Program or Area(s) of Study under Review:

CHEMISTRY

Summary of Program Review:

A. Major Findings

1. Strengths:

- Chemistry was able to respond to huge curricular~~ms~~ changes necessitated by switching to a new teaching modality during COVID.
- Chemistry has been involved in many outreach programs to stimulate interest in chemistry and STEM.
- The curriculum is current and up to date.
- Chemistry offered a supplemental in-person workshop to meet student needs

2. Areas for Improvement:

- Retention and completion rates in classes associated with math (Chem 110, Chem 120, Chem 121) are lower than the institutional average.
- Equity analysis shows that the retention rate for African Americans, and the completion rate for African Americans, Hispanics, and first generation students is lower than the institutional average.
- SLO assessment was hampered by changes to instruction modality .

3. Projected Program Growth, Stability, or Viability:

Stability –
Chemistry had previously seen its highest enrollment in some time but has since come back to more reasonable and sustainable demand.

B. Program's Support of Institutional Mission and Goals

1. Description of Alignment between Program and Institutional Mission:

The Chemistry department offers many transfer levels courses that form the foundation for further study in Chemistry or associated disciplines including Biology, Geology, and Physics. Introductory Chemistry is our most popular class as it serves as a prerequisite for many Health Occupation Programs, as well as serving as a general education class for "science with a lab".

2. Assessment of Program's Recent Contributions to Institutional Mission:

- The department developed online laboratory curriculum to continue offering Introductory and General chemistry courses. These courses are foundational courses that are used by other programs on campus.
- Developed a five week "Chemistry Laboratory Skills Workshop" to give students a chance to learn hands-on skills in a laboratory setting (for students who took only online chem).

3. Recent Program Activities Promoting the Goals of the Institutional Strategic Plan and Other Institutional Plans/Initiatives:

- Members of the department worked with the AR/VR student club which competed in the national collegiate student challenge: NASA Suits. This required students to learn and implement high level software and hardware programing.
- Members of the department worked with the MESA Student Research Internship program which gave students a chance to work on applicable scientific research.
- The department has worked closely with MESA's summer bridge program to help bring first generation, Hispanic, and African American junior and senior high school students to the campus.

C. New Objectives/Goals:

1. The department needs to fund, recruit, and hire a replacement ~~3rd~~ Organics Chemistry FT faculty~~hire~~ in order to keep up with the demand of upper-level Chemistry students.
2. The best way to increase productivity in chemistry is by creating larger, modern labs. This will require a significant investment by the college but will have the added benefit of having an improved facility and ability to attract new students and as a showcase for the community.

D. Description of Process Used to Ensure "Inclusive Program Review"

This report was discussed and shared with faculty members through all points in the process. This report is reflection of considered thought from the entire department.

Program Review Report | Fall 2022

This report covers the following program, degrees, certificates, area(s) of study, and courses (based on the Taxonomy of Programs on file with the Office of Academic Affairs):

Program	Chemistry		
Area of Study	Introductory Chemistry	General Chemistry	Organic Chemistry
Courses	CHEM 110	CHEM 120	CHEM 240
	CHEM 111	CHEM 121	CHEM 241

Taxonomy of Programs, July 2022

I. PROGRAM DATA

A. Demand

1. Headcount and Enrollment

	2019-2020	2020-2021	2021-2022	Change over 3-Year Period
Headcount				
Within the Program	929	936	704	-24.2%
Across the Institution	8,181	7,208	6,714	-17.9%
Enrollments				
General Chemistry	**301**	**334**	**214**	**-28.9%**
CHEM-120	186	210	152	-18.3%
CHEM-121	115	124	62	-46.1%
Introductory Chemistry	**764**	**745**	**586**	**-23.3%**
CHEM-110	685	670	543	-20.7%
CHEM-111	79	75	43	-45.6%
Organic Chemistry	**96**	**65**	**37**	**-61.5%**
CHEM-240	53	45	26	-50.9%
CHEM-241	43	20	11	-74.4%
Within the Program	**1,161**	**1,144**	**837**	**-27.9%**
Across the Institution	**33,102**	**30,409**	**25,580**	**-22.7%**
Source: SQL Enrollment Files				

RPIE Analysis: The number of students enrolled (headcount) in the Chemistry Program decreased by 24.2% over the past three years, while headcount across the institution decreased by 17.9%. Enrollment within the Chemistry Program decreased by 27.9%, while enrollment across the institution decreased by 22.7%.

Enrollment in all areas of study and courses within Chemistry decreased by more than 10% between 2019-2020 and 2021-2022:

- *CHEM-241 (-74.4%)*
- *Organic Chemistry (-61.5%)*
- *CHEM-240 (-50.9%)*
- *CHEM-121 (-46.1%)*
- *CHEM-111 (-45.6%)*
- *General Chemistry (-28.9%)*
- *Introductory Chemistry (-23.3%)*
- *CHEM-110 (-20.7%)*
- *CHEM-120 (-18.3%)*

Program Reflection:

Enrollment in Chemistry took a sharp downturn in 2021-2022 throughout the program. This is a symptom of several phenomena~~on~~ all happening at once.

