Re-envisioning a Comparative Physiology Course – The Assessment Data

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Curriculum Reform

Completed in 2016

Reasons for Curriculum Reform

- Alignment with Vision and Change:
  - National call to action from the American Association for the Advancement of Science and the National Science Foundation – changing biology education

- Flexibility for students and faculty

Core/Foundational Classes

Biology Curriculum

Core/Foundational Biology courses (both tracks) - 6 courses

General Biology I (BL 1250/51)
General Biology II (BL 1300/01)
Introduction to Research (BL 2000)
Genetics (BL 3610/11)
Evolution (BL 4800)
Biology Capstone (BL 4940)

Required related courses (both tracks)

General Chemistry I and II (CH 2610 and 2630)

Recommended related courses

Statistics (PH 4900 or PY 2100); Organic Chemistry I and II (CH 2710/20 and 2730/40); Physics I and II (PH 2800/10 and 2900/10); Biochemistry (CH 3310); Calculus I (MT 1800)

Organismal Track requirements

Three Organismal courses

General Physiology (BL 3700/01)	Odd Year: Fall
Plant Biology (BL 3350/51)	Even Year: Fall
Comparative Vert Anatomy (BL 3400/01)	Odd Year: Spring
Invertebrate Zoology (BL 3200/01)	Even Year: Spring

One Molecular course

Immunology (BL 4700/01)	Fall
Biotechnology (BL 4600/01	Fall
Molecular Biology (BL 3650/51)	Spring
Cell Biology (BL 3620/21)	Spring

One Systems course

Environmental Biology (BL 3460/61)	Odd Year: Fall
Ecology (BL 4810/11)	Even Year: Fall
Animal Behavior (BL 3230)	Odd Year: Spring
Field Biology (BL 3320 or BL 3330)	Even Year: Spring local Odd Year: Spring abroad

Molecular Track requirements

Three Molecular courses

Immunology (BL 4700/01)	Fall
Biotechnology (BL 4600/01)	Fall
Molecular Biology (BL 3650/51)	Spring
Cell Biology (BL 3620/21)	Spring

One Organismal course

General Physiology (BL 3700/01)	Odd Year: Fall
Plant Biology (BL 3350/01)	Even Year: Fall
Comparative Vert Anatomy (BL 3400/01)	Odd Year: Spring
Invertebrate Zoology (BL 3200/01)	Even Year: Spring

One Systems course

Environmental Biology (BL 3460/61)	Odd Year: Fall
Ecology (BL 4810/11)	Even Year: Fall
Animal Behavior (BL 3230)	Odd Year: Spring
Field Biology (BL 3320 or BL 3330)	Even Year: Spring local Odd Year: Spring abroad

Two Elective Courses

Microbiology (BL 3100/01)

Human Anatomy/Physiology I (BL 3030/31

Huamn Anatomy/Phsiology II BL 3040/41)

Parasitology (BL 4200)

Any additional organismal, molecular, or systems courses may be taken as electives.

Changes to Anatomy and Physiology Offerings

- Human A&P I and II transitioned from 2000 level to 3000 level
- Both Human A&P courses can count as electives for the major
- Advanced Human Anatomy was discontinued
- General Physiology transitioned from a mammalian/human focus to a comparative course that covered plant, fungi, and animal physiology

Gen Phys Course Objectives

- Develop a basic understanding of the physiological processes governing the following processes in plants, fungi, and animals
  - Water: osmoregulation/water balance
  - Energetics/nutrition
  - Response to the environment
  - Reproduction
- Critically analyze and articulate scientific information in writing and via a poster presentation

Writing Intensive

- **Washington Post Article** - "Why can't college graduates write coherent prose?" By Jeffrey J. Selingo (2017)[1]
- **Rockhurst University Learning Themes:**
  - Communication: The ability to communicate effectively in a variety of contexts and with awareness of purpose and audience.
- **Rockhurst Biology Department SLO**
  - Articulate scientific information both orally and in writing

Class Structure

- Met Tuesday and Thursday for 75 minute class
- Tuesday class: Lecture outlining physiological processes
- Thursday class: Students present and discuss primary literature
- Lab closely followed material in lecture (emphasized evolution)

Literature reviews (3 @100 pts each)	300 pts
Poster presentation (50 pts)	50 pts
Weekly written worksheet (15 @ 20 pts each)	300 pts
Weekly participation (15 @10 pts each)	150 pts
Total	800 pts

Participation Rubric[2]

