Teaching Millennials in the New Millennium,
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Science Writing, Wikis, and Collaborative Learning

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Science Writing, Wikis, and Collaborative Learning in the Laboratory

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Science Education Reform

- Science education should be inquiry-based
- Student-centered, active learning
- Collaborative groups
- Teaching laboratories should be place for investigations

American Assoc. for the Advancement of Science (1989)
National Science Teachers Association (1989)
National Research Council (1996)
Commission on Undergraduate Education in the Biological Sciences (1969)
Biological Sciences Curriculum Study (1970s)

New pedagogy not needed; just use new ways to engage them in that pedagogy

- Millennials are team-oriented, risk-averse, digital natives
  - Strengths = capacity for collaborative work; use of new technology
  - Weaknesses = high levels of stress; risk-averse; poor metacognitive skills

Inquiry-driven laboratories

- Get students to participate in process of doing science
  - Making observations
  - Posing questions
  - Incorporating outside sources of info
  - Planning and conducting investigations
  - Using tools to gather, analyze, and interpret data
  - Proposing answers, explanations, and predictions
  - Communicating the results

Students fail to see the purpose of the lab report

Writing to learn

Lab reports as authentic science activity; not simply a summary of experiment

Science is collaborative!

- We had them go separate ways to write individual reports

- Need to emphasize that writing is an important part of the collaborative process of science

•Advantages of collaborative writing…BUT…

Using Wikis for collaborative lab reports

A web space where groups can collaborate, share, build, and review content online

1. Writing is messy
2. Writing is a socially collaborative act
3. Wiki technology is a tool that enables writers to get into the mess and the social nature of writing

(Loudermilk-Gaza and Hern. 2005, Texas A&M University-Corpus Christi)

• Wiki **history** provides way to assess student contributions

Online Collaborative Writing

Changing The Academic Publishing Process

Wikis for Millennials

- Team-oriented

- Risk-averse

- Digital natives

- Metacognitive skills
    - Assignments focus on strategies, planning, etc.
    - Opportunities for self-assessment and reflection
    - Opportunities for peer review

Wiki logistics

- Wiki module in Moodle

    "Separate Groups" mode

    - One wiki per group
    - Can view & edit only their group's wiki

- Practice wiki

- Structured organization

    – Intro, Methods, Results, Discussion

- Clearly defined student roles

View | Edit | Links | History | Attachments

Plant Hormones Report Wiki

Literature Summaries
Abstract
Introduction
Methods
Results
Discussion
Literature Cited

Student roles

Wiki Section	Draft	Review process	Final Draft
Title	Group effort	everyone	Group effort
Abstract	Group effort	everyone	Group effort
Introduction	Bob	everyone	Bob
Methods	Carol	everyone	Carol
Results	Carol	everyone	Carol
Discussion	Ted	everyone	Ted
Literature Cited	Group effort	everyone	Group effort
Overall (PI) = Bob			

Assessment

- Report rubric

Enzyme Report (45 pts)

Section Points			Poor 1 2 3	Excellent 4 5	Section Scores
1		**Title**			0.00
	1	Describes content concisely, adequately, appropriately			0.00
2		**Abstract**			0.00
	2	Summarizes paper concisely, adequately, appropriately			0.00
8		**Introduction**			0.00
	3	Successfully establishes context of the study with brief, relevant background information			0.00
		e.g., what SDH is and does; why interest in SDH, etc.			
	2	Effectively incorporates relevant studies into Intro			0.00
	2	Effectively presents objectives and purpose of study			0.00
	1	Introduction well written in coherent, concise style			0.00
6		**Methods**			0.00
	4	Enough relevant info to allow for replication of procedures			0.00
	1	Narrative well written in past tense			0.00
	1	Methods well organized and concise			0.00
6		**Results**			0.00
	2	Visually presents results clearly and accurately in figures or table			0.00
		Figures (graphs) are clear; proper captions; axes correct and labeled; tables (if any) are clear and well constructed with proper titles.			
	3	Text clearly summarizes findings; points out important relationships and trends			0.00
	1	Successfully integrates textual and visual representations;			0.00
		results are presented concisely, neatly & clearly			
11		**Discussion**			0.00
	1	States how results relate to experimental question and objectives			0.00
	5	Provides sufficient and logical explanation for results, showing understanding of the biology involved			0.00
		> Explanation of variable's effect on SDH at molecular level			
	3	Effectively incorporates relevant studies into discussion of results.			0.00
	1	Discusses weaknesses and/or new questions to be studied			0.00
	1	Discussion is coherent and flows well			0.00
11		**Presentation/Overall**			0.00
	2	Citations of references adhere to proper format			0.00
	2	All sources in the report (at least 3) are correctly listed in Literature Cited section			0.00
	2	Grammar and spelling are correct			0.00
	2	Writing is neat, coherent, and flows well			0.00
	3	Evidence of good team work and a positive writing process			0.00
45				**Points Earned:**	0.0
					out of 45

