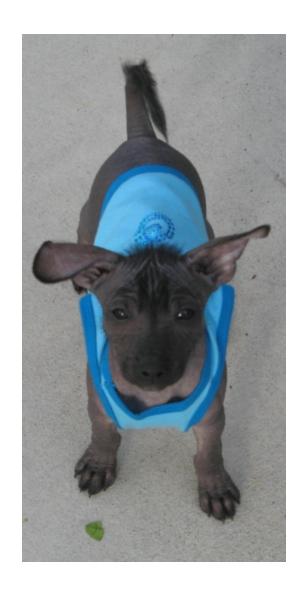# The Importance of Rubric Design in Scientific Writing;
Giving Students an Input

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Overview

- Why have students design rubrics

- Rubric architecture

- How is design incorporated

- Study design

- Activity

Class Example Activity

- Mock summary of a Materials and Methods
- 2nd lecture (Small group activity)
- Required to read the article before
- Content summary before activity

Scientific writing **requires** conciseness and precision. Unnecessary details, redundancy, digressions, vague or inaccurate statements each weaken your scientific argument.

Learning Goal: Use rubrics to help you improve your writing

Objective: Demonstrate the ability to:

- read a paper critically

- evaluate the holistic quality of a student summary

- assess the quality of a rubric

Cognitive Learning

(Bloom's Taxonomy)

Analysis

•The ability to break information into parts to understand it better.

Evaluation

•The ability to check, judge, and critique materials.

Using Rubrics: Introduction to Activity

- A lower division writing course is a prerequisite for Bio100. You have probably taken Writing 39B (Critical Reading and Rhetoric) and 39C (Argument and Research). While Bio100 may be your first exposure to scientific writing, you have a background in rhetorical writing and critical thinking.

- Each writing assignment requires many of the same concepts used in rhetorical essays for 39B and 39C

  – Keep a central theme flowing through the paper.

  – Interest the reader.

  – Write at the level of the intended audience.

  – Avoid complex words, obscure abbreviations and acronyms.

  – Use active and passive voices appropriately.

  – Avoid ambiguous pronouns.

  – Vary sentence structure.

  – Employ simpler sentences over long, complicated sentences.

Activity

1. Read the Materials and Methods section for the paper on "A stepwise model system for limb regeneration" (Endo, T., Bryant, S.V., Gardiner, D.M. 2004. A stepwise model system for limb regeneration. *Dev. Biol*. 270:135-145).

2. Work in groups of four to six.

3. Read the "Student Summary" of the Materials and Methods section for the paper on "A stepwise model system for limb regeneration" (*Endo et al.*, 2004).

4. Grade the "Student Summary" on the following objectives.

    1. The paper includes all pertinent information and details
    2. The paper avoids unnecessary information
    3. The paper is organized in a logical manner
    4. The paper is easy to read and understand

Example Rubric

Content Objective (criteria)	Full credit	75% credit	50% credit	25 % credit	No Credit
Included all pertinent information and details	Complete with a clear understanding	Major points with reasonable understanding	Superficial, missing points	Limited and simplistic	Overall poor quality
Avoided unnecessary information	Concise	Mostly concise	Unnecessary information	A lot of unnecessary information	Overall poor quality
Organized in a logical manner	Clearly focused argument, good paragraph transitions, well organized	Somewhat focused and organized, problems with transitions	Organization problems, transition & flow problems	Focus and organization problems	Overall poor quality
Easy to read and understand	Yes, no ambiguous terms or phrases	Generally readable with minor confusion or ambiguity	Overall reasonable, but sections and terms ambiguous	Had to reread sentences to understand content	Overall poor quality

After Grading the Student Summary

- Would the "Student Summary" lose any points for?
  - Inaccurate citations
  - Inaccurate statements
  - Wordiness or use of unscientific phrases
  - Grammatical and spelling errors
- If so, please identify them

What advice would you give this student to help them?

"Student Summary"

The researchers used axolotls that were born at Indiana or UCI. When they wanted to do surgery on them they used an anesthesia called MS222. Then they would cut off their legs to cause a new leg to be grown. Sometimes they would move the nerve around or add an extra piece of skin. After a while they would amputate the limbs and fixed the tissue so they could look at it using immunohistochemistry. Each section was washed with PDST and then incubated with the antibiotic BrdU to help see the cells. The researchers add a cell tracker dyes to label the cells next to the wound. Observations were made and then were photographs taken.