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	Exemplary (90%- 100%)	Proficient (80%-90%)	Developing (70%-80%)	Poor (70%-60%)	Unacceptable (<60%)
Attendance	Arrives to class on time, is prepared before the class has started	Arrives to class on time, takes a few minutes of class time to prepare	Arrives a few minutes late, takes a few minutes of class time to prepare	Arrives more than 5 minutes late	Does not attend class
Distractions	No distracted behavior (e.g. looking at cell phones, websites other than those related to class, etc.)	Fewer than 3 distracted behavioral events observed	Between 5-7 distracted behavioral events observed	More than 7 distracted behavioral events observed	Little to no attention is paid to the class
Frequency of participation in class	Initiates contributions more than twice in each class.	Initiates contribution once in each class.	Initiates contribution at least in half of the classes each week	Does not initiate contribution & needs instructor to solicit input	Does not initiate contribution & does not respond to instructor
Quality of comments	Comments always insightful & constructive; uses appropriate terminology. Comments balanced between general impressions, opinions & specific, thoughtful criticisms, questions, or contributions. Students has prepared for class.	Comments mostly insightful & constructive; mostly uses appropriate terminology. Occasionally comments or questions are too general or not relevant to the discussion. Some class preparation is obvious.	Comments are sometimes constructive, with occasional signs of insight. Student does not use appropriate terminology; comments not always relevant to the discussion. Questions indicate a lack of preparation.	Comments are uninformative, lacking in appropriate terminology. Heavy reliance on opinion & personal taste, e.g., "I love it", "I hate it", "It's bad" etc. Questions indicate no class preparation.	No comments or questions are made.
Listening Skills	Student listens attentively when others present materials, perspectives, as indicated by comments that build on others' remarks, i.e., student hears what others say & contributes to the dialogue.	Student is mostly attentive when others present ideas, materials, as indicated by comments that reflect & build on others' remarks. Occasionally needs encouragement or reminder from the instructor of focus of comment.	Student is partly attentive when others present ideas, materials, as indicated by comments that reflect & build on others' remarks. Needs encouragement or reminder from the instructor of focus of comment repeatedly.	Student is often inattentive and needs reminder of focus of class. Occasionally makes disruptive comments while others are speaking.	Does not listen to others; regularly talks while others speak or does not pay attention while others speak; detracts from discussion; sleeps, etc.

Weekly Worksheets

- Why is water required for life to exist? (Audience = 6 year olds)

- Explain water potential to a non-science major, college graduate. Your answer must include an explanation of osmotic and pressure potential and cover the information presented in slides 10-18. You may use scientific terms but clarify them so that someone who has not taken a science class could understand your point. You may write as much as you like although if you go over 5 pages, I may get cranky grading your assignment.

- Explain why etiolation is necessary for proper germination. Your answer needs to include the morphological difference between dark and light grown plants. Audience – high school biology

Weekly Worksheets

- On Google scholar, search for the term stomata. Summarize the results of one paper published on stomata between the years 2014 and 2017. You may only use 10 sentences. Your target audience is your class. I will be sharing these summaries on Blackboard.

- What are plastids and how did they evolve? (Audience = college biology professor)

- Lit review development:
  - Propose several lit review topics related to plant physiology
  - Provide 10 potential sources for your proposed lit review topic

Literature Reviews

Students were required to write three, 10-12 page literature reviews (one for each section of the course: plant, fungi, and animals) discussing the current knowledge and questions regarding a topic in physiology.

Grading rubric focused on explaining a complex topic, selecting appropriate sources, synthesizing results from multiple sources, and analysis or research methodology.

Lit Review Rubric[3]

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Criteria	0-3 pts	4-6 pts	7-9 pts
Justified criteria for inclusion and exclusion from review.	Did not discuss the criteria inclusion or exclusion	Discussed the literature included and excluded	Justified literature included and excluded
Distinguished what has been done from what needs to be done.	Did not distinguish what has and has not been done	Discussed what has and has not been done	Critically examined the state of the field
Placed the topic or problem in the broader scholarly literature	Topic not placed in broader scholarly literature	Some discussion of broader scholarly literature	Topic clearly situated in broader scholarly
Placed the research in historical context of the field.	History of topic not discussed	Some mention of historical literature	Critical examination of history of topic
Acquired and enhanced the subject vocabulary.	Key vocabulary not discussed	Key vocabulary defined	Ambiguities in definitions discussed and resolved
Articulated important variables and phenomena relevant to the topic.	Key variables and phenomena not discussed	Reviewed relationships among key variables and phenomena	Notes ambiguities in literature and proposes new relationships
Synthesized and gained new perspective on literature.	Accepts literature at face value	Some critique of literature	Offered new perspective
Identified the main methodologies and research techniques that have been used in the field, and advantages and disadvantages of them.	Research methods not discussed	Research methods used to produce claims discussed	Research methods critiqued or new methods introduced
Related ideas and theories to research methodology.	Research methods not discussed	Discussed appropriateness of research methods to warrant claims	Critiqued appropriateness of research methods to warrant claims
Rationalized the practical significance of the research problem.	Practical significance of research not discussed	Practical significance discussed	Practical significance of research critiqued
Rationalized the scholarly significance of the research problem.	Scholarly significance of research not discussed	Scholarly significance discussed	Scholarly significance of research critiqued
Written with a coherent, clear structure that supports review.	Poorly conceptualized, haphazard	Some coherent structure	Well developed, coherent
Mechanics	Many grammatical, spelling, or punctuation errors.	A few grammatical spelling, or punctuation errors.	No grammatical, spelling or punctuation errors.