1. In the years prior, enrollment actually surged during COVID compared to pre-COVID when we switched to all online classes because we were able to enroll many more students without having to find space in the laboratory. In previous years, there has been a natural cap on enrollment because the program only

has two labs rooms for all classes. Added onto that, students were much more likely to enroll in Chemistry classes when they didn't have to come to do a lab or be on campus at a specific time. In~~s~~ 2021-2022, we transitioned all chemistry courses to a Hybrid modality which included an in-person lab. This dropped enrollment dramatically, especially in upper level chemistry. For example, students that might have otherwise taken Chem 121 as a science elective when it was online might now opt for an easier class.

2. With the COVID induced switch to online modality from Spring 2020 to Fall 2021, there were several other consequences. Without the in-person lab component of the class, students were not as successful at understanding the material and certainly not retaining it. This is one of the reasons chemistry transitioned back to in-person labs as soon as possible.

3. Another consequence of the online modality from Spring 2020 to Fall 2021 stemmed from the lack of proctored exams: Cheating became rampant and led to two possibilities.
    a. In some cases, students were able to pass these classes without attaining the knowledge necessary to succeed in subsequent classes in the series. When students did not pass these next courses, they could no longer move on in the series and enrollment dropped. We see this more than anywhere in our Chem 240 and Chem 241 which saw huge drops in enrollment.
    b. In other cases, students were caught cheating which typically led to not passing the course. These students did not usually continue in Chemistry.

We imagine chemistry will continue at our current enrollments. We are down from our previous highs but see steady enrollment now that we are offering consistent teaching modalities through the program.

2. Average Class Size

	2019-2020		2020-2021		2021-2022		Three-Year	
	Sections	Average Size	Sections	Average Size	Sections	Average Size	Average Section Size	Trend
General Chemistry	**12**	**25.1**	**13**	**25.7**	**11**	**19.5**	**23.6**	**-22.4%**
CHEM-120	7	26.6	8	26.3	7	21.7	24.9	-18.3%
CHEM-121	5	23.0	5	24.8	4	15.5	21.5	-32.6%
Introductory Chemistry	**31**	**24.6**	**32**	**23.3**	**27**	**21.7**	**23.3**	**-11.9%**
CHEM-110	27	25.4	28	23.9	23	23.6	24.3	-6.9%
CHEM-111	4	19.8	4	18.8	4	10.8	16.4	-45.6%
Organic Chemistry	**4**	**24.0**	**4**	**16.3**	**2**	**18.5**	**19.8**	**-22.9%**
CHEM-240	2	26.5	2	22.5	1	26.0	24.8	-1.9%
CHEM-241	2	21.5	2	10.0	1	11.0	14.8	-48.8%
Program Average*	**47**	**24.7**	**49**	**23.3**	**40**	**20.9**	**23.1**	**-15.3%**
Institutional Average*	**1,348**	**24.6**	**1,171**	**25.9**	**1,105**	**23.1**	**24.6**	**-6.1%**

Source: SQL Enrollment and Course Sections Files

Average Section Size across the three-year period for courses, and both within academic years and across the three-year period for the program and institutional levels is calculated as:

$$\frac{\text{Total \# Enrollments}}{\text{Total \# Sections}}$$

It is not the average of the three annual averages.

<u>RPIE Analysis</u>: Over the past three years, the Chemistry Program has claimed an average of 23.1 students per section. The average class size in the program has been lower than the average class size of 24.6 students per section across the institution during this period. Average class size in the program decreased by 15.3% between 2019-2020 and 2021-2022. Average class size at the institutional level decreased by 6.1% over the same period.

Average class size in the following course changed by more than 10% (±10%) between 2019-2020 and 2021-2022:

Areas of study and courses with decreases in average class size:

- *CHEM-241 (-48.8%)*
- *CHEM-111 (-45.6%)*
- *CHEM-121 (-32.6%)*
- *Organic Chemistry (-22.9%)*
- *General Chemistry (-22.4%)*
- *CHEM-120 (-18.3%)*
- *Introductory Chemistry (-11.9%)*

Program Reflection:

The average class size in chemistry is determined by the size of our labs, or at least it was before March 2020. When we were forced to move to all online instruction, we saw a dramatic increase in enrollment as we no longer had to carve out physical space for students. This led to class sizes that were far above average and relied on instructors taking on a greater responsibility which we always knew would be a temporary situation. Once we returned to in-person labs, our class sizes needed to drop to our previous hard caps.