Class Results

Content Objective (criteria)	Full credit	75% credit	50% credit	25 % credit	No Credit
Included all pertinent information and details	6-10%	36-50%	30-40%	5-20%	1-3%
Avoided unnecessary information	7-12%	Somewhat focused and organized, problems with transitions	Organization problems, transition & flow problems	22-26%	6-8%
Organized in a logical manner	2-4%	8-12%	30-35%	42-45%	11-15%
Easy to read and understand	15-20%	15-41%	19-40%	3-13%	1-2%

Rubric Architecture

- Criteria (Question)
  - Exact requirements
  - Assignment objectives

- Rating Scale (Levels of performance)
  - 3 (Above, Meets, Below)
  - 4 (Mastery, Good, Some Evidence, Little or No Evidence)
  - 7

Types

- Analytic

- Holistic

Incorporating Upper Division Rubric into 7 Level Rating Scale

Elements

1. Critical Thinking and Analysis
2. Use of Evidence and Research
3. Development and Structure
4. Generic and Disciplinary Conventions

	Elements at			
Rating	Mastery	Good	Some Evidence	Little or No Evidence
7	All			
6	3*	1		
5	2	2		
4		4		
4	1	3		
3		3	1	
3		2	2	
3		1*	3	
2			3	1
2			2*	2
1				4
	* Must be in Critical Thinking			

Rating Scale: Seven Levels

7	**A+++++**	Student demonstrates superior understanding and logic, supported and integrated their statements in a concise and precise manner
6	**A**	Student demonstrates very good understanding but a small amount of supporting material is missing (Narrative is still concise and precise)
5	**A-,B+**	Student demonstrates very good understanding but narrative is not precise or concise
4	**B**	Student demonstrates very good understanding but does not include supporting materials
3	**B-, C+**	Student demonstrates average understanding but is missing elements or logic is flawed
2	**C**	Student demonstrates average understanding but the assignment text is more of a list than an narrative
1	**D**	Student shows little understanding of the assignment (If assignment text contains quotes, the quoted material should be assumed to not be present when grading the assignment.)

How is rubric design incorporated?

Why have students design rubrics
Rubric architecture
How is design incorporated
Study design
Activity

1. Mock summary of a Materials and Methods

2. 4 rating level Hypothesis rubric design

3. 1st assignment

   – Draft rubric available before draft due

   – In class grading of examples with draft rubric

   – Discussion about "problems" with the rubric

4. 2nd and 3rd assignments

   – Draft rubric available before draft due

   – In class grading of examples with draft rubric

   – Voting on what rubrics should be changed

   – Group redesign of specific rubric question rating level criteria

   – Filtering of rubric designs by TAs and instructors

   – Class voting for rubric to be used

Study

Why have students design rubrics
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Activity

- Students design 7 level ratings for 2 of 10 rubric criteria for each assignment

- Compare inter-rater reliability
  - Students use a peer review program called **Peer**ceptiv™ (Panther Learning)

- Compare quality of rubric design to quality of student's work (longitudinally)

Activity
Redesigning Rubrics

Design **1** of the possible 7 levels for the Criteria

Did the student include relevant background information for an audience of peers who have taken the UCI Bio core?

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2	C	Student demonstrates average understanding but the assignment text is more of a list than an narrative
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Did the student include relevant background information for an audience of peers who have taken the UCI Bio core?

#7: Student demonstrated excellent understanding of relevant background material. Student gave brief general background and a more concise focused background. The context and purpose of the experiments were included in the writing. Student demonstrated an exemplary lead into the hypothesis.

#6: Student demonstrated good understanding of the background material. They provided brief general background and focused background. Student demonstrated a good lead into the hypothesis. The context and purpose of the experiments were included in the writing. Student demonstrated a good lead into the hypothesis.

#5: Student provides adequate background information for the experiment. Student demonstrated satisfactory amount of understanding of the background information. They provided brief general background and focused background, although the ratio of the two were not ideal. The context and purpose of the experiments were included in the writing to a modest extent. Student demonstrates a fair lead into the hypothesis.

#4: Student demonstrated an average understanding of relevant background material, although minor details were missing. Student gave excess general background and an insufficient focused background. The context and purpose of the experiments were moderately included in the writing. Student demonstrated a mediocre lead into the hypothesis.

#3: Student demonstrated a slightly below average understanding of background material. Student gave excessive general background and an insufficient focused background. The context and purpose of the experiments were not included in the writing. Student demonstrated a below average lead into the hypothesis. Major details were missing. Student could use improvement for the lead into the hypothesis.

#2: Student demonstrated poor understanding of relevant background material. Student gave insufficient or excessive general background and insufficient or no concise focused background. The context and purpose of the experiments were missing in the writing. Student did not demonstrate a lead into the hypothesis. Student includes irrelevant material.

#1: Student failed to demonstrate any understanding of background material. Student gave no general background or no concise focused background. The context and purpose of the experiments were not included in the writing. Student did not demonstrate a lead into the hypothesis. Student included inaccurate or false statements and misrepresented facts.

What was the most helpful class activity?

- "Rubric design because they make us think about what is important in a good paper."

