Subcommittee Summary Report

Regarding

Curriculum Reform for

Integrated Basic Science

University of Colorado School of Medicine

Integrated Basic Science Subcommittee (IBSc) Membership

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1. Summary

A) Statement of the problem/definition/charge

Within the Medical School Curriculum, basic medical science content that forms an essential part of the foundation of clinical practice is currently aggregated into a chunky, inhomogeneous amalgam with clinical content, with the result that the basic medical science content is often not effectively integrated with the clinical content. This has three deleterious effects:

- First, ineffective integration reduces student motivation for learning basic science content because the connections to medical practice – medical students' over-riding interest – are often not evident.
- Second, ineffective integration reduces student comprehension of content, most notably clinical content, because student's ability to effectively apply basic science concepts to clinical situations is under-developed.
- Third, ineffective integration reduces student retention of content, both clinical and basic, because when scientific explanations presented in the basic science components of the curriculum are not clearly connected to clinical content, the mental "stories" that students need to construct in order to help organize their thinking are incomplete and confusing, and are thus not memorable.

In order to overcome these deficiencies arising from the current Medical School curriculum, the Integrated Basic Science subcommittee (**IBSc**) proposes 5 Essential Recommendations and 3 Suggested Recommendations, as listed below.

B) Recommendations (Essential and Suggested)

Essential Recommendations

1) Cultivate, support, and utilize a small cadre of Master Medical Educators to develop, direct, and deliver the Basic Medical Science curriculum.
2) Triage the existing Essentials Core (Phase I-II) learning goals and objectives into 3 Phases, to facilitate integration of basic medical sciences across all levels of medical school.
3) Reduce the curricular time devoted to preclinical training.
4) Deliberately and explicitly integrate the Basic Medical Science curriculum with all levels of clinical training across UME.
5) Delay the USMLE Step 1 Exam until after Core Clerkships.

Suggested Recommendations

1) Re-structure the organization of current Phase 1 and Phase 2.
2) For the proposed new Phase 1, adopt classroom strategies and methods of assessment that promote critical thinking, build skills for life-long learning, and foster curiosity.
3) Meaningfully integrate current Foundations of Doctoring and Essentials Core Threads with the preclinical basic science curriculum.

2. Purpose of the committee

The purpose of the IBSc subcommittee is to develop plans to reform the way basic science education—what is currently taught to first and second year medical students—is taught and integrated into the rest of the curriculum. To focus the committee's proposals, working definitions for the following terms are needed:

Basic Medical Science: the (i) scientific principles, concepts and facts that (ii) must be mastered by all medical students. Thus "basic" refers to scientific content that underlies medical practice; it does not refer solely to content taught in the first 2 years of the current curriculum, nor does it refer to science that is not directly relevant to clinical practice (as in "basic research" versus "translational research").

Integration: fusion of basic medical science content with clinical content in a manner that fosters sound understanding of normal and abnormal function and of rationales for clinical diagnosis and therapeutic intervention.

Goals of integration of the basic and clinical components within the overall curriculum

- Efficiently and effectively relate basic medical science content to clinical reasoning and practice.
- Improve student comprehension and retention of basic science and clinical content by better engaging students through the use of more active learning strategies.
- Promote student enthusiasm for, and the habits of mind that lead to, life-long learning (related to curiosity and also leadership).
- Instill a philosophy of critical thinking (important in diagnosis, and in evaluation of evidence).
- Teach students when they are primed to learn: use cases, diseases and patients to motivate student learning.

Finally, in a reformed curriculum, however it is reformed, education of medical students should continue to place some emphasis on the nature of scientific advances that underlie medical practice, to prepare them to be life-long learners capable of evaluating and integrating new knowledge into their clinical practice. Thus students should be taught not only basic medical science that is currently known, but also elements of the history of medical advances.

3. Review of best practices

We divided members into 3 Working Groups to research best-in-class approaches to integrating basic sciences. Each group was tasked with reviewing a subset of medical schools that are part of the AMA's Accelerating Change in Medical Education Consortium, plus of few non-consortium schools engaged in innovations in medical education. In total, we reviewed 19 schools through a combination of website reviews, questionnaires, and phone or in-person discussions. Eight of the schools reviewed employ a traditional 2+2 model with an organ-system block structure for the Basic Sciences in years 1-2, which is similar to the current model at CUSOM. The remaining 11 schools offer alternative practices to strengthen and improve the integration of basic sciences. The alternative practices are summarized in the table below.

