ASSESSMENT RESULTS FOR QCC EDUCATIONAL OUTCOME #2 – STEM Academy Spring 2014 (CHEMISTRY, BIOLOGY, MATH)

GEN ED #2 - USE ANALYTICAL REASONING TO IDENTIFY ISSUES OR PROBLEMS AND EVALUATE EVIDENCE IN ORDER TO MAKE INFORMED DECISIONS	
QCC Outcomes: a. Distinguish the multistep problem and propose solution or answer. b. Differentiate between different ways to solve the problem and come up with multiple strategies to solve a problem. c. Evaluate the quality of evidence	
GEN ED OUTCOME ADDRESSED IN ASSESSMENT:	• Develop logical and consistent plan to problem solving, recognize the consequences of solution choice and be able to articulate the reasoning behind a particular choice of answers.

1. **EVIDENCE/MEASURABLE DATA**
   a. **Describe artifacts reviewed**

A1. Question #28 on Exam # 4 in **Genetics Lecture BI-356**. It is a multiple step problem and requires knowledge of several techniques learnt in class to answer the question. Student must develop a strategy to answer the problem correctly. Student must use analytical reasoning and evaluate their evidence at each step to move forward in a problem.

A2. In **MA-441 D135** a three-part assignment was given in separate stages. Please see the attached documents. Part 2 was given after Part 1 was collected. Part 3 was given after Part 2 was collected. In Part 1, students were asked for a strategy to estimate sin(0.5585) without technology; in Part 2 they were asked to implement their strategy; in Part 3 they were asked to read about and use a 3^{rd} degree Taylor polynomial to estimate sin(0.5585) and compare the results to those found in Part 2.
Essentially, in parts 1 and 2, students were asked to solve and discuss a HW problem based on material, linearization, which was covered a few weeks earlier in the course. Part 3 introduced concepts not previously discussed, asked for an implementation of these concepts and comparison, based on numerical and graphical evidence, with previous results.

A3. In **CH-151 X13B** two in class exams were given to the students. The exams were in short answer format.

   b. **Number of artifacts N = 16 (BI 356); 24 (CH-151); 24 (10 students) MAD-441**
      Total 64
   c. Number of course sections: BI356 PNET, MAD-441 D135, CH-151 X13B

2. RUBRIC

Excellent Skill Level (4)	Above Average Skill Level(3)	Average Skill Level(2)	Below Average Skill Level(1)	No Skill Level (F)
Can solve multi step problem, can choose an efficient method and explain the process used to derive the answer with complete accuracy.	Choose the appropriate formula to solve the problem correctly. Can explain the process used to derive the answer with almost accuracy.	Choose the appropriate formula to solve the problem but does not always reach correct solution. Can explain the process used to solve the problem with some accuracy.	Cannot solve the problem correctly. Has difficulty explaining the process used to answer the question.	Cannot solve the problem and cannot explain anything done in the process.

3. RESULTS

MA 441	**Excellent Skill Level (4)**	**Above Average Skill Level(3)**	**Average Skill Level(2)**	**Below Average Skill Level(1)**	**No Skill Level (F)**
	Can solve multi step problem, can choose an efficient method and explain the process used to derive the answer with complete accuracy.	Choose the appropriate formula to solve the problem correctly. Can explain the process used to derive the answer with almost accuracy.	Choose the appropriate formula to solve the problem but does not always reach correct solution. Can explain the process used to solve the problem with some accuracy.	Cannot solve the problem correctly. Has difficulty explaining the process used to answer the question.	Cannot solve the problem and cannot explain anything done in the process.
Itemized tasks					
Identified related procedures	**3/10**	**5/10**	**1/10**	**0/10**	**1/10**
Justified appropriateness of said procedures	**0/10**	**0/10**	**1/10**	**8/10**	**1/10**
Outlined solution steps	**2/10**	**5/10**	**1/10**	**1/10**	**1/10**
Solved the problem	**2/10**	**5/10**	**1/10**	**0/10**	**2/10**
Solved problem with alternate (instructor suggested) method	**4/10**	**1/10**	**0/10**	**1/10**	**4/10**
Made comparison	**1/10**	**0/10**	**1/10**	**3/10**	**5/10**
Provided evidence for comparison	**1/10**	**0/10**	**0/10**	**2/10**	**7/10**

