



Brining Examples to Life: Case Study Writing Assignment in Biochemistry

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BACKGROUND

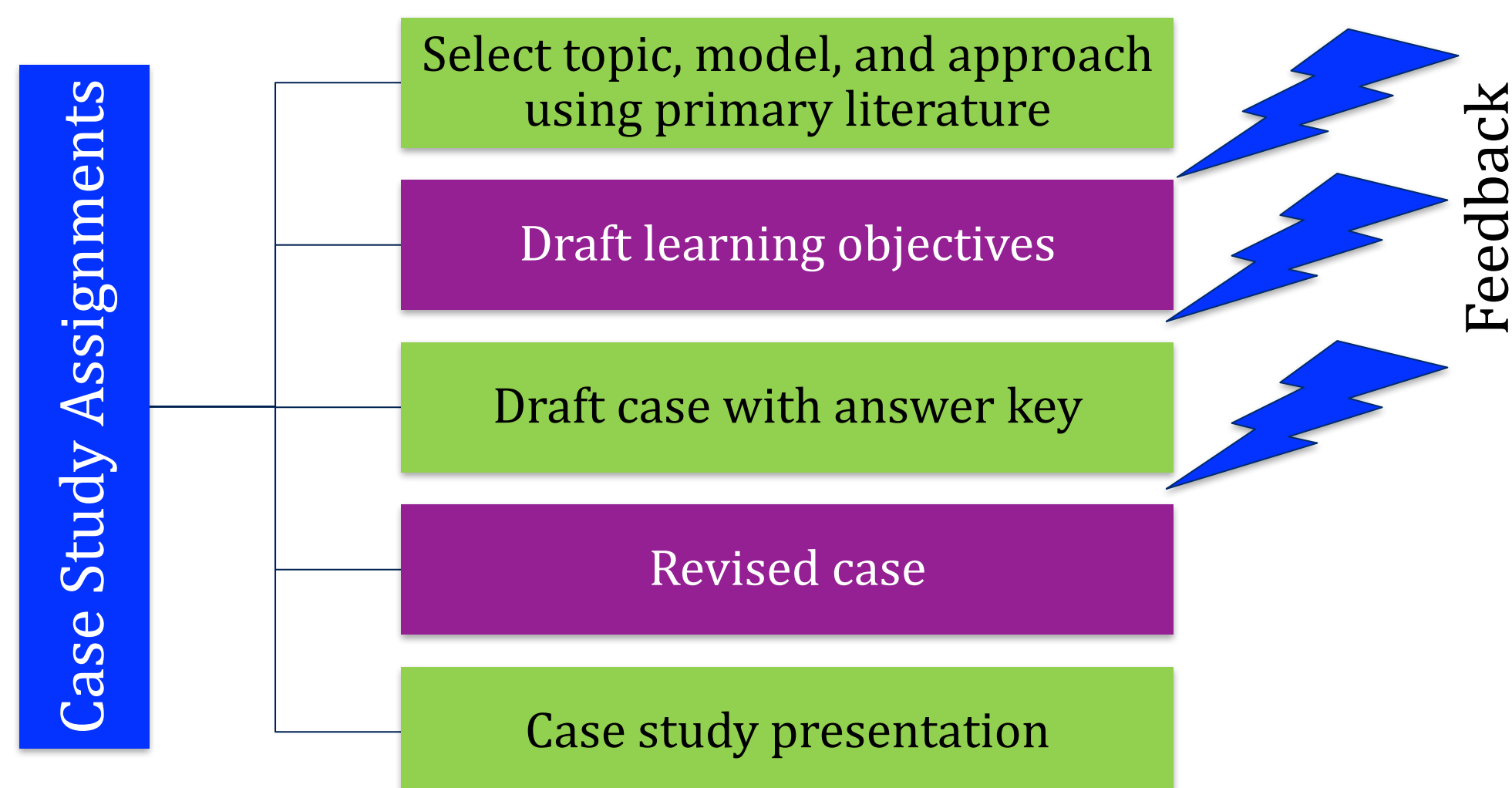
Case study teaching is a powerful to introduce students not only to teach concepts and content, but also critical thinking and problem solving skills. Cases bring content to life using examples and approaches that can interest students. Biochemistry students wrote short cases in groups to share with their classmates about protein structure function relationships utilizing a variety of models. Assignment will help students practice the following skills:

- Collaboration
- Information literacy
- Written and oral communication skills
- Application of structure and function relationship