It is important to note that organic chemistry pulls our overall average down. There are two reasons for this: Organic Chemistry is our most advanced class and has the most stringent prerequisites. It also has a narrow focus and is not needed by as many students as our other classes so the class size tends to be small. But, more importantly, those students taking Organic Chemistry are often in the more advanced Biology classes so we find it necessary to work around each other's schedule. As a consequence, two sections are offered to give our students a choice of lab time and this has the effect of diluting the section size and dropping the average section size for our program.

The chemistry program is in high demand and it is possible to grow our section size only if a new facility is built that provides for <u>more and</u> larger labs. Growth in chemistry becomes a safety issue. To be safe, there must be limits on the size that these labs are allowed to grow. New labs that hold 30 students would work well for us but labs that are larger than this would become unsafe and are not recommended.

3. Fill Rate and Productivity

Fill Rate*			
	Enrollments*	**Capacity**	**Fill Rate**
2019-2020	1,030	1,050	98.1%
2020-2021	934	1,010	92.5%
2021-2022	729	908	80.3%

Three-Year Program Total	2,693	2,968	90.7%
Institutional Level	79,507	106,455	74.7%
Productivity*			
	FTES	**FTEF**	**Productivity**
2019-2020	260.1	13.4	19.4
2020-2021	258.9	13.8	18.8
2021-2022	182.7	13.1	13.9
Three-Year Program Total	701.7	40.3	17.4
Source: SQL Enrollment and Course Sections Files			

RPIE Analysis: Fill rates within the Chemistry Program tend to be higher than the fill rate at the institutional level. [Compare program-level rate of 90.7% to institution-level rate of 74.7% over the past three years.] Between 2019-2020 and 2020-2021, both enrollment and capacity decreased, resulting in a decrease in fill rate (due to a higher rate of decrease in enrollment). Between 2020-2021 and 2021-2022, both enrollment and capacity decreased, resulting in a decrease in fill rate (due to a higher rate of decrease in enrollment).

Productivity ranged from 13.9 to 19.4 over the past three years. [Productivity has not been calculated at the institutional level.] The three-year program productivity of 17.4 mirrors the target level of 17.5, which reflects 1 FTEF (full-time equivalent faculty) accounting for 17.5 FTES (full-time equivalent students) across the academic year. (This target reflects 525 weekly student contact hours for one full-time student across the academic year.)

**Note: Fill rates and productivity reported in the table do not include 18 Chemistry section offerings for summer terms over the past three years. As a result, the enrollment figures reported here might differ from those reported in Section I.A.1.*

Program Reflection:

The chemistry program plans the number of sections to correspond to previous demand and expected demand for classes in a series, both informed from previous semester data. In the case of 2021-2022, our use of previous data did not correspond to actual demand as those two years were mostly online and the switch to in-person labs caused a large drop in enrollment. In 2021-2022, We decided to let many of those classes run to give students as much flexibility in their schedules but that is not a long term strategy and have been corrected. This also explains the very large drop in productivity as well.

The chemistry program has now decreased the number of sections offered until increased enrollment necessitates adding more sections.

One final note, our labs are only set up to hold 24 students. Overfilling them by 25% is a poor way to improve productivity for very obvious safety reasons. Now, assuming a fill rate of 95%, and a constant FTEF of 14, by increasing our labs to 30 students would give us a productivity of about 20, well above the goal of 17.5. The only way for chemistry to meet this target would be for a new facility to be built with at least one more lab (three total) and for these labs to be larger (30 max). Having a total of four labs would be preferable, as it would allow for more flexibility in scheduling of classes to meet the time demands for our students and the availability of part time faculty schedules.

4. Labor Market Demand

This section does not apply to the Chemistry Program, as it is not within the Career Technical Education Division.

B. Momentum

1. Retention and Successful Course Completion Rates

Level	Retention Rates (Across Three Years) Rate	Retention: Course Rate vs. Program Rate – Above	Retention: Course Rate vs. Program Rate – Below	Successful Course Completion Rates (Across Three Years) Rate	Success: Course Rate vs. Program Rate – Above	Success: Course Rate vs. Program Rate – Below
General Chemistry	86.9%		X	***70.5%***	***X***	
CHEM-120	***82.2%***		***X***	63.4%		X
CHEM-121	***95.2%***	***X***		***83.2%***	***X***	
Introductory Chemistry	88.1%	--	--	***61.4%***		***X***
CHEM-110	89.0%	--	--	***60.3%***		***X***
CHEM-111	***80.5%***		***X***	***72.6%***	***X***	
Organic Chemistry	***93.0%***	***X***		***80.7%***	***X***	
CHEM-240	89.5%	X		70.2%	X	
CHEM-241	***98.6%***	***X***		***97.3%***	***X***	
Program Level	**88.1%**			**65.1%**		
Institutional Level	90.4%			74.8%		

Source: SQL Enrollment Files
-- Indicates a value that is within 1% of the program-level rate.
Bold italics denote a statistically significant difference between the course-level rate and the program-level rate.
Bold denotes a statistically significant difference between the program-level rate and the institutional rate.
Note: Grades of EW (Excused Withdrawal) for spring 2020 and beyond are not included in the calculations of the three-year retention and successful course completion rates reported above. This approach reflects the standard recommended research practice of not including EWs in either the numerator or the denominator for these rates.

