on Content and Organization (what should be taught, how should the curriculum be organized); Clinical Skills (a new, more relevant model that exposes students early to professional modeling of the physician-patient experience, especially in interdisciplinary practices of the future); Pedagogy (innovative pedagogy, the role of the lecture, interactive experiences, “flipped” classroom, ideal learning-group size, team-based learning, who should teach—content experts, pedagogy experts, both?); Milestones/Assessment (longitudinal, integrated assessment that reinforces learning; balance between safe learning environment and higher expectations and accountability); and Learning Space (space configurations and technology needs to accommodate pedagogical innovation).

In June 2013, these subcommittees presented their recommendations at the annual PME Medical Education Retreat. Two major themes gained traction, enthusiasm, and excitement:

**Innovative Pedagogy:** The new vision is based on more interactive approaches that foster active learning and critical thinking: a shift from superficial, fragmented “surface” learning to integrated, coherent, problem-based “deep” learning; to classrooms for interactive reasoning rather than conveying content passively; to the “flipped” classroom model; from the rigidity of large classrooms and small-group problem-based learning tutorials to experimentation with different interactive group sizes and principles of team-based learning; and to a better balance between a safe learning environment, on the one hand, and higher expectations and student accountability for their own
learning, on the other. A learning sequence comprising self-study, team-study, group learning and reflection was proposed as the foundation of the new teaching approach. A directed self-learning model will help students develop the skills to identify—and devise strategies to remedy—their own learning gaps. During the previous two years, many of these principles were expressed in pilot projects by course directors, and new, experimental teaching spaces were designed and brought online to support experimentation with these new pedagogies.

**Integrated Preclerkship Organization:** The Task Force formulated guiding principles for an organizational schedule of the preclerkship curriculum: 1) Students should be given more time to digest biological science material; 2) integration of biological and clinical science should be made explicit; 3) social and population science courses should be timed as immersion intersessions; 4) a seminar on discovery of science should be a core course; 5) the curriculum should be punctuated by periodic integrated, cumulative assessment experiences; and 6) study time should be allocated for national boards and timed to be less distracting to learning in preclerkship courses. After reviewing organizational approaches to the preclerkship curriculum at other schools (e.g., organ-system-based modules, thematic models that supersede disciplinary boundaries), the guiding principles articulated during their deliberations, and barriers encountered within our own curriculum, the Task Force arrived at a consensus model of introductory “foundations” (basics of anatomy, histology, embryology, biochemistry, molecular and cellular biology, neoplasia, genetics, immunology, introductory pharmacology concepts [e.g., receptor biology], “discovery in science”) followed by integrated organ-system-based modules that combine structure/function and normal/abnormal for each system (anatomy, histology, embryology, physiology, pathophysiology, pathology, pharmacology, imaging, nutrition). In addition, instead of our current very short blocks, longer modules during which complementary organ systems are taught simultaneously in longer parallel blocks (e.g., cardiovascular and respiratory) were proposed. This approach leverages such complementarity between organ systems to migrate towards thematic models: support of aerobic metabolism, homeostasis 1 (cardiovascular, respiratory, hematology); food, water, mineral metabolism, maintenance of internal balance, homeostasis 2 (gastrointestinal, renal, endocrine/reproductive); nervous system and behavior; and immunity in defense and disease (dermatology/rheumatology/systemic immune-inflammatory diseases).

An even more radical departure from the current curriculum, which has generated substantial enthusiasm, is a plan to integrate the entire curriculum more seamlessly in a way that creates a more meaningful “just-in-time” learning model.

The subcommittee on content and organization offered a proposal for a distribution of the basic and population sciences between a shortened preclerkship period and a longer post-Principal Clinical Experience (PCE) period. The core basic/population science needed to succeed in clinical clerkships would be taught prior to the core clinical year, while the richness of more advanced science that is best suited to students after they have had clinical ward experience would be taught following completion of the core clinical clerkships. Therefore, in the preclerkship year, “Foundations” and organ-system blocks would focus on the core basic and population science principles absolutely necessary to prepare for the core clinical clerkships. After the intellectual transformation that occurs during the core clinical year, students will be more receptive to courses in advanced scientific and clinical topics; required and/or selective courses in organ-based pathophysiology; selective courses in basic/ translational science, social/population science, and medical humanities; individual, faculty- mentored scholarly projects; clinical electives and subinternships; and Steps 1 and 2 of the national boards. This structure would allow for earlier clinical exposure (Year II); and reinforce more advanced, student-tailored basic/population science (during Years III and IV) that is better suited for students after the PCE. For these advanced courses, students’ actual patient encounters would be incorporated, reinforcing and building upon prior knowledge, modeling the relevance of basic science to clinical medicine, and achieving better-integrated learning. This plan also eliminates the
distraction of preparation for Step 1 of the national boards during the preclerkship curriculum by moving Step 1 to the third year (after the clinical year and early advanced courses/clerkships) and allows for more individualized learning, a dedicated and better-timed scholarship block, and selective choices of advanced topics based on clinical interest.

Thus, after the completion of the PCE, students would embark on a more meaningful, rigorous, relevant, and structured post-clerkship experience, during which clinical and basic science advanced electives would be comingled and during which students could engage more deeply in their scholarly projects. This proposal allows students to revisit basic/population science, after they have had clinical seasoning and to go beyond the “basics” to inspirational, cutting-edge content (that does not resonate when taught currently prior to clerkships); moreover, the basic/population advanced elective or selective courses could be tailored to students’ career choices. The scholarly project, which could begin in Year III and extend into Year IV, would be undertaken when students are more developmentally ready and more mature, after they have been exposed to substantially more curriculum content, including all the preclerkship and clerkship disciplines, and when they have a better idea of what their chosen discipline might be. In short, the initial focus on the preclerkship curriculum was replaced by a unified vision of the entire four-year curriculum that would be better integrated and developmentally more appropriate for learners.

The recommendations of the Task Force Subcommittees were endorsed at the PME Medical Education Leadership Retreat in June 2013, and these plans have been well received by other HMS leadership groups. Small design teams have been constituted to develop detailed plans for the content and duration of “Foundations” as well as the organ-system blocks and population science courses for the new preclerkship curriculum. Their reports are anticipated by February 2014, after which feedback from the HMS community will be solicited. The rest of the 2014 academic year, extending into AY15, will be devoted to designing the new preclerkship courses and early planning for the basic/population courses to be offered in the post-PCE, Year-III curriculum; AY15 will also be devoted to detailed designs for the new clinical skills course and for the design of longitudinal assessment. Faculty development programming for the novel approach to pedagogy is a high priority for the Academy in both AY14 and AY15, and planning work with an academic architectural firm has already begun on alterations to the Tosteson Medical Education Center that would be needed to accommodate new learning spaces. As currently envisioned, implementation of Year I of the preclerkship curriculum will begin for the class entering in August 2015 (AY16), and the design of new postclerkship courses will be completed for implementation of Year III of the new curriculum in AY18.

II. Rationale and Charge

During the Medical Education Reform Initiative (MERO) that preceded the implementation of the New Integrated Curriculum in August 2006, a substantial effort was focused on a redesign of the clinical curriculum. In the preclerkship years, most of the basic biological science courses were retained; some courses were abbreviated somewhat; pharmacology was shortened and moved to the beginning of Year II from the winter of Year I; a few topics were reassigned to different courses; and a set of new population/social science courses and a new Human Development course were introduced. The basic biological science courses were felt to be robust and not in need of major revision; therefore, instead of redesigning these courses or the way they were organized and structured, efforts were invested in coordinating content across courses and in leveraging dialogue among course directors to integrate concepts both horizontally and vertically within the preclerkship Fundamentals of Medicine portion of the curriculum and to explore the use of more consistent teaching methods.

Another necessity of curriculum reform during the previous decade was a truncation of the time devoted to the preclerkship courses (to accommodate the new Principal Clinical Experience [PCE] and the Scholarship in Medicine program), evolving from ending in May to ending in March of Year
II. For many of the preclerkship courses, course structure and content remained relatively static, while most courses were required to reduce approximately 10% of content to meet the new, leaner schedule.

As soon as the New Integrated Curriculum was introduced, our faculty engaged in task forces to evaluate the way we teach introductory clinical skills and to reconsider our approach to classroom learning in the lecture hall, the tutorial room, and the lab. To teach clinical skills, a more integrated Year-I-II course that combines PD-I and II and that adds longitudinal ambulatory experiences was proposed. In large and small group teaching sessions, i.e., lectures and tutorials, more interactive approaches that foster critical thinking were proposed and piloted, and new, experimental teaching spaces were designed and brought on-line. At the same time, generational changes in the way students learn, engage with faculty and course content, and rely on digital resources contributed to a degradation of the learning environment, creating an imperative to consider innovative approaches.

While HMS considered its approach to organizing and teaching preclinical courses, many of our peer schools adopted innovative and forward-looking preclerkship curricula. In addition, many of the new medical schools established during the last decade collaborated on the design of the most innovative approaches to medical education, including a complete integration of preclinical and clinical curricula. Finally, the Harvard Initiative on Learning and Teaching (HILT) has engaged all the schools of the university in the introduction and acceleration of innovative pedagogy. With all this curricular foment and innovation surrounding us, in June 2012, Harvard Medical School initiated a comprehensive review of what we teach, when we teach, how we teach, who teaches, where we teach, and how we assess our students’ learning.

Therefore, following the Program in Medical Education Annual Leadership Retreat in June 2012, a Task Force on Redesign of the Preclerkship Curriculum began to address the following questions:

- What knowledge and skills (including basic and population sciences fundamental to the study and practice of medicine) should our students acquire to be prepared for the clinical experiences in the PCE?
- How should the requisite material be organized and taught?
- Should we consider incorporating more realistic interdisciplinary approaches rather than our more discipline-based courses?
- Should we continue to rely on multiple faculty members who are experts in narrow domains, or would students be better served by a cadre of core teaching faculty who have broader content expertise and who place additional emphasis on the best pedagogy?
- How much emphasis should be placed on amassing content versus acquiring a scholarly approach to independent learning and team learning?
- How can we change the “culture” of HMS in the preclerkship curriculum to enhance further our students’ curiosity and diminish the perception of medical education as memorization of minutiae and facts?
- How can we do even better at making the preclinical sciences more relevant to the learning of clinical medicine?
- How best do we promote persistence of knowledge, skills, and behavior in the way we teach/assess in the preclerkship curriculum?
- What milestones should students achieve at various key points in the preclerkship curriculum, and what are the ideal domains for assessment?
- How should we adopt and deploy new learning technologies that address the generational change in the way students engage and learn?
How should we be teaching preclinical sciences at a time when access to, processing of, and analysis of information trump absorption of information; when the team is held more accountable than the individual; when technology is transforming the way we obtain information and learn; and when current teaching approaches, not having kept pace with contemporary understanding of effective pedagogy, fall short of addressing the needs of learners?

