Program Review Summary Page
For Instructional Programs

Program or Area(s) of Study under Review: Chemistry

Term/Year of Review: Fall 2019

Summary of Program Review:

A. Major Findings

1. Strengths:

1. Chemistry is in a growth phase.
2. Demand is strong and has increased over the past three years.
3. Fill rates are among the highest in the institution.
4. AS degrees associated with Chemistry accounted 70.5% of those conferred in 2018-2019.
5. The curriculum is current and up to date.
6. Chemistry has maintained a rigorous SLO assessment schedule and responds quickly to the assessment results.
7. Chemistry has been involved in many outreach programs to stimulate interest in chemistry and STEM.

8. Areas for Improvement:

1. Retention and completion rates in classes associated with math (Chem 110, Chem 120, Chem 121) are lower than the institutional average.
2. 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.
3. SLO3 (safety and technique) in all chemistry courses is not easily assessed and the data does not map to any institutional learning outcomes.

4. Projected Program Growth, Stability, or Viability:

Chemistry is a gateway class to degrees in biology, geology, engineering, chemistry, and nursing, so it is in high demand. Chemistry was associated with 70% of the degrees conferred in 2018-2019. The chemistry program is currently in a growth phase and this trend is likely to continue into the foreseeable future.

B. New Objectives/Goals:.

The goal is to increase retention and completion rates for all students, including equity students, increase productivity, and have a meaningful set of SLOs for the entire chemistry curriculum. To meet these goals, the chemistry program proposes the following set of objectives:

1. Prepare students for STEM prior to entering NVC. It is proposed that the NVC STEM faculty meet with their counterparts in the local high schools to come to an understanding of the expected level

of education required upon entering college. It is expected that NVC faculty would help produce appropriate teaching materials and set the level of required work for the HS students so that they will find more success at the college level. This has the advantage of introducing our faculty to incoming students and makes NVC a more inviting institution. We can measure success by the increased diversity of the incoming students and their success rate. The current funding for Summer Bridge should be diverted to this new project.

2. The only way to increase productivity in chemistry is by creating larger 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.
3. Chemistry needs to take a critical look at our safety and technique SLO3 and make changes that are easier to assess and link to institutional outcomes.

Program Review Report Fall 2019

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 2019

I. PROGRAM DATA

A. Demand

1. Headcount and Enrollment

	2016-2017	2017-2018	2018-2019	Change over 3-Year Period
Headcount				
Within the Program	820	839	914	11.5%
Across the Institution	8,930	8,843	8,176	-8.4%
Enrollments				
Introductory Chemistry	650	677	736	13.2%
CHEM-110	596	613	661	10.9%
CHEM-111	54	64	75	38.9%
General Chemistry	251	266	323	28.7%
CHEM-120	169	171	196	16.0%
CHEM-121	82	95	127	54.9%
Organic Chemistry	83	87	75	-9.6%
CHEM-240	49	48	47	-4.1%
CHEM-241	34	39	28	-17.6%
Within the Program	984	1,030	1,134	15.2%
Across the Institution	36,525	36,115	32,545	-10.9%
Source: SQL Enrollment Files				

RPIE Analysis: The number of students enrolled (headcount) in the Chemistry Program increased by 11.5% over the past three years, while headcount across the institution decreased by 8.4%. Similarly, enrollment within the program increased by 15.2%, while enrollment across the institution decreased by 10.9%.

Enrollment in the following courses changed by more than 10% (±10%) between 2016-2017 and 2018-2019:

Courses with enrollment increases:
- *CHEM-121 (54.9%)*
- *CHEM-111 (38.9%)*
- *CHEM-120 (16%)*
- *CHEM-110 (10.9%)*

Courses with enrollment decreases:
- *CHEM-241 (-17.6%)*

Enrollment across the following Areas of Study increased by more than 10%:
- *General Chemistry (28.7%)*
- *Introductory Chemistry area (13.2%)*

Program Reflection:

Programs in the STEM field have seen a surge in enrollment in recent years. Jobs are plentiful and well-paying. Chemistry is a gateway program in STEM which is required as a prerequisite by many of the STEM programs and

as a consequence, we have enjoyed an increase in enrollment. Students that enroll in chemistry are sticking with it longer. In the past, the primary path of students taking Chem 110 has been as a prerequisite for the Nursing Program. Fewer students are choosing this path, so while the Introductory class enrollment has increased by a modest 10.9%, we have seen a larger increase in the more advanced classes because more of these students have decided to go into STEM fields rather than nursing programs.