School (degree)	Key Innovations for Integration of Basic Sciences
AT Still Univ. (DO)	• 1+3 Model • Year 1 provides integrated basic + clinical sciences using a Clinical Presentations Model (120 core patient presentations) • Years 2-4 are in clinic
Case Western (MD)	• 1.5 years Foundations of Medicine & Health curriculum (basic sciences + early clinical training), primarily using organ system blocks with minimal lectures. Each block includes 3 weekly small-groups Case Inquiries (PBL format), and each block is followed by a full week of Clinical Immersion. • 1.5 years of Clerkships with Basic Science integration achieved through 1 weekly afternoon of small-group Case Inquiry throughout. Step 1 after Clerkship phase • Year 4: Sub-I's, advanced electives, and continuation of the weekly afternoon small group Case Inquiry
Emory (MD)	• Year 1 = Basic Science focus • Year 2 = Clerkships • Uses active learning formats with focus on small groups, and emphasis on the vertical and horizontal integration of basic and clinical sciences across all years (*unclear exactly how this is achieved*)
Harvard (MD)	• Preclinical phase is about 13 months long, strong team-based focus with nightly readings/videos and a pre-quiz before sessions, also features patients with relevant diseases that come to lecture to be interviewed by students, and clinical cases (1-2) are provided weekly, all exam questions are based on the cases (essay questions, exams every 2-3 Fridays). • Year 3-4 features selection of advanced courses that blend basic + clinical sciences (e.g., cancer boil, transplantation, biomed engineering, advanced pharmacology)
New York Univ. (MD)	• New C21 curriculum features an 18-month preclinical curriculum with emphasis on learner-centered technologies, patient-centered and disease-focus curriculum. • Step 1 is taken in Year 3.
Univ. of Connecticut (MD)	• New M-Delta curriculum • Stage 1 (18 months), uses case-oriented TBL, labs, and small groups (no lecture) for basic science focus • Claim they are "still figuring out basic science integration in Stages 2-3"
Univ. of Michigan (MD)	• Tree model with branches for individualization. • Year 1 includes basic science sequences. • Year 2 includes a clinical focus, but dedicated revisiting of basic sciences is achieved through daily (first half Yr-2) or weekly (second half Yr-2) afternoon small group sessions. • Step 1 is taken in Year 3. • Year 4: students teach a basic science course, Discovery project can include strong basic science focus
Univ. of North Carolina (MD)	• New TEC curriculum uses 'coils' for basic sciences integration in the Foundation Phase, with emphasis on TBL/PBL/group learning • GUTS (get up to speed) first course.
Vanderbilt (MD)	• Phase 1 (year 1, New Curriculum 2.0) = Foundation of Medical Knowledge, uses diverse learning modalities including teamwork on structured cases. • Phase 2 (year 2) = Clerkships + Longitudinal Core Clinical Curriculum (25 presenting problems) • Phase 3 Immersion (Year 3-4): continues to reinforce basic sciences with Integrated Science Courses
Vermont (MD) **non-consortium*	• Level 1 = 1.5 yrs, features Foundations Blocks integrating basic + clinical sciences. • Plans to go 100% lecture-free → fully flipped classroom. Curriculum deliberately progresses from more Teacher-Directed to more Student-Directed learning to promote habits of lifelong learning. • Level 2 = 1.5 – 2.75 yrs, Clerkships • Level 3 = 2.75 – 4 yrs, Step 1 taken after Clerkships
Duke (MD) **non-consortium*	• Year 1 = Basic Science Foundations (5 blocks), using various flipped classroom and small group formats. Basic science content is integrated into interdisciplinary courses to provide appropriate context, and the basic science subjects are pared down to the essentials needed for medical practice. • Year 2 = Clerkships • Year 3 = Scholarly Experience, for many this serves as an extended basic science curriculum centered on area(s) of individual interest to their clinical practice • Year 4 = Capstone, strong basic science focus possible