What should distinguish HMS preclerkship education?
What general qualities should distinguish graduates of HMS?

In addition, the Task Force was committed to addressing the following themes:

- Integration of basic science and clinical medicine;
- Development of skills in critical thinking and clinical reasoning ("deep" learning over "surface" learning);
- Development of clinical skills ranging from communication to physical diagnosis, to value-added, patient-centered, team-based care, to the ability to assess and foster systems of care that support quality and patient safety, and that prepare students to enter the PCE;
- Development of humanistic, empathic physicians capable of self-reflection;
- Support of the highest intellectual, personal and professional standards among faculty and students;
- Promotion of scholarship through a curriculum that inspires students.

The Task Force was chaired by Richard Schwartzstein, MD, director of the first-year FOM course, Integrated Human Physiology, and of the HMS Academy, and co-chaired by Melanie Hoenig, MD, director of the second-year Human Systems-Renal course, and composed of faculty leaders from preclerkship basic science, population science, and clinical skills courses; leaders of clinical clerkships and the PCE; senior faculty at large; senior students; and faculty/staff leaders of evaluation, of pedagogical innovation, and of information technology (see attached membership list, Appendix A, and more detailed list of charge guiding questions, Appendix B).

III. Task Force Statement of Principles, Vision, and Values

Between October 2012 and January 2013, the Task Force reviewed new models of medical education at other medical schools and developed an overall vision for the direction and design of a new preclerkship curriculum. In January 2013, the Task Force issued a statement of its principles, vision, and values:

A. Statement of Problem/Rationale for Preclerkship Curriculum Change

We need a curriculum that can address the
- Rapid growth in medical knowledge;
- Advances in technology that reduce the time needed to access information and increase the range of topics/content that can be obtained within seconds to minutes;
- Mismatch between the current generation of teachers and learners and the implications for pedagogical techniques that engage students;
- Increasing need for performance of teams as learners and as providers of care;
- Increasing need to support/develop skills and attitudes that are necessary for life-long learning;
- Challenges in achieving integration of knowledge across disciplines;
- Importance of reinforcing cohesive common themes;
- Challenges of having an adequately prepared, highly committed group of faculty to support the curriculum;
Increased focus on medical errors and cognitive processing that would diminish errors and improve patient safety; and
Maintenance of longitudinal faculty-student and mentor-student relationships.

B. Organizing Principles of New Curriculum

The new curriculum will...

- **Inspire** our students to pursue excellence as competent, curious, caring physicians;
- **Enhance integration** among the basic biological, social and population sciences; and between the basic and clinical sciences while reinforcing the importance of scientific rigor;
- Enhance development of **life-long learning** by focusing on student acquisition of content/knowledge, skills, attitudes, and principles of self-reflection via self-study in team-based activities with the assistance of a variety of learning resources that accommodate the heterogeneity of learning styles;
- Enhance development of **critical thinking** by focusing on the processing of information to support higher order cognitive tasks, i.e., evaluation, synthesis, analysis;
- Enhance **durable learning and personal accountability** with assessment/evaluation activities that foster learning, that address cumulative knowledge and skill development, and that are structured as multifaceted exercises to examine content as well as thinking skills with a focus on application of knowledge to solve problems;
- Rely on **innovative, effective and efficient pedagogic models** that are student-centered and engaging, that model creativity and scholarship, that renew/reinforce the excitement of learning, that are adaptive and flexible, and that draft off the level of Harvard University-wide curricular foment captured by the Harvard Initiative in Learning and Teaching (HILT);
- Raise the level of **scientific rigor and clinical relevance**; and
- **Promote inquiry and scholarship** while providing our students with the skills needed to be leaders of teams and in their fields to enable them to catalyze innovation in all dimensions of medicine by being agents of change.

C. Values Embedded Within the New Curriculum

In developing a curriculum, we will be guided by the following values:

- **Student centeredness**
  - Preparation for future careers as clinicians, educators, and/or scientists
  - Active learning
  - Flexibility to incorporate different learning styles, venues, and class sizes
  - Liberation of creativity
  - Fostering and supporting a culture of curiosity and inquiry
  - Achieving an appropriate balance between a safe learning environment and high expectations for scholarship and professionalism
  - Creation of assessments that enhance learning
  - Creation of opportunities for students to develop mastery of material

- **Patient centeredness**
  - Early clinical experiences
  - Longitudinal patient experiences
  - Supporting and modeling value added, team-based care
  - Supporting and modeling humanistic, empathic care

- **Disease-themed emphasis**
• Highlighting important diseases/disorders that re-emerge as longitudinal threads throughout the curriculum and that foster the reinforcement of biological science and population science principles

• Commitment to Community and Society
  o Respect for and understanding of diverse patient populations
  o Providing care within a social and system context

• Commitment to Excellence
  o High standards; mastery of material
  o Performance-based assessment linked to developmental milestones
  o Uniformity of rigor across small-group learning sites (tutorials, clinical sites, etc.)
  o Application of a continuous quality improvement mindset to further refinements of curriculum

• Commitment to Professionalism
  o Embedded in all courses and activities
  o Mentoring and modeling

• Commitment to Life-long Learning
  o Self-directed learning that incorporates reflection and self-assessment
  o Developmental, stepwise complexity
  o Team learning and problem-solving
• **Appropriate use of technology** to enhance the educational experience
  - Innovative, forward-looking pedagogy
  - Incorporation of skills/learning labs
  - Clinical Skills Center with simulation
  - On-line resources
  - Question banks

• **Partnership between Faculty and Students**
  - In teaching and learning
  - In scholarly inquiry
  - In a culture of intellectual discourse

**IV. Task Force Subcommittee Charges**

Once a broad vision for the new curriculum was articulated, Task Force Subcommittees were convened (including original Task Force members plus expanded membership, Appendix C) to meet in the spring and early summer of 2013. The subcommittees were charged as follows:

**Content and Organization**
- What should be taught (what content is truly relevant and necessary for learning clinical medicine)?
- How should the requisite content be organized and taught (discrete courses versus interdisciplinary thematic modules; normal followed by abnormal biology versus integrated normal-abnormal biology organized by organ systems)?
- Who should teach (content experts, pedagogy experts, a combination of both)?

**Clinical Skills**
- How can we introduce a more relevant model for teaching clinical skills during the preclerkship curriculum?
- How can the new model for teaching clinical skills (including early longitudinal ambulatory experiences, modeling of professional behavior, and functioning in teams) form a scaffold for integrating and assessing the teaching of basic biological and social sciences?
- What is the best preparation for the clinical immersion experiences of the Principal Clinical Experience year?

**Pedagogy**
- What novel pedagogic approaches should be considered to foster critical thinking, to replace or supplement traditional lectures, tutorials, and laboratory exercises?
- What should the role be of lectures, and should all large-group sessions be modeled on an interactive “flipped classroom” design?
- What is the ideal class size for interactive learning?
- How can we incorporate the benefits of team-based learning?
- How can we deploy advanced digital tools and technology to enhance learning in the classroom and the laboratory?

**Milestones/Assessment**
- How can we foster longitudinal student assessment across the preclerkship curriculum to enhance learning and teaching?
- How can we adopt a more integrated, comprehensive assessment process that integrates and reinforces learning developmentally?
• How can we achieve balance between a “safe” learning environment on the one hand and high expectations (accountability of the individual and the team) for scholarship and professionalism on the other?
• What milestones should students achieve at various key points in the preclerkship curriculum?
• Should we incorporate intersessions to review, consolidate, and assess formatively achievement of milestones?

Learning Space
• What are the learning/teaching space configurations and technology needs to address the recommendations for pedagogical innovation?

Between September 2012 and June 2013 (AY13), a parallel programming study of the learning space on the HMS quadrangle, specifically, the Tosteson Medical Education Center (TMEC), was conducted with CO Architects, an architectural firm that has extensive experience in developing contemporary medical education facilities. The study was overseen by Associate Dean for Campus Planning and Facilities, Rick Shea, and Associate Dean for Medical Education Planning and Administration, Jane Neill, along with Deans for Medical and Graduate Education and other members of the Task Force who served on a TMEC Planning Steering Committee. The programming study considered space and technological needs and space configurations for a 21st century learning environment for preclerkship medical education and assessment. Reviewing the preclerkship curriculum and the TMEC learning space simultaneously and in parallel was intended to facilitate the modification of outdated, time-worn learning spaces to address Task Force recommendations for pedagogical innovation and to ensure that form follows function.

V. Reports of the Task Force Subcommittees

During the annual Program in Medical Education Leadership Retreat in June 2013, a year from the launch of the Task Force, the Subcommittees presented progress reports.

A. Subcommittee on Content and Organization—Drs. Bernard Chang and Randy King, Chairs

The subcommittee identified problems and concerns with the current curriculum; explored alternative curriculum models within the HMS system, at peer schools, and based on the subcommittee’s imagination of what could be improved; and searched for an organizational model that matched most closely the values of our ideal curriculum within the constraints of feasibility. In the current curriculum, the Fundamental of Medicine (Year-I/II) curriculum emphasizes normal processes in Year I and abnormal processes in Year II. All course content is required, and everyone pursues a uniform sequence, after which students take Step 1 of the national boards, a standardized test, which distracts their focus during more than half of Year II. After the Principal Clinical Experience (PCE), fourth-year students take a required subinternship and advanced electives. In the current curriculum, students begin to work on their required scholarly projects in the fall of Year I, after they have experienced only a small minority of the preclerkship curriculum and none of the PCE disciplines.

