	Assurance of Student Learning					
	2019-2020					
Ogden	School of Engineering and Applied Sciences					
	Mechanical Engineering, 543					
	Program Coordinator: Chris Byrne					

Use this page to	list learning outcomes, measurements, and summarize results for your program. Detailed information must be completed in th	e subsequent p	oages.					
Student Learnin	ng Outcome 1: Ability to identify, formulate, and solve complex engineering problems by applying principles	of engineerin	ng, science,					
and mathemat	ics.							
Instrument 1	Apply rubric to solution examples from selected course exams							
Instrument 2	Exit murrare of ME Sonione							
Instrument 2	Exit surveys of ME Seniors							
Instrument 3	Average grades in relevant courses							
Based on your r	esults, circle or highlight whether the program met the goal Student Learning Outcome 1.							
Duseu on your i	esuits, en été or mement «néther the program net the gour student Deurning Outcome 1.	Met	Not Met					
Student Learnin	ng Outcome 2: Ability to apply engineering design to produce solutions that meet specified needs with conside	ration of pul	olic health,					
safety, and we	Ifare, as well as global, cultural, social, environmental, and economic factors.							
Instrument 1	Apply Rubric to Design Reports from selected courses							
Instrument 2	Exit surveys of ME Seniors							
Instrument 2	Exit surveys of Mile Semons							
Instrument 3	Average grades in relevant courses							
Based on your r	esults, circle or highlight whether the program met the goal Student Learning Outcome 2.	Met	Not Met					
Student Learnin	ng Outcome 3: Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use	e engineerin;	g judgment					
to draw conclu	usions							
Instrument 1	Apply Rubrics to Artifacts (Lab reports in multiple ME courses)							
Instrument 2	Exit surveys of ME Seniors							
Instrument 3	Average grades in relevant courses							
Based on your r	esults, circle or highlight whether the program met the goal Student Learning Outcome 3.	Met	Not Met					
		Mict						
	ary (Briefly summarize the action and follow up items from your detailed responses on subsequent pages.)	<u> </u>						
	nt of student performance under Student Learning Outcomes 1, 2 and 3 is acceptable according to rubric-ba							
	tion, graduates are completing relevant courses with good grades, and students have positive perceptions of		-					
assessment indicates the curriculum for Mechanical Engineering prepares graduates with the abilities and skills needed to be successful practicing								

engineers. The WKU Mechanical Engineering Program will continue to prepare graduates with the same Student Learning Outcome activities and measures.

	Student Learning Outcome 1					
Student Learning Outcome		Graduates of the mechanical engineering program should show an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics				
Measurement Instrument 1	A scoring rubric specifically structured to directly assess the attributes stated in the outcome is applied to exam questions in the engineering science courses EM303, ME220, ME325, which capture key aspects of both the mechanical systems and thermo-fluid systems which mechanical engineering students' study. The rubric assesses 4 main attributes of problem solving. The selected courses have math and physics pre-requisites and utilize those specific skills in the solution of engineering problems. The mechanical systems component is captured by EM303, the thermo-fluids systems component is captured by both ME220 and ME325. The ME325 course is usually taken in the senior year and students have by then developed strong analytical skills and have experience applying math and science concepts in earlier design course projects and in earlier engineering science courses.					
Criteria for Student Success	Numerical results from applying the rubric to student work should reach a value of 3.0 on a 4.0 scale for senior level work. Scores of sophomore/junior level work may be somewhat lower, which can be used to track student development in the curriculum					
Program Success Target for this	Measurement	Cohort average of 3.0 on a 4.0 scale	Percent of Program Achieving Target	Senior cohort score of 3.13		
Methods	The exam solutions from each student in the course is reviewed separately from course grading. Select questions are identified and the outcome rubric applied to assess achievement. Values from each student are recorded, and a class average is determined. This approach captures every student graduating in the assessment year, and students who are rising to senior status. As such ME325 results give a representation of the graduating cohort for each academic year since it is offered once per year. Over the years the graduating cohorts have been as small as 18, and as large at 48 students.					
Measurement Instrument 2	knowledge of	of ME Seniors. One question on the Senior mathematics, science, and engineering, as ng in their program and their resulting abi	sking ME graduates abo	ut their awareness of this knowledge		
Criteria for Student Success	ME graduates	self-report that they know about the math are capable of performing at a level indication of the second sec	ematics, science, and er	ngineering training they were		
Program Success Target for this	Measurement	Score of 4.0 or higher on a 5.0 scale	Percent of Program Achieving Target	Score of 4.6 on a 5.0 scale		
Methods	Achieving Target Graduating students complete a survey of their academic experience in the program while enrolled in their capstone course. A part of this survey is their assessment of the program learning outcomes. The December 2019 ME graduates self-reported that they knew about the mathematics, science, and engineering training they were receiving and could perform at a level of 4.6/5.0. (May 2020 graduate surveys lost due to online semester end) This self-					

