

## Competency Rubric Bank for the Sciences (CRBS)

| #        | Competency   | 5   | 4 | 3  | 2 | 1   | Suggested assignment types                     | Suggested scale for developmental stage |
|----------|--|---|---|--|---|---|--|---|
|          | <b>Content Knowledge</b>   |   |   |  |   |   |  |   |
| <b>1</b> | Content Knowledge: Accuracy of scientific understanding            | <ul style="list-style-type: none"> <li>Reflects well-developed understanding of current scientific theory and concepts.</li> <li>Explicitly summarizes essential background information.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Reflects understanding of current scientific theory and concepts.</li> <li>Summarizes most of the essential background</li> </ul>   |   | <ul style="list-style-type: none"> <li>Reflects inaccuracies or large gaps in understanding of current scientific theory and concepts.</li> <li>Does not summarize essential background and information</li> </ul>  | Paper<br>Notebook<br>Poster<br>Oral            | Entry (5)<br>Mid (5)<br>Capstone (5)    |
|          | <b>Higher Order Cognitive Skills (HOCS)</b>                        |   |   |  |   |   |  |   |
| <b>3</b> | Analysis: Clarity of Research Question                             | <ul style="list-style-type: none"> <li>Clearly identifies the research question and its inherent complexities</li> <li>Identifies a study that is feasible and testable</li> </ul>  |   | <ul style="list-style-type: none"> <li>Identifies a research question</li> <li>Identifies a study that is feasible and/or testable.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Does not clearly identify a research question or line of study.</li> <li>Gaps in feasibility and testability were evident from the outset.</li> </ul>  | Paper<br>Notebook<br>Poster<br>Oral            | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| <b>4</b> | Analysis: Identifies Rationale, Hypothesis, or Systematic Approach | <ul style="list-style-type: none"> <li>Very clearly identifies a hypothesis, rationale, or clarifies a systematic approach for exploration</li> <li>Explicitly draws support for his/her rationale from experience, observation, and/or the literature base.</li> <li>Most variables are thoughtfully identified.</li> <li>Explicit link of current theory to the individual's own research study.</li> </ul> |   | <ul style="list-style-type: none"> <li>Identifies a hypothesis, rationale, or approach for exploration</li> <li>Limited support for the rationale</li> <li>Some variables are identified.</li> <li>Links current theory to the individual's own research study (may be implied or vague).</li> </ul> |   | <ul style="list-style-type: none"> <li>Hypothesis, rationale, or line of inquiry is not identified or has inconsistencies.</li> <li>Does not support rationale</li> <li>Variables are inadequately addressed</li> <li>Does not link current theory to the individual's own research study.</li> </ul> | Paper<br>Notebook<br>Poster<br>Oral            | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| <b>5</b> | Synthesis: Design of Methodology                                   | <ul style="list-style-type: none"> <li>Demonstrates meaningful synthesis of prior research to design appropriate methodologies including procedures, techniques, instrumentation and precautions.</li> <li>Clear and complete description of steps that will achieve the purpose of the research study and</li> </ul>   |   | <ul style="list-style-type: none"> <li>Designs an appropriate methodology to achieve the purpose of the study including procedures and instrumentation.</li> <li>Description of steps for research study are included.</li> </ul>  |   | <ul style="list-style-type: none"> <li>Methodology is confusing or contains gaps.</li> <li>Methodology will not achieve the intended purpose of the study.</li> <li>Does not include description of steps for research study.</li> </ul>  | Paper<br>Notebook<br>(3)<br>Poster (3)<br>Oral | Entry (3)<br>Mid (4)<br>Capstone (5)    |

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|---|--|---|---|--|---|---|---|---|
|   |  | allow for replication of the study.   |   |  |   |   |   |   |
| 6 | Application: Safety and Ethical Considerations         | <ul style="list-style-type: none"> <li>All necessary safety hazards including appropriate handling of materials and equipment discussed thoroughly.</li> <li>Considers and addresses all ethical aspects.</li> <li>Seeks IRB approval, if applicable.</li> </ul>  |   | <ul style="list-style-type: none"> <li>Most necessary safety hazards including appropriate handling of materials and equipment discussed.</li> <li>Attempt is made to address ethical issues.</li> <li>Seeks IRB approval, if applicable.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Safety hazards and ethical considerations not addressed.</li> </ul> AND <ul style="list-style-type: none"> <li>IRB approval not met.