Tools to Successfully Integrate Clinical and Basic Sciences

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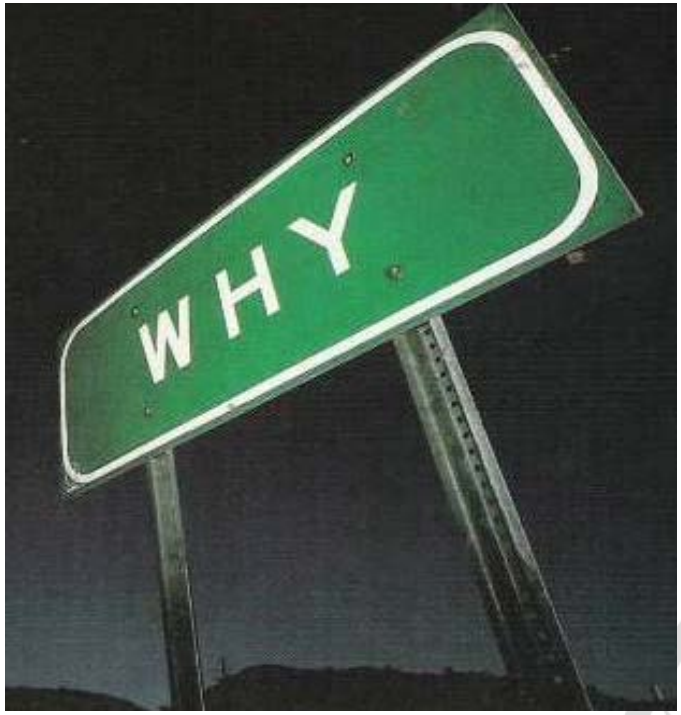
Why is it important to integrate foundational science with clinical science?



"AAMC Reviewer: Novel concept but is this important?"

Foundational Science in an Integrated Curriculum

Foundational sciences underlie the basis for life at the molecular level, for all disease states, and for the genetic, pharmaceutical, and biological treatment of disease.

Flexner Revisited: The Role and Value of the Basic Sciences in Medical Education

Edward P. Finnerty, PhD, Sheila Chauvin, MEd, PhD, Giulia Bonaminio, PhD, Mark Andrews, PhD, Robert G. Carroll, PhD, and Louis N. Pangaro, MD

Acad. Med., 2010

IAMSE-initiated study

Driven by "perceived reduction in time and focus on foundational sciences"

Value and Role:

"Sciences are not simply a compendium of facts but an integrated approach to problem-solving, a framework for understanding perturbations of normal functions, and a means to predicting the potential outcomes."

When and How:

"…sciences should be studied early and often ***throughout*** the UME experience."

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Foundational sciences underlie the basis for life at the molecular level, for all disease states, and for the genetic, pharmaceutical, and biological treatment of disease.

the role of basic science

Preparing medical students for future learning using basic science instruction

Maria Mylopoulos[1] & Nicole Woods[2]

Med. Educ., 2016

"...ability to **learn** new information from available resources, relate new learning to past experiences and demonstrate innovation and flexibility in problem solving."

Conclusions:

Our results show that the inclusion of basic sciences instruction **enhanced the learning of novel related content**.

Cause and Effect: Testing a Mechanism and Method for the Cognitive Integration of Basic Science

Kulamakan Kulasegaram, PhD, Julian C. Manzone, MSc, Cheryl Ku, MSc, Aimee Skye, PhD, Veronica Wadey, MD, and Nicole N. Woods, PhD

Acad. Med., 2015

"...results suggest that creating proximity between basic science and clinical concepts may not guarantee cognitive integration. Although cause-and-effect explanations may not be possible for all domains, making explicit and specific connections between domains will likely facilitate the benefits of integration for learners."

To achieve maximal impact, basic and clinical sciences need to be integrated on a "minute-by-minute" basis.