Organic chemistry has a very specific path. Students taking Organic Chemistry tend to major in Chemistry, Chemical Engineering, and Biology. We are seeing fewer students moving into these fields. Students at NVC prefer Engineering majors that do not require Organic chemistry or only require one semester of organic chemistry in order to complete the major.

We expect this trend to continue. The numbers in our Introductory classes will continue to rise and more students will move into the more advanced chemistry classes in pursuit of their engineering degrees, but second semester organic chemistry will remain lower than the other classes because of the specialized nature of the need.

2. Average Class Size

	2016-2017		2017-2018		2018-2019		Three-Year	
	Sections	**Average Size**	**Sections**	**Average Size**	**Sections**	**Average Size**	**Average Section Size**	**Trend**
Introductory Chemistry	31	21	29	23.3	31	23.7	22.7	13.2%
CHEM-110	27	22.1	25	24.5	27	24.5	23.7	10.9%
CHEM-111	4	13.5	4	16	4	18.8	16.1	38.9%
General Chemistry	10	25.1	11	24.2	12	26.9	25.5	7.2%
CHEM-120	6	28.2	6	28.5	7	28	28.2	-0.6%
CHEM-121	4	20.5	5	19	5	25.4	21.7	23.9%
Organic Chemistry	4	20.8	4	21.8	4	18.8	20.4	-9.6%
CHEM-240	2	24.5	2	24	2	23.5	24	-4.1%
CHEM-241	2	17	2	19.5	2	14	16.8	-17.6%
Program Average*	45	21.9	44	23.4	47	24.1	23.1	10.3%
Institutional Average*	1,474	24.8	1,406	25.7	1,313	24.8	25.1	1.2%

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.

RPIE Analysis: Over the past three years, the Chemistry Program has claimed an average of 23.1 students per section. The average class size of 25.1 students per section across the institution has exceeded the average class size within the program during this period. The average class size in the Chemistry Program increased by

10.3% over the past three years. Average class size at the institutional level increased by 1.2%

Average class size in the following courses changed by more than 10% (±10%) between 2016-2017 and 2018-2019:

Courses with increases in average class size:

- *CHEM-111 (38.9%)*
- *CHEM-121 (23.9%)*
- *CHEM-110 (10.9%)*

Courses with decreases in average section size:

- *CHEM-241 (-17.6%)*

Average class size in the following Area of Study increased by more than 10%:

- *Introductory Chemistry (13.2%)*

Program Reflection:

The average class size in chemistry is determined by the size of our labs. Our labs have lockers and equipment available for 24 students per section. When you consider that we have a program average of 23.1 students per section, this means that are at 92.4% of capacity. Perhaps more importantly, and more meaningful, is the fact that the average class size in General Chemistry is 25.5 students per section in a lab room that only holds 24 students. In General Chemistry we are at 102% of capacity.

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 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**
2016-2017	886	998	88.8%
2017-2018	939	950	98.8%
2018-2019	1,002	1,025	97.8%
Three-Year Program Total	2,827	2,973	95.1%
Institutional Level	94,614	117,777	80.3%
Productivity*			
	FTES	**FTEF**	**Productivity**
2016-2017	200.7	14.1	14.2
2017-2018	211.2	12.6	16.8
2018-2019	227.5	13.4	17

Three-Year Program Total	639.4	40.1	15.9
Source: SQL Enrollment and Course Sections Files			

RPIE Analysis: Fill rates within the Chemistry Program tend to be higher than fill rates at the institutional level. [Compare program-level rate of 95.1% to institution-level rate of 80.3% over the past three years.] Between 2016-2017 and 2017-2018, enrollments increased while capacity decreased, resulting in an increase in fill rate. Between 2017-2018 and 2018-2019, both enrollments and capacity increased, resulting in a stable fill rate.