The subcommittee articulated the following concerns with the current curriculum structure: As offered currently, the curriculum is locked into a rigid, inflexible “2-plus-2 year” format that separates artificially the teaching of normal from abnormal, leading to inefficiency and duplication. In addition, tension exists between the delivery by faculty of core content that students actually need to know and rich, exciting, inspirational advanced content that faculty want to cover but to which students, still in a college frame of mind and burdened by the sheer volume of information presented to them, are not receptive. Much of this advanced material would be suited better for students seasoned by a
clinical year—after students have acquired clinical context. The timing of USLME Step 1 detracts from student focus on important Year-II content, effectively “hijacking” and limiting curriculum effectiveness dramatically. The scholarly project is given inadequate time in the preclerkship curriculum and is situated much too early in the curriculum to align with student interest and career trajectory. Moreover, the rigidity of the curriculum allows no chance for electives or tailoring of learning to student interest until Year IV and limits the time after the PCE during which to decide on a career path.

The Subcommittee arrived at a consensus for a new curriculum structure that affected not only the preclerkship curriculum but also the entire four-year sequence. This new curriculum structure would support personalized and developmentally appropriate education at HMS.

Proposed Curriculum Organization

**Year 1**

*Introduction to the core content needed for the practice of medicine*
Foundational material, organ-based content, interdisciplinary topics

*Required course content, uniform sequence*

**Year 2**

*Introduction to the core practice of medicine*
Principal clinical experience

*Required clerkships, but variable sites and variable sequence*

**Years 3 and 4**

*Advanced scientific and clinical topics in medicine*
Required and/or selective courses in organ-based pathophysiology
Selective courses in basic/translational science, social/population science, and medical humanities
Individual mentored scholarly project
Clinical electives and subinternships
USMLE steps 1 and 2

*Selective experiences (within required framework), variable sites and variable sequence*

In this model, the preclerkship curriculum begins with a grounding in the foundational building blocks to study medicine (“basic building blocks”). Included in this period of “foundations” are fundamentals of anatomy/histology, biochemistry/molecular and cellular biology; genetics; immunology; and introductory pharmacologic principles. This introductory period should equip students with the tools and language to navigate the study of organ systems. Then, the remainder of the preclerkship curriculum would be organized around organ-system-based modules, during which structure-function/normal-abnormal for each organ system would be integrated—anatomy, physiology, pathophysiology, pathology, pharmacology, imaging, and nutrition. In addition, instead of our current, isolated, very brief blocks, time devoted to each organ system could be expanded by teaching two complementary organ systems (e.g., cardiovascular and respiratory) simultaneously in parallel blocks over a longer period. Doing so would allow students more time to “digest” each system and difficult concepts, to consolidate learning, and to appreciate the complementarity between systems.

The more “radical” recommendation of the Subcommittee would be to dissociate critical core knowledge required to prepare for the PCE—to be taught in preclerkship Year I—from more
advanced material that would be better suited to students who have already been seasoned by clinical ward experiences—taught in post-PCE Years III and IV.

This novel curriculum organization acknowledges that core basic/population science knowledge and skills are needed prior to the clinical year but that the richness of more advanced science is best suited to students who have already had clinical ward experience. The change also fulfills the aspiration for earlier clerkship exposure by moving the PCE into Year II and creates an opportunity for longitudinal integration of the introductory, preclerkship clinical skills course (Practice of Medicine) with the Primary Care Clerkship during the PCE, yielding the potential for two years of longitudinality and continuity with a single ambulatory-medicine preceptor and clinical practice.

Years III and IV in this novel structure (“advanced basic and clinical sciences”) would be devoted to teaching advanced knowledge and skills that go beyond core material but are critical to the understanding and the practice of modern medicine. This time would be devoted to integrated basic/population science and clinical experiences—a mixture of advanced basic/population science courses, the required subinternship, clinical electives, integrated basic-clinical courses, a dedicated block of time devoted to the scholarly project, and time to take USLME Step 1 and Step 2. Moving USMLE to Year III allows for undistracted, focused attention on core sciences in Year I, which would capture lost time/focus and contribute to the efficiency of the preclerkship curriculum. Unlike other schools that have adopted a 1-year preclerkship curriculum, in this proposal, we are not advocating for cramming two years worth of material into one; instead, the plan is to distribute what is now taught in the preclerkship years between Year I and a “return to the classroom” (physically and intellectually) after the clinical year to revisit the basic and population sciences but in a clinically nuanced way. In Year III, the expectation is that students would return, having lived in a clinical context for a year, to be more engaged in learning advanced basic and population sciences that are now much more relevant and compelling to them. At the same time, working with students better prepared to appreciate the relevant basic and population sciences would attract and excite senior basic/clinical faculty as they encounter a cohort of students more receptive to exploration.

Advanced electives and selectives would include such experiences as advanced pathophysiology courses and integrated subjects, e.g., genetics, cancer, nutrition, human development/aging, population health, social medicine, clinical-translational science, clinical anatomy, clinical therapeutics, and medical humanities. Some of these advanced courses would be required, others would be selective (a requirement to take one or more from a set menu), others would be elective, but the overriding principle is that the Year III-IV curriculum could be tailored to each student based on interest and career choice. New selective courses would bring together and integrate topics in a manner not possible in the current system; students would have increasing contact with faculty content experts, our specialized faculty would be able to teach students deeply in their areas of interest, and, as a result, faculty engagement would be enhanced in Years III and IV. In addition, improved reinforcement of learning would be the product of comingled clinical and basic science advanced courses. Similarly, embarking on a scholarly project after having experienced every preclerkship and clerkship discipline would allow students to choose personally relevant projects and mentors at the most developmentally ideal time. This format allows for more individualized learning—both a dedicated scholarship block and selective choices of advanced topics tailored to interest and career path.

**Advantages**

Such a curriculum structure would change the HMS culture from a siloed “2+2” (2 years basic, 2 years clinical) school to an integrated 4-year continuum and would yield more meaningful, rigorous, relevant, and structured postclerkship experiences and rich, exciting post-PCE content that is worthy of our students and faculty. Most importantly, this curriculum reorganization would be developmentally more appropriate for learners; such “just-in-time” or “on-demand” teaching would align learning to the
period in time when students are most receptive—from a “college-student” mindset in the preclerkship curriculum to a clinician mindset in the post-PCE curriculum.

Challenges
Such a departure from the current curriculum would pose substantial challenges: How would we organize the “frame-shift” between the current Fundamentals of Medicine (Year I-II) curriculum and the new preclerkship (Year-I) curriculum, anticipating the potential for overlapping course offerings (as current Years I and II are merged, components of preclerkship courses will have to be taught in one way to Class-of-2018 students and in another way to Class-of-2019 students, requiring faculty to teach the same material twice in one year; for the new clinical skills course, potentially, additional preceptors will have to be recruited to teach simultaneously both the second-year class in the current curriculum and the new first-year class in the new curriculum)? Similarly, how would we engineer the “frame-shift” of the overlap in PCE classes during the transition year (with the potential to have two complete classes on the wards at the same time)? How can we approach consensus over what would belong in “foundations”? In the organ-systems component of the preclerkship curriculum, deciding what is truly pre-PCE core content and what should be postponed to Year III will be a challenge. What will the balance in Year III be between required, selective (mandatory courses chosen from a specified menu of offerings), and elective learning experiences? Might this approach narrow the breadth of students’ knowledge as the focus shifts to a more individualized curriculum? How can we avoid the notion that Year I is being “dumbed down”? The reimagined post-PCE curriculum will require the development of entirely new courses and a new model for advising and supervision during the post-PCE curriculum. What will the impact be on the PCE (and clinical readiness/emotional maturity) of having students with only one year of preclerkship preparation? How can we ensure that students are adequately prepared and emotionally/intellectually ready for their clinical clerkships? What will be lost by eliminating the pre-PCE consolidation of knowledge that comes from studying for national boards, or how can we replace this valuable learning experience? How will the restructuring of the schedule affect scheduling of HSDM, HST, and MD-PhD students?

Weighing the risks against the potential benefits, the Subcommittee supported the new organizational structure enthusiastically. Although the calendar of the preclerkship curriculum remains to be determined, the novel organization of the curriculum that dissociates Year-I and Year-III core content attracted broad appeal.

B. Subcommitteee on Pedagogy—Drs. Melanie Hoenig and Richard Schwartzstein, Chairs

The subcommittee advocated for more interactive classroom approaches that foster active learning and critical thinking, that favor “deep” learning (integrated, coherent, linked to previous knowledge, reflective, relevant to everyday experience, problem solving/analysis) over “surface” learning (fragmented, disorganized, unlinked to previous knowledge, unreflective, memorization). Passive transfer of information and content should be the responsibility of individual students and student teams and should no longer occupy the precious time during which faculty and students interact in the classroom. Instead, students should prepare in advance for highly interactive classroom sessions in which problem solving, reasoning, and consolidation of knowledge are paramount, i.e., the “flipped” classroom model. Included in their recommendations were experimentation with different class group sizes and approaches (team-based learning and case-based learning models); identifying an ideal balance between a “safe environment” and high expectations/accountability for scholarship and professionalism; and consideration of the elements to establish a core-faculty teaching model. Underlying these recommendations is a foundation on self-directed, life-long learning.

The Pedagogy Subcommittee made the following recommendations:
1) Learning system for biological, population, and social sciences: To enhance the core values embedded in the curriculum, teaching will occur within the framework of a learning system comprising the following elements in the following sequence: self-study, team study with limited faculty involvement, group discussion with faculty leadership, and reflection. Students will receive explicit assignments for preparation for each class session. Learning of content will occur largely via self-study followed by regularly scheduled team study (e.g., six students per team, to which students would be assigned) in skills areas. Self study and team study will be guided by explicit assignments that may include readings, problem sets, and prerecorded videos. Skills areas will have a range of resources including a member of the core faculty (see below), student teaching assistants, simulators, anatomy models and prosections, and computer-based learning tools. Attendance at team study sessions will be required of all students; individual students and student teams will be help accountable for their learning.

Group discussions will occur in sessions with the class divided into four Society-based learning groups. These sessions will be highly interactive and will focus on clarifying difficult concepts and application of content to solve problems. Group discussions will incorporate features of team-based learning, such as a readiness assessment exercises to evaluate level of preparation by the group and problem solving by team units. Assessment of class participation will include a meaningful contribution to overall evaluation of student performance. Attendance at group discussions will be required of all students.