4. Aspects of CUSOM curriculum to be maintained

The current curriculum at CUSOM offers several strengths that should be maintained with our reform efforts:

- Several Blocks in the Essentials Core currently provide exemplary continuity, with one faculty member leading the teaching of an entire section of the block, or an entire topic across blocks (e.g., Dr. French with pharmacology, Dr. Cohen with immunology). Such continuity is necessary for a cohesive curriculum, helps ensure that gaps are filled, and allows for deliberate repetition, linking and scaffolding of knowledge. This strength should be expanded upon, which is possible if a smaller cadre of dedicated master medical educators is cultivated and supported.
- High value clinical experiences in the preclinical curriculum are a powerful way to promote the downward integration of clinical sciences. The dermatology patient activity is one example of a successful session that promoted the correlation of basic and clinical sciences, and helped student to better understand and retain the material. More gems like this should be identified and serve as the basis for the development of others.

5. Recommendations

We propose 5 recommendations that we deem essential, and 3 additional suggested recommendations. A description of each, along with rationale and potential challenges or opportunities, is provided below.

5.1 Essential Recommendations

#1) *Cultivate, support, and utilize a <u>small</u> cadre of Master Medical Educators to develop, direct, and deliver the Basic and Advanced Medical Sciences curriculum.*

Rationale:

- Developing and sustaining the curriculum reform initiatives will require a small, dedicated group of educators. This group of educators must include basic science <u>and</u> clinical faculty working collaboratively on an on-going basis.
- The large size of the current teaching faculty (N=1962!) makes it challenging to provide curricular continuity for the students, both within a block and across the Essentials Core.
- The large size of the current teaching faculty does not foster a deliberate, tight-knit community committed to the mission of educating future physicians, because it hinders regular dialogue, collaboration, and integration.
- There is a lack of accountability and engagement among many current faculty involved in teaching our medical students (last minute changes, lack of attention to deadlines/requirements)

Opportunities:

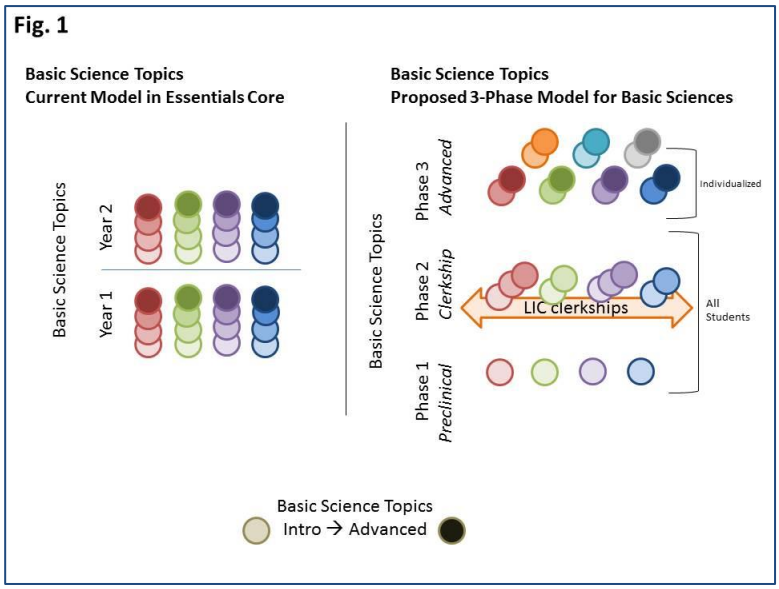
- The reform initiative, both Phase 1 and the upcoming Implementation Phase, offer an opportunity to begin to establish this cadre of dedicated master educators.
- There is precedent at the UCCS branch campus for hiring and retaining master educators with a higher FTE devoted to teaching and education, and some individuals in similar roles already at CUSOM, that may serve as models.
- Current “Content Steward” roles in the Essentials Core (e.g., pharmacology, pathology) may provide a model for educational leadership roles that extend beyond a single block or curriculum phase.