CH-151	**Excellent Skill Level (4)**	**Above Average Skill Level(3)**	**Average Skill Level(2)**	**Below Average Skill Level(1)**	**No Skill Level (F)**
(A) Exam #2 (03/03) Phosphorus reacts with iodine as shown in the chemical reaction below. What is the **percent yield** of the reaction if 28.2 g PI_3 is obtained from the reaction of 48.0 g of I_2 with excess phosphorus? $2P(s) + 3I_2(s) \rightarrow 2PI_3(s)$	**5 students (20.8%)**	**2 students (8.30%)**	**0 students (0.00%)**	**6 students (25.0%)**	**11 students (45.8%)**
(B) Exam #3 (03/24) How many **liters of chlorine gas** at 25°C and 0.950 atm can be produced by the reaction of 12.0 g of MnO_2 with excess HCl (aq) according to the following chemical equation? $MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2$ **(C)** $(aq) + 2H_2O(l) + Cl_2(g)$	**16 students (66.7%)**	**0 students (0.00%)**	**4 students (16.7%)**	**0 students (0.00%)**	**4 students (16.7%)**

BI-356 **Results, as graded from the questions** **# of students**	**Excellent (15 points)**	**Good (12 points)**	**Minimally Acceptable (9 points)**	**Poor (5 point)**	**Insufficient evidence (0 points)**
	7	**4**	**3**	**1**	**1**

4. STATUS – degree to which students have met the General Education Outcome (use a scale)

BI 356

STATUS – Degree to which students have met Gen. Ed. Outcome	**Excellent (15 points)**	**Good (12 points)**	**Minimally Acceptable (9 points)**	**Poor (5 point)**	**Insufficient evidence (0 points)**
	44%	**25%**	**19%**	**6%**	**6%**

Total 88% of the class met the Gen Ed Objective set forth by the exam question. 12% didn't meet the standard.

MA-441

STATUS – degree to which students have met Gen. Ed. Outcome **#of students per category; total 10 students**	**Excellent (4 points)**	**Good (3 points)**	**Minimally Acceptable (2 points)**	**Poor (1 point)**	**Insufficient evidence (0 points)**
	10%	**20%**	**30%**	**20%**	**20%**

CH-151

(A) Exam #2 (03/03)

Based on the results, 20.8% of the students completely understood how to solve the multistep problem with explanation, and thus have met the Gen. Ed. Outcome.

STATUS – degree to which students have met Gen. Ed. Outcome	Excellent 100-80% of students	Good 79-60% of students	Minimally Acceptable 59-40% of students	Poor 39-20% of students	Insufficient evidence 19-0% of students
CHECK ONE				X	

(B)Exam #3 (03/24)

Based on the results, 66.7% of the students completely understood how to solve the multistep problem with explanation, and thus have met the Gen. Ed. outcome.

STATUS – degree to which students have met Gen. Ed. Outcome	Excellent 100-80% of students	Good 79-60% of students	Minimally Acceptable 59-40% of students	Poor 39-20% of students	Insufficient evidence 19-0% of students
CHECK ONE		X			

5. RATIONALE - briefly explain the rating above

BI 356

There was a three part question a) b) and c). Each part is weighed equally 5 points each. If everything is answered perfectly a student can earn 15 points or Excellent. If one point is lost in each section the rating is still good at 12 points. However if student earns 3 points in each section then minimally acceptable at 9 points however anything less than that is poor understanding of the concepts and therefore not acceptable.

CH-151

A question on determining percent yield was asked during the second exam (03/03). Fifty percent of the students developed no skills and were not able to solve the multi-step problem. Almost half of the students (45.8%) were also not able to complete the initial calculations of converting mass to moles. Only 20.8% of the students were able to fully solve the muti-step problem in this category.

