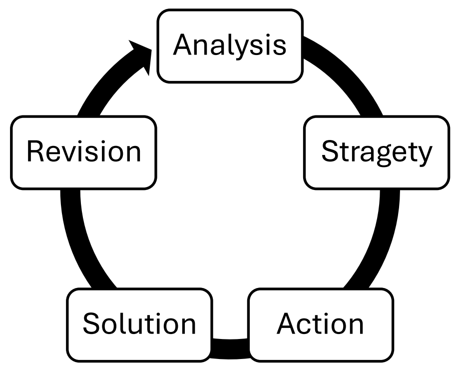
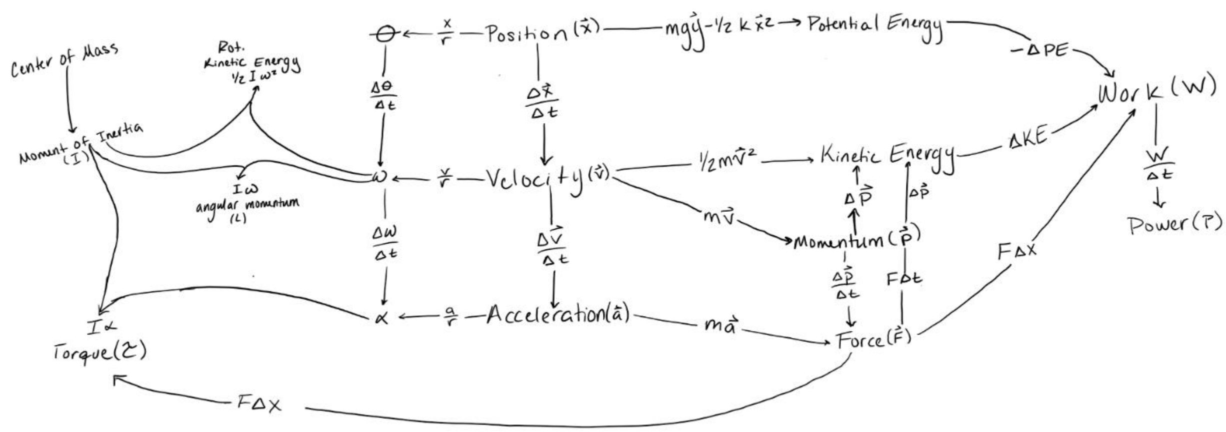
Teaching Statement

Physics is a challenging subject for students, especially when they first begin their study of physics. The difficulty often arises from the shift in how students must process and internalize information. Physics requires not only a deep conceptual understanding but also the ability to link those concepts with their mathematical representations. Additionally, the interconnected nature of physics demands that students grasp how seemingly distinct topics are related, forming a cohesive mental map of the subject. Given the need for this cognitive restructuring, and the abstract nature of many physics concepts, I believe a cognitivist approach is particularly well-suited for lecture-based physics courses. This approach emphasizes active engagement with material, helping students build and organize knowledge in a way that aligns with the demands of the discipline.



In my teaching, I focus on creating opportunities for students to engage deeply with the material, guiding them beyond the mere memorization of formulas toward a true understanding of the underlying principles and how they fit within a larger conceptual framework. This foundation is essential for fostering critical thinking and problem-solving skills—key goals in physics education. To support this, in my introductory courses most assessments are formative. Students initially attempt to solve problems independently and submit their work for grading. Afterward, they receive the correct solutions and have the chance to earn back missed points by analyzing their mistakes or misconceptions and resubmitting their corrected work along with an explanation. This process emphasizes comprehension and reflection over simply arriving at the correct answer, reinforcing the importance of understanding the material in depth. By asking students to reflect on their problem-solving processes, identifying where they encountered difficulties, and thinking about how they can improve, I aim to encourage and develop metacognition.

