

GUIDING CRITICISM OF SYSTEMS OF OPPRESSION THROUGH THE LENS OF A  
BIOMEDICAL SCIENCE COURSE: WORKING IN THE CLASSROOM TO IMPROVE  
PUBLIC HEALTH AND SOCIETY

by

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## DEDICATIONS

I would like to dedicate this paper to my supportive family and friends. My mom, dad, Trevor, Shelby, Hannah, Tori, Vanessa, and Kat. I also owe so much to my world class team at Tam High, Grace, Angela, Alex and Jess. I would love to acknowledge the time and efforts of Nina Portugal of the Lead by Learning program at Mills College. She is a fantastic coach, and I don't know what I would have done without her.

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## ABSTRACT

This study was conducted to enrich critical thinking experience within a technical Biomedical Science class. This was achieved by challenging student misconceptions and guiding higher order thinking to develop students' original ideas as they discussed the intersectionality of -isms (race, gender, etc) & public health. Students analyzed specific assessment criteria and determined ethical solutions to common issues in public health. Within this assessment criteria data was collected in the form of three performance tasks, two student perception surveys and individual student interviews. In this qualitative analysis, it follows the growth and struggles of white and BIPOC (Black, Indigenous, and People of Color) students respectively grappling with countering the culture of predominant whiteness in medicine. Alongside use of real medical research technology, students synthesized equitable policies to service people of all walks of life resulting in varying success and engagement.

## INTRODUCTION AND BACKGROUND

### The New Frontier

The beginning of the 2021 school year marked an unforeseen transition in my teaching career. My previous professional development and career training could not prepare me for the impending teaching changes that began March 2020. The spread of coronavirus impacted human life on a global scale, creating immense hardships. Civil unrest broke out across the United States, as white privilege and the call for ending police brutality came to a violent head. As an educator, the very structure of education as we know it was turned inside out, leaving many (myself included) feeling stuck, unmotivated, and lost. In the beginning, resources for pandemic-friendly instruction were non-existent, rendering the materials educators rely upon to be either ill-fitted or too in-depth for students to digest during short virtual learning sessions.

As an adolescent educator, it is critical to account for how the worldwide pandemic has disrupted normal life. Cardenas (2020), noted “...its highly likely that this measure has had an adverse impact on nutrition, education, safety and mental health of vulnerable children and adolescents, particularly those from impoverished households” (p. 1). The pandemic has had indisputable negative effects which disproportionately impact at-risk students. In my classroom, I have students from many walks of life, and as my curriculum develops, I have come to find that my disadvantaged students engage more when medical technology curriculum material is taught using real-world context.

To demonstrate a timeline, my particular school shifted to distance learning on March 13, 2020, and remained remote until February 23, 2021, when we returned and initiated a

three-cohort in-person hybrid instructional model. This transition was far from smooth, and many students struggled to meet attendance and learning expectations. At well over a year in the pandemic; time has transformed my perspective of my job and role in my student's lives. Gone are the days of "busy work" and long content-based tests. Everything I ask of my students has to be with intention and purpose, being cognizant that some students are still conducting remote learning from home. Learning is a job for my students; therefore, amplifying their individual stories and respecting their time has become my new starting point for course work planning.

### The Covid Conundrum

The coronavirus pandemic is a crisis with lasting negative effects and trauma felt by many. Young adults are impressionable during adolescent development, experiencing both emotional and physical vulnerabilities. As mentioned by Griffin (2017), "The gradual brain developments which take place during the adolescent period show themselves in behavioral, cognitive, and emotional changes. This critical period for brain development enables adolescents to negotiate their trial-and-error journey towards independence" (p. 3). Several recent studies have determined that "COVID-19-associated mental health risks will disproportionately hit children and adolescents who are already disadvantaged and marginalized" (Fegert et al., 2020, p. 6), noting that economic recessions can leave students especially endangered as income loss is connected to increased levels of domestic violence. The researchers also note that quarantining in packed homes with many family members also contributes to added student stress. The classroom setting is a critical safe haven for students. I believe the loss of daily adult oversight (outside of stable parenting)

and consistent structure will have lasting effects for students I instructed during the pandemic. It is critical to be evermore cognizant of the valuable role educators play in students' lives, especially with the loss of stable income, parenting, or housing.

### Guidance from Student Voice

As established by Giroux (1988), “The process of involving students in the planning and assessment of their educational experiences may also empower students by providing them a voice within the school system and, perhaps, contribute to their sense of belonging and value within the classroom” (p. 110). This line of thought guided my teaching over the past year, so I challenged myself to consider how I could foster students' voices within the classroom. I started by determining how my student participants could engage their ideas related to equity in public health while distance learning. The current study explored these concepts in a Biomedical Science elective course I designed and having been instructing for the last five years. I figured my current section would be a small-scale environment to do a deep dive into addressing and exploring student perceptions and ideas related to educational inequities via surveys, individual interviews and student work.

Part of what inspired me to explore educational inequity as a research objective in my Biomedical Science course is connected adjustments, I have made over the years to my student learning outcomes. In the beginning of my instruction, I was heavily focused on teaching science content, while also exposing my students to undergraduate-level lab experiences. Over time, I found that I was able to attract disadvantaged students of color to my Biomedical Science course through relationships I cultivate and maintain with this

cohort of participants. Students chose to enroll in the course because I was the instructor, and not necessary because they were attracted to the challenge of engaging in a hard sciences course curriculum. In order to make the content more connected to actual medical experiences, I formed units around different jobs in biotechnology and designed content as a simulation of patient treatment or diagnosis. In education, real world connections model actual events, or situations for individuals. These experiences can be successful, or unsuccessful depending on the end result and care for the individual. Patient experience is directly connected with equity and access, because inequities happen all the time, and medical processes can be improved with informed critique. In turn, this intent shifted the expectations to more of an ethics, access, and public health course, high level labs still included.

To start to develop my instrument, at the beginning of the term, I sent out a survey to my Biomedical Science class as a pre-assessment. The survey asked “As a student currently in a pandemic, please give me examples of opportunities you have had to express your individual voice in your learning. (Your evidence can be a specific assignment, or narrative experiences).” This survey yielded a variety of responses and the two that stood out to me most are below.

I don't really think I have had any opportunities to express my individual voice. I can't think of anything really in school that wasn't completely academic. Even in art class, most things come with a specific prompt; we have only had one or two assignments that were free choice. For normal school assignments I have been unmotivated to put a personal touch into my assignments as I feel like it is lost over the internet.

I found this first response most interesting as this student interpreted the opportunity for “individual voice” as an unstructured assignment format in the classroom. In my mind,

voice can be integrated in a variety of manners, but I assumed students would struggle without some expectations. During the time of remote learning, traditional assessment mechanisms are no longer effective, where students' unsupervised access to the internet makes it difficult to determine their actual understanding.

Many of my students see science learning as a content memorization task. For learning to represent the requirements of the Next Generation Science Standards (NGSS Lead States, 2013), students must learn content alongside skill building in relation to other scientific concepts. Assessing the transect of these three components is not an easy feat. I can assess and probe for understanding in one-on-one conversations, but with the time constraints of virtual learning, this was not feasible. I then wondered how I would go about introducing a more open-ended assessment. I looked to my student's responses from the pre-assessment survey as a starting point.

The only other opportunities I've gotten or seen in any of my classes where you get to use your own voice is when you're writing an essay or answering some sort of discussion question. A lot more of the individual voice expression happens in writing and is less vocal now.

This response affirmed my desire to break the mold for assessment. I felt exploring my idea for an alternative version of an assessment using writing and critical thinking would be the structure of my treatment. My intent for adjusting assessments is to try and create an equitable measure of success that can be accessible through many learning histories, and points of view. According to Caroline Gipps (1994), the means for performance assessment seems to be the most appropriate approach.

It is important to remember that 'objective' assessment has traditionally been seen as an instrument of equity: the notion of the standardised test as a way of offering impartial assessment is of course a powerful one, though if equality of educational opportunity does not precede the test, then the

'fairness' of this approach is called into question. Most attainment tests and examinations are amenable to coaching and pupils who have very different school experiences are not equally prepared to compete in the same test situation (p. 273).

Increasing difficulty and asking more open-ended questions is the framework to begin writing the learning tasks. Gipps (1994) also suggests the idea of using a less structured form of assessment called performance tasks. She outlines the criteria for performance assessments below:

Performance assessments (PA) are assessments which model real tasks, i.e., require the pupil to perform in the assessment what we wish them to learn in the classroom; usually they focus on higher levels of cognitive complexity; require the production of a response (in a range of modes); and require qualitative judgements to be used in the marking (p. 275).

To eliminate the chance of bias, open ended questions with qualitative answers will be most equitable for students of all backgrounds. The intent of this alternative assessment was to also help my students of color see their communities in their content acquisition and hard work, especially in the predominantly white medical field.

### Focus Question

My focus question was, Using strategies of culturally responsive teaching, how can I shift my means of assessment?

Sub-questions included the following:

1. What are students' impressions on using performance tasks vs. traditional assessment as a means of determining understanding?

2. How do students challenge misconceptions and develop their original thought when talking about the intersectionality of -isms (race, gender, etc) & public health?
3. How do my students of color see their identities and societal progress in these performance task assessments?

### Ideal Outcomes Post Analysis

In order for white students to develop awareness of inequities, the onus lies on the critique of whiteness as the dominant culture in public health and society. For many students dissecting structures of white supremacy is not a familiar action within their science learning. As such, the table below was used as a means for tracking the critique progress for my white students.

