NSTA Blog
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Rubrics in Action

In-Class Activity

What are Rubrics?

A rubric is a scoring tool that outlines specific criteria and performance levels for an assignment or task. Rubrics contain criteria, or specific aspects of the assignment that will be evaluated, and performance levels, like exemplary, proficient, and developing, that describe the different levels of achievement for each criterion.

What are the Benefits of Rubrics?

Rubrics have several benefits, including, but not limited to:

- **Clear expectations:** Rubrics make assignment requirements explicit and allow students to focus on the learning goals and objectives.
- **Self-Assessment:** Rubrics allow students to monitor their progress and revise their work effectively.
- **Consistent Evaluation:** Rubrics promote fairness and consistency in grading, especially in large classes and many sections.
- **Efficient Grading:** Rubrics provide a structured framework for assignments, making grading more efficient and consistent among all submissions.

How Do I Use a Rubric?

For each student's work, carefully evaluate each criterion on the rubric, selecting the appropriate performance level. Once complete, calculate the total score by adding up the points for each section. Finally, provide further written feedback to the student, referencing specific criteria on the rubric.

How Do I Complete This Assignment?

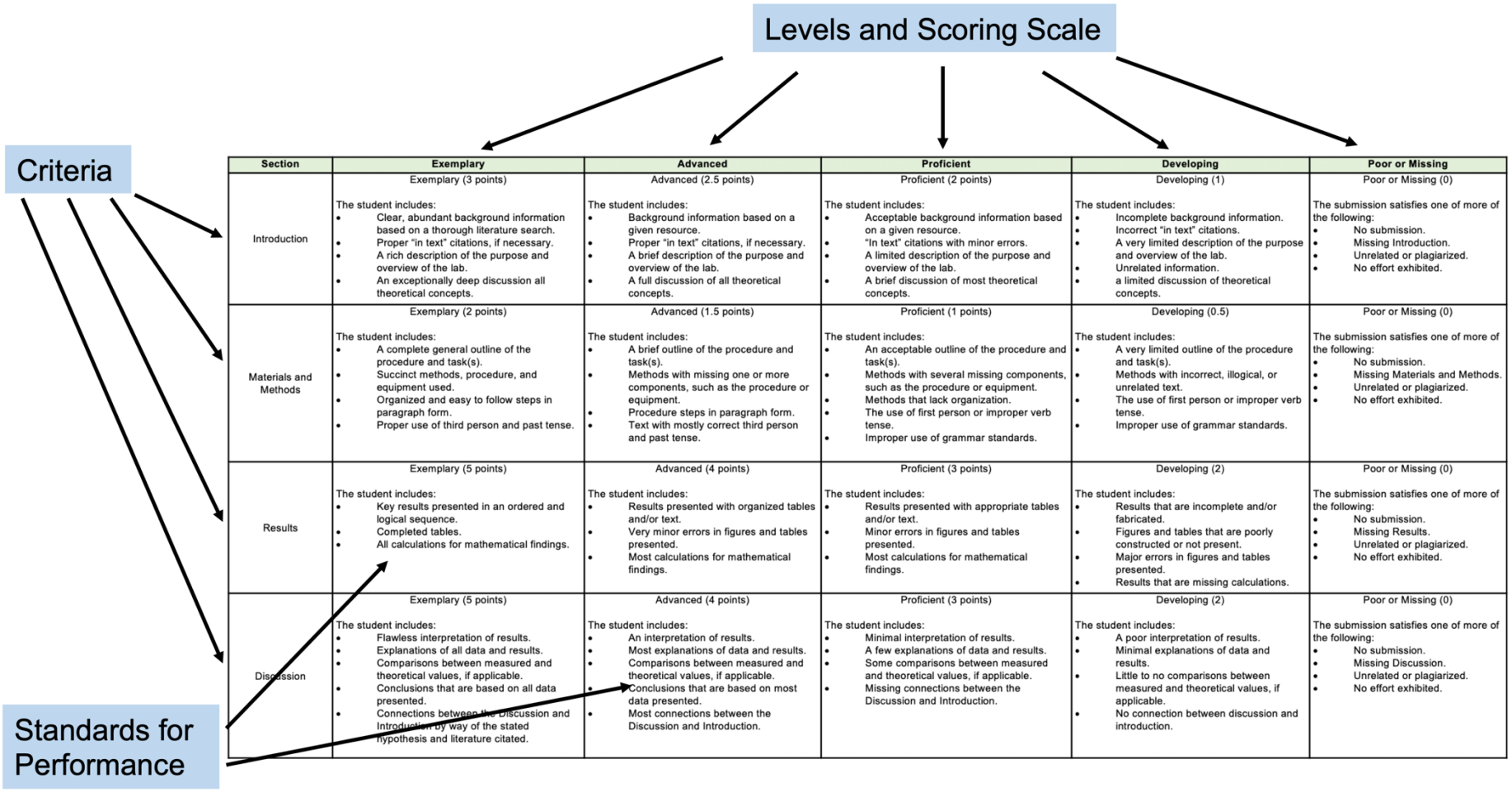
Read through the following Introduction and Discussion sections of the lab reports. Grade the assignment using the rubric provided. Include a number and supporting comments for each section.