Challenges:

- Master Medical Educators must be adequately supported. This support must include explicit financial support, with protected time through a designated FTE, as well as support for continued professional development training including but not limited to workshops, certificates, conferences, etc. Importantly,

the support of our Master Medical Educators must extend beyond the strict classroom or contact time; support must include protected time for on-going dialogue, planning, and development of curriculum on a year-round basis.
    - We believe that currently, Block Director roles are closer to about 0.7-0.9 FTE during the Block (depending on length of Block), and approximately 0.10-0.25 FTE for the rest of the year.
    - Time dedicated to the Block is strongly influenced by the level of change/innovation that the Block is experiencing, and has increased as new policy requirements have been implemented (e.g., mandatory academic support meetings, exam revisions, cumulative exams, proctored exams, calls for more practice questions and exam question reform).
- Faculty with primary teaching roles must have a clear pathway to promotion and tenure. Current P&T guidelines may need to be modified to support this change, and the SOM must ensure that all Basic and Clinical departments appropriately interpret and consistently apply the revised guidelines for P&T of teaching-intensive faculty.

#2) ***Triage the existing Essentials Core (Phase I-II) learning goals and objectives into 3 Phases, to facilitate integration of basic medical sciences across all levels of medical school (Fig. 1)***



Phase 1: Basic Medical Sciences – Preclinical

Goal: Phase 1 will introduce the basic foundational medical science knowledge needed before preclinical training. The core objectives remain to be determined, but we believe they can likely be addressed in significantly less time than the current Essentials Core. The exact time needed should be determined only after consensus on the content redistribution. Preliminary ideas for the structure of Phase 1 are outlined in Section 5.2 – Suggested Recommendations.

Phase 2: Basic Medical Sciences – Clerkship

Goal: Phase 2 has two goals. First, to deliberately review parts of the core foundational medical sciences (i.e., Phase 1 content) in a manner that is aligned with the clinical experiences during clerkship. Second, to provide more depth, complexity, and context/application for select basic science topics, building on the knowledge base established in Phase 1. We strongly recommend that Phase 2 Foundational be tightly integrated with the Core Clerkships occurring during the initial phase of focused clinical training; suggestions for this are outlined in Recommendation #4.

Phase 3: Advanced Medical Sciences

Goal: Phase 3 will offer individualized options for pursing advanced training in basic sciences for medicine, allowing students the opportunity to focus their studies on areas that align with their future specialty or career goals, and allow for curiosity and exploration. We recommend that a predetermined minimum number of Advanced Science units should be required for each student. Preliminary ideas for the structure of Phase 3 are outlined in Recommendation #4.

Rationale:

- Current Essentials Core curriculum provides too much detail and depth, includes some highly advanced (specialty-level) topics that are not appropriate for novice medical trainees without clinical experience
- Prior to immersive clinical experiences, students lack the authentic context in which to apply a lot of the basic science concepts. Redistributing basic science content to clinical phases of training will increase motivation for learning, offer many opportunities for contextualized learning
- A true vertically/longitudinally integrated basic science curriculum takes advantage of spaced practice, retrieval practice, and interleaving, cognitive principles of learning that have been shown to improve deep understanding and long term retention
- Fosters curiosity and independence, development of skills needed for life-long learning

Opportunities:

- The current map of curriculum learning objectives for Phase I-II Essentials Core is comprehensive and robust. This provides a strong base from which to deliberately redistribute topics throughout all years of medical school. In this triage process, some topics may be identified as missing (gaps), which will require that new objectives or goals be developed, though we believe this will be minimal. The triage process may also highlight some objectives that are unnecessary for medical education; these should be pruned from the curricular map.

Challenges:

- The core Basic Medical Science knowledge will need to be carefully and deliberately determined through discussions with both basic science and clinical faculty. While our environmental scan highlighted that many schools are reducing the preclinical time, we have not explored how they have reduced and/or redistributed traditional 'basic science' content. This task will require significant effort and will undoubtedly be a major focus of the Implementation Phase of CUSOM Curriculum Reform. It may be worthwhile to reach out to other schools who have recently undertaken this task.
    - The guiding principle for determining Phase 1 topics should be: "what do students need to know before starting clinical rotations?"
- Developing the objectives for the 3 Phases and its associated curriculum will require a small, dedicated group of educators with dedicated time for this important task. This group of educators must include basic science and clinical faculty working collaboratively on an on-going basis.
    - See Recommendation #1
- Care must be taken to reassure basic science faculty and departments that content/time removed from the preclinical curriculum will indeed be meaningfully integrated into later clinical training. The historic legacy surrounding this topic has come up frequently in IBSc discussions, and in the co-chairs discussions beyond the committee, and there is general feeling of lack of trust stemming from the last curriculum reform at CUSOM.