- "I liked designing the rubric design with my group because it allowed me to discuss with my group what was required of assignment 2 and 3. It helped answer my questions with respect to both assignments."

- "Rubric design so that everyone could see how difficult it is to come up with a rubric."

Questions?

Original Text

Animals

Axolotls (*Ambystoma mexicanum*) were spawned at either the Indiana University Axolotl Colony or at the University of California, Irvine. Larvae (4.5–8 cm, snout to tail tip) were maintained at 20–22°C in 20% Holtfreter's solution. Animals were anesthetized in 0.1% MS222 solution for surgical procedures.

Surgical procedures

To induce ectopic blastemas (bumps), a square of skin (1.0–1.5 mm on a side) was removed from the anterior or posterior side of the mid-upper arm, making sure that the underlying muscle was not damaged. A ventral incision was made from the shoulder to the elbow, and the brachial nerve was dissected free and severed at the elbow level. The nerve was rerouted beneath the skin to bring the cut end to the center of the skin wound.

To induce ectopic limbs, skin wounds were made as described above, except that a rectangular piece of skin (1–1.5 × 2–3 mm) was removed. A square piece of skin was removed from the opposite position on the contralateral limb (i.e., posterior for an anterior wound and vice verse) and grafted to the site of the skin wound. Skin grafts were labeled with carbon particles (ink) to confirm that grafted tissues had healed into the host site.

To test if the growth of the bump is nerve-dependent or independent, we performed denervation of bumps. Bumps were made as described above, and at days 6 and 10 after nerve deviation, the 3rd, 4th, and 5th spinal nerves were exposed at the scapula level and severed.

Immunohistochemistry and histology

Limbs were amputated at the shoulder level, fixed overnight in 10% neutral buffered formalin, processed and embedded in paraplast, and sectioned at 10 μm. For BrdU and acetylated-tubulin immunohistochemistry, sections were de-paraffinized and rehydrated in PBS with 0.1% Tween 20 (PBST). BrdU samples were treated with 2 M HCl at 37°C for 60 min. Sections were incubated with anti-BrdU antibody (Roche, diluted 6:100) or anti-acetylated tubulin antibody (Sigma, diluted 1:1000) for 60 min at room temperature (RT). Sections were washed several times in PBST and incubated with 1:50 alkaline phosphatase (AP)-conjugated anti-mouse IgG (Sigma) at RT for 60 min. Sections were washed with PBST and incubated in NBT/BCIP (Roche) reaction mix for 30 min. For routine histology, sections were stained with either hematoxylin and eosin or Mallory's triple stain ([Humason, 1979](#)).

DiI labeling

CellTracker CM-DiI (chloromethylbenzamide; Molecular Probes) in ethanol (0.5%) was diluted 1:9 with 0.3 M sucrose containing 0.1% Nile blue sulfate ([Li and Muneoka, 1999](#)) and used to label dermal cells adjacent to wounds. To label cells in vivo, small volumes of DiI were injected with a fine glass capillary needle inserted through the intact skin into the space between the skin and the underlying muscle and connective tissues. One day after injection, a skin wound was made adjacent to the location of the DiI-labeled cells (visualized using a fluorescence dissecting microscope). To label cells in vitro, a piece of skin adjacent to a wound was placed dermal surface up in a sterile culture dish. DiI was microinjected into the dermal connective tissue layer multiple times, and the skin was then grafted back to its original location adjacent to the lateral wound. Labeled cells in bumps were observed in sections. In wounds, DiI-labeled cells were observed and photographed in anesthetized animals using a fluorescence dissecting microscope.

"Mock Summary"

The researchers used axolotls that were born at Indiana or UCI. When they wanted to do surgery on them they used an anesthesia called MS222. Then they would cut off their legs to cause a new leg to be grown. Sometimes they would move the nerve around or add an extra piece of skin. After a while they would amputate the limbs and fixed the tissue so they could look at it using immunohistochemistry. Each section was washed with PDST and then incubated with the antibiotic BrdU to help see the cells. The researchers add a cell tracker dyes to label the cells next to the wound. Observations were made and then were photographs taken.

UCI
Upper Division Writing Rubric

Across all disciplines

Critical Thinking and Analysis

- **Mastery:** The approach is insightful, and/or creative, persuasive, unique, and worth developing.
  - The level of thinking/analysis is sophisticated
  - The ideas are clearly communicated with focus and specificity
  - The content seems expertly tailored to disciplinary audience
- **Good:** The approach is acceptable, reasonable, thoughtful
  - The level of thinking/analysis is appropriate
  - The ideas offered are usually specific and focused
  - Some ideas are insightful
  - The ideas are usually communicated clearly
  - The writer has take some care to include content appropriate to the disciplinary audience
- **Some Evidence:** The approach is adequate (even if barely so)
  - Some evidence of critical thinking/analysis
  - Some of the ideas offered are clearly thought-through and appropriate
  - The writer has included content that is relevant to the disciplinary audience
- **Little or no Evidence:** The approach is inadequate or indeterminable.
  - Little evidence of critical thinking or analysis
  - While some ideas have merit, the level of insight or the clarity of the presentation are lacking
  - Other facets or perspectives are missing, or simplistic or inappropriate
  - Focus is lacking
  - Unclear
  - Awareness of disciplinary audience is minimal

