



# WEST VIRGINIA STATE UNIVERSITY

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## Academic Affairs Assessment of Student Learning Report for Academic Year 2020-2021

Department/Program Chemistry  
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1. Which learning outcomes did you measure this past year? [Please indicate whether any of these measures were conducted as follow-up to a previous year's issues or in response to Program Review. Be specific.]

Program Learning Outcomes, PLOs 1 and 3 will be measured during the 2020-2021 academic year.

- PLO 1. Explain the fundamentals in organic, analytical, physical, inorganic, and biological chemistry.
- PLO 3. Apply problem-solving strategies to scientific problems

2. In which course(s) were assessments conducted?

For the Fall 2020 the following courses were used to evaluate learning outcomes 1 and 3.

PLOs Assessed	Assessment point	Assessment tool (Direct or Indirect)
1 and 3	Chem. 106 General Chemistry II	ACS 2 <sup>nd</sup> semester General Chemistry Exam (Direct)
1 and 3	Chem. 206 Organic Chemistry II	ACS two semester Organic Chemistry Exam (Direct)
1 and 3	Chem. 301 Physical Chemistry I	ACS 1 <sup>st</sup> semester Physical Chemistry Exam (Direct)

\*ACS: American Chemical Society

For the Spring 2021 semester the following courses were used to evaluate learning outcomes 1 and 3.

PLOs Assessed	Assessment point	Assessment tool (Direct or Indirect)
1 and 3	Chem. 106 General Chemistry II	ACS• 2nd semester General Chemistry Exam (Direct)
1 and 3	Chem. 206 Organic Chemistry II	ACS two semester Organic Chemistry Exam (Direct)
1 and 3	Chem. 450 Senior Seminar	ACS DUCK** Exam (Direct)
1 - 6	Chem. 450 Senior Seminar	Department Graduate Exit Survey (Indirect)

\*ACS: American Chemical Society

\*\*DUCK: Diagnostic of Undergraduate Chemistry Knowledge (DUCK test)

3. **How did you assess the selected program learning outcomes?** (i.e., what did you assess – group project, skills demonstration, presentation, performance, debate, lab experiment, online discussion, etc. *and*- what tool (measure) did you use - rubric, nationally or state-normed exam, item analysis, pre-posttest design, skills inventory, survey, etc.)

The American Chemical Society is the world's largest scientific professional society. It has a Committee on Education and a national test center that develops a test for numerous classes in the standard chemistry curriculum. The department decided to use this standardized test sequence due to its ability to place students in a national percentile so we can determine how our students stack up against other nationally. Each of the tests can be further broken down to give use data on where our students are struggling in the sub disciplines of general, organic, physical, and chemistry overall Diagnostic of Undergraduate Chemistry Knowledge (DUCK test).

4. **How many students were included in the assessment(s) of each PLO in a course?**

The number of students who took each examination is broken down in the following table. The Chemistry 106 and 206 had a significant percentage of Biology majors taking the test while the Chemistry 301 and 450 assessment tool was strictly chemistry majors.

Assessment Evaluation	Number of students who completed the assessment tool
Second term General Chemistry test – Chemistry 106	0
Second term Organic Chemistry test – Chemistry 206	15
First Term Physical Chemistry test – Chemistry 301	0
Senior Seminar – Chemistry 450 – DUCK Test	6
Graduate Assessment Survey	7

5. **How were students selected to participate in the assessment of each outcome** (Helpful details might include- whether this assessment represents all students, a sample of students in a class, or a sample of students across sections)?

Every student who completed the courses in question were given a copy of the exam as part of their course work. All graduates for the corresponding survey were sent a copy of the graduate survey and asked to complete the survey. With reminders the surveys were completed and submitted to the College Administrative Assistant until after graduation to protect the anonymity of the graduate submitting the survey.

6. **In general, describe how each assessment tool (measure) was constructed** (i.e. in-house, national, adapted).

