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| **Analytic Rubric for Conducting an Experiment in the Lab** | | | |
| **Attribute** | **Exemplary**  **(3)** | **Competent**  **(2)** | **Needs Work**  **(1)** |
| **Materials** | All materials needed are present and entered on the lab report;  The materials are appropriate for the procedure;  The student is not wasteful of the materials. | All materials are present, but not all are entered on the lab report, or some materials are absent and must be obtained during the procedure;  The materials are appropriate for the procedure. | All materials needed are not present and are not entered on the lab report;  The materials are not al appropriate for the procedure or there are some major omissions. |
| **Procedure** | The procedure is well designed and allows control of all variables selected;  All stages of the procedure are entered on the lab report. | The procedure could be more efficiently designed, but it allows control of all variables selected;  Most stages of the procedure are entered on the lab report. | The procedure does not allow control of all variables selected;  Many stages of the procedure are not entered on the lab report. |
| **Courtesy & Safety** | While conducting the procedure, the student is tidy, respectful of others, mindful of safety, and leaves the area clean. | While conducting the procedure, the student is mostly tidy, sometimes respectful of others, sometimes mindful of safety, and leaves the area clean only after being reminded. | While conducting the procedure, the student is untidy, not respectful of others, not mindful of safety, and leaves the area messy even after being reminded. |
| **Purpose** | Research question and hypothesis are stated clearly and the relationship between the two is clear;  The variables are selected. | Research question and hypothesis are stated, but one or both are not as clear as they could be, or the relationship between the two is unclear;  The variables are selected. | Research question and hypothesis are not stated clearly, and the relationship between the two is unclear or absent;  The variables are not selected. |
| **Data Collection** | Raw data, including units, are recorded in a way that is appropriate and clear;  The title of the data table is included. | Raw data, including units, are recorded although not as clearly or appropriately as they could be;  The title of the data table is included. | Raw data, including units, are not recorded in a way that is appropriate or clear;  The title of the data table is not included. |
| **Data Analysis** | Data are represented in ways (charts, tables, graphs) that best facilitate understanding and interpretation;  Error analysis is included. | Data are presented in ways (charts, tables, graphs) that can be understood and interpreted, although not as clearly as they could be;  Error analysis is included. | Data are presented in ways (charts, tables, graphs) that are very unclear;  Error analysis is not included. |
| **Evaluation of Experiment** | The results are interpreted and compared with literature values;  The limitations and weaknesses are discussed and suggestions are made on how to limit or eliminate them. | The results are interpreted and compared with literature values, but not as fully as they could be;  The limitations and weaknesses are discussed, but few or no suggestions are made as to how to limit or eliminate them. | The results are not interpreted in a logical way or compared with literature values;  The limitations and weaknesses are not discussed, nor are suggestions made as to how to limit or eliminate them. |
| (Adapted from Stevens, D.D. & Levi, A.J., (2205). *Introduction to Rubrics*. Sterling, VA: Stylus) | | | |

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| **Analytic Rubric for Undergraduate Research Project in the Sciences** | | | |
| **Attribute** | **Exemplary**  **(3)** | **Acceptable**  **(2)** | **Unacceptable**  **(1)** |
| **Statement of the Problem/ Hypothesis** | The student has independently identified and developed a research question/hypothesis that provides a contribution to the scientific literature in the research area. | The student has made independent contributions and development to a general idea or project suggested by faculty advisor. | The question under study is poorly specified and/or is completely specified by the faculty advisor with no development or contribution by the student. |
| **Role of Theory** | The experiment is a novel test of one or more current theories, or the experiment tests an important set of novel phenomena;  Relevant theory is clearly and correctly descripted so that the contribution of the experiment is clear. | The experiment tests one or more current theories or seeks to document and expand understanding of phenomena described in the empirical literature. | The experiment is unrelated or misconstrues current theory and is a poor extension of the empirical literature. |
| **Development of Idea** | Logical, testable prediction(s) are identified and tested in the final experiment;  One or more follow on experiments are conducted to expand theoretical conclusions or rule out alternative explanations. | Logical, testable prediction(s) are identified and tested in a single experiment. | The logic underlying the experiment is incorrect, badly explained, or missing entirely. |