</li> </ul>  | Notebook<br><br>Instructor observation of technique | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 7 | Application and analysis: Data Collection and Analysis | <ul style="list-style-type: none"> <li>Very appropriate use of instruments &amp; tools to make careful measurements.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Appropriate use of instruments &amp; tools to make careful measurements.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Inappropriate use of tools &amp; instruments.</li> </ul>   | Notebook<br><br>Instructor observation of technique | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 8 | Application: Data Presentation                         | <ul style="list-style-type: none"> <li>Highly consistent and appropriate use of scientific units of measurement, labels, symbols, and equations.</li> <li>Concise visuals convey pertinent data that are otherwise difficult to convey; thus, increasing the efficiency and effectiveness of the presentation.</li> <li>Visuals enhance the communication process by utilizing the appropriate balance between effective visuals and text.</li> </ul> |   | <ul style="list-style-type: none"> <li>Consistent use of scientific labels, units of measurement, symbols, and equations.</li> <li>Minor inaccuracies or omissions noted, such as skipping a step, inaccurate equation (e.g., lack of labels, typographical errors, etc.)</li> <li>Visuals convey data that are pertinent and add to the presentation, with some balance between text and visuals</li> </ul> |   | <ul style="list-style-type: none"> <li>Does not attempt to use scientific labels, symbols, or equations.</li> <li>Major inaccuracies or omissions are noted.</li> <li>Visuals distract from presentation by being too wordy or too limited (e.g., too much text or visual)</li> </ul> | Paper<br>Notebook<br>Poster<br>Oral                 | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 9 | Synthesis: Conclusions                                 | <ul style="list-style-type: none"> <li>Clearly addresses the research question(s).</li> <li>Draws inferences that are highly consistent with the data and scientific reasoning</li> </ul> <p><i>Example 1: Significance in differences or similarities between samples are determined statistically; an inference is drawn appropriately from that statistical assessment.</i></p>  |   | <ul style="list-style-type: none"> <li>Addresses the research question(s).</li> <li>Identifies conclusions based on observation.</li> <li>Attempts to identify directions for future research</li> <li>Defines limitations in broad terms</li> </ul>   |   | <ul style="list-style-type: none"> <li>Conclusions do not address the research question(s).</li> <li>Conclusions not evaluated for accuracy and precision.</li> <li>Does not identify future directions</li> <li>Does not identify limitations.</li> </ul>                            | Paper<br>Notebook<br>Poster<br>Oral                 | Entry (3)<br>Mid (4)<br>Capstone (5)    |

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|    |   | <p><i>Example 2: A trend(s) is identified and evaluated statistically; an inference is drawn appropriately from that statistical assessment.</i></p> <ul style="list-style-type: none"> <li>Identifies well-reasoned directions for future research.</li> <li>Explicitly discusses limitations.</li> </ul>   |   |  |   |  |                                     |   |
| 10 | Evaluation: Accuracy & Precision  | <ul style="list-style-type: none"> <li>Evaluates the accuracy &amp; precision of the data.</li> <li>Clearly examines the evidence and identifies specific sources of error and determines means for reducing error in future studies.</li> <li>Carefully selects and systematically applies appropriate data analysis (quantitative, qualitative, exploratory or other)</li> </ul> |   | <ul style="list-style-type: none"> <li>Examines the evidence and identifies error in general terms.</li> <li>Notes that there may be some inconsistencies in data but explanation is not developed.</li> <li>Selects and applies appropriate data analysis method with few errors (quantitative, qualitative, exploratory or other)</li> </ul> |   | <ul style="list-style-type: none"> <li>Conclusions are not evaluated for accuracy and precision</li> <li>Sources of error are not identified.</li> <li>Does not use appropriate data analysis method.</li> </ul> | Paper<br>Notebook<br>Poster<br>Oral | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 11 | Evaluation: Relevance<br><br>NOS: Social and Cultural Nature of Science<br>Understandings: Science is a human enterprise, practiced within and affecting society and culture. | <ul style="list-style-type: none"> <li>Clearly articulates scientific and societal relevance of the study.</li> </ul>  |   | <ul style="list-style-type: none"> <li>Identifies a general relevance of the study.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Does not identify the relevance of the study.</li> </ul>  | Paper<br>Poster<br>Oral             | Entry (3)<br>Mid (4)<br>Capstone (5)    |
