

Major/Program:Chemistry/Biochemistry/Physics/Astronomy

Annual ASSESSMENT of the Major/Program

Fall 2020-Spring 2021

What are the student learning outcomes in the major/program? When were they last revised?
Goal 1. Students will achieve a solid foundation in all fields of chemistry
Goal 2. Students will carry out and perform scientific experiments as well as accurately record, analyze and interpret scientific problems including the ability to master scientific writing in chemistry
Goal 3. Students will be skilled in problem solving, critical thinking, analytical reasoning and learn to interpret and evaluate scientific findings.
Goal 4. Students in introductory courses will understand the two basic components of the scientific method: theory and experimentation.
Which outcome(s) did you assess this academic year?
1,3 and 4
How did you assess the learning outcomes this academic year?
A 14 year study was conducted to assess the efficacy of CHEM-C101 as a preparatory course for CHEM-C105. C105 has a large DWF rate and that is affecting not only our majors but also the majors of other sciences.
Please summarize the data you have collected this academic year.
Please see attached internal report.
Please describe any programmatic changes you have made or are planning to make based on the data you have collected (action steps).
A new course, CHEM-C103, specifically for preparing students to be successful in CHEM-C105 will be taught beginning in the FALL 2022. See attached report for details.
Please report on the progress of your action steps reported in 2019-2020. See http://www.iun.edu/campus-assessment/assessment-results/index.htm for your previous unit reports.

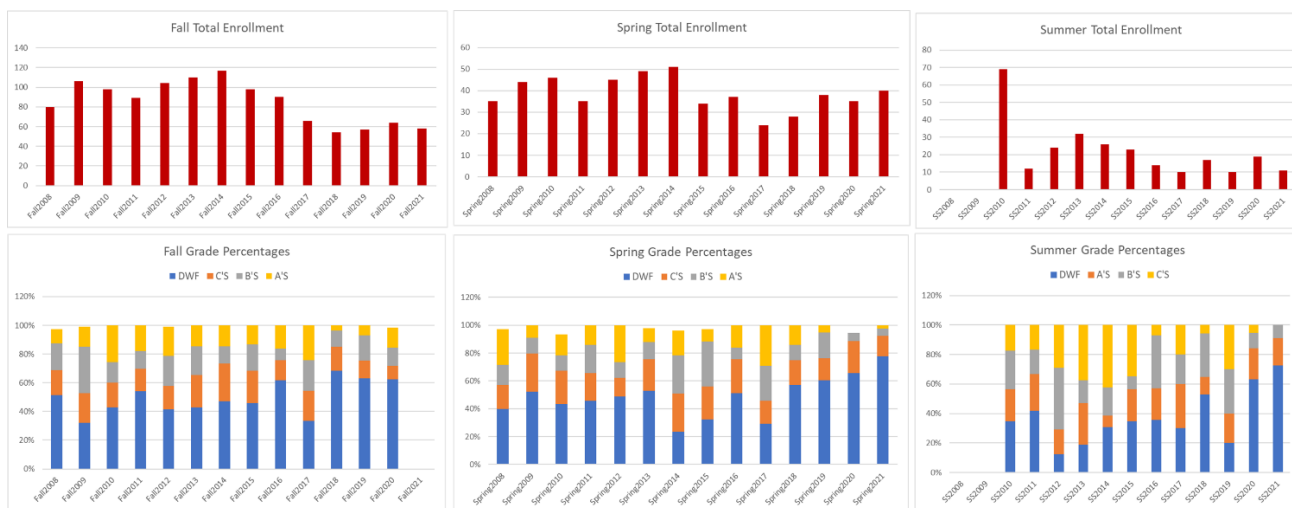
****Note:** Please use this template to provide the responses to the prompts above.**

Indiana University Northwest
Department of Chemistry/Biochemistry/Physics/Astronomy
New Course Proposal
CHEM-C103 (5 Cr, Lecture + Lab)
(Passed 9/24)