	assessed valu	e is fairly consistent with the other measu	rements for this outcome	2.			
Measurement Instrument 3	Average grad	Average grades in relevant courses. The mechanical engineering curriculum builds upon math and science courses with engineering science courses in both mechanical systems and thermo-fluids systems courses. These courses are					
	•	ndicators of student capabilities in this student learning outcome. At the time of this report the ME program is					
	0	orking with institutional research to create comprehesive reports of student grades to aid in this assessment method.					
		ot yet available.					
Criteria for Student Success	average. This	cal engineering student performance in the s indirect instrument method helps to iden is to track student learning.	•	6 6			
Program Success Target for this	Measurement	Average score of 2.8 out of 4.0	Percent of Program Achieving Target	NA			
Methods	Grades in the math, science and engineering science courses are assembled and reviewed for each graduating mechanical engineering student. This includes the courses ME220, ME240, ME310, ME325, ME330, ME344, EM222, EM303, EM313, Math136, Math137, Math237, Math331, Phys255, Phys265, Chem120 (or Chem116). For						
	the 2020 coho	ort average course grades are not available st this measurement method will indicate	e at time of writing repor	t. However our quick sur			
Based on your results, highlight		gram met the goal Student Learning Outcome		Met	Not Met		
Actions (Describe the decision-ma	king process and	actions for program improvement. The actions sh	nould include a timeline.)				
		der Outcome 1 is acceptable according to					
		es with satisfactory grades in the curricu					
		problems by applying principles of eng					
		pare graduates with the same curriculum		_			
Ū.	eports are mad	le available that measure will be utilized	to finalize this annual as	ssessment. No need for pr	rogrammatic		
adjustments has been found.	ments has been found.						
Follow-Up (Provide your timeline	for follow-up. If	follow-up has occurred, describe how the actions	above have resulted in progr	am improvement.)			
0 0	•	ntinue with program assessment on an an an of student learning outcomes.	nnual basis. The accredit	ting agency, ABET, requir	es continual		
		6					
	ase describe your	assessment plan timetable for this outcome)					

Student Learning Outcome 2						
Student Learning Outcome	Student Learning Outcome Graduates of the mechanical engineering program should show an ability to apply engineering design to produce					
	solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global,					
	cultural, social, environmental, and economic factors.					