Table 1. Desired outcomes for my white students in performance task results.

What I want for my white students in this process:	
1	Dissecting their thought process when approaching a task related to equity
2	Be less philosophical when talking about race, using accurate evidence rooted in story.
3	Isolating race as to center people and experience, acknowledging “gaming” of the system
4	Acknowledge historical oppression and medical violations of the rights of BIPOC individuals.
5	To see that advocacy and compassion are necessary components of working as a medical professional.

I ultimately want to see similar awareness from my students regardless of skin color. As for the only two BIPOC students in my class, I want them to witness their peers engage in respectful discourse with a deep understanding without having to be too vulnerable.

## CONCEPTUAL FRAMEWORK

Consciousness Outside the Conscious

The educational classroom can be a place of self-discovery in conjunction with a place of vulnerability. As leader in a position of power within the classroom, the importance of compassionate interactions in a diverse setting can be critical for success. In *Other People's Children*, Delpit (1995) reminds educators how “we all carry worlds in our heads and those worlds are decidedly different.... Indeed, many of us don't even realize that our own worlds exist only in our heads and in the cultural institutions we have built to support them” (p.xxiv). As a high school instructor, I not only have to be careful of how I communicate the content, but also of the fact that I myself am a white educator. I work to be aware of my privilege at all times and to dissect my implicit biases. If I do not acknowledge the impact my walk of life as a white woman has in the classroom; I believe it can have detrimental effects on students who already struggle with feeling safe and accepted in a school setting. It has been documented time and time again at my school that many minority students struggle with the micro-aggressions on a daily basis from their majority Anglo-White peers.

Consideration of race is a key factor for context, providing meaningful insight into the lens with which students process knowledge. As Inoue (2015) points out “as a social construction, race is complex, often composed of multiple factors that intersect in one's life despite the fact that it is a fabrication by people over time. We made up race, then it became something real” (p. 26). This reality is alive and well in the classroom.

Content and understanding must be approachable from differing angles. Forcing a structure based upon cultural norms, i.e., standardized tests, leaves space for discrimination against people who are not present in the room during the development of these societal instruments.

I utilized the text *Difficult subjects: Insights and strategies for teaching about race, sexuality, and gender* (Ahad-Legardy & Poon, 2018), as a starting place for my inquiry. I then specifically homed in on the presence of disparities within STEM classrooms and how to mitigate these disparities in my science class. The text cites a study by Daniel Willingham (2010) that summarizes the root of my pursuit of equity in my classroom.

Willingham speculated that students in diverse, active-learning classrooms demonstrated better learning because they are able to build relationships between new material and their own personal histories. Furthermore, Willingham reasoned that the variation in student mastery of a particular subject is due to the vast experiential diversity found in any cohort of students. Thus, when compared to a demographically homogenous classroom, a diverse classroom produces a broader range in student insights on any given subject, which best stimulates learning (Ahad-Legardy & Poon, 2018, p. 223).

As my Biomedical Science course is framed around active learning labs and discussions that will benefit my students of color, as well as my white students who should be capable of “a broader range of insights” within and after the class ends. Hopefully this mode of teaching will make my Biomedical Science course a safe space and more attractive to future BIPOC enrollees. Word of mouth is very powerful for class recruitment at my school.

### Anti-Racism and Culturally Responsive Teaching

There are unimaginable challenges within public education to provide meaningful rigorous instruction applicable to children of all walks of life. When this is acknowledged and internalized, I have seen this idea empower educators to make culturally competent decisions and operate from a much more empathetic standpoint for children from differing backgrounds. Issues can arise when an educator does not understand the power of their own cultural lens. I have seen white biases inflicted on BIPOC students many times in my workplace. Usually from my observation it can lead to students feeling uninvolved, misunderstood, or functionally unsure of how to navigate our school's culture. The idea of finding an assessment technique that fits all students appropriately seems difficult in practice, but I believe there is incredible value in educators who try and meet students in this space.

In order to seek appropriate guidance, I found an assortment of texts related to the implementation of Culturally Responsive Teaching and Anti-Racist Educator texts. One particularly insightful resource came from Dena Simmons (2019), who describes herself as a "social and emotional learning practitioner-scholar," and her writings have resonated with me deeply during the development of my project. In her article "How to be an Antiracist Educator" she organized five concise objectives educators can enact to engage in an antiracist future these five actions are as follows (p. 1):

1. Engage in Vigilant Self Awareness
2. Acknowledge Racism and the Ideology of White Supremacy
3. Study and Teach Representative History

4. Talk about Race with Students
5. When you see Racism, Do Something

With these five actions in mind for myself, and my classroom I searched for resources target specifically for acknowledgement of race and classroom assessment.

Within Inoue's (2015) text, "*Antiracist writing assessment ecologies: Teaching and assessing writing for a socially just future.*" I found the core of my pursuit.

An antiracist classroom writing assessment ecology provides for the complexity and holistic nature of assessment systems, the interconnectedness of all people and things, which includes environments, without denying or eliding linguistic, cultural, or racial diversity, and the politics inherent in all uneven social formations. (p. 77)

In order to foster the self-reflection for white students as detailed in Table 1, I looked closer at the recommended criteria for antiracist assessment. "The seven interconnected and holistic elements are: power, parts, purposes, people, processes, products, and places" (p. 119). These components are critical for meaningful context, and do not necessarily all have to be present for an appropriate "ecology." Inoue cites the work of Marilyn Cooper (2011) as a guiding outline of desired outcomes for the students within antiracist assessment:

She says that "agency is an emergent property of embodied individuals," and is "based in individuals' lived knowledge that their actions are their own" (p. 421,426). Emergent rhetorical agency is "a response to a perturbation that is shaped by the rhetor's current goals and past experiences," but it's also an "enactive" system—that is, individuals act without knowing exactly what they are doing or that they may be changing the system (2015, p. 119).

I interpreted this to mean my assessment cannot not be a driving component of change, but rather one piece within a larger intertwined non-linear ecosystem. Regardless of the

number and types of anti-racist ecologies I incorporate into my performance task assessment, I am cognizant of the fact that this in itself will not be a direct cause for change. Inoue aptly describes the desired effect as:

Consequences...occur because of the ecology or complex system, not because of individual actions by students or a teacher or a rubric alone. They may be instigators, causing perturbations in the system, but it is the system, the ecology as a whole, that determines what possible outcomes, effects, changes, or products there will be. Thus, any learning or educational benefits to students one might hope from an antiracist writing assessment ecology will be a product of the dance of perturbations and response of elements in the entire complex system. (p. 120)

As an educator, it is my job to create the stimulus for change. I cannot guarantee the success of this stimulus and realize that the cascade of change will likely be slow and intangible within the subconscious of my students. I will likely not personally see the direct results of this stimulus for my students until they are asked to draw upon the experience in a different setting. Maybe time will pass, and they will never draw upon it, but the process and attempts within this study are still worth trying for the sake of exposing students to challenging the predominant culture.

### The Value of Student Voice

In my pursuit of the benefits of a performance assessment, I turned to a resource I found called *Engaging with Student Voice in Research, Education and Community* (Mockler & Groundwater-Smith, 2015). The core idea in this book resonated with my holistic method for teaching and engaging students to learn.

Privileging student voice and putting democratic concerns regarding education at the center of discussions of curriculum demands that particular attention be paid to the learning needs, interests, prior and background

knowledge, cultural knowledge and life outside the school of the students being taught. (p. 143).

Within their variety of recommendations for modes of engaging student voice, the suggestion that seemed most applicable was utilizing storytelling and role play in order to respond to a case study and allow students to innovate and be creative. In Appendix B-E, I have attached all three of the assignments for my Performance Assessment Tasks (PATs). I introduce each of these assignments as imaginary scenarios, and I place my students into these stories as the person in leadership, (doctor, legal medical expert, etc.) who is able to make recommendations that facilitate change using evidence and rationale.

#### Classifying the Abstract Knowledge Acquisition

Utilizing Iowa State's Revised Blooms taxonomy (Anderson, 2001); I identified the cognitive processes alongside the knowledge dimension needed for the PATs. In the figure below, the revised taxonomy gives more nuanced descriptors for how students can demonstrate their understanding. I asked students to analyze and evaluate abstract procedural and metacognitive knowledge as described in Figure 1. This is not an easy ask, and in order to see success from my students I will need to scaffold them to reaching the high level of rigor needed to demonstrate meaningful understanding. Within the figure below, I strived to have students conquer abstract metacognitive knowledge and do so by "deconstructing one's biases" and "designing an efficient project" (Anderson, 2001). I saw this taxonomy as a means to develop the language of higher order thinking

as required for the PATs. I intended for this mode of student assessment to allow for interpretation and flexibility in their critiques and solution design.

