AN EXPERIMENT TO EVALUATE OPTIONS FOR PROMOTING EXPLORATION IN THE FIRST-YEAR UNDERGRADUATE EXPERIENCE: PHASE TWO

SUBMITTED BY:

IAN WAITZ, JEROME C. HUNSAKER PROFESSOR OF AERONAUTICS AND ASTRONAUTICS, VICE CHANCELLOR FOR UNDERGRADUATE AND GRADUATE EDUCATION

KATE WEISHAAR, FIRST-YEAR EXPERIENCE COORDINATOR, OFFICE OF THE VICE CHANCELLOR

JOSHUA ANGRIST, FORD PROFESSOR OF ECONOMICS

JON DARIES, SENIOR PROJECT MANAGER, INSTITUTIONAL RESEARCH, OFFICE OF THE PROVOST

ANNE MARSHALL, ASSOCIATE DIRECTOR FOR ASSESSMENT AND EVALUATION, MIT TEACHING AND LEARNING LABORATORY

GENEVRE FILIAULT, ASSISTANT DEAN FOR CURRICULUM AND FACULTY SUPPORT, OFFICE OF THE REGISTRAR

ERYN HEYING, ASSISTANT DIRECTOR OF THE MIT SCHOOL EFFECTIVENESS AND INEQUALITY INITIATIVE

GRACE KIM, LECTURER, ANTHROPOLOGY

SUSAN SILBEY, LEON AND ANNE GOLDBERG PROFESSOR OF HUMANITIES, PROFESSOR OF SOCIOLOGY AND ANTHROPOLOGY, PROFESSOR OF BEHAVIORAL AND POLICY SCIENCE, SLOAN SCHOOL, CHAIR OF THE FACULTY

THIRD DRAFT FOR CUP DISCUSSION: MARCH 6, 2019

SUMMARY

This document presents a DRAFT proposal for Phase Two of a curricular experiment to be conducted with the September 2019 incoming first-year students. The proposed experiment is a modified continuation of the current curricular experiment approved by the Committee on the Undergraduate Program (CUP) for the September 2018 entering first-year students (Phase One). Both phases of the experiment are designed to assess the strengths and weaknesses of options for enabling greater exploration of fields and majors during the first-year. Both objective and subjective measures of students' undergraduate careers at MIT will be used, including information on their range of experiences, academic progress, and health and well-being. In addition, data from survey- and interview-based self-assessments along with student opinions about the MIT experience will be collected. These measures from the entering first-years of 2018 and 2019 will be compared to those of the entering first-years of 2017, which will serve as the control group (and whose experiences choosing a major were the subject of a detailed study by the CUP).

The experiment to be evaluated is as follows:

1. **Control group**: The entering first-years of 2017 and their experiences and outcomes with the existing policies.

2. **Phase One (in process)**: Students who entered in the fall of 2018 are able to designate up to three science core GIRs as Pass/No Record (P/NR) after their first semester at MIT. (The first semester was still graded P/NR, and the second semester ABC/NR).

3. **Phase Two (proposed)**:

   A. The Phase One experimental grading policy will be continued for students entering in the fall of 2019.

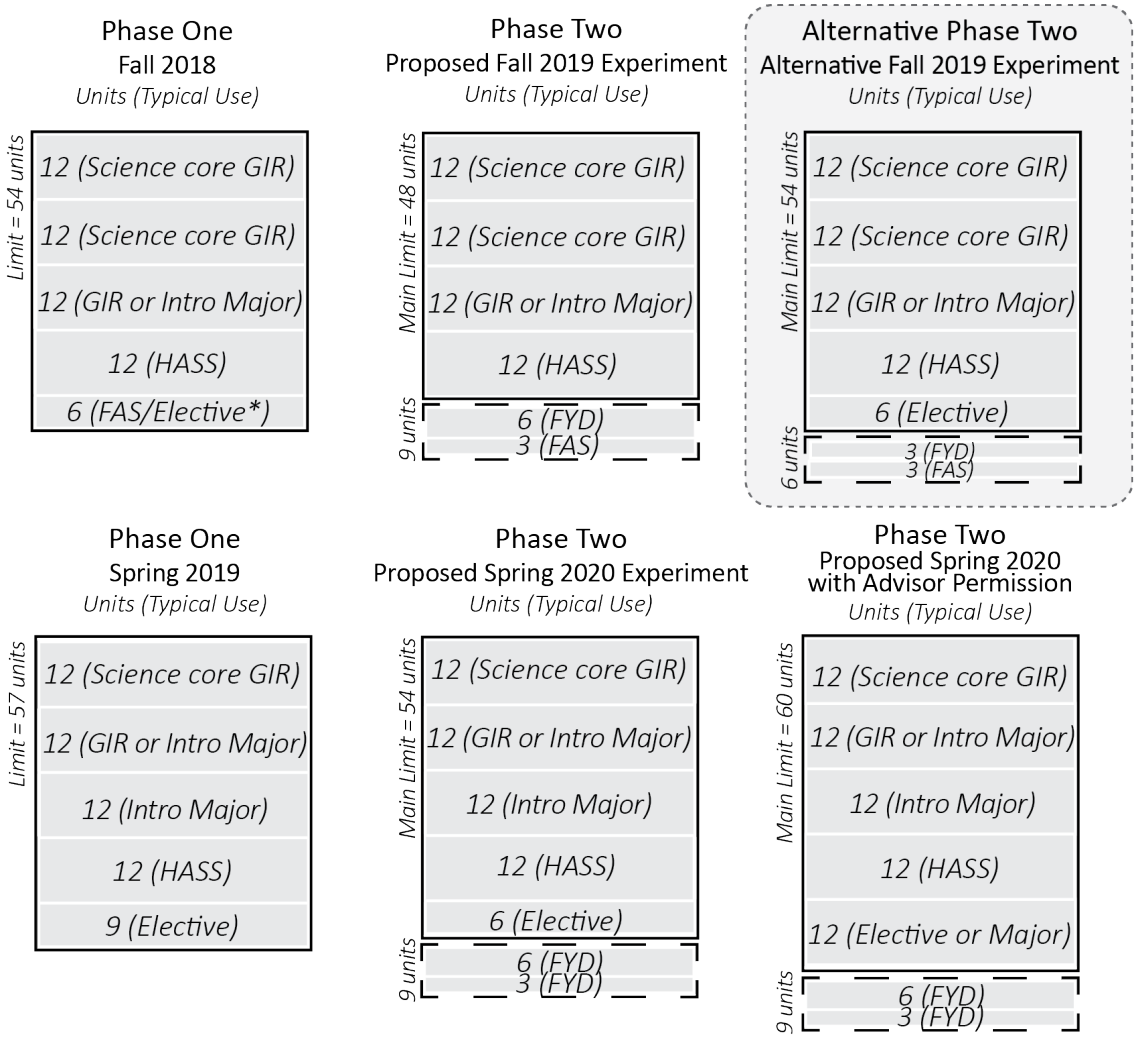
   B. Additionally, students will be able to take up to 9 units of "First-Year Discovery Subjects (FYDs)" and/or First-Year Advising Seminars (FASs) during the first semester without counting them towards the main credit limit. FYDs are typically 1-6-unit subjects designed for exploring majors and minors and must be approved by the Committee on Curriculum to fall under this separate 9-unit "Discovery Limit". FASs can be 3 or 6 units as determined by each advisor. If a student chooses to take more than 9 units of FYD or FAS subjects, they must count the additional units towards the main credit limit.

   C. Because the first-year fall credit limit was structured to allow students to take four 12-unit subjects plus an FAS, moving FASs outside the limit will remove the need for the credit limit to be 54 units rather than 48 (a difference of half a standard subject). To reduce the risk of students choosing to overload their schedules, the credit limit will therefore be reduced to 48 units.

   D. For spring semester of the first-year, students will not be eligible to take early sophomore standing. Instead, we will implement a 54-unit main credit limit for all students, with up to 9 units of FYDs that can be taken outside the main credit limit. And, students who wish to exceed the 54-unit main credit limit may do so with the written approval of their academic advisor but up to 60 units only. All students also will be able to request a supplemental advisor in one or more departments in which they are considering majoring or minoring. Requesting an advisor in no way obligates a student to major or minor in that department.

In Figure 1 we graphically show the relationship between the experimental 2018 fall term and the proposed 2019 experimental fall term for a typical subject selection. Note, that we have added an alternative for consideration for the 2019 fall term where the main credit limit is not reduced from 54 to 48 units. However, we do not recommend this alternative due to potential impacts on student health and well-being as discussed later in the proposal. We also show the proposed experimental spring 2020 semester in relation to the experimental spring 2019 semester for a typical subject selection. In this case, the "with Advisor Permission" graphic with a 60-unit main credit limit would be allowed with first-year advisor approval (it is not an alternative proposal, but a flexible aspect of the proposal we are putting forward).

Figure 1. Diagram of proposed credit limit changes (listed classes are only examples, students would have the freedom to choose within the main and discovery bins as they wish)



Notes:
FYD = First-Year DIscovery Subject, 1-6 units, Fall or Spring
FAS = First-Year Advising Seminar, 3-6 units, Fall only
Discovery Limit (denoted by dashed box) can be filled with FAS or FYD subjects or UROP for credit.
**The most popular 6-unit elective is 6.0001. Other common subjects include musical performance groups such as MITSO.*

Later in the proposal we discuss the Phase One experimental policy and the Phase Two experimental proposal relative to the existing policies (Control) and to the Alternative shown in Figure 1 and a second alternative where students are permitted to exchange any science core GIR for 12 units of exploration classes. We found it helpful to think about these in relation to each other in two dimensions, the extent to which they enable flexibility (e.g. how many units do the students have at their disposal/control) and the extent to which the policies encourage exploration. We have shown this graphically in Figure 2. We note that the positions of these policy options are not based on data it is purely conceptual.

Figure 2. Flexibility and Encouragement to Explore Created by Policy Options (a cartoon, not based on data)

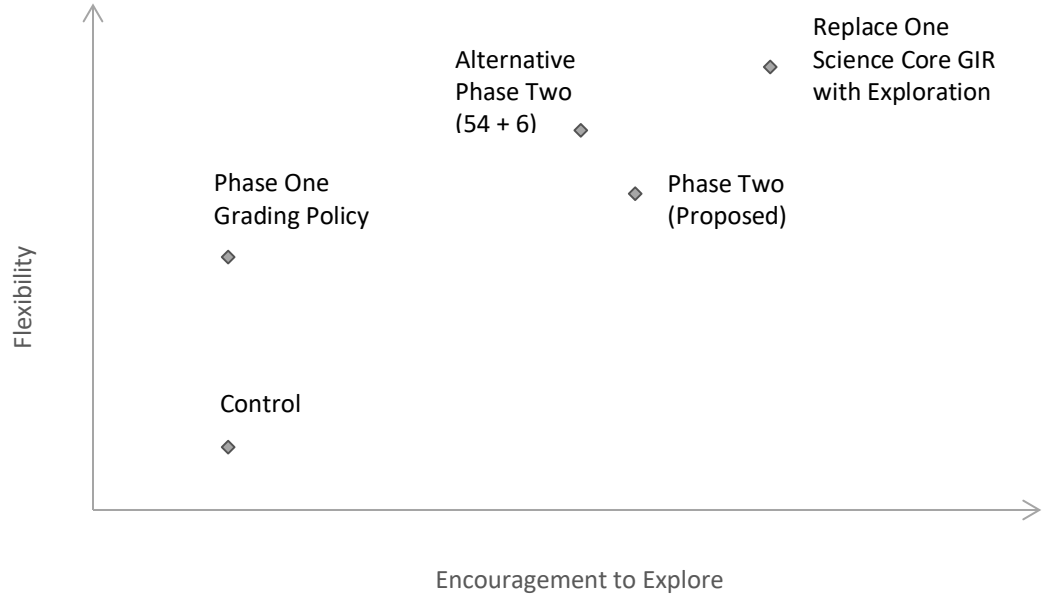


TABLE OF CONTENTS

A NOTE ON TERMINOLOGY: EXPLORATION VS. DISCOVERY

It is important to note the distinction between “exploration” and “discovery” as they are used in this proposal.

The term “exploration” refers to any action undertaken by students that exposes them more deeply to a field of interest. Students typically target exploration activities in fields that already interest them as potential majors or minors or concentrations but may also explore a topic that they do not anticipate pursuing further. For example, a student might explore Course 6 by taking 6.00, as it provides sufficient CS exposure for most students to decide whether they enjoy programming enough to make it a significant part of their academic experience. Another student might explore using the same subject but do so simply because they feel it is beneficial to their general education, not because it might lead to a major or minor.

The term “discovery” refers to any opportunities for students to gain limited exposure to fields they would like to learn more about. Students may explicitly choose to “discover” a certain field that they are curious about or they may take a broad subject that allows them to discover many fields or topics, knowing that they may then want to explore a subset of these in depth. For example, a student might take 20.s901, “Exploring Majors at the Intersection of Engineering, Life Sciences and Medicine”. Despite the subject’s use of the word “exploring”, the focus of the subject is discovering the applications of life sciences and medicine in several different departments at MIT.

Many students and faculty list 6-12 unit subjects such as 2.00B, 7.01x, and 14.01 as good “exploration” subjects. These subjects are a first-year project class, a science core GIR, and an introductory major/minor subject, respectively, so they each have other goals besides enabling exploration. However, they are alike in that they provide accessible but thorough introductions to a particular field.

Discovery subjects, meanwhile, are typically 1-6 units and may address any number of topics. Discovery subjects may also take the form of the 12-unit “survey courses” that are typical of many universities, but 1-6 units is typically preferred by both students and faculty given the constraints of an MIT schedule. Discovery subjects emphasize breadth over depth and should focus on helping students gain exposure to new fields and identify areas to pursue in depth later on rather than trying to transmit content.

BACKGROUND AND RATIONALE FOR THE EXPERIMENT

The predecessor to the CUP was created in 1949 by the Lewis Committee in part to address the very same issues that this experiment seeks to inform.

> *"One of the most damaging criticisms of our undergraduate program is that the students feel so harassed by rigid routine and so overburdened by the quantity of work required in the individual subjects that they do not have time for reflective thinking or for the social experience that should be an important part of a college education. We recognize this unrelieved tension as a serious evil and we think that steps should be taken to remedy it.”*
>
> *“We think it particularly serious in the freshman year.”*
>
> *“We conclude that the undergraduate education at M.I.T. is everyone’s responsibility and therefore no one’s responsibility. We recommend that this situation be remedied by the establishment of a Committee on Undergraduate Policy, having broad authority...”* (Committee on the Educational Survey, Lewis et al., 1949.)

These and many other issues mentioned in the Lewis Committee report remain concerns at MIT today, as highlighted by these quotes from students describing why they wanted to participate in the "Designing the First-Year at MIT" class in 2018:

> *"For me it felt like there was no choice freshman year. I felt like I was moving along a conveyor belt and I had no control."*
>
> *"I went to MIT undergrad and had an experience that made me believe I didn't enjoy learning anymore."*
>
> *"MIT is not giving its freshman a proper sense of direction."*
>
> *"I took all the GIRs and then didn't start my major until sophomore year. I didn't really love it but felt stuck in it because of scheduling and was afraid I'd be a year or semester behind all of my friends."*

"DESIGNING THE FIRST-YEAR AT MIT" CLASS

In July 2017, the Chancellor charged the newly created Office of the Vice Chancellor with improving the first-year undergraduate experience. The result was the creation of a novel subject, "Designing the First-Year at MIT." The rationale for the approach was simple: students are our best advocates for the change they want to see at MIT. The students in the class identified the following key needs, which informed their final recommendations for the first-year:

1. More support for **choosing a major** / encouraging intellectual **exploration and discovery**
2. Improved **advising** (especially vital in the first-year)
3. Frequent opportunities to **feel inspired** by a topic and experience the **love of learning**
4. More **flexibility** / fewer GIRs to enable the above

More than 100 students, faculty, and staff participated in the class, and many hundreds more at MIT provided input and were engaged in discussions with the students. The class took input from, and reported its work to, Institute Faculty Meetings, School Councils, Academic Council and the MIT Corporation.

This proposal directly aligns with many of the findings and recommendations made by MIT students from the class (see: https://ovc.mit.edu/fye_course/). At the Faculty Curriculum Workshop on June 14, 2018, attended by approximately 100 faculty, staff and students, many participants echoed the importance of addressing these key needs in the first-year and spoke in favor of a both a deep reconsideration of the GIRs and for pursuing significant educational experiments.

ADDITIONAL DATA AND INFORMATION ON THE NEED FOR DISCOVERY AND EXPLORATION IN THE FIRST-YEAR

The need for major discovery and exploration in the first-year was also underscored in the 2018 Perceptions of Majors Survey released in June 2018. 27% of undergraduate students surveyed did not feel prepared to select a major; only 33% strongly agreed that they were well-prepared. 38% of those who changed majors (who represent 30% of all respondents) indicated that an unsatisfactory experience with introductory subjects contributed to their decision to change majors. The GIRs compete with these introductory experiences, yet our official policies (those applied to students who entered prior to fall 2018), grading systems, and messaging to first-year students encourage them to complete the GIRs early at the expense of exploration. 77% of the first-year class who entered in fall 2017 took 3 or 4 science core GIRs in their first semester at MIT while on P/NR grading.

The problem is particularly acute for students who start at MIT with fewer Advanced Placement (AP), Advanced Standing (AS), or Transfer Credits (TC) as shown in Table 1 for the cohort that entered in Fall 2017. Students with

zero or one science core GIRs of advanced standing typically have much less opportunity to explore in the first-year than those with two or more science core GIRs of advanced standing. From the 2017 Student Quality of Life Survey, students with fewer AP/AS/TC science core GIR credits to start their first year are statistically more likely to express dissatisfaction with their ability to balance academic and other aspects of their lives and are less likely to rate their academic experience as 'very good' or 'excellent.'

