the

STEM Academy

of Mamaroneck High School

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Background

In the fall of 2019, Superintendent of School Dr. Robert Shaps invited STEM-oriented teachers, as well as the district technology coaches to discuss his plans for a new Design Lab at Mamaroneck High School. Soon after, the idea of creating a school-with-a-school for our STEM-based elective classes was envisioned.

This proposal is the result of several conversations with various stakeholders in the program, including the computer science and engineering teachers.

Current Model

Currently, there are four STEM elective tracks at Mamaroneck High School—three four-year programs in computer science, engineering, or Original Science Research, as well as a three-year program in architecture. For the most part, the programs operate independently of one another, with the expectation of the ***Collaborative Design Lab*** for upperclassmen of the engineering and computer science programs.

Courses of *The STEM Academy*

STEM 1

STEM 1 is to be the year-long introductory course of *The STEM Academy*. All four teachers of *The Academy*—both computer science teachers, the engineering teacher, and the architecture teacher—will be responsible for creating and delivering content to students in this course. Four marking-period-long mini-courses will operate within one section of ***STEM 1***. This will enable students to learn about the fundamental topics of computer science, engineering, and architecture, all within their first year of *The STEM Academy*.

Each teacher will be responsible for creating ten weeks worth of experiences. In September, each teacher will be assigned a roster of 25 students. At the end of the first marking period (ten weeks), this roster will be transferred to another teacher within *The STEM Academy*. This will happen at the end of each marking period to guarantee that students engage in each of the four mini-courses offered in ***STEM 1***.

Students in any grade are eligible to take ***STEM 1***, though we anticipate that freshmen will drive enrollment in the course. Currently, it is proposed that two year-long sections (eight 25-student rosters) of ***STEM 1*** will run concurrently throughout the academic year.

STEM 2

STEM 2 builds upon the knowledge that students will have gained from ***STEM 1***. Similar to the first-year ***STEM 1*** course, students in ***STEM 2*** will receive instruction from each of the four teachers of *The STEM Academy.* Students will rotate through four different marking-period-long mini-courses.

Only students who have previously taken ***STEM 1*** are eligible to enroll in ***STEM 2***. We anticipate that sophomores will drive enrollment in the course. Currently, it is proposed that one year-long section (four 25-student rosters) of ***STEM 2*** will run throughout the academic year.

Immersion Courses

These two courses are designed to give students an immersive experience. Both courses are already in existence.

Collaborative Design Lab (CDL)

CDL is a year-long course currently offered at Mamaroneck High School. This course is designed to simulate an operational design/media firm that enables individual and collaborative work. Students in this course engage in long-term, open-ended projects in order to develop a solution(s) to a problem. Project work is constructed to bridge together multiple disciplines, thereby creating connections between science, technology, engineering, art, and mathematics. Currently, this course is the capstone experience for students enrolled in the computer science program, the engineering program, and the design program, and is taught by one computer science teacher, the engineering teacher, and one design teacher.

Typically, only students in their senior year enroll in ***CDL*** after having spent the past three years in either the computer science program, the engineering program, or the design program. With the creation of *The STEM Academy*, it is recommended that

students take this course in either their sophomore or junior year, after successful completion of ***STEM 1*** and ***STEM 2***. Because of this, the current proposal includes one year-long section (three 25-student rosters) of ***CLD***.

Only two teachers from *The STEM Academy* will facilitate this class, while the third teacher will remain as one of the design teachers.

AP Computer Science (APCS)

APCS is currently the third-year computer science course offered at Mamaroneck High School. This course will continue to exist for advanced computer science students, though not in its current form. Currently, ***APCS*** covers the second half of the College Board's AP Computer Science A curriculum, while the first half is covered in the current *Introduction to Java Programming* course (formerly CS 2). Considering that the current plans for *The STEM Academy* do not include the *Introduction to Java Programming* course, our ***APCS*** course will need to cover the entirety of the College Board's AP Computer Science A curriculum.

Currently, this course is taken mostly by juniors, after successful completion of *Introduction to Java Programming.* There are a few seniors who enroll in the course, only because they did not begin taking computer science courses until their sophomore year.

The current proposal includes two year-long sections of ***APCS***. Students can enroll in ***APCS*** after successful completion of ***STEM 1*** and ***STEM 2***.

Electives

In the current proposal, ***electives*** will be facilitated by either three or four of the teachers of *The STEM Academy*. Each ***elective*** is intended to be a semester-long course (with a 25-student roster), enabling students to choose specific topics that interest them.