		The Knowledge Dimension			
		<b>Factual</b> (The basic elements a student must know to be acquainted with a discipline or solve problems in it.)	<b>Conceptual</b> (The interrelationships among the basic elements within a larger structure that enable them to function together.)	<b>Procedural</b> (How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.)	<b>Metacognitive</b> (Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.)
The Cognitive Process Dimension	<b>Create</b> (Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure.)	<b>Generate</b> a log of daily activities.	<b>Assemble</b> a team of experts.	<b>Design</b> an efficient project workflow.	<b>Create</b> a learning portfolio.
	<b>Evaluate</b> (Make judgments based on criteria or standards.)	<b>Check</b> for consistency among sources.	<b>Determine</b> relevance of results.	<b>Judge</b> efficiency of sampling techniques.	<b>Reflect</b> on one's progress.
	<b>Analyze</b> (Break material into constituent parts and determine how parts relate to one another and to an overall structure or purpose.)	<b>Select</b> the most complete list of activities.	<b>Differentiate</b> high and low culture.	<b>Integrate</b> compliance with regulations.	<b>Deconstruct</b> one's biases.
	<b>Apply</b> (Carry out or use a procedure in a given situation.)	<b>Respond</b> to frequently asked questions.	<b>Provide</b> advice to novices.	<b>Carry out</b> pH tests of water samples.	<b>Use</b> techniques that match one's strengths.
	<b>Understand</b> (Construct meaning from instructional messages, including oral, written and graphic communication.)	<b>Summarize</b> features of a new product.	<b>Classify</b> adhesives by toxicity.	<b>Clarify</b> assembly instructions.	<b>Predict</b> one's response to culture shock.
	<b>Remember</b> (Retrieve relevant knowledge from long-term memory.)	<b>List</b> primary and secondary colors.	<b>Recognize</b> symptoms of exhaustion.	<b>Recall</b> how to perform CPR.	<b>Identify</b> strategies for retaining information.

Figure 1. A model of learning objectives based on a revision of Bloom's (1956) taxonomy (Anderson, 2001).

Utilizing the classification from the revised taxonomy as a reference, I developed my rigorous PAT questions. Going forward I will reference this question as my “Metacognitive Analysis/Evaluate” question as I analyze each assessment.

## METHODOLOGY

### Demographics

Biomedical Science is an upper-division elective course, which focused on hands on experience with medical technology as well as professional medical simulations. In the 2020-2021 cohort, all 21 students in the class were juniors and seniors. There were fifteen female students and six male students. I taught four of the students previously, and the remainder were new relationships. I had two special education students, one was a female Filipina student, and the other was a white male. The white male was on a modified curriculum without assessments, so he was not able to complete the PATs for the purpose of this study. I have three students who identify as BIPOC. They are all female, one is the Filipina student listed above, the next identifies as African American, and the last is of Persian descent, but she prefers to identify as white. The research methods utilized and performed in this lab were approved for an exemption from Montana State University's Institutional Review Board (Appendix A).

### Treatment

In Biomedical Science I collected data in the form of PATs, student perception surveys, and individual interviews. I created assessments that asked students to reflect socially, personally, and academically on medical technology and accessibility in public health. The first unit focused on teaching students the concept of public health and weaving ethics into the content. Public health is a very vast idea. In my classroom, students assessed various components of public health science along with the strengths

and weaknesses of the current United States public health system through the lens of the COVID-19 pandemic. This unit lasted from the beginning of the 2020 school year until mid-October.

The second unit was titled “Immunologist” and focused on studying and analyzing the complexities of the immune system. The unit also incorporated case studies of individuals living with incurable inflammatory disorders. For this assessment I asked students to formulate a claim, to find three pieces of evidence, and provide reasoning to answer the “Metacognitive Analysis/Evaluate” questions (Appendix C). Why is lack of systemic prioritization of public health related to prevalence of autoimmune disorders? What would the quality of life for individuals of different backgrounds with autoimmune disorders look like? The intention of these questions was for students to identify disparities related to the diagnosis, treatment and management of autoimmune disorders, and how the disparities are connected to uncontrolled socioeconomic factors.

Leading into the last assessment, I wanted to allow students to refresh themselves about their previous PATs and use my feedback to prepare for one final assessment. In this revisit, students reflected on their performance on their previous assessments and dissected the complexity of their “Metacognitive Analysis/Evaluate” question responses in the first two assessments (Appendix D). Students then moved on to the third and final PAT, called DNA where students examined forensics scenario and used the content to justify the benefits of using DNA evidence in the criminal justice system, as well as develop solutions to improve the utilization of DNA evidence within the criminal justice system (Appendix E).

Instrument

The table presented below represents the rubric provided to students to guide their responses and understand the grading criteria.

Table 2. Rubric for grading and assessing the depth of the student PAT responses.

	Below Basic 10/40	Developing/ Basic 20/40	Proficient 30/40	Advanced 40/40
Perspective - provides your reader with the connection to people who are affected. There are many different walks of life that are affected by public health. The more experiences you cite make your designed solution more effective. This is also where you should draw on key ideas and concepts from your issue you are working to solve.	Does not provide perspective, only provides unrelated perspective, or personal perspective only.	Provides perspective that connects very few experiences with the solution design. Does not provide full understanding of the population affected and how the designed solution provides better public health.	Explanation provides perspective that is... -Clear (Clearly communicated and goes beyond one's own experience.  -Connected (using objective language, explains why the experiences are important or why it is relevant in this particular case)  -Integrated: broadly or vaguely connects scientific concepts, societal structures, and vocabulary to support understanding of why the reform is valuable. -Mentions experiences but does not connect it well to the solution's design.	Exhibits that research has been completed about many perspectives involved (with citations) to explain why the experience affects the solution suggested.  Reasoning shows full depth of content understanding with  Innovative/justified systemic reform ideas.

The rubric in Table 1 was intended to push students to the level of self-dissection needed to address misconceptions and develop their original thought when talking about the intersectionality of -isms (race, gender, etc) and public health. Assessment components can be found in appendices A-D.

Survey Questions

1. On a scale of 1-5 from Strongly Agree to Strongly Disagree, please rate the clarity of the unit
2. Can you please tell me in a sentence or two why you answered the way you did in the above question?
3. On a scale of 1-5 from Strongly Agree to Strongly Disagree, please rate how interesting the LAB in the unit was
4. Can you please tell me in a sentence or two why you answered the way you did in the above question?
5. On a scale of 1-5 from Strongly Agree to Strongly Disagree, please rate how engaging the CONTENT of the unit was taught.
6. Can you please tell me in a sentence or two why you answered the way you did in the above question?
7. On a scale of 1-5 from Strongly Agree to Strongly Disagree, how useful are the skills that you have learned so far?
8. Can you please tell me in a sentence or two why you answered the way you did in the above question?
9. On a scale of 1-5 from Strongly Agree to Strongly Disagree, the work we do in class prepares me for our assessments.
10. Can you please tell me in a sentence or two why you answered the way you did in the above question?
11. Content Specific Question 1  
Immunology unit:  
DNA Unit: What is the relationship between DNA and public health?
12. Content Specific Question 2.  
Immunology unit:  
DNA Unit: How do we utilize this relationship to prevent false convictions?
13. What was the purpose of the performance task I had you complete at the end of the DNA unit?
14. Have you ever had a performance task as a way to wrap up a unit in any of your other courses?
15. If so, what did that look like?
16. Did you feel successful when you are able to use your notebook on the assessment?
17. What was the hardest part of the performance task?
18. What was the easiest part of the performance task?
19. What do you think would help improve your learning in class and why?

AR Question Matrix

Table 3. Data Triangulation Matrix.

	Data Source 1	Data Source 2	Data Source 3
Using strategies of culturally responsive teaching, how can I shift my means of assessment?	Literature Review	Performance Task/ Reflective assignment scores (Perspective rubric)	Individual student Interviews
What are student's impressions on using performance tasks vs. traditional assessment as a means of determining understanding?	Performance Task/ Reflective assignment scores (Perspective rubric)	Student Survey impressions post Performance Task	Classroom observations
How do students challenge misconceptions and develop their original thought when talking about the intersectionality of -isms (race, gender, etc) & public health?	Performance Task/ Reflective assignment scores (Perspective rubric)	Student Survey impressions post Performance Task	Individual student interviews
How do my students of color see their identities and societal progress in these performance task assessments?	Performance Task responses/ Reflective assignment scores (Perspective rubric)	Student Survey impressions post Performance Task	Individual student interviews

In order to synthesize the perceptions and conclusions mentioned above, the data sources were triangulated to depict students' perceptions and reasoning. To ensure validity and reliability in my instrument, I worked closely with my science department team, site resource specialists, and my Mills Lead by Learning Coach. At each step in the instrument development process, I received input and guidance on revisions from these external experts and peers. This qualitative data came in the form of student's work, student surveys responses, and individual student interviews with a sub-set of the student

cohort. The quantitative data was based upon student answers to Likert questions preceding open ended survey questions.

## DATA COLLECTION AND ANALYSIS

Performance Task Results

Overall students scored well on the assessment, the first one had an average of 97.25%, the second had an 84.35% and the last increased to 90.73%. The first assessment was most successful, and the second was the least successful as the scores were out of 40 points. The averages scores of the class's PATs are compared in the Figure 2 below ( $N=19$ ).