Productivity increased from 14.2 to 17 over the three-year period. The three-year program productivity of 15.9 is lower than the target level of 17.5, which reflects 1 FTEF accounting for 17.5 FTES across the academic year. (This target reflects 525 weekly student contact hours for one full-time student across the academic year.) Productivity has not been calculated at the institutional level.

**Note: Fill rates and productivity reported in the table do not include 15 Chemistry course sections offered during 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 carefully plans the number of sections offered to correspond to the anticipated demand. We err on the side of too few sections when demand is unclear and then add sections as necessary. This keeps our fill rates high – at or near capacity.

A direct consequence of the way we plan our sections is that our productivity has increased over the last few years. Productivity is measured as the ratio of the number of FTES to FTEF. To increase this number we must either increase the number of students in our sections or decrease the number of full time equivalent faculties. At the moment, neither of these strategies are possible and is very likely unwise to attempt to increase productivity in chemistry using our current facility. An increased number of students is a safety issue in chemistry. An instructor can only keep track of so many students during the course of a lab session (30 max) and any more than that and the lab becomes unsafe for everyone. Currently, our labs are only set up to hold 24 students. Overfilling them by 25% is a poor way to improve productivity.

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).

The alternative, to decrease the number of full time faculty in chemistry, is not considered a viable solution to the productivity problem.

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

	Retention Rates (Across Three Years)			Successful Course Completion Rates (Across Three Years)		
Level	**Rate**	**Course Rate vs. Program Rate**		**Rate**	**Course Rate vs. Program Rate**	
		Above	**Below**		**Above**	**Below**
Introductory Chemistry	***86.4%***		***X***	***73.3%***	***X***	
CHEM-110	***81.3%***		***X***	67.9%		X
CHEM-111	***95.4%***	***X***		***82.9%***	***X***	
General Chemistry	89.0%	--	--	67.3%		X
CHEM-120	89.6%	--	--	67.5%		X
CHEM-121	***82.9%***		***X***	***64.8%***		***X***
Organic Chemistry	***92.2%***	***X***		***81.6%***	***X***	
CHEM-240	88.2%	--	--	74.3%	X	
CHEM-241	***98.0%***	***X***		***92.1%***	***X***	
Program Level	88.6%			**70.0%**		
Institutional Level	89.8%			75.1%		

Source: SQL Enrollment Files
-- Indicates a value that is within 1% of the program level value.
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.

RPIE Analysis: Over the past three years, the retention rate for the Chemistry Program was lower than the rate at the institutional level. (The difference was not statistically significant.) The retention rate in the Introductory Chemistry Area of Study was significantly lower than the program-level rate. The retention rates for CHEM-110 and CHEM-121 were significantly lower than the program level rate. Other Chemistry courses (highlighted in the table) had retention rates that were significantly higher than the program-level rate. The retention rate for Chemistry falls in the 29th percentile among program-level retention rates (across 59 instructional programs, over the past three years).

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 successful course completion rate for CHEM-121 was 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 Chemistry falls in the 20th percentile among program-level successful course completion rates (across 59 instructional programs).

Over the past three years, the difference between retention and successful course completion at the program level (18.6%) was higher than the difference at the institutional level (14.7%). This figure represents the proportion of non-passing grades assigned to students (i.e., grades of D, F, I, NP). The following Chemistry courses claim differences (between retention and successful course completion) exceeding 10%:

- *CHEM-120 (22.1%)*
- *CHEM-121 (18.1%)*
- *CHEM-240 (13.9%)*
- *CHEM-110 (13.4%)*
- *CHEM-111 (12.5%)*

Program Reflection:

The retention rate and completion rates can be broken into two major groups: General and Organic Chemistry, and these differences are due primarily to the math (or lack thereof) required for completion of these courses.