Table 1. The relationship between advanced standing for science core GIRs and how many science core GIRs students take in the first-year

# GIRs with AP, AS, or TC	GIRs Taken FY FA17					GIRs Taken FY SP18			
	0	1	2	3	4	0	1	2	3
0* (27% of class)	0%	0%	4%	91%	5%	4%	36%	40%	21%
1 (43% of class)	0%	0%	6%	90%	3%	5%	50%	43%	2%
2 (17% of class)	0%	3%	36%	62%	0%	38%	53%	9%	0%
3+ (14% of class)	14%	33%	45%	9%	0%	67%	32%	1%	0%
Grand Total	2%	5%	16%	74%	3%	19%	44%	31%	7%

**Note: To simplify this table, credit for GIRs refers to number of completed GIRs. Students who received credit for half of 18.01 through partial ASE credit or after receiving a 5 on the AP AB Calculus test are counted as having advanced credit for 0 GIRs. Approximately 44% of the students shown here with no AP, AS, or TC credit take the 18.01A/18.02A sequence. Also, for simplicity, we have counted the 18.01A/18.02A sequence and 8.01L each as ONE subject in the fall because they begin in the fall and extend into IAP.*

Consequently, for some students, the feeling that an initial major choice is a poor fit may not develop until the end of sophomore year. Moreover, 26% of respondents to the 2018 Perceptions of Majors Survey did not agree that they have sufficient flexibility to change majors. As a result, there is sometimes a feeling of being "stuck" in a major. Surprisingly, few students consult with faculty or an advisor on major choice. We would like to make this sort of consultation a norm rather than an exception. More classroom interaction with more faculty is a natural place to start.

We also note that since 2010, roughly a quarter of respondents to the MIT Senior Survey indicated they were generally or very dissatisfied with flexibility as an aspect of their major. Over this same period MIT has had a consistently higher proportion of respondents dissatisfied with flexibility compared to peer schools. This is related in part to the fact that our curriculum has a greater number of requirements than the curricula of almost all of our top peers.

During the 2017-2018 academic year the CUP Study Group on Undergraduate Majors Selection, led by Professor Jeffrey Grossman, used surveys and interviews to collect detailed information about the preferences, attitudes, and information sources used by first-year students in choosing a major, from before they arrive at MIT through the time they make their choice. When finalized, this study will provide a more detailed assessment than ever before of the paths that students take to choose a major and will serve as an excellent baseline for comparison going forward.

We note that 77% of the respondents in the study said that making the science core GIRs Pass/No Record whenever they are taken would have improved the major selection process for them, more than any other option they were asked to consider (with the highest ratings being from those with advanced standing credit for fewer than 3 science core GIRs).

PHASE ONE PRELIMINARY RESULTS

While many of the results of Phase One will not become apparent until later in the students' MIT careers or even after they graduate, our initial data suggest that the overall effect of the experimental policy was as hypothesized. Many students chose to take fewer science core GIRs in their first semester and instead used the time to explore a wide range of other subjects.

The following enrollment data is courtesy of the Registrar's Office and reflects student registration as of the fifth week of the specified term. The term "science core GIRs" refers to the following general institute requirements: Physics 1 (8.01 and variants), Physics 2 (8.02 and variants), Calculus 1 (18.01 and variants), Calculus 2 (18.02 and variants), Chemistry (3.091, 5.111, and variants), and Biology (7.01x and variants). "Advanced Credit" refers to credit awarded via an advanced standing exam, transfer credit, or an Advanced Placement test.

There were 538 fewer enrollments in science core GIR subjects during the fall of 2018 compared to the fall of 2017, with most students choosing to take Biology or Chemistry later as shown in Figure 3. This corresponds roughly to one fewer science core GIRs being taken by half the students. Table 2 shows the distribution as a function of advanced standing credit. Overall 44% of the 2018 class took three or more science core GIRs in the first semester compared to 77% in 2017.

Figure 3. Fall Enrollment in science core GIRs by First-Year Students

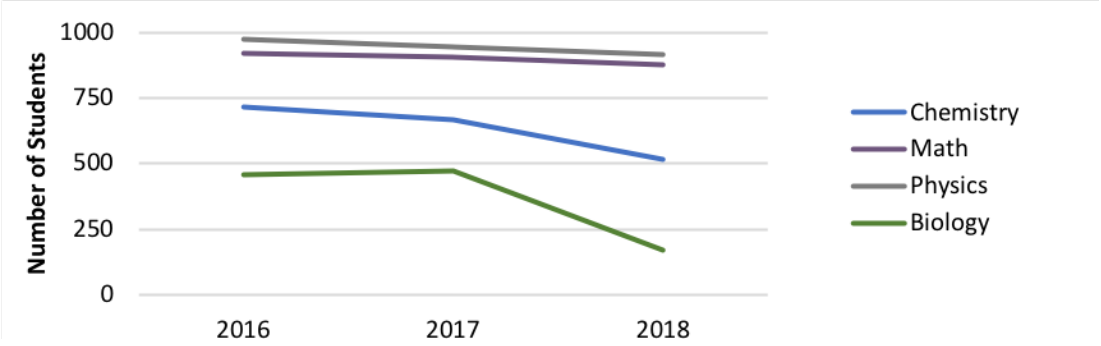


Table 2. Change in number of science core GIRs taken under experimental policy – Fall Semester

Advanced credit	Fall 2017					Fall 2018				
	0	***1***	***2***	***3***	***4***	***0***	***1***	***2***	***3***	***4***
0	0%	0%	4%	91%	5%	0%	2%	31%	67%	1%
1	0%	0%	9%	90%	3%	0%	2%	44%	53%	0%
2	0%	3%	36%	62%	0%	1%	17%	50%	32%	0%
3+	14%	33%	45%	9%	0%	38%	33%	26%	3%	0%
Total	2%	5%	16%	74%	3%	6%	10%	39%	44%	0%

As shown in Table 3, while many first-year students arrive with credit for one or more GIRs or test out of some through Advanced Standing Exams offered during orientation, roughly a quarter of the class each year does not enter with credit for any science core GIRs. Nearly half of the first-year students have credit for only one GIR. Most of this credit is for 18.01, which can be satisfied with a score of 5 on the AP Calculus BC exam.

Table 3. Percent of students with science core GIR credits through Advanced Credit

Advanced Credit	Fall 2017	Fall 2018
0	27%	22%
1	42%	42%
2	17%	19%
3+	13%	16%

During the spring term, the reduction in GIR enrollments was less significant, with only 192 fewer enrollments in science core GIRs in Spring 2019 as compared to Spring 2018 (we note that these numbers are preliminary and likely to change further between now and the fifth week of the term). The change by subject is shown below in Figure 4. Table 4 shows the distribution as a function of advanced standing credit. Overall 28% of the 2019 class registered for two or more science core GIRs in the spring semester compared to 38% in 2018. Given that our messaging suggested that students take most of their science core GIRs in the first year but leave one or two for subsequent years, we also examined how many science core GIRs each student would have remaining after their first year. The per-student totals were based on credits awarded through the end of IAP as well as registration for spring term. The percentage of the class that we anticipate will have different numbers of science core GIRs remaining is shown in Table 5.

Figure 4. Spring Enrollment in science core GIRs by First-Year Students

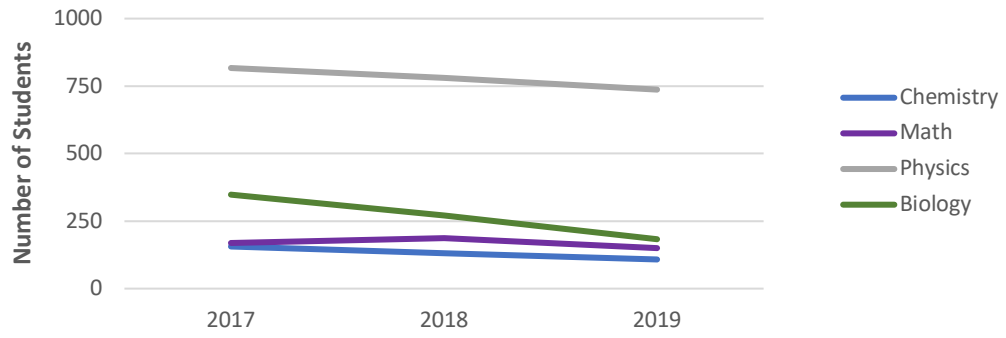


Table 4. Change in number of science core GIRs taken under experimental policy – Spring Semester

Advanced credit	Spring 2018				Spring 2019			
	0	1	2	3	0	1	2	3
0	4%	36%	40%	21%	4%	38%	45%	12%
1	5%	50%	43%	2%	10%	60%	28%	2%
2	38%	53%	9%	0%	45%	45%	10%	0%
3+	67%	32%	1%	0%	64%	33%	3%	0%
Total	19%	44%	31%	7%	24%	48%	24%	4%

Table 5. Percentage of first-year class with different numbers of science core GIRs remaining after first year

Science core GIRs left after first year	AY2017	AY2018	AY2019
0	50%	45%	20%
1	44%	46%	42%
2	5%	8%	30%
3	1%	2%	6%
4	0%	0%	2%
5	0%	0%	0%

Of the students who are taking science core GIRs during Spring 2019, more than half are choosing to do so on P/NR. Table 6 shows the percent of students taking GIRs who are doing so entirely on P/NR, mixing P/NR and grades, and doing so entirely on grades. Note that these students may change the grading type until add date, so the numbers may change. Table 7 shows the percent of students in each GIR subject electing regular grades or P/NR.

Table 6. Percent of students taking science core GIRs during spring semester electing each grading type

Advanced credit	All P/NR	Some P/NR	All ABC
0	58%	8%	34%
1	63%	4%	33%
2	62%	2%	36%
3+	64%	0%	36%
Total	62%	4%	34%

Table 7. Percent of students by science core GIR subject number electing each grading type

Subject	GIR	ABC	P/NR
7.013	Bio	43%	57%
ES.7013	Bio	33%	67%
7.014	Bio	31%	69%
5.111	Chem	51%	49%
ES.5111	Chem	50%	50%
3.091	Chem	26%	74%
18.01	Math 1	86%	14%
18.02	Math 2	45%	55%
18.02A	Math 2	40%	60%
ES.1802	Math 2	38%	63%
8.011	Phys 1	44%	56%
ES.8022	Phys 2	80%	20%
8.022	Phys 2	45%	55%
CC.802	Phys 2	38%	63%
8.02	Phys 2	32%	68%
ES.802	Phys 2	29%	71%

Further, the registration, survey and interview data suggest that students are taking a broad approach to exploration. While first-year students are always free to enroll in science core GIRs or to take other subjects, provided they have the necessary pre-requisites, they were explicitly encouraged this year to postpone one science core GIR subject and use the time to explore. During orientation, they were given a list of subjects that the departments deemed suitable for exploring. 75% of the new enrollments enabled by the decreased enrollments in science core subjects were spread among these 190 Academic Exploration Subjects identified by departments.

Additionally, the total number of unique subjects first-years took in the first semester increased by 14% (from 280 to 318). The number of unique subjects taken in the spring also increased, but only by 4% (from 403 to 420). Only six subjects in the fall term had enrollment increases of 20 or more first-year students, and where needed, OVC provided TA funding to departments to support the additional students. In the spring term, nine subjects had increases of 20 or more first-year students, but only two had increases of more than 30. The distribution of non-GIR enrollments among MIT's five Schools for each semester is shown in Tables 8 and 9.

Table 8. First-year Fall enrollment in subjects beyond science core GIRs by School

School	Fall 2017	Fall 2018	% Change
Sloan	14	30	+114%
SA&P	113	134	+19%
Science	299	498	+67%
SHASS	1,012	1,092	+8%
Engineering	637	935	+47%
Total	**2,366**	**2,924**	**+23%**

Table 9. First-year Spring enrollment in subjects beyond science core GIRs by School

School	Spring 2018	Spring 2019	% Change
Sloan	51	192	+276%
SA&P	100	107	+7%
Science	1,029	1,141	+11%
SHASS	961	1,009	+5%
Engineering	1,627	1,831	+13%
Other	331	212	-36%
Total	**4,099**	**4,492**	**+10%**

The one-on-one interviews with first-year students in the Class of 2022 helped illustrate some of their many approaches to exploration. The interviews reinforced the preliminary findings of the CUP Study Group on Undergraduate Major Selection which found that students can be categorized as *focused* (Firm about their desired major at entry and seek to engage and explore within that major), *focused/open* (Have 2-4 majors in mind and seek to explore to choose among them), and *open* (No idea what their major will be and seek to explore to discover their major interest). These students use the flexibility provided by the experimental policy differently.

A few quotations from these interviews are included below:

> *"I think for me though, since I don't know what I want to major in, it's really hard to just start exploring right away. I sort of feel like GIRs are an exploration, since they are still like Chemistry and Biology and all those things are still intro level, and if I enjoy one of them then I might continue with it." (open)*

"What the policy has enabled me to do is take more higher-level classes, maybe what a sophomore fall would take, or a freshman spring would take, in my freshman fall, and really get exposed to the subject itself. I think allowing us to learn at like a faster pace, move ahead in the curriculum, is really helpful, because it's more exploratory in nature." (focused)

"I feel like you can't model what this career will be through just one class or just like a class in general. I feel like you have to go out and see what it's actually like about like working and stuff or trying to figure out what your major is."

"I think it would be kind of cool if like we offered more exploratory 6 credit classes… But if you do like three or four of that kind of class, in different areas, you get to explore it. And also, you have less work, so it's not that much commitment, which also enables you to take more." (open)

"So I feel pretty lucky to have had the opportunity to not have to take all of my GIRs right now, to be able to incorporate some possible majors into my courses, especially because I didn't know what I wanted to major in once I got here." (open)

As shown in Table 10, students categorized as "Open" had fewer GIRs coming in on average (1.2 compared to 1.5 or 1.6). We hypothesize that because they may have felt "behind" and needed GIRs for pre-reqs for majors, they took more GIRs in the fall and spring. This left them with less opportunity to take classes in their major of interest in the first year, and less time to take exploration classes. However, by the end of the spring semester, they will have passed the students who are focused or focused/open in terms of completing GIRs, but at the expense of exploration. They are the group that may benefit most from the Phase Two proposal.

Table 10: How do students behave along the focused-open spectrum? (categories from SNS 2018)

	Focused	Focused/ Open	Open	Did not answer SNS
% of fall subjects in Application major	14%	14%	9%	13%
% of fall subjects matching Early Sophomore major	23%	27%	19%	30%
# Incoming GIRs (avg)	1.6	1.5	1.2	1.4
# Fall GIRs (avg)	2.1	2.2	2.5	2.1
# Fall Exploratory Subjects (avg)	1.1	1.2	1	1.2
# Spring GIRS (avg as of 2/12)	1	1	1.2	1
# GIRs remaining after FY (avg)	1.3	1.3	1.1	1.4

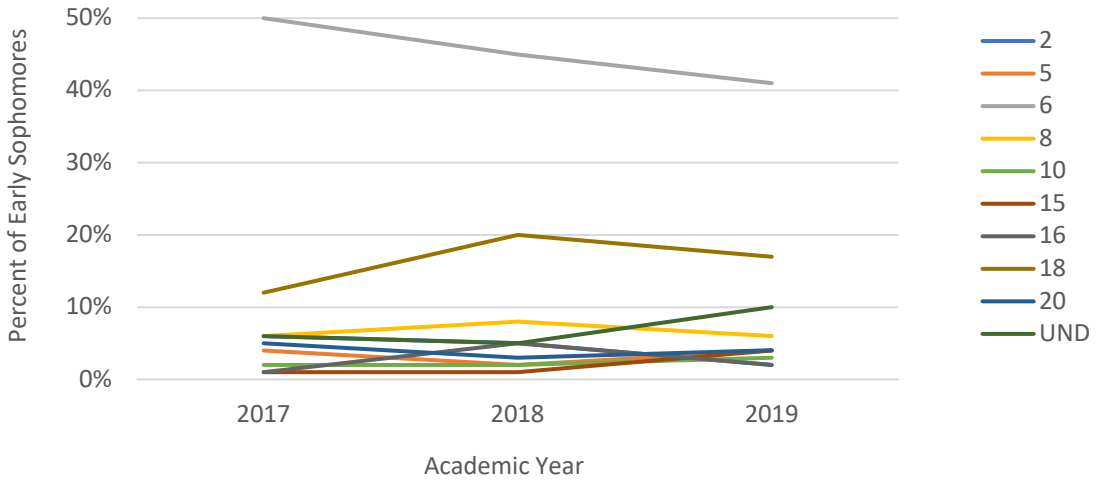
Some students chose to take subjects in the major they listed on their application. The percentage of fall subjects taken in these listed majors increased this year (8% in Fall 2016, 9% in Fall 2017, and 12% in Fall 2018). The increase is statistically significant. These are likely students we would categorize in the "focused" or perhaps the "focused/open" groups. There was also a statistically significant increase in the percent of subjects taken by early sophomores that were in the major they declared (18% in Fall 2016, 19% in Fall 2017, and 25% in Fall 2018). These data do not distinguish between students choosing to take these subjects to get major requirements out of the way and students choosing to take these subjects to explore the major.

We are also monitoring the performance of students who elected to register for classes for which they did not have the pre-requisites (and were permitted to do so by the teaching staff). We note that we explicitly encouraged faculty to enforce pre-requisites (some did, some did not). And we told all of the first-year students, first-year advisors and associate advisors that the faculty would be enforcing the pre-requisites. Thus far we don't

have data to assess how many students fall into this category and what their performance was. For the few cases we have considered the N was small and the effects were not significant. For example, last year 15 students took graduate classes in their fall term. This year, 21 students did so. Almost all of these students received A's in the classes (and did better on average than the prior year, but again, the numbers are too small to be significant).

Figure 5 shows the top ten majors declared by early sophomores over the past three years. We have not yet determined how strongly early sophomore declaration percentages correlate with the total declarations of major later in the spring. Notably, the total number of unique majors declared increased from 17 in Spring 2018 to 19 in Spring 2019.

Figure 5: Percent of Early Sophomores in Each Major (Top 10)



We also collected data on student priorities in the post-orientation survey that is run each year. The survey asks about their orientation and move-in experience as well as their priorities and experiences when they selected their subjects. Many of the questions were asked in last year's survey as well, allowing us to compare the priorities of this class to the priorities of the previous class. Additional questions about exploration were added this year, giving us more detailed insight into how students approach major exploration, although not in a way that can be compared to past years. The survey results presented in Figure 6 show that the class entering in 2018 placed greater weight on opportunities to explore when choosing their subjects (a reflection of our efforts to change our messaging). They were also exploring in many ways as shown in Figure 8. Finally, Figure 8 shows that a significant fraction of the class attributed taking fewer science core GIRs to the experimental policy, consistent with the registration data shown in Table 2.