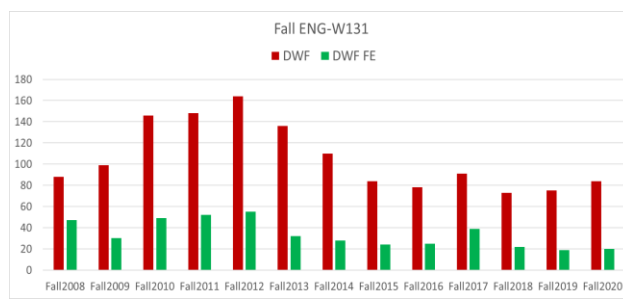
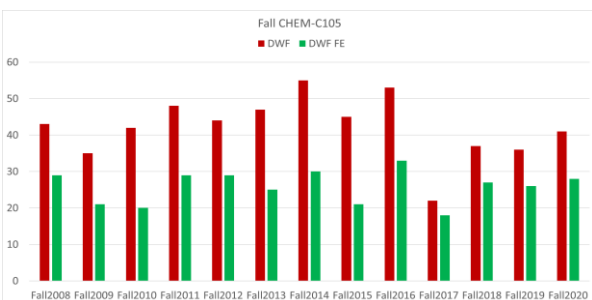
I) Overview

The first semester course in General Chemistry is CHEM-C105. Together with CHEM-C106 and associated labs, the two courses constitute first year general chemistry. Several majors in the sciences require the C105/C106 sequence. These majors include Chemistry BS/BA, Biochemistry BS/BA, Biology BS/BA, Geoscience BS, Neuroscience BS/BA and Psychology BS. C105 plays an important and pivotal role in the success of the students in these majors. Successful students in general chemistry enroll in higher level courses in the sciences. Unsuccessful students in general chemistry tend to drop out.

C105 is a difficult course for students. The charts below show the enrollment and grade percentages for C105. The charts span every semester (Fall, Spring, Summer) from 2008 to present. Aside from enrollment trends (which mirror the overall campus enrollment), one should note the high DWF (students receiving a grade below a C- including a W) percentages “rate”. The high DWF percentages across 14 years indicates that C105 has always been a challenging course.



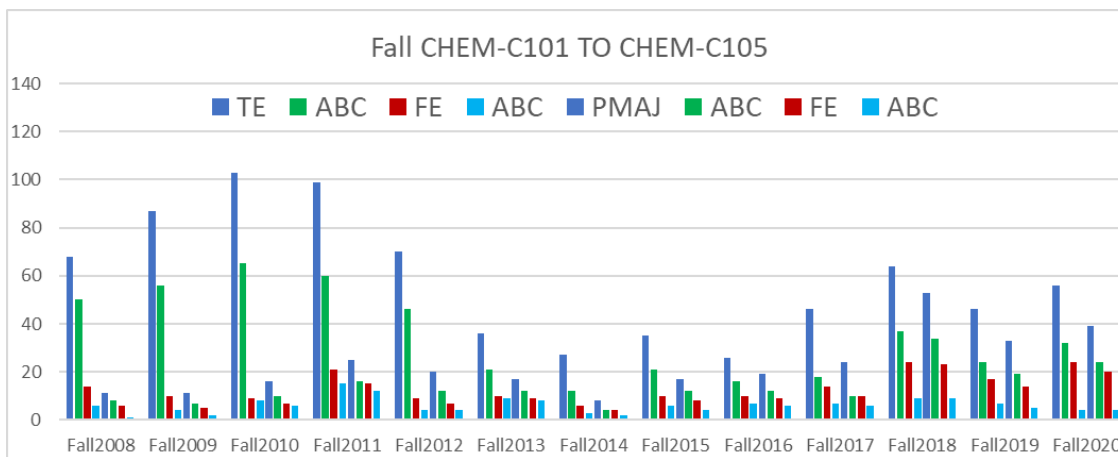
What happens to the students that get a DWF in C105? Consider the chart below on the left. This chart has the number of DWF students in Fall C105 (maroon) and the number of those DWF students that subsequently enrolled at IUN the following Fall (green). For example, in Fall of 2014, 55 students received a grade of D, F or W. Of those 55 only 30 re-enrolled at IUN. This means that 25 students in that group did not come back to IUN the following Fall. Presumably these students were lost to IUN. While this result may paint a dark picture of student attrition from C105, attrition is much higher from other freshmen courses. For example, the same information is shown on the chart on the right for ENG-W131.



The attrition for ENG-W131 is historically much higher than C105. This distinction for C105 is worth keeping in mind.