- Wiki contributions

Group	SECTION	Abstract	Intro	Methods	Results	Discuss	Lit Cited	SUM	Factor	Peer Reviews		AVG Review	comments	Section Grade (x/10)	AVG ALL Factors	COUNT	Report Grade	Actual Grade	Actual %
T_EH,DI,CM																	39.25		87.2
student1	Intro/PI	1	2	1	1	1	1	7	11.05	10	10	10		10	10.26	6	40.28	40	88.9
student2	M&R		1	2	1	2	1	7	11.05		10	11	10.5	most helpful c	7.5	9.888	5	38.81	41	91.1
student3	Discussion		1		1	2	1	5	7.89	10	10		10		9.8	9.424	4	36.99	38	84.4
								19											

I was responsible for the discussion and the first draft I wrote was terrible! I incorporated too much of what should have been in the introduction, so I rewrote it myself according to your instructions before edits were done by others in the groups. The most important suggestion I received was to incorporate sources. I also changed both grammatical errors and citation errors I had originally made as well as fixed a couple awkward phrases to mold the final paper.

submitted her discussion section on time so that edits could be made. Her discussion section did require a number of changes because it did not include the key concepts of the experiment outlined in the handout. Unfortunately did not seem to have any edits on any other section of the lab report until the day it was due. Her comments would have been helpful if they had been made during the revision process. was a great lab partner during the labs and was focused. She was also helpful in creating the graphs and doing calculations.

was a bit late in submitting his section of the lab report, which made it harder to make all necessary edits and comments. made many revisions to his rough draft after comments were made and he produced a well-written introduction. A good amount of time was needed to make several more revisions to improve organization and fulfill all the requirements but in the end, a strong introduction was produced. In lab, was a great partner and very thoughtful in his calculations, helping to produce valid results.

Outcomes

- Objective learning outcomes (Direct)
  - Better engaged in science process
- Metacognitive outcomes (Indirect)
  - Focus on report not as end product for grade, but as way of reflecting on investigation
  - Iterative process of writing
  - Reflective assessments
- Collaboration outcomes (Indirect)
  - Learn to resolve challenges as a group

(West & West. 2009. Using Wikis for Online Collaboration. San Francisco: John Wiley & Sons)

Genetic engineering, a type of biotechnology used to manipulate DNA molecules , can be used to clone a piece of DNA to produce a protein that is normally made by another organism. Through genetic engineering, a specific part of one organism's genome known as "foreign" DNA can be placed into another organism. In a process known as transformation, a specific part of the genome known as foreign DNA can be transformed into a bacterial plasmid, most often Escherichia coli. (Here would be the best time to explain what a plasmid is and how plasmids are used during transformation.)

+(Very good suggestions by ▅▅▅▅▅▅. I don't think the lac operon was mentioned, either, and its function in the role of beta-galactosidase expression. Are there also any background readings to be used and cited?)

+

diffusion rates due to the fact that each compound contains two hydroxyl groups that form a strong bond with water. Conversely, the n-propanol and ethanol should have contained the fastest diffusion rates because both have only one hydroxyl group, which greatly correlates to the compounds' partition coefficients. Yet, in comparing which of the two alcohols have the fastest diffusion rate, it comes down to the formula weight or molecular size (Scott 1993). For example, n-propanol was awarded the fastest diffusion rate because it possessed a larger, non-polar portion of the alcohol molecule than the ethanol, making it more permeable to the membrane. Thus, it appeared that lipid solubility was the best indication in determining the relative penetration rate across red blood cells, yet formula weight helps to further specify which compound is the most permeable, a conclusion that is evident in the alcohol-related compounds. +

+

+I think this was overall good. I think you should explain what the experimental error was. I believe it was that we may have stopped the stopwatch at the the proper time everytime, because it was difficult to know how exactly the solution of cells should have looked when the cells had lysed. Another explanation is that the solution of cells may not have been homogenous, and there could have been a higher concentration of cells at the bottom of the tube than where we were looking, so it depended upon which part of the test tube we were looking through.