Figure 6. "When you chose your classes, how important were the following?" (data from Orientation Survey)

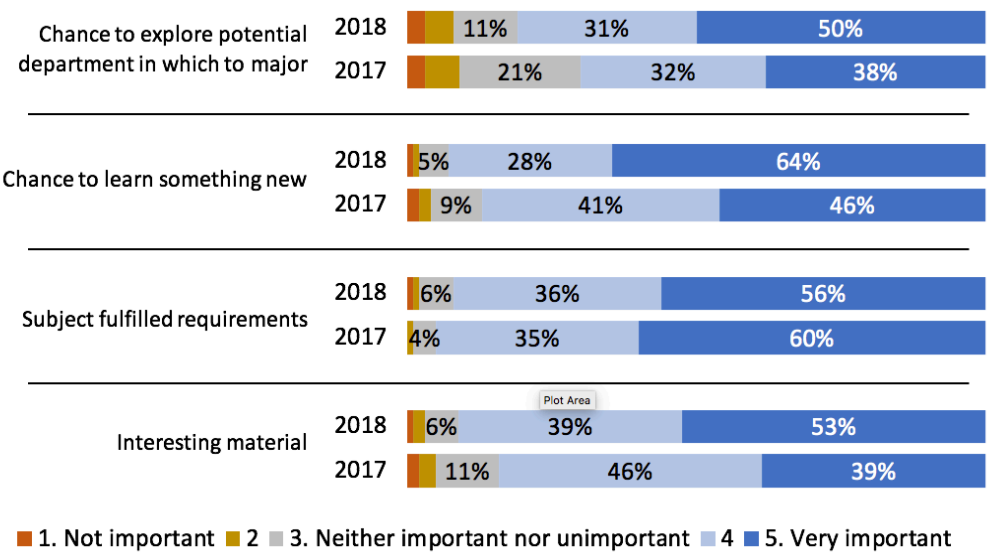


Figure 7. "In what ways are you exploring different academic fields, majors, and minors this first semester? (mark all that apply)" (data from Orientation Survey)

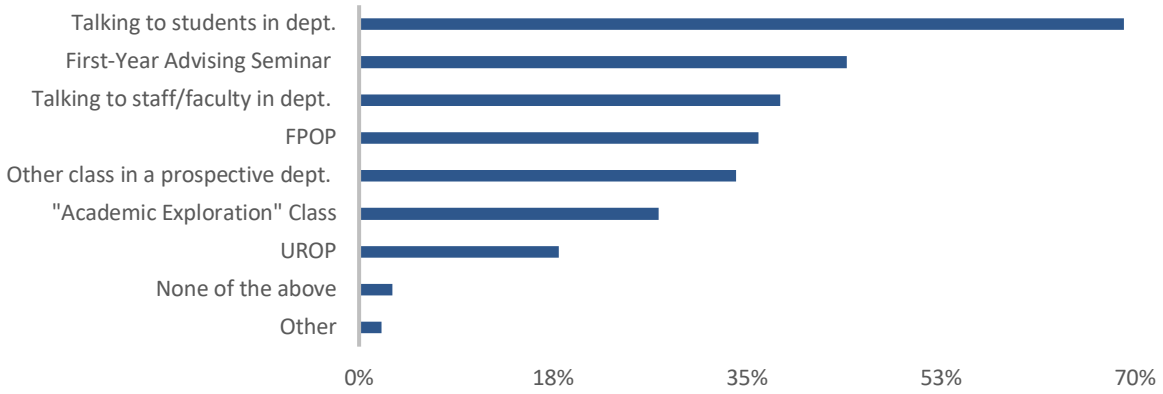
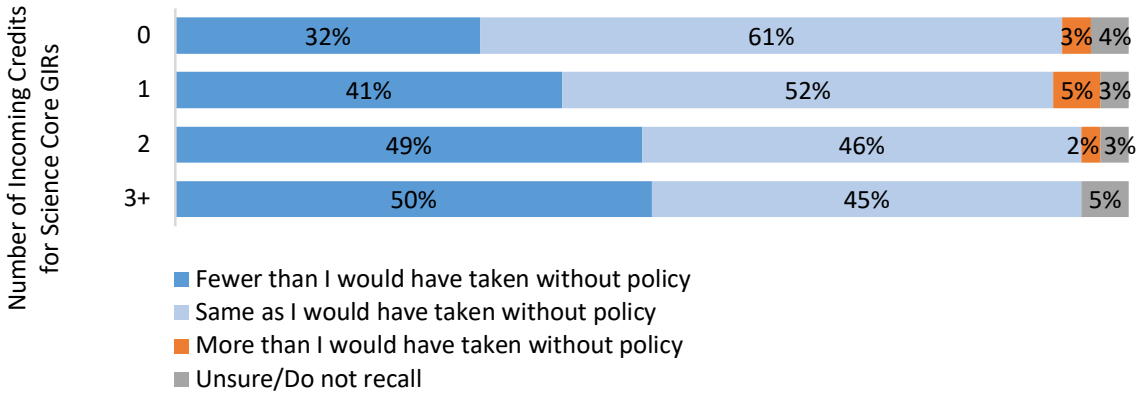


Figure 8. "How did the experimental P/NR GIR policy affect your choice of how many science core GIRs to take during the fall semester?" (data from FYX IAP 2019 Survey)



As shown in Figure 8, we also found that students with fewer incoming credits were less likely to indicate that the policy reduced the number of GIRs they decided to take during the fall semester. This is consistent with the regression analysis that was performed on the fall registration data as shown in Table 11. For the model with all factors included (columns 3, 6, 9, and 12), students with no advanced standing (column 3) took 0.34 fewer science core GIRs on average, compared to 0.48, 0.45, and 0.59 fewer for students with one, two, or three or more advanced credits, respectively (columns 6, 9 and 12 respectively). Other interesting effects observed included a slightly weaker policy effect for female students: female students in the Class of 2022 took 0.41 fewer GIRs on average whereas their male counterparts took 0.53 fewer GIRs. International students experienced a stronger policy effect than students from the United States, with an average reduction of 0.15 GIRs beyond the average effects for their class. For the complete regression data, see Appendix A.

Table 11: Number of science core GIRs taken Fall term split by number of incoming science core GIR credits (AP/AS/TC)

	0			1			2			3+		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Class of 2022	-0.340***	-0.342***	-0.342***	-0.480***	-0.481***	-0.480***	-0.476***	-0.466***	-0.454***	-0.560***	-0.588***	-0.591***
	(0.025)	(0.025)	(0.025)	(0.021)	(0.021)	(0.021)	(0.049)	(0.050)	(0.050)	(0.071)	(0.069)	(0.069)
Female		0.045*	0.030		0.059**	0.047*		0.113*	0.106*		0.320***	0.263***
		(0.022)	(0.022)		(0.020)	(0.020)		(0.046)	(0.047)		(0.068)	(0.068)
Asian		-0.036	-0.031		-0.034	-0.023		-0.171***	-0.145**		-0.369***	-0.426***
		(0.031)	(0.032)		(0.023)	(0.023)		(0.052)	(0.051)		(0.081)	(0.082)
URM		-0.008	-0.014		-0.002	0.001		-0.034	-0.012		0.204	0.094
		(0.025)	(0.025)		(0.025)	(0.025)		(0.065)	(0.064)		(0.140)	(0.141)
International		-0.059	-0.043		-0.127**	-0.093*		-0.136	-0.109		-0.424***	-0.420***
		(0.036)	(0.036)		(0.041)	(0.041)		(0.091)	(0.091)		(0.111)	(0.112)
First Gen		-0.005	-0.002		0.030	0.021		0.004	0.007		0.222	0.168
		(0.028)	(0.028)		(0.027)	(0.027)		(0.074)	(0.073)		(0.138)	(0.139)
Family Income[1]	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Anticipated major[2]	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1119	1119	1119	1867	1867	1867	830	830	830	608	608	608

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

A major reason cited by students for not modifying their behavior was the need to use certain GIRs as pre-requisites for their intended major. Table 12 demonstrates the difference in policy effect for those students who indicated an interest in a life sciences-related major on their application. Students in the Class of 2022 who indicated an interest in a life sciences field on their application took an average of 0.260 fewer science core GIRs, all else being equal. Students who did not indicate a life science interest, by comparison, took 0.495 fewer GIRs on average. Life sciences majors were most likely to require chemistry and/or biology as a prerequisite for sophomore subjects. For students who chose to take advantage of the policy in their first semester, chemistry and biology were the most commonly postponed science core GIRs. Moreover, we explicitly advised students who are interested in pre-health (~ 10% of the class and a significant fraction of those interested in the life sciences) not to take advantage of the P/NR policy as we are unsure of how medical schools will view additional P/NR grades on student records.

It is worth noting that there are not statistically significant variations in student feelings of preparedness to choose a major between the Class of 2021 and the Class of 2022. 65% of the respondents in IAP 2018 and 64% in IAP 2019 either “somewhat agreed” or “strongly agreed” with the statement “I feel prepared to choose my major” at the

mid-point of the academic year (data from the CUP Study Group on Undergraduate Majors Selection Survey #3 and FYX IAP 2019 Survey, respectively). We also noted the following changes relative to last year:

- % open to having their mind changed about a major has increased (78%—>85%)
- % finding the major decision process stressful has decreased (48%—>43%)
- % who want to explore majors they do not know much about has increased (53%—>59%)
- % whose level of major choice stress has increased since coming to MIT has decreased (46%—>39%)

However, given the small sample size of the CUP Study Group survey, these have low statistical significance.

Table 12: Number of science core GIRs taken Fall term split by Interest in Life Sciences Major (Y/N)

	Yes			No		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.300***	-0.303***	-0.260***	-0.546***	-0.554***	-0.495***
	(0.050)	(0.049)	(0.039)	(0.028)	(0.026)	(0.020)
Female		0.222***	0.078*		0.304***	0.107***
		(0.043)	(0.035)		(0.024)	(0.018)
Asian		-0.306***	-0.098*		-0.440***	-0.095***
		(0.049)	(0.040)		(0.029)	(0.022)
URM		0.019	-0.050		0.044	-0.024
		(0.057)	(0.045)		(0.032)	(0.024)
International		-0.182*	0.004		-0.410***	-0.174***
		(0.092)	(0.073)		(0.044)	(0.033)
First Gen		-0.019	-0.087		0.198***	0.043
		(0.069)	(0.055)		(0.034)	(0.026)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	710	710	710	3714	3714	3714

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Pre-requisites came into play for majors beyond the life sciences as well, as expressed by multiple students during the one-on-one interviews:

> *"So course 10, being one of the more restrictive courses, and especially having so many classes with prerequisites, I just kind of knew I had to get my GIRs out of the way."*

> *"I wanted to take a mechanical engineering course, but those have like a billion pre-reqs -- like I have to take Differential Equations first and all that. And I looked at a couple other departments, but I didn't find*

anything that I really wanted to take that I could take as a freshman first semester, so I ended up just taking three GIRs."

Other students expressed a need to catch up with their peers, citing a weaker high school background:

"In a sense the PNR for the whole year I felt really only affected people who had a very strong background coming in… my school didn't have AP credits, so in the end I still wanted to get most of my GIRs out of the way so that I could start taking classes I liked later on….for someone like me or my friends who don't have AP credit or came from like international schools where there was no AP or IB credit it's kind of like we're still here taking the GIRs."

Regarding this last observation, it is not clear that it would change with additional P/NR flexibility since the students are responding to our overall GIR requirements and pre-requisite structure. Therefore, in the proposal for Phase Two of the experiment we are recommending changes to the credit unit limit (to exempt certain light load subjects that are explicitly designed to enable discovery). The credit unit limit has a strong influence on student subject registration in the first year. In Table 13 we show the percent of students in the Class of 2021 and the Class of 2022 that registered for different numbers of units. In both years, the majority of first-year students registered for exactly 54 units.

Table 13: Percent of First-Year Students with Total Unit Loads as of Fifth Week of Fall Semester

Total Units	Fall 2017	Fall 2018
36-45	1%	2%
48	23%	22%
49-52	4%	2%
54	61%	67%
55+	11%	7%

Approximately 75% of first-year students each year took 54 or more units during the fall semester. Students who exceed the credit limit do so for a number of reasons: exempted subjects such as Seminar XL or Terrascope subjects, adding a different version of a GIR based on midterm scores (e.g. some students are registered for both 8.012 and 8.01 as of the fifth week), or simply waiting to drop certain subjects.

Many students reach 54 units through four full subjects plus an advising seminar, but other combinations include music ensembles, half-term subjects, and varying the "full" subjects to include 9, 15, or 18-unit subjects. An important decision for CUP is determining which of these types of subjects should fall under a Discovery Limit, which could be entirely exempt, and which should remain under the main limit. We recommend that Seminar XL be entirely exempt, as it typically does more to reduce stress than add to it and is often added after students have solidified the rest of their schedule. Meanwhile subjects such as for-credit UROPs, performance ensembles, and learning community seminars could count towards the Discovery Limit, as they achieve similar goals to FAS and FYD subjects.

Overall in the fall semester, the students in the Class of 2022 performed at least as well as their peers in the Class of 2021. Although we do not show the data (consistent with the intentions of the hidden grading policy), we note that there was a small but statistically significant increase in the overall GPA. When broken down into GPA for science core subjects and GPA for all other subjects, the increases were smaller and not statistically significant. There was also no difference in the incidence of CAP actions for first-year students in Fall 2018 as compared to the previous two classes.

We note that there is much data that will continue to be gathered as the Phase One experiment proceeds. This includes spring term registration data, additional surveys and interviews, performance in follow-on subjects that

depend on the GIRs, and student-reported stress and satisfaction. Some of this data will be collected as this proposal is being discussed and will be shared with CUP when it becomes available. Such data includes student reports of sources of stress and their ability to balance academics and other aspects of their lives on the Enrolled Student Survey in March.

SPECIFICS OF THE PROPOSED PHASE TWO EXPERIMENT

The Phase One experiment increased opportunities for students to explore, typically through taking a 12-unit subject in place of a GIR. However, many students who would prefer to discover multiple majors through 1-6 unit subjects found themselves in an FAS that they selected over the summer and lacking space within the credit limit for an additional small subject.

While several smaller discovery subjects were offered during Fall 2018, they attracted few students. Early pre-registration data suggests that Spring 2019 discovery subjects may be similarly undersubscribed even though we are working hard to advertise them.

The need for time-efficient ways to discover majors and minors has been expressed by many current students and alumni, so a primary goal of Phase Two is creating a larger and more diverse selection of subjects that meet this need. The proposing team therefore recommends that the credit limit be restructured to create separate limits for standard subjects and for FASs and First-Year Discovery subjects (FYDs), a new type of discovery-focused subject. In an attempt to isolate the effects of changing the credit limit policy, we propose continuing the experimental grading policy so that it is identical to Phase One.

Anecdotal data from one of our university peers that has a very flexible curriculum, no strong credit unit limit, and many "taster" subjects shows that even then many students want to start with "real classes" related to their intended major and they are not willing to trade those subjects for broader discovery. Thus, different structures for unit limits may produce very different effects. Because most students like to have what they interpret to be a "full schedule" their first year, we will establish two schedules (with associated unit limits), one for general subjects, and one for FASs and FYDs.

GRADING

First-year students entering during the Fall of 2019 will be eligible to designate up to three science core GIRs to be graded on a Pass or No Record basis (P/NR) after their first term. Other regular MIT grading policies including first-year (freshman) grading remain in effect.

General guidelines:

- Students may designate a total of up to three science core GIRs to be graded P/NR after the first semester (all subjects taken during the first semester will be graded P/NR).
- The science core GIRS to be graded P/NR should be so designated by Add Date of the semester in which the subject is being taken (this is the same deadline to designate Exploratory Subjects and Junior-Senior P/D/F).
- Regular deadlines for adding and dropping subjects remain in effect.
- In a science core GIR taken under P/NR, a grade of P signifies C- or better performance.
- In a science core GIR taken under P/NR, a grade of D or F would be reflected as NR; students would earn no credit for subjects with D and F grades.
- First-year students who earn a grade of NR in a science core GIR under P/NR in their first semester or ABC/NR in their second semester will be required to retake the subject.

- Students may subsequently designate that same subject as one of their three P/NR options or take it for regular grades.
- Upper-level students who earn a grade of NR in a science core GIR they have designated to be graded P/NR may retake it as many times as needed to pass on P/NR without using up an additional P/NR opportunity.
- Upper-level students who earn the grade of D in a science core GIR taken under P/NR may elect to switch the P/NR grading to regular grades so that a grade of D would count as passing. The grade will be reflected on their transcripts and will count towards their GPA. Students are still considered to have used their P/NR option for this subject and may not elect an additional (fourth) subject to take under P/NR. The deadline to request to change to regular grading for a particular subject is Registration Day of their next semester at MIT, except for final term seniors who must make this request by [Deadline TBD considering needs around graduation].
- There will be no change to Advanced Standing Exam (ASE) grading policies.
- Students cannot elect to take an ASE for a science core GIR under P/NR after their first semester.

DISCOVERY SUBJECTS AS PROPOSED BY THE FACULTY OFFICERS (RICK DANHEISER, SUSAN SILBEY, AND CRAIG CARTER) WITH MINOR MODIFICATIONS

What we will refer to as “First-Year Discovery (“FYD”) Subjects” of 1-6 units each will be offered in the fall and spring semesters involving most or all MIT major, minor, and HASS concentration options.

The aims of the FYD subjects will be threefold:

1) To provide students with an introduction to what is exciting in a field

2) To inform students with regard to potential career paths associated with a major or minor

3) To provide students with roadmaps and information on major and minor programs at MIT

As suggested by the spring 2018 FYE Class, these subjects will feature presentations by both faculty and alumni. In addition, the FYD subjects could include “field trips” and “site visits” to local companies, tours of MIT research laboratories, and hands-on activities. Meetings involving upper-level students may also be valuable.

First-Year Discovery Subjects will be allowed to count towards a separate “Discovery Limit” as described below that will exist on top of the main First-Year Credit Limit. The Committee on Curricula (CoC) will be charged with reviewing and approving the list of FYD subjects that will fall under this Discovery Limit. FYD subjects will not be permitted to be required as part of any major or minor program.

FYD subjects will be low-commitment (one meeting per week, minimal or no work outside of class meetings) and will be graded P/NR in both the fall and spring semesters.