Parts of a Rubric

Criteria. Categories being measured.

Levels. Degrees of completion, success, performances, etc.

Standards for Performance. Describe the intersection of levels and criteria.



Section	Exemplary	Advanced	Proficient	Developing	Poor or Missing
Introduction	Exemplary (3 points) The student includes: • Clear, abundant background information based on a thorough literature search. • Proper "in text" citations, if necessary. • A rich description of the purpose and overview of the lab. • An exceptionally deep discussion all theoretical concepts.	Advanced (2.5 points) The student includes: • Background information based on a given resource. • Proper "in text" citations, if necessary. • A brief description of the purpose and overview of the lab. • A full discussion of all theoretical concepts.	Proficient (2 points) The student includes: • Acceptable background information based on a given resource. • "In text" citations with minor errors. • A limited description of the purpose and overview of the lab. • A brief discussion of most theoretical concepts.	Developing (1) The student includes: • Incomplete background information. • Incorrect "in text" citations. • A very limited description of the purpose and overview of the lab. • Unrelated information. • a limited discussion of theoretical concepts.	Poor or Missing (0) The submission satisfies one of more of the following: • No submission. • Missing Introduction. • Unrelated or plagiarized. • No effort exhibited.
Materials and Methods	Exemplary (2 points) The student includes: • A complete general outline of the procedure and task(s). • Succinct methods, procedure, and equipment used. • Organized and easy to follow steps in paragraph form. • Proper use of third person and past tense.	Advanced (1.5 points) The student includes: • A brief outline of the procedure and task(s). • Methods with missing one or more components, such as the procedure or equipment. • Procedure steps in paragraph form. • Text with mostly correct third person and past tense.	Proficient (1 points) The student includes: • An acceptable outline of the procedure and task(s). • Methods with several missing components, such as the procedure or equipment. • Methods that lack organization. • The use of first person or improper verb tense. • Improper use of grammar standards.	Developing (0.5) The student includes: • A very limited outline of the procedure and task(s). • Methods with incorrect, illogical, or unrelated text. • The use of first person or improper verb tense. • Improper use of grammar standards.	Poor or Missing (0) The submission satisfies one of more of the following: • No submission. • Missing Materials and Methods. • Unrelated or plagiarized. • No effort exhibited.
Results	Exemplary (5 points) The student includes: • Key results presented in an ordered and logical sequence. • Completed tables. • All calculations for mathematical findings.	Advanced (4 points) The student includes: • Results presented with organized tables and/or text. • Very minor errors in figures and tables presented. • Most calculations for mathematical findings.	Proficient (3 points) The student includes: • Results presented with appropriate tables and/or text. • Minor errors in figures and tables presented. • Most calculations for mathematical findings.	Developing (2) The student includes: • Results that are incomplete and/or fabricated. • Figures and tables that are poorly constructed or not present. • Major errors in figures and tables presented. • Results that are missing calculations.	Poor or Missing (0) The submission satisfies one of more of the following: • No submission. • Missing Results. • Unrelated or plagiarized. • No effort exhibited.
Discussion	Exemplary (5 points) The student includes: • Flawless interpretation of results. • Explanations of all data and results. • Comparisons between measured and theoretical values, if applicable. • Conclusions that are based on all data presented. • Connections between the Discussion and Introduction by way of the stated hypothesis and literature citated.	Advanced (4 points) The student includes: • An interpretation of results. • Most explanations of data and results. • Comparisons between measured and theoretical values, if applicable. • Conclusions that are based on most data presented. • Most connections between the Discussion and Introduction.	Proficient (3 points) The student includes: • Minimal interpretation of results. • A few explanations of data and results. • Some comparisons between measured and theoretical values, if applicable. • Missing connections between the Discussion and Introduction.	Developing (2) The student includes: • A poor interpretation of results. • Minimal explanations of data and results. • Little to no comparisons between measured and theoretical values, if applicable. • No connection between discussion and introduction.	Poor or Missing (0) The submission satisfies one of more of the following: • No submission. • Missing Discussion. • Unrelated or plagiarized. • No effort exhibited.

Part 1: Introductions

Directions. Read the following three sample introductions and use the General Introduction Rubric (below) to grade the assignment. Then provide any written feedback that would help the author of this text.

