

# Science Education 201: Matter and Energy in Physical Systems

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*Fall 2022*

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Class meetings: **Face to Face** MWF 2:00 - 3:50 pm  
Instructor: Dr. Emily Borda she/her/hers [bordae@wwu.edu](mailto:bordae@wwu.edu), SL 250D  
Office hours: T 2-3, Th 10:30-11:30 in SL 250D or Class Zoom OR by appointment  
Teaching Assistant: Lauren McDonald, [cajilil@wwu.edu](mailto:cajilil@wwu.edu), Office hrs W 12-2 PM SL 220  
Zoom Link\*: [bit.ly/ebSCED201Zoom](https://bit.ly/ebSCED201Zoom) (pw = ebSCED201)  
*\*In the case of positive COVID cases, inclement weather, or other situations requiring remote instruction*

## COURSE OVERVIEW AND LEARNING GOALS

This is a student-centered, discussion oriented physics course intended for students pursuing a career in K-8 teaching. The course has four major learning goals:

- 1) *Physics content.* Students develop deep understanding of basic physics concepts and reasoning in order to explain everyday phenomena. Topics include those that are covered in the elementary school science curriculum.
- 2) *Scientific practices.* Students will develop knowledge of science and engineering practices defined in the Framework for K-12 Science Education, as well as link these practices to their experiences in SCED 201.
- 3) *Learning about learning.* Students will develop awareness of how their own ideas change and develop, and how the structure of the learning environment and curriculum facilitates these changes.
- 4) *Equity in STEM fields.* Students will develop awareness of structural and cultural issues that limit representation in STEM by women and certain racial and ethnic groups. Students will learn how limited representation in STEM limits the inherent equity and advancement of STEM and society, and will explore its implications for K-8 STEM instruction.

As an LSCI GUR, this course also fulfills the following GUR competency: *Use quantitative and scientific reasoning to frame and solve problems.* The following literacies and core competencies are also addressed in this course: *Quantitative, scientific, and technological literacies; creative and problem-solving literacies; and critical and reflective literacies.*

## YOU WILL NEED:

- A SCED 201 coursepack (purchased at the bookstore). This packet contains modules from the Physics and Everyday Thinking curriculum, specifically developed for future teachers.

## COURSE STRUCTURE AND ALTERNATIVE REMOTE PLAN

This course is **face to face** and will meet MWF 2-3:50 PM in SL 240. [Attendance](#) is required.

However, in the case of positive COVID cases and/or inclement weather events:

- You will select a “Zoom buddy”. If either you or your buddy needs to quarantine in the case of possible COVID exposure, and/or has mild COVID-like symptoms, the person who is in class will “[Zoom in](#)” the person at home so they can participate in discussions.
- If one or more class sessions must be taught remotely, we will all join the [Zoom](#).

*This syllabus is subject to change. Changes, if any, will be announced in class. Students will be held responsible for all changes announced in class.*

### WHAT TO EXPECT DURING CLASS MEETINGS

SCED 201 is a student-centered, lab-based physics course intended primarily for students interested in a career in K-8 teaching but is open to all students. The course is focused on the foundational concepts of energy and forces. We will develop and apply an energy-based model and a force-based model for motion and interactions for real-world situations and phenomena. There will be little traditional lecturing in this course. Instead, students generate knowledge through their own work and discussion. The instructor will serve as a facilitator rather than the source of knowledge. Thus, learning is student directed and achieved through collaboration and consensus.

### CLASSROOM CLIMATE

We will establish and maintain a classroom climate that is inclusive and respectful of all students. Learning includes being able to voice and hear a variety of perspectives, and classroom discussion is essential to building your knowledge and understanding. We will work hard to create an environment where it is safe to share ideas, even if they may be different from other students' ideas, or if we are afraid they might be wrong. We will also commit to honoring each others' identities by learning and using each others' preferred names and personal pronouns.

### ATTENDANCE AND PARTICIPATION

First things first: **If you feel any cold/flu/COVID-19-like symptoms, do not come to class.** Instead, [join remotely](#) if you feel well enough. Having said that, this is a collaborative class, which hinges on experimentation and discussion. Because of this, it is important to attend all class meetings, in person if you can, and arrive on time. Each unexcused absence will drop your course grade by 3%, unless you have a situation like a long-term illness, elongated family emergency, etc., in which case please contact the [office of student life](#) who will coordinate with me to make a plan. If you do miss a class, you must make up the work prior to the next class. You may have up to 3 excused absences, with no penalty to your grade. You must contact the instructor, before class if you can, to get an absence excused.

Excusable absences include:

- If you are ill and don't feel well enough to participate in class (please don't ask for a note from the health center; your word is enough);
- A planned trip away from campus that is associated with a school organization (e.g., you are a WWU basketball player traveling to a game in Ellensburg); or
- A family emergency.

Reasons that will not be excused include:

- A family vacation for which your plane ticket was already purchased;
- A dentist appointment;
- Going to the office hours of the instructor for one of your other classes; etc.

*Late arrivals.* Due to the intensely collaborative nature of this class, it is imperative that everyone arrives to class on time and ready to go. Late arrivals are unacceptable and will negatively impact your grade. Three late arrivals (5+ minutes each) will be marked as an unexcused absence.

*Communication.* I use Canvas announcements to communicate to the whole class and email to communicate with individual students. You are expected to check your WWU email and Canvas daily.

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## ASSIGNMENTS AND GRADING POLICIES

You will earn a base grade that will be determined by your scores and completed work for all work products except mini-projects. This grade will then be modified by your engagement with the [mini-projects](#). Your base grade is determined through a points-based grading system. Each assignment except mini-projects will carry a certain amount of points. For some assignments, points are awarded based on completion and effort. For others, they are awarded based on correctness. Each assignment type is worth a percentage of your base grade, as shown below. You should strive to complete all the assignments, because they are the way you will learn the material. However, I realize life happens. To give you some wiggle room, for some assignment types, one or more of your lowest scores will be dropped, as shown below. If circumstances arise where you will need added flexibility (e.g., long-term illness), please email me and we can work out a plan. Most assignments will be administered by/turned in to Canvas.

Grade category	Description	Percent of base grade	Number of lowest scores dropped
Participation	Your participation grade will be based on: active participation in small and large group discussions as measured by self and peer evaluations; up-to-date workbook; and completion of pre- and post-instruction surveys.	20%	1
Review Assignments	After most activities, there will be a review assignment to reinforce ideas developed in the activities, provide practice applying the key ideas to new situations, and offer opportunities for feedback on your thinking. In some cases, review assignments will contain a reading, <a href="#">reflection survey</a> , and/or discussion board assignment. There will be revision opportunities for most Review Assignments.	25%	1
Extension Activities	Extension activities are online multiple choice activities that check understanding and introduce new ideas. They will be assigned after we complete most activities, and will be due at the start of the following class. You will have unlimited attempts to get 100% on the Extensions, and I highly recommend you do so.	15%	1
Midterms	There will be two take-home midterms. You may refer to your notes and other materials from class as well as relevant resources online for midterms. After your midterm is returned, you will make revisions based on the feedback you received. There will be revision opportunities for the Midterms.	25%	0
Collaborative Final Project	Together with one or two classmates, you will engage in a final project instead of taking a final exam. Details about the project will be given at least 2 weeks prior to the <a href="#">due date</a> .	15%	0

Your base grade will then be determined using the following grading scale:

	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
%	93+	90	87	83	80	77	73	70	67	63	60	59-

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*Modifying your base grade.* Mini-projects will be used to modify your grade. Two are required. Failing to turn in two mini-projects will decrease your grade. Turn in more to boost your grade. You decide which weeks to turn in a mini-project, and what form it will take. You will always have several options to choose from for your mini-project (these will be listed on Canvas), but more options will be added as we develop concepts during the quarter. Some examples include: writing about a scientist of color; connecting a consensus idea we developed in class to your everyday life; or building a Rube Goldberg machine.

A rubric will be used to grade mini-projects. For a mini-project to count, it needs to: 1) be turned in on time, and 2) fully satisfy all rubric criteria. You will have an opportunity to turn them in most Mondays. You will be given unlimited revision attempts to satisfy rubric criteria, but failing to do so will result in a mini-project not being counted. The table below summarizes how mini-projects will work.

Number of on-time* mini-projects that meet all rubric criteria	Affect on your base grade
0-1	<b>Lower</b> by $\frac{1}{3}$ of a letter grade (e.g., from A- to B+, C+ to C)
2-3	<b>Stay the same</b>
4+	<b>Boost</b> by $\frac{1}{3}$ of a letter grade (e.g., from B to B+, C+ to B-)

\*The original mini-project needs to be turned in on time, but if it doesn't at first meet all rubric criteria and needs to be revised, it still counts as long as you eventually make the revisions and meet all criteria.

## TENTATIVE SCHEDULE

Dates	Units/Topics	Guiding questions
Week 1 (9/21-23)	<ul style="list-style-type: none"> <li>● Course overview</li> <li>● Course norms</li> <li>● Mystery Tube Activity</li> </ul>	<ul style="list-style-type: none"> <li>● What is the structure of this course?</li> <li>● How do I succeed in this course?</li> <li>● How can we create a collaborative and productive classroom environment?</li> <li>● What is scientific modeling and why is it important?</li> </ul>
Week 2 (9/26-30)	<ul style="list-style-type: none"> <li>● Mystery Tube Activity</li> <li>● NGSS Standards</li> <li>● EM-A1: Interactions and Motion</li> <li>● EM-A2: Motion and Energy</li> </ul>	<ul style="list-style-type: none"> <li>● What is scientific modeling and why is it important?</li> <li>● What is important to teach about science in elementary and middle school? Why?</li> <li>● How is an object's motion affected by an interaction?</li> <li>● How can we represent motion graphically?</li> <li>● What is needed (if anything) to change the kinetic energy of an object?</li> <li>● What is evidence that energy is changing?</li> <li>● How can we represent energy changes and transfers?</li> </ul>
Week 3 (10/3-7)	<ul style="list-style-type: none"> <li>● EM-A3: Slowing and Stopping</li> <li>● PEF-A1: Elastic objects and energy</li> </ul>	<ul style="list-style-type: none"> <li>● Why do moving objects tend to slow down and stop? Where does the energy go?</li> <li>● What happens to the rate of change of speed of moving objects as the amount of friction changes?</li> <li>● How can we describe friction interactions in terms of energy?</li> <li>● What energy changes take place in elastic objects when they are involved in contact push/pull interactions?</li> </ul>
Week 4 (10/10-14)	<ul style="list-style-type: none"> <li>● PEF-A3: Magnetic and Static Electric interactions and energy</li> <li>● PEF-A4: Gravitational interactions and energy</li> <li>● Review of energy-based models</li> </ul>	<ul style="list-style-type: none"> <li>● How can we describe magnetic and static electric interactions in terms of energy?</li> <li>● How can we describe more than one interaction that combine to produce multiple changes in energy for multiple objects in a system?</li> <li>● What energy changes take place when an object falls?</li> <li>● How can we describe gravitational interactions in terms of energy?</li> <li>● What is common among different types of potential energy?</li> <li>● How can we describe interactions in terms of energy transfers and transformations?</li> </ul>
Week 5 (10/17-21)	<ul style="list-style-type: none"> <li>● <b>Take home midterm #1 due Mon, 10/17</b></li> <li>● Underrepresentation in STEM</li> <li>● EM-A4: Warming and Cooling</li> </ul>	<ul style="list-style-type: none"> <li>● Why are certain groups underrepresented in physics and other STEM disciplines?</li> <li>● Why does this matter?</li> <li>● What other interactions can change the temperature of objects?</li> <li>● How do we describe these interactions?</li> </ul>

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Dates	Units/Topics	Guiding questions
Week 6 (10/24-28)	<ul style="list-style-type: none"> <li>EM-A5: Electric circuit interactions</li> <li>EM-A6: More on keeping track of energy</li> <li>Energy as a Cross-Cutting Concept/ Energy Theater</li> </ul>	<ul style="list-style-type: none"> <li>How can we trace the flow of energy through a system of interacting objects (including the surroundings)?</li> <li>How can we keep track of amounts of energy as it flows through a system of interacting objects (including the surroundings)?</li> <li>How does energy help explain things in different science disciplines?</li> <li>Why is energy important to teach?</li> </ul>
Week 7 (10/31-11/4)	<ul style="list-style-type: none"> <li>FM-A1: Interactions and Force</li> <li>FM-A2: Motion with a continuous force</li> <li>FM-A3: Pushes and slowing down</li> </ul>	<ul style="list-style-type: none"> <li>When does the force of a quick push stop acting on an object?</li> <li>When an object is moving, does this mean there must be a force pushing it in the direction of its motion?</li> <li>How does an object move when a force of constant strength continuously pushes it forward?</li> <li>What effect does a 'backward' push have on the motion of an object?</li> <li>What happens if a continuous 'backward' push is applied to a moving object?</li> </ul>
Week 8 (11/7-9) <b>No class 11/11</b>	<ul style="list-style-type: none"> <li>Review force model</li> <li><b>Take home midterm #2 due Wed, 11/9</b></li> <li>Underrepresentation in STEM</li> </ul>	<ul style="list-style-type: none"> <li>What do we know so far about how to model interactions with forces?</li> <li>What are the affordances and limitations of energy and force diagrams?</li> <li>Why are certain groups underrepresented in physics and other STEM disciplines?</li> <li>Why does this matter?</li> <li>What are implications for education?</li> </ul>
Week 9 (11/14-18)	<ul style="list-style-type: none"> <li>FM-A4: Forces and friction</li> <li>FM-A5: Changing force strength and mass</li> <li>FM-A6: Falling objects</li> </ul>	<ul style="list-style-type: none"> <li>Is friction a force? If so, in what direction does it act?</li> <li>How does friction work?</li> <li>When a single force acts on an object, how is the object's motion affected by 1) the strength of that force and 2) the object's mass?</li> <li>How does the mass of an object affect how it falls?</li> <li>How do we describe gravitational interactions in our force model?</li> </ul>
Week 10 (11/21) <b>No class 11/23,25</b>	<ul style="list-style-type: none"> <li>CF-A1: Combinations of forces</li> </ul>	<ul style="list-style-type: none"> <li>How do objects behave when more than one force acts on them?</li> </ul>
Week 11 (11/28-12/2)	<ul style="list-style-type: none"> <li>CF-A2: Motion with Balanced Forces</li> <li>Review and wrap up quarter</li> </ul>	<ul style="list-style-type: none"> <li>What is an object's motion like when a balanced combination of forces acts on it?</li> <li>How can we put our ideas about forces and energy together to explain different phenomena?</li> </ul>
Thurs, 12/8	Final projects due 2 PM	

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## UNIVERSITY RESOURCES AND POLICIES

I want each and every one of you to thrive at WWU, and in this class. I encourage you to check out and utilize the following list of resources. Check out this [Overview of Student Services](#) for even more.

- [WWU counseling center](#): Did you know about 1/3 of WWU students utilize the counseling center? Asking for help is ok! Please stop by, virtually or in person, if you are feeling anxious, depressed, overwhelmed, or just need to talk to someone.
- [Student Health Center](#): In case of a medical concern or question
- [Office of Student Life](#): In the case of a family or personal emergency
- [Resources for Racial Justice](#): self-care, learning, and Black-led LGBTQ+ organization

*Reasonable Accommodation.* Reasonable accommodation for persons with documented disabilities should be established within the first week of class and arranged through the [Disability Access Center](#): telephone 360-650-3083; email [drs@wwu.edu](mailto:drs@wwu.edu); and on the web at [disability.wwu.edu](http://disability.wwu.edu). Review their [Documentation Guidelines](#) for the procedure for providing reasonable accommodations for students with disabilities. See also the [Accessibility Map](#).

*Religious Accommodation.* Western provides reasonable accommodation for students to take holidays for reasons of faith or conscience or for organized activities conducted under the auspices of a religious denomination, church, or religious organization. Students seeking such accommodation must provide written notice to their faculty within the first two weeks of the course, citing the specific dates for which they will be absent. “Reasonable accommodation” means that faculty will coordinate with the student on scheduling examinations or other activities necessary for completion of the course or program and includes rescheduling examinations or activities or offering different times for examinations or activities. Additional information about this accommodation can be found in [SB 5166: Providing religious accommodations for postsecondary students](#).

### *Academic Integrity:*

- Academic Honesty: All Western Washington University students have an obligation to fulfill their responsibilities as members of an academic community. Academic integrity is demanded; moreover, academic dishonesty at Western is a serious infraction dealt with severely. No student shall claim as his or her own the achievements, work, or arguments of others, nor shall he or she be a party to such claims. It is the instructor’s responsibility to confront a student and to take appropriate action if such academic dishonesty has occurred. See [Appendix D: Academic Honesty Policy & Procedure](#) of the catalog for examples, procedures, and methods of appeal and [Ensuring Academic Honesty](#) for appeal rules and timeline.
- Plagiarism: Plagiarism is presenting as one’s own—in whole or in part—the argument, language, creations, conclusions, or scientific data of another without explicit acknowledgement. See the Library’s [Plagiarism Policies & Guidelines](#) for examples and citation guides. See [Appendix D: Academic Honesty Policy & Procedure](#) of the catalog for examples, procedures, and methods of appeal and [Ensuring Academic Honesty](#) for appeal rules and timeline.

*COVID-19:* Each student is responsible for understanding, and complying with, WWU’s [COVID-19 policies](#).