Some FYD subjects will be offered by single departments, but most will involve a collaboration of 2 to 3 departments. Examples could include 7/20/5 (Biology, Biological Engineering, and Chemistry), 6/18 (Computer Science and Math), and 14/21H/17 (Economics, History, and Political Science). Some FYD subjects could involve more than 3 departments (e.g., a collaboration involving several Course 21 departments).

Multi-disciplinary FYD subjects could be up to 6 units at the discretion of CoC.

It will be left up to the faculty coordinators of each FYD subject to determine the structure of the subject, i.e., whether the semester is simply divided into sections devoted to each department, or whether there is more coordination with some or all meetings devoted to multiple departments.

We anticipate that students will view these joint FYD subjects as a valuable aid to help them in choosing between several related majors, and that this will lead to increased interest in registering for these subjects.

We hope that the sharing of workload will also lower the barrier for departments to consider providing such subjects.

In addition to creating a new class of subjects under the Discovery Limit, we recommend that First-year Advising Seminars also be moved under the Discovery Limit. Further, we recommend that faculty teaching existing FASs be given the option to reduce them to 3 units. Many FASs currently offered only take 3 units of time despite granting 6 units of credit, so adjusting the unit load would require only minimal changes to curricula. Individual FAS instructors can opt to maintain a 6-unit FAS if they so choose.

CREDIT LIMIT POLICY

To ensure that students do not overload themselves, new credit limits are proposed. In the fall, the main credit limit would be reduced to 48 units, and an additional 9 "Discovery units" would be available for FYDs, FASs, and UROP. In the spring, the main credit limit would be 54 units, plus an additional 9 "Discovery units" would be available. Students who wished to exceed the 54-unit main credit limit in the spring term could do so up to 60 units with written permission of their advisor. No changes would be made to the IAP credit limit. Students will not be able to petition CAP to exceed either the fall main credit limit of 48 units or the spring main credit limit of 60 units. Advisors would be given explicit guidelines for assessing with their advisees whether 60 units is an appropriate load for that specific student. Advisors and advisees would be encouraged to meet again after a few weeks to ensure that the student's schedule still seems reasonable and discuss the possibility of dropping a subject if needed.

Discovery units could only be used for subjects designated as FAS, FYD, ROTC, FLC seminars, 6-unit performance subjects, or UROP-for-credit. An FAS could be 3 or 6 units depending on the instructor's choice, whereas an FYD could be 1-6 units. ROTC, FLC, and UROP for credit could be up to 9 units. Students cited UROP as a key way that they choose to explore, and many first-year students find UROPs after the direct funding deadline and would therefore want to take them for credit if allowed to do so.

If a student wishes to exceed 9 units of subjects eligible for the Discovery Limit, they must count the additional units towards the main credit limit.

Any FAS that provides a significant discovery or exploration component could also be offered as an FYD. Students who wish to participate in the advising component would still select the FAS during the summer, whereas the FYD version would be open for registration on Registration Day. Students in the FYD version could be enrolled in a different FAS or have traditional or learning community advising. The FYD and FAS versions of a subject should be the same number of units. Students would not be able to switch between the versions after registering, though the FYD version could be dropped like a normal subject.

In conjunction with the opportunity for all students in this cohort to take up to 60 units in the main credit limit with advisor approval, students in this experimental cohort will not be offered Early Sophomore Standing. All students who wish to have major- or minor-specific advice could request a mentor in one or more departments of interest. These mentors would be faculty and staff who are assigned by departments to meet with first-year students to discuss their major, minor and career goals.

STRENGTHS AND WEAKNESSES OF PROPOSED GRADING POLICY

Regardless of whether the proposed credit limit and FYD-subject policies are adopted, the CUP must decide whether to extend the Phase One grading policy to the students entering in Fall 2019. The arguments below are meant to illustrate both sides of this discussion and are written under the assumption that the credit limit and FYD policies ARE approved for Fall 2019. However, many of the arguments would also apply to the Phase One grading policy in isolation.

Arguments FOR including Phase One policy in experiment for Fall 2019:

- The FYD and credit limit aspects of Phase Two were conceived in the context of student behavior with the P/NR experimental policy in place and were designed to enable and encourage exploration and discovery. Having only the FYD aspect of the proposal (with lower main credit limits, and not having the flexibility of P/NR) is likely to limit student exploration through 12-unit introductory subjects, which we understand to be an important mode of learning about potential majors or minors for a significant fraction of our students (perhaps 30%-60%). In particular, the policy enables first-year exploration of departments that do not offer an FYD-style subject or a core GIR. Most of the subjects with increases of more than 20 first-years were in departments that fit this description (6.009, 6.042, 9.01, 14.01).

- An additional treatment cohort on P/NR boosts statistical power. With one cohort treated, we have statistical power to assess changes of ~0.1 in GPAs only for outcomes with a large sample size (like overall GPA). But we are interested in narrower subject-specific effects as well, like effects on non-GIR GPA and in individual courses. The current sample size also limits our ability to distinguish effects in subgroups (e.g. by fields of interest, demographics, incoming GIR credit, etc.). An additional treatment cohort allows us to look for smaller and more specific effects.[1]

- Students can "learn for the sake of learning" without pressure of grades in the science core GIRs. Students cited this as a benefit during the Fall 2018 interviews conducted for the experiment. We also saw an increase in the percentage of students listing "chance to learn something new" as "very important" when picking fall subjects (46% in 2017 to 64% in 2018).

- A grade of C is defined in the Faculty Rules as "Adequate performance, demonstrating an adequate understanding of the subject matter, an ability to handle relatively simple problems, and adequate preparation for moving on to more advanced work in the field." Based on this definition, any passing grade under P/NR would be sufficient regardless of whether the subject was being used as a prerequisite for further coursework or simply as exposure to that scientific field.

[1] We are using final subject grades to assess academic performance (e.g. in GIR subjects in which some students take P/NR, or in follow-on subjects which use GIRs as pre-requisites). In a large number of scholarly studies of academic performance, specific values for grades have been found to be somewhat arbitrary, therefore the appropriate practice is to measure treatment effects on such outcomes by standardizing to mean zero and unit variance. It is also customary to report results in terms of effect size, which are numbers like 0.1σ where σ is the standard deviation. The statistical precision of an estimated treatment effect is determined by its standard error (SE). The SE reflects all relevant considerations: variability in outcomes, sample size, and changes in variability from year-to-year including those induced by treatment. We have precision for effects around 0.1σ, a common benchmark in education research. The standard deviation of GPA within classes is fairly uniform and constant in time and typically ranges between 0.6 and 0.8. To "reliably detect" (operationalized as power = 1 minus the probability of a Type II error = 0.8) we often need a t-statistic of around 2.5. So, we ballpark the SE needed and compare this with the standard-deviation-implied effect size. For an outcome like GPA that has a standard deviation of 0.7, a treatment effect size of 0.1σ is an effect of 0.07 in natural units. To detect this, we need a SE no larger than 0.07 * 0.4 (where 0.4 = 1/2.5) = 0.028. Importantly, we meet this level of precision for some large cohort outcomes (e.g. performance of all students in all subjects), but not others. In particular, for single-subject results where samples are small, or for subsets of students, more data will be needed. If we add another treated cohort year, we will increase N by a factor of 1.5 (control plus two treatment years instead of one), so the standard errors will be reduced by $\frac{1}{\sqrt{1.5}} = \frac{1}{1.2}$.

- The reduced pressure to take science core GIRs in the fall allows students to focus more on their personal goals such as exploration, wellness, and research. Many students chose to use this added flexibility to pursue a UROP. As of 12/4/18, 182 first-year UROP applications for Fall 2018 were approved (up 75% from last year). We have also been told (but do not yet have the data) that there were an unusually high number of students earning PE credits this fall.

- Students can postpone science core GIRs that they perceive to be more difficult and/or less interesting and/or less important to them and take them P/NR later instead of taking them all during the first semester, resulting in a less stressful and potentially more inspiring transition to MIT.

- Students might choose to register for subjects rather than cramming for an ASE if they are not confident that they have mastered the material. 13% of respondents to the FYX IAP 2019 survey reported that they took fewer ASEs than they would have taken without the experimental policy (3% reported taking more, 17% did not recall the policy's effect on their choice, and 67% took the same number).

- Data suggest a small but significant increase in student openness to "having their mind changed about their planned major" in the experimental cohort as compared to the control group (CUP Choice of Major Survey #3 compared to FYX IAP 2019 Survey, $p<0.05$).

- The policy is largely regarded by first-year students as an improvement and would most likely be well-received by incoming students.

- Scaling back to a more conservative policy could make it more difficult to push for significant permanent change later on. However, if the data show that outcomes worsen without the experimental policy, that could provide sufficient support to bring it back as a permanent policy.

- Removing the deferred P/NR option and adding support for FYDs instead could imply a preference for discovery (fewer units, broad exposure) over exploration (more units, deep exposure).

- Some faculty members and students have expressed strong support for continuing the policy. Many of the same faculty members and students have also been frustrated by failed change processes in the past and might view "backing down" on the P/NR policy as an indication that this process is also unlikely to create lasting improvements.

- We could observe any interaction effects between a policy designed to enable exploration and a policy designed to enable discovery. We could observe the extent to which different populations engaged in each of these activities.

- A second P/NR cohort makes the treatment a more a more natural part of the environment, allowing students from multiple years to interact in subjects with grading on the same basis.

Arguments for NOT including Phase One policy in experiment for Fall 2019:

- Initial data indicates an increase in the number of students taking subjects during the FY fall term without satisfying the prerequisites. Many faculty members choose to overlook prerequisites for legitimate reasons, making an exact number impossible to calculate. However, we have noted that first-year enrollments in subjects that list prerequisites beyond what can be satisfied through Advanced Standing Exams rose from 91 enrollments in Fall 2017 to 167 enrollments in Fall 2018. However, we have not seen a negative impact on overall GPA (we have seen a small increase).

- The pressure of grades after first semester might result in increased student effort in their science core GIRs. We do not have data currently that indicates whether this is the case. However, data collected when

MIT moved from two semesters of P/NR to only one semester of P/NR indicated a statistically significant improvement in student grades.

- Omitting it from further experiments would send a message that it was truly a temporary experiment. Some faculty and students have expressed concern that the experiment may be viewed as a permanent policy change by students, making it difficult to end the experiment and return to the official grading policies.

- Waiting another year or two to see the full effects of the experimental policy before considering applying it to another class will allow us to see whether the net effects of the policy were positive or negative. Though we have observed both positive and negative behaviors in the experimental cohort so far, these data are still preliminary.

- Some faculty members have expressed opposition to continuing the policy for students entering in Fall 2019 for the reasons stated above.

- This would allow us to compare the effects of a policy designed to enable exploration vs. a policy designed to enable discovery. We could collect data about whether one or the other is sufficient to create the desired change and whether they affect different populations. We would not, however, be able to observe any interaction effects between the policies.

- Simultaneously having P/NR deferral, new categories of Discovery subjects, and two different types of credit limits leaves us with a more complex set of policies.

ALTERNATIVE GRADING POLICIES CONSIDERED

P/NR POLICY THAT INCORPORATES ADVANCED STANDING

Students entering in fall of 2019 will be able to take up to four science core GIRs Pass/No record outside of the first semester. This can be done in one of two ways:

1) Receiving credit for an Advanced Placement score, Advanced Standing Exam, or transfer credit at any time.
2) Taking the subject in any semester after the first semester. Students must elect to use a Pass/No Record grading slot by ADD Date of the semester in which they are taking the subject.

Based on this grading policy, a student with:

- Zero advanced credit for science core GIRs would have the opportunity to designate 4 science core GIRs as P/NR any time after the first semester (so they might do 2 on P/NR in the first semester and be able to take their remaining 4 on P/NR anytime)

- One advanced credit for a science core GIR would have the opportunity to designate 3 science core GIRs as P/NR any time after the first semester (so they might do 2 on P/NR first semester and be able to take their remaining 3 on P/NR anytime)

- Two advanced credits for science core GIRs would have the opportunity to designate 2 science core GIRs as P/NR any time after the first semester (so they might do 2 on P/NR first semester and be able to take their remaining 2 on P/NR anytime)

- Three advanced credits for science core GIRs would have the opportunity to designate 1 science core GIRs as P/NR any time after the first semester (so they might do 2 on P/NR first semester and be able to take their remaining 1 on P/NR anytime)

- Four (or more) advanced credits for science core GIRs would not have the opportunity to designate additional science core GIRs as P/NR after the first semester (so they might do 2 on P/NR first semester and be done with them)

Potential benefits:

- This may act to more directly balance the uneven opportunities for exploration in the first-year (shown in Table 1, p. 7), because the opportunity to explore would no longer be dependent on how much advanced credit a student has.

- All students (with fewer than five science core GIRs already completed before the fall semester) may be incentivized to take approximately two science core GIRs on regular fall semester P/NR, as those could not be shifted to a later semester on P/NR. This is consistent with our philosophy for a well-balanced first semester (2 science core GIRs, a HASS, and the remaining schedule time being used for exploration of fields, majors, or taking subjects for personal interest and fulfillment).

Potential risks:

- Students with no incoming credit may still choose to take 3 science core GIRs in their first semester. The registration behavior we are seeing is driven both by our downstream pre-requisite structure, and as we are learning in the interviews, a desire to catch up with peers. Without changing the number of GIRs or the pre-requisite structure, changing the P/NR policy further may not produce the desired effect. Thus, there may be both educational and personal benefits that the students realize by catching up on the science core GIRs in the first semester if they have no advanced standing.

- Notwithstanding the above, it may be premature to consider this change. We only have one semester of registration data, and therefore do not yet know how the students who took three GIRs in the fall will organize their spring schedules and/or take advantage of the P/NR policy.

- It adds some administrative complexity compared to the Phase One policy.

- If combined with the FYD Subject and credit limit policy changes, it would complicate our efforts to understand the impacts of the individual policy changes.

- Some may view it as not being fair because it helps some students more than others (e.g., students with two advanced standing science core GIR subjects under their belt are only helped with two additional science core P/NR GIR opportunities beyond the fall semester, while students with zero or one advanced standing subjects would have up to four or three later P/NR science core GIR opportunities).

- It may have negative or stigmatizing effects on some students, for example in group discussions if a student is asked, “How many P/NRs do you get to have?” It may provide an easy way to generalize and/or label someone. Although we note that this occurs to some extent already based on what subjects a student is taking in their first year.

- It does not allow us to study the variation generated by interaction of the treatment with advanced standing.

COUPLED P/NR EXTENSION + DEFERRED DECLARATION OF MAJOR (PROPOSED BY PROF. HAZEL SIVE, BIOLOGY)

This option is based on an assumption that the science core GIRs should serve a dual purpose: acting as universal prerequisites that grant students unrestricted entrance to any major at MIT and as eye-opening exposures to fields of science that may have been neglected or poorly taught during the student's high school experience. To effectively serve both of these purposes, students must take all of the science core GIRs before selecting a major.

Specifics of the proposal:

- Allow students to take up to three science core GIRs P/NR after the first semester **through Fall semester of the sophomore year**.
- Encourage students to put off declaring a majoring until the end of the fall semester of their sophomore year.

Potential benefits:

- Students would have two extra semesters in which to take science core GIRs P/NR, as compared to students who entered before Fall 2018.
- Because students would be encouraged to complete their science GIRs within three semesters, they would be able to choose, without delay, from the full spectrum of majors that require the science core GIRs as prerequisites.
- Students can currently choose to postpone their major declaration until sophomore year, but very few choose to do so. An official policy promoting this delay might reduce the pressure to decide during the first year.
- Waiting an extra semester to declare a major could promote more extensive exploration and result in a more informed choice.

Potential risks

- There are unknown impacts on departmental degree paths for students, especially in engineering where much of the sophomore fall schedule is devoted to foundational material for the majors. This may imply a significant restructuring of the curriculum would be required in some departments.
- Delaying major declaration may also delay the assignment of major advisors unless we deploy mentors as we are proposing.
- Increasing the pressure to complete the science core GIRs within three semesters could result in students delaying other prerequisite or exploration courses until later semesters due to credit limits and scheduling conflicts.
- Certain GIRs may not be offered every semester, which would require students to carefully plan out when they would take each science core GIR subject or that we change the scheduling of these subjects.
- Students may feel pressured to overload on units or take subjects that meet at conflicting times in order to complete their science core GIRs within the first three semesters.
- If the option remains for students to declare their major prior to sophomore fall and get a major advisor, it may be difficult to shift the culture towards a later declaration date. This may result in the current system being maintained in practice even if the official policy changes.

- Sophomore fall advising would need to be handled centrally rather than through the departments. Resource implications of this would need to be addressed as would the recruitment of additional faculty advisors (or convincing existing first-year advisors to take on more advisees).

- Delaying choice of major was considered by many students to be less likely to improve their major selection process than the other interventions listed as shown in Figure 7.

STRENGTHS AND WEAKNESSES OF PROPOSED "DISCOVERY SUBJECT" MODEL

Initial Spring 2019 pre-registration figures indicate that first-year students have limited interest in the several new low-commitment academic discovery subjects being offered this spring. In addition, relatively few departments have developed new subjects of this type for introduction in the coming semester.

One possible explanation for this student behavior is that they feel constrained by the first-year credit limit. First-year students are limited to registering for 54 and 57 units in the fall and spring semesters, respectively. Given a typical program of four 12-units subjects, this leaves 6-9 units available for academic discovery and exploration subjects. At present, students frequently fill this space with 6-unit subjects that are not primarily intended for discovery. For example, many first-year students currently register for half-term subjects in the fall to take advantage of P/NR grading, or in the spring to prepare for advanced subjects and/or summer internships. This leaves little or no space for additional discovery subjects.

First Year Advising Seminars (FASs) are also a popular option for the remaining 6 units under the fall credit limit but many have the limitation that they typically focus on only a single potential major or area of interest, while other excellent (and worthwhile) seminars are not aimed at the exploration of a major, minor, or HASS concentration at all. While FASs are a valuable learning experience for many students, their current form makes them difficult to pair with small discovery subjects.

Many of the subjects on the current list of "Academic Exploration Subjects" (http://uaap.mit.edu/academic-exploration-subjects) are 9-12-unit subjects that are not specifically designed to provide students with "discovery" or "exploration" experiences. Discovery, in particular, is noticeably lacking on that list. While most of the subjects offer valuable exploration for some students, these subjects do not provide efficient opportunities for discovery.