RPIE Analysis: Over the past three years, the retention rate for the Chemistry Program was significantly lower than the rate at the institutional level. The retention rates for CHEM-111 and CHEM-120 were significantly lower than the program-level rate. The retention rates for Organic Chemistry, CHEM-121, and CHEM-241 were significantly higher than the program-level rate. The retention rate for the Chemistry Program falls in the first quartile (Q1) among program-level retention rates (across 58 instructional programs, over the past three years). The retention rate for Chemistry is among the lowest 25% of retention rates among NVC programs.

Over the past three years, the successful course completion rate for the Chemistry Program was significantly lower than the rate at the institutional level. The retention rates for Introductory Chemistry and CHEM-110 were significantly lower than the program-level rate. Other Chemistry courses (highlighted in the table) had successful course completion rates that were significantly higher than the program-level rate. The successful course completion rate for the Chemistry Program falls in the first quartile (Q1) among program-level successful course completion rates (across 58 instructional programs, over the past three years). The successful course completion rate for Chemistry is among the lowest 25% of successful course completion rates among NVC programs.

Over the past three years, the difference between retention and successful course completion at the program level (23.0%) was significantly higher than the difference at the institutional level (15.6%). This figure represents the proportion of non-passing grades assigned to students (i.e., grades of D, F, I, NP).

The following Chemistry area of studies and courses claimed a difference (between retention and successful course completion) that exceeded 10%:

- *CHEM-110 (28.7%)*
- *Introductory Chemistry (26.7%)*
- *CHEM-240 (19.3%)*
- *CHEM-120 (18.8%)*
- *General Chemistry (16.4%)*
- *Organic Chemistry (12.3%)*
- *CHEM-121 (12.0%)*

Program Reflection:

The retention rates and course competition rates over this last cycle are reflective of an experiment in all-online instruction for Chemistry that simply did not work. The switch was necessitated by COVID but was fully embraced by the faculty as our best option to continue instruction under the circumstances. As mentioned previously and will be detailed here, there were multiple facets to the instructional inadequacy of our foray with all online instruction.

From Spring 2020 to Fall 2021, there was no in-person lab component to the class. As a consequence, students were not as successful making connections with the chemical concepts and certainly not at retaining it without the hands-on component to this class. This had the effect of both discouraging students (retention) as well as hindering their understanding (course completion). This was noted at the time due to poor exam scores late in the semester and also evident from the low course completion rate despite the high retention for our Chem 110 course. In addition, this could have been a contributing factor to the lower retention rates in Chem 120 and 111 as students lacked a solid foundation in Chemistry.

Another consequence of the online modality from Spring 2020 to Fall 2021 stemmed from the lack of proctored exams: Cheating became rampant which led to two possibilities.

a. In some cases, students were able to pass these classes without attaining the knowledge necessary to succeed in subsequent classes in the series. While they might have completed the initial course, they were unable to pass the subsequent course contributing to poor retention.
b. In other cases, students were caught cheating which typically led to not successfully completing the course or outright dropping it. Both Chem 110 and Chem 120 had (outrageously) high rates of cheating on exams which led to many failed exams and poor completion results.

Of note, Chem 110 had recently been forced to remove its Math pre-req based on requirements resulting from AB705. To combat this issue several measures were put in place. At this time, it would be wholly inappropriate to evaluate those measures as their effect is completely obfuscated by the pedagogical shift necessitated by the COVID pandemic. It is noted ~~it~~ here for future reviews to consider when evaluating the next cycle.

2. Student Equity

	Retention Rates (Across Three Years)		Successful Course Completion Rates (Across Three Years)	
	Program Level	**Institution Level**	**Program Level**	**Institution Level**
African American/Black	82.3%	87.5%	***54.8%***	66.6%
Latinx/Hispanic			***60.5%***	71.2%
First Generation			***59.6%***	73.9%
Veteran			***65.6%***	72.6%
19 or less			***64.6%***	73.1%

Source: SQL Enrollment Files

Bold italics denote a statistically significant difference between rates at the program and institutional levels, with the lower of the two rates in ***bold italics***.

Shaded cells pertaining to retention rates indicate that statistically significant differences for those groups were not found at the institutional level.

Note: Grades of EW (Excused Withdrawal) for spring 2020 and beyond are not included in the calculations of the three-year retention and successful course completion rates reported above. This approach reflects the standard recommended research practice of not including EWs in either the numerator or the denominator for these rates.