+
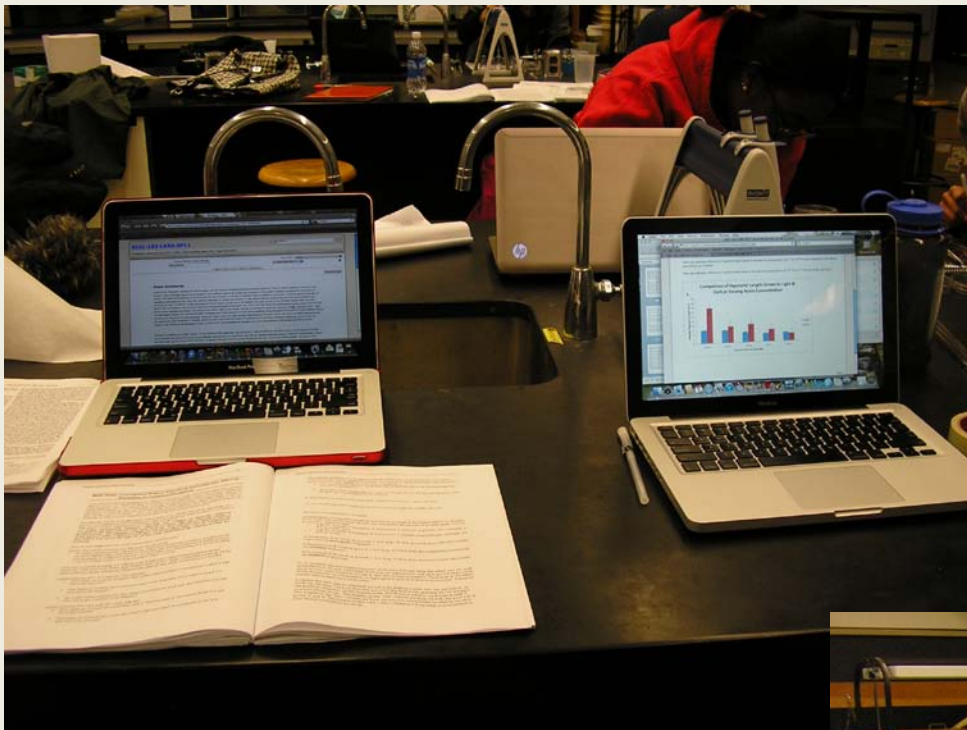
These three different strains included the pUC18 transformants, the host "DH5" strain used for transformation, and a normal wild-type E coli. The B-galactosidase activity was measured by streaking these strains on various indicator plates.These plates included MacConkey base agar (no sugars added), MacConkey-lactose agar (0.5% lactose), and MacConkey-glucose agar (0.3% glucose). After adding o-nitro-B-phenyl-B-D-galactosidase, an analogue of lactose, activity was measured. Due to E. coli's ability to ferment sugars to acid and the MacConkey indicator plates containing methyl red, once E. coli fermented this acid the plate turned red. (This seems more of a methods section. Try to talk more about how we are determining the expression of the beta galactosidase gene in three strains of E coli. Discuss what is/are the inducers ad indcuible enzyme, and also more about how we will be able to determine the three strains of ecoli by indication of whether there was sugar fermentation.

+(Should there be a brief description of the rationale and objectives (questions being investigated/hypotheses) again at the end, as it states in the guidelines?)

Good job vanessa. You need to mention how for the ONPG assay "strain Z" the yellow color in the lactose and glucose conditions were delayed or less intense. Explain why yellow color was less in the glucose condition than in the other conditions and why the yellow color in lactose condition was less than the "no sugars" condition. -Emily

For Emily's part. i have no suggestions...I think it is pretty much straight forward

+ -I notice you say that a purple color means that glucose or lactose was fermented. However fermentation of the sugar causes acidic conditions and that would turn the colony red i believe. Read the Last paragraph on page 2 in the Gene expression and DNA technology II -Look at moodle, he says that we should use the class data in our discussion, so look at the class data for editing the discussion -connor

End-of-semester evaluation

71% agreed:

- Relative to writing individual reports (as in Biol 182 last semester), writing group reports helped me think about the strengths and weaknesses of my own writing

64% agreed:

- Relative to writing individual reports (as in Biol 182 last semester), writing group reports helped my confidence in my ability to write scientifically

- …helped my understanding of the concepts presented

End-of-semester evaluation

90% agreed:

- The amount of work during lab sessions was appropriate to the time available (77% agreed previous year)

87% agreed:

- The total workload for the lab was appropriate (74% agreed previous year)

Typical responses

Positive:

- "It made effective use of my time during the year. The lab reports offered a chance to more fully investigate the labs we conducted without the effort of writing a whole lab report. At the same time we were able to learn how to write better because of the feedback from our group and also by observing other's work."

Negative:

- "Using the wiki was fine but I hated having group projects I felt like my grade in this class suffered because of my group members and their inefficiency to get their work done."

Future use?

- ## Expand wiki use
  - Include pre-lab preparation, in-lab notebooks, repository for raw data and stats, literature summaries, etc. → more of an "e-portfolio"

- ## Solve technical problems
  - New version of Moodle has vastly superior Wiki

- ## Assessment
  - Post-test scoring of reports for understanding of science and science process