Lectures will be relatively few in number and will be reserved for a) an overview of the course, b) elaboration of key and/or difficult core concepts, c) patient sessions, and d) integration of material.

Traditional laboratory exercises will likely be reduced from their present use and deemphasized compared to skills-loft exercises, but laboratories will be retained when appropriate for specific course content, particularly in anatomy, pathology, and/or microbiology.

2) Daily Schedule: Students will have time (varying from 60-120 minutes) assigned each day for team learning. Group discussion sessions will last 80-100 minutes. If students are taking two courses, e.g., cardiovascular and respiratory systems, simultaneously, group discussion will not exceed 3 hours/day.

3) Faculty Model: The majority of teaching for any given block in the schedule will be provided by core education faculty members, one of whom will serve as course director. Core faculty will lead large-group interactive class sessions and team-based learning sessions for student learning groups (four groups of 45 students).

Core faculty will also be required to participate in professional development activities and to familiarize themselves with strategies for teaching and assessing analytical reasoning. Their responsibilities will include the following: preparation of syllabus materials; preparation of concept videos in cooperation with content expert faculty; managing team-based learning exercises; staffing the skills areas; assessment (in class and written exercises, e.g., quizzes, exams, reflection papers); remediation of students and communication with course faculty in succeeding courses about strengths and areas of concern for particular students (i.e., increase longitudinal oversight/monitoring of student performance); case writing in cooperation with content expert faculty; and regular communication with Practice of Medicine (clinical skills) faculty to foster coordination between the basic science courses and the clinical skills course (basic-clinical science integration).

For the organ system-based courses, in addition to core faculty, theme faculty will assist in
addressing content areas across the continuum of the preclerkship curriculum. Themes suggested would include anatomy/histology, pathology, radiology/imaging, pharmacology, nutrition, microbiology/infectious diseases, ethics and professionalism, critical thinking, clinical epidemiology/cognitive biases/evidence-based medicine, cross-cultural education, etc. Theme faculty will also contribute to the development of syllabus materials to determine key topics that must be addressed at different points in the curriculum and will co-teach with core faculty when appropriate.

**Content faculty experts** will be called upon as needed by the core faculty. These faculty members may co-teach/lead group discussions or lectures with core faculty from another discipline.

4) **Technology**: The subcommittee acknowledged that novel technology (including on-line discussion forums, simulation in skills areas, animations, etc.) will be required to enable pedagogic innovation but deferred specific recommendations to a time when course structure and content are more definitive. Instructional technology experts and technology facilities will have to be available to core faculty to enable them to use a range of software in their courses.

**Advantages**
The advantages of this teaching model include opportunities to weave a comprehensive and original curriculum with robust horizontal and vertical integration; establishment of a dedicated teaching faculty committed to developing expertise in the range of educational methods; opportunities for students to have substantive long-term relationships with core faculty (improved longitudinal assessment and identification and remediation of struggling students) and to spend more time with faculty applying knowledge and solving problems; leveraging the Society infrastructure for constituting 40-45-student-group sessions; increased required preparation by students for interactive sessions with faculty; increased consistency of teaching by core faculty; enhanced preparation of students for learning sessions; greater interactivity in group discussions to facilitate enduring learning and problem-solving skills; and opportunities for students to practice skills needed for life-long learning and effective interactions with teams.

**Challenges**
The challenges posed by the new model include requirements for training the core faculty to do team-based learning well; the task of identifying and selecting candidates for core and theme faculty positions; recognition of the considerable demands on faculty for preparation and face/contact time with students; the need for new learning spaces for skills areas and intermediate-size group discussions; the culture shift that will be necessary in expectations and accountability of students for their own and their team's learning—students will have to be taught how to learn in these novel ways and to be motivated to come to class prepared; the culture shift for faculty in adopting these new methods of teaching and assessment; the complexity of scheduling student time in the skills loft; and apportioning the learning time expected of students to accommodate the new learning environments/formats (self study, team study, large-class interactive sessions, reflection) without expecting an expansion of learning hours per day. In addition, finding the correct balance and synergistic interactivity among content experts, theme experts, and content experts will be demanding. Finally, if we are successful in introducing these approaches to pedagogy, we will have to review our clinical clerkship experiences to avoid undermining gains achieved in the preclerkship curriculum.

C. **Subcommittee on Clinical Skills**—Drs. Fidencio Saldaña and Alberto Puig, Chairs

A previous, 2009-2010 Taskforce on Teaching Clinical Skills drafted a detailed plan for a *Practice of Medicine* (POM) course designed to incorporate and unify clinical skills teaching in the preclerkship
years (unifying Patient Doctor I and II), to integrate clinical skills teaching with basic and population science teaching, and modeled around a continuum of early clinical exposure and longitudinal patient care. The Task Force Subcommittee endorsed the work of the previous task force and made recommendations for aligning the new POM course with a redesigned preclerkship curriculum.

Among the goals of the new clinical skills course is the addition of early longitudinal ambulatory experiences and modeling of professional behavior in highly functioning team-based practices. Especially as we migrate to a more streamlined preclerkship curriculum, a paramount deliverable will be the optimal preparation for the clinical immersion experiences of the PCE core clerkship year.

The Subcommittee on Clinical Skills made the following recommendations:

1. Define, determine how to teach, and assess the skills, attitudes, and knowledge that are expected of a clinical clerk arriving on the first day of the PCE. Equipped in this way by the POM course, students should be competent in basic clinical skills (details to be addressed during the design phase of curriculum reform) and should be capable, in a respectful and timely manner, of accomplishing the following: Perform a full history and physical exam that is tailored to a patient’s clinical presentation (“targeted” history and physical); document, present, and explain clinical reasoning and be able to integrate information based on an understanding of the underlying basic and social sciences; formulate an assessment and plan for a clinical problem; conduct themselves with the degree of professionalism, communication skills, and cross-cultural sensitivity expected of a physician; demonstrate a basic understanding of the healthcare system and the role of other health professionals; and be able to access and apply the best available evidence.

2. Establish milestones that students should be able to satisfy upon completion of different stages of clinical education (details to be addressed in conjunction with the Subcommittee on Milestones and Assessment during the design phase of curriculum reform).

3. To model professional behavior and clinical habits, to provide exposure to a rich variety of patient experiences and clinical problems, to allow students to appreciate the patient as the center of the clinical experience and to witness the entire course of illness, longitudinal clinical experiences should be incorporated into POM. Towards this end, students or student teams should be assigned to one preceptor or preceptor team from the beginning of medical school, and innovative use of outpatient settings should be adapted to provide interprofessional education (e.g., the Crimson Care Collaborative, “Academic Innovations Collaborative” practices, medical home practices, etc.).

4. Continue to rely on the strengths and resources of the inpatient clinical setting, where, currently, history taking and physical diagnosis are taught primarily. Teaching in inpatient clinical settings takes advantage of patients who are readily available for longer, less rushed, blocks of time than in the outpatient setting. In addition, a much larger variety of clinical findings can be found reliably in the inpatient setting.

5. Develop an appropriately resourced and trained “core faculty” at each of the clinical sites to be responsible for design, implementation, oversight, and assessment of clinical skills education.

6. Organize clinical skills teaching into a “Firm” or “Hub” structure. The POM course proposal is structured to provide clinical education delivery around a firm/hub framework, consisting of four major teaching sites (“hubs”) as centralized nuclei into which smaller, associated clinical sites (“spokes”) are linked, an organizational structure similar to that of the four hospital PCE sites. In addition, to ensure consistency, the clinical skills curriculum should be the same at all
sites.

7. The clinical skills curriculum should span all four years of medical education and be designed for integration and teaching in parallel with basic and clinical sciences at the appropriate level. Because students in the new curriculum are expected to enter the PCE as much as a year earlier than they do now, substantial thought and attention should be given to the time allotted and frequency of teaching clinical skills and diagnosis. If necessary, expectations of a student starting the PCE may need to be adjusted in accordance with the realities of the new curriculum. Opportunities should be developed to individualize advanced clinical education in Years III and IV.

8. This new vision for clinical skills training may facilitate continuity of longitudinal interactions spanning 2 years (or more) between students and faculty preceptors (and between students and patients) by linking POM sites/preceptors during the preclerkship curriculum and Primary Care Clerkship sites/preceptors during the PCE. In addition, imaginative approaches might allow longitudinal continuity of ambulatory experiences during Years III and IV.

Advantages
The proposed approach will unify and streamline current clinical skills teaching into a seamlessly integrated course; add longitudinality of patient-centered care through an ambulatory clinical experience that, potentially, could span the preclerkship and clerkship curriculum during the first two years of medical school; model from the very beginning of medical school the professional relationship between a patient and a physician/physician team and the centrality of well functioning primary care values and delivery; integrate and reinforce learning and learning principles across the clinical skills course (POM) and the preclerkship basic/population science courses; familiarize students with other health professionals and their roles (interprofessional care); equip students to communicate with sensitivity and cross-cultural sophistication; and provide students with the context for appreciation of the health care system, systems improvement, and quality/safety.

Challenges
One of the most challenging aspects of the new clinical skills course will be faculty development and recruitment. Faculty may not be able to commit the time necessary in ambulatory settings or to maintain a durable connection to students extending beyond one year. Not all faculty preceptors may be able or willing to teach students across Years I-III or to reinforce basic/population science principles. Similarly, matching students with preceptors for extended periods may pose logistical obstacles. Designing a novel ambulatory experience will be challenging, as will be identifying ambulatory sites/space/preceptors for student learning and integration of inpatient and outpatient clinical sites for education. Finally, establishing and launching a core faculty will be a demanding undertaking.