Measurement Instrument 1	Program faculty apply a scoring rubric, specifically structured to directly assess the attributes stated in the outcome, to selected student work from junior design (ME300) and senior capstone design (ENGR490 and ENGR491). These courses capture the many aspects of complicated design projects that are undertaken to prepare the students to be capable engineers. The rubric assesses 6 main attributes of design. The selected courses have engineering science pre-requisites and utilize those specific skills in the creation of feasible mechanical designs.						
Criteria for Student Success	work. Scores	Numerical results from applying the rubric to student work should reach a value of 3.2 on a 4.0 scale for senior level vork. Scores of sophomore/junior level work may be somewhat lower, which can be used to track student levelopment in the curriculum					
Program Success Target for this	ccess Target for this MeasurementScore of 3.2 out of 4.0Percent of Program Achieving TargetScore 3.5 out of 4						
Methods	applied to ass approach capt	ports from each team in the course is revi ess achievement. Values from each repor tures every student graduating in the asses 90/ENGR491 results give a representation	t are recorded, and a class average is a sement year, and students who are rising	determined. This ng to senior status. As			
Measurement Instrument 2	Exit surveys of ME Seniors are used as an indirect measure. One question on the Senior Exit Survey is used to assess their to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. They are asked about their awareness of this knowledge focused training in their program and their resulting ability to apply effectively						
Criteria for Student Success	U	s self-report that they know about the engination a level indicated by a numerical scale.	neering design training they were reco	eiving and are capable of			
Program Success Target for this		4.0 on a 5.0 scale	Percent of Program Achieving Target	Score of 4.5 out of 5.0			
Methods	Graduating students complete a survey of their academic experience in the program while enrolled in their capstone course. A part of this survey is their assessment of the program learning outcomes. The December 2019 ME students self-reported that they knew about the engineering design training they were receiving and could perform at a level of 4.5/5.0. (May 2020 graduate surveys lost due to online semester end) This self-assessed value is fairly consistent with the other measurements for this outcome.						
Measurement Instrument 3	engineering so These courses ME program	Average grades in relevant courses. The mechanical engineering curriculum builds upon math, science, and engineering science courses with engineering design courses from sophomore through senior capstone courses. These courses are indicators of student capabilities in this student learning outcome. At the time of this report the ME program is working with institutional research to create comprehesive reports of student grades to aid in this assessment method. That data is not yet available					
Criteria for Student Success	The mechanic average. This	cal engineering student performance in the s indirect instrument method helps to iden is to track student learning and developme	tify areas of weakness in student perfe	_			

Program Success Target for this Measurement		3.0 out of 4.0	Percent of Program Achieving Target	NA	4		
Methods	Grades in the design courses are assembled and reviewed for each graduating mechanical engineering student. This includes the courses ME200, ME300, and the 2 semester capstone sequence ENGR490/ENGR491. For the 2020 cohort average course grades are not available at time of writing report. However our quick survey of grades suggest this measurement method will indicate our success target will be met.						
Based on your results, circle or l	highlight whethe	er the program met the goal Student Learning (Outcome 2.	Met	Not Met		
Actions (Describe the decision-ma	aking process and	l actions planned for program improvement. The	actions should include a timeline.)				
completing relevant courses produce solutions that meet s and economic factors. The W this student learning outcom assessment. No need for pro-	The assessment of student performance under Outcome 2 is acceptable according to rubric-based direct evaluation of student work. Graduates are completing relevant courses with satisfactory grades in the curriculum assuring that ME graduates have the ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. The WKU Mechanical Engineering Program will continue to prepare graduates with the same curriculum content, and monitor this student learning outcome with these measures. Once our grade reports are made available that measure will be utilized to finalize this annual assessment. No need for programmatic adjustments has been found.						
		f follow-up has occurred, describe how the action					
The mechanical engineering faculty will continue with program assessment on an annual basis. The accrediting agency, ABET, requires continual improvement through systematic assessment of student learning outcomes.							
Next Assessment Cycle Plan (Ple	Next Assessment Cycle Plan (Please describe your assessment plan timetable for this outcome)						
	·	This SLO is assessed ann	ually				

	Student Learning Outcome 3						
Student Learning Outcome	Graduates of t	Graduates of the mechanical engineering program should show an ability to develop and conduct appropriate					
	experimentati	on, analyze and interpret data, and use eng	gineering judgment to draw conclusio	ons (ABET SLO 6)			
Measurement Instrument 1	outcome, to see many aspects assess the Des	Program faculty apply scoring rubrics, specifically structured to directly assess the major attributes supporting the outcome, to selected student work from several key mechanical engineering courses. These courses capture the many aspects of engineering experimentation that prepare the students to be effective practitioners. The rubrics assess the Design, Inquirey, Analysis and Application aspects of this outcome. The selected courses have students create artifacts which represent those specific skills.					
Criteria for Student Success	work. Scores	Numerical results from applying the rubric to student work should reach a value of 3.2 on a 4.0 scale for senior level work. Scores of sophomore/junior level work may be somewhat lower, which can be used to track student development in the curriculum.					
Program Success Target for this	Program Success Target for this Measurement 3.2 out of 4.0 Percent of Program Achieving Target Score of 3.32 out of						