Scheduling Options

Option 1 - An Exclusive Experience

Option 1	Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8
CS 1	STEM 1	STEM 1	STEM 2	Common Planning			APCS	Electives
CS 2	STEM 1	STEM 1	STEM 2		APCS			Electives
Engineering	STEM 1	STEM 1	STEM 2			CDL		Electives
Architecture	STEM 1	STEM 1	STEM 2			CDL		Electives
# of Students	100	100	100		25	50	25	100|100

This first option closely models that of the PACE program. The core, integrated classes (***STEM 1*** and ***STEM 2***) ***must*** meet at the same time, as must the ***electives***. These concurrently running classes can be offered during any period of the day. Each teacher of *The STEM Academy* facilitates a period of semester-long ***electives***. Both computer science teachers facilitate a section of ***APCS***, while the engineering and architecture teachers facilitate ***CDL***.

This particular option prioritizes ***electives*** of *The STEM Academy* to students who have previously completed ***STEM 1*** and ***STEM 2***.

Advantages

By offering ***electives*** during the same period, this will allow students in *The STEM Academy* to choose the topics that they can further explore during their junior or senior year. A student can take a computer science teacher's mobile app development class one semester and the engineering teacher's electronics and robotics class the next. In the current scheduling model, a student would have to enroll in a teacher's elective course for an entire year, even if *all* of the topics in the course don't particularly interest them.

Currently, only one of the computer science teachers facilitates ***APCS***. This scheduling option allows both computer science teachers to facilitate a section of ***APCS***, thus promoting more collaboration.

In this model, there is at least one period of common planning. However, depending on the scheduling of the ***CDL*** and ***APCS***, there is the potential for two or three periods of common planning for the teachers. (Two if one section of ***APCS*** is offered at the same time as ***CDL***, three if both sections of ***APCS*** are offered at the same time as ***CDL***.)

Disadvantages

As discussed in the courses section of this proposal, ***CDL*** is currently facilitated by our engineering teacher and one of our computer science teachers. Much of the course is built upon the integration of engineering, design, and computer science. In order to offer *every* ***elective*** at the same time, and given that our current enrollment in ***APCS*** necessitates two sections of the course, this computer science teacher must now facililitae a section of ***APCS*** and an elective. Their schedule will not allow them to facilitate ***CDL***. This could change the nature of ***CDL***. This can be remedied by having the architecture teacher facilitate ***APCS*** or by having the other computer science teacher facilitate both sections of ***APCS.***

This option will unintentionally make *The STEM Academy* a very exclusive place. Since the ***electives*** are all offered at the same time, it makes it hard for anyone who's not a part of *The STEM Academy* to enroll in one of these courses.

Additionally, this scheduling option is very prescriptive, and will likely be challenging to implement from a "master scheduling" perspective.

Option 2 - Welcoming Visitors to The STEM Academy

Option 2	Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8
CS 1	STEM 1	STEM 1	STEM 2			Electives	APCS	Common Planning
CS 2	STEM 1	STEM 1	STEM 2		APCS		Electives	
Engineering	STEM 1	STEM 1	STEM 2		Electives	CDL		
Architecture	STEM 1	STEM 1	STEM 2	Electives		CDL		
# of Students	100	100	100	0 ~ 25|25	25 ~ 25|25	50 ~ 25|25	25 ~ 25|25	

This second option is similar to the first in that the core, integrated classes (***STEM 1*** and ***STEM 2***) **must** be offered concurrently. Different in this model, though, is that ***electives*** are offered during four periods of the day, rather than just one.

This particular option prioritizes that ***electives*** of *The STEM Academy* be made accessible to students throughout the building.

Advantages

By spreading out the ***electives*** to four periods of the day rather than one, this will allow more students throughout the building to in classes offered by *The STEM Academy*. Perhaps a sophomore who's too intimidated or nervous about committing to a year (or more) of STEM, is recommended (or they elect) to take ***Website Development*** in the spring after having completed health in the fall. Much to their surprise, they really enjoy the course and decide to take ***STEM 1*** and ***STEM 2*** during their junior and senior years, respectively. In general, depending on capacity, students throughout the building will be given alternatives to free periods.

As a result of the ***electives*** being offered throughout the day, more flexibility will be created when attempting to add this to the "master schedule."

Finally, this scheduling option still allows for a singular common planning period. Throughout the day, though, teachers will have common preps with at least one other member of the team.

Disadvantages

To ensure that ***APCS*** is taught by a computer science teacher and to ensure that each teacher facilitates an elective, this option requires ***CDL*** to be facilitated by the engineering and architecture teachers, rather than the engineering and computer science teachers (similar to scheduling option 1). Again, this can be remedied if ***APCS*** is taught by the architecture teacher or the other computer science teacher.