Sample Introduction 1

Density is mass per unit volume. Mass can be found by weighing something on a scale. Volume can be measured using length, width, and height for things that are shaped regularly. For irregular things, we use volume displacement. Different substances have different densities, like gold and silver. But copper, no matter the size, has the same density because it's an intrinsic property.

This lab was about finding the density of water, ethanol, and copper. We also looked at how to dilute copper sulfate solutions.

General Introduction Rubric

Section	Exemplary (3 points)	Advanced (2.5 points)	Proficient (2 points)	Developing (1 point)	Poor or Missing (0 points)
Introduction	Includes clear, abundant background information based on literature; proper in-text citations; rich description of purpose and lab overview; deep discussion of theoretical concepts.	Includes background information from given resources; proper in-text citations; brief description of purpose/overview; full discussion of theoretical concepts.	Includes acceptable background information; in-text citations with minor errors; limited description of purpose/overview; brief discussion of most theoretical concepts.	Includes incomplete background information; incorrect/missing citations; very limited purpose/overview; unrelated or superficial theoretical discussion.	No submission, missing Introduction, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 3
Comment(s):

Sample Introduction 2

Density, an intrinsic property, is defined as the mass per unit volume of a substance. Unlike extrinsic properties, density remains constant regardless of the amount or shape of the substance present. For instance, a copper block and a copper sinker, despite their different shapes, will possess the same theoretical density.

Mass, a fundamental property of matter, can be precisely determined using an electronic balance. Volume, the amount of space occupied by a substance, can be measured through various techniques depending on the object's geometry. For regularly shaped objects, such as a copper block with uniform sides, volume is calculated by multiplying its length, width, and height (V = L x W x H). Conversely, the volume displacement method is employed for irregularly shaped objects, where the volume of the object is equivalent to the volume of fluid it displaces.

The purpose of this experiment was to determine the densities of water, ethanol, and copper using various measurement techniques and to investigate the effects of dilutions on copper (II) sulfate solutions. This investigation involved applying fundamental principles of density calculation and solution preparation.

General Introduction Rubric

Section	Exemplary (3 points)	Advanced (2.5 points)	Proficient (2 points)	Developing (1 point)	Poor or Missing (0 points)
Introduction	Includes clear, abundant background information based on literature; proper in-text citations; rich description of purpose and lab overview; deep discussion of theoretical concepts.	Includes background information from given resources; proper in-text citations; brief description of purpose/overview; full discussion of theoretical concepts.	Includes acceptable background information; in-text citations with minor errors; limited description of purpose/overview; brief discussion of most theoretical concepts.	Includes incomplete background information; incorrect/missing citations; very limited purpose/overview; unrelated or superficial theoretical discussion.	No submission, missing Introduction, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 3
Comment(s):

Sample Introduction 3

Density is mass divided by volume. I can find mass with a scale. I can find volume by length times width times height. We also used volume displacement. Gold and silver have different densities. Copper always has the same density.

I wanted to find the density of water, ethanol, and copper. I also wanted to see how to make solutions weaker.

General Introduction Rubric

Section	Exemplary (3 points)	Advanced (2.5 points)	Proficient (2 points)	Developing (1 point)	Poor or Missing (0 points)
Introduction	Includes clear, abundant background information based on literature; proper in-text citations; rich description of purpose and lab overview; deep discussion of theoretical concepts.	Includes background information from given resources; proper in-text citations; brief description of purpose/overview; full discussion of theoretical concepts.	Includes acceptable background information; in-text citations with minor errors; limited description of purpose/overview; brief discussion of most theoretical concepts.	Includes incomplete background information; incorrect/missing citations; very limited purpose/overview; unrelated or superficial theoretical discussion.	No submission, missing Introduction, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 3

Comment(s):

Part 2: Discussions

Directions. Read the following two sample discussions and use the General Discussion Rubric (below) to grade the assignment. Then provide any written feedback that would help the author of this text.

Sample Discussion 1

I learned about density in this lab. My water density was 1.0 g/mL, which is good because the real density is 1.0 g/mL. My ethanol density was 0.8 g/mL, and the real density is 0.789 g/mL, so that's close. Copper was 8.8 g/mL both times, but the real density is 8.96 g/mL. Why was it the same? I guess because density is just density. We also made solutions.

I think some errors were from me measuring wrong. Like, I might not have read the volume correctly. The scale could also be off. I think the copper might have had some air on it when I put it in the water. That made my numbers wrong.