General Chemistry: With the advent of AB705 the prerequisite landscape changed for our General Chemistry classes. We can no longer require Math 94 as a prerequisite for our classes and instead must rely on HS grade point averages and self-reporting. For many years we suspected that our students didn't know enough math to prosper in our classes but had no way of quantifying our assumptions.

With the Introduction of AB705 we added a math assessment quiz to our Introductory Chemistry class that enables us to quantify the readiness of our students and judge the efficacy of the assembly bill. Only 30% of our introductory students passed the math assessment quiz.

Over the years we have labored under the assumption that our students were adequately prepared for the rigors of chemistry if they had passed intermediate algebra. That assumption has proven to be wrong. We believe that we are seeing a direct consequence of this lack of preparation in math by the low retention and course completion rates in those classes that have a heavy math emphasis – specifically, Chem 110, 120, and 121.

To remediate this lack of mathematical proficiency we've instituted a policy whereby students can receive tutoring and special instruction in mathematics and take the math proficiency quiz as many times as necessary until they pass it. This is the first year of this new policy so it will be interesting to see if retention and completion rates increase in the next few years.

The lack of mathematical literacy is also seen in the differences in the retention and completion rates for Chem 120 and Chem 121. Normally, we would expect to see these metrics rise as students advance through our program, but in this case both metrics decrease as students move from Chem 120 to Chem 121. The reason for this is clear – Chem 121 uses the most advanced math of all of our chemistry classes and requires our students to solve equations that aren't seen anywhere else in our program.

For students to do well in Chem 121 they should take Math 106 either as a prerequisite or concurrently but we are not able to add this to the COR because it is not a requirement used by UC or CSU. But, we can add the admonishment used by UCs for their Chem 2 class; "Concurrent enrollment in mathematics at or above the level of MAT H 106 strongly recommended" in our catalog and COR. We believe that improved math skills will improve both retention and successful completion rates for this class.

Organic Chemistry: By its nature, organic chemistry (Chem 111, 240, and 241) is concept based and has very little or no math component. As a direct consequence, retention and completion rates are much higher for these classes than for our general and introductory chemistry classes. In addition, a tenured instructor has taken over responsibility for Chem 111 which has helped stabilize this offering and made it more attractive to students. We anticipate that retention and completion rates for these classes to remain high.

2. Student Equity

	Retention Rates (Across Three Years)		Successful Course Completion Rates (Across Three Years)	
	Program Level	**Institution Level**	**Program Level**	**Institution Level**
Black/African American	***77.5%***	85.8%	***50.0%***	64.2%
Hispanic			***65.9%***	72.9%
First Generation			***64.6%***	73.9%

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.

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

Within the Chemistry Program, retention and successful course completion rates were significantly lower than the rates at the institutional level for all three groups:

- *Black/African American: retention and successful course completion rates*
- *Hispanic: successful course completion rate*
- *First Generation: successful course completion rate*

This pattern reflects the findings from the comparison of retention and successful course completion at the program vs. institutional level (with the institution-level rates exceeding the program-level rates). (See Section I.B.1 above).

Program Reflection:

It is difficult to know the cause of low retention and completion rates in these populations but it is suspected that it is because of a lack of sufficiently rigorous preparation for these classes. 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, hosting visits from

local Middle schools, hosting science students from local high schools, being advisors for NVC science clubs like SACNAS, WISE, the Discovery Club, and SHPE, and participated in off campus events like "An Evening with Professionals" at UC Davis. 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. These events did not produce the results we were trying to achieve. 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.

In recent discussions, it has been decided that a two-week summer program in STEM is not sufficient intervention to generate interest nor prepare students for a future in the sciences. A more fundamental approach is needed. We must reach into the high schools and provide a better education before these students come to our college.

To this end, discussions have now switched from a Summer Bridge program to 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 diversity when we make our decision who to hire.

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

This section does not apply to the Chemistry Program, as courses associated with the program were not offered through multiple delivery modes within the same academic year between 2016-2017 and 2018-2019.

