

# General Education Learning Goals

## 4. Quantitative and Scientific Reasoning

# Introduction

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- ▶ All EOSC students take courses in Natural Sciences, Physical Sciences, and Mathematics/Statistics
- ▶ For the assessment, the Division decided to include courses that are taken by most EOSC students, and those that apply mathematics
  - ▶ Natural Science: Biology – Fall even years
  - ▶ Physical Science: Chemistry – Fall odd years
  - ▶ Online Natural Science: Environmental Science – Fall odd years



# Methods

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- ▶ Pull student results from existing assessments / assignments
- ▶ Add specific assignments if needed (e.g., graphing) and evaluate student performance
- ▶ Compare the number of student attempts with number of student successes, and present as a percentage for each assessment (question or assignment; can also report the proportion of students that earned a minimum grade on an assignment)
  - ▶ Example
    - ▶ 10 questions about the scientific method attempted by 16 students = 160 attempts
      - What proportion of those students obtained the correct answer?
    - ▶ Number “Correct” on assignments defined by those students that scored at least 60% on that assignment



# Results of Fall 2019 Assessment

Chem 1315 and Biol 2103

## 4.1. Describe and delineate the components of the scientific method

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### ▶ Environmental Science

		Percentage Correct 2019	Percentage Correct 2017
Attempt	61	90.2 %	90.3 %
Correct	55		

### ▶ Chemistry

		Percentage Correct 2019	Percentage Correct 2017
Attempt	64	91.7%	83.8 %
Correct	59		



## 4.1, cont'd

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### ▶ 4.1 All sciences combined

		<b>Percentage Correct 2019</b>	<b>Percentage Correct 2017</b>
Attempt	125	91.2%	84.5 %
Correct	114		



## 4.2. Apply scientific and mathematical methods to solving problems

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- ▶ Environmental Science
- ▶ Applying scientific methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	26	80.8 %	73 %
Correct	21		
(score on FE)	90.6%	85.7%	

- ▶ Applying mathematical methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	34	88.2 %	92.9 %
Correct	30		

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## 4.2, cont'd

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- ▶ Chemistry
- ▶ Applying scientific methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	110	78.2%	74.3 %
Correct	86		

- ▶ Applying mathematical methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	96	73%	60.4%
Correct	70		





## 4.2, cont'd

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- ▶ 4.2 All sciences combined
- ▶ Applying scientific methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	136	74.1 %	74.1 %
Correct	107		

- ▶ Applying mathematical methods

		Percentage Correct 2019	Percentage Correct 2017
Attempt	130	76.9 %	65.4 %
Correct	100		



## 4.3. Collect, graph, and summarize data and make relevant observations and statements of results and formulate questions

- ▶ Environmental Science
- ▶ Collect/summarize data

		Percentage Correct 2019	Percentage Correct 2017
Attempt	14	100 %	100 %
Correct	14		

- ▶ Graph data

		Percentage Correct 2019	Percentage Correct 2017
Attempt	14	85.7 %	89.4 %
Correct	12		



## 4.3, cont'd

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### ► Interpret graph / table

		Percentage Correct 2019	Percentage Correct 2017
Attempt	85	69.4 %	82.8 %
Correct	59		

$53 / 71 = 74.6\%$  interpreting graphs in quizzes

$6 / 14 = 42.9\%$  interpreting their own graph



## 4.3, cont'd

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- ▶ Chemistry
- ▶ Graph data

		Percentage Correct 2019	Percentage Correct 2017
Attempt	160	81.2%	79.5 %
Correct	130		

- ▶ Interpret graph

		Percentage Correct 2019	Percentage Correct 2017
Attempt	66	72.2 %	69.4%
Correct	34		

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## 4.3, cont'd

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- ▶ 4.3 All sciences combined
- ▶ Graphing data

		Percentage Correct 2019	Percentage Correct 2017
Attempt	72	94.4 %	82.4 %
Correct	68		

- ▶ Interpreting graphs / tables

		Percentage Correct 2017	Percentage Correct 2015
Attempt	151	61.6 %	78.4 %
Correct	93		

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## 4.4. Evaluate evidence and determine if conclusions based upon data are valid and reliable

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### ▶ Environmental Science

		Percentage Correct 2019	Percentage Correct 2017
Attempt	19	89.5 %	80 %
Correct ( ≥ 70%)	17		

### ▶ Chemistry

		Percentage Correct 2019	Percentage Correct 2017
Attempt	42	81 %	75.7 %
Correct	34		

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## 4.4, cont'd

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### ▶ 4.4 All Sciences combined

		<b>Percentage Correct 2019</b>	<b>Percentage Correct 2017</b>
Attempt	61	83.6 %	77.8 %
Correct	51		



## 4.5. Distinguish sound scientific works from non-scientific works

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### ▶ Environmental Science

		Percentage Correct 2019	Percentage Correct 2017
Attempt	17	76.5 %	76.4 %
Correct	13		



### ▶ Chemistry

		Percentage Correct 2019	Percentage Correct 2017
Attempt	64	75%	73.0%
Correct	48		





## 4.5, cont'd

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### ▶ 4.5 All sciences combined

		Percentage Correct 2019	Percentage Correct 2017
Attempt	81	75.3 %	74.1 %
Correct	61		



# Summary

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- ▶ **91.2 %** of students could describe and delineate the components of the scientific method (4.1)
- ▶ **75.5 %** of students could apply scientific and mathematical methods to solve problems (4.2)
- ▶ **78.0 %** of students could collect, graph, and summarize data and make relevant observations and statements of results and formulate questions (4.3)
- ▶ **83.6 %** of students could evaluate evidence and determine if conclusions based upon data are valid and reliable (4.4)
- ▶ **75.3 %** of students could distinguish sound scientific works from non-scientific works (4.5)



# Conclusions

## Environmental Sciences

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- ▶ Students achieved all learning outcomes with at least 69.4 % proficiency (76.4 % in 2017)
- ▶ Weaknesses from 2019
  - ▶ Interpreting results in graphical or tabular format
- ▶ Closing the loop from 2017
  - ▶ Increase exercises that require math to solve problems resulted in greater ability to use math
  - ▶ Increase tutorials on how to graph improved graphing ability
- ▶ 2019 findings
  - ▶ Students showed greater proficiency in using math and in graphing
  - ▶ Still struggle with graph interpretation
    - ▶ Need to add tutorial on how to interpret a graph



# Conclusions

## Chemistry

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- ▶ Students achieved all learning outcomes with at least 70 % proficiency
- ▶ Improvement
  - ▶ Specific chemical concepts
  - ▶ Work in groups to learn basic algebra equations and problem solving
  - ▶ Learn new techniques to interpret results in graphical or tabular format
- ▶ Closing the loop
  - ▶ Increase group discussion to low-scoring concepts
  - ▶ Increase classroom exercises early on that require math to solve problems
  - ▶ Provide more time for students to interpret graphed data on their own



Questions? Suggestions?