D. Subcommittee on Assessment—Drs. Graham McMahon and Ed Krupat, Chairs

The Subcommittee made the following recommendations:

The approach to assessment should be longitudinal, cumulative, and multifaceted, and assessment points should be scheduled throughout the curriculum. Each assessment point should consist of one or more methods (e.g., peer assessment, multiple choice questions, short-answer responses, teamwork assessment, etc.), and any assessment adopted should conform to a minimum quality construction standard. All assessments should be included in periodic reports, which students should use to generate an individualized learning plan. These individualized learning plans should be reviewed at regular intervals by faculty mentors and students, and faculty mentors should monitor a student’s compliance and progress. Reflection, self-assessment, and peer assessment should be
incorporated as components of periodic assessments. Assessment should be designed primarily to enhance learning, to promote the highest level of performance for each student, and to send the message that “we assess what we value.” In the proposed assessment system, formative evaluation becomes increasingly important; therefore, feedback to students needs to be useful, constructive, and derived from various sources.

In terms of cumulative assessment, assessment materials from early courses should be incorporated in later courses. In this vein, course directors of early courses should work with faculty from later courses to determine how best to incorporate assessment in later courses.

To achieve peer assessment, students should provide feedback about one another, and individual students should be held accountable for performance of their teams on team tasks. For peer and team assessment to flourish requires an atmosphere of safety, which will require culture change and the development of assessment metrics that are scientifically reliable and valued.

In addition to feedback about quantitative scores, students should receive narrative feedback about strengths and weaknesses from their tutors, course directors, peers, and faculty mentors. Quantitative and qualitative data from global assessments should be used to guide the generation of individual learning plans. All such feedback should populate individual student portfolios, which will include student reflections on their learning and contributions to their teams. These portfolios will provide students, faculty, and advisors/mentors with a tool for monitoring each student’s longitudinal, progressive development through the curriculum. Ideally, a faculty mentor should be consistent for the same small group of students over at least a year and should assess students as they engage in teamwork together.

Remediation time, which will be required for a proportion of students, should be built into protected time during the curriculum calendar. Such remediation should be individualized and personally tailored and supported by an infrastructure of available staff and resources.

Advantages
This proposed approach to milestones and assessment incorporates principles of cumulative, longitudinal, personal and team, multiple-metric and multiple-observer evaluation. With a cadre of core faculty assessors trained and delegated to oversee assessment, potentially, more uniform, meaningful, and constructive assessment could enhance learning, remediation, and reinforcement.

Challenges
Potential problems that could result in failure of the assessment proposal include inadequate faculty development; an inadequate longitudinal relationship between students and faculty to inform assessment; inadequate protected time for assessment and inadequate protected time for remediation; focusing assessment too much on knowledge acquisition and not enough on critical thinking; insufficiently informative and directive feedback to students; failure of peer feedback to be useful, constructive, helpful, and aimed at improvement; and feedback and remediation that is perceived as punitive. Even if we can identify and train faculty who are expert in assessment, we will be challenged to maintain this system of active faculty involvement over time and to extend the system beyond the preclerkship faculty to hospital faculty and residents.

E. Learning Space Programming Study—Jane Neill and Richard Shea, Chairs

Our current architecture is a barrier to innovation. As currently configured, the TMEC has facilities primarily for large lectures and small, 8-student tutorials, very little for anything in between or for experimentation with intermediate-sized learning groups, team-based learning, etc. We need flexible space to adopt novel pedagogy. Therefore, in AY13, through a competitive search, Campus Planning
and the Program in Medical Education identified an education architecture firm, CO Architects, to undertake a TMEC Programming Study. The goals of the study—to consider how to adapt HMS teaching space to new methods of instruction and the learning needs of the revised preclerkship curriculum—were the following:

- How we can improve the teaching, study, and social spaces in TMEC;
- How we can make the space as flexible as possible for multiple uses and into the future;
- How to make the best use of new technologies throughout the building; and
- How the space can be reconfigured to allow incorporation of innovative changes in teaching methods?

From the very design and construction of the HMS Quadrangle, which opened in 1906, flexibility to adapt space to new teaching methods was a guiding principle. Twenty-six years ago, in 1987, the Tosteson Medical Education Center (TMEC), an extension of one of the original Quad buildings (Building E), opened at HMS. The building was designed to foster problem-based learning (PBL) and the School’s New Pathway curriculum, in which small-group learning was the centerpiece, and the educational and advising structure was designed around Academic Societies. Teaching space in the building is organized in five clusters that include a skills/lab area, a 40-50 person classroom, and a bank of small tutorial rooms (sufficient for 22-24 PBL tutorial groups for each of the two preclerkship classes) for each of the five Academic Societies. Currently, teaching space is available primarily for the two extremes of two large-lecture amphitheaters and multiple small-group PBL tutorial sessions, but flexibility for other teaching spaces between these two extremes is limited. In short, the original guiding principle of the HMS Quadrangle for adaptable and flexible space was no longer being realized for the education mission of the school.

Changes in the HMS curriculum have also involved the introduction of innovative uses of information technology, including medical simulation and virtual microscopy, and a heightened emphasis on the development of teaching skills of our basic science and clinical faculty. Since the New Pathway was established, new methods of evaluation, such as multistation objective, structured clinical examinations (OSCEs) in which students interact with a standardized patient actor and faculty evaluator in exam room settings, have been introduced as well. These enhancements to the medical education program require newly configured space.

In 2009, the PME appointed a faculty task force to consider classroom teaching, including the nature of small-group teaching and problem-based learning tutorials, in HMS courses. The task force was asked to consider space as a factor in the recommendations that they made about pedagogy, which included the need to construct flexible, multipurpose space for small-group teaching and learning, including increased use of intermediate sized teaching sessions, such as case method rooms. Feeding this aspiration for more active, interactive classroom learning has been a major shift in elementary, college, graduate, and professional education favoring active learning classrooms or “learning studios,” in which clusters of students at small, rearrangeable tables foster interactions between teachers and students anchored by the use of technology and collaborative, team-based pedagogy. Instead of teaching in large lecture halls in which the teacher speaks before a classroom of students who sit passively and take notes, learning has been shown to be more effective, successful, deep, and durable when classroom exercises require small groups of students to work actively together in teams, interacting among themselves, other student teams, and the teacher, in solving problems that require application of learned principles.

Emanating from the AY13 Task Force on Revising the Preclerkship Curriculum, as reviewed above, was the recognition that the physical learning environment of the TMEC was too inflexible to accommodate the introduction of novel approaches to pedagogy. Even with renovations and space additions over recent decades, effectively, the TMEC has been disengaged from the surrounding Quadrangle.
Thus was the stage set for CO Architects to conduct a programming study, in parallel with the work of the Task Force on Revising the Preclerkship Curriculum, of the learning space on the TMEC within the HMS Quadrangle. Through a process of detailed analysis of TMEC learning spaces, comparison to peer-institution learning spaces, exploratory meetings and feedback sessions with multiple HMS constituencies, and consideration of multiple potential options, CO Architects developed a “blue sky” program that addressed the articulated needs of the new curriculum, issues of identity and access within the building, and connections to its surroundings. These plans contain a template for understanding how space can support the innovative pedagogy of the new curriculum and include phasing and staging strategies for implementation of the space changes. The space plan also provides a framework for organizing spaces and a viable roadmap for infrastructure upgrades to the existing TMEC building, paving the way for a framework of space types that are flexible, scalable, and adaptable to meet the needs of the new curriculum, even as these needs remain tentative during the curriculum redesign process.

Based on this extensive programming study, CO Architects presented a design concept—including a redistribution of physical space to favor needs and address shortcomings—with the following features:

- Flexible classrooms and flat “learning studios” with movable walls
- “Skills lofts” - simulation, virtual microscopy/anatomy
- Dissection labs – with the potential for progressive “drying out” in future years as the roles of anatomical dissection, prosection, and digital anatomy/simulation evolve
- Dedicated study space for students
- Dedicated social space for students
- The “Big Room”—a flatter (less steep) auditorium that can be partitioned and that contains moveable furniture (for team-based learning exercises)
- Windows and glass walls to allow light throughout the building
- Bridges to connect the TMEC floors across the Atrium and to improve flow
- Addition of learning studio space—extension of TMEC to Longwood Avenue; 1-story addition between Building C and TMEC—that will provide both swing space during renovations and permanently available active learning classrooms

An important caveat about the need for reconfigured space is that the timetables for implementation of the new curriculum and for completion of planned space renovations do not coincide temporally. Although the full complement of new and reconfigured space would be needed for long-term, sustained support of the new curriculum and its contemporary pedagogy, completing the space reconfiguration—relying as it will on fund raising—will not be possible in time for the introduction of Year I of the new curriculum in the summer of 2015. We do have a plan, however, about how to use the current space with relatively small-scale, practical renovations that will allow us to introduce the new pedagogy. In the short-term, accommodating the learning spaces for the new curriculum might require using spaces already available both in the mornings and afternoons, instead of only in the mornings as we do now, until our space is reconfigured on a large scale. While this solution is not optimal, we believe it will enable us to move forward with the planned curriculum, generate excitement that may facilitate fundraising, and provide experience with the new pedagogy that will help inform the ultimate building redesign.
VI. Annual Medical Education Leadership Retreat Deliberations, June 2013

During the retreat, after subcommittee reports were presented, moderated discussions focused on group suggestions for implementation of recommendation of the four curriculum task force subcommittees (i.e., the learning space programming study was not included in this exercise). Retreat attendees were assigned to small-group breakout teams that included a balance of both preclerkship and clinical-clerkship leadership. The suggestions of the retreat participants are being shared with the design groups being convened in the fall and winter of AY14.

Content and Organization:
At the retreat, the breakout groups made preliminary suggestions for what core content belonged in the preclerkship curriculum; what types of basic/population science courses, integrated basic-clinical courses, and thematic courses could be candidates for the post-PCE advanced basic-clinical science curriculum; what the balance should be between required and selective/elective courses in the post-PCE curriculum; and types of new courses that could be introduced in the new post-PCE curriculum.

Pedagogy:
The breakout groups focused on how to ensure that students come to class prepared for interactive learning sessions; challenges associated with the new model of pedagogy; criteria for Year-I core faculty; and the advantages/disadvantages of subdividing the class into four sections of 40-45 students each.

Clinical Skills:
Breakout group teams offered suggestions about the basic clinical skills that should be expected of a clinical clerk upon entry into the PCE; other skills that should be taught in the introductory clinical skills course (e.g., professionalism, boundaries, how to solicit and receive feedback and to self-assess, critical thinking, cross-cultural sensitivity, interprofessional collaboration, leadership); the fundamental ingredients of successful ambulatory settings for the new model clinical-skills learning; the ideal balance between inpatient and ambulatory learning settings; and criteria for a core teaching faculty of clinical preceptors.