SUPPORTING STUDENT CHOICE

Model Type & Definition	Extra Credit	Criteria to Receive Extra Credit
Diagrams: These 2D depictions are most common model that are encountered in biology textbooks, study materials, and research literature.	0	Since diagrams and animations can be found in ready to use in either the primary literature or on websites like YouTube no extra credit will be awarded to groups that select these model types.
Animations: a dynamic visualization that can display the components of a system or dynamics of structure as a sequence of events occurring in time and space.	0	
Simulation: An imitation of a real-world process or system. Simulations allow users/participants to manipulate variables or views to observe changes and make/test predictions of phenomena. The phenomena normally explored using simulations can be difficult to directly observe because of inaccessibility due to temporal or spatial scales.	Up to 10 points	You would not need to make the simulation but instead write a case for an existing program. Include instructions on how to access and use the simulation by including screen shots. Instructions should include information on how to manipulate models to answer questions.
Tactile models: 3D models that can be handled by learners.	Up to 15 points	You would not make the program to print the molecules. Either identify company to produce model for a reasonable price or use fused filament 3D printers to create 4 sets of printed tactile models. Possibly colorize tactile models to support student interpretation of models. The case and the questions need to be written such that the model is significantly utilized.

SCAFFOLDED ASSIGNMENT PROCESS



STUDENT CASES TAKE APPROACHES THAT ENHANCE INTEREST

Group #	Model	Protein	Approach
1	Tactile & Diagrams	Troponin C- protein that is important in cardiac muscle contraction	Presents heart attack scenario where troponin C levels are elevated in the blood
2	Diagrams	BCR-Abl- a mutant protein that causes Chronic Myelogenous Leukemia (CML)	Dialogue between research student and professor describing drug binding and resistance
3	Tactile & Diagrams	Leptin- a signal that causes the feeling of fullness	Theoretical mutation changes in receptor confirmation and effects
4	Diagrams	Beta Hexosaminidase A- component of enzyme that breaks down fatty substance GM2 ganglioside which is toxic to neurons in brain and spinal cord	Dialogue between doctor and parents describing symptoms and mutation that occurs in Tay Sacks disease