On the third exam (03/24), students had better mastered the skill of converting mass to moles and incorporating this knowledge in accurately solving multi-step problems. 83.3% of the students were able to obtain an above average skill level at converting mass to moles (compared to 45.8% on 03/03) and 66.7% of the students were able to fully solve the muti-step problem (compared to 20.8% on 03/03).

MA-441

1/10 under "Excellent" means the work of one student received a rating of 4. This was based on students' scores on the itemized tasks.

In Part 1, students were mostly correct in identifying linearization as the tool to use and listing steps for obtaining the approximation. In general, students were not successful in explaining why linearization is appropriate for this problem.

In Part 2, students had some success but not as much as might be expected given that material was covered in class previously.

In Part 3, students had some success in finding the 3rd degree Taylor polynomial and using it to estimate sin(0.5585). However, comparisons of estimates through the polynomial to estimates through the tangent line were lacking.

I would assign an overall score of around 2.5 for the entire group.

6. **DISCUSSION OF THIS PROCESS: What did you learn and what would you recommend?**

BI 356

Students had a hard time mastering this problem because it required students to have the knowledge of 7 different techniques learnt in class and use it to complete one problem. Those students who have done these techniques hands on in a lab have better time understanding it compared to students who learn these concepts in lecture alone. As an instructor, I have recently incorporated an undergraduate research experience in this class therefore students will get a chance to complete a hands on lab to get a better understanding of these concepts.

MA-441

Overall, students did meet the objective "Use quantitative skills and mathematical reasoning to solve problems with the aid of the tools and techniques learned in calculus" but did not do so well with developing and articulating a plan as described in the learning outcome on page 2, communicating results or evaluating evidence. It would be inappropriate to draw general conclusions based on this single assessment. More so, developing and articulating a plan is more common in experimental science than in mathematics. However, I think the results reflect the traditional coverage of material, which tends to focus more on procedural knowledge and less so on communication and conceptual understanding. Frequent and small writing assignments may improve students' ability to communicate their results.

CH-151

At the beginning of the semester, students were taught how to perform mass to moles conversions. They were later taught how to use this knowledge to further determine 1) percent yield of a chemical reaction and 2) the theoretical volume of a gaseous product in a chemical reaction.

A question on determining percent yield was asked during the second exam (03/03). Fifty percent of the students developed no skills and were not able to solve the multi-step problem. Almost half of the

students (45.8%) were also not able to complete the initial calculations of converting mass to moles. Only 20.8% of the students were able to fully solve the muti-step problem in this category.

On the third exam (03/24), students had better mastered the skill of converting mass to moles and incorporating this knowledge in accurately solving multi-step problems. 83.3% of the students were able to obtain an above average skill level at converting mass to moles (compared to 45.8% on 03/03) and 66.7% of the students were able to fully solve the muti-step problem (compared to 20.8% on 03/03).

After the second exam (03/03) students were given a sheet of additional homework problems on mass to moles conversions and multistep problems that involved these conversions. One question from this sheet was assigned to each student. During one class period before their third exam, each student presented their assign question to the class. It was assumed that the improvement in students' understanding of the material was as a result of the additional practice which was made mandatory and public. This strategy will be further tested in future semesters.

ASSESSMENT RESULTS FOR QCC EDUCATIONAL OUTCOME #2
STEM Academy, Spring 2014 (Engineering Technology)

