Michigan Technological University

Undergraduate Student Learning Goal 2: Knowledge of the Physical and Natural World Rubric (for use 2022-23)

Students demonstrate knowledge of the physical and natural world. This is accomplished by studying mathematics and the physical and natural sciences. Mathematics courses are responsible for "Interpretation of Mathematical Representations" and "Assumptions" and should contribute to the others as appropriate. Science courses are responsible for "Data Analysis," "Scientific Knowledge," and "Proposes Solutions/Models/Hypotheses" and should contribute to the others as appropriate.

Knowledge of Physical & Natural World	*What is being assessed*	Beginning 1	Developing 2	Proficient 3	Exemplary 4
2.1. Scientific Knowledge	Knowledge of the physical and natural world, including phenomena, concepts, theories, and models within current disciplinary frameworks.	• Recognizes relevant scientific terminology. • Demonstrates some understanding of relevant scientific phenomena, concepts, and theories or models (for example, by problem solving and conducting directed experiments), but may still have some basic misconceptions. • Has some difficulty solving single-concept problems or answering single-concept questions.	• Understands relevant scientific terminology. • Is generally able to demonstrate understanding of relevant scientific phenomena, concepts, and theories or models (for example, by problem solving, model building and evaluation, or carrying out experiments) with few misconceptions. • Is able to solve single-concept problems or answer single-concept questions.	• Ably uses scientific terminology. • Demonstrates understanding of relevant scientific phenomena, concepts, and theories or models (for example, by correct multi-concept problem solving, model building and evaluation, and carrying out or designing experiments) with few misconceptions. • Is able to solve multiple-concept problems or answer multiple-concept questions.	• Precisely and correctly uses scientific terminology. • Demonstrates sophisticated understanding of relevant scientific phenomena, concepts, and theories or models (for example, by problem solving, model building and evaluation, carrying out or designing experiments). • Demonstrates inter-related knowledge of scientific concepts and theories or models beyond one discipline.
2.2. Quantitative Problem Solving (Problem Solving)	Ability to apply known procedures to solve quantitative problems, and to interpret the results.	• A solution is attempted but is both unsuccessful and not comprehensive.	• The attempted solution is either unsuccessful or represents only a portion of the steps required to successfully solve the problem. The interpretation of the final result is incorrect, incomplete, or not addressed.	• The solution is essentially correct and sufficiently comprehensive to solve the problem. A correct interpretation of the result is given.	• The solution is correct, comprehensive, and presented elegantly (clearly, precisely, etc.). The final result is correctly, clearly, and fully interpreted.
2.3. Interpretation of Mathematical Representations (Quantitative Literacy)	Ability to explain or to ably use information that is presented in mathematical form (e.g., equations, graphs, diagrams, tables)	• Attempts to explain or use information presented in mathematical form, but draws incorrect conclusions about what the information means.	• Provides somewhat accurate explanations or partly makes use of information presented in mathematical form, but occasionally makes minor errors related to computations or units.	• Provides mostly accurate explanations of or able use of information presented in mathematical form.	• Provides accurate explanations of or able use of information presented in mathematical form. Makes appropriate inferences based on that information.
2.4. Assumptions (Quantitative Literacy)	Ability to make and evaluate key assumptions in estimation, modeling, and data analysis.	• Attempts to describe assumptions in mathematical estimation, modeling, and data analysis.	• Explicitly describes assumptions in mathematical estimation, modeling, and data analysis.	• Explicitly describes assumptions in mathematical estimation, modeling, and data analysis, and provides compelling rationale for why assumptions are appropriate.	• Explicitly describes assumptions in mathematical estimation, modeling, and data analysis, and provides compelling rationale for why assumptions are appropriate. Shows awareness that confidence in final conclusions is limited by the appropriateness of the assumptions.
2.5. Data Analysis (Quantitative Literacy)	Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis.	• Uses primarily qualitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.	• Uses quantitative analysis of data as the basis for rudimentary (without inspiration or nuance, ordinary) judgments, drawing possible conclusions about this work.	• Uses quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	• Uses quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.
2.6. Proposes Solutions/ Models/ Hypotheses (Problem Solving)	Ability to propose and evaluate questions, solutions, models, and/or hypotheses related to a problem or a description of a natural phenomenon, within current discipline-specific frameworks.	• Demonstrates a basic understanding of the problem or phenomenon, but is unable to provide even a superficial approach to solve the problem, or to understand or conceptualize the phenomenon.	• For a given problem or phenomenon, is able to provide an appropriate solution, model, or hypothesis to solve the problem or to understand or conceptualize the phenomenon. • Carries out only superficial or rudimentary solutions, perhaps incorrectly. • Is able to pose basic original questions about phenomena.	• For a given problem or phenomenon, is able to provide an appropriate solution, model, or hypothesis to solve the problem or to understand or conceptualize the phenomenon. • Carries out correct analysis to solve the problem or evaluate models and/or hypotheses. • Is able to pose insightful original questions about phenomena.	• Proposes one or more solutions, models, or hypotheses indicating a deep understanding of the problem or phenomenon. • Carries out correct, detailed solution or discipline-specific analysis to completion, with awareness of limiting factors based on approximations and/or assumptions. • Poses insightful original questions about phenomena and can articulate a reasoned approach for further investigation.

Adapted from Association of American Colleges & Universities (AAC&U) VALUE rubric [http://www.aacu.org/value-rubrics] on problem solving and quantitative literacy.