Under the current policy, most departments have not developed low-commitment discovery subjects. By moving these subjects outside the credit limit, hopefully we can enable more students to take them. Ideally, this increase in demand would also drive more departments to create subjects of their own.

Other benefits and risks may include:

Potential benefits

- Moving FYDs and FASs outside the credit limit would prevent these subjects from competing with required subjects.

- Students would be able to discover multiple majors/minors in a single term.

- Students who would otherwise have only a few electives during their time at MIT could be exposed to more unique disciplines.

- Increased demand for FYDs would help catalyze their creation.

- Because these subjects are not required for any major and are graded P/NR, they are easy to add/drop and may make only limited contributions to student stress levels.

- FYDs would typically have smaller enrollments than large required lectures, making them ideal for forming the friendships and mentoring relationships that students rely on to get through more difficult required subjects.

- Students have clearly expressed a desire for more of these types of subjects, both during the Designing the First-Year Experience subject in spring 2018 and through a survey to first-year students in January 2019 as shown in Figure 9. Furthermore, the desire appears to be stronger in students with less incoming credit as shown in Figure 10. It is worth noting, however, that students with less incoming credit tended to rate all possible interventions higher than did their peers with more incoming credit.

Potential risks

- Students may view the decreased main subject limit as restricting. For the most recent fall semester, we estimate that 16% of the class (181 students) would have had to choose a different schedule than the one they did (for example, replacing a sub-term subject like 6.0001 by an FYD subject). For the two most recent spring semesters, among the students who took early sophomore standing 15% of the early sophomores (30 students) in spring 2017 and 22% of the early sophomores (43 students) in the spring of 2018 exceeded 60 units in the spring term of their first year (this only includes units for subjects they did not drop). Overall, that is 3% of the Class of 2020 and 4% of the Class of 2021 who would have been impacted by the proposed policy change in the spring semester.

- Students who choose to use the full main credit limit plus the discovery limit would take more units than first-years in previous years, potentially increasing stress levels. Below we have a separate discussion of academic stress and how it may relate to credit unit limits.

- Departments that do not currently offer FYDs may find it more difficult to attract students.

- OVC and instructors may dedicate time and resources to creating FYDs only to find that even with the revised credit limit, students are not interested in taking them.

Figure 9. "To what extent would the following changes improve the choice of major process for you?" (data from FYX IAP 2019 Survey)

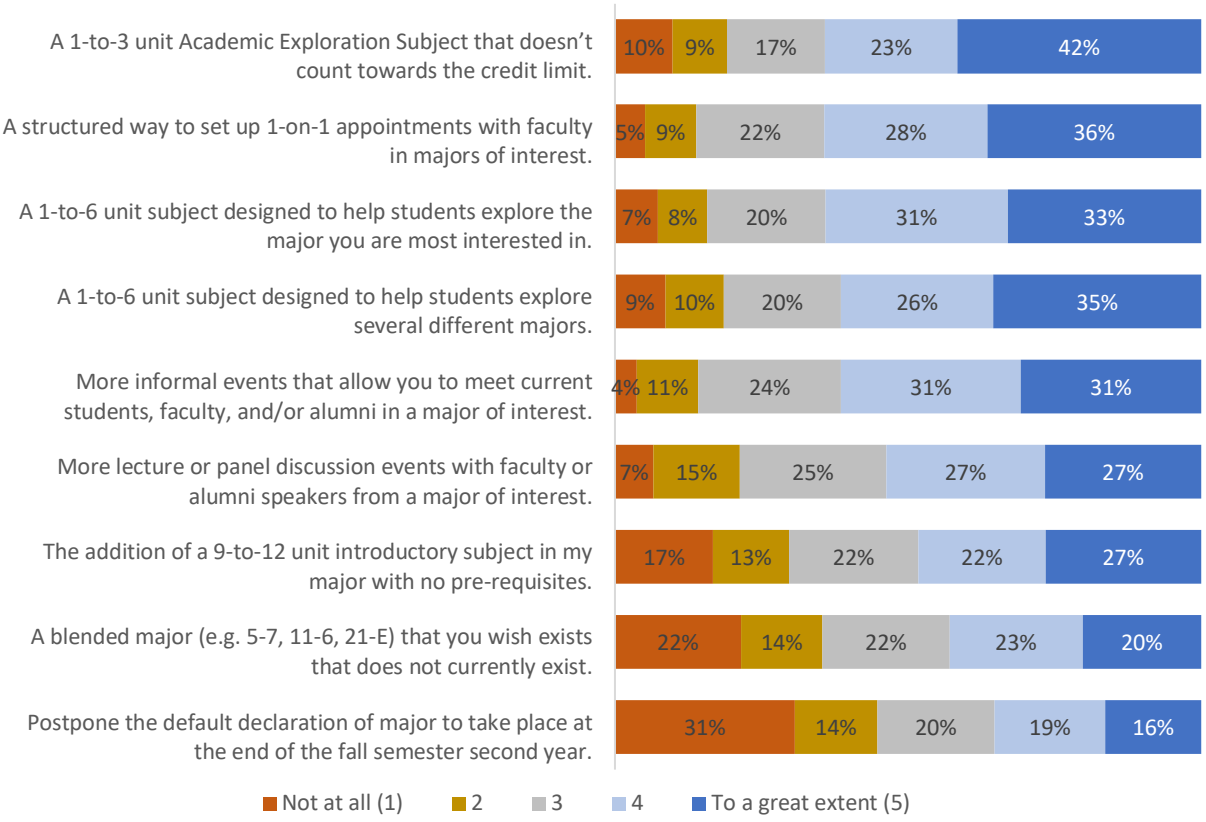
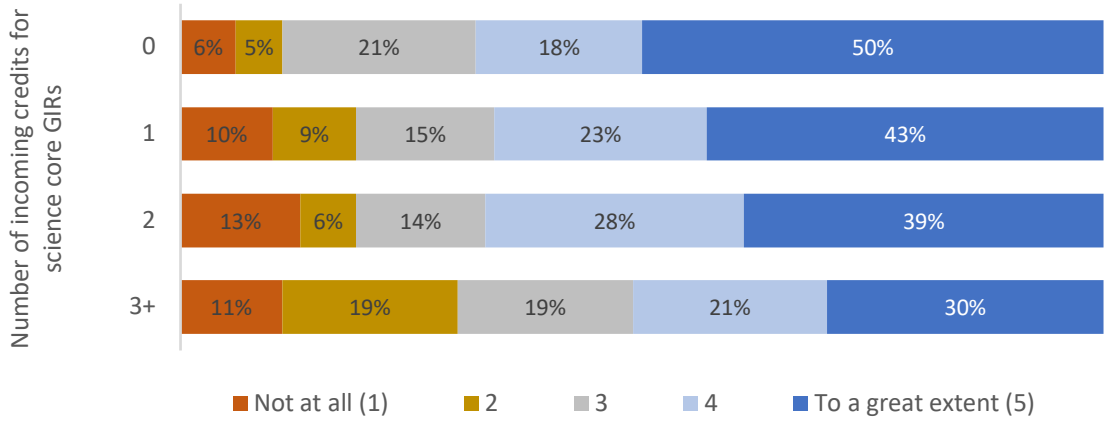


Figure 10. "To what extent would the following changes improve the choice of major process for you?" Option: "A 1-to-3 unit Academic Exploration Subject that doesn't count towards the credit limit" with breakout by incoming credit (data from FYX IAP 2019 Survey)



VARIATIONS CONSIDERED FOR "DISCOVERY SUBJECT" MODEL

- Minimum requirement
    - It is important to provide incentives for students to register for FYD subjects, and to motivate departments to develop these subjects. The CUP may wish to consider making it mandatory for students to take a certain minimum number of units of FYD subjects in their first year, though we do not recommend this.
    - Implementing this type of requirement would also be difficult until every department is represented by at least one FYD subject.
- Maximum per semester
    - Provided that the landscape of FYD subjects becomes substantial enough for students to find several FYD subjects of interest, students may decide to take multiple FYDs per term. While this behavior is certainly encouraged as it allows students to explore multiple academic interests, it could become problematic if they take a substantial number of units.
    - Adding a cap adds a layer of complexity for students, advisors, and staff who must enforce the policy. As the risk of abuse of this policy is relatively low, it might be simpler for all involved to just strongly recommend that the total units of FYD subjects per term not exceed a certain limit. This recommendation could be shared with advisors, OFY staff, and students and be posted on the relevant websites, but the decision of whether or not to enforce the recommendation would be left to individual advisors.
    - 9 units of FYD and FAS subjects makes it easy for students to explore multiple opportunities each semester. It also sets a typical maximum expectation. Expanding the total number of units also makes it easier for students to accept a decrease in the main credit limit, while restricting the FYD units to exclusively small and first-year-friendly subjects reduces the risk of adding to academic stress.
- Counting First-Year Advising Seminars as FYD subjects
    - Several existing first-year advising seminars currently serve the functions described for FYD subjects (e.g. 4.A01, 10.A14). There are several possible options for how FASs might interact with FYDs
        i. Remain an FAS: Instructors could choose to keep their FAS at 6 units or reduce it to 3 units. The FAS would only be available to students who sign up for it as their primary advising method over the summer.
        ii. Convert to FYD: Offer seminar advisors the option to offer their subject as an FYD subject instead of as a seminar. The advisor could choose to continue as a traditional advisor or simply teach the FYD subject and not participate in first-year advising. Students would register for this subject on registration day.
        iii. Offer multiple versions of the subject: Allow students to register for either the FYD version or the FAS version. Students would sign up for the FAS version over the summer as usual. They would be advised as is typical in an FAS. Students not registered for the FAS version would have the option to register for an FYD version on registration day.
    - While all of these options come with certain advantages and challenges, the main goal of any choice should be promoting as much access to high-quality discovery opportunities as possible.

Neither students nor professors should feel that they are being forced into a system that is worse than the current system. Option iii creates the most flexibility for students, enabling them to do things such as choosing another advising seminar and taking the subject version of a discovery seminar or taking multiple discovery seminars in their "subject" form. However, this could prove administratively difficult.

STRENGTHS AND WEAKNESSES OF PROPOSED CHANGES TO EARLY SOPHOMORE ELIGIBILITY

Over the last year, the CUP has had multiple discussions of the shortcomings of the early sophomore standing policy. Those discussions informed the below thoughts of the proposing group.

Currently about half the class has achieved the 96 units of credit required to be offered early sophomore standing. Accepting early sophomore standing has the following effects: they no longer have a spring semester credit unit limit, they are on full grades rather than ABC/NR, and they are connected with a departmental advisor (as of this year this happens after spring Registration Day).

The current policy links academic preparation to provision of advice related to an intended major. And it furthers the pressure to choose a major early versus exploring. The most common reason cited by students for electing early sophomore standing is the ability to take more credits. We note that the availability of the experimental P/NR grading policy makes retaining the ABC/NR grading less important than in the past (but it was never as strong a motivator for students as the desire to take more units — typically 60 units for most students).

As of February 11, 2019, roughly a quarter of the first-year class had taken early sophomore standing. Student comments as to why they chose to accept sophomore standing followed a few key themes. The most popular reason was to exceed the credit limit, with 58% of students citing that as a reason. Other common themes related to the added freedom, listing things like being able to add a UROP for credit, explore more classes, or pursue a double major. Some students expressed an interest in using the sophomore exploratory option earlier. Others simply felt no need to retain the ABC/NR safety net.

As noted above, only a small number of students choose to exceed 60 units if they receive sophomore standing: 15% of the early sophomores (30 students) in the Class of 2020 and 22% of the early sophomores (43 students) in the Class of 2021, which is 3% and 4% of the full class, respectively.

A better system would be one in which all students have access to advice related to an intended major or minor. We also envision a system in which decisions to allow a student to exceed the credit unit limit by a small amount could be made by the student's advisor. An incentive structure that ties departmental advice to declaring a major and taking on a higher credit limit puts unnecessary pressure on students to rush into difficult decisions. We believe that separating these decisions will allow students to think more carefully about both their choice of major and their credit load during their spring semester.

Requesting advice in a department would in no way bind a student to that department and would function as another method for exploring departments to enable a more informed decision. We also believe we should maintain encouragement for students to explore through exempting some number of FYD units from the credit unit limit. We don't see significant weaknesses with abolishing sophomore eligibility with the changes we have proposed.

WHAT WE KNOW AND DON'T KNOW ABOUT THE RELATIONSHIP BETWEEN ACADEMIC LOAD AND ACADEMIC STRESS

One of the key concerns about increasing the credit unit limit is the impact on student academic stress. For context, we note that a quarter of our undergraduate students are patients of MIT Mental Health and Counseling. Therefore, anything that has the potential to exacerbate mental health issues on campus must be considered very carefully. This is not a topic that the proposers of this experiment are expert in, so we have taken three actions. The first is to see if there is a relationship between unit load and reported student stress in survey data that MIT collects. The second is to review relevant literature and activities of our peers. The third is to seek the advice of experts on campus, in particular, Dr. Karen Singleton who leads MIT Mental Health and Counseling, and David Randall, Senior Associate Dean for Student Support and Well-Being. We discuss each of these in turn below.

Using survey data from 2017 Student Quality of Life Survey (which went to all undergraduates) we explored the relationship between the number of units a student was taking in the term of the survey (Spring 2017) and three stress-related questions on the survey:

1. Within the current school year, how would you rate the overall level of academic stress you have experienced? (10 point scale, No stress to Tremendous Stress)
2. Based on your experience and observation, rate the general climate at MIT along the dimensions below. (1 Stressful to 6 Calm)
3. Students take pride in how stressed out they are at MIT. (5 points: Strongly disagree to Strongly Agree)

For the 1,700 to 1,800 undergraduates who answered these questions (response rates vary by question), there was no significant relationship with credit load controlling for after controlling for demographics.

However, the research literature (e.g. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5193280/) shows that academic stress can be exacerbated by perceptions of academic workload, academic self-perceptions, and expectations to perform (both pressure from others and oneself). Thus, stress can be caused both by students doing too much, and by students feeling that they are not doing enough relative to their peers. The latter may be particularly relevant for our student population given the prevalence of imposter syndrome. Therefore, one may not expect to see a correlation between reported stress and academic load. Last year Columbia University reduced their credit limit (all four years) in an effort to reduce academic stress. It is too early to tell the impacts of this action.

Given the above, we sought the advice of our campus experts Dr. Karen Singleton and David Randall. Below are their responses to our questions.

1. Will increasing credit unit limits have a negative effect on student health?

   We have reservations about increasing the credit limits and, looking at the proposed and alternative plans, are most in favor of a 48-unit limit in the Fall (we are aware that the limits are currently 54). Although we certainly acknowledge that there are a substantial number of students who could handle more units, we are concerned about the tail of the distribution. In other words, we worry about the students who are seriously underprepared for MIT or otherwise disadvantaged.

   We also worry that by increasing the credit limit, a disparity could be created between the haves and have nots. Underprepared students will either a) feel ashamed that they can't handle the load that others can or, b) try to attempt a higher load and get themselves in personal/academic/financial trouble. If those particular students are experiencing imposter phenomena (which is all too often the case), it would only further exacerbate those challenges.

The data you sent about the correlation and number of units is interesting. I'm not sure we would expect to see a correlation because the students who we're most concerned about are relatively small in number, but highly vulnerable. We're not sure statistical analyses would pick them up.

We do also want to share that in both scenarios we were a little apprehensive about the extra 9 or 6 units (FYD/FAS). Our primary concern is that developing something that's intended to be about exploration and personal development then morphs over time into another academic requirement - additional boxes to be checked off. What's happened with IAP comes to mind, so we would advise putting up substantial guard rails to prevent creep in the future.

2. Is there evidence of positive or negative effects or decreasing/increasing limits elsewhere? (For example, last year Columbia reduced their credit limit in an effort to reduce academic stress. Is that leading to positive effects?)

   We're not aware of such research, and haven't heard any discussed at our professional conferences. Karen has reached out to colleagues at Columbia to see if she can learn more.

3. If yes, what effects do you anticipate if we were to increase allowed credits?

   See our comments to #1.

4. If yes, can you qualitatively describe how significant the effect would be? (very minor, minor, significant, major crisis, what fraction of the population would be impacted, etc.)

   Given that our concern is about the tail of the distribution, we think the impact to these students (perhaps 5-10%) could be significant.

5. Does it matter what kind of units they are (e.g. for light load discovery subjects or more strenuous classes)?

   We are cautious about adding anything without taking something away. We hear from students that our requirements are already so intense that adding anything, even fun or exploratory stuff, could feel overwhelming. Adding academic requirements seems like it could be especially overwhelming to students who already find MIT to be challenging.

On the basis of the above, we believe it is prudent to balance the addition of FYD units with the removal of some number of units from the main credit limit in both the first semester and second semester of the first year. We understand that this may constrain the schedule choices of perhaps 16% of the students in the fall and 3%-4% in the spring. However, would do not wish to jeopardize the health and well-being of perhaps 5%-10% of our student population as noted by Dr. Karen Singleton and David Randall.

ADDITIONAL EXPERIMENTAL POLICIES CONSIDERED

REPLACE ONE SCIENCE CORE GIR WITH DISCOVERY/EXPLORATION

Students will be required to take at least 12 units of academic discovery/exploration in the first-year. This could include classwork and up to 6 units of UROP or other approved experiential learning opportunity and be completed in at least two departments (divided up in any fashion, 3-9, 6-6, 9-1-2, etc.). In exchange for taking 12 units of academic discovery/exploration, students will be permitted to skip any one of the following science core GIRs: Calculus 2, Physics 2, Biology, or Chemistry, provided that the GIR is not a prerequisite for later subjects

and/or required for the major. (Note that Calculus 1 and Physics 1 do not qualify because they are prerequisites for Calculus 2 and Physics 2, respectively.) This option will only be available to members of the Class of 2023. Members of other class years at MIT will not have this option, or be grandfathered into this option, since the purpose is to encourage discovery and exploration in the first-year, and those students have completed their first-year.

The subjects or experiential learning opportunities will be selected from an approved list that will be distributed to first-year students prior to fall registration and will include at least one opportunity per department. This list will be compiled from a combination of existing subjects and new subjects designed specifically for this purpose. Students will be permitted to file a petition to count experiences beyond those on the approved list. Petitions will be decided by the CUP.