Methods Measurement Instrument 2	 The written reports from each student or team in the course is reviewed separately from course grading. The outcome rubric is applied to assess achievement. Values from each report are recorded, and a class average is determined. This approach captures every student graduating in the assessment year, and students who are rising to senior status. As such ME333 results give a representation of the graduating cohort through this capstone experience. The "Experimentation" was assessed by artifacts from ME347, ME332 and ME333, which gave a combined average score of 3.4. The ME347 work was assessed by extensometer reports (3.4/4), ME331 by conservation law reports (3.46/4), and ME333 by convection experiment reports (3.32/4). Exit surveys of ME Seniors are used as an indirect measure. One question on the Senior Exit Survey is used to assess their to ability develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions . They are asked about their awareness of this knowledge focused training in their program and their resulting ability to apply effectively. 				
Criteria for Student Success	-	s self-report that they know about the eng rforming at a level indicated by a numeric		y were receivi	ng and are
Program Success Target for this		4.0 out of 5.0	Percent of Program Achieving Target	Score of 4.2	out of 5.0
Methods	student work the ME curric analyze and i Program will	ent of student performance under Outcome. Graduates are completing relevant course culum assuring that ME graduates have the nterpret data, and use engineering judgme continue to prepare graduates with the sa these measures. No need for programma	ses which produce assessable experim- ne ability to develop and conduct appr ent to draw conclusions. The WKU M me curriculum content, and monitor the	entation artifa opriate experi echanical Eng	cts within mentation, gineering
Measurement Instrument 3	Average grades in relevant courses. The mechanical engineering curriculum builds upon math, science, and engineering science courses and laboratories with engineering experimentation lab courses from sophomore through senior year. The lab courses ME241, ME347, ME332 and ME333 are indicators of student capabilities in this student learning outcome. At the time of this report the ME program is working with institutional research to create comprehesive reports of student grades to aid in this assessment method. That data is not yet available				
Criteria for Student Success	The mechanical engineering student performance in the core laboratory courses are expected to be near a B grade on average. This indirect instrument method helps to identify areas of weakness in student performance and is used on a continual basis to track student learning and development in the program				
Program Success Target for this	Measurement	3.0 out of 4.0	Percent of Program Achieving Target	NA	A
Methods	includes the c available at ti	a lab courses are assembled and reviewed courses ME241, ME347, ME332, and ME ime of writing report. However our quick success target will be met.	E333. For the 2020 cohort average cou	irse grades are	e not
Based on your results, circle or h		r the program met the goal Student Learning (Dutcome 2.	Met	Not Met

Actions (Describe the decision-making process and actions planned for program improvement. The actions should include a timeline.)

The assessment of student performance under Outcome 3 is acceptable according to rubric-based direct evaluation of student work. Graduates are completing relevant courses with satisfactory grades in the curriculum assuring that ME graduates have the ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. The WKU Mechanical Engineering Program will continue to prepare graduates with the same curriculum content, and monitor this student learning outcome with these measures. Once our grade reports are made available that measure will be utilized to finalize this annual assessment. No need for programmatic adjustments has been found.

Follow-Up (Provide your timeline for follow-up. If follow-up has occurred, describe how the actions above have resulted in program improvement.)

The mechanical engineering faculty will continue with program assessment on an annual basis. The accrediting agency, ABET, requires continual improvement through systematic assessment of student learning outcomes.