|    | <b>Communication Skills</b>   |  |   |  |   |  |                                     |   |
| 12 | Organization & Sequence   | <ul style="list-style-type: none"> <li>Clearly organized and logical using format of commonly accepted scientific literature.</li> <li>Explicitly differentiates main from secondary ideas.</li> </ul>   |   | <ul style="list-style-type: none"> <li>Organized, using clear divisions of the segments within the presentation.</li> <li>Main ideas are emphasized.</li> </ul>  |   | <ul style="list-style-type: none"> <li>Format is disorganized.</li> <li>Main ideas are lost</li> </ul>   | Paper<br>Poster<br>Oral             | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 14 | Writing Conventions   | <ul style="list-style-type: none"> <li>Very consistent use of discipline specific language*</li> </ul>   |   | <ul style="list-style-type: none"> <li>Attempts to use discipline specific language*</li> </ul>  |   | <ul style="list-style-type: none"> <li>Does not attempt to use discipline specific language*</li> </ul>  | Paper<br>Poster                     | Entry (3)<br>Mid (4)                    |

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|    |  | AND<br>• “Excellent” quality of writing on university writing rubric  | AND  | • “Competent” quality of writing on the university writing rubric  | AND                                 | • “Unacceptable” quality of writing on the university writing rubric | Oral                       | Capstone (5)                            |
| 15 | Oral Presentation Skills   | <ul style="list-style-type: none"> <li>Exhibits exemplary professional demeanor</li> <li>High level of poise</li> <li>Communicates high level of preparation for the presentation.</li> <li>Communicates an enthusiasm or strong scholarly interest in the subject manner.</li> <li>Handles questions from the audience with confidence</li> <li>Rate of speech (or presentation) facilitates audience understanding</li> </ul> | <ul style="list-style-type: none"> <li>Exhibits professional demeanor</li> <li>Maintains composure throughout the presentation.</li> <li>Communicates competent level of preparation.</li> <li>Communicates a desire to perform well</li> <li>Communicates willingness to interact with the audience.</li> <li>Rate of speech (or presentation) does not detract from audience understanding</li> </ul>      | <ul style="list-style-type: none"> <li>Does not exhibit professional demeanor</li> <li>Composure is lost during presentation.</li> <li>Seems unprepared</li> <li>Communicates little interest in the subject manner.</li> <li>Lackadaisical attitude is evident.</li> <li>Rate of speech (or presentation) detracts from audience understanding.</li> </ul>                              | Poster<br><br>Oral                  | Entry (3)<br>Mid (4)<br>Capstone (5)                                 |                            |   |
|    | <b>Nature of Science</b>   |   |  |  |                                     |  |                            |   |
| 16 | <b>Empirical NOS:</b><br>Scientific knowledge is based on and/or derived from observations of the natural world (data)     | <p><u>Research paper or presentation</u><br/><i>Permeated with the</i> understanding that scientific knowledge is based on and/or derived from observations of the natural world.</p> <p><b>Example:</b><br/>- Empirical observations (data) are presented and serve as the primary basis for the conclusions</p>   | <p><u>Research paper or presentation</u><br/><i>Expresses</i> the understanding that scientific knowledge is based on observations of the natural world.</p> <p><b>Example:</b><br/>- empirical observations (data) are presented, but only weakly support the conclusions<br/>- conclusions primarily recite prior theory or note experimental expectations, with little logical connection to the data</p> | <p><u>Research paper or presentation</u><br/><i>Does not express</i> the understanding that scientific knowledge is based on observations of the natural world.</p> <p><b>Examples:</b><br/>- empirical observations (data) are not presented and/or may not support conclusions;<br/>- conclusions only recite prior theory or note experimental expectations based on that theory.</p> | Paper<br>Notebook<br>Poster<br>Oral | Entry (5)<br>Mid (5)<br>Capstone (5)                                 |                            |   |