The course assessment examinations were written by faculty from across the country in their professional service the American Chemical Society's Division of Chemical Education Examination. The graduate survey was written by faculty within the Department.

7. **Who analyzed results and how were they analyzed**

The professor who taught the course is the faculty member who was responsible to do the assessment for the examination. The Assessment Coordinator then compiles the assessment for the Department Reports. The Course examinations were broken down into the content areas to determine where students achieved the poorest scores.

Assessment examination	Faculty responsible for assessment
Chemistry 106 General Chemistry II	Ernest Sekabunga
Chemistry 206 Organic Chemistry II	Micheal Fultz
Chemistry 301 Physical Chemistry	Sundar Naga
Chemistry 450 Senior Seminar	Micheal Fultz
Graduation Survey	Micheal Fultz

8. **Provide a summary of the results/conclusions from the assessment of each measured Program Learning Outcome.** *Report scores for this assessment, as well as students' strengths and weaknesses relative to this learning outcome.*

Based on the individual tests given during the 2020-2021 academic year the following items were noted.

- ACS 2<sup>nd</sup> semester General Chemistry Exam: This test was not given due to the COVID pandemic. Students were not all able to meet in person and the exam could not go online due to test security issues. The exam will be given to the students for Fall 2021 to resume assessment.
- ACS two semester Organic Chemistry Exam: The results of the two sections of students who took this exam during the academic year has been item analyzed by topic. Each question was classified into one of six

topic/concept areas – general organic, alkenes, carbonyls, mechanisms, synthesis, and spectroscopy. Based on the item analysis data, students, areas of greatest weakness was carbonyl chemistry. The second lowest area was synthesis. Carbonyl chemistry is difficult to adjust as it comes at the end of the semester and text book so there is no chance for long term exposure and repetitive learning. Synthesis just needs more practice in the recitation periods.

- ACS 1<sup>st</sup> semester Physical Chemistry Exam: This ACS was not given due to national test security signed by the chair of the department. The professor taught the course online (COVID related) and with the transient students in the class there was no way to have them all together in one space for the test. The test will be used again in fall 2021
- ACS Diagnostic of Undergraduate Chemistry Knowledge (DUCK) Exam: This exam is given to graduating seniors in Senior Seminar at the end of the Spring 2021 semester. Student scores in chemistry sub-disciplines increased in the following respective order; Physical, Inorganic, Biological, Physical, Analytical, and Organic. We have hired a new physical chemist to start Fall 2021.
- Department Graduate Exit Survey: The graduation survey, aligned to the Department's PLOs, solicits graduating students' opinions on how well the department is achieving its PLOs. They were asked to respond as Extremely Well, Very Well, Adequately Well, Not Very Well, or Not at all. PLO 1, then worded as "Explain the fundamentals in organic, analytical, physical, inorganic, and biological chemistry" was subdivided into the five sub-disciplines of chemistry listed.

Since its introduction seven years ago the department has collected and sealed surveys for almost every graduate of the program. This year seven surveys out of a possible seven surveys for the Fall 2020 and Spring 2021 semesters. These surveys were unsealed at the end of the Spring 2021 period. The scores and comments the graduates provided for our department are listed in the learning outcomes below.

## Program Learning Outcome

Graduates were given a survey to complete to determine their experience in each of the five traditional areas of chemistry. They were instructed to grade their experience based on the following scale.

**Extremely Well** = “5 of 5” or “Greatly above my expectations” or “Well above average”

**Very Well** = “4 of 5” or “Above my expectations” or “Above average”

**Adequately Well** = “3 of 5” or “Met my expectations” or “Average”

**Not Very Well** = “2 of 5” or “Somewhat below my expectation” or “Below average”

**Not at All** = “1 of 5” or “Far below my expectations” or “Far below average/did not meet expectations at all”

1. Demonstrate a conceptual understanding and integration of the fundamentals in organic, analytical, physical, inorganic, and biological chemistry.