RPIE Analysis: This analysis of student equity focuses on the five demographic groups with significantly lower retention and/or successful course completion rates found at the institutional level (vs. the corresponding rates among all other demographic groups, combined) over the past three years. Tests of statistical significance were conducted to compare program-level and institution-level rates among the five groups listed above.

Within the Chemistry Program, the retention rate among African American/Black students was lower than the rate at the institutional level. (The difference was not statistically significant.)

Within the Chemistry Program, the successful course completion rates among African Americans/Blacks, Latinx/Hispanics, First Generation students, Veterans, and students ages 19 or less were significantly lower than the rates at the institutional level.

These patterns are consistent with the findings that emerged from the comparison of retention and successful course completion at the program vs. institutional level, where the program-level rates were significantly lower than the institution-level rates for both retention and successful course completion. (See Section I.B.1 above).

Program Reflection:

Retention and completion rates for the groups listed are below the institutional level. As noted in the RPIE analysis above, all groups retention and completion rates are lower in Chemistry and this is an extension of that.

While this is not a welcome state of affairs, the issues leading to aggregate poor performance have been listed above.

Historically, the Chemistry program has been involved in several programs that are meant to promote interest in STEM programs and chemistry in particular. These include participation in the annual MESA STEM Fair, STEM Open Houses, being advisors for NVC science clubs like SACNAS, WISE, the Discovery Club, and SHPE, and NASA SUITS challenge. While Chemistry faculty members remained somewhat active, this was heavily restricted by the ongoing limitations from COVID. Support from resources like MESA were also heavily restricted despite the best effort of admin and staff. The curtailing of these resources did not help retention and course completion disparity between student groups.

In addition, we have attempted to generate interest in chemistry and the STEM programs by providing a Summer Bridge Program that specifically targets first generation, Hispanic, and African American junior and senior high school students. Enrollment in this program took a sharp decline over the last three years which could be the reason the program did not see positive results. A few high school students chose NVC based on their experiences in Summer Bridge and other programs but those few students did not move the needle very much and success rates did not increase.

To this end, discussions have brought up the idea of a STEM Summit that brings high school science teachers to the college for a few days of meetings where we discuss the gaps that we find in the knowledge base of incoming students and discover ways that these gaps might be filled at the high school level. This will most certainly mean that new materials and methods will be developed that will align the high school programs more closely to the students' college experience. We believe that doing this will improve the success rates of our underserved students by providing them a better foundation for when they enter college.

We also believe that there is a lack of diversity in our teaching staff. When our students look at their STEM instructors, they don't see anyone who looks like them and we believe that this is an impediment to success for these students. This is certainly true for chemistry. Given a range of potential applicants, we have to be mindful of the need for ethnic and gender diversity when we make our decision who to hire. For this reason, it is absolutely imperative that Chemistry get a fill the Organic Chemistry FT faculty vacancy.~~3rd~~ hire. It should be noted that the Chemistry department did have a female, immigrant, first generation ~~3rd~~ hire, but that person has since left the department to care for her mother. Her presence, though brief, was noted by our students as a positive addition,~~;~~ an~~d~~ addition we intend to fill in kind in the future.

3. Retention and Successful Course Completion Rates by Delivery Mode (of Courses Taught through Multiple Delivery Modes, i.e., In-Person, Hybrid, and Online)

	Retention Rates (Across Three Years)			Successful Course Completion Rates (Across Three Years)		
	In-Person	Hybrid	Online	In-Person	Hybrid	Online
CHEM-110						
In-Person vs. Hybrid	73.7%	82.1%		46.7%	46.2%	
In-person vs. Online	73.7%		88.5%	46.7%		57.6%
Hybrid vs. Online		78.2%	86.7%		48.9%	56.2%
CHEM-120						
Hybrid vs. Online		71.5%	95.2%		53.1%	71.4%
CHEM-121						
Hybrid vs. Online		88.6%	92.3%		74.3%	92.3%
Program Total						
In-Person vs. Hybrid	73.7%	78.7%		46.7%	47.6%	
In-person vs. Online	***73.7%***		86.8%	***46.7%***		57.2%
Hybrid vs. Online		78.2%	87.1%		48.9%	56.3%
Institutional Total						
In-person vs. Hybrid	86.6%	***80.2%***		69.0%	***62.0%***	
In-person vs. Online	85.1%		***81.5%***	72.2%		***63.2%***
Hybrid vs. Online		***79.1%***	81.0%		***61.5%***	64.0%

Source: SQL Course Sections Files
This table compares student performance in courses offered through multiple delivery modes within the same academic year.
Bold italics denote a significantly lower rate within that delivery mode.
Note: The analysis of retention and successful course completion by delivery mode does not include spring 2020 – spring 2021 because most courses shifted to an online/hybrid delivery mode beginning in spring 2020 due to the COVID-19 pandemic (thereby blurring the distinction between delivery modes).