| 17 | <b>Tentative NOS:</b><br>Scientific knowledge is subject to change with new observations and with the reinterpretations of | <p><u>Research paper or presentation</u><br/>• <i>Clearly acknowledges</i> the principle that scientific knowledge <u>is</u> subject to change.</p> <p><b>Examples:</b><br/>- Introduction and/or conclusions note gaps or misunderstandings in</p>   | <p><u>Research paper or presentation</u><br/>• <i>Acknowledges</i> the principle that scientific knowledge <u>is</u> subject to change.</p>  | <p><u>Research paper or presentation</u><br/>• <i>Expresses the naïve view</i> that scientific knowledge <u>is not</u> subject to change.</p> <p><b>Examples:</b><br/>- Fails to acknowledge gaps or misunderstandings, varied</p>   | Paper<br>Notebook<br>Poster<br>Oral | Entry (3)<br>Mid (4)<br>Capstone (5)                                 |                            |   |

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|    | existing observations.   | current scientific knowledge-base (e.g. "It is currently unknown whether...");<br>varied interpretations of data;<br>controversies/alternative theories   |   |   |   | interpretations , or controversies<br>- States the purpose of research as confirming rigid theory or reproducing prior findings<br>- <i>Uses naïve language</i> by stating non-tentative conclusions: e.g. " <i>prove</i> " |  |   |
| 18 | <b>Inferential NOS:</b><br>Scientific knowledge is based on both observation and inference.<br><br>There is a critical distinction between scientific claims (e.g., inferences) and evidence on which such claims are based (e.g., observations) | <u>Research paper or presentation</u><br>• <i>Inferences are made appropriately and well-justified:</i><br><br><i>Examples:</i><br>Conclusions are formed after the evidence is critically evaluated in relation to, and synthesized with<br>- accepted theory(ies), AND<br>- other evidence (e.g. published data)<br><br>• <i>Clearly shows evidence of the distinction</i> between inference and observation<br><br><i>Example:</i><br>- appropriate scientific language, such as: "The data presented here support the following conclusion:..." | <u>Research paper or presentation</u><br>• <i>Inferences are made but not well-justified:</i><br><br><i>Examples:</i><br>Conclusions are formed after the evidence is evaluated relative to<br>- accepted theory, OR<br>- other evidence (e.g. published data)<br><br><i>Shows evidence of the distinction</i> between inference and observation. | <u>Research paper or presentation</u><br>• <i>Inferences are not made, or are not justified:</i><br><br><i>Example:</i><br>Evidence is not evaluated in relation to prior theory, NOR synthesized with other evidence.<br><br><i>Does not distinguish</i> between inference and observation.<br><br><i>Example:</i><br>- The conclusions may only restate the observations or expectations. |   |   | Paper<br>(Notebook?)<br>Poster<br>Oral | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 20 | <b>Theory-laden NOS:</b><br>Scientific knowledge and investigation are influenced by scientists' theoretical and disciplinary commitments.   | <u>Research paper or presentation</u><br>• <i>Clearly and appropriately acknowledges</i> prior theory by applying a well-founded theoretical model to the rationale for the research project, and any conclusions or inferences   | <u>Research paper or presentation</u><br>• <i>Acknowledges</i> prior theory; states a theory-based rationale for the research project, and bases some inferences on established theory  | <u>Research paper or presentation</u><br>• <i>Does not acknowledge</i> prior theory; no reference to prior theory or theoretical model is made  |   |   | Paper<br>Poster<br>Oral                | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| 22 | <b>Myth of the "Scientific Method":</b><br>There is no universal   | <u>Research paper or presentation</u><br><i>Uses or articulates multiple approaches</i> to generating knowledge   | <u>Research paper or presentation</u><br><i>Uses or articulates an alternative</i> approach to validating findings.   | <u>Research paper or presentation</u><br><i>Does not propose any alternative approach</i>   |   |   | Paper<br>Poster<br>Oral                | Entry (3)<br>Mid (4)<br>Capstone        |

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|               | <p>step-wise method that guarantees the generation of valid scientific knowledge</p> <p>Many different methodologies are valid means of scientific knowledge formation, and contribute together to validate a hypothesis</p> | <p>- multiple alternative approaches may include alternate experimental designs, and/or non-experimental studies, such as correlative field studies, informatics, or modeling work</p> <p><i>Example:</i><br/>Alternative methodologies are suggested in a paragraph on 'future work' in the discussion</p>   | <p>- multiple alternative approaches may include alternate experimental designs, and/or non-experimental studies, such as correlative field studies, informatics, or modeling work;</p> <p><i>Example:</i><br/>An alternative methodology is suggested in a paragraph on 'future work' in the discussion</p> |  |   | <p><i>Endorses the naïve viewpoint</i> that there is one universal step-wise method that guarantees the generation of valid knowledge (i.e., myth of "scientific method")</p> <p><i>Example:</i><br/>Discussion of 'Future work' is restricted to repetition of the same methodology</p> |  | (5)                                     |