Acceptable exploration should consist of 12 units from the following:

1. First-Year Discovery subjects
2. CoC-Designated Major Introduction Courses
    - These subjects would be >3 units and therefore not eligible to become FYD subjects but would still have exploration as a primary goal. Examples include 2.00B, 7.002, 8.s10, and 16.00.
3. HEX Subjects
    - Any of the approved HEX subjects listed here are eligible: http://catalog.mit.edu/mit/undergraduate-education/general-institute-requirements/#hassrequirementtext
    - A HEX subject used to satisfy the exploration requirement MAY NOT count as one of the student's 8 required HASS subjects, but may be counted towards the communications requirement as appropriate.
    - HEX subjects that are jointly listed in two or more departments will count as exploring "two or more departments". HEX subjects listed in only one department must be taken in addition to another exploration subject in a different department such as a 1 or 2 unit FYD.
4. An approved exploratory UROP for credit or pay. A UROP may satisfy up to 6 units of the requirement and must be designated "exploratory" in the initial proposal submitted to the UROP office. The CUP and OVC would work with the UROP office to identify criteria that exploratory UROPs must meet.

Students will be expected to demonstrate that they have completed their 12 units of academic discovery/exploration by the end of the first-year. Students who fail to complete 12 units of academic discovery/exploration in their first-year will be expected to complete all 6 science core GIRs.

If a student chooses to take all 6 science core GIRs in addition to 12 units of academic discovery/exploration, they may be excused from one of their two required REST subjects unless that subject is required for their major. This provision provides opportunities for students who need all the GIRs to satisfy prerequisites or who receive advanced standing and do not have any remaining GIRs that they could feasibly skip.

- Potential benefits include:
    - It explicitly requires academic discovery/exploration, which is our primary objective.
    - It does so in a prescribed manner where we can control what constitutes "discovery/exploration" subjects and experiential learning opportunities.

- The presence of a guaranteed market of students for subjects may provide stronger encouragement for departments to create more academic discovery subjects.
- The learning in the GIRs is not diminished by a change in grading policy, and in fact may be promoted if students are no longer taking some of the GIRs on P/NR in the first semester.

- Potential risks include:
  - The students will miss one GIR.
  - The distribution of which GIRs students choose to omit may disproportionately impact certain departments.

RESEARCH QUESTIONS TO BE ADDRESSED BY PHASE TWO

We propose to use the experimental and quasi-experimental research methods of social science to evaluate the consequences of added flexibility and additional opportunities to explore alternative majors. Outcomes of interest include a set of objective and subjective measures related to students' undergraduate career at MIT, range of experiences, academic progress, health and well-being, duration in a major and survey- and interview-based self-assessments and opinions about the MIT experience such as those collected in the CUP Study Group on Undergraduate Majors Selection study of the first-year students entering in the fall of 2017.

Our original hypothesis from Phase One is that expanded opportunities for major exploration enabled by increased curricular flexibility will lead to increased confidence in students' initial choices and to higher levels of satisfaction with choice of major (i.e., fewer students say that if they had to do it again, they would have picked a different major). It may also diversify and improve the undergraduate experience as a whole, encouraging students to engage in a wider range of academic opportunities. This may lead to greater overall satisfaction with the undergraduate experience at MIT, and possibly to improved academic performance and reduced stress.

Phase Two will continue to test this hypothesis, as well as the hypothesis that creating a separate credit limit for discovery will motivate students to optimize their main credit limit and discovery limit separately.
To that end, we propose to examine treatment effects on the following outcomes:

I. From administrative data
   A. Take-up
      a. Departments, programs, and fields that are discovered/explored
      b. Science core GIRs students choose to take P/NR vs. on grades
   B. Programmatic
      a. Science core GIR completion timing
      b. Number and timing of HASS, major, FYD, and academic exploration subjects
      c. Program diversity: The number of departments to which a student has exposure
      d. Subject distribution: The concentration of subject enrollment measured by something like a Gini coefficient (an elaboration on a. and b.)
      e. Choice of majors, including timing (e.g. through early sophomore standing)
      f. Fields of internships, UROPs, global and other experiences
      g. Changes of major
   C. Academic
      a. Fifth-week flags
      b. CAP actions, including warnings
      c. Add/Drop patterns for subjects including the science core GIRs
      d. Credit completion, academic probation, withdrawal or transfers

e. Grades in general, including OX grades, and specifically in science core GIR subjects and subjects for which science core GIRs are prerequisites

II. From survey data

A. Student experience reports, including duplicating aspects of the CUP Study on Undergraduate Majors Selection with the first-year students entering in the fall of 2018 and fall of 2019.
B. Student satisfaction, climate indicators, self-assessments of stress, and other data from various institutional surveys including the Student Quality of Life Survey (Spring 2021) and the Perceptions of Majors Survey
C. Additional surveys prepared and implemented by the study team to gather comparison data between the first-year students entering in the fall of 2017, fall of 2018, and fall of 2019.

For all of the above objective and subjective measures we will investigate how the outcomes vary with student characteristics, such as: level of preparation, incoming Advanced Placement credit, qualified transfer credit and other advanced standing credit, and URM, gender, socioeconomic and first-generation status.

We also think it will be important to get input from faculty and staff about their experiences with the experimental policies and hope to do so in a way that gives balanced input.

RESEARCH DESIGN

The treatment we propose is the second phase of an ongoing experiment where the first-year students entering in the fall of 2017 are the control (existing policies). The first-year who entered in the fall of 2018 are treatment group 1. And the first-years entering in the fall of 2019 are a treatment group for a different intervention as described in this proposal.

As with all such research by MIT faculty, our research plan is subject to the approval of the Committee on the Use of Humans as Experimental Subjects (COUHES) and may be amended in view of COUHES guidance.

Because this work is carried out for institutional purposes, we expect any analysis of existing administrative data to be exempt from full Institutional Review Board (IRB) review. Surveys, should they be conducted in consultation with the research team, will be approved by COUHES and participants will be consented. In addition, FERPA allows education institutions to use their own data for educational improvement.

Note that we have considered some potential “failure modes” and ways to mitigate them, like documenting the subjects required for students to enter different majors and listing majors students cannot finish in four years if they take certain GIRs later in their undergraduate careers, so that we can share this information in advance with students and advisors.

PLANS FOR CREATING MORE DISCOVERY SUBJECT OPTIONS

The Office of the Vice Chancellor has worked with departments to help create new discovery and exploration options for first-year students during AY2019. Some of these subjects were run during IAP 2019 or will be run during Spring 2019. Others will be implemented during AY2020. Additionally, we have provided support for existing “discovery-like” subjects that required minor revisions or increased publicity.

Revisions to existing subjects

- 3.001 - Introduction to Materials Science and Engineering (3 units) – F. Ross
- 8.S10 - Techniques of Experimental Physics (9 units)- R. Milner and C. Paus
- 20.S901 - Exploring majors at the intersection of engineering, life sciences & medicine (1-3 units)- M. Jonas

New subjects AY19

- 5.001 - Exploring Chemistry (2 units) – J. Johnson
- 5.302 - Introduction to Experimental Chemistry (3 units) – M. Shoulders and J. Dolhun
- 10.000 - Engineering Molecular Miracles: Exploring Careers and ChemE @ MIT (2 units)- T. Kinney
- 12.00 - Frontiers and Careers in Earth, Planets, Climate, and Life (2 units) - T. Herring
- 12.12 - Nature's Sandbox: The History of Ancient Environments, Climate, and Life (3 units) - K. Bergmann
- 15.000 - Explorations in Management (3 units)- J. Orlin
- 21G.012 - Exploring Globalization through Chinese Food (1 unit) – E. Teng
- 21M.803 & 21M.806 – HOC Mural (3-6 units) - S. Brown
- SP.361 - Majors and Careers through a Terrascope Lens (3 units) – D. McGee, A. Epstein

New subjects to be implemented AY20

- 21.00 - SHASS Exploration (1 unit) - A. Rayo
- Number TBD - The Future (6 units)- J. Fernandez, W. Deringer, W. Minicozzi, D. Darmofal, R. Rigobon

A description of some of these subjects may be found in Appendix B. Many of these existing "Academic Exploration Subjects" can be easily modified or approved as-is by the CoC as "Discovery Subjects". We expect that roughly 10 subjects will fall into this category. We will also support instructors of first-year advising seminars who wish to convert their seminar into a Discovery Subject, regardless of whether they may also count the subject as an advising seminar.

Additionally, we will continue to support departments and programs who wish to develop new Discovery Subjects to be implemented in AY2020. We will also help facilitate interdepartmental collaborations to create broader discovery subjects that cover multiple fields.

RESOURCES

This topic continues to be the single highest priority for undergraduate educational innovation within the Office of the Vice Chancellor. As evidenced by the 30-person team that worked to develop and deliver the "Designing the First Year at MIT" subject and the creation of a dedicated staff position to coordinate this effort, the continued efforts of the FYX Study team who authored this proposal, and the DFY Fun-Sized subject over IAP, we will bring whatever financial and human resources are at our disposal to ensure this experiment is successful. We also have the full support of the MIT Senior Administration and will request additional resources if necessary.

REPORTING AND OVERSIGHT

The experiment will be conducted through the Office of the Vice Chancellor. The experiment will be supervised by the Committee on the Undergraduate Program, consistent with MIT Rules and Regulations defining the duties and responsibilities of the CUP, c.f. 1.73.2:

c. Encouraging experimental innovation in undergraduate education, including the approval and supervision of limited educational experiments and granting of exceptions to allow any experiment to depart from specific Faculty Regulations and MIT administrative procedures. Descriptions of experiments and reports on their progress and outcome shall be circulated to the Faculty. Experiments that show enduring value should be incorporated in the usual ways into the Faculty Regulations and administrative practices.

In order to fulfill the reporting expectations as above, the following plan for reporting to the CUP, and with the CUP to the MIT Faculty, is proposed:

- Some data will be collected as a matter of course, through ongoing or existing surveys. We will share these with the community as they become available and are released (e.g., as with the Perceptions of Majors Survey, etc.)

- Preliminary/ongoing updates will be reported as requested by the CUP.

- Integrated analysis and assessments, that aggregate and synthesize the take-up, programmatic, academic, and other data sources will be made after the fall 2019 semester, early in the spring 2020 semester, and then late in the spring 2020 semester to inform consideration of subsequent experiments or actions.

- In subsequent years as we track the first-year students who entered in the falls of 2017, 2018, and 2019, we will provide annual reports each summer.

ENGAGEMENT AND OUTREACH

Members of the First-Year Experience core team have been engaging key stakeholders including: first-year students; first-year advisors; first-year associate advisors; advisors in the major; upper-level students; faculty and staff; and alumni. Key messages have included: how the incoming class has more opportunities and space to explore, should they choose to do so; how the experiment is being run; data collected so far related to the experiment; and what the goals are as well as possible drawbacks.

When time allowed, engagements also included time for stakeholders to suggest changes relating to both policy and process for Phase Two of the experiment.

Presentations made during fall 2018 included the following audiences:

1. Orientation Leaders -8/23
2. FY advisors - 8/27
3. Associate Advisors - 8/27
4. SHASS Council - 9/6
5. Undergraduate Academic Administrators - 9/11
6. UA Council - 9/12
7. Creative Arts Council - 9/12
8. OVC All Hands - 9/17
9. IACME - 9/19
10. Representatives from the Class of 1960 - 9/20
11. Undergraduate Officers - 9/24
12. Academic Council - 9/25
13. Division of Student Life - 9/26
14. Institute Communications Group - 9/26
15. UA Forum (open to all students) - 10/4
16. Science Council - 10/15
17. Institute Faculty Meeting - 10/17
18. Faculty Policy Committee - 10/18
19. MacVicar Lunch - 10/25
20. Vice Chancellor's office hours (open to all students) - 10/29
21. Math Department - 10/31
22. Biology Department - 11/1

23. Chemistry Department - 11/5
24. OMESAC - 11/5
25. Heads of House - 11/14
26. Mechanical Engineering Department - 11/30
27. EECS Department - 12/3
28. UROP Coordinators - 12/4
29. Committee on Student Life - 12/7
30. Engineering Council - 12/10
31. OMEFAC - 12/10
32. Chemical Engineering Department - 12/17
33. Sloan Faculty Meeting - 2/5
34. Science Council – 2/12
35. Institute Faculty Meeting – 2/20
36. Economics Faculty Meeting – 2/27

Visits to departments will continue during spring 2019, and the presentation will be updated to inform audiences about Phase Two of the experiment when a decision has been reached.

For Phase Two of the experiment, we will continue to make dedicated training and preparation of advisors and associate advisors a key focus of our activities. This will be done as an augmentation to our existing training. We will continue to make data on both phases of the experiment publicly available when possible.

TIMING

Below are the key dates in the timeline:

Feb 6 & 20: CUP discussion of AY19 data and AY20 experiment proposals
Feb 20: Present data and proposals at Faculty Meeting; solicit faculty and community input
March 1: Revised proposal from OVC to CUP and community for input
March: Further CUP discussion of AY20 experiment and input
Apr 3: CUP vote on AY20 experiments
Early Apr: Briefings on experiments shared with MIT community and prospective undergraduate students
April 10: Deadline for Office of the First Year to input fall 2019 FAS information for the CoC. May need to be extended if experiment promotes significant changes to FASs
April 12: Experimental policy explained to prospective students and parents during CPW
Late August: Class of 2023 arrives on campus, trainings for Orientation Leaders, FY Advisors, and Associate Advisors

INDIRECT BENEFITS OF THE PROPOSED EXPERIMENTS

Other indirect benefits from conducting a class-wide experiment are of note, even if difficult to measure. While the goal is to enhance the academic experience and promote more intellectual exploration, in so doing, we expect there will be other positive outcomes.

- The experiment demonstrates how MIT is “listening to its students.” It also sends a message that we are living up to our commitment to follow through on the recommendations of the “Designing the First-Year at MIT” subject.

- Parents of undergraduates will likely appreciate (and expect) MIT's concern and attention to improving the first-year experience. Alumni have also expressed support: preserving the magic of MIT but making it better.
- The policy options described may promote improvements in health and well-being by reducing academic stress and pressure to choose the right major, especially among the cohort of students who do not feel well-prepared to do so (27% in the Class of 2021). As one recent alumnus said, *"You can have all the puppy labs in the world, but if you do not fundamentally think about ways to improve the academic experience… it is all for nothing."*
- Improving the first-year may help with admissions yields, especially relative to cross-competes with other top schools. The following is a list of some of the reasons why admitted students say "no" to MIT:
    - MIT perceived as too "narrow" in its educational focus and opportunities
    - MIT forces students to choose their path (i.e. major or field) too early, with no space or time to explore
    - The MIT experience is too "soul crushing, stressful, depressing" in a way that makes all the above worse
    - Students want more access to liberal arts people, topics, and concerns; putting STEM in a social context

APPENDICES

Appendix A: Regression analysis of fall registration data
Appendix B: Existing FYD-style Subjects

FYX Regressions Fall 2018

Jon Daries

October 18, 2018

Institutional Research
Office of the Provost

List of Tables

List of Figures

Table 1: Demographics of regression sample

	Class of 2022	Classes of 2019-2021
N	1,114	3,310
Gender		
Male	51%	54%
Female	49%	46%
Race/Ethnicity		
White	30%	35%
Asian	36%	32%
URM	26%	22%
International	8%	10%
Parental Education		
First Generation	18%	17%
Family Income		
Less than $50K	16%	15%
$50K to $100K	16%	15%
$100K to $150K	13%	13%
$150K to $200K	10%	10%
$200K to $250K	7%	7%
$250K to $300K	6%	5%
Greater than $300K	14%	10%
No Financial Aid application[1]	18%	24%
Preparation		
Mean SME GIRs AP/ASE/Transfer	1.4	1.3

[1] Family income unknown for those who do not apply for financial aid.