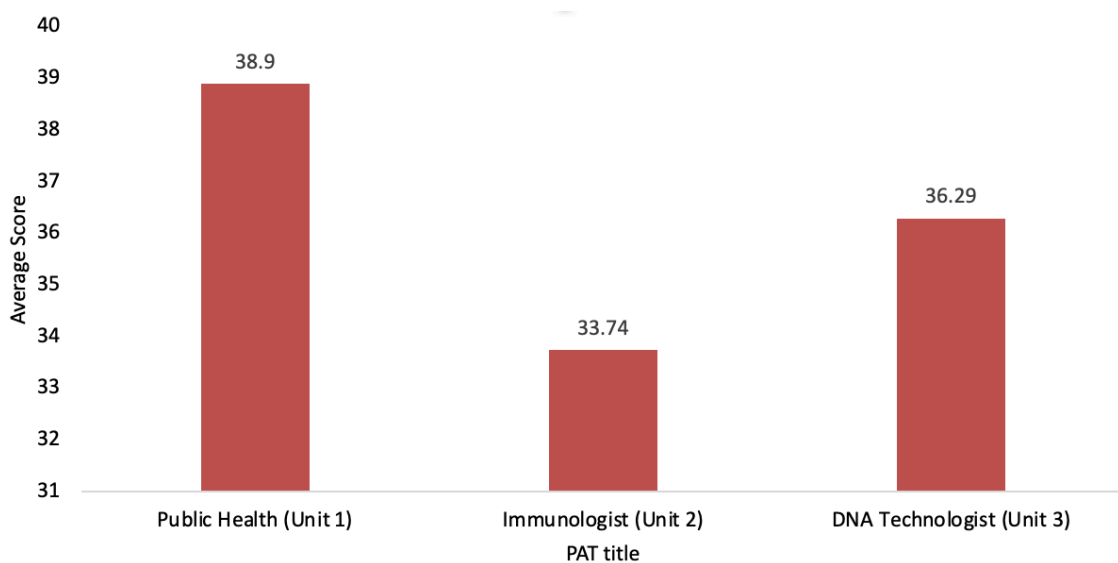


Figure 2. Average score of student performance organized by PAT.

The “Metacognitive Analysis/Evaluate” question was the most revealing of student’s dissection of self. For the Public Health PAT (Appendix B) the metacognitive analysis/evaluate level question was “What are your recommendations on how to mitigate and/or prevent the racial disparities seen in Marin & COVID-19 for the short term and long term?” Looking at the responses, 78% of my students gave an adequate

response to reflect the rigor of abstract thought in conjunction with the identified cognitive processes.

The Immunologist PAT metacognitive/analysis/evaluate question was: “Why is lack of systemic prioritization of public health related to prevalence of autoimmune disorders? What would the quality of life for individuals of different backgrounds with autoimmune disorders look like?” This task saw a large decline in scores as only 47% of my students were able to successfully answer the “Metacognitive Analysis/Evaluate” question properly. In all fairness, this task was considerably harder. The idea that autoimmune diseases can eventually lead to long term disabilities was a key factor for students to make a valid claim and answer the metacognitive/analysis/evaluate question, and some students struggled to make this connection. This task also had a comparative component with the previous unit which was more of an ask from the previous task.

DNA Technologist’s question “How can we make a proposal to reform the system for the better to prevent and exonerate others at risk of false imprisonment in situations like Bob’s?” Although the average score increased from Immunologist, this success rate was the lowest, where only 37% of students provided an adequate assessment response. In the DNA Technologist assessment, I was able to provide better constructive feedback, as students were no longer unfamiliar with the performance assessment. I was able to emphasize patient perspective in my grading and feedback as seen in the rubric in the methodology section above. My most compelling evidence in pursuit of transparent student thought was my individual interviews with focal students.

### Individual Student Case Studies

My most compelling evidence in pursuit of transparent student thought was my individual interviews with focal students. I chose four different students to interview that represented different personal backgrounds in my classroom. I interviewed both of my BIPOC students, named Renée and Serena as well as two white students Allison and Ben. The highlights of these interviews are detailed in the following sections.

#### Renée

Renée is a Filipina female senior in my Biomedical Science class. I had her as a freshman student in my Integrated Science class, where I pushed for special ed to assess her which led to her current accommodations. By nature, Renée is shy and soft-spoken. She grew up in a predominantly black local public housing community, so she is used to having to endure and adapt to the majority white population at Tamalpais High School. When I met Renée, she had a GPA of 1.83. She has bloomed and improved immensely throughout her secondary education and now holds a GPA of 2.75. Her progression was notable in the depth of her responses in the PATs. For the Public Health PAT, (Appendix B) Renée answered the “Metacognitive Analysis/Evaluate” question with a short and direct response.

Race plays out with COVID: In San Rafael where COVID hit hardest in the county has people who are mostly immigrants living there. They are struggling to deflect systemic failure and playing out nationally as Latinx/other communities of color are still fighting against deadly COVID.

In this response, it is clear that Renée struggled to fully communicate her thoughts. She touched on the right concepts, but she did not engage her personal perspective or cite any perspectives of the stakeholders affected by the scenario.

I tried to delegate time to work individually with Renée to get a little more insight into the reasoning behind her answer above. I met with her and asked her to identify which parts of the response correlate with the prompt. Unfortunately, with distance learning, it was very difficult to get Renée to remember to show up to the tutorial time on my Zoom. Renée struggles with organization and memory issues, so this was not a surprise. In her attempt of the Immunologist PAT, she did not connect the information to any larger public health/societal pieces used to answer the “Metacognitive Analysis/Evaluate” question. She mainly gave physiological info about autoimmune disorders and the symptoms. Upon looking at her survey responses, she gave confident answers to the content-based questions. When she was asked about the hardest part of the performance task and what would help her learning, she answered both with “I don’t know.”

I turned my focus to work individually with her out of class to help her build the confidence to meet the criteria for my third focal question “How do my students of color see their identities and societal progress in these performance task assessments?” For this final PAT, she ended up missing the assignment submission deadline by one week, so I reached out and scheduled a one-on-one intervention. We sat down, and I had her give her answers verbally while I typed them out for the first part. She felt confident after I got

her started and she ended up completing the “Metacognitive Analysis/Evaluate” question on her own. Her response was as follows:

I feel like its related to what's happening around the world where colored people are being judged by the color of their skin. There are so many pieces of evidence like DNA that can be used and is important because if someone is falsely imprisoned their life gets taken away. I think it's because people are racist and want to frame POC as bad people. I feel like they should look over all of the evidence provided about the person and their life. What about this person's life is related to the crime or not related? The person could have a bystander telling the truth, but sometimes these bystanders could be told that they are lying by police. Instead of police, investigators who are scientists to collect samples. DNA squad! To be considered a detective, you need some school and training. These investigators need to have patience, and maybe some psychology knowledge and mental health awareness/training. I think it means to me that the whole system is messed up in a way, there are some racists, some not, some people who make mistakes and ruin people's lives. I think for me it means you don't know what will happen next in my life. I could be a bystander, I could you never know. As a person of color, as a bystander that would be hard, so you don't make a mistake and give false information.

Renée showed growth by citing her identity in this response, and she also synthesized an idea for societal progress. Leaning on her own personal experience, and within her community, she identified the need for a structural equitable task force to investigate and pursue justice. Her humility in her response is what struck me the most. She felt comfortable enough to share and put herself in the shoes of the stakeholders and utilized metacognitive evaluation in her reflection. Renée also responded to the DNA perception survey and wrote that the hardest part of the task was not asking for help sooner. She also wrote that asking questions would help improve her learning in class. In the process of my treatment, Renée transformed from a subdued student who frequently would answer questions with “I don't know,” to a classroom advocate who stands up for fellow people of color.

Serena

I met Serena when she approached me a year ago and told me that she was going to take Biomedical Science with me because she wanted to be a plastic surgeon. She has an incredible vivacious demeanor and is the president of Tam's Black Student Union chapter. Serena is very outspoken, empathetic, and humorous. She sometimes struggles with turning in assessments on time, but usually she and I spend time individually together and she regains the confidence to finish strong. Serena has a cumulative high school GPA of 3.24.

For her first assessment, "Create a communication on the role that race plays on Covid infections in Marin" she answered:

A 3<sup>rd</sup> of the county's cases is from the Hispanic canal neighborhood and with living paycheck to paycheck it is hard to afford all the medical services needed. 3% of the county's tests come back positive and 20% of that is from the canal neighborhood. Most canal people are essential workers. Latinos are getting sick and dying from COVID-19 at higher rates than others. Latinos make up 30% of California but 60% have been infected. One cannot just stop working because like I said they have essential jobs and if they get sick with COVID they can't pay their bills.

I ended up asking Serena to do a one-on-one interview so I could further probe her responses to the PAT questions. One of the questions I asked her was if she could tell me a little bit more about her thought process when creating her communication above.

S: Yeah, so I feel like with the racism, as it is hard to prevent racial disparities, people are still going to have a small bit of racism. The first thing I see all the time is how the canal has a lot of cases and they are Hispanics, and all people want to do is judge them for being Hispanic. Where I was going with that was that things will always be hard for people of color. Things were already hard for POC before this happened. As it was hard for POC to get access to COVID testing and hospital services. That was my basis for the race answer.

As evidenced in her answer above, Serena defined public health with context to the greatest affected population at the time. She identified all components of the disparity and was very clear in her answer both verbally and written.

The final “Metacognitive Analysis/Evaluate” question asked students to give a solution to mitigate inequity in Marin COVID infection rate for the short and long term. Serena answered: “You can’t prevent things if people are racist. Insurance should cover your house bills if you get COVID. The hospital should provide free services for [those who] contract COVID.” Serena nailed the question in a succinct and direct manner. I wanted to know more of her inner narrative, so I asked her about it as well in our one on one interview.

Then when it said how to end COVID-19 racial disparities for the short and long term, I said insurance as a lot of people don’t have insurance to be in the hospitals. I mentioned that hospitals should provide services because if you get contracted with COVID, you should not have to pay for that especially if you are low income. I feel like there should be services that help out low-income people so you are able to get treated. Most of the time, it’s mainly white people who are able to get tested, treated and space in the hospital. I was reading how many Hispanics don’t get time in the hospital.