Next Assessment Cycle Plan (Please describe your assessment plan timetable for this outcome)

This SLO is assessed annually

Student Learning Outcome 1: Upon graduation, our students have the ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

	Capstone	Milestones		Benchmark
	4	3	2	1
Calculation	Calculations attempted are	Calculations attempted are	Calculations attempted are	Calculations are attempted but
(Quantitative Literacy VALUE	essentially all successful and	essentially all successful and	either unsuccessful or	are both unsuccessful and are
Rubric)	sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)	sufficiently comprehensive to solve the problem.	represent only a portion of the calculations required to comprehensively solve the problem.	not comprehensive.

Define Problem (Problem Solving VALUE Rubric)	Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors.	Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, and problem statement is adequately detailed.	Begins to demonstrate the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is superficial.	Demonstrates a limited ability in identifying a problem statement or related contextual factors.
Identify Strategies (Problem Solving VALUE Rubric)	Identifies multiple approaches for solving the problem that apply within a specific context.	Identifies multiple approaches for solving the problem, only some of which apply within a specific context.	Identifies only a single approach for solving the problem that does apply within a specific context.	Identifies one or more approaches for solving the problem that do not apply within a specific context.
Evaluate Potential Solutions (Problem Solving VALUE Rubric)	Evaluation of solutions is deep and elegant (for example, contains thorough and insightful explanation) and includes, deeply and thoroughly, all of the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is adequate (for example, contains thorough explanation) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is brief (for example, explanation lacks depth) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is superficial (for example, contains cursory, surface level explanation) and includes the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution, and weighs impacts of solution.

Student Learning Outcome 2: Upon graduation, our students have the ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

	Capstone	Miles	stones	Benchmark
	4	3	2	1
Acquiring Competencies (Creative Thinking VALUE Rubric)	Reflect: Evaluates creative process and product using domain-appropriate criteria.	Create: Creates an entirely new object, solution or idea that is appropriate to the domain.	Adapt: Successfully adapts an appropriate exemplar to his/her own specifications.	Model: Successfully reproduces an appropriate exemplar.
Solving Problems (Creative Thinking VALUE Rubric)	Not only develops a logical, consistent plan to solve problem, but recognizes consequences of solution and can articulate reason for choosing solution.	Having selected from among alternatives develops a logical, consistent plan to solve the problem.	Considers and rejects less acceptable approaches to solving problem.	Only a single approach is considered and is used to solve the problem.
Embracing Contradictions (Creative Thinking VALUE Rubric)	Integrates alternate, divergent, or contradictory perspectives or ideas fully.	Incorporates alternate, divergent, or contradictory perspectives or ideas in a exploratory way.	Includes (recognizes the value of) alternate, divergent, or contradictory perspectives or ideas in a small way.	Acknowledges (mentions in passing) alternate, divergent, or contradictory perspectives or ideas.
Connecting, Synthesizing, Transforming (Creative Thinking VALUE Rubric)	Transforms ideas or solutions into entirely new forms.	Synthesizes ideas or solutions into a coherent whole.	Connects ideas or solutions in novel ways.	Recognizes existing connections among ideas or solutions.
Implement Solutions (Problem Solving VALUE Rubric)	Implements the solution in a manner that addresses thoroughly and deeply multiple contextual factors of the problem.	Implements the solution in a manner that addresses multiple contextual factors of the problem in a surface manner.	Implements the solution in a manner that addresses the problem statement but ignores relevant contextual factors.	Implements the solution in a manner that does not directly address the problem statement.
Identifying specific project objectives, standards, and constraints based on general project requirements	All important objectives, standards, and constraints are identified and clearly implemented	Most important objectives, standards, and constraints are identified and implemented with minor deficiencies	Some objectives, standards, and constraints are identified with some deficiencies	Objectives, standards, and/or constraints not clearly identified or contain significant deficiencies