Milestones and Assessment:
Breakout group teams considered and made recommendations about 1) specific information to be included in students’ portfolios to help them craft an ideal “individualized learning plan” (e.g., exam results, case write-ups, evidence-based medicine papers, reflection papers, patient panels, OSCE results, mid-point and year-end feedback, self-assessments, activity diaries, group assessments, formative and summative comments, list of must see conditions and skills, demonstration of clinical reasoning skills, journaling); 2) changes needed to make peer-team assessments safe and effective for students (e.g., pass-fail versus graded peer assessment with grade distributions, moderated peer assessment to facilitate constructive discussion, whether preclinical peer evaluations are anonymous and/or part of grade transcripts; and 3) assessment changes needed during and at the end of courses to promote high levels of performance more effectively (to promote students’ passion for learning and to motivate them to be the best adult learners; to facilitate remediation and improvement for students who encounter learning difficulties; to identify trouble areas in which students may encounter struggles in academic, personal, and professional performance; and to inspire students to high standards as part of the HMS culture).

VII. Phase-1 Design Teams AY14

During AY14, phase-1 design teams, small multidisciplinary groups that include Fundamentals of Medicine course directors and clinical faculty, will establish a broad overview of Year-I courses—
what goes into “Foundations and” what goes into each organ-specific module. After these teams
develop topics and content to be included in the preclerkship curriculum, their recommendations will
be distributed for review to the HMS community, whose feedback will be incorporated into final
plans that will be developed further and in more detail by phase-2 design groups.

**Charge for Preclerkship Curriculum Phase-1 Design Teams to Identify the Key Concepts in Each Discipline:**

One of the main tenets established by the Task Force during AY13 was that the new preclerkship
curriculum should focus on core principles in the biological, population, and social sciences that are
necessary for students to learn and function well in their clinical clerkships. Therefore, phase-1
design in AY14 will focus on defining the core principles required prior to the clerkships and, in
tandem, the scientific concepts deemed to be “advanced” and/or best appreciated and learned during
year III or IV, after students have had their comprehensive core clinical clerkship exposure and
experience.

During Design Phase 1, the material to be presented in “foundations” and the fundamental elements
of each organ-system subject will be defined— how these fundamental elements contribute to
patient care and exploration of unanswered frontiers. The task for this phase is not simply to list
disease entities or scientific topics, to list materials currently covered in existing courses, or to create
vague charges to understand all the material; instead, this phase is meant to define the scaffolding
needed for students to build and explore as they become more sophisticated learners and clinicians.
Core basic science courses will be integrated with population/social science courses and the teaching
of clinical skills.

**Core Basic Sciences**

For “Foundations,” the design team will determine how to introduce the foundational concepts of
molecular and cell biology; biochemistry; microbiology; pharmacology; anatomy; embryology;
histology; cell injury, death, and host response; neoplasia; and genetics.

Design teams for organ-system courses, composed of current course directors and representatives
from the clinical clerkships, will address how to integrate the presentation of structure/function and
normal/abnormal biology (incorporating anatomy/histology/imaging, physiology,
pathophysiology/pathology, pharmacology, nutrition) for the following blocks in which
complementary organ systems are taught simultaneously in parallel:

I. **HOMEOSTASIS I** – Cardiac and respiratory anatomy, histology, physiology and
pathophysiology, pathology, pharmacology, radiology; hematology

II. **HOMEOSTASIS II** – gastrointestinal, renal; and endocrine/reproductive anatomy, histology,
physiology and pathophysiology, pathology, pharmacology, radiology

III. **NERVOUS SYSTEM/BEHAVIOR** – Neuroscience; psychiatry; behavioral development
anatomy, histology, physiology and pathophysiology, pathology, pharmacology, radiology

IV. **IMMUNITY IN DEFENSE AND DISEASE** – dermatology/rheumatology/systemic immune-
inflammatory diseases and relevant anatomy, histology, physiology and pathophysiology,
pathology, pharmacology, radiology

To guide the development of these organ-system courses, the phase-1 design teams will focus on key
questions about an area of study that must be asked and answered by a student to understand the
diagnosis and treatment of the most common diseases encountered in the core clerkships during the
Principal Clinical Experience. For example, rather than relying on such objectives as, “Understand
the anatomy of the glomerulus,” course designers will consider fundamental questions that a student should understand, such as, “How does the unique anatomy of the glomerular capillaries (situated between two resistance vessels) affect the intraglomerular pressure, renal blood flow, and filtration?” For each organ system, a similar set of guiding fundamental questions has been drafted.

**Core Population/Social Sciences**
Simultaneously, a phase-1 design team will address the teaching of the social and population sciences, most likely to be taught during immersion intersessions during the preclerkship year:

SOCIAL/POPULATION SCIENCE – social medicine, medical ethics, clinical epidemiology/population health, health care policy

**Clinical Skills**
A phase-1 design team will address how to teach clinical skills in a new course, the *Practice of Medicine*, to be integrated with the teaching of organ systems, to include an ambulatory component, and to run each week of the preclerkship curriculum as a longitudinal, continuity curricular element:

PRACTICE OF MEDICINE - Clinical Skills

The focus of design phase 1 is to identify material that is essential for our students to progress to the clerkships. Design for the new advanced courses in Years III/IV will follow, but the phase-1 design teams will be encouraged also to identify material that might be included in exciting advanced courses and, in some instances, consider material that should be required in Years III/IV but that is not necessary in the new preclerkship curriculum. For example, additional course work in Social/Population Science will be required for all students in the third year when they, as more sophisticated learners who can rely on examples from their own clinical experience, can consider advanced ethical dilemmas and health care policy challenges. Similarly, a broad overview of clinical therapeutics might be judged necessary for all future physicians. In contrast, the study of subtleties of organ-specific advanced pathophysiology, rather than being required of all students, could be selected by students based on their individual interests and chosen residency discipline.

Phase 1 design teams will meet between November 2013 and early January 2014 to create a realistic draft of relevant course topics and the time allotted to each section of the preclerkship curriculum. In late January 2014, phase-1 design teams will convene for a retreat to share their course-outline drafts with one another and to find additional areas of overlap and continuity.

Once the key topics have been defined and guiding questions have been articulated by the late winter of 2014, Phase-2 Design will begin. During this phase, the difficult work of crafting the details of courses will be undertaken, curriculum syllabus materials written (including cases, student learning assignments), and study resources identified, all with careful consideration of strategies needed to teach course content in a manner that enhances critical thinking and analytical reasoning and that fosters a culture of inquiry and curiosity. Phase-2 Design Teams will be expanded to include contributions from core clerkship faculty and curricular theme experts, and input will be required from pedagogy and technical experts. During Phase-2 Design, teams will also be charged with developing assessment strategies and tools, evaluation exercises, and a faculty mentoring program. Phase 3 will be devoted to designing the advanced basic and clinical science curriculum for Years III and IV. As the curriculum redesign process is pursued, simultaneous effort will be devoted to faculty development (see section VIII) and assessment of the new program.
VIII. Faculty Development
The Academy and the Academy Center for Teaching and Learning are devoting substantial resources to faculty development in anticipation of the changes in pedagogy, curriculum organization, and assessment required for the new curriculum. Included among these offerings and events during this academic year (AY14) are the following:

**Medical Education Grand Rounds**
- Panel discussion by education reform subcommittee chairs
- The impact of student background on learning
- Lessons learned from curriculum reform at other medical schools
- Pathways to culture change in medical schools
- How people learn and how we can learn better
- Team-based learning: Rethinking the concept of small-group learning

**Medical Education Day**
- Supporting self-directed learning to enhance development of life-long learning skills

**Interest Group Symposia**
- Cross-Cultural Care – Designing and Implementing Curricula
- Confronting the Hidden Curriculum: Leading Culture Change in Academic Medicine
- Teaching and Learning with Concept Maps: A Window into the Learner’s Mind
- An Approach to Evaluation and Feedback Designed to Improve Performance

**Other Events**
- HMS Interhospital Medical Education Collaborative
- Annual Spring Symposium on the Science of Learning

IX. Methods for Evaluating Results
The PME’s Center for Evaluation will be involved directly in evaluating the new curriculum relying on a variety of approaches, including student surveys and focus groups, comparison of standardized exam performance (USMLE and Shelf Exams), performance in clerkships and on OSCEs. Students in the current curriculum will serve as controls. We used a similar approach when assessing the curriculum changes made in 2006-2008, including the introduction of the Cambridge Integrated Clerkship and the PCEs. We will also be monitoring the Graduation Questionnaire, and we are in the process of developing a new instrument to assess the extent to which the learning environment has been improved and our learning objectives achieved.

X. Projected Timeline (AY13-AY18)

**June 2012**
Annual Medical Education Leadership Retreat—Launching of the Task Force on Revision of the Preclerkship Curriculum

**Year 1—AY13: Task Force and Subcommittees**
- **October-January:** task force reviews new models at other medical schools, develops overall vision for direction and design (thematic curriculum organization, balance of pedagogical approaches, novel clinical skills approach, blueprint for a comprehensive assessment plan).
- **February-June:** Subcommittees are established and develop plans for *content and organization; clinical skills; pedagogy; milestones/assessment*. Task Force continues to meet periodically to review subcommittee plans and facilitate integration.
May-June: Present progress reports to the HMS Curriculum Cabinet (May) and Dean’s Cabinet

September-June: Consider teaching space needs to accommodate new pedagogy and technology; TMEC Programming Study by architectural firm CO Architects, with input from the Task Force and Subcommittees.

**June 2013** Annual Medical Education Leadership Retreat—Report of the task force subcommittees, consensus established for direction of curriculum reform

**Year 2—AY14: Design Committees**

A subcommittee of the Task Force met over the summer and early fall of 2013 to consider feedback from the June 2013 retreat and outline curriculum content areas as well as a timeline and time allotments for each content area. Small Curriculum Design Teams were appointed in November to develop Year-I course curricula and pedagogical approaches for implementation in AY15 and define content of Year-I courses and design courses

*Phase 1 - November 2013-February 2014:* Curriculum Design Teams determine content of “Fundamentals” and Organ-System Blocks, then distribute plans to the HMS community for feedback.