Seeing the subtext to her answer was personally exciting, as the answer was rigorous and directly connected to my focus question: “How do my students of color see their identities and societal progress in these performance task assessments?” Serena leveraged her personal reflection to answer the question. She lives in the same public housing community as Renée and is well aware of what life for essential workers looks like. This gave her an edge over her more privileged peers in answer the PAT because she did not hesitate to identify root causes and inequitable observations. Watching the development of her academic identity in ‘real time’ during the interview, not only

provided a benchmark for what an advanced student response looks like, but also gave me hope that this assessment is another way Serena can continue to develop her agency.

When it came time for Serena to take the second assessment, she was anxious about turning it in, so we scheduled a time to go over it together. In the Immunologist assessment, Serena quickly found sources to cover her claim, and after some probing, she was able to use effective reasoning to support her claim as well.

Public health doesn't serve everyone completely. If you have wealth and tons of money, it is easy for you to get health care, if you are under privileged it is harder to get health care. There isn't enough money in the health care system to get tests and cures for autoimmune diseases. We know the amount of money that needs to be put towards autoimmune disease, but it is about the president and board to put aside more money for people who can't afford treatments. There is no way for a person who is under privileged to find out they have an autoimmune disease unless they have good health care providers. A person with wealth would be able to find out very quickly that they had an autoimmune disease by being able to pay for all hospital visitations.

The root of the question asked students to evaluate what the quality of life for individuals of different backgrounds with autoimmune disorders look like. Serena found evidence that indicated that individuals with autoimmune disorders might not have the access and resources to be able to slow the symptoms and treat it long term. Another strong piece of evidence she cited was how autoimmune disorders can be either genetic-based or a result of exposure to unsafe chemicals.

Not every family member will specifically have the same disease, but they inherit a susceptibility to an autoimmune condition. Being that autoimmune diseases are rising; researchers suspect environmental factors like infections and exposure to chemicals or solvents might also be involved. So, all that to say, researchers and scientists don't know exactly what causes autoimmune diseases. It could be from genetics to the diet of a person, infections, and exposure to chemicals. I think that low-income people are affected because their housing is not up to standard, and they are not able to have housing that is free of harmful chemicals that are considered no longer

safe. People who are living in poverty also don't have the means to remove themselves to safer living conditions. If there is budget allocated for poor people to keep building safe, because buildings can carry harmful chemicals and mold and such. We would not get as many diseases if we could have safer housing. Trips to the doctor are expensive, and it's hard when healthcare is not available.

In her class, Serena was the only student to identify that poorly maintained living conditions (usually found in public housing or other poverty-stricken living structures) are a risk factor for developing autoimmune disorders. This level of reflection offered an incredibly applicable perspective and was the most in depth and well researched answer I had read from this assessment.

Serena can articulate her reflections and desires while leveraging her life experiences in a candid and confident manner. In the perceptions survey for the "Immunologist" assessment, I asked how engaging the content felt. She answered, "I loved how our class was based on things going on in 2020." This struck a chord for me because although this year was an incredible rollercoaster for the world, Serena saw my intention of trying to have our course reflect on current cultural and societal happenings. When asked what would improve her learning in the class, Serena cited active learning strategies, as previously mentioned by "*Difficult subjects: Insights and strategies for teaching about race, sexuality, and gender.*" I am so proud of the leader Serena is becoming.

### Allison

Allison is a white, well-meaning, privileged child. She has played water polo all four years and has been able to successfully secure a spot on a collegiate team at a D1 school. Allison has taken countless AP and Honors courses successfully and has a

cumulative GPA of 4.22 as a senior. In my capstone experience, Allison gave me the biggest challenge when it came to targeting my focus question “How do students challenge misconceptions and develop their original thought when talking about the intersectionality of -isms (race, gender, etc) and public health?” I intended to give these assessments to have Allison ask herself questions about her role in the world, and how other walks of life are different in relation to hers. This was not an easy task. As she wants to be pre-med, I saw it as very important for me to coach Allison to look outside her experiences. Allison is a student who likes to put down what she thinks I want to hear. Checking off boxes is a space of comfort and success for her in other courses. This is not helpful for students to practice metacognitive abstract thinking.

For the public health assessment, Allison made a colorful display and chose to create her own creative response, which was encouraged if the student desired. For her answer to how race has factored into COVID infection and spread, she identified that although the canal is very close to Mill Valley, where she lives, there is a disparity. She completed this by citing important quotes and statistical analysis.

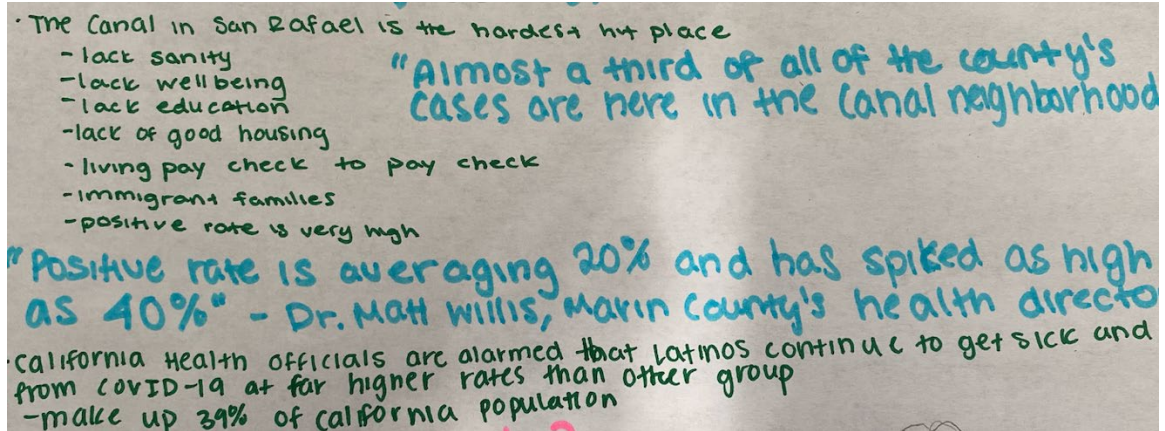


Figure 3. This image represents an excerpt of Allison’s responses to the Public health PAT question “Create a communication on the role that race plays on Covid infections in Marin”

She clearly did a good job referencing the article I provided for reference. She cites examples of equity disparities, but she doesn’t give much elaboration or reflection.

Her answer to the final question was an important catalyst for my work to refine my assessments. When asked to describe short- and long-term solutions she wrote:

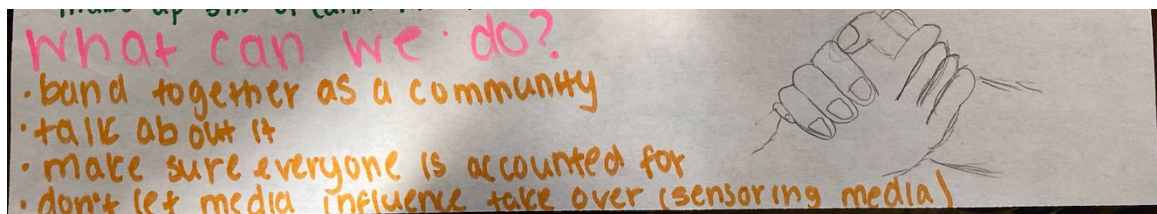


Figure 4. Allison’s response to the final “Metacognitive Analysis/Evaluate” question “What are recommendations on how to mitigate and/or prevent the racial disparities seen in Marin & Cov-19 for the short term and long term?”

When referring back to my focus question related to original thought and intersectionality, this response does not demonstrate challenging any misconceptions. I thought the answer was a “soft” safe answer and indicated she did not absorb the critical conversations we had in class. I didn’t see evidence of her diving into her own experience

or thinking outside of herself. How could I help her develop a reference point, challenge her to figure out what she doesn't know? It's not currently common at Tam for white students to experience discomfort when a white narrative is no longer the focus.

In my interview I probed her further to see what the core of her response was rooted in.

Me: So, let's dig into your answer for the last question. For your recommendations for long and short term, you mentioned band together as a community, talk about it, make sure everyone is accounted for, and don't let media influence and censor information. Can you please touch on what you referenced to create this answer?

A: Well, I just took when anything happens in a community where people feel excluded, and what you can do to make them feel included. Especially the "talk about it" many people brush it to the side and act like it's not their personal problem, so I was referencing it from small things happening in a community. If you brush it aside it won't get fixed, and if it isn't personally your problem then you should be talking about it and listening at least.

This response gave some subtext that moved closer to my research focus. I decided to push further and ask her what she thought were examples of "banding together" and "talking about it."

A: maybe start a talk group, or a Zoom so maybe you could have a discussion group. I would look for evidence for where COVID infections are happening, and where it's mostly originated from, talking to people who have had it, or had friends who have it, and some who have not had any encounter and bring them all together to talk about their experiences. That is what I want to do.

This response was very helpful. Her understanding that wishing and wanting the world to be a better place is a start, but not necessarily productive to address systemic issues. How could I help her identify all of the moving parts that contribute to change and create pertinent actions?

For the “Immunologist” assessment Allison hit some points and missed others.

Her starting claim was very strong:

The importance of autoimmune diseases and the consequences it has on people’s lives has not been emphasized in today’s times very much. Autoimmune disorders can arise from both genetic predispositions and environmental factors. If we took more time to understand autoimmune diseases and the different susceptibilities of people, we would be able to accommodate and eliminate known triggers to make a more comfortable living space, workspace, and make the overall quality of life better for people that deal with them every day.