RPIE Analysis: Over the past three years, four courses within the Chemistry Program have been offered through at least two delivery modes within the same academic year. In 2021-2022, CHEM-110 was offered through in-person, hybrid, and online formats. In 2021-2022, CHEM-120 and CHEM-121 were offered through hybrid and online formats. This analysis focuses on program-level rates. Details for the course level are reported in the table above.

Within the Chemistry Program:

- *The retention rate in in-person sections was lower than the retention rate in hybrid sections. (The difference was not statistically significant.) This pattern deviates from the findings at the institutional level, where the retention rate in hybrid sections was significantly lower than the retention rate in in-person sections.*
- *The retention rate in in-person sections was significantly lower than the retention rate in online sections. This pattern deviates from the findings at the institutional level, where the retention rate in online sections was significantly lower than the rate in in-person sections.*
- *The retention rate in hybrid sections was lower than the retention rate in hybrid sections. (The difference was not statistically significant.) This pattern reflects the findings at the institutional level (although the difference at the institutional level was not statistically significant).*

Within the Chemistry Program:

- *The successful course completion rate in in-person sections mirrored the rate in hybrid sections. This pattern deviates from the findings at the institutional level, where the successful course completion rate in hybrid sections was significantly lower than the rate in in-person sections.*
- *The successful course completion rate in in-person sections was significantly lower than the successful course completion rate in online sections. This pattern deviates from the findings at the institutional level, where the successful course completion rate in online sections was significantly lower than the rate in in-person sections.*
- *The successful course completion rate in hybrid sections was lower than the successful course completion rate in online sections. (The difference was not statistically significant.) This pattern reflects the findings at the institutional level (although the difference at the institutional level was statistically significant).*

Program Reflection:

Due to the restrictions brought on by the COVID pandemic, Chemistry was forced to offer several new modalities of instruction. Some of these were fraught with issues that plagued the department as mentioned earlier and will be discussed below in the case of all online instruction. At the same time, this forced us to consider additional instructional modalities that the department may continue to employ in the case of Hybrid instruction.

As a department, Chemistry saw that retention rates increased as our courses become more online (in-person --> Hybrid --> all online). The most obvious explanation for this trend is that when students aren't required to attend, they are less likely to drop the course. Chemistry courses, even at the 110 level, can be difficult and we often lose students as the semester goes on. Students often stop attending a class that they are not doing well in when they have to show up in person. Since Chemistry offers all online courses both asynchronously as well as synchronously, students don't need to show up and therefore may not drop a class as readily even when performing poorly. This can easily be seen in the transition from all in-person to hybrid. The retention rate goes up for the hybrid modality even though student course completion remains the same.

Interestingly, though quite deceivingly, all online instruction appears to offer the best outcomes for students taking those courses. It must be state explicitly: this is a mirage. Students appears to perform and retain better in all-online instruction classes because of the widespread spread cheating with this modality. Classes such as Introductory and General Chemistry rely on principles that have a wealth of information available on internet making assessment incredibly difficult. Additionally, websites like Chegg and Course Hero have routinely been employed to subvert our assessment tools. We have found our exams uploaded to these sites during the assessment period. The department has employed measures to counteract these issues but have only succeeded modestly in this endeavor. For these reasons, we do not plan to offer all-online instruction at any point in the future.

To combat the aforementioned issues with online instruction, the department created a five week -"Chemistry Laboratory Skills Workshop" to give students a chance to learn hands-on skills in a laboratory setting. This workshop ran in the Fall 2021 once it was possible to get students in person. Students reported much more satisfaction with their chemistry knowledge and wish they had this option while they were enrolled in our courses.

a. Student Achievement

1. Program Completion

This section does not apply to the Chemistry Program, as it does not confer degrees or certificates, based on the most recent taxonomy (July 2022).

2. Program-Set Standards: Job Placement and Licensure Exam Pass Rates

This section does not apply to the Chemistry Program, as the discipline is not included in the Perkins IV/Career Technical Education data provided by the California Community Colleges Chancellor's Office, and licensure exams are not required for jobs associated with the discipline.

II. CURRICULUM

A. Courses

Subject	Course Number	Date of Last Review *(Courses with last review dates of 6 years or more must be scheduled for immediate review)*	Has Prerequisite* Yes/No & Data of Last Review	In Need of Revision *Indicate Non-Substantive (NS) or Substantive (S) & Academic Year*	To Be Archived *(as Obsolete, Outdated, or Irrelevant)* & Academic Year	No Change
Chem	110	2021	Yes 8/2021	No	No	x
Chem	111	2018	Yes 6/2018	No	No	x
Chem	120	2021	Yes 8/2021	No	No	x
Chem	121	2015	Yes 6/2015	(NS) – 2022/23	No	
Chem	240	2018	Yes 6/2018	(S) -2022/23	No	
Chem	241	2018	Yes 6/2018	(S) -2022/23	No	

*As of fall 2018, prerequisites need to be validated (in subsequent process) through Curriculum Committee.