The DWF percentage is too large in C105 – our objective is to lower this DWF “rate” without compromising the integrity of the course. How can this objective be accomplished? Currently, aside from the MATH-M117 prerequisite, the department has two ways of identifying student preparedness for C105: (1) a chemistry placement exam and (2) CHEM-C101/CHEM-C121. Students who do not pass the placement exam take C101 in preparation for C105. How well does C101 prepare students for C105?

C101 is an example of a “funnel” course: Science students taking C101 are expected to “funnel” into C105. An effective funnel course will have a high percentage of its students funnel to the next course **and** succeed in it. Does C101 fulfil these characteristics of a successful funnel course? The chart below examines this question by looking at the number of students taking C101 in the Fall who then take C105. The data covers the past 14 years. Each Fall term consists of eight bars. These bars should be viewed as two groups of four (dark blue, green, maroon and cyan). The group of four to the **left** in each Fall term are for all students in the C101 class, whereas the group of four on the **right** is only those students in the C101 class whose major was in the sciences (see above).



As an example, consider the group of 8 bars for Fall 2011. The group of four bars on the left have the following information for the Fall 2011 C101 cohort of students,

- Dark Blue bar: total number Fall 2011 C101 of students in the class (99)
- Green bar: number of Fall 2011 C101 students who received a grade of C- or higher (60)
- Maroon bar: number of Fall 2011 C101 students who subsequently enrolled in C105 (21)

- Cyan bar: the number of Fall 2011 C101 students who received a grade of C- or higher in C105 (15)

The group of four bars on the right is the same as left group except only for the science majors – these are the students that of particular interest to science departments.

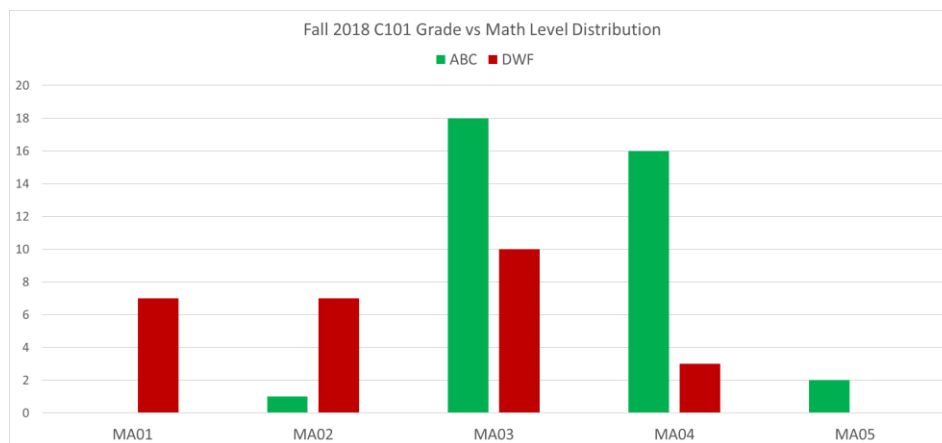
There are several immediate takeaways from this chart:

1. Historically, C101 has a high DWF rate. This is true overall as well as for the science cohort of the course.
2. C101 historically serves a much larger population of students than just those students majoring in the sciences.
3. The percentage of science students in C101 who funnel into C105 and succeed in it is very low – sometimes well below 20%.

C101 thus falls short of as an effective funnel course to C105.

Why is C101 not an effective funnel course to C105? One reason is that C101 has a much larger population of students than just science majors. This has always been the case for C101 and it leads to a curriculum that does not necessarily focus on developing the skills students need to succeed in C105. Another reason is the prerequisite. The prerequisite for C101 is currently listed as M007. This course (M007 does not exist today, MATH-A101 should be in listed instead). Thus, in effect, there is no math requirement for C101. Below is a math level chart of students in C101 during Fall 2018. This chart has the distribution of students according to their math level at or before the time they took this (Fall2018) C101 class. The green bars represent the students who succeeded in this C101 class, whereas the red bars represent the number of students that received a grade of D, W or F. There are five math levels at IUN:

- MA01: Below college level remedial math
- MA02: College level remedial math
- MA03: Ready for MATH-M117 – college algebra
- MA04: Ready for precalculus and trigonometry (MATH-M125, MATH-M126, MATH-M127)
- MA05: Ready for calculus (MATH-M215, MATH-M216, MATH-M311)



This chart clearly indicates that success in C101 is directly related to a student's math preparedness. The 14 or so students with a math level of MA01 or MA02 level were almost guaranteed to be unsuccessful in the class. This is not a surprise. The surprise is that we allowed these MA01 and MA02 students take C101 to begin with.