|               | <b>NOS items, for explicit NOS assignments</b>   |   |  |  |   |  |  |   |
| <b>16 NOS</b> | <p><b>Empirical NOS:</b><br/>Scientific knowledge is based on and/or derived from observations of the natural world (data)</p>   | <p><i>Assignment explicitly about NOS:</i><br/><b>Clearly expresses the understanding that</b> scientific knowledge is based on and/or derived from observations of the natural world.</p>  | <p><i>Assignment explicitly about NOS:</i><br/><b>Expresses</b> the understanding that scientific knowledge is based on observations of the natural world.</p>   | <p><i>Assignment explicitly about NOS:</i><br/><b>Does not express</b> the understanding that scientific knowledge is based on observations of the natural world.</p>  |   |  | NOS-specific assignment: (e.g. essay or class discussion regarding NOS concepts) | Entry (5)<br>Mid (5)<br>Capstone (5)    |
| <b>17 NOS</b> | <p><b>Tentative NOS:</b><br/>Scientific knowledge is subject to change with new observations and with the reinterpretations of existing observations.</p> <p>Scientific knowledge is not absolute nor certain.</p>           | <p><i>Assignment explicitly about NOS:</i></p> <ul style="list-style-type: none"> <li>• <b>Clearly acknowledges</b> the principle that scientific knowledge <u>is</u> subject to change, with examples.</li> <li>• <b>Clearly expresses</b> the principle that scientific knowledge <u>is not</u> absolute nor certain, providing more than one reason</li> </ul> <p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>- There is uncertainty in scientific knowledge due to current lack of data or theory to explain data</li> <li>- uncertainty due to <b>social/cultural NOS</b></li> </ul> | <p><i>Assignment explicitly about NOS:</i></p> <ul style="list-style-type: none"> <li>• <b>Acknowledges</b> the principle that scientific knowledge <u>is</u> subject to change.</li> <li>• <b>Expresses</b> the principle that scientific knowledge <u>is not</u> absolute nor certain</li> </ul>           | <p><i>Assignment explicitly about NOS:</i></p> <ul style="list-style-type: none"> <li>• <b>Expresses the naïve view</b> that scientific knowledge <u>is not</u> subject to change.</li> <li>• <b>Expresses the naïve view</b> that scientific knowledge <u>is</u> absolute and certain</li> </ul> <p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>- Explains scientific controversies only in terms of one party not fully understanding the data or theory, or only being politically swayed to the wrong conclusions</li> </ul> |   |  | NOS-specific assignment: (e.g. essay or class discussion regarding NOS concepts) | Entry (3)<br>Mid (4)<br>Capstone (5)    |

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|               |  | - uncertainty due to <b>creative NOS</b><br>- there is historical development of theories (e.g. paradigm shifts; revolutions)   |  |   |   |   |  |   |
| <b>19 NOS</b> | <b>Creative NOS:</b><br>Science is a creative process, not completely rational, lifeless and orderly<br><br>In this manner, there is an unavoidable subjectivity in science<br><br>Thus, scientific concepts, such as atoms or species, are useful models, not perfect copies of reality | <u>Assignment explicitly about NOS:</u><br>• <b>Clearly states a role for creativity</b> in the formation of research questions, study design, and inference making<br><br>• <b>Clearly acknowledges</b> subjectivity in science deriving from creative NOS<br><br>• <b>Clearly acknowledges</b> the imperfect match of models with reality   | <u>Assignment explicitly about NOS:</u><br>• <b>States a role for creativity</b> in the formation of research questions, study design, OR inference making<br><br>• <b>Acknowledges</b> subjectivity in science deriving from creative NOS<br><br>• <b>Acknowledges</b> the imperfect match of models with reality | <u>Assignment explicitly about NOS:</u><br>• <b>States the misconception that the practice of science is not creative</b><br><br>• <b>Naively equates science</b> with non-creative objective rationality<br><br>• <b>Naively equates</b> reality with models   |   |   | NOS-specific assignment: (e.g. essay or class discussion regarding NOS concepts) | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| <b>20 NOS</b> | <b>Theory-laden NOS:</b><br>Scientific knowledge and investigation are influenced by scientists' theoretical and disciplinary commitments.