Use of Evidence/Research

– **Mastery:** Evidence and sources used appropriately, with understanding of discipline
  - Considers previous knowledge in discipline
  - Sources used to develop writer's purpose
  - Evidence and sources are clearly and correctly represented and integrated smoothly
  - Correct and appropriate use of citation methods

– **Good:** Uses evidence and sources appropriately and sometimes effectively with understanding of discipline
  - Shows awareness of previous knowledge in discipline
  - Evidence and sources generally contribute to author's purpose
  - Evidence and sources usually clear, with no misreading
  - Evidence and sources smoothly integrated into author's purpose (the writer controls the ideas, the sources do not)
  - Correct and appropriate use of citation methods

– **Some Evidence:** Some evidence and sources used appropriately to further writer's argument
  - Some evidence of discipline
  - Evidence and sources presently somewhat clearly, although some misreading or simplification may occur
  - Evidence and sources may overwhelm the author's voice and purpose
  - Evidence and sources usually integrated into writing
  - Some success with citations and quotations

– **Little or no Evidence:** Evidence and sources, if present, are often used inappropriately, simplistically or are misread
  - Little or no evidence of understanding of discipline
  - Evidence and sources are mismatched with writer's purpose
  - Lack of awareness of citation and documentation standards

Development & Structure

- **Mastery:** Writing is clear and organized
  - Coherent
  - Contributes to the overall purpose of the writing
  - Insightful, specific and focused
  - Development of ideas is organized into paragraphs or sections
  - Sophisticated transitions used to progress logically
  - Reader is effortlessly guided through progression of ideas
- **Good:** Prose illustrates the writer's understanding of discipline
  - The organization is apparent
  - Usually coherent
  - Usually contributes to the overall purpose of the writing
  - Usually specific and focused
  - Development of ideas is somewhat insightful and follows a logical progression
  - Appropriate transitions connect ideas and show relations between ideas. Some transitional devices are used.
  - Reader is guided through progression of ideas
- **Some Evidence:** Prose sometimes illustrates writer's understanding
  - Organization is apparent, usually coherent and sometimes contributes to the overall goals
  - Development of ideas is sometimes insightful, specific, focused and logical
  - Some transitional devices are used to connect ideas
  - The reader can follow chain of reasoning or progression of ideas
- **Little or no Evidence:** Prose does not clearly illustrate writer's understanding
  - Organization is random, simplistic or inappropriate and rarely contributes to overall goals
  - Some development of ideas evident, but with little insight, focus or logic
  - Lacks coherence
  - Few or inappropriate transitional devices used
  - Reader has difficulty following reasoning or ideas

Generic & Disciplinary Conventions

- **Mastery:** Writing is styled and eloquent with an easy flow, rhythm and cadence
  - Sentences have a clear purpose and vary in structure
  - Sentences and paragraphing show skill with a wide range of rhetorical, disciplinary or generic conventions
  - Words chosen for precise meaning and appropriately specific
  - Illustrates writer's facility within discipline's discourse
  - Mechanics (spelling, punctuation, grammar, etc.) enhance overall readability and purpose
  - Almost entirely free of errors showing careful proofreading and editing
- **Good:** Writing is appropriately styled and has an easy flow, rhythm and cadence
  - Sentences are purposeful and varied in structure
  - Sentences and paragraphing show an appropriate use of rhetorical, disciplinary or generic conventions
  - Writer usually chooses words precisely and appropriately specific
  - Author's understanding of discipline is illustrated
  - Mechanics contribute to the overall purpose
  - Almost free of errors showing proofreading and editing occurred
  - Errors do not detract from readability
- **Some Evidence:** Writing illustrates some aspects of style and rhythm
  - Sentences are varied in structure
  - Sometimes, the writer illustrates understanding of rhetorical, disciplinary or generic conventions
  - Words sometimes chosen for precise meaning and specificity
  - Mechanics contribute to overall purpose
  - Some errors occur, but without detracting reader
- **Little or no Evidence:** Writing lacks polish, flow or rhythm.
  - Sentences often lack purpose
  - Structure lacks much variety
  - Writing shows lacks use of rhetorical, disciplinary or generic conventions
  - Word choice is often inappropriate or generalizes
  - Writing shows little understanding of disciplinary discourse
  - Mechanics detract from overall purpose
  - Error evident illustrate lack of proofreading or editing or inability to control language