She then moved on to cite resources that described rheumatoid arthritis and gave recommendations for how to improve an office space for someone with an autoimmune disorder. Usually if someone is working in an office space, they probably have healthcare benefits or the means to acquire healthcare. Any exceptions would be a small percentage.

If working in an office space you could have...

- kitchen knife equipped with a handgrip helps protect your finger and wrist joints
- cushioned chair
- be close to the focal point of the office to reduce walking
- make a smoke free place
- could make it that they only have to come in a certain amount of times during the week

Some of these points had a weak correlation with her claim, and did not reflect any challenging of misconceptions, or understanding of intersectionality in experience. For this evidence I decided to give her feedback in the form of probing questions.

1. What are the factors affecting all people? What would the quality of life for individuals of different backgrounds with autoimmune disorders look like?
2. What suggestions can we make for all people who suffer, especially those who are not served properly by our current system?

Her next piece of evidence and reasoning was closer to giving an original thought outside of her experience.

#### Environmental Factors and Multiple Sclerosis

- climate, stress, occupation, cigarette smoking, and diet
- high salt, high fat, high protein, and high sugar intake (Westernized foods)
- women are twice as likely to have it as men are
- Someone from Mid-West is more likely to have MS
- People with an autoimmune disorder need accommodations and if there aren't any then it is hard to get a job and feel comfortable and healthy
- this leads to further decreased health, poor living conditions, and lower income

Acknowledging the projected outcome for those living in poverty with an autoimmune disorder was an improvement for Allison, but she again linked it to altering an office space for accessibility. I wanted her to expand her reasoning a little farther to make systemic recommendations to reduce extra harm to those in poverty.

As I graded the second performance task, I realized that Allison wasn't shifting her answer because there was no pressure to. I had given her 100% on the previous assessment because I was not sure how to approach feedback on such sensitive topics. I let my anxious thoughts get in the way of a valuable lesson. Allison is not primarily concerned with diving into her whiteness, she is concerned with her grade. This made me realize that I needed to incentivize her looking at her assessments so far and reflecting on them so she can improve.

In Allison's reflection, or as I called it Unit 3, part 1 assessment (Appendix D). I saw her begin to dissect her progress and use abstract thought. I asked the class to open up their previous assessments and look at the feedback I had given.

I think that I can answer more broad-based questions because a lot of the notes that you had given me on my Immunology Tasks were talking about

people as a whole. I do think that my claim was pretty spot on because it really incorporated all of the aspects that I wanted to write about in my final presentation. I also think that looking more into the health system could have helped me in general gain more knowledge that I could have used in the project.

Allison's claim was very good, but she didn't find accurate evidence to truly demonstrate the skills required. Her suggestion to gain knowledge about the health system so she could identify disparities was a step in the right direction. When it came to addressing and including different perspectives, Allison had much to grow from this as she defended her suggestion to improve an office space rather than thinking of other workspaces that are more common for people who are disadvantaged.

I do think that I incorporated other's perspectives because I used articles from people who had suffered from an autoimmune disease and articulated what affected them the most and therefore what we could do for others like them to make them feel more comfortable in a work environment. I think that I could have incorporated interviews with businesses/firms that have workers with autoimmune disorders and what they do to the environment to make them feel more comfortable and safe.

For the DNA assessment, Allison did a solid job setting up her response and performing the necessary research to give a meaningful answer. She focused on altering and regulating pre-trial detention centers in order not to traumatize or stress subjects to the point of falsely confessing to a crime. She found a source stating that more severe criminal sentences are linked to people who have longer detention stays during the pre-trial phase of the legal process. This was a unique perspective that was not touched on by her classmates, and she cited an example using a person of color for her reasoning. Her final PAT was excellent, and she only lost credit because the prompt asked for self-reflection in relation to this systemic reform. Allison did not incorporate any dissection of self, or of whiteness in general.

After the third assessment, I read Allison's responses to the perception survey for the DNA unit. One of her responses particularly struck me:

I know that our class really deals with public health but sometimes it feels like more of a social justice and racial awareness class then (sic) it does biomedical science. I think I just expected to be learning about more biomedical technology and medicine then we are.

It seemed like Allison was pushing back on the process of examining equity and how to serve all people utilizing science and medicine. Before this assessment, we spent a month and a half performing Polymerase Chain Reaction to replicate DNA, gel electrophoresis to visualize the samples, and re-learned concepts related to DNA structure and replication. I only brought in the forensic context in order to set up the assessment. I sensed a disconnect in her response. She saw discussions of race as a "thing" that you talk about and move on from. As a doctor, and in the research field, ethics is one of the top considerations when working with patients and formulating solutions for real life problems. Ignoring the context and nuances of the people who will benefit or suffer from medical technology or processes only feeds into an avoidance of acknowledging whiteness and the potential harm it could cause. Allison was unable to dissect herself within these assessments and pushed against analysis of decentering whiteness in medicine.

In the introduction I mentioned previously in table 1 the five things I desired white students to demonstrate in this process. As I reflect on Allison's performance in conjunction with these outcomes, I believe she only achieved ideal outcome number two. She was able to find real life stories of disparity in the PAT topics and use that as evidence for her claim. She was unable to dissect her thinking, isolate race, acknowledge

historical oppression or understand the interpersonal requirements for success in medicine. When asked directly about minority experience in the context of false incarceration, she described minorities as “easy targets” and cited that they would be prejudiced against, but she did not acknowledge the painful history of this discrimination and its lasting long-term effects.

Ben

Ben is an openly queer white male student in my Biomedical Science class. He has been very successful academically by earning an A in eight honors and APs as only a junior. This hard work has paid off as Ben has a 4.38 GPA. Ben had very strong responses to all of the unit assessment tasks, and he represents a white student who is comfortable decentering whiteness and actually does it very well.

In the public health assessment, Ben created an excellent resource that could be usable in a public informational setting. He identified the bigger issues at play:

In order to truly put an end to this we must face the terror of systemic racism as the country is doing now and keep working hard until any trace is gone. To lessen this gap, we need to first directly help the communities in need by putting more attention and resources toward testing, treatment, and community healthcare.

Ben already had the background knowledge to reflect on the societal significance represented in the scenario. In this response he clearly demonstrates outcome #1 and #5 from my desired outcomes (Table 1) for my white student. He dissected the evidence, and claimed advocacy and compassion as a necessary tool for bettering public health.

In immunologist, Ben's answer to the "Metacognitive Analysis/Evaluate" question entailed a full essay, rather than just the graphic organizer of evidence as seen in Appendix C. He began strong with a claim: "The disparity between social classes that we see in our world today stems from several historical wrongdoings that take longer than a lifetime to fix." Ben also consistently modeled outcome #3, "A direct correlation has been drawn between neighborhood deprivation -a scale of poverty and education levels in a neighborhood- and prevalence of autoimmune disorders." Ben also demonstrated outcome # 4. He models this by quoting the CDC, "Discrimination, which includes

racism, can lead to chronic and toxic stress and shapes social and economic factors that put some people from racial and ethnic minority groups at increased risk for COVID-19”

In his final assessment, Ben demonstrated the final outcome that was left from my desired list. Being less philosophical when talking about race, using accurate evidence rooted in story. This evidence came in the form of his response to the “Metacognitive Analysis/Evaluate” question.

I think that informing the public about stories like Miller’s and Vera’s are incredibly important for encouraging change in the system. Though I haven’t and will never claim to have faced anything as horrific as these people, I can understand the power that their stories hold and can respect their pain.

Ben not only cited actual stories of wrongful conviction, but he acknowledged the perspective of the people in the stories. To take it a step further he looked at his own life experiences and commented on the stark differences as well as validated the pain experienced by those being oppressed. Ben’s responses represented a solid understanding as well as a comprehensive allyship for oppressed populations

To give a visual representation of the performance of my varying case study students, I compiled their scores and created a visual representation of their performance. I observed some affiliation with performance and depth of metacognition in Serena’s and Ben’s responses. Renée’s and Allison’s responses represented the growth and coaching that led to students addressing misconceptions and dissecting self in their responses.

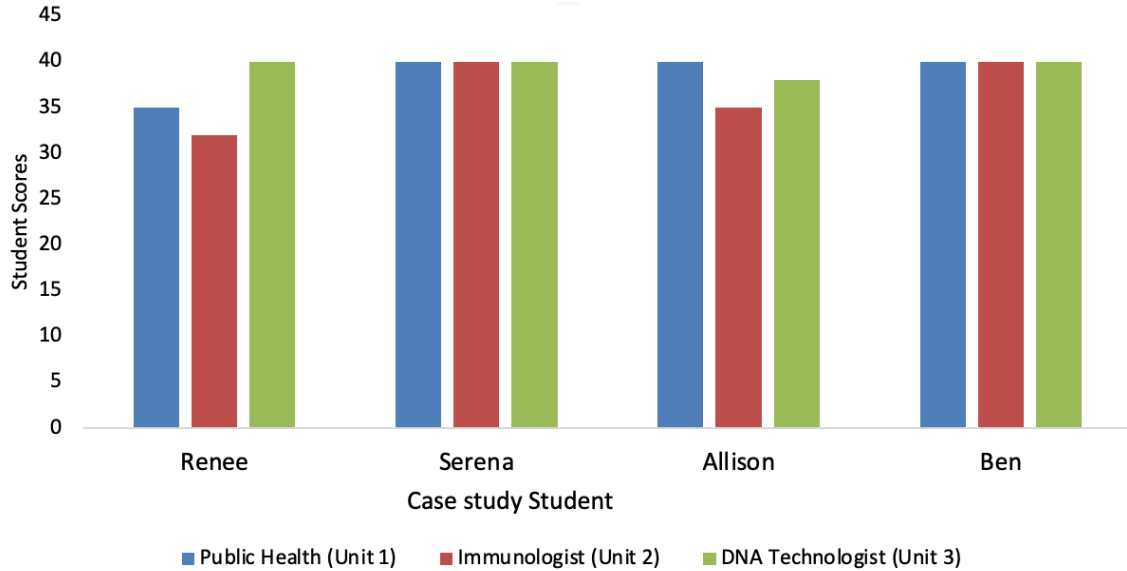


Figure 5. Scores of the case study students for each of the three PATs.