Poster Presentation[4]

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Category	1-3	4-6	7-8	9-10
Abstract	Unable to clearly connect abstract to research poster or presentation.	Somewhat able to see connection of abstract to research/presentation. Abstract did not contain sufficient information.	Abstract adequately presented student's research. More information would have been beneficial.	Abstract strongly represented the student's research. Clearly supported topic presented and contained important points.
Poster Content	Connection not found between poster content and purpose of study, research hypothesis/question(s), method, conclusions, or implications.	Content presented was difficult to understand and did not sufficiently convey a connection to the study, hypothesis, research question(s), method, conclusion, and/or implications.	The content was adequately presented but support for the study, research hypothesis, or question(s) is somewhat general. Conclusion and implications were reasonable.	Strong material. Well summarized. Clearly shows development of study or research. Material appears to accurately support purpose of study, hypothesis, or research question. Strong conclusion and implications presented.
Research Complexity **Appropriate to Discipline**	Less complex research project, given the field. Purpose of the study and analysis of results not easily interpreted by the audience.	Less complex research project given the field; however, purpose of the study and results easily interpreted by the audience.	Complex research project, given the field. Purpose of the research and results were difficult to interpret by the general audience.	Complex research project, given the field. Purpose of the study was completely defined and results displayed in a manner interpretable by the general audience.
Poster Appearance/ Clarity	Not visually effective.	Poster was acceptable but needs work to improve visual appeal through better utilization of fonts, colors, headings, and white space.	Poster was adequate but could improve effectiveness through better use of space through font size, colors, headings, and white space.	Visually appealing and strongly effective presentation. Easy to read. Effective utilization of fonts, headings, colors, and white space.
Poster Organization	Unable to understand link between information presented and topic of research.	Topic of research is not clear. Information presented is somewhat confusing.	Topic of the research is apparent. The presentation of information could use refining.	Topic of research is clearly evident. Layout of poster is logical, and provides sequential information from intro to conclusion and references.

Groups of 2 presented a topic not discussed in class during final exam period.

All students received an A on their poster.

Student Perception Survey

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Perception	Low		Mid			High	
Comfort with scientific writing	1	2	3	4	5	6	7
Perceived skill level at scientific writing	1	2	3	4	5	6	7
Comfort reading scientific literature	1	2	3	4	5	6	7
Comfort understanding scientific literature	1	2	3	4	5	6	7
Stress response to writing	1	2	3	4	5	6	7
Writing enjoyment level	1	2	3	4	5	6	7
Comfort level writing to different audiences	1	2	3	4	5	6	7