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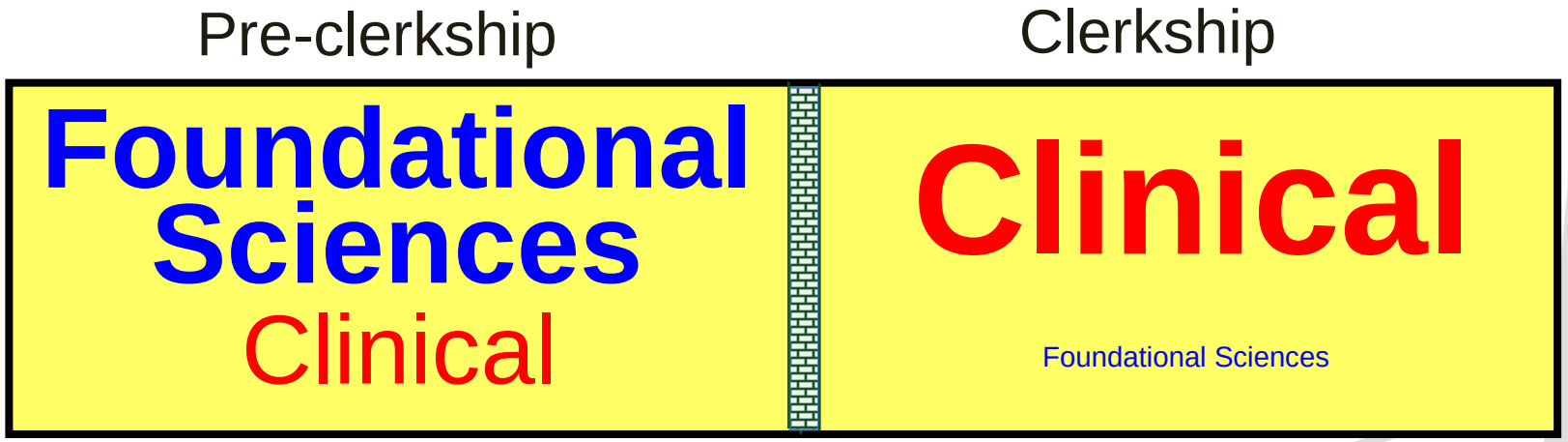
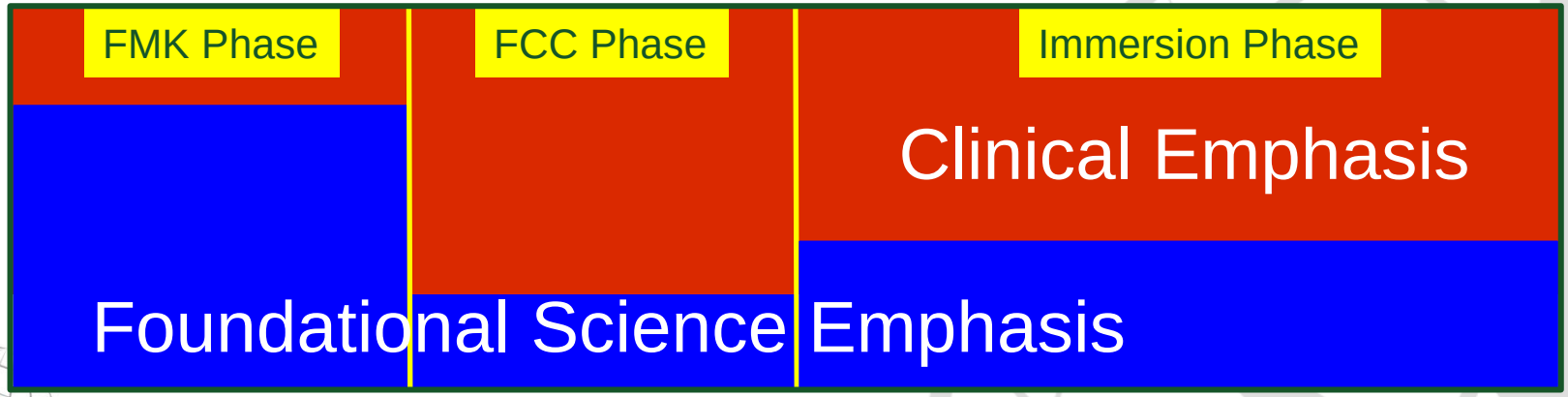
Traditional Curriculum *vs*. Curriculum 2.0