As we progress from basic kinematics into more complex topics like forces and rotational motion, I find that providing a visual representation of the concepts helps students better understand and connect the material. To facilitate this, I provide a mind map at the beginning of the semester, which serves as a roadmap throughout the course. This mind map allows students to visualize how different topics are interconnected, helping them see the relationships between concepts such as force, motion, and energy. By continuously referring to the mind map during lectures and discussions, students can better grasp how each new concept fits into the larger framework of physics. This visual tool not only aids in comprehension but also reinforces the idea that physics is a cohesive discipline where each concept builds upon and relates to others, which is crucial for developing a deeper understanding of the subject.



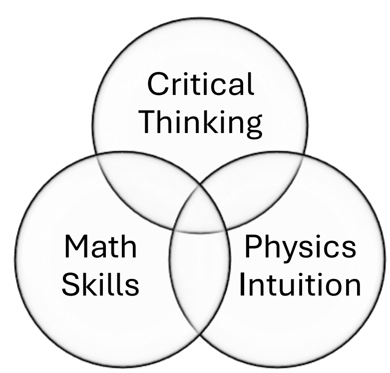
I view my role as a teacher not only as a guide through the material but also as a model for how to approach complex problems with a structured, logical mindset. In class, I emphasize a step-by-step problem-solving process that includes identifying known and unknown variables, analyzing the information given, and selecting the appropriate physical laws to apply. However, I go beyond simply demonstrating the mechanics of solving problems—I also share my cognitive process as I work through each step. By thinking out loud, I expose students to my internal dialogue, allowing them to understand how I approach challenges, weigh different options, and adapt when new information arises. This transparency gives students insight into how they might develop their own cognitive strategies for tackling complex physics problems independently.

Class time often includes quick in-class conceptual quizzes that assess understanding in real-time, helping students identify gaps in their knowledge. These quizzes are followed by Socratic questioning, which challenges students to think deeply about the phenomenological aspects of the material—such as the physical meaning behind equations or the conceptual implications of certain physical laws—rather than simply memorizing formulas and plugging in numbers. By prompting students to reflect on *why* certain principles apply, rather than just *how* to apply them, I aim to cultivate a deeper level of critical thinking and encourage students to see physics as a different way to approach thinking (approaching problems with curiosity and logic), not just a set of mathematical procedures.

In the context of upper-level undergraduate courses, I believe that fostering physics intuition is just as critical as mastering complex mathematical derivations. While the ability to perform detailed, step-by-step derivations is undoubtedly essential, developing an intuitive understanding of the underlying physical principles is foundational. This intuition helps students recognize when a particular solution method or conceptual framework makes sense, even before engaging in rigorous calculation. It enables them to anticipate the physical behavior of systems and assess whether their solutions are reasonable based on the physical context.

In my teaching, I place significant emphasis on discussing how and why complex derivations work, rather than simply focusing on the mechanics of math. For example, when deriving Maxwell's equations or working through Hamiltonian mechanics, I ensure that students not only follow the algebraic steps but also understand the physical meaning behind each term and how the derivation fits within the broader framework of physics. By encouraging students to ask, "What is this equation telling us about the system?" or "How does this result align with our physical expectations?", I aim to cultivate an intuitive grasp of the material alongside their formal skills.

This focus on intuition is particularly important as students progress into more advanced areas of physics, where the concepts can become increasingly abstract and the math more complex. In these cases, intuition serves as a crucial guide, helping students to navigate complicated problems, make sense of results, and explore alternative approaches. Without developing this intuitive layer of understanding, students may find themselves mechanically solving equations without truly comprehending the physical implications of their work, limiting their ability to apply their knowledge in novel situations



By drawing on cognitive learning theories, I aim to support students as they build new knowledge structures, develop the problem-solving, intuitive, and critical thinking skills necessary to succeed in physics and beyond. Through reflective practices, real-world applications, and a structured approach to problem-solving, I strive to make learning physics an accessible and rewarding experience for all student, regardless of academic background.