Table 2: Anticipated major of regression sample

	Class of 2022	Classes of 2019-2021
School of Engineering		
Civil & Env. Eng.	2%	3%
Mech. Eng.	8%	10%
Mat. Sci. & Eng.	2%	2%
EECS	28%	25%
Chem. Eng.	7%	6%
Aero. % Astro.	6%	5%
Bio. Eng.	8%	10%
Nuclear Eng.	1%	1%
Unspecified Eng.	3%	5%
School of Eng. Total	66%	66%
School of Science		
Chemistry	2%	2%
Biology	3%	3%
Physics	7%	8%
Brain & Cog. Sci.	3%	2%
EAPS	1%	0%
Math	10%	10%
Unspecified Sci.	0%	0%
Pre-Med.	1%	1%
School of Sci. Total	27%	28%
School of Arch. & Planning		
Architecture	1%	1%
DUSP	0%	0%
School of Arch. & Planning Total	1%	1%
School of Hum. Arts & Soc. Sci.		
Economics	2%	2%
Poli. Sci. (incl. Pre-law)	0%	0%
Humanities (21x)	0%	0%
Ling. & Phil.	1%	0%
CMS	0%	0%
Mus. & Theater Arts	0%	0%
SHASS Total	3%	3%
Sloan School of Mgmt.		
Sloan Total	2%	2%
Other		
Other/Undecided/Unknown	1%	1%

Table 3: Means of regression outcomes

	Class of 2022	Classes of 2019-2021
Count of subjects		
SME GIRs Fall Term	2.2	2.7
non-SME-GIR Science Subjects Fall Term	0.4	0.3
non-SME-GIR Engineering Subjects Fall Term	0.8	0.5
SAP/SHASS/Sloan Subjects Fall Term	0.5	0.5
non-SME-GIR Exploratory Subjects Fall Term	1.1	0.7
Credit units		
SME GIRs Fall Term	26.6	32.8
non-SME-GIR Science Subjects Fall Term	4.5	2.7
non-SME-GIR Engineering Subjects Fall Term	7.3	3.7
SAP/SHASS/Sloan Subjects Fall Term	13.0	11.6
non-SME-GIR Exploratory Subjects Fall Term	12.3	7.8

Table 4: Outcome: SME GIRs Fall Term (count of subjects)

	(1)	(2)	(3)
Class of 2022	-0.513***	-0.523***	-0.460***
	(0.025)	(0.024)	(0.018)
Female		0.306***	0.100***
		(0.021)	(0.016)
Asian		-0.413***	-0.096***
		(0.025)	(0.020)
URM		0.044	-0.029
		(0.028)	(0.021)
International		-0.386***	-0.151***
		(0.040)	(0.030)
First Gen		0.172***	0.032
		(0.031)	(0.023)
Family Income[1]	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes
Anticipated major[3]	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 5: Outcome: non-SME-GIR Subjects Fall Term (count of subjects)

	Science Subjects			Engineering Subjects		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	0.166***	0.175***	0.144***	0.357***	0.361***	0.332***
	(0.022)	(0.021)	(0.018)	(0.024)	(0.023)	(0.022)
Female		-0.161***	-0.048**		-0.174***	-0.084***
		(0.019)	(0.017)		(0.021)	(0.021)
Asian		0.164***	-0.028		0.273***	0.158***
		(0.023)	(0.020)		(0.025)	(0.025)
URM		-0.047	0.009		-0.030	-0.017
		(0.026)	(0.022)		(0.028)	(0.027)
International		0.221***	0.057		0.229***	0.168***
		(0.036)	(0.031)		(0.039)	(0.038)
First Gen		-0.124***	-0.027		-0.033	-0.004
		(0.028)	(0.024)		(0.030)	(0.030)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 6: Outcome: non-SME-GIR Subjects Fall Term (count of subjects)

	SAP/SHASS/Sloan Subjects			Exploratory Subjects		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	0.107***	0.105***	0.098***	0.406***	0.411***	0.378***
	(0.017)	(0.017)	(0.017)	(0.027)	(0.027)	(0.026)
Female		-0.003	0.017		-0.117***	-0.010
		(0.015)	(0.016)		(0.024)	(0.024)
Asian		0.089***	0.061**		0.243***	0.068*
		(0.018)	(0.019)		(0.029)	(0.029)
URM		0.048*	0.058**		-0.107***	-0.065*
		(0.020)	(0.020)		(0.032)	(0.031)
International		0.128***	0.106***		0.064	-0.043
		(0.028)	(0.028)		(0.045)	(0.044)
First Gen		-0.010	0.010		-0.089*	-0.014
		(0.022)	(0.022)		(0.035)	(0.034)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 7: Outcome: SME GIRs Fall Term (credit units)

	(1)	(2)	(3)
Class of 2022	-6.152***	-6.271***	-5.523***
	(0.302)	(0.285)	(0.212)
Female		3.676***	1.205***
		(0.255)	(0.197)
Asian		-4.954***	-1.152***
		(0.304)	(0.236)
URM		0.528	-0.345
		(0.341)	(0.254)
International		-4.638***	-1.815***
		(0.478)	(0.359)
First Gen		2.070***	0.382
		(0.374)	(0.280)
Family Income[1]	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes
Anticipated major[3]	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit units range from 0 to 72 with 12 units for each SME GIR earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 8: Outcome: non-SME-GIR Subjects Fall Term (credit units)

	Science Units			Engineering Units		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	1.747***	1.848***	1.478***	3.594***	3.636***	3.318***
	(0.225)	(0.221)	(0.183)	(0.213)	(0.207)	(0.196)
Female		-1.881***	-0.561***		-1.771***	-0.793***
		(0.197)	(0.170)		(0.185)	(0.182)
Asian		1.952***	-0.263		2.887***	1.583***
		(0.236)	(0.204)		(0.221)	(0.219)
URM		-0.509	0.125		-0.325	-0.161
		(0.264)	(0.219)		(0.248)	(0.235)
International		2.494***	0.648*		2.119***	1.353***
		(0.371)	(0.310)		(0.348)	(0.332)
First Gen		-1.391***	-0.277		-0.715**	-0.350
		(0.290)	(0.241)		(0.272)	(0.258)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit units range from 0 to 72 with 12 units for each SME GIR earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 9: Outcome: non-SME-GIR Subjects Fall Term (credit units)

	SAP/SHASS/Sloan Units			Exploratory Units		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	1.392***	1.387***	1.316***	4.494***	4.548***	4.141***
	(0.164)	(0.165)	(0.164)	(0.298)	(0.293)	(0.277)
Female		-0.309*	-0.072		-1.461***	-0.159
		(0.147)	(0.152)		(0.262)	(0.257)
Asian		0.821***	0.502**		2.870***	0.760*
		(0.176)	(0.183)		(0.313)	(0.309)
URM		0.476*	0.577**		-1.156***	-0.659*
		(0.197)	(0.196)		(0.351)	(0.332)
International		1.376***	1.150***		0.447	-0.879
		(0.277)	(0.278)		(0.492)	(0.470)
First Gen		-0.095	0.108		-1.179**	-0.262
		(0.216)	(0.216)		(0.385)	(0.366)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit units range from 0 to 72 with 12 units for each SME GIR earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 10: SME GIRs Fall Term (count of subjects) split by Gender

	Male			Female		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.582***	-0.593***	-0.503***	-0.450***	-0.445***	-0.414***
	(0.039)	(0.036)	(0.026)	(0.031)	(0.030)	(0.024)
Asian		-0.618***	-0.170***		-0.242***	-0.041
		(0.040)	(0.031)		(0.031)	(0.025)
URM		0.023	-0.025		0.006	-0.067*
		(0.039)	(0.028)		(0.041)	(0.033)
International		-0.450***	-0.183***		-0.314***	-0.124**
		(0.056)	(0.041)		(0.055)	(0.045)
First Gen		0.190***	0.037		0.118*	0.007
		(0.042)	(0.030)		(0.046)	(0.037)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	2342	2342	2342	2082	2082	2082

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 11: SME GIRs Fall Term (count of subjects) split by URM

	URM			non-URM		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.425***	-0.429***	-0.398***	-0.557***	-0.577***	-0.481***
	(0.034)	(0.034)	(0.031)	(0.031)	(0.030)	(0.021)
Female		0.093**	0.021		0.319***	0.111***
		(0.034)	(0.031)		(0.026)	(0.019)
First Gen		0.006	-0.019		0.240***	0.056
		(0.040)	(0.036)		(0.041)	(0.029)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	1031	1031	1031	3393	3393	3393

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 12: SME GIRs Fall Term (count of subjects) split by country of origin

	International			Domestic		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.601***	-0.663***	-0.486***	-0.509***	-0.521***	-0.458***
	(0.104)	(0.102)	(0.071)	(0.026)	(0.025)	(0.018)
Female		0.266**	0.102		0.229***	0.085***
		(0.086)	(0.061)		(0.022)	(0.017)
First Gen		0.261*	0.056		0.137***	0.020
		(0.107)	(0.074)		(0.034)	(0.025)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	424	424	424	4000	4000	4000

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 13: SME GIRs Fall Term (count of subjects) split by Advanced Standing (Y/N)

	Has ASE Credit			No ASE Credit		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.485***	-0.537***	-0.563***	-0.388***	-0.390***	-0.392***
	(0.060)	(0.056)	(0.042)	(0.018)	(0.018)	(0.017)
Female		0.455***	0.115**		0.054***	0.039*
		(0.056)	(0.043)		(0.016)	(0.015)
Asian		-0.491***	-0.182***		-0.099***	-0.043*
		(0.067)	(0.051)		(0.019)	(0.018)
URM		0.124	-0.041		0.012	-0.007
		(0.093)	(0.069)		(0.019)	(0.018)
International		-0.463***	-0.202**		-0.021	-0.038
		(0.092)	(0.069)		(0.031)	(0.030)
First Gen		0.329***	0.106		0.015	-0.002
		(0.094)	(0.070)		(0.022)	(0.021)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	1134	1134	1134	3290	3290	3290

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Jump to Table of Contents

Table 14: SME GIRs Fall Term (count of subjects) split by number of Advanced Standing subjects

	0			1			2			3+		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Class of 2022	-0.388***	-0.390***	-0.392***	-0.537***	-0.555***	-0.559***	-0.503***	-0.557***	-0.660***	-0.405***	-0.419***	-0.428***
	(0.018)	(0.018)	(0.017)	(0.062)	(0.062)	(0.056)	(0.103)	(0.103)	(0.097)	(0.109)	(0.108)	(0.089)
Female		0.054***	0.039*		0.180**	0.130*		0.104	0.070		0.338**	-0.006
		(0.016)	(0.015)		(0.062)	(0.058)		(0.106)	(0.097)		(0.122)	(0.107)
Asian		-0.099***	-0.043*		-0.219**	-0.120		-0.274*	-0.293*		-0.255	-0.120
		(0.019)	(0.018)		(0.072)	(0.065)		(0.124)	(0.116)		(0.163)	(0.136)
URM		0.012	-0.007		0.012	-0.035		0.108	-0.033		0.261	-0.004
		(0.019)	(0.018)		(0.088)	(0.079)		(0.194)	(0.181)		(0.272)	(0.228)
International		-0.021	-0.038		-0.016	-0.091		-0.084	-0.288		-0.080	-0.015
		(0.031)	(0.030)		(0.114)	(0.104)		(0.171)	(0.157)		(0.186)	(0.153)
First Gen		0.015	-0.002		0.224*	0.113		0.135	0.057		0.100	0.153
		(0.022)	(0.021)		(0.099)	(0.089)		(0.172)	(0.161)		(0.230)	(0.187)
Family Income[1]	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	3290	3290	3290	595	595	595	266	266	266	273	273	273

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 15: SME GIRs Fall Term (count of subjects) split by number of incoming SME GIR subjects(via AP/ASE/TC)

	0			1			2			3+		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Class of 2022	-0.340***	-0.342***	-0.342***	-0.480***	-0.481***	-0.480***	-0.476***	-0.466***	-0.454***	-0.560***	-0.588***	-0.591***
	(0.025)	(0.025)	(0.025)	(0.021)	(0.021)	(0.021)	(0.049)	(0.050)	(0.050)	(0.071)	(0.069)	(0.069)
Female		0.045*	0.030		0.059**	0.047*		0.113*	0.106*		0.320***	0.263***
		(0.022)	(0.022)		(0.020)	(0.020)		(0.046)	(0.047)		(0.068)	(0.068)
Asian		-0.036	-0.031		-0.034	-0.023		-0.171***	-0.145**		-0.369***	-0.426***
		(0.031)	(0.032)		(0.023)	(0.023)		(0.052)	(0.051)		(0.081)	(0.082)
URM		-0.008	-0.014		-0.002	0.001		-0.034	-0.012		0.204	0.094
		(0.025)	(0.025)		(0.025)	(0.025)		(0.065)	(0.064)		(0.140)	(0.141)
International		-0.059	-0.043		-0.127**	-0.093*		-0.136	-0.109		-0.424***	-0.420***
		(0.036)	(0.036)		(0.041)	(0.041)		(0.091)	(0.091)		(0.111)	(0.112)
First Gen		-0.005	-0.002		0.030	0.021		0.004	0.007		0.222	0.168
		(0.028)	(0.028)		(0.027)	(0.027)		(0.074)	(0.073)		(0.138)	(0.139)
Family Income[1]	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Anticipated major[2]	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1119	1119	1119	1867	1867	1867	830	830	830	608	608	608

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Jump to Table of Contents

Table 16: SME GIRs Fall Term (count of subjects) split by Interest in Life Sciences Major (Y/N)

	Yes			No		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.300***	-0.303***	-0.260***	-0.546***	-0.554***	-0.495***
	(0.050)	(0.049)	(0.039)	(0.028)	(0.026)	(0.020)
Female		0.222***	0.078*		0.304***	0.107***
		(0.043)	(0.035)		(0.024)	(0.018)
Asian		-0.306***	-0.098*		-0.440***	-0.095***
		(0.049)	(0.040)		(0.029)	(0.022)
URM		0.019	-0.050		0.044	-0.024
		(0.057)	(0.045)		(0.032)	(0.024)
International		-0.182*	0.004		-0.410***	-0.174***
		(0.092)	(0.073)		(0.044)	(0.033)
First Gen		-0.019	-0.087		0.198***	0.043
		(0.069)	(0.055)		(0.034)	(0.026)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	Yes	No	No	Yes
Observations	710	710	710	3714	3714	3714

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Table 17: SME GIRs Fall Term (count of subjects) split by Interest in EECS Major (Y/N)

	Yes			No		
	(1)	(2)	(3)	(4)	(5)	(6)
Class of 2022	-0.603***	-0.618***	-0.574***	-0.474***	-0.485***	-0.417***
	(0.048)	(0.046)	(0.037)	(0.029)	(0.028)	(0.020)
Female		0.265***	0.086*		0.314***	0.102***
		(0.044)	(0.036)		(0.024)	(0.018)
Asian		-0.376***	-0.090*		-0.417***	-0.094***
		(0.052)	(0.043)		(0.029)	(0.022)
URM		0.063	0.001		0.041	-0.040
		(0.059)	(0.046)		(0.032)	(0.023)
International		-0.291***	-0.161*		-0.418***	-0.146***
		(0.082)	(0.065)		(0.046)	(0.033)
First Gen		0.127*	0.049		0.192***	0.024
		(0.061)	(0.048)		(0.036)	(0.026)
Family Income[1]	No	Yes	Yes	No	Yes	Yes
Incoming SME GIR credit[2]	No	No	Yes	No	No	Yes
Anticipated major[3]	No	No	No	No	No	Yes
Observations	1128	1128	1128	3296	3296	3296

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

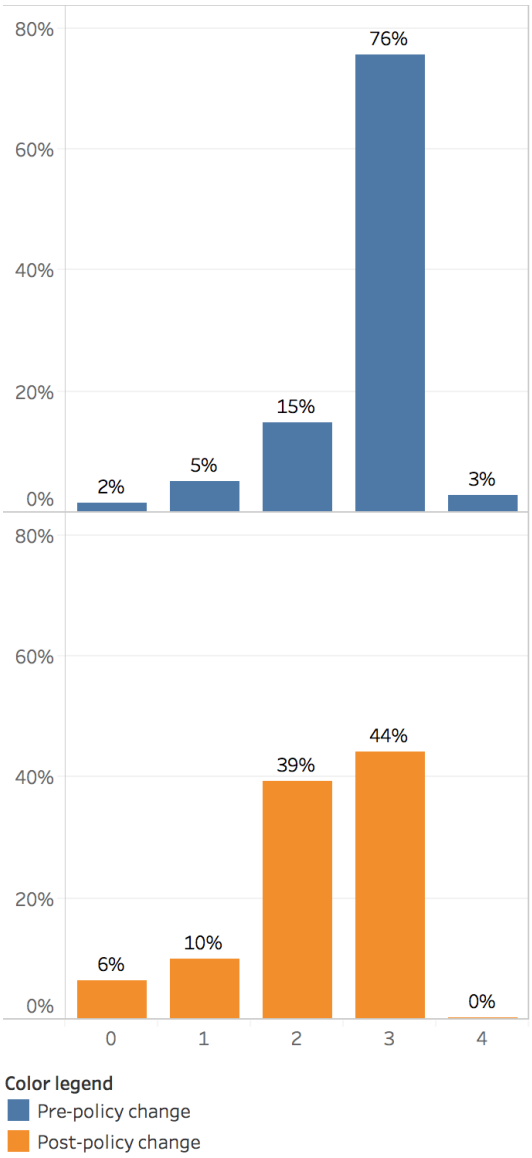
Sample is all undergraduate students on campus for Fall AY2019, N=4,424.

[1] Family income is annual income categorized into $50K bands ranging from 'Less than $50K' to 'Greater than $300K along with an indicator variable for whether the student applied for financial aid (family income is unknown for those who do not apply).

[2] Incoming credit ranges from 0 to 6 and is the number of SME GIRs earned through AP credit, transfer credit, or Advanced Standing Exams.

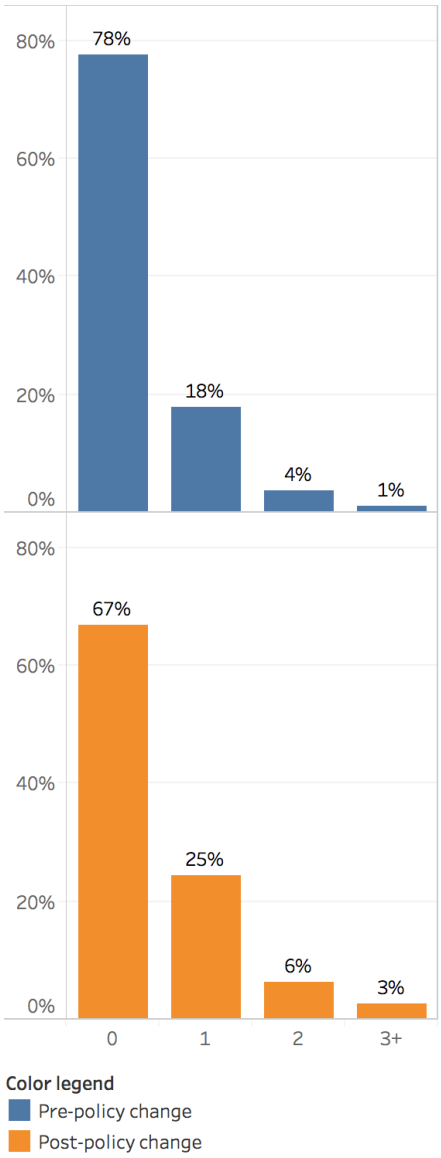
[3] Anticipated major from admissions application. Majors grouped into MIT departments along with 'Engineering (unspecified),' 'Science(unspecified),' and 'Other/Unknown/Undecided.'

