Connecting Research and Teaching Conference

Designing the Biology Major

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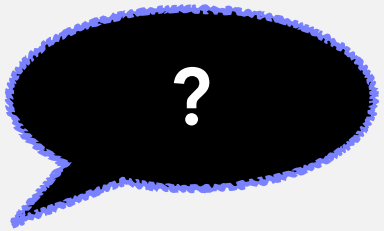
Molecular Biology & Genetics

May 29, 2020

Institutional memory should inform our assessment of learning outcomes

PhD candidate in Genetics, Genomics, and Development

TA for **BIOMG 2801: Laboratory in Genetics and Genomics**



Why are students taking the Genetics lecture and lab courses in different semesters?

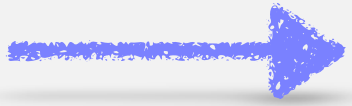
Why are students ***allowed*** to do that?

How does Genetics fit into the broader undergraduate curriculum?

How do the introductory biology courses relate to Genetics?

> Students… take a set of courses in six core areas of biology… the Introductory Biology Cluster consisting of the Investigative Biology Laboratory and two courses from three foundational areas of biology:
>
> Introductory Biology: Comparative Physiology;
> Introductory Biology: Cell and Developmental Biology; and
> Introductory Biology: Ecology and the Environment
>
> … [and] required courses in three additional core areas of biology:
>
> Introduction to Evolution and Diversity,
> Genetics and Genomics, and
> Biochemistry and Molecular Biology…
>
> Additionally, majors must complete one of 14 concentrations within the biological sciences major.

Courses of Study, 2019-2020

Learning objectives  Learning outcomes

What are the design principles of the Biological Sciences major?

A single undergraduate curriculum 1964

In the early 1960s, several committees were formed to assess the "fragmented, decentralized, and diffuse" structure of biology on campus.

This resulted in the creation of the Division of Biological Sciences in 1964.

> The promise of **a coherent and focused curriculum** for the basic biological sciences — **in the form of a single major** — proved attractive…
>
> "Task Force Report: Division of Biological Sciences Structural Review"
> March, 1998

A single undergraduate curriculum 1998

By the late 1990s, the Division was seen as dysfunctional and it was dissolved.

> Given the success and size of the existing undergraduate major, we propose to **retain a coordinated undergraduate curriculum** and student services.

> We feel that **it is essential to maintain a single, coherent, well-organized curriculum** in basic biological sciences.

> The Task Force strongly recommends that the University **retain a single, coordinated biology curriculum and major.**

"Task Force Report: Division of Biological Sciences Structural Review"

March, 1998

The Office of Undergraduate Biology was created to oversee the curriculum.

A single undergraduate curriculum 2008

The current structure of the Biological Sciences major was proposed in 2008.

> We strongly believe that Cornell should continue to offer a **general major in Biological Sciences, with a common set of core courses for all students in the major**…

"Teaching Introductory Biology at Cornell University"
February, 2008

A unifying foundation

> A **common freshman experience** is desirable as a foundation to the major in Biological Sciences. A freshman experience should include an **environment for bonding** among freshmen, an **introduction to the scientific method**, and experience in the **analysis and writing** up of data.

"Teaching Introductory Biology at Cornell University"

February, 2008

Small class sizes

> The current **high enrollments in Introductory Biology courses create problems for staffing and challenges to effective instruction** and, thus, generally **diminish learning outcomes for students**.

> Smaller class size may be accomplished by **increasing the number of tracks of courses** that introduce basic biology, each tailored to the needs of a **different constituency**.

"Teaching Introductory Biology at Cornell University"

February, 2008

Fewer key concepts, at greater depth

> The Task Force recommends… **a set of freestanding courses representing the core areas of biology**. This will simultaneously provide a balanced **in-depth introduction** and allow our undergraduate majors considerable flexibility… The costs of repetition of some introductory material… will be significantly outweighed by the benefit of **enhanced retention of knowledge** by students.

"Teaching Introductory Biology at Cornell University"
February, 2008

What are the design principles of the Biological Sciences major?

1. A single undergraduate curriculum
2. A unifying foundation
3. Small class sizes
4. Fewer key concepts, at greater depth

The 2008 Undergraduate Biology Curriculum Task Force proposed expanding the 2-semester intro course into a 5-semester “core series”

> The current requirement of a year of Introductory Biology plus three core courses… will be replaced by an **expanded core of five courses**… This set of core courses will **cover the full spectrum of biology currently covered in Bio101-102, but in considerably more depth and over a five semester period** to enhance comprehension and retention of basic concepts of biology.

"Teaching Introductory Biology at Cornell University"

February, 2008

All of these:

1. Evolution & Diversity
2. Genetics & Genomics *
3. Biochemistry & Molecular Biology *

plus two of these:

4. Physiology
5. Cell & Developmental Biology
6. Ecology & Sustainability

> “The [Biology Curriculum Transition Committee] has been implementing the [Undergraduate Biology Curriculum Task Force] proposal **without imposing substantive changes**.”

Committee on Academic Programs and Policies Report

quoted in President Skorton’s letter to the University Assembly, June 28, 2010

This does not appear to match the perception of what the structure is for the major.

Intro Biology courses as “electives”

> “The idea is that there will no longer be this general survey course of biology and that you’ll **jump right in with a deeper but more specialized course**.”

Dr. Cole Gilbert

quoted in *The Cornell Daily Sun*, November 2, 2009

> **Without the broad introductory class and choice of electives,** there will be some topics to which students will not be exposed.

“Bio Major **Removes Intro Course**; Two **Electives** to Take Its Place”

Intro Biology courses as "electives"

> Incoming students in the biology major will **choose two of three elective courses to replace introductory biology**… While [Gilbert] believes this will benefit individuals with distinct goals, many undecided students may fail to find their ideal concentration.