#3) ***A reduction in the preclinical training time, to allow an earlier start for immersive clinical training***

We recommend an earlier start to immersive clinical training (i.e., clerkships), which in turn requires a reduction in the preclinical training time. As outlined in Recommendation #2, we propose to re-distribute the Essentials Core objectives into 3 Phases (Basic – Preclinical, Basic – Clerkship, Advanced), with Phase 1 of Basic Medical Science teaching occurring during the time devoted to preclinical training. With fewer objectives to cover prior to clerkships,

the time allocated to Phase 1 will be reduced compared to the current CUSOM Phases I-II. The exact length of Phase 1 must be determined after the redistribution of content. However, we are confident that Phase 1 can be achieved in significantly less time than the current Essentials Core.

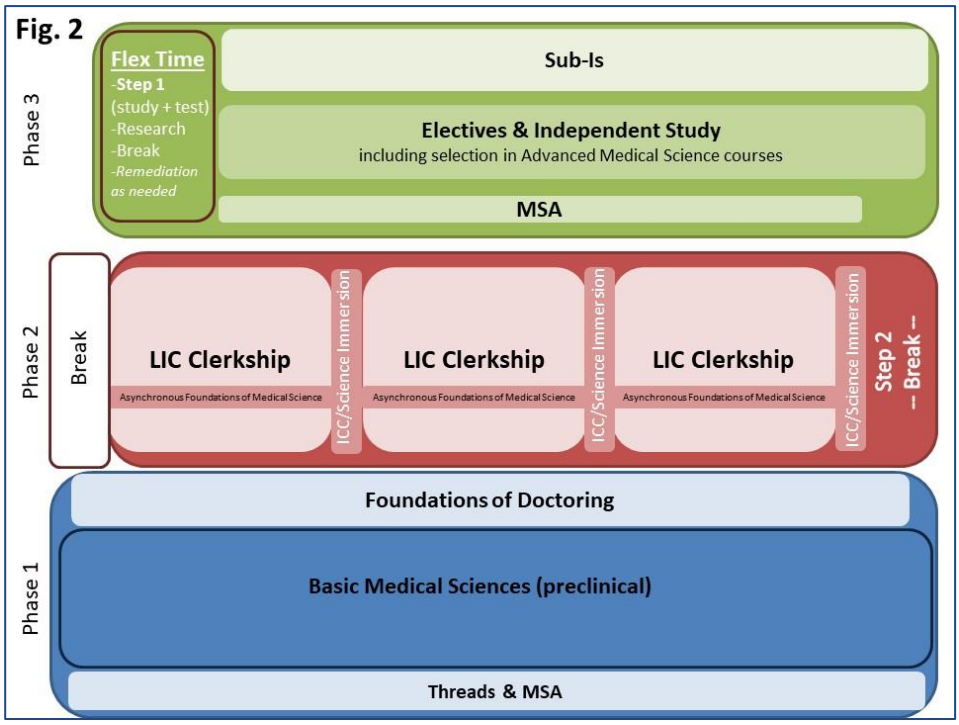
Rationale:

- Students primed for learning and motivated by clinical encounters, we can harness this for basic science learning by providing earlier authentic exposure to clinical experiences
- Facilitates contextualized or anchored learning, which is known to improve retention
- Earlier entry into clinic will help with professional identity formation

Challenges:

- Strain on faculty, space, resources when offering dual curricula when implementation of the new reduced preclinical curriculum happens. Will place heavy burden on current Phase II faculty and staff.

#4) Deliberately and explicitly integrate the Medical Science (Basic and Advanced) curriculum with all levels of clinical training across UME (Fig. 2)



Clerkship Training Phase

We recognize that informal bedside reviews of traditional 'basic science' content occurs in an ad hoc manner during many clinical rotations, and that many clerkships already devote some time (e.g., 1 afternoon) to reviewing basic sciences. Our goal is to formalize and standardize the integration of Phase 2 Basic Medical Sciences during clinical training. The eight core clerkships (Internal Med, Surgery, Peds, Family Med, Psych, Neuro, OB/GYN, Emergency Med) offer a rich, untapped opportunity to formally review the Phase 1 Basic Medical Science objectives addressed during the preclinical curriculum, while also providing an ideal clinical context for introducing new topics that provide more details, add complexity, and offer application of the Basic Medical Sciences (Phase 2).