Figure 1: Number of SME GIRs taken on campus fall term of first year



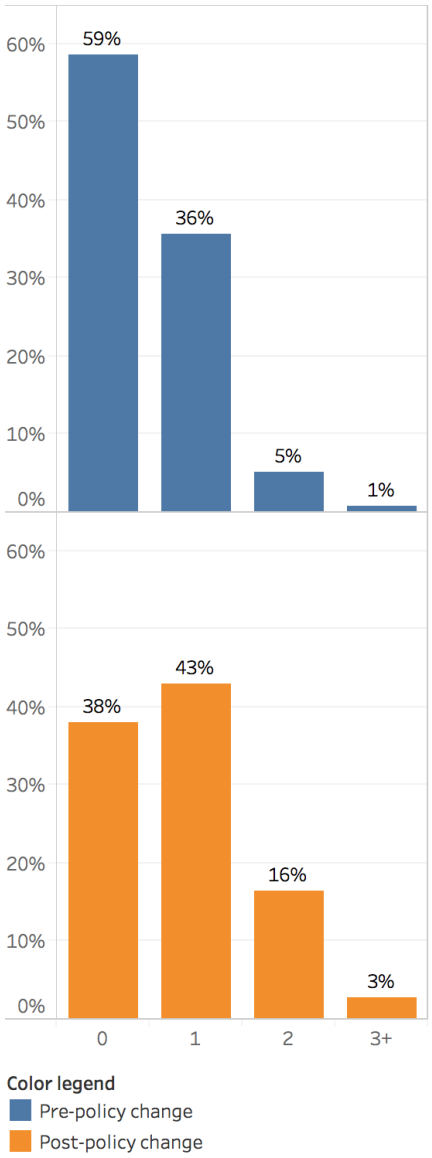
Labels are percent of students taking indicated number of SME GIRs

Figure 2: Number of non-SME-GIR Science Subjects fall term of first year



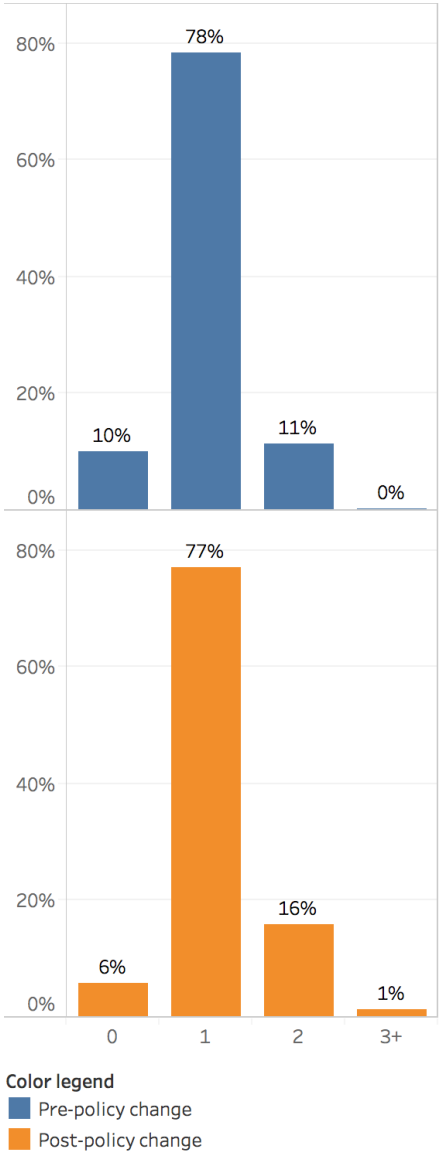
Labels are percent of students taking indicated number of subjects

Figure 3: Number of non-SME-GIR Engineering Subjects fall term of first year



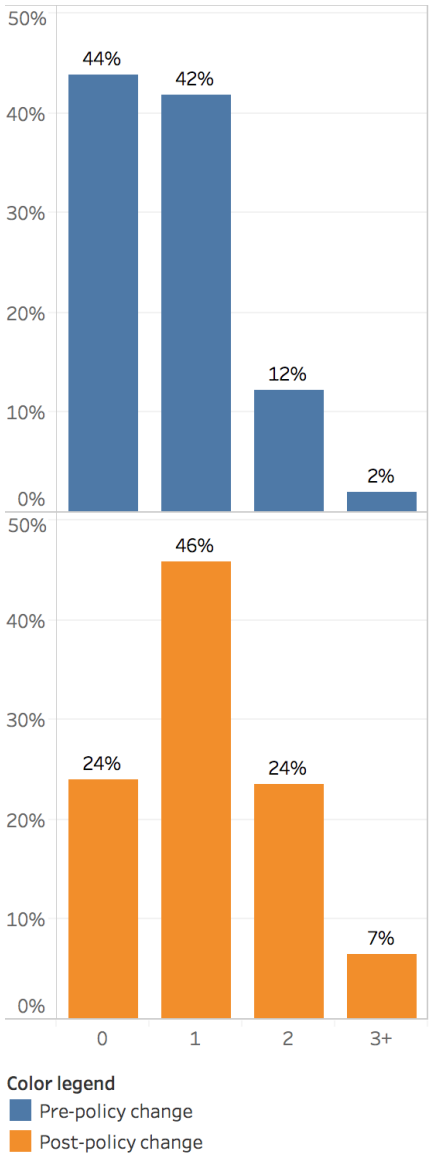
Labels are percent of students taking indicated number of subjects

Figure 4: Number of SAP/SHASS/Sloan Subjects fall term of first year



Labels are percent of students taking indicated number of subjects

Figure 5: Number of non-SME-GIR Exploratory Subjects fall term of first year



Labels are percent of students taking indicated number of subjects

Appendix B: Existing FYD-style Subjects

Most of the subjects created thus-far focus on helping students discover potential majors and minors, though they vary in size and scope and some add a reflection component that gives students structured support for choosing their academic path.

While major exploration was deemed a significant need in the first year, we believe that it is equally valid to help students broaden their education and discover fields that they have no intention of exploring further. For these students, taking an FYD subject might function similarly to attending a symposium, reading a book, or participating in a MOOC in a field unrelated to their own. Behavior of this sort sets our students on a path of lifelong learning, an undeniably desirable outcome in an increasingly complex world.

Our hope is that each of MIT's departments, labs, centers, and programs finds representation within the landscape of FYD subjects. A well-designed FYD subject might help a student narrow their choice of major or may leave them with more questions than when they started, but either way it should expand their mind by exposing them to a topic that they had not previously encountered.

The subjects listed in this document are meant to illustrate a range of approaches to discovery subjects that are already being taught or planned on campus. The potential range of approaches goes far beyond what is listed here.

> 21G.012 focuses on a specific topic but does so in a way that is enjoyable and accessible for students who are unfamiliar with the topic. The 1-unit format also makes it easy to add to existing schedules.
>
> 3.001 is focused on helping students discover academic and career pathways that relate to Materials Science and Engineering. It achieves this goal by bringing in a diverse set of speakers and including lectures from the primary instructor to help students understand the landscape of the field.
>
> SP.361 is similar to 3.001 in structure, but it organized around a cross-disciplinary focus: sustainability. While it is tied to an existing program and therefore primarily attracts an audience from within that program, its broad focus allows it to appeal to more students than a department-based subject.
>
> The Future is a 6-unit subject proposed for Fall 2019. It is designed to cover all departments at MIT by focusing on the UN Sustainable Development Goals (SDGs) as a framework for addressing how different disciplines approach problems. The time is split between multi-disciplinary panel discussions related to each SDG and focused self-reflection based on a Designing Your Life model.

21G.012 Exploring Globalization through Chinese Food

Prereq: None
Units: 1-0-0 [P/D/F]

Introduces students to some of the central themes of cultural globalization through the case study of Chinese food. An exploration of the cuisine in the local Boston area exposes students to the topics of global trade, migration, transnational business and labor, the transnational dissemination of knowledge, and cultural production. Readings and films include cookbooks, memoirs, reportage and documentaries. Includes walking tours of Boston's Chinatown. Students produce a blog to document their findings. Concludes with a Chinese cooking workshop. Limited to 15; preference to first-year students.

Tentative class schedule:

Tuesday, February 12 7 PM-8 PM: lecture

Tuesday, February 26 7 PM-8 PM: discussion

Tuesday, March 19 7 PM-8 PM: Nadia Ling talk and kitchen tour of Dumpling Daughter

Tuesday, April 9 7 PM-9 PM: film and discussion

Tuesday, April 23, 7 PM-10 PM: walking tour and dinner in Boston Chinatown

Friday, May 3, 2 PM-5 PM: cooking class in E51-095, with Prof. Anne McCants (MIT History) and Prof. Wen-hui Tang (Visiting Scholar MIT GSL)

This class will require approximately 14 hours from students. Emma Teng (Global Studies and Languages/History) will serve as the lead instructor for this class and has enlisted Prof. Anne McCants (MIT History) and Prof. Wen-hui Tang (Visiting Scholar MIT GSL) to assist with the hands-on cooking class. In future years she hopes to involve faculty or staff from other MIT units.

This exploratory subject will help students explore a minor in Chinese (21G), and also introduce students to key themes in globalization more broadly. A key networking opportunity is the chance to meet and talk with Nadia Liu Spellman, a local entrepreneur and owner of the Cambridge restaurant, Dumpling Daughter. Students will also have the chance to interact with faculty in 2 SHASS units, Global Studies and Languages and History. Students will also have the opportunity to interact with an upper-level student TA. The involvement of a Visiting Scholar from Taiwan also provides an opportunity for cross-cultural interaction.

3.001 Introduction to Materials Science and Engineering

Frances M. Ross, Instructor

The department is proposing to expand the speakers in this subject to include perspectives in both academia and industry.

Some comments from the Spring 2018 term include:
Student 12783 - A really great introductory course. I was already intent on MSE before this class, but these lectures help me find what areas within DMSE I'm most interested. Even though there were some weeks I wasn't personally enthralled with the subject, I loved that there was a strong variety so every student saw lectures they enjoyed.

Student 32215 - This seminar got me really excited about course 3! Seeing all the different research areas (especially how many were applied to energy and storage) is what pushed me to declare course 3.

Student 50533 - I really enjoyed all the presentations and the presenters were very engaging.

Based on these comments we felt it was important to expand this subject to invite exploration in materials science and engineering from a broader perspective.

Basic description of the course:
Provides a broad introduction to topics in materials science and the curricula in the Department of Materials Science and Engineering's core subjects. Lectures emphasize conceptual and visual examples of materials phenomena and engineering interspersed with guest speakers from both inside and outside academia. The speakers will be selected to illustrate different possible career paths.

A more detailed description of the course content:

Our aim is for 3.001 to help students explore the topics in Course 3. By sharing our enthusiasm for the overall subject of Materials Science and the opportunities provided by an education in this area, the students will be in a better position to make an informed decision about including Course 3 in their future studies.

The students will be expected to spend 2 hours a week in lectures and 1 hour per week on assignments.

The lectures will consist of a series of talks from the instructor to provide a coherent framework, interspersed with lectures from other faculty within DMSE (or possibly neighboring departments) and from external speakers. The instructor's lectures will discuss the range of areas covered by Course 3. This includes descriptions of core Materials Science topics as well as illustrations of areas where Materials Science intersects with other disciplines. The lectures from other faculty within DMSE will be chosen to emphasize the range of subject matter within

Course 3 and also to illustrate faculty activities other than research and teaching, such as how research ideas are developed into commercial ventures. The lectures from external speakers are intended to illustrate the range of career paths that are possible with an education in materials science. We will aim to recruit informative and interesting speakers who can represent large and small companies, National Labs, other governmental careers, and less traditional career paths for materials scientists.

The assignments will include activities such as reading or a web search related to careers or general interest materials science, aiming to engage the students and generate more active participation.

We anticipate that the students will receive useful networking and mentorship opportunities from the interactions with a variety of faculty members as well as with the external speakers.

SP.361 - Terrascope Exploration Subject: "Majors and Careers through a Terrascope Lens"

Subject name: Majors and Careers through a Terrascope Lens
Units: 3 units P/D/F 2-0-1

Your academic major is not your destiny, but it will help to determine the kinds of tools you leave MIT with, and it will affect the ways in which you shape your career. In this class, MIT alumni pursuing sustainability-oriented, "Terrascope-like" careers will describe ways in which their major and career choices have provided them with the lenses through which they see the problems they work to solve. Students will then participate in guided reflection, focused on making the discussion relevant to their own personal situations and affinities. Students will learn to think deeply about their goals, for MIT and for the world beyond, and they will come into direct contact with alumni who can continue to mentor them through this process. Open to all undergraduates, regardless of Terrascope affiliation.

Professor David McGee, Dr. Ari W. Epstein

Terrascope staff (Professor McGee, Dr. Epstein) will be responsible for conducting the class; MIT alumni will play a major role in the class, as described above and below. Terrascope staff (Dr. Epstein, Ms. Chambers) will coordinate alumni travel and supplies/meals for class.

Class will meet twice per week throughout IAP, for 2 hours mid-morning. Over a light breakfast/brunch (designed both to attract and retain students, and to build comfort and connection between visiting alumni and students), invited guests—alumni representing a diverse array of MIT majors, but all involved in sustainability-related work—will participate in conversations about the ways in which their majors prepared them for what they are doing now.

Between sessions students will use various media (the written word, audio, video, etc.) to reflect on how the day's discussion is relevant to their own lives and aspirations. The class will be informal in tone, collegial and community-oriented. First and last class sessions will not include guest speakers, and will instead be devoted, respectively, to establishing the goals and parameters of the class and to drawing general conclusions and tracing out next steps forward for each student.

As described above, the class will involve exploring opportunities across departments and schools at MIT. The class will be marketed to potential students via the Terrascope community, UA Sustainability, The Environmental Solutions Initiative, the MIT Energy Initiative, and the MIT Office of Sustainability.

The cornerstone idea of the class is that sustainability-related problems and careers can be found across all majors at MIT, so it will inherently cover multiple fields of study, although all will be seen through the common lens of environmental sustainability.

Through this class, students will come into direct contact with MIT alumni involved in a wide array of sustainability-related careers. We anticipate that students will continue to stay in contact with some of these alumni, as suits each student's interests.

The Future

A Class for First-Year Academic Exploration

Instructors: Profs. John E. Fernández (PI) and Will Deringer (Co-PI) Subject coordinators: Jen French and Sarah Meyers

Our idea is to develop a first-year class that explores how the various departments/disciplines at MIT ask questions about the world's greatest challenges. As an overall framework for the subject we will use the seventeen UN Sustainable Development Goals (SDGs) as chapters through which the future will be introduced. The subject will provide time and a variety of tools to investigate and reflect on their approach to the future. The subject will promote students to consider how they will shape and become a part of the future they want.

Goals

- Expose students to a diverse array of people and ideas and encourage intellectual exploration.
- Use the UN's Sustainable Development Goals (SDGs) to provoke students' imagination around solving *today's* and *tomorrow's* most pressing global challenges.

- Model various modes of inquiry and thinking that are found within the different departments at MIT by investigating the types of *questions that are asked* vis-à-vis solving global challenges.
- Invite students to reflect on their experiences, develop new ways of seeing and discover what is most compelling for them.
- Develop students' skills to reflect on their experiences, thinking about how to best use their four years as an undergraduate and, more broadly, cultivate life-long skills for thinking about how to design their futures going forward.

Course Structure

This course will meet 2 times per week. One weekly meeting will be a seminar series focused around panel discussions of 3 faculty (from different departments in different schools) discussing the types of questions that a few of the SDGs raise for their discipline.

Potential examples: Nuclear engineering might discuss the questions they ask when they think about alternative fuel sources; Political Science would pose the types of questions that are raised when considering public policy; Math could ask about how they model complex systems, and how do they predict the stability of those solutions, and what does that mean for our confidence in our models.

Speakers do not describe how to solve the problems or provide an array of approaches for answering these questions within their discipline. **The key idea is to expose students to how each discipline approaches challenges, not to how each discipline works.** Questions should lead to further questions. Rather than, "What solutions do you imagine?" it is, "What questions do you imagine will be relevant in 10 years? 50 years?"

The second weekly meeting will be a workshop focused on developing skills to reflect productively on their approach to the future. Student reflection is necessary in order to move from "exploration" to "decision." Principles and tools for reflection are taught as part of an integrated, iterative process for decision-making. Students learn to design their life-trajectories, which includes thinking about choosing a major and career pathway. We have seen several pedagogical models for doing this; one promising avenue is to use the "Designing Your Life" framework developed by Bill Burnett and Dave Evans at Stanford University, which was piloted by Dave Darmofal in a First-Year Advising Seminar during fall 2018.

In each workshop, students will spend time working with faculty and graduate students discussing their reflections and self-generated questions related to the SDGs. In this way, students are not only honing their own problem-asking skills but are also introduced the wide breadth of intellectual opportunities available at MIT – the first step in their own major exploration.

Additionally, guest lecturers from Sloan and other SHASS departments will help to work with students during workshops to develop their skills of reflection for the purpose of a final

advocacy project. Students will choose a medium – writing, social media, video, podcast, website, blog – and advocate for questions derived from the SDGs from 3 different perspectives. Developing this campaign will require:

1. Interviewing faculty
2. Interviewing community service groups to determine what kinds of questions they are asking
3. Looking into the impact that MIT students are making on campus related to SDGs
4. Framing their own passions and perspectives from different angles depending on audience and departmental alignment

Guest lecturers from all five schools will support students in developing skills related to listening attentively and with compassion, DYL framework for decision making, performance skills and presence, how to make a viral video or podcast, how to create a documentary film, how to develop a social media campaign.

Logistics

- Open to first-years
- 6 units, graded P/D/F
- Offered fall 2019 (and every fall after)
- Meet twice weekly – 1 panel, 1 workshop
- Class is broad-based with multiple departments involved, but mainly co-taught by Prof. John E. Fernández (ESI & Dept. of Architecture) and Prof. Will Deringer (STS)
- Learning coordinators: Jennifer French (MITx Digital Learning Scientist and Lecturer in the MIT math department) and Sarah Meyers (ESI Education Program manager) — logistics/scheduling/training
- For about 1/2 of class time: seminar series with Q&A, with panels of 3 instructor/faculty/ lecturers from as many MIT departments as possible. Speakers should be dynamic and enthusiastic, as they are providing first-years a glimpse into their given departments. They should be able to "speak for the department", i.e. effectively introduce students to the types of questions that are asked within their discipline even if not their own research area, and address students' misconceptions about the major.
- For about 1/2 of class time: series of workshops, facilitated in part by 2 graduate students, one student working with John E. Fernández, and one from STS or another humanities department.
- Units could go towards satisfying writing requirement.

Next steps

- Set logistics for class (location, days, times)
- Identify and schedule faculty participating in weekly panel discussion.

- Develop an outline/syllabus
- Develop curriculum for weekly workshops, pre-assignments and post-assignments.
- Core contributors and key resources include:
    - Profs. John E. Fernández and Will Deringer – primary faculty to organize SDG themes for each panel and corresponding workshop assignments
    - Resource commitments from ESI and STS for long term sustainability of the subject
    - Prof. Roberto Rigobon, Sloan School of Management
    - Prof. Dave Darmofal, MIT AeroAstro – including DYL resources
    - Jen French and Sarah Meyers as subject coordinators
    - Priscilla King Gray Public Service Center