Excerpt of Leptin Case with Diagram Supporting Tactile Model

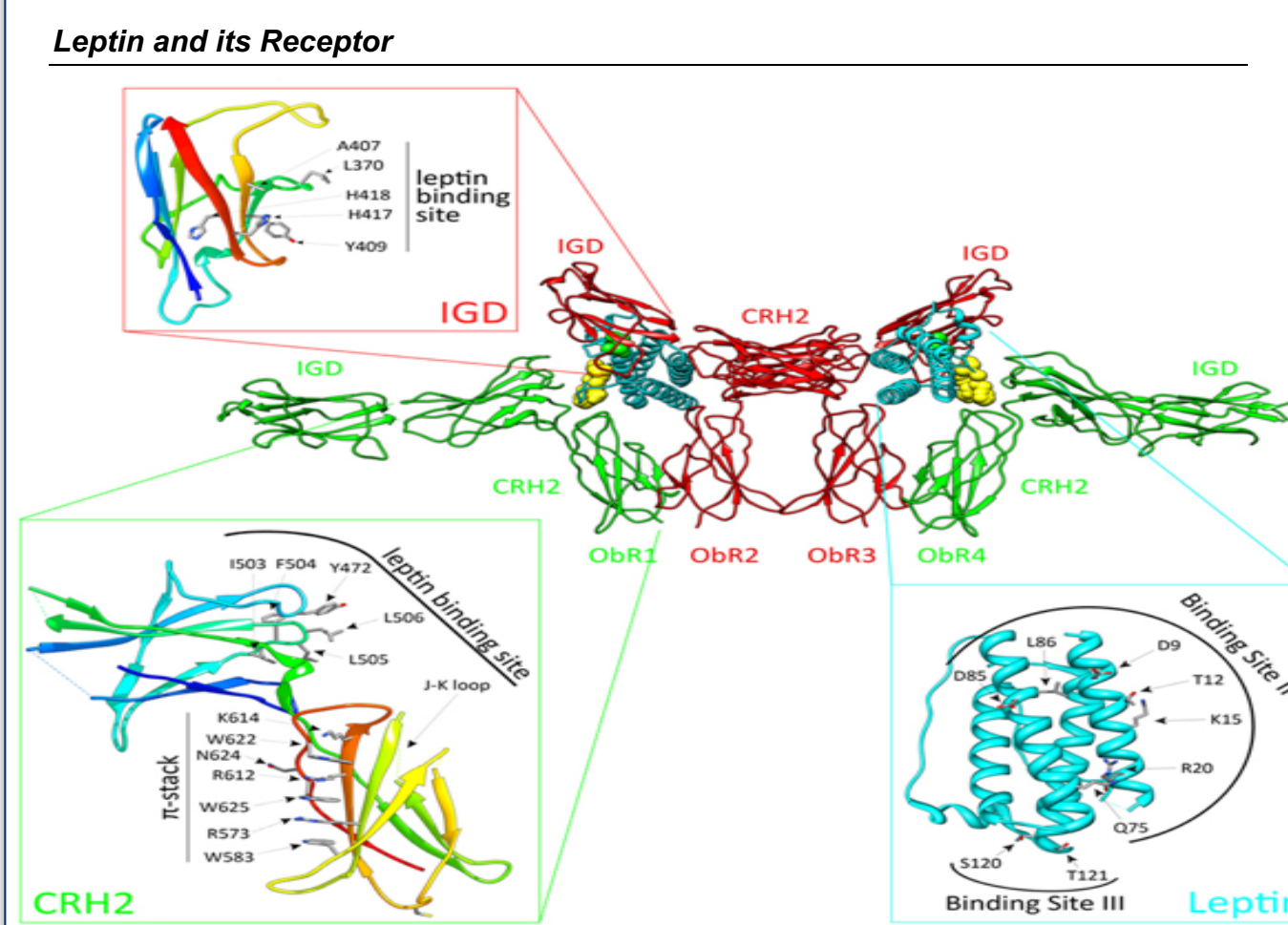


Figure 2: Diagram of the Leptin receptor. In this figure, the leptin protein is light blue, and the homodimerized leptin receptor is green and red. (Adapted from: The Leptin Receptor Complex: Heavier Than Expected? *Frontiers in Endocrinology* Wauman, Zabeau, Tavernier, 2017).