### Performance Task Impression Survey

The final piece of data analysis connects to my first focus question, “What are student’s impressions on using performance tasks vs. traditional assessment as a means of determining understanding?” I gave two surveys after the second and third PAT. The questions are listed in the methodology. Some students understood why we used PATs, while others did not. Students who understood the utility of the PAT connected the fact that highlighting inequities and suggesting improvements to the public health system will help health outcomes for everyone.

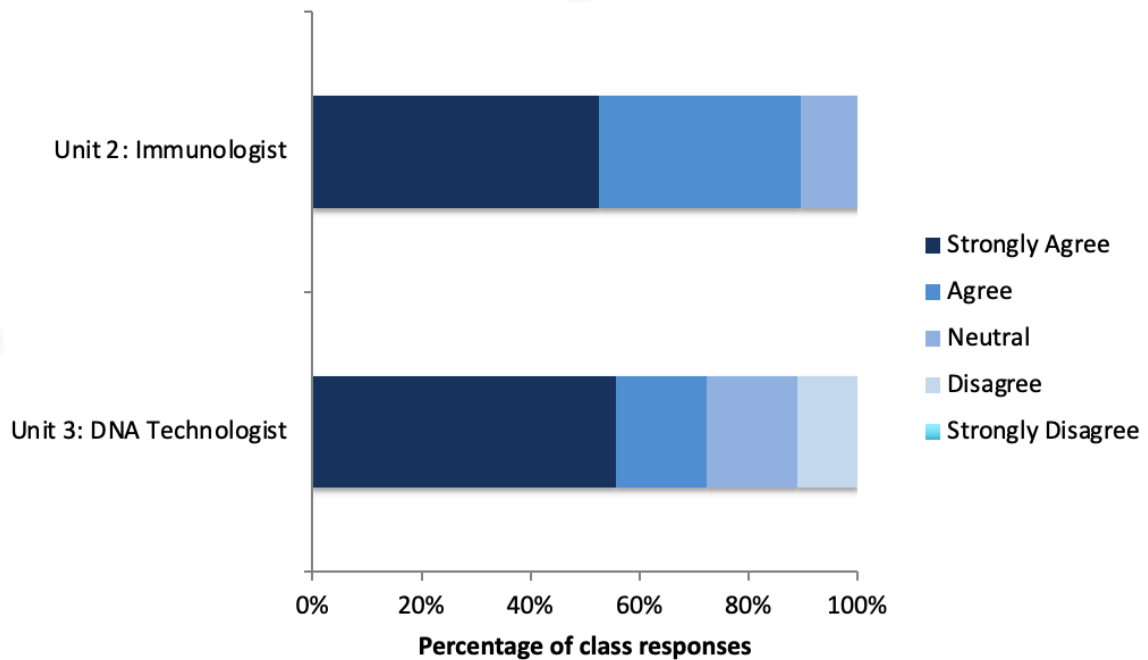


Figure 6. A bar chart representing shifts in student perceptions about how useful the skills from the units, ( $N=19$ ).

In the Figure 6 Likert survey, I noticed a shift in student perception about usefulness of the skills we learned. For the third unit, we had a few labs that could not be completed at home, so many expressed disappointed and felt as though they were missing out by not having hands-on labs. Only one student of the 19 voted that they disagreed.

The most revealing question related to the purpose of the PATs. Only five students were experienced with PATs like the ones I used in my Biomedical Science course. As well, their PATs experience primarily consisted of assessments such as presentations, graded discussions, and open-ended free response questions. Of the 19 responses provided for the immunologist survey, four students did not fully understand the purpose of the PAT and answered that it was to “measure understanding of the immune system.” The best answer came from Ben, “To dive deeper into the grand

scheme of biomedical science instead of peering through a microscope. Seeing how the world can actually be affected by this work, and how it is being damaged without it.”

In the final survey, after the DNA technologist unit, each students accurately identified that PATs re a tool that can be used to help students connect how DNA analysis can be used to combat inequalities. This was an excellent improvement, and a relief for me. My students not only gave innovative answers to the ethics questions I posed, but they also understood how fighting oppression can be used to benefit public health. To quote one of my students, “[Performance tasks] connect what we learned in class about DNA to real injustices happening in life.” This directly answered my survey question and addressed my first focal question.

## CLAIMS, EVIDENCE AND REASONING

Claims From the Study

In response to my action research question: “Using strategies of culturally responsive teaching, how can I shift my means of assessment?” I found that explicitly teaching and assessing using methods of critical thinking students assessed their roles in greater society when it came to identifying and working against systems of oppression. My area of focus was engaging students in self-analysis within matters of race and bias in the medical system. The purpose of this study was to transform my assessment approach and have students assess the efficacy of public health in the classroom. This ownership was valuable, and specifically forced my white students to dissect their role in racial disparities as seen within my individual interviews and artifacts of assessment responses.

To address the sub question: What are student’s impressions on using performance tasks vs. traditional assessment as a means of determining understanding? A useful piece of evidence was the student perception survey as it allowed students to respond in their own words to my inquiries. All students accurately identified the purpose of the PATs. Students challenged their misconceptions and developed their original thought when talking about the intersectionality of -isms (race, gender, etc) and public health within the scaffolded expectations of the assignments as seen in Appendix B-E. My assessment questions explicitly asked students to address the layers of intersectionality of race, gender, sexual orientation, etc. by making a relevant, solid claim. Their claims represented their acknowledgement and understanding. The final sub

question, of how my students of color see their identities and societal progress in these PATs was answered in the student interviews. Serena was very vocal about the value of the assessment questions and appreciated the explicit context. Renée also expressed her approval within our one-on-one conversations as I guided her through the assessments.

An iterative process was used to refine and improve my assessments over the three content units. I first looked at student data, particularly white student responses vs. students of color. My focal students were particularly helpful in this process, as they represent a spread of racial demographics and income levels. As I read through their responses, I identified what success looks like on a PAT which challenged students to think about equity and health. Interesting, I noticed a gap in understanding for my white students after the public health assessment. I identified signs of the learning gaps and assessment criteria and make changes to try and support deeper critical understanding in the Immunologist assessment. By the time we came to the final DNA assessment, I had enough familiarity with student performance/expectations to develop better scaffolding which probed the students to provide foundational research aimed at defending their answers to the “Metacognitive Analysis/Evaluate” question.

#### Value of the Study and Consideration for Future Research

It was interesting to notice the student’s “depths” of critical thinking in their assessments. Some students remained superficial and not seeing the deeper connections to inequity, while others either grew or remained in the same complex awareness. Grading was actually a joyful process, as I was able to see individualized responses and

amazing reflections. I think many of the students enjoyed the deep dive and the context, as many have either mentioned it in my surveys, or made comments to me personally. Although some students resisted the self-dissection, I hope they will reflect on the experience later. Particularly when they use critical thinking skill in their college courses. The resistance observed by students represents the limitations of this study, as well as in relation to my personal time. If I had more time to incentivize reflection and revision, I think there would have been more opportunities to engage. I also think conducting more one-on-one interviews would have been an effective tool to review feedback and probe further. If I were continue researching this topic, I would create PATs for each unit in this course and develop a more recognizable structure, where my criteria for success is standardized across assessments. This was an incredibly valuable teaching experience, and my assessment structures and techniques are forever changed.

#### Impact of Action Research on Author

I walked away from this experience not only proud of my students, but proud of the assessments I created. I figured out how students can see themselves and each other in their learning, even when distanced from the classroom. This was evidenced in my conversation with Serena, “As I re-read my answers- I like how I was able to show my voice about how I am feeling and about how I felt at that time talking about race and how I still feel.” Having this candid affirmation from her was not only a relief, but also my measure of success. In my study, I successfully solicited student impressions of non-traditional assessment structures. As quoted from the student perception survey, “The purpose was to have an original thought to come up with a solution that would benefit

almost all perspectives.” I coached my white students to dissect themselves, as well as the experiences and misconceptions of people from varying walks of life. I also nurtured my BIPOC to enable them to see themselves in these assessments. Observing the effects of this study I think both white and BIPOC students felt empowered to engage and motivate change in larger systems. I saw my students remove their ego as they demonstrated collective thinking. In order to do so, they had to conduct a deep analysis as well as evaluate abstract societal concepts. I consider this experience a success and I foresee continuing for the use of PATs in future Biomedical Science classes.