This particular option does not allow for the maximization of common planning time in a teacher's day.

Option 3 - Welcoming Visitors With Architecture Teacher Facilitating APCS

Option 3	Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8
CS 1	STEM 1	STEM 1	STEM 2			Electives	APCS	Common Planning
CS 2	STEM 1	STEM 1	STEM 2		Electives	CDL		
Engineering	STEM 1	STEM 1	STEM 2	Electives		CDL		
Architecture	STEM 1	STEM 1	STEM 2	APCS			Electives	
# of Students	100	100	100	25 ~ 25|25	0 ~ 25|25	50 ~ 25|25	25 ~ 25|25	

This third option closely resembles the second option, but has ***CDL*** being facilitated by the engineering teacher and a computer science teacher.

Advantages

Aside from the fact that the computer science teacher has put in a lot of time and energy into helping create ***CDL***, the course will likely benefit from having a teacher who has an in-depth knowledge of computer science.

This model also maintains all of the advantages of option 2.

Disadvantages

Depending on the background and knowledge of the architecture teacher, it might be challenging for them to facilitate ***APCS.***

Option 4 - Welcoming Visitors With CS Teacher Facilitating Both APCS Sections

Option 4	Per. 1	Per. 2	Per. 3	Per. 4	Per. 5	Per. 6	Per. 7	Per. 8
CS 1	STEM 1	STEM 1	STEM 2	APCS			APCS	Common Planning
CS 2	STEM 1	STEM 1	STEM 2		Electives	CDL		
Engineering	STEM 1	STEM 1	STEM 2	Electives		CDL		
Architecture	STEM 1	STEM 1	STEM 2			Electives	Electives	
# of Students	100	100	100	25 ~ 25|25	0 ~ 25|25	50 ~ 25|25	25 ~ 25|25	

This final option closely resembles the second and third options, in that ***CDL*** is being facilitated by the engineering teacher and a computer science teacher. The other computer science teacher, though, will teach both sections of ***APCS***, while the architecture facilitates two (ideally different) electives.

Advantages

Both sections of ***APCS*** will be taught by a proper computer science teacher.

This model also maintains all of the advantages of option 2 and option 3.

Disadvantages

There will only be one computer science elective, while there will be two architecture electives. That said, just because the architecture teacher has two elective periods in their schedule, does not then guarantee that there will be two architecture electives. Adjustments can be made regarding who teaches what elective(s). Just because they might not have been

comfortable in teaching ***APCS***, does not mean that they wouldn't excel in teaching a different, less-advanced computer science/STEM elective.

Potential Curricula

The tables below provide an overview of the topics that would be taught in each class. Please note that each table contains the same curricula, but there are adjustments to who is teaching what based on the above scheduling options.

All Options	STEM 1	STEM 2
CS 1	Graphics w/ Python	Physical Computing with Python
CS 2	Cybersecurity & Ethics	
Engineering	Mechanical Engineering	Engineering Management
Architecture	CAD 1/3D Printing	CAD 2/3D Printing

Options 1 & 2	Immersion	Electives
CS 1	APCS	Web Development
CS 2	APCS	Mobile Apps
Engineering	CDL	Civil Engineering
Architecture	CDL	Electronics & Robotics

Option 3	Immersion	Electives
CS 1	APCS	Web Development
CS 2	CDL	Mobile Apps
Eng.	CDL	Civil Engineering
Arch.	APCS	Electronics & Robotics

Option 4	Immersion	Electives
CS 1	APCS	APCS
CS 2	CDL	Mobile Apps
Eng.	CDL	Civil Engineering
Arch.	Web Dev.	Electronics & Robotics

STEM 1

Students in ***STEM 1*** will participate in four unique and engaging units of instruction during their year in the course. Every marking period, students will experience a new unit of the course, along with a new teacher from *The STEM Academy*. In levering the expertise of *The STEM Academy* teachers, this class will concentrate on computer graphics (via the Python programming language), cybersecurity and technology ethics, basic mechanical engineering, and basic computer aided design/3D printing. Each unit/mini-course will enable students to experience a STEM in a hands-on, project-based manner.