GEN ED #2 - USE ANALYTICAL REASONING TO IDENTIFY ISSUES OR PROBLEMS AND EVALUATE EVIDENCE IN ORDER TO MAKE INFORMED DECISIONS	
QCC Outcomes: **d. Distinguish the problem or question from a proposed solution or answer.** **e. Differentiate between facts, assumptions, and conclusions in the formulation of a proposed solution or answer compare the way questions, issues or problems are formulated.** **f. Differentiate between the perspectives of various field of study and describe and compare the way questions, issues or problems are formulated.** **g. Evaluate the quality of evidence from the artifacts.**	
GEN ED OUTCOME ADDRESSED IN ASSESSMENT:	**QCC EDUCATIONAL OUTCOME #2**
EVIDENCE/ MEASURABLE DATA • **Describe artifacts reviewed** • **No. of artifacts** • **No. of sections**	**Course project assignment from multiple class sections** **50 Artifacts from STEM Academy** **5 class sections**
RUBRIC	**See attached documentation for Rubrics** **ET 420 Computer Project Laboratory** In ET 420, faculty evaluated exercises where students: 1) Read a case study of leaking waste containers, and then they discuss it in class. 2) Read a case study of leaking microwave ovens and answer questions regarding the study. **ET 501 Computer Applications** In ET 501, faculty evaluated exercises where students: 1) Discuss and analyze a selected technology world scenario issue. 2) Discuss a current topic related to interaction between the Web and social issues. 3) Include a discussion on ethics and diversity as part of a Lab term report. 4) Prepare a table plus a report on ethical issues. 5) Include a topical list of responsibilities as part of a final report. 6) Discuss, research, and present ethics situations in groups as part of the Final Project. 7) Report on articles on responsibility in a section of the final report. Read an article about ethical issue and write a report about it. 8) Search for information on the Internet, download graphics, and text.
RESULTS	The results for performance indicator in the applicable courses were obtained by reviewing the students' performance on the selected exercises, which are indicated on the summary evaluation forms, and the quality point averages are as follows: ET 420: Avg = 3.25 (Fa 13) ET 420: Avg = 2.71 (Sp 13) ET 501: Avg = 3.04 (Fa 13) ET 501: Avg = 3.14 (Sp 13) A review of the assessment rubrics and student work indicates that students can describe the interrelationships between technology, professional responsibilities, and contemporary society. (Fa 13 and Sp 13). In ET 420, faculty noted that one student never returned after the storm (Sandy). One received a

	grade of INC. The case study of leaking microwave ovens was presented as a class discussion. All students present participated and offered meaningful comments (Fa 13). In the Spring of 2013, ET 420 faculty noted students who handed in the assignment all provided thoughtful responses indicating an understanding of ethical conduct and responsibilities. In ET 501 faculty noted that several students cannot write in prose, their report was in outline form. Spring of 2013, one ET 501 faculty member noted that many students have difficulty writing in prose. They tend to put thoughts and ideas in outline form. Faculty members have continued to developed new exercises, which can be used as a Final Project in ET 501. The exercises present students with a choice of scenarios, and ask the students to identify the issues, find information to address the issues, and provide possible approaches to solving the issues in the scenario. The students use the internet and library databases to support their topics, with proper citations, and they give team presentations to the class. The various scenarios considered include the following: 1) Lithium, which is used in Lithium Ion Batteries, as a national asset in Bolivia - Financial considerations and contract negotiations. 2) Sludge, waste from the Tennessee Valley Authority's coal-burning Kingston Fossil Plant, spill out of an earth dam - Cleanup and health issues. 3) Large increase in the number of major computers at the Stanford Linear Accelerator Center – Excessive amount of money spent to build the power and cooling systems. 4) Simulation of a cyber-attack aimed at paralyzing the nation's power grids, its communications systems or its financial networks – Real life attack on computers at Google Inc.				
STATUS – degree to which students have met Gen. Ed. Outcome CHECK ONE	**Excellent (4 points)**	**Good (3 points)**	**Minimally Acceptable (2 points)**	**Poor (1 point)**	**Insufficient evidence (0 points)**
	See attached data				
RATIONALE (Briefly explain rating above)	A faculty member has developed a new exercise based on cyber terrorism along with accompanying rubrics to be used for the assessment of Student Outcomes in ET 501.				
DISCUSSION OF THIS PROCESS: What did you learn and what would you recommend?	Faculty in courses such as ET 420 and ET 501will continue to facilitate exercises which provide students with the opportunity to describe the interrelationships between technology, professional responsibilities, and contemporary society. ET 501 instructors have modified exercises to encourage students to provide more technical content in their assignments.				