### Organic Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
6	1			

#### Comments:

- a. This was my favorite class load. These classes were taught exceptionally well and set me up for the future.
- b. This class was taught by Dr. Fultz and it is definitely one of the main reasons of what made me decide to major in chemistry. Left this class introduced into a whole different world in chemistry while having a lot of understanding in it.
- c. I really enjoyed and learned some material in this class.
- d. A rigorous course with a great professor. (Org I and II with Fultz)
- e. Even though I had trouble in much of the class it was obvious Dr. Fultz cared a lot about the subject and the students.
- f. Dr. Fultz did an amazing job with this class. He was very good at keeping the attention of the students by asking questions during the lecture, I very much enjoyed his class, and I feel like I have learned a lot. It was one of my favorite classes.

### Analytical Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
1	2			4

#### Comments:

- Nothing learned at all in class lecture or lab
- The professor did not care much for our education. 8 lectures done all semester 4 of which were done on statistics. Pretty upset about it because it was stressed it was one of the most important fields and then did not teach it.
- We did not get past the first three chapters and had only had a few oral lectures in this class.
- Learned quantitative transfer, that was about it.
- Is a little shaky for me, but I think I know it pretty well.

### Physical Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
4	2	1		

#### Comments:

- This was one of my favorite classes. I had a great time learning with Dr. Naga. He did a great job explaining the very abstract concepts in physical chemistry.
- I made connections in this course that tied all of chemistry together for me. (P Chem 1 and 2)
- The class was very difficult and he didn't always explain things as easily as he could. But after the class I received I learned more than I thought I did.

### Inorganic Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
1	1		5	

#### Comments:

- Due to the challenges of the semester we learned nothing
- I feel I missed a lot of information from inorganic, so I cannot say I understand it very well.

c. The course was going well until a substitute professor took over the class. We did not advance in the book at all during their time teaching. We had no oral lectures from them in the class.

d. One of the ones I found most interesting and then did not get taught it.

#### Biological Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
2	2	2	1	

#### Comments:

a. The labs could have been better.

2. Perform practical, standard laboratory procedures and techniques with a high level of precision and safety.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
6			1	

3. Apply critical thinking and fundamental problem-solving strategies to scientific problems ranging from hands-on laboratory research to theoretical concepts.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
5	1		1	

4. Demonstrate effective use of chemical literature through identifying various information sources in conjunction with the retrieval and critical analysis of scientific literature.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
5	1	1		

5. Demonstrate effective oral, written, and computer-aided communication skills pertaining to chemical applications.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
3		1	1	

6. Conduct independent systematic research.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at all
5		1	1	

Any other comments regarding the department.

- a. A major strength is the core lab; I feel like half of the chemistry I learned was through experience there.
- b. The emphasis on research is great here, and it really helps to prepare for grad school (or employment in the chemistry field.)
- c. Strengths: Almost every faculty member has been helpful at any time I needed it. Very open door policy and that's incredible. Weakness: Analytical dept, need more staff to alleviate faculty load and operate instruments (mass spec)
- d. I had a great experience in the chemistry department at WVSU. I was extremely disappointed in the lack of teaching in analytical and inorganic class. There were almost no lectures and we did not get past the review concepts in either class. I realize we were going through a pandemic, but that is not an excuse as all my other professors did an amazing job under strange circumstances. I feel unprepared for graduate school in these two areas.

9. **What are next steps?** (e.g., will you measure this same learning outcome again? Will you change some feature of the classroom experience and measure its impact? Will you try a new tool? Are you satisfied?)

While it is the job of every faculty member is to improve the comprehension of their students in the classes they teach. This does not stop, there is always room for improvement. To help with that there are several areas where the department is working to improve.

**General Chemistry (Chem 106)** – With the recent hiring of two new faculty members and a new lab manager we are working to improve the experiential learning of general chemistry II. This is something that has been planned in the past but revisions were never completed. We do a lab the lets a student measure chemical kinetics however nothing in thermodynamics. We are currently revising the lab manual and looking at adding a thermodynamics lab to incorporate it into the curriculum.