| **Experimental Design** | The design of the experiment is novel;  Independent and dependent variable(s) have been identified and possible confounding factors are controlled. | Appropriate independent and dependent variable(s) are used;  Adequate care has been taken to control possible confounding factors. | Inappropriate independent and/or dependent variable(s) are used;  Limited effort has been taken to control possible confounding factors. |
| **Analysis & Presentation of Data** | The data analysis technique is sophisticated and appropriate for data collection, and informative with respect to the question being studied | The data analysis technique is appropriate for the data collected and correctly computed;  Data is appropriately reported and displayed so that relevant findings are obvious. | The data analysis technique is inappropriate and/or incorrectly computed;  Data displays are incorrect, sloppy, or difficult to interpret. |
| **Interpretation of Results** | The conclusions drawn are appropriate given the data and analysis conducted;  Alternative interpretations are developed into follow-on experiments to further limit conclusions. | The conclusions drawn are appropriate given the data and analyses conducted;  Alternative interpretations are considered and either convincingly rejected or used as the basis for further research suggestions. | Conclusions are inappropriate given the data;  Obvious alternative interpretations are omitted. |
| (Adapted from Brown University as cited in The University of North Carolina at Chapel Hill’s Guide to using Rubrics to Assess Student Learning: <https://oira.unc.edu/wp-content/uploads/sites/297/2017/07/Developing-and-Using-Rubrics.pdf>) | | | |

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| **Science Lab Report Evaluation Rubric** | | | | |
| This analytic rubric is used to verify specific tasks performed when producing a lab report. The rubric permits students to self-assess as well as receive feedback from the instructor. | | | | |
| **Category** | **Scoring Criteria** | **Weight** | **Student Evaluation** | **Instructor Evaluation** |
| **Lab Introduction**  **15 points** | The question to be answered during the lab is stated. | **5** |  |  |
| Research references used to prepare for the lab are listed. | **5** |  |  |
| The hypothesis clearly shows it is based on research and not just speculation. | **5** |  |  |
| **Procedures**  **15 points** | Procedures are written as part of pre-lab preparation and clearly state the plan for the experiment. If adjustments are made during the lab, those changes are noted as they occur. | **5** |  |  |
| All procedures are followed in appropriate order. | **5** |  |  |
| Specific formulas for chemicals used or equations for reactions that occur during the lab, when required, are shown on the procedures side of the lab sheet. | **5** |  |  |
| **Observations**  **15 points** | Results that occur during a procedure are clearly recorded. | **5** |  |  |
| Measurements, when required, are recorded as observations, using proper units. | **5** |  |  |
| Calculations, when required, are clearly shown on the observation side of the lab sheet. | **5** |  |  |
| **Conclusion**  **25 points** | Reasoning for the lab design is summarized, listing any facts or assumptions on which the lab is based. | **5** |  |  |
| The essential data gathered during the lab is summarized. | **5** |  |  |
| Essential data from the lab is used to answer the lab question. | **5** |  |  |
| Aspects of the lab most likely responsible for measurable experimental error are identified. | **10** |  |  |
| **Presentation**  **25 points** | The report is neatly printed in ink, with no visible corrections. | **10** |  |  |
| The report is written in such a way that others could accurately duplicate the experiment and compare their data. | **5** |  |  |
| There is a clear diagram of the essential apparatus used in the experiment drawn in the largest available white space on the front of the lab report sheet. | **10** |  |  |
| **Lab Safety**  **5 points** | No group members were cited for safety violations during the lab period. | **5** |  |  |
| **Score** | **Total Points** | **100** |  |  |
| **Self- Evaluation** | Students are expected to honestly evaluate their own work. If the difference between the student evaluation and the teacher evaluation is more than 10 points, 5 points will be deducted from the teacher’s score when the grade is recorded. | | | |
| **Deadline** | Lab reports are due at the beginning of class the day after the lab. Reports will be accepted at the beginning of class the second day after the lab for 3/4 credit. No credit will be given after this time. | | | |
| (Adapted from California State University as cited in The University of North Carolina at Chapel Hill’s Guide to using Rubrics to Assess Student Learning: <https://oira.unc.edu/wp-content/uploads/sites/297/2017/07/Developing-and-Using-Rubrics.pdf>) | | | | |

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| **Analytic Rubric for Mathematical Proofs** | | | | |
| **Attribute** | **Exemplary**  **(4)** | **Proficient**  **(3)** | **Acceptable**  **(2)** | **Unacceptable**  **(1)** |
| **Use of Mathematical Notation** | The proof uses accurate and appropriate mathematical notation and terminology;  Symbolic notation is used where it clearly simplifies the discourse and avoided when English will better serve the reader. | Notation and terminology are correctly used;  There may be instances where the discourse would benefit from either more or less use of symbols versus English. | Most, but not all, the notation and terminology are used accurately;  Errors are identifiable and correctable by a reader of experience similar to the author. | Notation and/or terminology is frequently misused;  The writer may use personal rather than standard notation. |