In summary, C101 is not an effective funnel course for C105 because,

1. the curriculum is aimed at a wide range of students -many do not need to take C105,
2. the curriculum does not focus on preparing students for success in C105,
3. it does not have adequate prerequisites – especially math.

It should also be pointed out that C101 is a lecture class. Students who take C101 are not required to take the associated lab course CHEM-C121. As a result, the lab typically has many fewer students than the lecture. Chemistry is inherently a laboratory discipline. The laboratory section can only help students learn the scientific principles that are at the heart of chemistry.

Given the importance of math in the success of chemistry students in C101 (and therefore its effectiveness as a funnel course to C105) one might be tempted to raise the math prerequisites in C101 e.g., minimum MA03 (MATH-M117) level for C101 but otherwise leave the current C101/C105 funnel structure intact. For at least a few reasons modest change is not possible or desirable,

- Many IU campuses offer C101 as an IUOCC online class. If MATH-M117 is added as a prerequisite, the change would have to go through remonstrance in the IU system. All IU campuses would need to approve. If approved the course would be taken off IUOCC because IUOCC classes cannot have prerequisites. Therefore, other campuses are not likely to approve.
- The ability of students to solve scientific problems is crucial to success in chemistry. A good math background is necessary but not sufficient to gain this ability. This is especially true for students who do not arrive at IUN with a strong math/science background. The curriculum in C101 is not focused on problem solving.
- Chemistry lab is not required for C101.

It is for these basic reasons that we propose a new course CHEM-C103 that will address all of these deficiencies in the curricular structure of C101 as a funnel course for C105.

II) Proposal to CHEM-C103 to our schedule of classes

We propose adding CHEM-C103 to the schedule of classes at IU Northwest. The IU system already has CHEM-C103. It is 5 a credit course that includes both lecture and lab components. It is taught at Bloomington with the following course description,

CHEM-C103 Taken in preparation for C117 by students with deficiencies in chemistry. Content includes application of measurement and chemical formula/equation conversions; modern view of the atom; and solution processes that relate to chemical reaction. Emphasis of lectures, labs, and discussion sections will be problem-solving strategies. Credit given for only one of C101-C121 or C103.

C103 will not replace C101. We will continue to offer C101 for students not majoring in science. C101

can continue to be taught as an IUOCC class – ensuring the class of decent enrollment. C103 will replace C101 as the funnel course to C105.

Characteristics of C103 as a funnel course to C105

A. Who will take C103 or C105? Fall Freshmen science majors will place into one of three courses – depending upon their math level and the chemistry placement exam,

- Students at a math level of MA01 or MA02 will need to take MATH-M117 before taking C103
- Students with a minimum MA03 (or MATH_M117) math level but not passing the chemistry placement exam will take C103. MATH-M 117 will need to be taken as a corequisite.
- Students passing C103 with a grade C- or better will then take C105.
- Students with a minimum prerequisite of MATH-M117 and passing the chemistry placement exam will take C105/C125.

B. Curricular characteristics of C103,

- C103 is intended for students with a science major,
- Focus of the course is on preparing students for C105/C125,
 - a. Developing math skills,
 - b. Scientific problem solving,
 - c. Developing laboratory skills.
- Possibility: C103 lecture and lab may both take place in in the lab room.

C. Academic Calendar for C103

- C103 will be offered every Fall beginning with Fall 2022.
- C103 may be offered in summer – possibly as an eight week class.

D. Assessment of C103

A funnel course analysis will be conducted every year. This analysis will be similar to the one presented in this proposal. However, in this case the analysis will look at C103 students funneling into C105. The first such analysis will be possible at the conclusion of the Spring 2023 term.

E. Other

- C103 will likely need to be approved by the Curriculum Committee.
- C103 should be a Group 3A course.
- If approved by the department, C103 will be significant part of our department assessment over the next 3-4 years.
- If approved by the department we will need to meet with biology, geosciences and psychology to present the new course.