Survey administered first and last day of class

Student Perceptions

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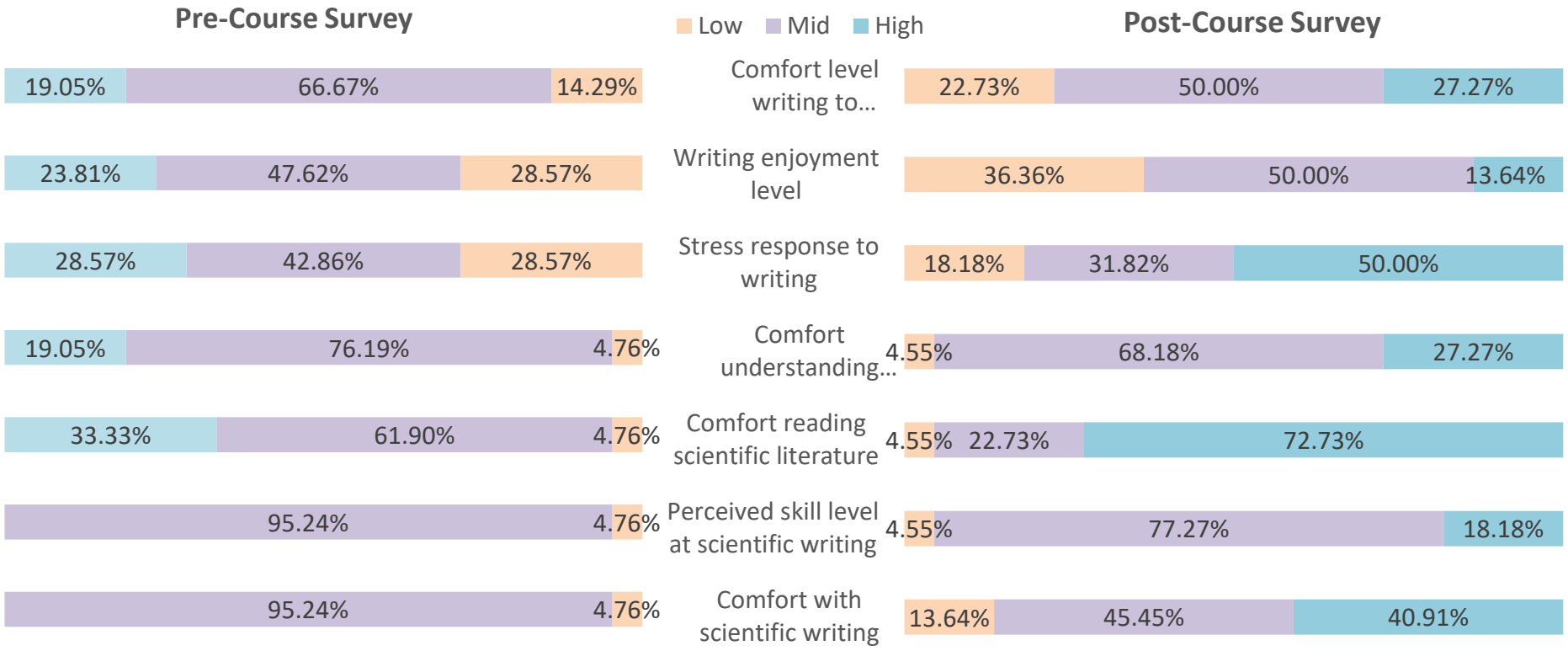

Lit Review Rubric Results

Criteria	Low	Mid	High
Justified criteria for inclusion and exclusion from review.	Did not discuss the criteria inclusion or exclusion	Discussed the literature included and excluded	Justified literature included and excluded
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**16 (73%) | 10 (45%) | 11 (50%)**	**6 (27%) | 12 (55%) | 11 (50%)**
Distinguished what has been done from what needs to be done.	Did not distinguish what has and has not been done	Discussed what has and has not been done	Critically examined the state of the field
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**21 (95%) | 22 (100%) | 10 (45%)**	**1 (5%) | 0 | 12 (55%)**
Placed the topic or problem in the broader scholarly literature	Topic not placed in broader scholarly literature	Some discussion of broader scholarly literature	Topic clearly situated in broader scholarly
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**3 (14%) | 0 | 6 (27%)**	**19 (86%) | 22 (100%) | 16 (73%)**

Lit Review Rubric Results

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Criteria	Low	Mid	High
Placed the research in historical context of the field.	History of topic not discussed	Some mention of historical literature	Critical examination of history of topic
Number = Plant | Fungal | Animal	**18 (82%) | 12 (55%) | 13 (59%)**	**4 (18%) | 10 (45%) | 9 (41%)**	**0 | 0 | 0**
Acquired and enhanced the subject vocabulary.	Key vocabulary not discussed	Key vocabulary defined	Ambiguities in definitions discussed and resolved
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**0 | 0 | 0**	**22 | 22 | 22**
Articulated important variables and phenomena relevant to the topic.	Key variables and phenomena not discussed	Reviewed relationships among key variables and phenomena	Notes ambiguities in literature and proposes new relationships
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**19 (86%) | 20 (91%) | 20 (91%)**	**3 (14%) | 2 (9%) | 2 (9%)**

Lit Review Rubric Results

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Criteria	Low	Mid	High
Synthesized and gained new perspective on literature.	Accepts literature at face value	Some critique of literature	Offered new perspective
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**2 (9%) | 4 (18%) | 3 (14%)**	**20 (90%) | 18 (82%) | 19 (86%)**
Identified the main methodologies and research techniques that have been used in the field, and advantages and disadvantages of them.	Research methods not discussed	Research methods used to produce claims discussed	Research methods critiqued or new methods introduced
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**19 (86%) | 10 (45%) | 6 (27%)**	**3 (14%) | 12 (55%) | 16 (73%)**
Related ideas and theories to research methodology.	Research methods not discussed	Discussed appropriateness of research methods to warrant claims	Critiqued appropriateness of research methods to warrant claims
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**19 (86%) | 8 (36%) | 10 (45%)**	**3 (14%) | 14 (64%) | 12 (55%)**