Rotation of Students in STEM 1

STEM 1	Marking Period 1	Marking Period 2	Marking Period 3	Marking Period 4
Group A	Graphics w/ Python	CAD 1/3D Printing	Mechanical Engineering	Cybersecurity & Ethics
Group B	Cybersecurity & Ethics	Graphics w/ Python	CAD 1/3D Printing	Mechanical Engineering
Group C	Mechanical Engineering	Cybersecurity & Ethics	Graphics w/ Python	CAD 1/3D Printing
Gourp D	CAD 1/3D Printing	Mechanical Engineering	Cybersecurity & Ethics	Graphics w/ Python

STEM 2

Students in ***STEM 2*** will participate in three unique and engaging units of instruction during their year in the course. During either the fall or spring semesters, students will engage in a semester-long experience of computer science, or they will engage in a marking period each of engineering and architecture.

The semester-long computer science experience will be facilitated by both computer science teachers and will continue to revolve around the Python programming language. Students will need to refine their programming skills before they can begin engaging in physical computing activities. Given the sequential nature of this experience, it only makes sense to combine two groups of students. Given that the teachers will work together throughout the semester, they will be able to accommodate 50 students at a time.

Meanwhile, the engineering and architecture teachers will be facilitating their own marking-period-long courses on engineering management and computer aided design/3D printing.

Rotation of Students in STEM 2

STEM 2	Marking Period 1	Marking Period 2	Marking Period 3	Marking Period 4
Group A	Physical Computing with Python		Engineering Management	CAD 2/3D Printing
Group B			CAD 2/3D Printing	Engineering Management
Group C	Engineering Management	CAD 2/3D Printing	Physical Computing with Python	
Gourp D	CAD 2/3D Printing	Engineering Management		

Electives

The STEM Academy will offer four unique semester-long electives. Currently, courses in web development, mobile app development, civil engineering, and electronics and robotics are slated to be offered, but this could easily change on the

Teacher Planning

In all but one instance (CS 1 teacher in option 4) does each teacher of *The STEM Academy* have four different "preps." Considering that the immersion courses require full-year curricula, that ***STEM 1*** and ***STEM 2*** require teachers to develop a ten-week long curriculum, and that ***electives*** require a semester-long curricula, it's as though the planning-load of a *STEM Academy* teacher is similar to that of two typical "preps."

Implications and Future Considerations

Elimination of Introduction to Java Programming

The elimination of this course has a handful of implications. The most important of the implications is that we must incorporate more topics into our ***APCS*** course. Given the nature of the high school schedule (rotating drop schedule), it will be challenging to cover the entire curriculum by May. This implies that only the brightest, most passionate computer science students—those who won't mind doing additional work outside of class—would take the course. Alternatively, this could be remedied by ensuring the students in ***APCS*** have contact with their teacher every day. This can be accomplished either by the creation/inclusion of lab periods for students enrolled in ***APCS*** or by before/after school classes on days when they don't meet during the regular school day.

As alluded to in the previous paragraph, this might make ***APCS*** appeal only to our most dedicated computer science students. This could decrease the number of sections of APCS we offer down to only one from the historic two. In the same breath, though, because more students are engaging in computer science during their high school career (via ***STEM 1*** and ***STEM 2***), there might be more interest from students who might not have otherwise considered ***APCS*** as a possibility because they would have otherwise chosen to engage in the engineering program or the architecture program.

Then again, this might be a moot point because of the transferable knowledge and skills students should have as a result of Python in ***STEM 1*** and ***STEM 2***. For example, they should be familiar with functions, variables, conditionals, basic object oriented paradigms, and many other basic programming skills, each of which will transfer well to Java (the required language of ***APCS***).

Utilization of the Design Lab and Other Spaces in the Building

More thought needs to be given to where these classes will operate from. For instance, the computer science portion of ***STEM 2*** can operate from the central gathering space of the Design Lab, but how will 50 students work with computers in this space? Similarly, it's likely that 75 students will need access to a computer during ***STEM 1***—in both computer science classes and in the architecture class. If we rely on the one computer lab (B335), this will be impossible. So, do we make use of the other computer labs in the building (A254 and A352), or do we bring laptops to the lab?

Also, will the design program remain in its current location (D219), or will it move into the Design Lab? If so, where? What happens to the current engineering (A256), architecture (A356), and computer science (A254) classrooms?

Transitioning from the Current Model to *The STEM Academy*

If the Design Lab is completed for use by September 2021, then it's possible that ***STEM 1*** could operate from this space during the 2021-2022 school year. The current, less-condensed version of ***APCS*** would run, in addition to ***CDL***. Unfortunately, more thought needs to be given to this portion of the proposal. In particular, whether ***STEM 2*** and/or ***electives*** of *The STEM Academy* would run during the 2021-2022 school year, and how ***STEM 2*** might operate.