"The Scientist: Cole Gilbert"

The Cornell Daily Sun, March 30, 2010

> **The choice would be based on student interest**… Clearly some of them *do* base it on interest. Others base it on their schedule. A lot of them don't have enough knowledge to know what they might be interested in… **They definitely have a choice**.

Dr. Kristina Blake, Instructor for the Genetics Lab Course

Genetics as “outside” the core

> At Wells College… we got rid of the one year-long Intro Bio course and we introduced four different courses… and one of them was Genetics. They put Genetics into that category of a core essential part… These are the four building block courses and you took Genetics as a sophomore.

Dr. Kristina Blake, Instructor for the Genetics Lab Course

Grouping courses by course number

- 3 gen bio (BIOG 1440, BIOMG 1350, BIOEE 1780)
  + 1 gen bio lab course (BIOG 1500)
- 1 genetics + lab (BIOMG 2800)
- 1 biochemistry (BIOMG 3300)

Comparative Anatomy
Cell & Developmental Biology
Evolution & Diversity

A junior Biological Sciences major

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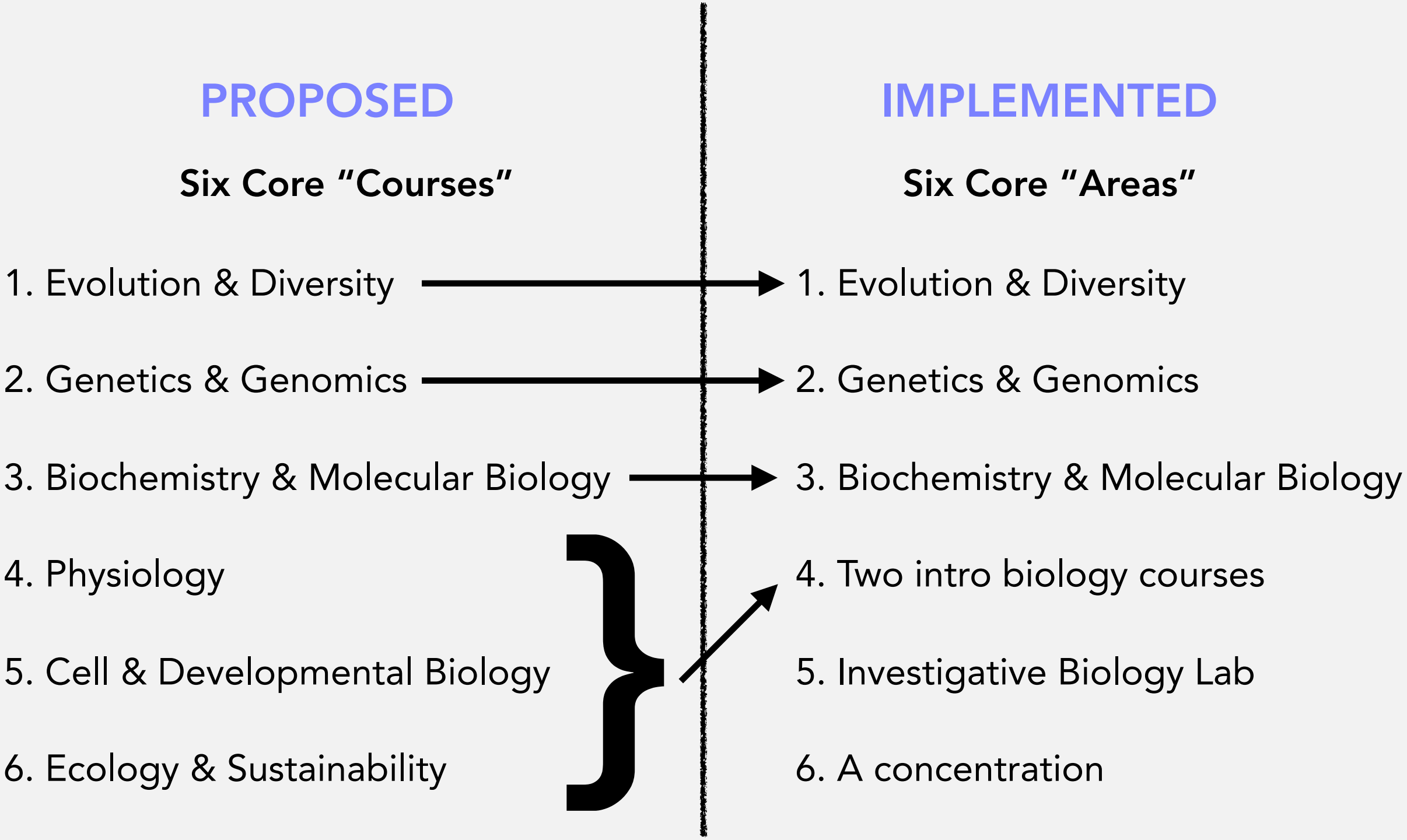
PROPOSED
Six Core "Courses"
1. Evolution & Diversity
2. Genetics & Genomics
3. Biochemistry & Molecular Biology
4. Physiology
5. Cell & Developmental Biology
6. Ecology & Sustainability
IMPLEMENTED
Six Core "Areas"
1. Evolution & Diversity
2. Genetics & Genomics
3. Biochemistry & Molecular Biology
4. Two intro biology courses
5. Investigative Biology Lab
6. A concentration

Instructors:

Advising

Coordination of curricula

Communication

This mismatch of expectations is important to probe in evaluating how well the structure of major serves its learning objectives

Conceptual schema

Decision-making

Students: