

## Fixing the Courses Everyone Loves to Hate

Large introductory courses are notorious for being tedious, confusing, and even harmful. The University of Michigan is betting it can change all that.

*Illustration by Barry Downard for The Chronicle*

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By BETH McMURTRIE

Ann Arbor, Mich.

Inside a squat, brick-and-concrete building here at the University of Michigan, about 300 freshmen gather on a gray Monday morning for their introductory biology class.

Under fluorescent lights, Matthew Chapman, miked up and on his second class of the day, speaks quickly as slides flash on the screen behind him in rapid succession. He has a lot to cover today, and most of his time is spent in a fast-paced lecture.

Halfway through the hourlong class, some students start to tune out. They scroll through their phones, bounce their legs, stare blankly ahead. One opens a Google Doc to work on a cover letter.



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Large introductory courses like this are a staple of the undergraduate experience. They funnel thousands of students each year through biology and economics, math and psychology — serving as gateways to dozens of majors. They are also, as Chapman would agree, hugely challenging to teach.

For one, foundational courses face an identity crisis: Are they supposed to help students master content or develop analytical reasoning skills? Are they more effective when they provide broad overviews of a discipline or when they go deep on a few key topics? And, in rigorous STEM courses, should they weed out weaker students or bring everyone up to a certain level of mastery? That last question is particularly fraught, given that the students who struggle in gateway courses are disproportionately lower-income, first-generation, or from underrepresented minorities.

*Can reimagined introductory courses draw students into the intellectual life of the college?*

Gateway courses present other problems, too. They draw students with a range of abilities and interests: While some want to explore a potential major, others are there just to fulfill a general-education requirement. Some might have come from top-notch high schools, others from weak ones.

These courses' sheer size and place in the curriculum also means that much about them becomes rote. Professors frequently default to lecturing about material and ideas they mastered long ago, and to measuring learning through multiple-choice exams. That can make the experience dull for both teacher and student.

Is it any wonder these are the courses that people love to hate?



Gyorgyi Csankovszki, an associate professor of biology, was skeptical when she first heard of the Foundational Course Initiative: "I didn't want consultants to come in and tell me how to do my job." (*Brittany Greeson for The Chronicle*)

**F**or Michigan, though, gateway courses represent something else: an opportunity. An opportunity to reimagine this nearly universal experience so that students are drawn into the intellectual life of college rather than alienated from it. An opportunity to close achievement gaps among students from different backgrounds. And an opportunity to reshape campus culture so that these courses become everyone's responsibility.

That's why the university started the Foundational Course Initiative, a \$5-million project to reform about 30 large-enrollment courses, affecting about 80 percent of undergraduates. While only 1 percent of the undergraduate courses offered at Michigan enroll more than 200 students, they account for one-third of all credit hours. No other set of classes has such a large impact on the undergraduate experience.

It may seem surprising that a research powerhouse is tackling one of the workhorses of undergraduate education. But Michigan has been laying the groundwork for years. In 2012 it began the Third Century Initiative, a \$50-million effort to modernize teaching and learning to better prepare students for the modern world. To do so, reformers argued, they needed to move away from thinking of teaching as imparting disciplinary knowledge and toward a broader conception of learning: one that is more experiential, active, and intellectually engaging.

Plenty of colleges try to reform gateway courses. Typically they rely on a few intrepid professors willing to experiment or run workshops to give instructors strategies to make their classes more engaging. But when those faculty members move on, or departmental priorities change, these courses often return to their default settings.

*The teaching center's staff can often seem like therapists as they guide professors through the course-redesign process.*

Michigan, instead, is treating these courses as community property, asking departments to reconceive the role they play in their schools and colleges. Can these courses be redesigned so that students are deepening their knowledge of a subject while also getting an overview of the major and possible careers? Can they be taught in a more coherent way that is exciting for instructors and students alike? Can they be restructured to support struggling students and close achievement gaps among different groups?

The Foundational Course Initiative is in its second year of a five-year plan, and professors say the process has sparked wide-ranging conversations among faculty members, something that had not happened before. So far professors representing 11 courses from a variety of disciplines, including movement science, film, public health, math, and physics, have agreed to participate in a three-year course-reform process. They are debating how to guide engineering students through the major, how to encourage more collaboration among students in the highly competitive business school, how to engage those who struggle in biology.

To translate those broad goals into concrete practices, the initiative brings professors, graduate-student instructors, and undergraduates familiar with the course together with teaching-center staff members who specialize in course design, learning analytics, pedagogy, and technology.

Those specialists are designing surveys to assess what students think of a course, crunching data to find out which groups struggle the most, developing active-learning strategies to reduce the amount of time professors spend lecturing, and introducing education technologies that may improve teamwork or support flipped classrooms.

Some course-redesign teams are eliminating chunks of course content in favor of deeper explorations of certain topics. Others are replacing multiple-choice quizzes with short essays that more accurately measure what students have learned. Still others are thinking of new ways to help students in their transition to college, like using peer mentors or adding lessons on effective study strategies.

The project is also experiencing growing pains. The plan has been to bring six new courses into the redesign process each year and work on them over a three-year cycle. But the teaching center's staff is already stretched serving the courses in the pipeline. The idea that teaching is community property remains a tough sell in some circles. And while the course teams are finding plenty of common ground with one another, each one is still fundamentally complex and unique. A course on the art of film is, after all, a different animal from introductory math.

“Right now we're very artisanal,” admits Matt Kaplan, executive director of Michigan's Center for Research on Learning and Teaching. For the university to change its teaching culture, it needs economies of scale. “What can we learn from this that we can build into all courses going forward?”

Along the way, he expects, there will be false starts and failed experiments.

“This project as a whole,” Kaplan says, “is a learning laboratory.”

**W**hen Gyorgyi Csankovszki first heard of the Foundational Course Initiative, she was skeptical. Ask outsiders for help? No, thank you. “I didn't want consultants to come in and tell me how to do my job,” says Csankovszki, an associate professor of biology.

Her department has long wrestled with Biology 172, a course she teaches, and the same one that some of Matthew Chapman's students were tuning out of. It's not as though they haven't been trying to fix the course's flaws. It's just that nothing has seemed to work that

well or for that long. “It’s like antibiotic resistance,” she says.

Csankovszki took a workshop on inclusive teaching but ended up thinking: I do a lot of this already in class. She and other instructors introduced video tutorials, but the students who need help are never the ones who watch. The instructors added active-learning exercises, but only about 10 to 15 percent of students participate. The rest pull out their phones.

Her colleague Steven Clark joined the initiative because he believes that Michigan has a responsibility to support struggling students. They are, after all, some of the brightest in the state.

“That student who gets a D in introductory biology is a student who was one of the smartest kids in their high school, got straight A’s, did well on SATs, dreamed of being a doctor or researcher or psychologist. Then they come in my classroom and get a D,” says Clark. “And they never take a science class again. Their take-home is that they can’t do science.”

Chapman too, had deep concerns about how to reach those struggling students. He is one of several professors, for example, who highlight the contributions of noted scientists of color but are searching for more ways to create an inclusive classroom environment.

Tim McKay, a physics professor who helped launch the Foundational Course Initiative and is now associate dean for undergraduate education, assured the biology professors that nobody was trying to tell them what to do. Instead, the consultants would ask what the professors wanted and then help get it done.

Since May, when they joined the second round of courses undergoing reform, the Biology 172 team has spent a lot of time analyzing data and crafting student surveys. They need to diagnose the problems before they can fix them.

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*“These large courses are so complex. One of the words we use is that it’s like an ecosystem.”*

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Thanks to a detailed course report produced by learning-analytics experts, Csankovszki confirmed one problem she suspected: Students of color, and black women in particular, struggle in introductory biology more than others. Virtually all students in introductory

science courses see a gap between their cumulative GPA and their grade in the course. For black women in Biology 172, it's three-quarters of a point on a four-point scale. For white men, it's only one-third of a point.

To better understand student-performance gaps, the team designed a survey given to students at the beginning and end of this semester. It's going to measure how well they use the resources available to them, such as online quizzes and discussion-section activities. And it's going to ask about their sense of inclusion. Do students say they feel that they belong in science? Do they have friends they can count on? Does their instructor create a welcoming environment? And how do those beliefs change over the semester?

Csankovszki says they're also looking for "small wins," or little changes they can make to improve the course for everyone. For example, reframing the standard, end-of-class "Does anyone have any questions?" to "What questions do you have?" she says, can help prompt more people to speak up.

As to whether the team can truly lower barriers facing students of color, or reach those disengaged students on their phones, Csankovszki isn't sure. "That's what I keep asking myself all the time," she says. "We identify the problem, but what can we do about it?"





Large introductory courses, like this 100-level biology lecture at the U. of Michigan, are a staple of the undergraduate experience. But they are also challenging to teach in a way that engages all students. *(Brittany Greeson for The Chronicle)*

**H**ere is a common fear. Professors in the initiative wrestle with a lot of worries. What if their colleagues won't adopt the changes they're proposing? What if there's turnover and they lose momentum? What if they make a bunch of changes and their course actually gets worse instead of better?

"It's this idea of not knowing where to start, the fear of pulling a string on a sweater," says Kairos Marquardt, a pedagogy and design consultant who is part of several teams. "If I pull it, the whole thing might unravel."

The teaching center's staff can often seem like therapists as they guide these teams through the course-redesign process.

Cathy Shakespeare, an accounting professor in the Ross School of Business who is making significant changes in a 200-level survey course, says she has relied on the experts every step of the way, from syllabus redesign to the introduction of a technology tool designed to help with team-based learning.

"I joke that if they leave, I leave," she says. "I don't have expertise in course design. I know that teamwork is important, but I don't have expertise in how to help teams work together."

Working with the teaching center's staff helped the team more clearly understand how to address the main problem with Business Administration 200, says Shakespeare: Students found it disjointed and confusing. It relied heavily on guest speakers, but those talks didn't sync well with the rest of the class.

During the first year of participation, Shakespeare's team came up with three big ideas. First, students should understand how different parts of business — like accounting and finance — interact. They should get more practice in integrative and analytical thinking. And students need experience working in teams.

Those changes are being put in place this year. Teamwork is now part of every class. And the syllabus has also been significantly redesigned. It now explains why and how the course has been refashioned to achieve the three main goals, complete with a three-page Q&A on teamwork. That change responds to one of the insights gleaned from surveys: Many

students in gateway classes don't understand why they're doing a particular assignment and how it relates to other parts of the course. Laying that out in plain language, complete with diagrams, Shakespeare says, has helped students answer those questions.

To some students, though, the experience still feels disjointed, which may show how challenging foundational courses are to improve.

Quinn Favret, a sophomore taking Business Administration 200 this fall, says it is better than Business Administration 100, a required introductory course that he called "absolutely horrendous." (That course joined the Foundational Course Initiative just this year.)

But, he says, even in the 200-level course, the parts never really connected to one another or added up to something larger, making it seem "kind of incoherent." He gave the example of a field trip to the Detroit Institute of Arts to see Diego Rivera's Detroit Industry Murals, an activity introduced this year. It was meant to encourage students to think about work and society. "In reality," he says, "we were there for 30 minutes and didn't do anything of substance."

Favret says he's talked with about 25 classmates who are taking the course, most of whom, he says, feel similarly. "Cathy is an excellent teacher. She does a great job of engaging the class," says Favret. "But the class could be so, so much stronger if we had an interrelated curriculum."

**A** weakness of many gateway courses is that they are billed as a broad overview of a major, but students encounter, instead, a collection of topics. They are often left wondering which ideas were the most important.

That has been true of Engineering 110, "Design Your Engineering Experience." A common elective among first-year students, it is supposed to provide an introduction to engineering, an overview of the university, and a primer for how to succeed in college.

It has also been, by many accounts, deadly dull. In 2013, a student survey asked what they thought of the course. A typical comment: This class is an easy A. But it's so boring, it's not even worth it.

That came as no surprise to Stacie Edington, director of the engineering college's honors and engagement programs, or to her colleague Frank Marsik, a lecturer and associate research scientist. Over the years the course had become something of a Frankenstein's monster: bits and pieces from different departments stitched together. Conversations about content were largely transactional: What are we teaching next week? Who is available next month to talk about majoring in mechanical engineering?

Now in its second year of a three-year redesign process, Engineering 110 has already undergone substantial changes to ensure that it gives students what they need to make informed decisions about their path through college. One of the twice-weekly lectures had been replaced by a discussion session. Now the course-redesign team is developing a video library to replace the remaining weekly lecture, so that students can choose topics of interest to them.

The use of undergraduate "ambassadors" — or upper-level students — has also been expanded in those sessions, because they were a hit.

The evolution of Engineering 110 is typical for the Foundational Course Initiative: deliberate and methodical. If team members decide to try out new course material, they might follow that up with a survey to find out whether students think the new content feels connected to the rest of the course. If they introduce new education technology, they monitor its usage throughout the course. They also test interventions: If office hours are expanded, do exam grades improve?

"These large courses are so complex. One of the words we use is that it's like an ecosystem," says Karishma Collette, assistant director for diversity, equity, and inclusion for the initiative. "You make a change in one part and it affects another. There's so much yet to understand about how these courses function."

