

The Science of Learning in Physics and Astronomy – PHYS 3500

Course Syllabus for Fall 2021

University of North Georgia's College of Science & Mathematics
Department of Physics & Astronomy

COURSE INSTRUCTOR

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COURSE CATALOG DESCRIPTION

The course is designed for students serving as Learning Assistants in the Department of Physics and who are interested in the science behind learning in physics and astronomy. This course will help students integrate educational theory, pedagogy, and practice. It will touch on theoretical issues in conceptual development, conceptual change, collaborative learning and students' conceptions of various topics in physics and astronomy, as well as practical issues encountered in facilitating learning, engaging in formative assessment, and responsive teaching. This is a seminar course where students are responsible for weekly readings, in-class discussions, reflections and projects which are coordinated with students' Learning Assistant field experiences. (2 credit hours)

RESPECT FOR DIVERSITY

I recognize that there is a vast untapped intellectual resource in all groups underrepresented in physics. For this reason, I am committed to making physics more accessible to everyone. It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a *resource*, *strength* and *benefit*. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups.

LEARNING GOALS

This course is designed to support new LAs working with students and to

- build knowledge about how people learn
- build community and relationships within our class and with your students
- foster the practice of listening and questioning; and eliciting and responding to student ideas
- build strategies for designing equitable and effective learning activities and environments
- engage students in effective group activity

Learning Assistants will

- reflect on and develop their views on their own teaching and learning
- make connections to relevant education theory and literature and share this with their lead faculty member

- try out a variety of strategies in their learning teams and revise these strategies according to their experience
- listen to their students, make claims about their students' ideas, and take action to address those claims (formative assessment)
- develop awareness of the intellectual, social, and cultural diversity of students and begin thinking about differentiated instruction
- discuss their roles and experiences working with students and faculty

Learning Assistants will develop skills to

- explore the science of learning and apply that knowledge to the undergraduate physics/astronomy classroom
- analyze samples of student-assessment data to uncover students' prior and/or intuitive knowledge in physics or astronomy
- apply research-based techniques in the undergraduate physics/astronomy classroom
- design and facilitate formative assessment activities
- synthesize classroom experiences with central ideas from education research

ASSIGNMENTS

Weekly Assignments

- **Class Readings, Discussion and Participation:** You are expected to contribute to class discussions, lead one or two class reading discussions, and come prepared each week with
 1. a provocative question
 2. something interesting you found in the article
 3. something you are confused about

The purpose of these discussions is to help all of us as individuals, and as a group, develop meaningful interpretations of the ideas found in the readings and to make connections to teaching experiences. You are expected to attend every class session and participate in the discussions and activities each week.

- **Weekly Teaching Reflections:** You are expected to spend 3–6 hours per week working with undergraduate physics or astronomy students in collaborative, learner-centered environments. Using this experience as a guide, you will submit a teaching reflection electronically in D2L each week.
- **Training Sessions with Lead Faculty:** Each week, you are responsible for meeting with the physics/astronomy course lead faculty member(s) and the other Learning Assistants in the department to plan and reflect on instruction and to discuss student achievement. You cannot pass this course if you fail to meet with your Lead Instructor each week (with allowances for necessary absences).
- **Your Students' Evaluations "LA-CQ":** Once during the semester, you will hand out an Comment/Questionnaire evaluation form (LA-CQ) to the students you work with and then analyze the resulting data. These data should be prepared in graphical/tabular form for presentation in the LA course.

Semester-Long Projects – Choose ONE OPTION from below:

Educational Research and Instructional Interventions: This semester-long assignment is designed to help you apply what you are learning from the readings, discussions, and experiences working with students. You may choose to work individually or with a small team (2-3 people), and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester.

1. **Intervention/Tutorial to Help with Student Difficulties:** You will design an instructional intervention that can help students work through a specific difficulty that you have observed. The product of this assignment will be something like a tutorial session, a recitation activity (or sequence of activities), a YouTube video, or some other media that can help students work through a difficulty you have noticed to be particularly common among students within a particular subject or concept. You will document your ideas in a project portfolio and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester. You should also meet with the Lead Instructor of the course to trouble shoot and share/develop ideas. The product of this work will be a poster presentation that describes the questions, process, and outcomes of your semester-long project.
2. **Insights into Student Ideas and Thinking or Classroom Contexts – Interviews:** You will investigate student ideas about a concept of your choosing by conducting student interviews. You may work alone or in a small team (2-3 people) to identify the concept of interest, develop interview questions, conduct interviews, and analyze the results. You will document your ideas in a project portfolio and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester. The product of this work will be a poster presentation that describes the questions, process, and outcomes of your semester-long project.
3. **Insights into Student Ideas and Thinking or Classroom Contexts – Student Work:** In this project, you will analyze student written work, such as homework or exams, to investigate their ideas or problem-solving strategies related to a conceptual area of interest. You will collect and photocopy / scan samples of student work a few times throughout the semester (removing names to protect their identity). You may choose to analyze more work over time from a small group of the same students, finding how their ideas develop over the semester. Or you may choose to collect a larger set of work from the class focused on one or two points in the semester to analyze the breadth of students ideas represented. You will document your ideas in a project portfolio and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester. The product of this work will be a poster presentation that describes the questions, process, and outcomes of your semester-long project.
4. **Insights into Student Ideas and Thinking or Classroom Contexts – Observations:** For this project, you will collect field notes from observations of small groups of students working together in order to analyze their ideas and/or problem-solving strategies. For instance, you might choose to sit among a group of students as they work through an entire tutorial session. You will need to develop a way to collect detailed observation notes and you will analyze data from observations of several groups of students. You will document your ideas in a project portfolio and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester. The product of this work will be a poster presentation that describes the questions, process, and outcomes of your semester-long project.

5. **Personal Developments of Your Beliefs about Teaching and Learning:** You will develop a presentation that describes changes or the development of your beliefs about student learning and teaching. You will need to discuss what you thought initially about some aspect of teaching and learning, what you think now, and what specific experiences or readings led to your development. You will document your ideas in a project portfolio and you will receive periodic written and verbal feedback from your pedagogy instructor throughout the semester. The product of this work will be a poster presentation that describes the questions, process, and outcomes of your semester-long project.

Poster Presentation

You will develop a poster presentation that describes the questions, process, and outcomes of your semester-long project. This poster will first describe the difficulty or the research question you were trying to address, the methods and learning theory you used to address these difficulties and or research questions and your instructional product or research findings from this project. Finally, you will discuss the relevance to physics or astronomy and to teaching and learning.

You will present your poster in a poster session scheduled for the last week of classes. The audience will be comprised of your peers and faculty from the Department of Physics & Astronomy.

(UN)GRADING

This course is about learning; it is not about points, GPA, or grades. Therefore, the grading system used in this course is probably vastly different from that of any other course you have taken. The grading system is actually not grading at all; it is even called *ungrading* or *going gradeless* by educators who implement it.

Research has informed us that descriptive feedback, rather than letter grades or scores, leads to higher learning gains and that using grades in an attempt to improve performance is not effective. There is evidence that grades encourage competition over cooperation, suppress creativity, foster a fear of failure, and reduce interest in learning. If you are curious, this review article discusses research related to grades: *Teaching More by Grading Less (or Differently)* (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4041495/>).

Much of this is confirmed by other researchers like Carol Dweck, whose book *Mindset* introduced the world to the concept of growth mindset, and Daniel Pink, whose book *Drive* argued that extrinsic rewards and punishments actually stifle creativity, higher-order thinking, and intrinsic motivation. It is my hope to engender the dispositions of growth mindset and intrinsic motivation in my students, so I want to eliminate any practices that work against students developing them.

In this class, after you turn in work for an assignment, you will receive written and/or verbal feedback about what you did well and what you can do to improve. You will also reflect on your work and your learning goals each week. Throughout the semester, you will have opportunities to assess your own work, to make improvements in response to feedback, and to elicit and receive new feedback – all of which has been shown to aid students in becoming more engaged and effective learners.

I understand that you will not automatically know how to evaluate yourself and your work, so I will help you learn methods of self-evaluation along the way. I hope to help you learn to move from talking about your performance (i.e. what an A looks like) to talking about your learning: what did you figure

out? What obstacles did you overcome? What remains challenging that you want to keep working on? What can you now do that you couldn't do before?

These questions are only some of what you can ask yourself when reflecting on and evaluating your learning. I hope that by the end of the semester, you will have your own language for describing and judging your own learning. This makes self-evaluation much more effective and even enjoyable, as you learn to articulate your thoughts about your own learning.

TEACHING REFLECTIONS

Each week you will submit a reflection on the pedagogical concept we discuss in class and how you apply the newly-learned methods as an LA. You will be prompted with specific questions to answer. However, you will always be given the opportunity to reflect on anything else relevant to your learning in this course. I recommend referring to the learning outcomes described at the beginning of this syllabus when you reflect on your teaching and learning. At the end of the semester, you will have an organized body of work that you will use to determine your final grade for the course.

Teaching reflections will be submitted weekly in D2L.

PROJECT PORTFOLIO

To help you keep track of your progress and learning in this course, and to aid in the planning and designing of your final project, you will use a project portfolio. You will use your project portfolio to collect literature related to your project, reflect on your learning, jot down thoughts and ideas, and collect data for your project.

You will contribute to your project portfolio in D2L whenever you have something relevant to add.

FINAL COURSE GRADE

Your final grade in this course will be determined based on the skills you learn and the learning goals you achieve. Throughout the semester, you will develop a body of work that will help you to self-assess your learning and make an honest appraisal of your effort and progress in the course. You will be afforded the agency to evaluate and examine your own learning and suggest your grade in the course.

At the end of the semester during final exams week, we will meet in a final "exit interview" where you will suggest your final grade, providing evidence from your body of work throughout the semester for why you believe your suggested grade is fair. I will provide feedback on your assessment and discuss your grade suggestion with you. Together, we will work toward an agreed upon grade, though I reserve the right to veto a suggested grade.

SUPPLEMENTAL SYLLABUS

<http://ung.edu/academic-affairs/policies-and-guidelines/supplemental-syllabus.php>

TENTATIVE SCHEDULE

Week	Topic	Description
1	Open and Closed Questions	For students to come to the conclusion that there are different ways a teacher can ask questions in class.
2	Discussion Techniques: Univocal/Dialogic Discourse	To investigate the impact of the type of discourse that takes place in the classroom between the teacher and students and among students.
3	Labor Day Holiday	No Classes
4	Questioning Strategies and Question Types	To recognize that a framework can be used for developing a variety of questions that utilize different thinking skills.
5	Mental Models	To gain a deeper understanding of students' "mental models" and the role that these mental models play in how students learn content that is presented in a class.
6	Pedagogical Content Knowledge	To connect subject matter knowledge and teachers' understanding of how to teach contents to students.
7	Student Conceptions and Formative Assessment	To begin developing an understanding that students have pre-instructional conceptions when they enter the classroom and that effective instruction must take these conceptions into account as they work with students toward more scientific/mathematical conceptions.
8	Student Conceptions in the Content Areas	For LAs to recognize that a teacher can view students' knowledge in terms of "resources" and that certain student conceptions can be very common.
9	Motivation and Cooperative Learning	To emphasize that an individual's learning is enhanced through interaction with others and that learning is enhanced in a motivating environment that can be established both internally and externally.
10	Mindset	To recognize that fundamental aspects of intelligence, and even intelligence itself, can be altered through training
11	LA Evaluations and Classroom Observations	To provide a safe environment in which students can share feedback about their LA observations and mid-term student feedback. Students will demonstrate reflective practice.
12	Metacognition	To understand what metacognition is and its usefulness in developing problem solving approaches and methods
13	Diversity and Inclusion	To provide a space for students to explore their own views of what it means to learn and practice physics and how that might be affected by gender and/or racial inequity.
14	Qualities of an Effective Teacher	To emphasize the importance of relationship within the classroom and to answer questions such as "What are the qualities of effective teachers?" "How do teachers show concern for their students?" "What inferences can be made from teacher statements?"
15	Poster Presentation	