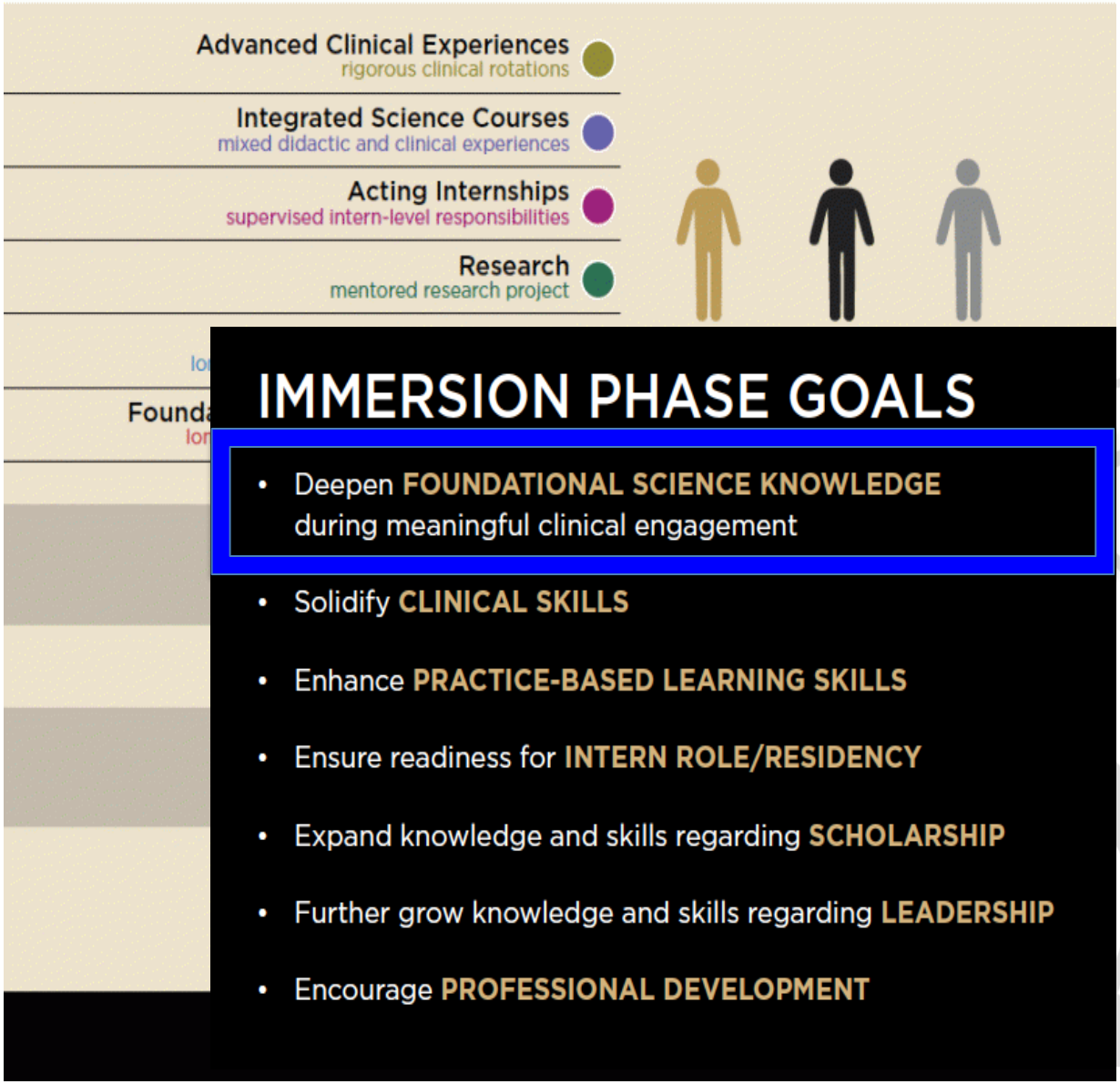
Curriculum 2.0



Teach foundational sciences across the medical school curriculum.
Teach foundational sciences in a context that prepares students for the clinical workplace.

Curriculum 2.0: Immersion Phase

A highly individualized post-clerkship phase
that uses clinical context to build upon prior learning



Immersion Phase Requirements

Minimum C2.0 Requirements (in Months)		
On-Campus	4	Integrated Science Courses (ISCs)
	1	Acting Internship (AI)
	4	Advanced Clinical Electives (ACEs) (Master Adaptive Learner)
On-Campus or Away	3	Research Immersion
	3	Competency and Interest-Driven Rotations (can be ISCs, ACEs, AIs or Electives)
15 required months		Must include: 1 Primary Care course 1 Acute Care course
4+2+1 (7 total)		*Flex months (4 + 2 month for Step 1 + 1 month for interviews)*

The focus of all ISCs is to teach 'foundational science' in the context of meaningful clinical engagement.