C. Student Achievement

1. Program Completion

	2016-2017	2017-2018	2018-2019
Degrees			
Natural Science-Life Science: AS	--	--	10
Natural Science-Physical Science: AS	--	--	16
Pre-Health Science: AS	--	--	57
Natural Science and Mathematics: AS	292	242	189
Total	292	242	272
Institutional: AS Degrees	**443**	**394**	**386**

Average Time to Degree (in Years)+			
Natural Science-Life Science: AS	--	--	3
Natural Science-Physical Science: AS	--	--	3
Pre-Health Science: AS	--	--	4
Natural Science and Mathematics: AS	4	4	4
Total	4	4	4
Institutional: AS Degrees	**4**	**4**	**4**

Source: SQL Award Files
+Average time to degree/certificate was calculated among students who completed a degree/certificate within 10 years (between first year of enrollment at NVC and award conferral year). Among 2018-2019 completers, the average time to degree/certificate was calculated among students who enrolled at NVC for the first time in 2009-2010 or later.

NOTE: The Taxonomy of Programs does not list any degrees directly associated with the Chemistry Program. [The AS degrees listed in the table above are assigned to Biology (per the Taxonomy of Programs.] Because requirements for the degrees listed above include Chemistry courses, they have been incorporated into the program review data for Chemistry. The analysis below pertains to all of the AS degrees listed above.

RPIE Analysis: The number of AS degrees associated with Chemistry decreased by 6.8% between 2016-2017 and 2018-2019. Over the same time period, the number of AS degrees conferred by the institution decreased by 12.9%. AS degrees associated with Chemistry accounted for 65.9% of AS degrees conferred by the institution in 2016-2017 and 70.5% of those conferred in 2018-2019. The average time to degree for AS degrees associated with Chemistry was 4 years, which reflects the average time to degree for AS degrees conferred by the institution across the three years examined.

Program Reflection:

Over this time period enrollment has declined by 10% in 2016-17 and another 10% in 2017-18. This is reflected in the 12.9% decline in AS degrees conferred by the institution of the same time period. The decline is AS degrees associated with chemistry have only declined by 6.8% which says that a higher percentage of students are getting AS degrees associated with chemistry than other AS degrees. This is confirmed by the statistic showing that the percentage of AS degrees has increased from 65.9% to 70.5% over the same time period.

This shows that the demand for chemistry is growing.

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

Subject	**Course Number**	**Date of Last Review**	**Has Prerequisite*** Yes/No	**In Need of Revision** *Indicate Non-Substantive (NS) or Substantive (S)*	**To Be Archived** *(as Obsolete, Outdated, or Irrelevant)*	**No Change**
CHEM	110	2019	Yes	(S) – in progress	No	X
CHEM	111	2018	Yes	No	No	X
CHEM	120	2019	Yes	(S) – in progress	No	X
CHEM	121	2015	Yes	No	No	X
CHEM	240	2018	Yes	No	No	X
CHEM	241	2018	Yes	No	No	X

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

Program Reflection:

With the advent of AB705 it was necessary to update the math prerequisite for Chem 110 and Chem 120. These updates have already been approved by the Curriculum Committee and should be implemented by Spring 2020. The rest of the courses in our program remain unchanged by AB705 so there is no need for additional updates. All of our classes have been updated within the last 4 years so no further updates are needed.

In addition, the chemistry department has submitted the paperwork needed for the UC Transfer Pathway (UCTP). This is meant to enhance student transfer and increase academic preparation for CCC students as they transfer into a UC campus. The University of California Transfer Pathways (UCTP) Guarantee pilot project was created to expand inclusive access, especially at traditionally low-sending CCC campuses, as a key component of fulfilling the intent of the Master Plan and the Vision for Success, providing opportunities and social mobility and serving the state of California by enhancing the transfer route to a four-year degree by developing and promoting guarantees of admission based on Transfer Pathways and Associate degrees built on those Pathways. The idea is to change the perception that “UC is not for me.”