We also recognize that the mode of integration must align and support the clerkship model for this phase of training. The proposal outlined below is flexible enough to work with either a Longitudinal Integrated Clerkship (LIC) or a Traditional Block Clerkship model. With either model, it is important to note that by adding a firm Basic Science curriculum to the Clerkships, time in Clerkship must necessarily increase so that students are not burdened.

For Each Clerkship:

- Define a set of specific learning objectives from the Phase 1 Basic Medical Sciences. This content will be deliberately reviewed and applied in-context during the clerkship. The preclinical and clerkship faculty should work collaboratively to define this.
- Define a set of new learning objectives that adds depth or complexity to the core Basic Medical Sciences (Phase 2 Basic Medical Sciences, see Recommendation #3). This content will be introduced and applied during the clerkship. The preclinical and clerkship faculty should work collaboratively to define this list.
- Develop curriculum around the two sets of LOs (Phase 1 + Phase 2).
    - Asynchronous digital learning modules can be used to minimize disruption to LIC experiences. Modules should be interactive, use formative and summative assessments, be clinically-based, and foster integration among the Basic Sciences, as well as integration between the Basic and Clinical Sciences.
        - To further maximize integration, we suggest that modules be linked to each student's Patient Logger. E.g., student logs visit with a patient presenting with headache; this entry triggers an invitation to complete an associated Clinical Foundations of Medical Science module that reviews and advances the foundational knowledge for this clinical scenario.
        - To prevent modules from accumulating, each should have a due date.
        - Completed modules should remain accessible for later review and Step 1 preparation.
        - It is imperative that meaningful incentives (grades, etc) be developed for the in-clerkship asynchronous learning modules, to ensure that students devote time to them
        - The length of each clerkship block (or the overall LIC time) should increase, to provide students will adequate time to complete the Basic Science component that is added to this phase
    - Additional non-clinic time should also be devoted to a formal in-person review or advancing of Basic Sciences Phase 2 content, with opportunity for students to ask questions through classroom or laboratory experiences. In a Block model, this can be accomplished by setting apart some time during or at the end of the clerkship. In an LIC model, this can be accomplished by extending the time currently used for ICCs during the clerkship year (but before Step 1).
        - These in-person sessions should emphasize active learning formats and the application, transfer, and integration of knowledge.
- We recommend that faculty who teach in Phase 1 continue to be involved in the teaching of Basic Science topics in Phase 2. This will prove critical for successful scaffolding and continuity between Phases.
- It is essential that we build a close-knit group of master educators to coordinate the integration of basic science topics during clerkships. Basic Science and Clinical faculty must work collaboratively.

For Sub-Is and Career Exploration Phase:

- Offer a series of electives in Advanced Medical Sciences, that allow students to customize their training in more advanced topics
    - Currently, electives do not count for credit and no minimum number is required. We recommend establishing a minimum requirement for Advanced Science training.
    - Advanced science electives could feature a mix of formats, including in-person classroom based, lab based, asynchronous or MOOCs (e.g., Coursera).
- Create formal Independent Study opportunities in various basic science domains to allow for tailored advanced training in the sciences (optional but could count towards the minimum requirement).

#5) *Delay Step 1 until after core clerkships*

We recommend that students take Step 1 after completing their Core Clerkships, following a dedicated study period. We also recommend that Step 1 be move to after the Step 2 exam, allowing students to take Step 2 immediately after the end of their Core Clerkships.

Challenges:

- Students are already anxious about Step 1. We need to tread cautiously when making changes to the timing of this exam. Care must be taken to continue to solicit and monitor student response around this change.
- We do not advocate changing the timing of Step 1 once a cohort has matriculated.