*Phase 2 - March 2014-June 2014:* Expanded Design Teams begin to establish details of courses; write curriculum materials (syllabi, cases, student learning assignments); determine needs for study resources; develop assessment strategies and tools, evaluation exercises, and a faculty mentoring program; and identify, recruit, and appoint core faculty. Convene working groups on assessment, faculty development, technology, core faculty and faculty compensation, and learning space planning.

*January 2014 –March 2014:* Solicit student nominations for service on curriculum design committees; ideally, student committee members should have completed the required preclerkship and PCE curricula and demonstrated an interest in education.

**June 2014** Annual Medical Education Leadership Retreat—Reports by Design Committees

This annual retreat will represent the milestone at which point a final decision will be made to proceed with final design and implementation of the various components of curriculum redesign, including plans for assessing the impact of the new program. By the time of the annual retreat in June 2014, a target curriculum calendar will have been established and preliminary plans will have been drafted for how to realize our vision and achieve our goals. Two of the most pressing needs will be concrete plans for 1) accommodating the overlap between the prior curriculum and the new curriculum and 2) providing the faculty development resources to equip our teaching faculty for the novel pedagogy to which we aspire. For the overlap between “old” and “new,” we will have to plan for the “frame-shift” in timing of teaching both Year II in the prior curriculum and Year I in the new curriculum (e.g., elements of pathophysiology will need to be taught for both classes during the same year), in securing faculty to precept in the prior *Patient Doctor-II* course and the new clinical skills course, *Practice of Medicine,* and, perhaps most challenging, in accommodating PCE core clinical clerkships for two classes at the same time during the months between the end of the Year-III PCE for the last class in the prior curriculum and the Year-II PCE for the first class of the new curriculum.

**Year 3—AY15: Design Committees**

- Design assessment; design advanced basic/clinical science courses

*Phase 3a June 2014-January 2015:* Core faculty groups continue to develop course details and syllabi; detailed faculty development plans developed; assessment exercises developed; develop
preliminary outline of the TMEC space renovations and timeline to accommodate needed changes in pedagogy

**Phase 3b January 2015 – June 2015:** Finalize course details and syllabi; conduct faculty development for core faculty; begin outlining Years III-IV, advanced basic and clinical sciences (“ABCS”)—required core, selective, and elective courses; Scholarship in Medicine. Plan for transition and “frame shift” between the current FOM curriculum and the new curriculum, anticipating the potential for overlapping course offerings

- For the preclerkship curriculum, as current Years I and II are merged, components of preclerkship courses will have to be taught in one way to students in the Class of 2018 and in another way to students in the Class of 2019, requiring faculty to teach the same material twice in one year.
- For the PCE, as the transition is made from its offering in Year III to its offering in Year II, the potential exists for an overlap period when two full classes will be on the wards in clinical clerkships at the same time for periods of 6-9 months or longer.

**June 2015** Annual Medical Education Leadership Retreat—Reports by Design Committees

**Year 4—AY16: Implementation I**
- Year-I curriculum for Class of 2019 entering in August 2015
- Continued planning and refining Year III
- Continued implementation of the new faculty development program for successive Year I courses and early Year III courses

**Year 5—AY17: Implementation II**
- Year-II curriculum (PCE) for class entering in August 2015
- Year-I curriculum for Class of 2020 entering in August 2016
- Continued design and planning for advanced basic and clinical science courses for Year III to begin in August 2018
- Continued focus on faculty development

**Year 6—AY18: Implementation III**
- Year-III advanced basic and clinical sciences curriculum for class entering in August 2015

**XI. Communication**

The proposals recommended by the *Task Force on Redesign of the Preclerkship Curriculum* and its Subcommittees are being presented broadly to the HMS community. To date, presentations made to the following have been well received:

- Faculty Council
- Curriculum Cabinet
- Curriculum Committee
- Clerkship Directors
- PME Annual Leadership Retreat
- Alumni Council
- Dean’s Cabinet
- Board of Fellows
- Masters and Associate Masters
- Hospital CEOs
- Harvard School of Dental Medicine
- HST Curriculum Committee
- Emeritus Faculty
- Faculty of Medicine Meeting

Included in additional communications plans are presentations to the following groups:
- Conference of Department Heads
- Departmental Executive Committees
- Preclinical Chairs
- HMS Visiting Committee
- Hospital faculty via grand rounds

XII. Curriculum Design Senior Executive Advisory Committee

For another, independent perspective, the Dean is convening an executive advisory committee drawn from the senior leadership of the faculty who are not actively and directly involved in curriculum redesign. They will meet periodically during the academic year to provide feedback on curriculum redesign proposals and recommendations.

XIII. Summary of Recommendations

The following are the AY13 recommendations of the Task Force Subcommittees, upon which curriculum design will be based, beginning in AY14

**Content and Organization:** In an effort to closely integrate basic science with early clinical experiences, the **Content and Organization subcommittee** has proposed a one-year (12 to 14-month), intensive preclerkship curriculum designed specifically to prepare students for the wards. The students would then enter the Principal Clinical Experience (PCE) with its current structure intact, several months earlier than in the current curriculum. Following the PCE year, the students would begin a redesigned third year, which would include a return to advanced basic science in the classroom, Boards study and exams, and sufficient time for the scholarly project. This developmentally progressive approach would allow for increased flexibility, provide opportunities for students to tailor their coursework to align with specific areas of interest, situate the scholarly project at a more appropriate time in the curriculum, and move Step 1 of the national boards to Year III (eliminating the distraction this exam creates for students currently during the culmination of the preclerkship curriculum).

**Pedagogy:** The deliberations of the **Pedagogy** subcommittee included discussions about the feasibility of a core faculty model with more concentrated teaching by a smaller cadre of faculty and a de-emphasis on guest lecturers who are content experts. Content would be acquired by students independently and in learning teams, and reliance on faculty-student time for passive relaying of information would be minimized. Instead, faculty-student time would be spent in interactive sessions for the purpose of clarifying and integrating material (the “flipped classroom” model) in a team-based learning model. The potential exists for establishing several “layers” of core faculty: content experts, theme-based faculty across organ systems, and faculty with expertise in education and assessment.

**Assessment and Milestones:** The **Assessment** subcommittee proposed longitudinal, multifaceted and cumulative assessments in a variety of formats and venues throughout the preclerkship curriculum. One of the keys to the success of this model is active participation by faculty with experience and expertise in assessment as part of the core faculty concept. An important aspect of this new assessment model is the balance between a “safe” learning environment on the one hand and high expectations as well as individual and team accountability for learning on the other hand.
Clinical Skills: The Clinical Skills subcommittee focused on one of the primary goals of curriculum reform—integration of early clinical experiences—with students assigned to practice sites upon matriculation. A key to this model’s success is faculty development for preceptors at the sites to ensure seamless integration with basic science in the clinical setting. The Clinical Skills subcommittee pursued translation of the plan articulated by the 2009-2010 Task Force on Teaching Clinical Skills, which includes adding a longitudinal ambulatory component that would model the patient-physician relationship and introduce students to innovative team-based, interprofessional practices.

Learning Space: Based on the TMEC programming study, CO Architects proposed a model to accommodate the needs articulated by the Task Force on Revising the Preclerkship Curriculum. The space design emphasizes flexible classroom space (that could be partitioned with movable walls); flat “learning studios,” i.e., active learning classrooms that foster highly interactive team-based learning; a flatter auditorium that can be partitioned and that contains moveable furniture for team-based learning exercises; and “skills lofts” for simulation, virtual microscopy/anatomy, and self-study in student teams. The plan has the potential to adapt to evolving needs for anatomical dissection, prosections, and digital anatomic resources and acknowledges the strong consensus that the education building needs dedicated, multipurpose, flexible-option study space for students and appealing social space for students. In addition, the proposal opens up TMEC to the Quadrangle campus and to Longwood Avenue, includes an emphasis on windows and glass walls to allow light throughout the building, and leverages Atrium bridges to improve flow across TMEC floors.

XIV. Culture Change

The specifics and challenges of introducing this new curriculum paradigm will be formidable, but underlying these innovations will be substantial culture change:

1. From a relatively rigid "2+2" curriculum divide (basic/population science in Years I-II, clinical in Years III-IV) to a continuum of integrated basic/population/clinical experiences and learning that spans all four+ years of the curriculum and that is developmentally more appropriate for learners;

2. From a curriculum in which passive transfer of information occurs regularly in large lectures to a curriculum in which lectures are deemphasized in favor of highly interactive classroom experiences that focus on problem solving (critical thinking) to reinforce concepts;

3. From a problem-based learning (PBL) paradigm to a Team-Based Learning (TBL) paradigm in which students are accountable not only for their individual learning and success but for the learning and success of teams (high expectations and accountability for personal and team learning);

4. From a teaching culture that is disjointed, siloed, and fragmented to one that is highly integrated, coordinated, and collaborative;

5. From an assessment approach that favors tidy “tying up” of each short block to one in which longitudinal cumulative learning (and the ability to summon concepts from previous blocks and disciplines) is expected and assessed;

6. From a culture of "one-size-fits-all" to a curriculum more individually tailored to interest and career path.
7. From students who like “being fed” and from faculty who like “to feed” to students and faculty who collaborate on self-directed learning; and

8. From a hierarchical learning paradigm to a horizontal partnership in scholarship.
Appendix A: Task Force on Redesign of the Preclerkship Curriculum

- Richard Schwartzstein, Chair (Integrated Human Physiology, the Academy; BIDMC)
- Melanie Hoenig, Co-Chair (Human Systems/Renal; BIDMC)
- Lisa Breen (Surgery Clerkship/Anatomy; BWH)
- Bernard Chiang (Human Nervous System and Behavior; BIDMC)
- Barbara Cockrill (Human Systems; BWH)
- David Cohen (HST)
- Michele Cohn, ex officio (Curriculum Services; HMS)
- Jules Dienstag, ex officio (Program in Medical Education; HMS)
- Rainer Fuchs, ex officio (Information Technology)
- Richard Haspel (pathology; BIDMC)
- Peter Howley (Quad faculty at large; HMS Microbiology and Immunobiology)
- Randy King (Molecular and Cellular Basis of Medicine; HMS)
- Edward Krupat (Center for Evaluation; HMS)
- Bruce Landon (senior faculty at large; HCP; HMS)
- Andrew Lichtman (Immunology, Microbiology, Pathology; BWH)
- Sophia McKinley (HMS IV)
- Graham McMahon (Human Systems/Endocrinology; BWH)
- Jane Neill, ex officio (Program in Medical Education; HMS)
- Alberto Puig (Principal Clinical Experience; MGH)
- James Rathmell (pharmacology; MGH)
- Jay Reidler (HMS IV)
- David Roberts (IHP/Human Systems/Respiratory, PCE, Academy Center for Teaching and Learning; BIDMC)
- Barrett Rollins (senior faculty at large; DFCI)
- Fidencio Saldaña (Practice of Medicine, BWH)

Appendix B: Expanded Task Force Charge Guiding Questions

1. Define the basic and population sciences fundamental and relevant to the study and practice of medicine that a student must master before embarking on clinical training (WHAT TO TEACH)
   a. What content in the basic and population sciences is really relevant and necessary for learning and practicing medicine?
   b. Do we have the correct balance (emphasis and time allotment) of subject matter in Years I and II?