| **Use of Definitions** | Relevant definitions appear where needed to guide the logical flow. | The proof accurately invokes all needed definitions, though they may appear other than precisely where needed. | Some relevant definitions are missing or misstated, but the proof is otherwise understandable. | Several relevant definitions are missing or incorrectly stated, compromising the argument beyond repair. |
| **Concise Writing** | The proof is well-organized and clear, without inclusion or irrelevant definitions or theorems. | The author generally avoids digressions but may repeat some ideas in an unnecessary way. | The proof is well-organized but includes extraneous steps, definitions, theorems, or unnecessary repetition. | The proof contains several extraneous steps which lead to a confused organization. |
| **Reference to Earlier Theorems** | The proof accurately references necessary prior theorems, with explicit statements or names. | Reference to necessary prior theorems is complete but may be vague. | Some theorems necessary to the deductions are used correctly, but others are missing, misused, or stated inaccurately. | Reference to prior theorems is generally lacking, or the theorems in question are stated inaccurately. |
| **Logical Flow** | A clear, complete, and properly ordered chain of deductive steps leads from hypothesis to the conclusion;  The proof moves seamlessly between symbolic notation and standard English. | The chain of deductive steps is complete and ordered correctly. | One or more intermediate deductive steps are missing or unclear, but the correctness of the proof is not compromised. | The hypothesis or conclusion is missing or incorrectly stated;  The stated chain of deductions does not lead to the stated conclusion. |
| (Adapted from Dartmouth College as cited in The University of North Carolina at Chapel Hill’s Guide to using Rubrics to Assess Student Learning: <https://oira.unc.edu/wp-content/uploads/sites/297/2017/07/Developing-and-Using-Rubrics.pdf>) | | | | |

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| **Engineering Design Project Analytic Rubric** | | | | | |
| **Topic**  **(Weight)** | **Unacceptable**  **(0)** | **Marginal**  **(1)** | **Acceptable**  **(2)** | **Exceptional**  **(3)** | **Points** |
| **Design Problem & Boundaries**  **(1)** | Little or no grasp of problem;  Incapable of producing a successful solution. | Some understanding of the problem and constraints;  Major deficiencies that will impact the quality of solution. | Overall sound understanding of the problem and constraints;  Does not significantly impair solution. | Clear and complete understanding of design goal and constraints. |  |
| **Alternative Designs**  **(2)** | Only one design presented or clearly infeasible alternative given. | Serious deficiencies in exploring and identifying alternative designs. | Alternative approaches identified to some degree. | Final design achieved after review of reasonable alternatives. |  |
| **Use of Computer-Aided Tools**  **(2)** | Serious deficiencies in understanding the correct selection and/or use of tools. | Minimal application and use of appropriate tools. | Computer-aided tools used with moderate effectiveness to develop designs. | Computer-aided tools are used effectively to develop and analyze designs. |  |
| **Application of Engineering Principles**  **(2)** | No or erroneous application of engineering principles yielding unreasonable solution. | Serious deficiencies in proper selection and use of engineering principles. | Effective application of engineering principles resulting in reasonable solution. | Critical selection and application of engineering principles ensuring reasonable results. |  |
| **Final Design**  **(3)** | Not capable of achieving desired objectives;  No implementation of resources conservation and recycle strategies. | Barely capable of achieving desired objectives;  Minimal utilization of resource conservation and recycle potentials. | Design meets desired objectives;  Moderately effective utilization of resource conservation and recycle potentials. | Design meets or exceeds desired objectives;  Effective implementation or resource conservation and recycle strategies. |  |
| **Process Economics**  **(1)** | No or totally erroneous cost estimates presented. | Reasonable cost estimates presented, but no profitability analysis included. | Reasonable profitability analysis presented, but no interpretation of the results. | Effective use of profitability analysis leading to improvement recommendations. |  |
| **Interpretation of Results**  **(2)** | No or erroneous conclusions based on achieved results. | Serious deficiencies in support for stated conclusions. | Sound conclusions reached based on achieved results. | Insightful, supported conclusions and recommendations. |  |
| **OVERALL PERFORMANCE** | **Unacceptable** | **Marginal** | **Acceptable** | **Exceptional** | **TOTAL** |
| **POINTS REQUIRED** | **0 – 9** | **10 – 19** | **20 – 29** | **30 – 39** |  |
| (Adapted from University of Wisconsin-Milwaukee as cited in The University of North Carolina at Chapel Hill’s Guide to using Rubrics to Assess Student Learning: <https://oira.unc.edu/wp-content/uploads/sites/297/2017/07/Developing-and-Using-Rubrics.pdf>) | | | | | |