Excerpt of BCR-Abl Case Dialogue, Diagram, and Questions

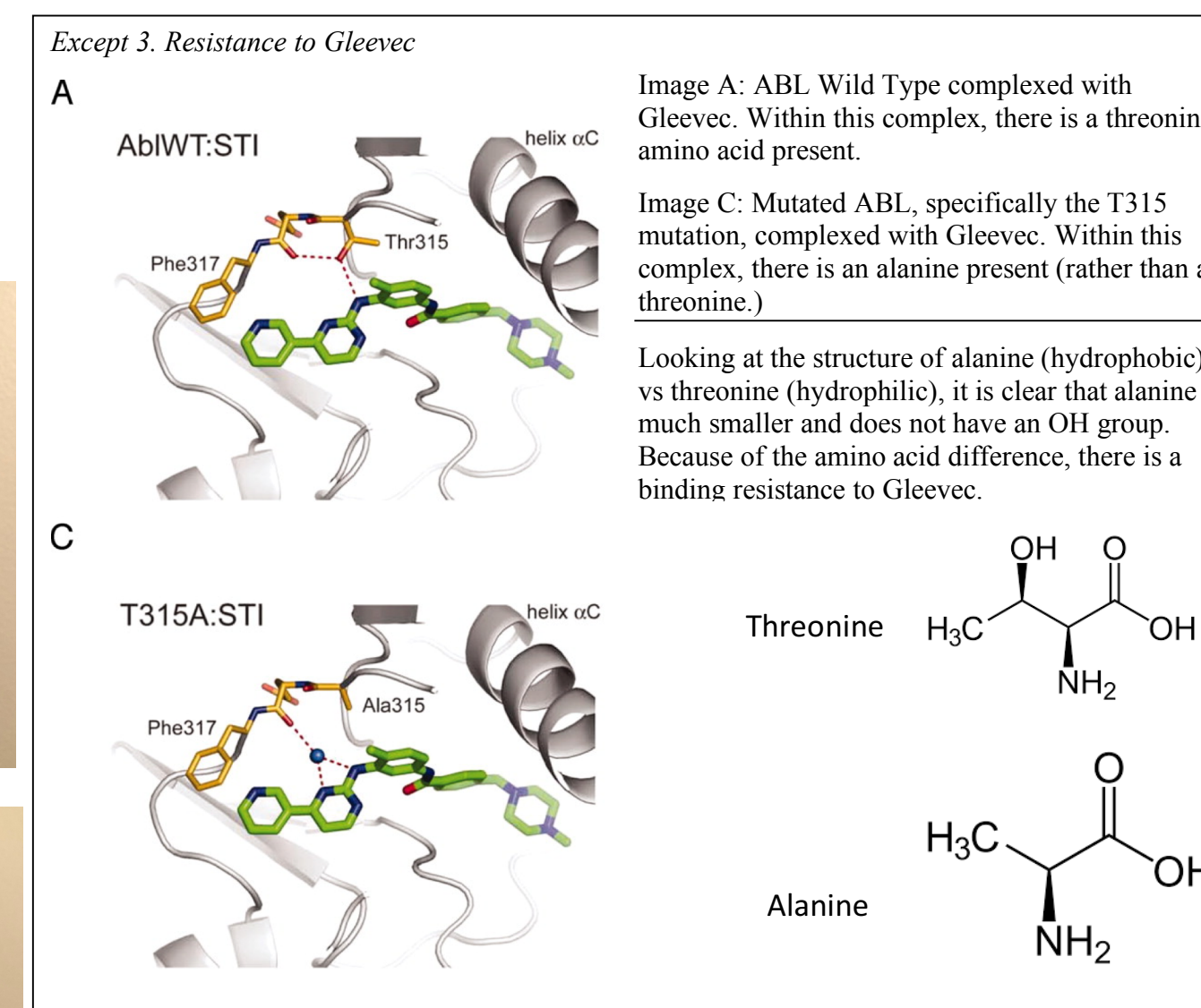
Part II – A Drug Inhibitor for BCR-ABL

“Sidney, are you aware that protein structure affects function?”

“Yes I am. I know that shape, length, and types of bonds can influence the structure of a protein which, of course, affects the function of a protein.”

“That is a great start! Understanding that structure affects function allows us to determine what type of inhibitor will work. It is essential that we find an inhibitor that prevents the cancerous cell from being activated.”

“I understand! So not all inhibitors will work to treat CML?”



Questions of Part II.

1. Why does Gleevec work as a better inhibitor than Parke-Davis?
2. What role does Gleevec play in the confirmation of BCR-Abl's the activation loop play and why does this cause enzyme inhibition?
3. How does the amino acid change cause resistance to Gleevec? Consider the structural differences between alanine and threonine.

STUDENT FEEDBACK ON ASSIGNMENT

What is most valuable aspect of writing and presenting case?

All year, the focus has been protein structure affects function. That, I knew - it was embedded in my brain. With that being said, the case study provided actual, real life examples (that I was interested in) about this learning objective. Having something that I could relate back to the core of the class was most valuable to me.”

“It forced me to independently research and learn from real peer review published articles in order to write my case.”

What changes would you recommend to the assignment or feedback to make assignment more effective?

“Maybe spend more time in class working on it with the professor present.”

“More checkpoints, for grades so the professor can oversee the progress of the project more closely.”

“I think it was pretty well structured. I think there should be more emphasis on the learning objectives and that type of information compared to the information that we had to put into our story.”

What changes would you recommend to the presentation?

“More time! If we are expected to answer the questions, we need the time to do it. Or, make the answers for a grade so everyone completes the studies and can turn them in on canvas at a later date.”

“I thought the presentations went well. I would recommend having the students read the ones that are presenting ahead of time and the. Bringing questions about it to class to save more time.”

“Requiring class participation for answering questions.”

Was your group effective in working together? Should part of the assignment include a peer evaluation?

“This assignment should include a peer review. My group did not work effectively together. I did the entire case study by myself.”

“YES! We were very effective working together. I 100% think that there should be a peer evaluation part for this section because some group members did work more than others and that is not fair.”

STUDENT SATISFACTION WITH ASSIGNMENT

Statement	Average Likert Scale Rating
I understand protein structure and function better after writing the case study.	4.6
I was proud of the case my group wrote.	4.8
I liked the choice of models.	4.0
I thought the incentives for tactile models and simulations was fair.	4.2
I would like to see a similar case study assignment in other classes.	3.5
If I had time, I would like to revise the case for publication.	3.5
I see the value in the case study assignment.	4.4
Students should be allowed to pick their own groups.	4.8
I did not understand the purpose of the case study assignment.	1.7

“I have a deeper understanding of why proteins are important to everyday life.”

“...Real life examples which I believe enhanced my understanding of this learning objective...”
understanding protein structure and function.

FUTURE DIRECTIONS

One group has chosen to sign up for Independent Research in the Spring to revise case for submission to National Center for Case Study Teaching in Science. Steps for semesters is to revise case, write teaching notes, teach case in Molecular Genetics course, submit, and revise case in response to peer review.

Changes to Assignment:

- Add in class work time to assist students in model selection and writing learning objectives to provide additional feedback.
- Add student examples to case assignment to show alignment between learning objectives and case activities.
- Add peer and self evaluation to assignment to make students accountable for effective group work.
- Have students complete case before class then discuss answerers to have more time in class for groups to discuss the case .

STUDENTS WRITE CASES IN OTHER COURSES

Can be used across curriculum to bring life to content:

- Research a specific person in a historical event
- Rhetorical analysis of government health campaign
- An artist’s process to explain color theory
- Factious counseling session to illustrate psychological theory