Lit Review Rubric Results

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Criteria	Low	Mid	High
Rationalized the practical significance of the research problem.	Practical significance of research not discussed	Practical significance discussed	Practical significance of research critiqued
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**8 (36%) | 5 (23%) | 2 (9%)**	**14 (64%) | 17 (77%) | 20 (91%)**
Rationalized the scholarly significance of the research problem.	Scholarly significance of research not discussed	Scholarly significance discussed	Scholarly significance of research critiqued
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**20 (91%) |16 (73%) | 8 (36%)**	**2 (9%) | 6 (27%) | 14 (64%)**
Written with a coherent, clear structure that supports review.	Poorly conceptualized, haphazard	Some coherent structure	Well developed, coherent
Number	**0 | 0 | 0**	**18 (82%) | 3 (14%) | 0**	**4 (18%) | 19 (86%) | 22 (100%)**
Mechanics	Many grammatical, spelling, or punctuation errors.	A few grammatical spelling, or punctuation errors.	No grammatical, spelling or punctuation errors.
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**6 (27%) | 2 (9%) | 3 (24%)**	**16 (73%) | 20 (91%) | 19 (86%)**

AAC&U VALUE Rubric[5]

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	Capstone	Milestones		Benchmark
	4	3	2	1
Context of and Purpose for Writing **Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).**	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).
Number = Plant | Fungal | Animal	**17 (77%) | 19 (86%) | 19 (86%)**	**5 (23 %) | 3 (14%) | 3 (14%)**	**0 | 0 | 0**	**0 | 0 | 0**
Content Development	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.	Uses appropriate, relevant, and compelling content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate and relevant content to develop and explore ideas through most of the work.	Uses appropriate and relevant content to develop simple ideas in some parts of the work.
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**3 (14%) | 8 (36%) | 12 (55%)**	**19 (86%) | 14 (64%) | 10 (45%)**	**0 | 0 | 0**
Genre and Disciplinary Conventions **Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields (please see glossary).**	Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices	Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choices	Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Attempts to use a consistent system for basic organization and presentation.
Number = Plant | Fungal | Animal	**21 (95%) | 22 (100%) | 20 (91%)**	**0 | 0 | 0**	**1 (5%) | 0 | 2 (9%)**	**0 | 0 | 0**

AAC&U VALUE Rubric[5]

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	Capstone	Milestones		Benchmark
	4	3	2	1
Sources and Evidence	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates an attempt to use sources to support ideas in the writing.
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**22 | 22 | 22 – (100%)**	**0 | 0 | 0**	**0 | 0 | 0**
Control of Syntax and Mechanics	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors.	Uses language that sometimes impedes meaning because of errors in usage.
Number = Plant | Fungal | Animal	**0 | 0 | 0**	**16 (73%) | 20 (91%) | 19 (86%)**	**6 (27%) | 2 (9%) | 3 (14%)**	**0 | 0 | 0**

Conclusions

- Student Perceptions of the following increased overall:
  - Comfort level writing to different audiences
  - Comfort understanding scientific literature
  - Comfort reading scientific literature
  - Perceived skill level
  - Comfort with scientific writing

- Pros of design
  - Students can pursue specific interests in physiology. Increase excitement and engagement.
  - Increased student knowledge in particular areas of comparative physiology
  - Writing skills improved
  - Emphasized evolution

- Cons of design
  - Superficial coverage of physiology across groups, with intense focus on small subsets of physiology

Changes for Fall 2019

- Start with animal rather than plant physiology
  - Animal | Fungi | Plant
- Remove historical component from rubric
- Redesign the lab to focus on more specific physiological detail rather than evolutionary change
- Invite English Dept. faculty to present tips for writing to different audiences

Sources

1 https://www.washingtonpost.com/news/grade-point/wp/2017/08/11/why-cant-college-graduates-write/?noredirect=on&utm_term=.f3b879ebab18

2 Modified from https://www.cmu.edu/teaching/assessment/examples/cfa/tools/participationrubric-cfa.pdf

3 Adapted from Hart, Chris. 1999. Doing a literature review: Releasing the social science research imagination. London: SAGE.

4 Modified from http://www.wtamu.edu/webres/File/Academics/Graduate%20School/Student%20Research%20Conference/SRC%20Competition%20Poster%20Rubric.docx

5 https://www.aacu.org/value-rubrics

Acknowledgements

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Questions?

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