5.2 Suggested Recommendations

#1) Re-structure the organization of the preclinical phase (current Phase I-II)

Concurrent with Phase 1 Basic Science in the preclinical curriculum, we recommend continuing to maintain the Foundations of Doctoring, longitudinal curricula (e.g., radiology), and thread sessions. Evidence-Based Medicine and Health Systems curriculum should be expanded and integrated. A full day each week could be devoted to practical FDC sessions, and the preclinical curriculum should include some more substantial clinical experiences as possible (e.g., clinical immersion week or interlude).

Before we can propose an organization structure for Phase 1 Basic Sciences, we advocate first determining the learning objectives and goals of this phase. Learning formats should support the learning goals, and be deliberately designed. This work remains to be determined. Some preliminary ideas (not an exhaustive list!) that IBSc has discussed includes:

- Short immersive boot camp-style mini-blocks to establish a common framework and language early on in the first year (e.g., anatomy, pharmacology, cell bio).
- A case-based curriculum structure to organize the teaching of the rest of the Core topics and facilitate integration between the basic sciences and between basic and clinical sciences. Cases could be grouped according to disease/system themes, but every traditional basic science discipline would essentially be a longitudinal curriculum. Cases should intentionally focus on the more commonly encountered and essential clinical topics like diabetes, sepsis, COPD, etc. (i.e., the bread & butter clinical context, rather than the rare & obscure conditions).
- Current block structure may not be ideal as it continues to silo content and fosters a memorize-and-dump mentality.

#2) Adopt more classroom strategies and assessments that promote critical thinking, build skills for life-long learning, and foster curiosity

Rationale:

- Our current lecture-heavy model does not engage our students (voting with their feet) and promotes memorization-and-dumping rather than critical thinking and habits of life-long learning
- Active learning strategies including flipped classroom models, TBL, PBL and other case-based approaches, and small group activities promote transfer and application of knowledge, help with retention, give students more ownership over their own learning, and aid with development of effective skills for life-long learning

Opportunities:

- Many Blocks and other aspects of the SOM UME curriculum have piloted innovative, active-learning sessions in the last few years. See examples in ECBD block reports.
- The Academy of Medical Educators has trained faculty and resources to help build on current pilot efforts

Challenges:

- Requires a trained faculty to effectively design and facilitate sessions, and support for continued training and professional development
- Requires cutting edge IT resources and support to aid in development of novel content delivery methods (e.g., MOOCs, modules, recorded mini-lectures, electronic TBL platforms, etc)
- Current MS1 and MS2 lecture halls in Ed 1 are less than ideal for team-based or group activities.
    - Could the Ed 1300 and 1500 lecture halls be renovated for collaborative learning?
        - Current classrooms in Ed 2 North (Rm. 1102, 1303, 2104, 2303) are lecture halls designed for collaborative learning (2 rows of desks on the same level, allows groups to form and work together, while still preserving lecture style seating)
        - SOM does not have priority access to the Ed 2 North rooms, and the rooms are often used by other programs for non-collaborative sessions. Could they be designated with priority for collaborative learning sessions?
    - CAPE floor could be renovated as a dedicated SOM collaborative learning space, once CAPE moves to the new building.
- An emphasis on non-didactic learning strategies requires flexibility in the timing of sessions. We must have options beyond a 50-mins slot.
- Current large class size poses many logistical challenges for adopting significantly more small-group sessions (is 10-12 really small group?) and/or non-MCQ assessments. These alternative formats are resource-intensive, including demand for quality facilitators.

#3) Meaningfully integrate the current Foundations of Doctor and current Essentials Core Threads/Longitudinal Curricula with the Phase 1 Basic Medical Sciences curriculum

Our current Essentials Core Blocks each nominally contain FDC and Thread sessions, but these are often poorly aligned with the Basic Science curriculum.

6. Suggested Outcome measures/ Evaluation of program

We support continued student surveys and focus groups across all levels of UME, through the Evaluation Office. Feedback from Clerkship preceptors and training faculty, and scores on USMLE Step 1 as well as Shelf Exams, will be valuable outcomes measures to consider. Long term, we believe it would be essential to receive feedback from Residency Directors and other training faculty at the GME stage, to evaluate the adequacy of our students' Basic Medical Science preparation during the UME level.

7. Pilot ideas and next steps

We support launching the pilot integration projects that are actively being considered for Phases 1 and 2 in the coming academic year.