*Skeptics will need proof. Do grades improve? Are students more satisfied with their courses?*

One of the more valuable exercises designed for the Engineering 110 team proved to be a series of focus groups with engineering advisers, professors, and department chairs. Those discussions started a conversation about the purpose of the course and, more broadly, about the path of an engineering student.

As a result, the Foundational Course Initiative is starting to have ripple effects within the college, Edington and Marsik say. It has kickstarted a larger project to improve experiential-learning options for students. And departments are talking about whether all engineering students could benefit from the kind of course and career planning that Engineering 110 provides. Professors often hear, for example, that students don't know how to talk to potential employers about their internships and research projects.

The initiative has begun to connect people across campus. A student taking part in the redesign of an introductory course in public health, for example, created a tool kit for guest speakers that tells them who they're speaking to and what the course has covered so far.

Now, instead of giving a PowerPoint lecture, a tobacco expert will participate in a Q&A to talk about his career, the evolution of public policy on smoking, and the ways in which smoking and vaping are treated differently by regulators and lawmakers. The Engineering 110 team liked the tool kit so much they've adapted it for their own use.



Dragan Huterer, a physics professor, works with students as they take on a group assignment during a 100-level physics course. For the most part, students in the class work through problems in small groups or on their own, calling for help as needed. (Brittany Greeson for *The Chronicle*)

f most of the courses in the initiative are taking the slow-and-steady approach, Physics 140 is hoping to turn science teaching on its head.

Here, in the new Biological Sciences Building, in a classroom of floor-to-ceiling windows and screens at every workstation, Dragan Huterer and Tim McKay circle the room as students work on problem sets.

The course itself focuses on mechanics, or the physics of motion. Huterer, a physics professor and the main instructor, offers short lectures and explanations of particularly tricky concepts throughout the two-hour class. But for the most part, students work through problems in small groups or on their own, calling for help as needed. In those instances, one of the professors, or an undergraduate learning assistant, gives a quick explanation on a whiteboard, then leaves the students to find their way to an answer.

There's a steady hum of conversation throughout the first hour of group work, as students debate how to solve problems involving collision and the center of mass. "Tell me how you got that," says one student to another as they work out an equation together. "Yeah, that makes sense."

This active-learning classroom is the brainchild of McKay, a national advocate for STEM-education reform. Long concerned that introductory science courses focus too much on memorizing formulas and not enough on understanding and applying concepts, McKay had experimented with course redesign within his department before advocating for similar reforms in other foundational courses at Michigan.

This fall, of the roughly 700 students who signed up for Physics 140, about 240 agreed to try out the new studio section. Of those, McKay notes, 45 percent are women, a notable figure considering that only 25 percent of students enrolled in the course overall are women. (Women tend to struggle more than men in gateway STEM courses.)

Like other courses taking part in the redesign initiative, Physics 140 will be tweaked, tracked, and studied by the teaching-center experts. They will want to know if students learn concepts more effectively in the active-learning classroom or in a more traditional lecture setting (which is also undergoing redesign, but in a less dramatic fashion).



Tim McKay, who helped launch the Foundational Course Initiative, assists students with a group assignment. In the traditional lecture model, McKay says, “a limited amount of learning is happening.” (*Brittany Greeson for The Chronicle*)

McKay doesn't know how the studio section will fare. But, he says of the traditional lecture model: “I've become convinced that a limited amount of learning is happening. It's still of value, but it's a starting point.”

Skeptics, of course, will need proof. Do grades improve in an active-learning classroom? Once a course is redesigned, are students more likely to persist in their intended majors? Are they more satisfied with their courses? Are they better prepared to succeed in college? Michigan intends to answer these questions, and more, through student surveys and learning analytics.

But a larger question looms: How much of an impact can course redesign have on deeply rooted problems, like weak science education in middle and high school, or disparities in educational quality and opportunity between rich and poor communities?

For now, Michigan is focusing on what it thinks it can fix. Make these classes more coherent, for one, and more interesting. Spell out for students why they should care, then hold them to a higher standard by testing them in meaningful ways. Let them know they

belong and show them how to “do” college.

Kaplan has continued to visit departments and talk with faculty members about what the Foundational Course Initiative can offer. People sometimes say they’re too busy to take it on, or short-staffed and don’t have anyone who can devote the time. But, when he has laid out all the ways in which the project hopes to improve gateway courses, there’s one response he never hears: “I don’t need that.”

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