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APPENDICES

APPENDIX A

MONTANA STATE IRB BOARD EXEMPTION



**INSTITUTIONAL REVIEW BOARD  
For the Protection of Human Subjects  
FWA 00000165**

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**MEMORANDUM**

**TO:** Alyssa Sandner and Walter Woolbaugh

**FROM:** Mark Quinn *Mark Quinn CJ*  
Chair, Institutional Review Board for the Protection of Human Subjects

**DATE:** November 13, 2019

**RE:** "Application and Analysis of How Tailored NGSS Rubrics Affect Student Performance and Attitudes"  
[AS111319-EX]

The above research, described in your submission of November 12, 2019, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

ASSESSMENT INSTRUCTIONS FOR UNIT 1

## Public Health Worker Performance Assessment: Marin County COV-19 Communication Tool

Congratulations on completing your training as a public health worker at Tamalpais Biomedical™. Your job today is to analyze our current Marin County public health data and create a COVID-19 communication tool (like a flyer or info post) *in your own words* for Marin County community members that includes the following:

1. A description of what public health in Marin means

2. A case definition of the Covid-19

Suggested references to use:

[CDC COVID 19 Case Definition](#)

[PAHO COVID 19 Case Definition](#)

[WHO COVID 19 Case Definition](#)

3. An analysis of the 5 California State Indicators- what the metrics to reopen are and where we are today (you may only be able to find what THREE of them are today, that's OK)

Suggested references to use:

<https://coronavirus.marinhhs.org/surveillance>

<https://coronavirus.marinhhs.org/progress>

<https://covid19.ca.gov/safer-economy/>

4. Create a communication on the role that race plays on Covid infections in Marin

\*\*Include *evidence* from [this article from NPR](#) along with the other assignments we have completed in class to form your *statements & arguments*

5. What are recommendations on how to mitigate and/or prevent the racial disparities seen in Marin & Cov-19 for the short term and long term?

Here is an EXAMPLE of what your layout may look like. You can follow this example or create your own!

You can either create a digital document and turn it in, or you can create something on paper, snap a photo, and turn that in.

This is a workplace exam, so you will need to complete this during our workplace time and turn it in by the end of the class period.

Have fun, get creative, and show off your Public Health Worker SKILLS!

(Your tool will be assessed via a rubric that looks for- content knowledge, depth/comprehensive coverage, original thought, presentation of the communication tool, mechanics, and appropriate for your target audience)

APPENDIX C

ASSESSMENT INSTRUCTIONS FOR UNIT 2 IMMUNOLOGIST

## Sandner Immunologist Task

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As your first semester at Tamalpais Biomedical™ comes to a close, let's take some time to reflect on all that we have discovered this semester. As public health workers, you now know how important the health of the entire community is, how **prevention is key**, and **how there are systemic inequities that plague our country**.

As immunologists, you have learned the **basic concepts behind antigen-antibody interactions**, and how these interactions **form the base of what seems to be an incomprehensibly diverse body system**. You have learned how biomedical research has led to a standard clinical test that can be used to find the presence or absence of antigens or antibodies, which then can be diversified to test for a multitude of applications.

Where would the world that we currently live in be without all of this knowledge? One thing is for sure- life expectancies would be much lower. Although it may seem like we have all of the answers, we don't- not by a long shot.

In order to maintain your employment at Tamalpais Biomedical™, your final immune task will be to come up with a justified proposal for why systemic prioritization of public health relates to prevalence of autoimmune disorders and What would the quality of life for individuals of different backgrounds with autoimmune disorders look like? (Our clientele) Your **proposal should not only highlight what you have learned while being employed here, it should also allow your true innovative, problem solving mind to shine**.

Your phenomena we explored for this unit was: Our immune systems keep us safe from pathogens, but some people's immune systems are super overprotective. How can someone be anaphylactic to a peanut? How can we test for the presence of antigens? What makes some immune systems turn against their own bodies? What are some potential solutions to help these patients?

Please read this evidence article to guide your answer:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4335798/>

Title: "Solving the puzzle of autoimmunity: critical questions" (2015)

I would like for you to find and reference **ANOTHER SOURCE OF EVIDENCE** alongside the above article to support your claim. **Remember you can choose MULTIPLE pieces of evidence from one source**.

You are welcome to use the graphic organizer below to plan/organize your thoughts. If you prefer to write in more of an essay format, or explain in a visual format, feel free to synthesize in a comfortable format.

Take joy on the learning journey and have fun. Be creative. Be innovative. Be Tamalpais Biomedical™.

**Claim-Evidence-Reasoning**

<p>Question: Why lack of systemic prioritization of public health is related to prevalence of autoimmune disorders? What would the quality of life for individuals of different backgrounds with autoimmune disorders look like?</p>		
<p>Claim:</p>		
<p>Source?</p>	<p>Evidence (Primary <b>data</b> that you collected OR <b>data</b> from a reliable source including observations of the natural world and results from a controlled experiment.)</p>	<p>Reasoning (Information that explains how the evidence supports your claim. Often scientific background from text, lecture or other source.)</p>
<p>Tying it all together, how do all of your pieces of evidence connect together to answer the question?</p>		

APPENDIX D

ASSESSMENT INSTRUCTIONS FOR UNIT 3 PART 1: DNA TECHNOLOGIST

### Unit 3 Performance task - part 1

Self examination as a means for deeper learning-

Open up your old performance tasks (I resurrected our old G-classroom)  
They are titled "Immunologist final task" and "Public health assessment task"

### Unit 2 Immunologist performance task analysis

Now that we look back and reread Unit 2, How well do you think you answered the original question? Please explain your thinking to me.

Do you think you incorporated others' perspectives and experiences in your response? If so, who's perspectives did you incorporate? If not, who's perspectives could you incorporate?

### Unit 1 Immunologist performance task analysis-

Open it up and re read your answer for the final question "Your recommendations on how to mitigate and/or prevent the racial disparities seen in Marin & Cov-19 for the short term and long term"

How well do you think you answered the original question? Please explain your thinking to me.

Do you think you incorporated other's perspectives and experiences in your response? If so, who's perspectives did you incorporate? If not, who's perspectives could you incorporate?

APPENDIX E

ASSESSMENT INSTRUCTIONS FOR UNIT 3 DNA TECHNOLOGIST

## Unit 3 DNA Performance Task- Sandner

## Learning Goal:

analyze a case study scenario (DNA profiling), identify appropriate laboratory investigations to solve a problem, and **make connections between DNA tech and public health**

**Imagine it's the late 80's you are an expert medical examiner/Lab tech who has been tasked with investigating and providing evidence for a court case related to a murder.**

[The Case Details are here](#)

Briefly summarize the case details below for your use later:

**There are six reasons for wrongful convictions please skim the articles to familiarize yourself with each one:**

- [Eyewitness misidentification](#)
- [False Confessions](#)
- [Inadequate Defense \(bad lawyer\)](#)
- [Government Misconduct](#)
- [Informants](#)
- [Improper Forensics](#)

I would like for you to pick **three reasons** that apply to the evidence in the Case of Bob Bobbington and analyze the link above about your chosen reasons in depth.

What reasons were exhibited in Bob's case?

Please cite why for each reason from the original case description and the provided links above

Reason 1:

Reason 2:

Reason 3:

As a medical examiner and expert witness in court, how would you describe the value of DNA testing in a court of law that has never used DNA evidence before? What would you need to explain to convince nonscientists?

**THE TASK: How can we make a proposal to reform the system for the better to prevent and exonerate others at risk of false imprisonment in situations like Bob's?**

If you were truly going to make change-

What information do you need? Who is the information from? Who is it not from?

What factors do you need to consider?

What are ALL of the stakeholders? (groups/people involved) List the stakeholders and why their perspective important/valuable.

Returning back to public health and inequities: what if Bob was a part of a minority racial group? From a low socioeconomic (poor, low resources and opportunities) background? How is this **perspective** important for meaningful solution design?

**Starting places for Reform ideas:**

- [Eyewitness misidentification](#)
- [False Confessions](#)
- [Inadequate Defense \(bad lawyer\)](#)
- [Government Misconduct](#)
- [Informants](#)
- [Improper Forensics](#)

**Your proposal should not only highlight what you have learned while being employed here, it should also allow your true innovative, problem solving mind to shine.**

In order to get an A on this assignment and in the “perspectives” category you must include:

- 1. Action items with explanations how these actions should be taken.**
- 2. Acknowledgement of the experience of oppressed populations with citations of REAL stories**

### 3. Your own reflection on how your life experiences do or do not tie into this systemic reform

Thoroughly describe what regulations, precautions, and or procedures can be done to keep the reasons for wrongful conviction from causing more wrongful convictions.

Please document your proposal here:

#### RUBRIC:

	<b>Below Basic 5/20</b>	<b>Developing/ Basic 10/20</b>	<b>Proficient 15/20</b>	<b>Advanced 20/20</b>
<p><b>Perspective</b> - provides your reader with the connection to people who are affected. There are many different walks of life that are affected by public health. The more experiences you cite make your designed solution more effective. This is also where you should draw on key ideas and concepts from your issue you are working to solve.</p>	<p>Does not provide perspective, only provides unrelated perspective, or personal perspective only.</p>	<p>Provides perspective that connects very few experiences with the solution design. Does not provide full understanding of the population affected and how the designed solution provides better public health.</p>	<p>Explanation provides perspective that is...</p> <p><b>-Clear</b> (Clearly communicated and goes beyond one's own experience.</p> <p><b>-Connected</b> (using objective language, explains why the experiences are important or why it is relevant in this particular case)</p> <p><b>-Integrated:</b> broadly or vaguely connects scientific concepts, societal structures, and vocabulary to support understanding of why the reform is valuable.</p> <p>-Mentions experiences but does not connect it well to the solution's design.</p>	<ul style="list-style-type: none"> <li>Exhibits that research has been completed about many perspectives involved (with citations) to explain why the experience affects the solution suggested.</li> <li>Reasoning shows full depth of content understanding with</li> <li>Innovative/justified systemic reform ideas.</li> </ul>