B. Degrees and Certificates+

Degree or Certificate & Title	Implementation Date	Has Documentation Yes/No	In Need of Revision+ *and/or* *Missing Documentation* & Academic Year	To Be Archived* *(as Obsolete, Outdated, or Irrelevant)* & Academic Year	No Change

*As of fall 2018, discontinuance or archival of degrees or certificates must go through the Program Discontinuance or Archival Task Force.

+Degrees and Certificates cannot be implemented until the required courses in them are approved and active.

Program Reflection:

Most of the courses taught in Chemistry were reviewed in the previous cycle to align with updated Math prerequisites from AB705. The notable exception was Chem 121 which is the second course in a series and many of the necessary changes come in the form of updates to Chem 120. This course will be reviewed soon to update the course materials.

Chem 240 and Chem 241 will be updated during this next year to align with recommendations from C-ID and preparation for the AB 1111 common course numbering system. This course is taught at many community colleges throughout California as a 5-unit course while it is only a 4 unit course in our department. This will be a substantive change, requiring us to add more lecture and lab hours to the course.

III. LEARNING OUTCOMES ASSESSMENT

A. Status of Learning Outcomes Assessment

Learning Outcomes Assessment at the Course Level

	Number of Courses with Outcomes Assessed		Proportion of Courses with Outcomes Assessed	
Number of Courses	Over Last 4 Years	Over Last 6 Years	Over Last 4 Years	Over Last 6 Years
6	5	6	83%	100%

Learning Outcomes Assessment at the Program/Degree/Certificate Level

Degree/Certificate	Number of Outcomes*	Number of Outcomes Assessed		Proportion of Outcomes Assessed	
		Over Last 4 Years	Over Last 6 Years	Over Last 4 Years	Over Last 6 Years
Natural Sciences AS PLO 1	1	1	1	100%	100%

Program Reflection:

In the past, the chemistry program maintained a rigorous schedule of assessment that exceeds the normal SLO assessment requirements. This cycle works well for us and is not particularly burdensome. This was disrupted by complications due to COVID. We did not opt for an online SLO quizzes to mirror the in-person SLO quizzes we typically give as our main assessment tool. This decision was based on two things:

1. We've been able to use the same quizzes for many years which has allowed us to look at long-term success rate over many years. This gives us insights into our own teaching but also the effects of pre-req and support changes. If this quiz were given online, it would end up on websites such as Chegg and Course Hero which would invalidate it as an assessment tool.
2. We could not trust the data with the wide availability to online tools or websites.

During this period of time, assessment was done ad-hoc at department meetings where we discussed the progress of students in our classes and advocated for ways to improve our students ability to understand chemical concepts.

B. Summary of Learning Outcomes Assessment Findings and Actions

Based on discussions with faculty and students, students taking online chemistry courses are now less prepared for future chemistry courses. Additionally, students overall grasp of chemical principles has been hampered by the lack of in-person labs. Not only have students received less in-person feedback, they do not get hands-on experience with chemical equipment and phenomena.
Assessment has also been affected as long-standing testing modalities are no longer available (paper long-answer vs. multiple choice).
Lastly, more students can attend online Office Hours than with traditional in-person ones.

In order to improve these issues, the chemistry department advocated for and scheduled hybrid and all in-person instruction.

Program Reflection:

The chemistry program plans to reinstitute SLO quizzes starting in Fall 2022. These results will be of particular interest as many changes have occurred outside of the department but will nonetheless have huge impacts on our students.

-The passing AB 1705 will limit the amount of math support students can receive before entering our Introductory Chemistry course.

-Students who recently graduated high school will have spent at least some time using remote learning as their only mode of instruction

The department will need to adapt to these changes and plan accordingly.

IV. PROGRAM PLAN

Based on the information included in this document, the program is described as being in a state of:

- ~~Viability~~
- ~~Stability~~
- ~~Growth~~

* Stability

*Please select ONE of the above.

This evaluation of the state of the program is supported by the following parts of this report:

- I.A.1 - Chemistry saw a surge in enrollment that has since dropped since returning to in-person courses.
- I.B.1 – Student success was impacted for several semesters as students could not attend in-person labs.
- I.B.3 – All online instruction was tested and found to be insufficient for both instructional and assessment needs.

Complete the table below to outline a three-year plan for the program, within the context of the current state of the program.