<br><br>Because scientific knowledge is theory-laden, there is an unavoidable subjectivity to science  | <u>Assignment explicitly about NOS:</u><br>• <b>Clearly acknowledges that</b> scientific inference formation is influenced by scientists' theoretical and disciplinary commitments, with examples (e.g. commitments to Newton's theories of motion impacted early models of the atom)<br>• <b>Clearly acknowledges</b> subjectivity derived from the theory-laden aspect of science | <u>Assignment explicitly about NOS:</u><br>• <b>Acknowledges that</b> scientific inference formation is influenced by scientists' theoretical and disciplinary commitments<br>• <b>Acknowledges subjectivity</b> derived from the theory-laden aspect of science   | <u>Assignment explicitly about NOS:</u><br>• <b>Does not acknowledge that</b> theoretical and disciplinary commitments influence scientific inference formation<br>• <b>Does not acknowledge</b> subjectivity in the theory-laden aspect of science<br><b>OR</b><br>• <b>inappropriately invokes extreme</b> subjectivity |   |   | NOS-specific assignment: (e.g. essay or class discussion regarding NOS concepts) | Entry (3)<br>Mid (4)<br>Capstone (5)    |
| <b>21 NOS</b> | <b>Social and Cultural NOS:</b><br>Science is a human  | <u>Assignment explicitly about NOS:</u><br><b>Clearly acknowledges</b> that science is a the human enterprise   | <u>Assignment explicitly about NOS:</u><br><b>Acknowledges</b> that science is a the human enterprise embedded   | <u>Assignment explicitly about NOS:</u><br><b>Does not acknowledge</b> that the social and cultural setting of  |   |   | NOS-specific assignment:   | Entry (3)<br>Mid (4)<br>Capstone        |

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|-----------|---|--|---|---|---|---|--|---|
|           | <p>enterprise, practiced within and affecting society and culture.</p> <p>Scientists are influenced by culture – in their beliefs, values, norms, and prior knowledge (thus, scientific knowledge is somewhat subjective)</p> <p>The scientific community is a culture unto itself, with its own norms and values, and systems of approving knowledge</p> | <p>embedded in society and culture</p> <p><b>Clearly acknowledges</b> that the social and cultural setting of research may affect the interpretation of the data; there are potential biases derived from the social/cultural setting</p> <p><b>Clearly acknowledges</b> the scientific community as a culture unto itself;</p> <ul style="list-style-type: none"> <li>- shared values and norms</li> <li>- funding agency directives</li> <li>- effect of the peer-review system</li> </ul> | <p>in society and culture</p> <p><b>Acknowledges</b> that the social and cultural setting of research may affect the interpretation of the data; there are potential biases derived from the social/cultural setting.</p> <p><b>Acknowledges</b> the scientific community as a culture unto itself;</p> <ul style="list-style-type: none"> <li>- shared values and norms</li> <li>- funding agency directives</li> <li>- peer-review</li> </ul> | <p>research may affect the interpretation of the data;</p> <p>Retains the naïve conception that science is purely objective and unaffected by the broader culture</p> <p><b>Does not acknowledge</b> the scientific community as a culture unto itself;</p> <ul style="list-style-type: none"> <li>- shared values and norms</li> <li>- funding agency directives</li> <li>- peer-review</li> </ul>   |   |   | (e.g. essay or class discussion regarding NOS concepts)                          | (5)                                     |
| 22<br>NOS | <p><b>Myth of the “Scientific Method”:</b><br/>There is no universal step-wise method that guarantees the generation of valid scientific knowledge</p> <p>Many different methodologies are valid means of scientific knowledge formation, and contribute together to validate a hypothesis</p>  | <p><b>Assignment explicitly about NOS:</b><br/><b>Clearly expresses the view that multiple methods are valid means of scientific inquiry, with examples</b> (e.g. social scientists, astronomers, earth scientists, and many ecologists work mostly without any classical experimental methods, yet still generate valid findings.)</p> <p><b>Clearly acknowledges the validity and necessity</b> of findings from multiple alternate experimental <u>and</u> non-experimental studies.</p>  | <p><b>Assignment explicitly about NOS:</b><br/><b>Expresses the view that multiple methods are valid means of scientific inquiry.</b></p> <p><b>Acknowledges the validity</b> of conclusions drawn from alternate experimental <u>and</u> non-experimental studies.</p>   | <p><b>Example:</b><br/>Correct use of “the method” gives us “the right answer”.<br/>- A “method” may be applied to the research paper as a veneer, when in fact the project was performed without any stated hypothesis or experiments.</p> <p><b>Assignment explicitly about NOS:</b><br/><b>Naively holds to a universal experimental method: Does not consider</b> non-experimental findings a valid means of knowledge generation</p> <p><b>Does not acknowledge the need for multiple converging methodologies</b> to best validate a hypothesis</p> |   |   | NOS-specific assignment: (e.g. essay or class discussion regarding NOS concepts) | Entry (3)<br>Mid (4)<br>Capstone (5)    |