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	6	6	100%	100%

Learning Outcomes Assessment at the Program/Degree/Certificate Level

UPDATE?	Number of Outcomes Assessed		Proportion of Outcomes Assessed	
Number of Outcomes*	Over Last 4 Years	Over Last 6 Years	Over Last 4 Years	Over Last 6 Years
0	0	0	N/A	N/A

*Include all areas of study, degrees, and certificates associated with the program in the table.

Program Reflection:

The chemistry program maintains a rigorous schedule of assessment that exceeds the normal SLO assessment requirements. This cycle works well for us and is not particularly burdensome. We only have 6 courses in our program and some of them are only offered once per year so doing assessment of these courses every time they are offered has not been a problem.

In general, SLO 1 and 2 for all courses are easily assessed either by an assessment exam or embedded questions in exams taken during the semester. SLO3 has been problematic. For all courses it reads, "Implement laboratory techniques correctly using appropriate safety procedures and express them clearly in written laboratory reports."

There is difficulty capturing information on the technique and safety portions of this SLO. At least some of our labs are quantitative so we usually capture the technique portion by looking at the percent yields. The higher the yield, the better the technique, but this does not capture any information about safety. In addition, we tend not to grade on grammar and punctuation, so it is difficult to assess a student's ability to express themselves clearly in written laboratory reports. We tend to look at right and wrong answers rather than the process that produces an answer and whether the answer is clearly stated. We need to revisit SLO3 across the program and find a better way of capturing the data. In addition, this SLO does not map to anything outside of our program so it is not obvious how it relates to learning outcomes in other areas across campus.

Although SLO1 and SLO2 are easily assessed across our curriculum, that doesn't mean that all of our outcomes are good. The most obvious lacking is the SLO2 for organic chemistry. This SLO strikes at the heart of organic chem and asks the students to demonstrate how organic reactions occur. Despite efforts to improve this SLO score, students continue to struggle. Our efforts to improve this SLO include adding Supplemental Instruction to these classes with an emphasis on reaction mechanisms (SLO2). In addition,

more handouts, homework, and extra time spent in the classroom in an attempt to improve this score have not been met with success. Scores continue to be low. New strategies are needed in order to improve the scores on this SLO.

Even so, overall, we seem to do pretty well with the results of our outcome assessment. The scores on most of our SLO's tend to be in the 70-75% range or higher. We are always looking for ways to improve our scores and we regularly discuss pedagogy to determine ways of delivering material in the most clear and efficient way possible.

The larger PLO assessment has not been done in a while. The chemistry program has agreed to set aside a day to complete the PLO assessment (Dec. 16, 2019), so this assessment will be done before the end of the semester, Fall 2019.

B. Summary of Learning Outcomes Assessment Findings and Actions

Learning outcome assessment has made us aware of deficiencies in two particular areas of chemistry.

1. Capturing data on chemical safety and technique.
2. Mechanisms of organic chemistry reactions.

The chemistry program will revisit the safety and technique SLO and considering changing it. The goal is to capture data that is relevant to the program but also maps to the larger program and institutional outcomes. This SLO has been particularly difficult to assess and does not map to any institutional outcomes so it has not proven to be particularly useful for the program or the institution at large.

The other SLOs have proven to be a useful measure of our students understanding of chemistry and we will continue using them. They highlight areas of strength but also places where our students require more work. We continue discussions on how to further strengthen the SLOs that are already strong (SLO1 across our curriculum), and look for ways to improve those SLOs where we are weak (SLO2-organic chem).

Program Reflection:

The chemistry program has a rigorous assessment schedule. We assess every class every semester. By doing so we are able to make changes in our teaching methods and immediately see whether those changes have improved our student learning outcomes.

Overall, we have been successful and responsive to the results of student learning outcome assessment. Shortcomings are addressed and new strategies are immediately implemented.

IV. PROGRAM PLAN

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

- ○ Viability
- ○ Stability
- ● Growth

*Please select ONE of the above.