PROGRAM: CHEMISTRY

Plan Years: 2023-2024 through 2025-2026

Strategic Initiatives Emerging from Program Review	Relevant Section(s) of Report	Implementation Timeline: Activity/Activities & Date(s)	Measure(s) of Progress or Effectiveness
New FT Chemistry Instructor	1. Growth 2. Enrollment	2023-2024	New faculty hired
New Facility/Larger and Additional Lab space	1. Enrollment 2. Class size 3. Fill rate	Dependent on passage of a bond.	Increased class size, productivity, and enrollment
Chemistry/STEM HS Summit	Student Equity	Summer 2022	Increased enrollment, retention, and success rate of underserved students.

Describe the current state of program resources relative to the plan outlined above. (Resources include: personnel, technology, equipment, facilities, operating budget, training, and library/learning materials.) Identify any anticipated resource needs (beyond the current levels) necessary to implement the plan outlined above.

Note: Resources to support program plans are allocated through the annual planning and budget process (not the program review process). The information included in this report will be used as a starting point, to inform the development of plans and resource requests submitted by the program over the next three years.

Description of Current Program Resources Relative to Plan:

1. The request for a new faculty member in chemistry will need to be made as soon as possible. The funds would come out of the NVC General Fund. Given the current fiscal climate it is unlikely to be funded this year but it is expected that the need will continue to rise over the next couple of years and that funding will likely be made available soon.
2. It is well known that NVC needs a new or refurbished science building. The funds for a project of this scope would have to come from state funding or a general obligation bond.
3. STEM Summit –

V. PROGRAM HIGHLIGHTS

The program-level plan that emerged from the last review (in fall 2019) included the following initiatives:

- Chemistry/STEM HS Summit
- New Facility/Larger and Additional Lab space
- New FT Chemistry Instructor

A. Accomplishments/Achievements Associated with Most Recent Three-Year Program-Level Plan

1. The department was still able to offer all chemistry courses despite requiring all laboratory curriculum to be rewritten in a few months.
2. The department was able to meet the demand of students despite the loss of part-time instructors and retirement of a full-time instructor
3. Chemistry has been involved in many outreach programs to stimulate interest in chemistry and STEM.
4. Developed a five week- "Chemistry Laboratory Skills Workshop" to give students a chance to learn hands-on skills in a laboratory setting (for students who took only online chem).

B. Recent Improvements

1. Chem 111 is now taught by a dedicated instructor instead of rotating part-time instructors
2. Chemistry was able to reintegrate support for Introductory Chemistry with the Math Success Center after a two year break due to COVID.

C. Effective Practices

1. Chemistry regularly produces a strong schedule of classes. Working closely with Biology and Math, the Chemistry program has responded well to the changing landscape and has managed to produce schedules that are able to meet the needs of our students without adding unneeded extra classes.
2. The result of effective scheduling is that chemistry enjoys a higher than average fill rate on campus.
3. Our scheduling practices allow students to find classes that fit into their schedule and this increases the fill rate in our program.
4. Adding chemistry to the Math Placement Tool has helped students' self-identify appropriate placement into our chemistry program.
5. Math Mastery quizzes in collaboration with the Math department and the Math success center has helped us identify the needs of our students and given our students the help needed to succeed in our classes.

Completed by Supervising Administrator:

Robert Van Der Velde, Senior Dean

Date:

11/3/2022

Strengths and successes of the program, as evidenced by analysis of data, outcomes assessment, and curriculum:

Chemistry's strength lies in its dedicated faculty who have remained committed to student success. Introduction to Chemistry is essential for preparation for allied health programs and as a general education course, and the General Chemistry through Organic Chemistry sequence is necessary for STEM majors including future Chemistry majors. The program regularly assessed curriculum and keeps it up to date, and has diligently adapted to shifts necessitated by the COVID pandemic.

Areas of concern, if any:

Chemistry requires a replacement full-time faculty member to maintain its offerings in Organic Chemistry, a necessary sequence for STEM transfer majors and a future ADT in Chemistry.
Retention and completion rates are low, particularly for historically underserved populations, and changes in Math have further impacted success rates. Continued collaboration with the Math department and Math Success Center is needed.

Recommendations for improvement:

Further efforts should be made to address the need to bolster Math skills needed for success in Chemistry, such as exploring use of math modules, non-credit support activities, and deeper collaboration with the MESA-STEM Center and learning communities.

Anticipated Resource Needs:

Resource Type	**Description of Need (Initial, Including Justification and Direct Linkage to State of the Program)**
Personnel: Faculty	Fulltime faculty member for Organic Chemistry
Personnel: Classified	
Personnel: Admin/Confidential	
Instructional Equipment	Chemistry storage room requires renovation; fume hoods in labs repeatedly break and should be replaced.
Instructional Technology	
Facilities	Chemistry needs a new or renovated building if any expansion is to be possible
Operating Budget	

Professional Development/ Training	
Library & Learning Materials	