**Organic Chemistry (Chem 206)** – Carbonyl chemistry and synthesis were the lowest scoring areas in the 2020-2021 assessment. There is a challenge in improving carbonyl chemistry since it is traditionally one of the last things in text books and covered in organic II. This is a challenge nationwide. To improve on this, we will look at the possibility of replacing one aldol lab with a redox lab to study the production of a carbonyl. As far as synthesis challenges more practice in the homework will be provided. Synthesis requires significant practice.



**Physical Chemistry (Chem 301)** – We just hired a new physical chemist to start Fall 2021. This individual is completely redoing the physical chemistry curriculum which includes the addition of several new laboratories for Chem 303. More information should be available after the Fall 2021 assessment.

**DUCK test** – Further study of the data from the DUCK test need to be conducted. Before any additional courses or overall curriculum modifications can be suggested we need to determine if there is a difference in the performance of the degree options. This needs to be done to confirm that the degrees are meeting the needs of the students graduating in those concentrations. Of the six students who took the test they scored in the 79, 94, 87, 83, 52, and 79th percentile nationally. All of our students scored above the national average.

**Graduate Survey** – Based on the graduate surveys and challenges in analytical and research activities we have hired two new faculty members. One in Biochemistry to bring the chemistry expertise to the course. The second faculty member has a physical chemistry and analytical chemistry background. They will be teaching the disciplines that were the lowest scoring areas on the DUCK test or graduate surveys.

10. **Please attach an example of the assessment tool used to measure your PLO(s).** These can be added as an appendix, a link to the assessment, or sent separately in email with your report.

While we are not able to share a copy of the assessment evaluations from the American Chemical Society due to the test security guarantees signed by the Department Chair. A copy of the graduate survey is attached.

DEPARTMENT OF CHEMISTRY  
GRADUATE EXIT SURVEY  
PROGRAM LEARNING OUTCOMES

**Directions** – The survey will not be examined until after graduation has commenced, your results will remain anonymous throughout the study as well. Read the Department of Chemistry Program Learning Outcomes below. Answer the questions on how you, the pending graduate of the Department of Chemistry, perceive how successful the department was in providing an education in the following fields. Feel free to make comments on our strengths and weaknesses in each of the areas.

Take a moment individualize your education in each of the areas. Check the box that corresponds to your judgment of education provided to you in each area. Feel free to make comments about the strengths and weaknesses in each area of your education.

Choice definitions based on Likert scales for quantitative data analysis of qualitative data.

**Extremely Well** = “5 of 5” or “Greatly above my expectations”

**Very Well** = “4 of 5” or “Above my expectations”

**Adequately Well** = “3 of 5” or “Met my expectations”

**Not Very Well** = “2 of 5” or “Somewhat below my expectation”

**Not at All** = “1 of 5” or “Far below my expectations”

Program Learning Outcome

1. Demonstrate a conceptual understanding and integration of the fundamentals in organic, analytical, physical, inorganic, and biological chemistry.

Analytical Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Comments:

Biological Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Comments:

Inorganic Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Comments:

### Organic Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Comments:

### Physical Chemistry

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Comments:

2. Perform practical, standard laboratory procedures and techniques with a high level of precision and safety.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

3. Apply critical thinking and fundamental problem-solving strategies to scientific problems ranging from hands-on laboratory research to theoretical concepts.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

4. Demonstrate effective use of chemical literature through identifying various information sources in conjunction with the retrieval and critical analysis of scientific literature.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

5. Demonstrate effective oral, written, and computer-aided communication skills pertaining to chemical applications.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

6. Conduct independent, systematic research.

Extremely Well	Very Well	Adequately Well	Not Very Well	Not at All

Any additional comments you would like to share about the strengths and weaknesses of the department.