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

1. 1A.1 – Despite the campus wide decline in enrollment, chemistry has enjoyed a 15.2% increase in enrollment.
2. 1A.2 – The average class size has increased by 10.3% over the last three years.
3. 1A.3 – The fill rate in chemistry is 95.1%
4. 1C.1 – The number of AS degrees associated with chemistry have increased from 65.9% to 70.5% of all AS degrees conferred by the institution.

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: _2020-2023_____

Strategic Initiatives Emerging from Program Review	Relevant Section(s) of Report	Implementation Timeline: Activity/Activities & Date(s)	Measure(s) of Progress or Effectiveness
Chemistry/STEM HS Summit	Student Equity	Summer 2020	Increased enrollment, retention, and success rate of underserved students.
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
New FT Chemistry Instructor	1. Growth 2. Enrollment	2020-2021	New faculty hired

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. STEM Summit – The Unit Plan for S&E includes a budget for a Summer Bridge Program. We are proposing that we temporarily suspend the Summer Bridge Program and use the money for a STEM Summit with neighboring high school STEM faculty. The monies would be used to support the Summit and aid in the production and/or purchase of educational materials for use in the high schools.
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. The request for a new faculty member in chemistry has already been made and is seeking approval at cabinet. 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.

V. PROGRAM HIGHLIGHTS

A. Recent Improvements

1. The chemistry program has rewritten its chemical hygiene plan. The last time it was done was 1985.
2. Organic chemistry now requires lab coats for all students to help protect them in case of accidental spillage.
3. All Chemistry curricula have been updated and are in compliance with AB705.
4. All lab manuals are produced in-house. This maximizes the use of available equipment and provides a closer link between the lab and lecture.
5. Our IA is now full time so there are no longer any lapses in lab preps, lab cleanup, maintenance, or chemical/equipment purchases.
6. The chemical storeroom has been rearranged to make chemical storage safer and chemicals that have gone unused have been removed.
7. Log books have been created to track student injuries and equipment breakage.
8. We've added chemistry to the NVC Math Placement Tool so that students can know if they are ready to take chemistry.
9. Chemistry has been assured a budget for program maintenance, chemicals, and equipment. As a consequence, we've been able to purchase and maintain everything that we need.
10. A student worker has been added to our program to help the IA do lab preps, maintain student equipment, help with inventory, and clean up after labs are finished.

11. 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 one of the highest fill rates 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.

Feedback and Follow-up Form

Completed by Supervising Administrator:

Robert Van Der Velde

Date:

11/15/2019

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

Chemistry is a strong program, offering support for the College's health care students as well as STEM majors seeking to transfer with General Chemistry and Organic Chemistry. The program has excellent faculty, both full-time and part-time, though not enough of them. Student success rates are appropriate and closely reviewed by the faculty. The program builds an effective schedule for students each semester, engaging in careful enrollment management to maximize limited lab space and faculty resources. The program has sufficient operational budgets and staff support to maintain current offerings.

Areas of concern, if any:

Chemistry fulltime faculty are stretched with unsustainable overloads, and departure of any one adjunct instructor would be crippling. Chemistry needs to recruit additional adjunct faculty as well as an additional fulltime instructor. Adjunct faculty compensation that is not competitive with neighboring colleges has added to this problem.

Recommendations for improvement:

Chemistry should continue to assess and revise Math Mastery Quizzes, and continue to review appropriate prerequisites.

Anticipated Resource Needs:

Resource Type	**Description of Need (Initial, Including Justification and Direct Linkage to State of the Program)**
Personnel: Faculty	Chemistry has a critical need to recruit and retain additional adjunct faculty as well as an additional full-time faculty member.
Personnel: Classified	
Personnel: Admin/Confidential	
Instructional Equipment	
Instructional Technology	
Facilities	Chemistry needs a new building to replace antiquated facilities and to meet student demand. Based upon new Science labs recently opened at Solano, it is estimated that a $30 million facility would be required.
Operating Budget	
Professional Development/ Training	

Library & Learning Materials	