Common Features of ISCs

- ***Primary goal: deepen foundational science knowledge during meaningful clinical engagement*** (Foundational science learning is anchored and reinforced by the patient experience)
- Students spend ~50 hrs/wk in course-related activities (clinical and didactic).
  - Use multiple modes of instruction, with an emphasis on experiential/active learning.
  - Active student involvement in patient care and assigned clinical tasks.
- Each core course learning objective should include foundational science content.
- Assessment of foundational science knowledge in clinical context using both qualitative and quantitative assessment methods

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Integrated Science Course (ISC) Menu

1) Cardiovascular Diseases
2) Critical Illness
3) Community Healthcare
4) Diabetes Mellitus
5) Emergency Care: Cell to System Science
6) Global Health
7) Getting Hooked: Immersion in Addiction
8) Healthy Aging and Quality Dying
9) Infectious Diseases
10) Injury, Repair, and Rehabilitation
11) Immunity and Infections in the Immune-Compromised Host
12) Medical Imaging and Anatomy
13) Precision Cancer Medicine
14) The Skinny on Obesity
15) Sexual Medicine and Reproductive Health
16) Working-Learning Health System

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https://medschool.vanderbilt.edu/ume/integrated-science-courses

Precision Cancer Medicine
Modes of Instruction

- Personal Learning Goals
- “Meet the Expert” Seminars
- Online Modules
- Case Based Learning
- Team Based Learning
- Clinical Experiences
  - Patient Encounters
  - Tumor Board Meetings
  - Clinical Experience Essays
- “Burning Questions” Presentation

Example Schedule: *Precision Cancer Medicine*

Week 1

Date	Day	Time	Topic
2/6	Monday	8:30-10:00 AM	Course Introduction
		10:00-10:15 AM	Break
		10:15-11:15 AM	"Meet the Expert" Seminar: Cancer Epidemiology
		PM	Longitudinal Curricular Content
2/7	Tuesday	AM	Hematology/Oncology Clinic
		PM	Longitudinal Curricular Content
2/8	Wednesday	8:30-9:30 AM	CBL1 (Day 1)
		9:45-11:00 AM	Online Module 1-3 review
		PM	Interventional Oncology Clinic
2/9	Thursday	AM	Hematology/Oncology Clinic
		PM	Hematology/Oncology Clinic
2/10	Friday	AM	Independent Study
		1:00-3:45 PM	TBL1: Precision medicine and oncogene addiction
		4:00-5:00 PM	"Meet the Expert" Seminar: Inherited Cancer Susceptibility

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ISC Evaluations

ISC (5 pt scale)

	A	B	C	D	E
Overall learning experience	4.91	4.81	4.86	4.80	4.75
ISC motivated me to continue learning in this area	4.82	4.67	4.57	4.90	4.75
ISC contributed to my professional development	4.91	4.78	4.86	4.80	4.75
Participation helped me learn relevant foundational sciences	4.73	4.61	4.43	4.90	4.56
I anticipate using the foundational science knowledge I acquired in this course in my future training and practice	4.82	4.83	4.43	4.90	4.75
I would recommend this course to my peers	4.91	4.67	4.86	4.90	4.81

Comments: Great experience learning practical knowledge… Fantastic integration of basic science with clinical medicine… Great balance of clinical and didactic learning… The mix of didactics and clinical experience was very cohesive… Good use of tying primary literature to clinical use… This was hands down the best class I've taken in my life... Everything we did was relevant… You should take this course… Great course, run by great faculty…

Our Challenges

- Maintaining scientific rigor
  - Master Science Teacher (MST) review
- Faculty Participation/Effort
- Recruitment of Course Director Team – Basic Scientists and Clinicians
- Faculty Development – Curriculum Design, Assessment
- Course Capacity, Diversity between Courses
- Student Buy-In (Marketing)
- Assessment of Student Performance

Questions

For more information on ISCs at Vanderbilt, see K.B. Dahlman, *et al.* (2018) *Med. Sci. Educ.* **28**, 145-154. "Integrating Foundational Sciences in a Meaningful Clinical Context in the Post-Clerkship Curriculum"