General Discussion Rubric

Section	Exemplary (5 points)	Advanced (4 points)	Proficient (3 points)	Developing (2 points)	Poor or Missing (0 points)
Discussion	Flawless interpretation of results; thorough explanations of data; clear comparison of measured vs. theoretical values; conclusions grounded in data; connects discussion directly to introduction and hypothesis.	Solid interpretation of results; explains most data/results; compares measured vs. theoretical values; conclusions based on most data; connects discussion to introduction.	Minimal interpretation of results; explains a few data points; some comparison of measured vs. theoretical values; lacks connections between discussion and introduction.	Poor interpretation of results; minimal data explanation; little to no comparison to theoretical values; generic error analysis ("human error").	No submission, missing Discussion, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 5

Comment(s):

Sample Discussion 2

In this lab, we found the densities of water, ethanol, and copper, and also made some diluted copper solutions. The density of water was 1.00 g/mL, which was very close to the theoretical density of 1.00 g/mL, with 0% error. For ethanol, the calculated density was 0.79 g/mL, and the theoretical density is 0.789 g/mL, so the percent error was about 0.13%. We expected water to be denser than ethanol. The copper block had a density of 9.0 g/cm^3 using length x width x height, and 9.0 g/mL using volume displacement. The theoretical density is 8.96 g/mL. Both had about 0.45% error. The density of copper was the same even though we measured its volume in two different ways. This is because density is an intrinsic property.

Some things that could have gone wrong are errors in reading the graduated cylinder, like not looking at the meniscus correctly. Also, the electronic scale might have had some error. For the volume displacement, maybe there were some air bubbles. These errors could have made our calculated densities a little bit off from the real values.

General Discussion Rubric

Section	Exemplary (5 points)	Advanced (4 points)	Proficient (3 points)	Developing (2 points)	Poor or Missing (0 points)
Discussion	Flawless interpretation of results; thorough explanations of data; clear comparison of measured vs. theoretical values; conclusions grounded in data; connects discussion directly to introduction and hypothesis.	Solid interpretation of results; explains most data/results; compares measured vs. theoretical values; conclusions based on most data; connects discussion to introduction.	Minimal interpretation of results; explains a few data points; some comparison of measured vs. theoretical values; lacks connections between discussion and introduction.	Poor interpretation of results; minimal data explanation; little to no comparison to theoretical values; generic error analysis ("human error").	No submission, missing Discussion, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 5

Comment(s):

Sample Discussion 3

This investigation aimed to determine the densities of water, ethanol, and copper, and to examine the preparation of dilute copper (II) sulfate solutions. The calculated density of water was 1.003 g/mL, which demonstrated a low percent error of 0.3% compared to the theoretical value of 1.00 g/mL. The density of ethanol was determined to be 0.787 g/mL, resulting in a 0.25% error when compared to its theoretical density of 0.789 g/mL. Both values are consistent with the understanding that water is denser than ethanol at room temperature. The densities of the copper block, measured by both the length x width x height method and volume displacement, were 8.97 g/cm^3 and 8.97 g/mL, respectively. Both measurements yielded a 0.11% error compared to the theoretical density of 8.96 g/ cm^3. The consistency in the calculated density of copper across different measurement techniques is expected because density is an intrinsic property of a substance, meaning it is independent of the sample's size or shape.

Potential sources of error in this experiment include inaccuracies in reading the meniscus in the graduated cylinder, leading to imprecise volume measurements. For example, if the volume of water was read slightly high, the calculated density would be artificially low. Similarly, minor variations in temperature could affect the density of the liquids, as theoretical densities are often reported at specific temperatures. In the volume displacement method, air bubbles clinging to the copper sinker could lead to an overestimation of the displaced volume, thereby underestimating the calculated density. For the copper block measured by dimensions, slight imperfections in the block's shape or human error in measuring precise lengths could introduce discrepancies. The dilutions of copper (II) sulfate solutions showed a clear trend of decreasing color intensity with decreasing concentration, which qualitatively supports the accuracy of the prepared solutions.

General Discussion Rubric

Section	Exemplary (5 points)	Advanced (4 points)	Proficient (3 points)	Developing (2 points)	Poor or Missing (0 points)
Discussion	Flawless interpretation of results; thorough explanations of data; clear comparison of measured vs. theoretical values; conclusions grounded in data; connects discussion directly to introduction and hypothesis.	Solid interpretation of results; explains most data/results; compares measured vs. theoretical values; conclusions based on most data; connects discussion to introduction.	Minimal interpretation of results; explains a few data points; some comparison of measured vs. theoretical values; lacks connections between discussion and introduction.	Poor interpretation of results; minimal data explanation; little to no comparison to theoretical values; generic error analysis ("human error").	No submission, missing Discussion, plagiarized text, or no effort exhibited.

Grade and Supporting Comment(s)

Grade: _____ out of 5

Comment(s):