2. Consider the organization and sequence of the requisite content in Fundamentals of Medicine (STRUCTURE, interdisciplinary approaches)
   a. Should the curriculum be organized as discrete courses or around interdisciplinary thematic modules (e.g., Case Western Reserve: Human Blueprint; Food to Fuel; Homeostasis; Host Defense and Response, etc.)?
   b. Should we retain organization of the curriculum as normal biology followed by abnormal biology or should normal and abnormal be integrated within organ systems?

3. Consider the introduction of novel pedagogic approaches that foster critical thinking to replace or supplement traditional lectures, tutorials, and laboratory exercises (HOW TO TEACH)
   a. Is there still a role for the traditional lecture or should all large group sessions be modeled on a “flipped classroom” design?
   b. Do we have the right size and model for small group learning sessions (PBL, case-based, team-based)?

4. Consider whether to continue relying on multiple faculty who are experts in narrow domains or whether students would be better served by a cadre of core teaching faculty who have broader content expertise and who place emphasis on the best pedagogy (WHO SHOULD TEACH)
a. What model best fosters our teaching mission and inspires students to learn and lead—traditional topic experts, a dedicated core of teachers/educators who focus on integration across topics, courses, and themes, or a combination of both?

b. What is the right balance between teachers who are content experts (traditional, inspirational role models) and those who are pedagogy experts?

5. Consider how technology can enhance teaching and learning in the Fundamentals of Medicine curriculum (TECHNOLOGY)
   a. Are we keeping pace with advances in educational technology in the way we teach specific subjects, e.g., histology, anatomy, pathology, physiology, pathophysiology, etc.?
   b. What new technologies can be applied to meet the needs and expectations of 21st century learners and faculty?

6. Consider space needs and the ideal space configurations for a 21st century learning environment for pre-clerkship medical education (WHERE TO TEACH)
   a. How can we modify our teaching spaces to promote active, dynamic learning that enhances collaborative student-faculty and student-student interaction?
   b. How can we design learning spaces that meet our assessment goals, including assessment of clinical skills, critical thinking, and content knowledge and understanding?

7. Consider approaches to longitudinal student assessment across the pre-clerkship curriculum (HOW TO ASSESS)
   a. How can we leverage assessment to enhance learning and teaching?
   b. Can we migrate toward a more integrated, comprehensive assessment process that integrates and reinforces learning developmentally?

8. Consider how best to integrate development of clinical skills with the learning of normal and abnormal processes (CLINICAL SKILLS)
   a. How can the new model for teaching clinical skills (including early longitudinal ambulatory experiences, modeling of professional behavior, and functioning in teams) form a scaffold for integrating the teaching of basic biological and social sciences?
   b. What is the best preparation for the clinical immersion experiences of the Principal Clinical Experience year?

Appendix C: Task Force Subcommittees (AY13)

Content and Organization
- Randy King, co-chair
- Bernard Chang, co-chair
- Zoltan Arany
- Michele Cohn
- Peter Howley
- Bruce Landon
- Andrew Lichtman
- James Rathmell
- Jay Reidler
- Jeremy Richards
- Trudy Van Houten

Pedagogy
- Richard Schwartzstein, co-chair
- Melanie Hoenig, co-chair
- Rainer Fuchs
- Richard Haspel
• Matthew Lavoie
• Alexander McAdam
• Emma Morton-Eggleston
• Michael Parker
• David Roberts
• Evan Sanders

Clinical Skills
• Alberto Puig, co-chair
• Fidencio Saldaña, co-chair
• Jules Dienstag
• Lisa Breen
• Rebecca Cunningham
• Diane Fingold
• Kristen Goodell
• Colleen Graham
• Daniel Hunt
• Sophia McKinley
• Katharine Treadway
• Beverly Woo

Milestones/Assessment
• Graham McMahon, co-chair
• Edward Krupat, co-chair
• David Cohen
• Barbara Cockrill
• Jane Neill
• Nora Osman
• Stephen Pelletier
• Laurie Raymond
• Barrett Rollins
• Amy Ship

Appendix D: Phase-1 Design Teams (AY14)

FOUNDATIONS:
• Randy King (cell biology/biochemistry) – leader
• Jules Dienstag (Program in Medical Education)
• Joel Hirschhorn (genetics)
• Andrew Lichtman (pathology)
• Diana Longden (Curriculum Services)
• Alex McAdam (microbiology)
• Carl Rosow (pharmacology) [James Rathmell, consultant]
• Trudy Van Houten (anatomy)

ORGAN SYSTEM BLOCKS:

HOMEOSTASIS I
• Richard Schwartzstein (Respiratory Year I) - leader
• Jonathan Aster (Hematology)
• Barbara Cockrill (Respiratory Year II)
• Duane Pinto (Cardiovascular Year I)
• Thomas Rocco (Cardiovascular Year II)
• Evan Sanders (Curriculum Services)

HOMEOSTASIS II
• Melanie Hoenig (Renal Years I and II) – leader
• Caitlin Hoey (Curriculum Services)
• Daniel Kamin (Gastrointestinal Year I)
• Anastasia Koniarsis (Reproductive, Year I)
• Graham McMahon (Endocrine/Reproductive Year II)
• Helen Shields (Gastrointestinal Year II)
• Joseph Wolfsdorf (Endocrine Year I)

NEUROSCIENCE/BEHAVIOR/DEVELOPMENT
• Bernard Chang (neuroscience) - leader
• Jonathan Alpert (psychiatry)
• Michele Cohn (Curriculum Services)
• Matthew Lavoie (neuroscience)
• Kristen O’Neil (Curriculum Services)
• Alison Schonwald (development)

IMMUNITY IN DEFENSE AND DISEASE
• Andrew Lichtman (immunology/pathology) - leader
• Rachael Clark (dermatology)
• Michele Cohn (Curriculum Services)
• Simon Helfgott (rheumatology)
• Alexander McAdam (consultant, immune-inflammatory diseases)

SOCIAL/POPULATION SCIENCE
• Haiden Huskamp (health policy) – leader
• Sally Bartlett (Curriculum Services)
• Edward Hundert (ethics)
• Jonathan Finkelstein (clinical epidemiology/population health)
• David Jones (social medicine)
• Jane Neill (Program in Medical Education)

PRACTICE OF MEDICINE
• Fidencio Saldaña (Patient Doctor-II, BWH/Faulkner) – co-leader
• Alberto Puig – co-leader (PCE, MGH)
• Jules Dienstag (Program in Medical Education)
• Sara Fazio (Center for Primary Care, Medicine Clerkship Director, BIDMC)
• Diane Fingold (Patient Doctor-II, MGH)
• Kristen Goodell (Center for Primary Care)
• Colleen Graham (Curriculum Services)
• Alex Green (Cross Cultural Care Education Committee, MGH)
• David Hirsh (Patient Doctor-II, PD-II OCSE, PCE, CHA)
Appendix E: Examples of Guiding Questions for Phase-1 Design Groups

Respiratory System component of Homeostasis I – Maintaining Aerobic Metabolism

Anatomy/Radiology

- How does the anatomy of the chest wall, lung, and pleura contribute to the development of intra-thoracic pressure?
- How does the vascular supply of the lungs differ from most other organs?
- How do the anatomic features of the lungs protect the tissue from hypoxic injury?
- How does the anatomy of the airway change as it moves from the trachea to the alveolus? What are the implications of these changes for airflow?
- How do the anatomic features of the respiratory system help protect against infection?
- How does the anatomy of the respiratory system correlate with findings on a chest radiograph?

Physiology

- How does the physiology of the lung and chest wall interact to determine the lung volumes functional residual capacity, total lung capacity, and residual volume?
- How does the physiology of the chest wall, lungs and airways interact to determine airway resistance and airflow at different lung volumes?
- How does gas exchange (transfer of oxygen and carbon dioxide) occur in the lungs? How do changes in physiology of the respiratory system contribute to hypoxemia and hypercapnia?
- How does the respiratory system contribute to regulation of the acid-base status of the body?
- Why do we breathe? How does the physiology of the respiratory system regulate the rate and depth of breathing?

Pathophysiology

- How do pathologic changes in the lung parenchyma and airways contribute to increased airway resistance? How are these changes reflected in pulmonary function tests and gas exchange? How do the physiologic consequences of increased airway resistance contribute to dyspnea?
- How do pathologic changes in the lung and chest wall contribute to decreased compliance of the respiratory system? How are these changes reflected in pulmonary function tests and gas exchange? How do these changes contribute to dyspnea?
- How do respiratory infections manifest in the lungs? What are the physiologic consequences of respiratory infections? How are these changes reflected in pulmonary function tests and gas exchange?
- How does cancer manifest in the lung? What are the physiologic consequences of cancer in the lungs?
- What are the radiographic manifestations of obstructive and restrictive lung disease? What are the radiographic manifestations of respiratory infections?
Pharmacology

- How does the pharmacology of aminophylline, beta agonists and anti-cholinergics determine their dosing, toxicity, and effects as bronchodilators?
- How does the pharmacology of corticosteroids determine their dosing, toxicity, and effects in inflammatory lung disease?