Student Learning Outcome 3: Upon graduation, our students have the ability to communicate effectively with a range of audiences. Written Communication Benchmark Capstone Milestones 2 3 1 4 Demonstrates a thorough Demonstrates adequate Demonstrates minimal **Context of and Purpose for** Demonstrates awareness of Writing understanding of context, consideration of context. context, audience, purpose. attention to context. audience. (Written Communication audience, and purpose that is audience, and purpose and a and to the assigned tasks(s) purpose, and to the assigned VALUE Rubric) responsive to the assigned clear focus on the assigned (e.g., begins to show tasks(s) (e.g., expectation of task(s) and focuses all elements task(s) (e.g., the task aligns awareness of audience's instructor or self as audience). of the work. with audience, purpose, and perceptions and assumptions). context). Uses appropriate, relevant, and Uses appropriate and relevant **Content Development** Uses appropriate, relevant, and Uses appropriate and relevant (Written Communication compelling content to illustrate compelling content to explore content to develop and explore content to develop simple mastery of the subject, VALUE Rubric) ideas within the context of the ideas through most of the ideas in some parts of the conveying the writer's discipline and shape the whole work. work. understanding, and shaping the work. whole work. Uses graceful language that Uses straightforward language Uses language that sometimes **Control of Syntax and** Uses language that generally Mechanics skillfully communicates meaning that generally conveys conveys meaning to readers impedes meaning because of meaning to readers. The (Written Communication to readers with clarity and with clarity, although writing errors in usage. VALUE Rubric) fluency, and is virtually error language in the portfolio has may include some errors. free. few errors. Interpretation Provides accurate explanations Provides accurate explanations Provides somewhat accurate Attempts to explain explanations of information (Quantitative Literacy of information presented in of information presented in information presented in VALUE Rubric) mathematical forms. Makes mathematical forms. For presented in mathematical mathematical forms, but draws appropriate inferences based on instance, accurately explains forms, but occasionally makes incorrect conclusions about what the that information. the trend data shown in a minor errors related to information means. graph. computations or units. Technical/Professional Technical/Professional Content Technical/Professional Technical/Professional information at an appropriate information at an appropriate information at a marginal level information unacceptable for level for course, Key concepts level for course, some concepts for course, many concepts course, most concepts unclear and terms explained clearly. unclear or not discussed. not completely clarified, or not discussed, reader gains Research and/or analysis of topic research and/or analysis of Reader gains little new no new knowledge or insight clearly evident Reader gains topic generally evident. Reader knowledge or insight significant new knowledge and gains some new knowledge and insight insight.

	Capstone	Milestones		Benchmark
	4	3	2	1
Design Process (Inquiry and Analysis VALUE Rubric)	All elements of the methodology or theoretical framework are skillfully developed, Appropriate	Critical elements of the methodology or theoretical framework are appropriately developed, however, more	Critical elements of the methodology or theoretical framework are missing, incorrectly developed, or	Inquiry design demonstrates a misunderstanding of the methodology of theoretical framework.
	methodology or theoretical frameworks may be synthesized from across disciplines or from relevant subdisciplines.	subtle elements are ignored or unaccounted for	unfocused.	
Conclusions (Inquiry and Analysis VALUE Rubric)	States a conclusion that is a logical extrapolation from the inquiry findings.	States a conclusion focused solely on the inquiry findings. The conclusion arises specifically from and responds specifically to the inquiry findings.	States a general conclusion that, because it is so general, also applies beyond the scope of the inquiry findings.	States an ambiguous, illogical, or unsupportable conclusion from inquiry findings.
Compliance with Standards	Test performed in full compliance with applicable standard	Test performed in general compliance with standard with only minor procedural error that does not completely invalidate the result	Test performed in general compliance with standard, but a procedural error resulted in faulty results	Test not performed in compliance with standard and results invalid
Application of Results	Results of experiment applied completely and accurately to the situation	Results applied generally/conceptually correct with only a minor error	Results applied generally/conceptually correct with a few errors	Results not applied correctly t the situation
Designing an experiment or experimental procedure	Students select and/or design all appropriate test(s) or process(es) to the situation at hand.	Students generally select and/or design the appropriate test(s) or process (es) to the situation at hand.	Students select or design some appropriate tests or processes, with a notable error or omission.	Students select or design som appropriate tests or processes, with significant errors or omissions.

Student Learning Outcome 6: Upon graduation, our students have the ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions