SCED 201: Matter & Energy in Physical Systems

Syllabus | Fall 2020 | Western Washington University

This syllabus is subject to change. Changes, if any, will be announced in class. I adapted the learning goals, course description, and some assignment logistics from a syllabus provided to me by Professor Thanh Lê. My policy on children in the classroom is adapted from Professor Melissa Chayney's example. The description of office hours that appears here was adapted from the Cornell University Learning Strategies Center.

Zoom information

We will use the same Zoom meeting ID for lecture and extra help time (or 'office hours'):

- Zoom meeting ID: 974 2009 1544
- Join by web: https://wwu-edu.zoom.us/j/97420091544
- Join by phone: https://wwu-edu.zoom.us/u/ao6XIXIEZ

Instructor information

Name: Dimitri Dounas-Frazer
Pronouns: He, him, his
E-mail: dounasd@wwu.edu
Help time: Thursdays from 11-11:50 am and from 1-1:50 pm
Note: I go by Dimitri, Dr. Dounas-Frazer, Professor Dounas-Frazer, or Professor.

Teaching assistant information

Name: Isabel Mills
Pronouns: She, her, hers
Help time: Mondays and Wednesdays from 1-1:50 pm
Email: millsii@wwu.edu
Note: I go by Isabel.

Course information

Website: http://www.wwu.edu/canvas
Time: CRN 41564: Mondays, Wednesdays, and Fridays from 10:00 AM – 11:50 AM
     CRN 40517: Mondays, Wednesdays, and Fridays from 12:00 PM – 1:50 PM
     *Live lectures take place only during the first hour of class.*
Zoom ID: 974 2009 1544
Credits: 4

Textbook information

Title: Next Generation Physical Science and Everyday Thinking
Authors: F. Goldberg, S. Robinson, & V. Otero

*You do not need to purchase the textbook.*
Learning objectives

After completing SCED 201, students will be able to

1. Interpret and generate clear and accurate explanations of physical phenomena using energy- and force-based models of interactions.

2. Translate between algebraic, graphical, diagrammatic, and language-based representations of energy changes, energy transfers, and forces.

3. Provide peers with authentic praise and prioritized suggestions to improve the clarity and accuracy of their scientific explanations.

4. Describe careers or research interests of living women and nonbinary people (mostly women of color) with a degree in physics or a related field.

I hope that participating in SCED 201 is an enjoyable and interesting experience for you, even though learning physics will inevitably be uncomfortable, frustrating, or tedious at times. Accordingly, another of my goals is for you, me, and others to have positive experiences teaching and learning physics together.

Course description

SCED 201 is a remote lecture-based course that consists of recorded and live lectures. Recorded lectures will range from 5-15 minutes each, and there will be up to a total of 50 minutes of recorded content for each class meeting. I aspire to upload recordings two days in advance so that you can choose to watch them at times that are convenient to you. Live lectures will last 60 minutes, and they will take place during the first hour of the scheduled meeting time for the class. I will use a videoconferencing software program called Zoom to facilitate live lectures. Attendance during live lectures is required; please review the labor-based grading contract for more details.

During live lectures, we will work through guided activities following an established, research-based curriculum called ‘Next Generation Physics and Everyday Thinking.’ In breakout rooms, you and your partners will make predictions, watch videos of experiments, complete exercises, and work with computer simulations. You and your partners will collaboratively make sense of ideas and formulate explanations. Then, during the full-class discussions, groups will share their ideas and results, allowing you to check, verify, and perhaps modify the ideas from your small group work. The expectation is that you will keep notes in your own digital or physical notebook, though I will not collect notebooks. You do not need to purchase the ‘Next Generation Physics and Everyday Thinking’ textbook.

In recorded and live lectures, I will regularly present about women and nonbinary physicists, especially women of color. Occasionally, I will discuss physics as a socio-technical endeavor. The goal of these presentations and discussions is to challenge prevailing and incorrect notions that white men are better suited for physics than other groups and that physics is an objective, apolitical, and technical field. In addition, I believe that ‘learning physics’ involves learning who does physics and for what purposes.

Some students who take SCED 201 have little or no background in physics, and other have had negative experiences in previous physics classes. I aspire to cultivate a learning environment in which you and your peers feel comfortable and supported to share ideas even when your ideas are incomplete or unclear or you are uncertain that they are correct. You will receive full credit for your work as long as you show up to most classes, complete most of your work on time, and participate to the best of your abilities.
Help time description

Help time (also called office hours) is dedicated out-of-class time when you can meet with me or the teaching assistant to discuss course logistics, material being presented in class, or other related interests you have. You are not required to attend help time. I expect you to decide for yourself when you need or want to participate.

Course-related discussions include asking for extra help, seeking clarification of material presented in class, and following up on aspects of the class you find compelling. I do not have lessons planned for help time. I expect you to drive these meetings with your questions and ideas. A good way to prepare for help time is to attempt your homework, review your notes, and identify as clearly as you can what you do not understand. I will work with you to uncover the source of your questions. Often, I will ask you to show me your work, tell me where they got stuck, and explain what you were thinking as you moved from step to step. As described in the labor contract, you can improve your course grade by discussing physics topics with me during office hours.

University policies

Integrity: Integrity applies to all of the principles, values and behaviors that contribute to good character, including honesty, fairness, respect, courage and responsibility. All members of the Western community have the right to be treated fairly, and to have support and representation if accused of violating university policies related to integrity. They also have the responsibility to exhibit honest behavior, and to encourage others to do the same. If a student is suspected of dishonest behavior, the instructor must address the issue with the student by use of the official university procedures. Not only does this ensure continuity in dealing with such issues, but provides students formal opportunity for representation and appeal. Note that these incidents do not appear in a student’s academic record. For procedures and details, visit provost.wwu.edu/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.

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. Examples and citation guides are available in the Library’s online Plagiarism Policies & Guidelines. Regarding academic honesty and plagiarism, examples, procedures, and methods of appeal are provided online in Appendix D: Academic Honesty Policy & Procedure of the catalog. For appeal rules and timeline, please visit www.edu/registrar/contact.shtml.

Disability Resources for Students: 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; and on the web at disability.wwu.edu. The procedure for providing
reasonable accommodations for students with disabilities is provided in the following Documentation Guidelines. A campus Accessibility Map is available online.

**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.

**Ethical Conduct with WWU Network and Computing Resources:** Once a student receives a unique identification number or other means of identification for use of computing or network resources, the student is solely responsible for all actions taken while using that identification. For details, including use of email, networks, and labs, review Ethical Conduct with WWU Network and Computing Resources.

**Your Civil Rights and How to Protect Them:** Instructors at Western are committed to an environment free of discrimination and harassment. The laws, as well as Western’s equal opportunity and sexual misconduct policies, protect everyone against discrimination based on: Race, Color, Creed, Religion, National Origin, Sex (including pregnancy and parenting status), Disability, Age, Veteran Status, Sexual Orientation, Gender Identity and Expression, Marital Status, or Genetic Information. For more information, contact the Equal Opportunity Office (360-650-3307 or [wwu.edu/eoo](http://wwu.edu/eoo)). If you feel the classroom climate does not reflect this commitment, you are encouraged to discuss this with your instructor. Instructors can also provide you with information about reporting options and confidential support resources. Like other Western employees (except counselors and medical staff), instructors are required to report instances of discrimination or sexual violence to the Title IX Coordinator. For confidential support, contact CASAS and the Counseling Center.

**Gender Neutral Restrooms:** A map showing the locations of gender-neutral restrooms is available from the Campus Maps website:

**Finals Preparation Week:** In preparation for Finals Week, with some exceptions, exams are not to be administered and new graded assignments shall not be introduced beyond the 5th week of the term that would be due this week.

**Finals Week:** Final examinations, given in most courses at Western during the last week of the quarter, are administered according to a Finals Schedule (exceptions for lab courses). This generally differs from the usual class meeting times. The scheduled days and hours for these examinations may not be changed. If students find they are scheduled to take three or more examinations in one day, any of their instructors may arrange an examination later during finals week. The Catalog includes details about what happens when a student does not take a final.

**Medical Excuse Policy:** It is the policy of the Western Washington University Student Health Center to not provide medical excuses for short-term absences that result in
missed classes, exams or assignments due to illness or injury. In certain circumstances where the illness or injury is prolonged (an absence of more than five days) and requires medical attention or hospitalization, we will work with students in providing appropriate documentation. Review the Medical Excuse Policy for details. In these situations, contact your professor or teaching assistant as soon as possible.

**Student Conduct Code:** It is important that you understand the university’s student conduct process. Review the listing in Reporting a Concern & Making a Complaint. This can appear at first glance to be a daunting list. No one expects you to visit each and every site and/or download, but do be aware of this site’s existence for reference.

**Grades:** Students may designate a course as Pass/No Pass by submitting a request with the Registrar’s Office after registering for the course; they may change this designation by submitting the change to the Registrar’s Office at any time through the seventh week of a quarter; for extension program courses, pass/no pass grading designation may be elected up to the end of the seventh week for regular quarter-long courses, or prior to the third class meeting for shorter courses. Students may be advised to stay with a letter grade if required for accreditation, veteran status and benefits, or other purposes. For more information, please review the fall 2020 grading policy.

**Course policies**

**Attendance:** SCED 201 incorporates live and recorded lectures. I expect you to participate in live lectures if you are able to do so. You can miss up to three (3) live lectures without incurring any penalty to your grade. If you four (4) or more live lectures, your grade will be lowered according to the rules outlined in the labor-based grading contract. *If you know ahead of time that you have a systematic schedule conflict, please contact me so I can work with you to modify the grading contract.*

**Internet usage:** Engaging with lectures and homework requires access to the internet. I will use email and Canvas to communicate. You are expected to check your WWU e-mail account and the Canvas site daily.

**Children, family members, housemates, or pets on Zoom:** Many of us share a common living space with others. Teaching and learning from home can be an imposition on the other people in our home. Moreover, children who are staying home from school sometimes require attention during the time we set aside for teaching or learning. Therefore, when joining office hours, lectures, or labs via Zoom, it is okay for the other people in your home to make cameo appearances! The same is true for pets. You may also be interested in using a virtual Zoom background. If there is background noise that may disrupt other learners in the Zoom video conference, please mute your mic.

**Lecture videos:** Lecture videos will be copyrighted using a Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND) license. This license allows you to download my videos and share them with others as long as you credit me, but you can’t change them in any way or use them commercially.
Labor-based grading contract for SCED 201

The concept of a labor-based grading contract was first introduced to me by Professor Thanh Lê, who shared with me Asao Inoue’s book Labor-Based Grading Contracts. Inoue identifies two main drawbacks of conventional grading schemes. First, they often result in students focusing more on acquiring points or pleasing/fooling the grader than on their own learning. Second, grades often create a culture of risk avoidance where students worry about being punished for making mistakes or admitting that they don’t understand something. I would add to Inoue’s critiques a third issue: conventional grading schemes typically force instructors to arbitrarily ascribe points to different types of mistakes, which reduces the complex process of providing feedback to an act of counting mistakes and subtracting points.

In SCED 201, I want to work toward a learning environment that focuses on and rewards effort, process, and dialogue (including written feedback). I will pay attention to your ideas as they are articulated during class discussions, written assignments, and conversations with me via email or during office hours. I commit to providing feedback on your scientific thought and practice, often in the form of guiding questions. I will also create a classroom culture where you and your peers regularly give and receive feedback to and from each other. However, you will not receive grades from me. Like Inoue, sometimes I will not even comment directly on your work, except in class or during office hours when you present your ideas to your peers or to me.

Therefore, if you attend most live lectures and complete most required assignments on time, you are guaranteed a B (or 3.00 on a 4.00 scale) in SCED 201. An initial draft of labor requirements is described below. These requirements include engaging with lecture videos, coming to live lectures prepared to learn, participating fully during class, embracing the spirit of learning physics from and with your peers, and completing out-of-class assignments on time. It will not matter what your peers and I think of your work; if you put in the labor, you are guaranteed a B for the course. If you miss too many classes, turn in too many assignments late, or forget to do assignments, you will get a lower grade.

Labor requirements for a grade of B (3.00)

**Lectures:** In this course, information is conveyed from the professor to the students through recorded and live lectures. You are expected to watch all recorded lecture videos and to attend as many live lectures as you are able. In this course, students generate physics knowledge and understanding through a process of collaborative discovery. It is essential to ask questions, respond to the questions of other students, and offer your own ideas. Engagement is critical both during small group work as well as in the full class summarizing discussions.

**Peer-Assisted Reflection (PAR) assignments:** PAR assignments provide students with the opportunity to attempt challenging problems, reflect on their initial approach with input from a peer, and revise their solutions. To complete the assignment, you must attempt an initial solution, exchange feedback with a peer, and revise your solution (h/t Dan Reinholz). PAR assignments will be assigned on Mondays, peer feedback on initial attempts will be exchanged during class on Wednesdays, and revised solutions will be due on Fridays. You will be responsible for completing a PAR assignment each week during weeks 2-9.
**Extension activities:** Extension activities are online multiple-choice surveys that check understanding from class and introduce some new ideas. They will be assigned after we complete most activities, and they will be due at the start of the following class. You will be responsible for completing 22 extension activities: 11 each focused on energy- and force-based models of interactions. You will be responsible for completing an extension activity each class period starting in week 2 and ending right before fall break.

**Learning commentaries:** In weeks 6 and 10 (just before fall break), you will be asked to write a 750-word essay reflecting on your understanding of energy- or force-based models of interactions. The commentary should use excerpts from your class notes and homework assignments to provide evidence for changes in your understanding over time. More details will be available on Canvas. Learning commentaries will be due on October 26 and November 23.

**Panel and panel commentary:** In the last week of the quarter, there will be a panel of researchers and educators with a degree in physics. Prior to the panel, you will be asked to generate questions for panelists about their career trajectories, physics interests, and connections between their work and content from class. After the panel, you will be asked to write a 750-word essay reflecting on what you learned during the panel. The panel will be held on December 2, and the commentary will be due on December 4.

**Surveys:** Depending on factors outside my control, I may administer surveys at the start and end of the quarter. These surveys focus on students' collective understanding of certain energy-related concepts. They were not designed to provide insight into an individual student’s understanding. Rather, they are meant to help evaluate the impacts of the course on the class as a whole.

I am aware that we are teaching and learning in unprecedented circumstances, and we all deserve flexibility and grace. Further, I appreciate that exclusively online classes may pose a barrier to accessible learning for some people, and I understand that there are barriers to obtaining official accommodations from the university. I am willing to work with students on a one-on-one basis to amend this labor contract through a shared understanding of what types of participation, collaboration, and individual work are accessible and equitable for you.

**Extra labor that can improve your grade**

You may choose to improve your grade by performing extra labor. Below, I’ve described several items that count as extra labor. Each item will boost your grade by a third of a letter grade: from B to B+ (3.00 to 3.33), B+ to A− (3.33 to 3.67), or A− to A (3.67 to 4.00).

**Three (3) extra discussions about physics:** At any point in the quarter, you may attend either help time (or ‘office hours’) to discuss topics or assignments from class. You must come prepared with questions of your own, and you must review all relevant class materials beforehand. You must attend help time at least three times to perform enough extra labor to boost your grade. At least one discussion must be with me (Dimitri). Discussions about course logistics or degree requirements do not count as discussions about physics.
**Extra explanation of physical phenomena:** As a supplement to learning commentaries, you may choose to provide a scientific explanation for a phenomenon of your choice. You must describe a phenomenon, pose a question, and describe your answer using diagrams, graphs, and written narratives. Each extra explanation on its own constitutes one item of extra labor. More details will be available on the midterm. Extra explanations will be due on October 26 and November 23.

**Physicist biography:** Once each in weeks 4 and 8, you may submit a 750-word biographical essay about a physicist of your choice. The biography should cite at least two online resources that you referenced when learning about the physicist. Each biography on its own constitutes one item of extra labor. More details will be available on Canvas. Biographies will be due on October 12 and November 9.

**Learning skills commentary:** Once each in weeks 5 and 9, you may submit a 750-word essay reflecting on your experiences with one of several lifelong learning skills, e.g., organization, communication, persistence, or self-compassion. Each commentary on its own constitutes one item of extra labor. More details will be available on Canvas. Learning skills commentaries will be due on October 19 and November 16.

**Some other labor that benefits the class:** Do you want to demonstrate your physics knowledge through art, music, or performance? Are you interested in economic, social, or political aspects of energy? Would you like to create a lesson plan for teaching children how to make and interpret graphs? If you have an idea, let me know. We will plan it together so that the amount of labor is appropriate.

**Grading scale**

Again, if you show up to class and complete your work on time, you are guaranteed a B. There are many legitimate reasons why you might miss a class or deadline, and you can miss a small number of classes or deadlines and still receive a B. However, too many missed classes or deadlines will result in a grade reduction, as summarized in the following table:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Numerical equivalent</th>
<th>Late assignments</th>
<th>Very late assignments</th>
<th>Ignored assignments</th>
<th>Absences</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (default)</td>
<td>3.00</td>
<td>0–8</td>
<td>0–1</td>
<td>0</td>
<td>0–3</td>
</tr>
<tr>
<td>B−</td>
<td>2.67</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>C−</td>
<td>1.67</td>
<td>12</td>
<td>5</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
<td>13</td>
<td>6</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
<td>14</td>
<td>7</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>D−</td>
<td>0.67</td>
<td>15</td>
<td>8</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>F/Z</td>
<td>0.00</td>
<td>16 or more</td>
<td>9 or more</td>
<td>2 or more</td>
<td>11 or more</td>
</tr>
</tbody>
</table>
Late, very late, and ignored assignments are defined as follows:

- **Late assignments** are assignments that are submitted after the deadline but within 48 hours of the deadline. This window of time is called a "grace period."
- **Very late assignments** are assignments that are submitted after the grace period. Very late work is a more serious mark against your contract because its absence negatively impacts you and your classmates for multiple class meetings.
- **Ignored assignments** are assignments for which I have no record of you doing the work or turning it in.

You may improve your grade by completing extra labor, as described in the previous section. If you are completing required labor at the B level, extra labor will improve your grade as follows:

- 1 extra item = course grade of 3.33, or B+
- 2 extra items = course grade of 3.67, or A−
- 3 extra items = course grade of 4.00, or A

If you are working toward a baseline lower than a B due to missed classes or assignments, you may complete more than 3 extra items to continue to raise your grade. Western Washington University does not award grades of A+.

**Mulligan:** Once during the semester, you can use a mulligan to ignore an assignment with no penalty to your grade. Alternatively, you can use the mulligan to negate a grade reduction due to too many late assignments, very late assignments, or absences. If you use a mulligan, you will be ineligible for a grade boost due to exemplary labor. The purpose of the mulligan is to provide relief to students who are feeling overwhelmed or who are experiencing unexpected circumstances that interfere with coursework. *However, when asking to use a mulligan, you do not need to explain your circumstances to me.*

**Exemplary labor:** At the end of the quarter, if you have not missed any classes or deadlines and have not used a mulligan, then you will earn an extra third of a letter grade (equal to one extra item) on your final grade. This rule is meant to reward students who engage in all the labor required for the course in the fullest spirit asked of them.

By staying in this course and attending class, you accept this contract and agree to abide by it. I (Dimitri) also agree to abide by the contract, and administer it fairly and equitably.
<table>
<thead>
<tr>
<th>Week #</th>
<th>Class #</th>
<th>Day</th>
<th>Date</th>
<th>Topic</th>
<th>PAR due</th>
<th>Extension due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>W</td>
<td>05/23</td>
<td>Introductions and course logistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>09/25</td>
<td></td>
<td>UM:1: Modeling and the mystery tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>09/28</td>
<td></td>
<td>EM:1: Interactions and motion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>W</td>
<td>09/30</td>
<td></td>
<td>EM:2: Motion and energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>10/02</td>
<td></td>
<td>EM:3: Slowing and stopping</td>
<td>PAR 1 initial attempt</td>
<td>EM-A: Speed-time graphs</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>10/05</td>
<td></td>
<td>EM:4: Friction as an interaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>W</td>
<td>10/07</td>
<td></td>
<td>PEF:1: Elastic objects and energy</td>
<td>PAR 2 initial attempt</td>
<td>EM-F: Effects of friction</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>10/09</td>
<td></td>
<td>PEF:4: Gravitational interactions and energy</td>
<td>PAR 2 revised solution</td>
<td>EM-F: More on forces and energy</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>10/12</td>
<td></td>
<td>EM:5: Warming and cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>W</td>
<td>10/14</td>
<td></td>
<td>EM:6: Electric circuit interactions</td>
<td>PAR 3 initial attempt</td>
<td>EM-G: Mechanisms of electric currents</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>10/16</td>
<td></td>
<td>EM:7: More on keeping track of energy</td>
<td>PAR 3 revised solution</td>
<td>EM-H: More on kinetic energy and work</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>10/19</td>
<td></td>
<td>Flex day; topic tbd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>W</td>
<td>10/21</td>
<td></td>
<td>Review of energy-based models</td>
<td>PAR 4 initial attempt</td>
<td>EM-I: Efficiency at work</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>10/22</td>
<td></td>
<td>FM:1: Interactions, force, and motion</td>
<td>PAR 4 revised solution</td>
<td>EM-J: Reviewing energy and work</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>10/26</td>
<td></td>
<td>FM:2: Motion with a continuous force</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>W</td>
<td>10/28</td>
<td></td>
<td>FM:3: Pushes and slowing down</td>
<td>PAR 5 initial attempt</td>
<td>FM-B: Pushing a charged object</td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>10/30</td>
<td></td>
<td>FM:4: Forces and friction</td>
<td>PAR 5 revised solution</td>
<td>FM-C: Connecting forces</td>
</tr>
<tr>
<td>18</td>
<td>M</td>
<td>11/02</td>
<td></td>
<td>FM:5: Changing force strength and mass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>F</td>
<td>11/06</td>
<td></td>
<td>FM:6: Falling objects</td>
<td>PAR 6 initial attempt</td>
<td>FM-E: Changing direction</td>
</tr>
<tr>
<td>20</td>
<td>M</td>
<td>11/09</td>
<td></td>
<td>CF:1: Combinations of forces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>F</td>
<td>11/13</td>
<td></td>
<td>CF:2: Balanced forces</td>
<td>PAR 7 initial attempt</td>
<td>CF-A: Newton's 2nd Law</td>
</tr>
<tr>
<td>22</td>
<td>M</td>
<td>11/16</td>
<td></td>
<td>CF:3: Situations involving friction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>W</td>
<td>11/18</td>
<td></td>
<td>CF:4: Comparing forces during interactions</td>
<td>PAR 8 initial attempt</td>
<td>CF-C &amp; D: Unbalanced forces</td>
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<tr>
<td>24</td>
<td>F</td>
<td>11/20</td>
<td></td>
<td>Flex day; topic tbd</td>
<td>PAR 8 revised solution</td>
<td>CF-E: Newton's 3rd Law</td>
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<tr>
<td>25</td>
<td>M</td>
<td>11/23</td>
<td></td>
<td>Review of force-based models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>11/30</td>
<td></td>
<td>Prep for panel</td>
<td></td>
<td></td>
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<tr>
<td>27</td>
<td>W</td>
<td>12/02</td>
<td></td>
<td>Panel: Physics researchers and educators</td>
<td></td>
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<tr>
<td>28</td>
<td>F</td>
<td>12/04</td>
<td></td>
<td>Closing and course debrief</td>
<td></td>
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</tbody>
</table>

**Tentative course schedule**

**Weeks:**
- **10**
- **Finals Week:**
  - **10**

**PAR deadlines:**
- **PAR 1:** Initial attempt
- **PAR 2:** Revised solution
- **PAR 3:** Initial attempt
- **PAR 4:** Revised solution
- **PAR 5:** Initial attempt
- **PAR 6:** Revised solution
- **PAR 7:** Initial attempt
- **PAR 8:** Revised solution

**Extension due:**
- **EM-A:** Speed-time graphs
- **EM-F:** Effects of friction
- **EM-G:** Mechanisms of electric currents
- **EM-H:** More on kinetic energy and work
- **EM-I:** Efficiency at work
- **EM-J:** Reviewing energy and work
- **FM-B:** Pushing a charged object
- **FM-C:** Connecting forces
- **FM-E:** Changing direction
- **CF-A:** Newton's 2nd Law
- **CF-C & D:** Unbalanced forces
- **CF-E:** Newton's 3rd Law
- **CF-F:** Reviewing forces

**Featured physicists:**
- Jami Valentine Miller & Sultana Nahar
- Guneeta Singh Bhalla
- Carolyn Brinkworth & Xandria Quichocho
- Joanne Behrman
- Elizabeth Walker & Zaniya Al-Shahrani
- Munazza Alam
- Junellie González
- Sookyung Choi
- Cristine Villagonzalo
- Elena Long
- Ximena Cid
- Luz Martínez
- Ruby Leung & Margaret Redsteer
- Sara Mueller & Kim Anh Tran
- Carolina Chanda Prescod
- Wanda Díaz
- Myriam Telus
- Valerie Otero
- Moumita Das & Kandice Tanner
- K. Renee Horton
- Chanda Prescod
- Alvarado Miranda & Arti Agrawal
- Weinstein & Quiles & Ashley Walker
- ahra Hazari
- andria Quichocho
- Jeanette R. Davis & Marta Espinosa
- Britteny Ramdhas & Amandeep Kaur Singh
- Linda Kwak & Ayesha Mirza
- Balen P. Singhal & Kritika Singh
- Emily V. Fishkin & D. Jennifer Smith
- Janet D. Koon & M. Kathleen McGahan
- Julie A. Rebeyko & Venkata Chary Surendran

**Learning outcomes:**
- **Learning skills commentary 1:**
- **Learning skills commentary 2:**
- **Physicist biography 1:**
- **Physicist biography 2:**
- **Learning commentary 1:**
- **Learning commentary 2:**
- **Extra explanations 1:**
- **Extra explanations 2:**

**Course materials:**
- **PhET: Forces and Motion**
- **PhET: Energy transfer and changes**
- **Comparing forces during interactions**
- **Physics researchers and educators**
- **Panel commentary**
- **Jami Valentine Miller & Sultana Nahar**
- **Guneeta Singh Bhalla**
- **Carolyn Brinkworth & Xandria Quichocho**
- **Joanne Behrman**
- **Elizabeth Walker & Zaniya Al-Shahrani**
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- **Linda D. Koon & M. Kathleen McGahan**
- **Ruby Leung & Margaret Redsteer**

**CRN 41564 (10 am section):**
- **10:** 10:00 am to 12:30 pm on Tuesday 12/08

**CRN 40517 (12 pm section):**
- **10:** 10:00 am to 12:30 pm on Friday 12/11

**Extra comments:**
- **age 10 of 10**