Dr. Ben Carlson PHS-030

# Physics for Future Presidents: PHS-030

## Summary


- Instructor: Dr. Ben Carlson
- Email: bcarlson@westmont.edu
- Ph: 805-565-7015
- Office: Winter Hall 324

- Student Hours: TBD
- Backup Zoom: https://westmont.zoom.us/j/92450214359?pwd=eGVRaXcySzdFWGVnaUd0TFIwTC81QT09
  Meeting ID: 924 5021 4359 Passcode: Carlson

**Class hours:** MWF 12:45-1:50 pm
**Location:** TBD

**Credit hours:** 4.

**Course description**: An introduction to physics that focuses on what a future world leader would need to know. Fundamental principles of physics will be discussed: energy, forces, atoms, nuclei, radioactivity, electromagnetism, light, quantum physics and relativity. These principles will be used to discuss applications that impact society at large: power generation, including alternative energy sources such as solar cells, the electrical grid, radioactivity, nuclear waste and climate change.

**Prerequisites**: None

**Required books:**

- *Physics and Technology for Future Presidents: An Introduction to Essential Physics Every World Leader Needs to Know*, Richard Muller, Princeton University Press, 2010. (ISBN: 978-0691135045)
- *Science and Society*: *Understanding Scientific Methodology, Energy Climate and Sustainability*, Eric Swanson, Springer, 2016 (ISBN 978-3-319-21986-8)
- *Philosophy of Natural Science*, Carl Hempel, Prentice Hall, 1966 (ISBN: 978-0136638230)
- *The Structure of Scientific Revolutions*, Thomas S. Kuhn, University of Chicago Press, (ISBN: 978-0226458120)
- *The Soul of Science: Christian Faith and Natural Philosophy*, Nancy Pearcey & Charles Thaxton, Crossway Books, 1994 (ISBN: 978-0891077664)

**Other materials**: Scientific calculator, laptop

**Library reserves**:

**Mission Statement of the Physics Department**: The mission of the Westmont Physics Department is to prepare students majoring in Physics and Engineering/Physics for graduate school and careers in physics, engineering, education and other professional fields by helping them develop both experimental and theoretical skills in classical and modern physics with opportunities

**Commented [BC1]:** For the additional readings beyond the primary textbook by Muller, I'm looking into pricing a course packet with excerpts.

**Commented [2]:** $50

**Commented [3]:** $25 paperback

**Commented [BC4]:** $10

**Commented [BC5]:** $15

**Commented [BC6]:** $15

**Commented [BC7]:** It's possible I could move some of the books into library reserves with 4 copies.

for research and internships. We serve students in other majors by providing challenging courses in physics and astronomy to encourage interest in and understanding of the principles, methods and concepts of the physical sciences. We explore with all of our students the interactions of faith and science with the goal of enabling each student to communicate a mature worldview that incorporates both.

**General Education:** The general education curriculum at Westmont College requires that each student complete one course in the area Common Inquiries: Exploring the Physical Sciences and Quantitative and Analytical Reasoning. To satisfy this requirement, students can choose certain designated courses. Physics for Future Presidents (PHS-030) has been approved as a course that satisfies the Physical Science component of the G.E. curriculum. Furthermore, since mathematical modeling of physical systems, calculation of numeric data, as well as the interpretation of graphical representations are central to this course, it also fulfills a G.E. requirement in the area of Common Skills: Quantitative and Analytical Reasoning.

**Commented [8]:** Note that approval is currently being requested.

**Course Learning Outcomes:**
*For specific details on topics that will be covered, see the tentative schedule*

| Student Learning Outcome | Instructional Activity | Assessment |
|---|---|---|
| Use the general principles of the scientific method to explain the structure and interactions of matter to explain common technologies and issues in the modern world, and to interpret claims in the context of the scientific method. | Lectures, readings | Exams, response essay, assignments |
| Find and summarize data and models from scientific literature as well as the impact on your community. | Lectures, readings, team project | Physics in the news, assignments, exams, team project |
| Articulate a Christian response to issues related to the interplay between science & society or scientific observations and faith. | Lectures, readings | Response essay, exams |

**Commented [BC9]:** Physical Sciences Criteria (1): identify the basic properties and principles of matter

Physical Sciences Criteria (2): identify the creative and systematic aspects of scientific method and give examples of the power of theory and prediction with the framework of empirical/experimental modes of inquiry;

**Commented [BC10]:** Quantitative and analytical reasoning criteria (1'): compute and interpret numeric data, summative statistics and/or graphical representations;

Quantitative and analytical reasoning criteria (2) reflect on the strengths and weaknesses of particular quantitative models or methods as tools in the natural and social sciences;

Quantitative and analytical reasoning criteria (3) be able to interpret, reflect on, and use quantitative models and data in public, vocational, and/or private decision making.

Physical Sciences Criteria (4): demonstrate sufficient comprehension of science to read intelligently about and express informed opinions on science-related issues that affect individuals and society.

**Commented [11]:** Physical Sciences Criteria (3): articulate a model of the relationship between faith and science both historically and in the current culture

**Commented [BC12]:** This addresses the question: why would a non-major be interested in this course, as required by the GE syllabus guidelines

**Personal introduction to the course:** This course is not watered-down physics. Rather, I have tried to identify fundamental principles of physics that are ubiquitous in the modern world. The philosophy of the course is that if you are a president (of the world, company or PTO of a school) you will be able to interpret the world and make informed decisions.

This course is not structured like a typical science course. For one thing, the course is neither structured around mathematical formulations of physics, nor around a conceptual explanation of physics. Yes, in this course you will learn the key concepts of physics and how they form the foundation of our society. You will do much more though.

The reason for this course is that understanding scientific information is of utmost importance for your generation. In the next century, society will face immense challenges related to the interplay of energy, climate change and the technology that supports and has led to these issues. The common theme of all of these issues is that in some way they are caused by or mitigated by technology. The majority of the technologies in turn build on the study of physics. Of course, modern physics goes beyond providing the tools of engineering – there are fundamental questions that drive the majority of physics: the nature of spacetime, the origins of the universe, and the quest for the underlying structure of matter.

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This course is designed to be accessible to all majors, including those without significant mathematical background. We will do some calculations, but those will involve minimal algebra and instead focus on broad themes. Finally, I hope that this course will enrich your liberal arts education regardless of your major, and perhaps encourage you to further study physics.

**Attendance and class etiquette**: Attendance is required, and I expect you to attend lectures and engage with me and other students. According to Westmont guidelines, you may be miss 3 class periods before attendance will be factored into your grade (see grading).
https://www.westmont.edu/office-registrar/academic-policies-and-procedures/attendance-policies

**Commented [13]:** Assuming the course is offered MWF as currently planned.

**Class participation:** There will be regular discussions and exercises that we do during class periods. Your participation in these activities will count as a portion of your grade.

**Reading / listening assignments**: You will be giving a variety of reading assignments from the textbook and other sources. In some cases, I will assign "listening" assignments, such as a podcast. Please see the Special Accommodation section of the syllabus and notify me of any issues with auditory learning.

**Assignments**: Regular assignment questions will assess your knowledge based on lectures, the textbook and other readings. These will typically be multiple choice or involve a short paragraph with a conceptual explanation of a physical concept. In some cases, there may be short calculations to perform as part of these assignments.

**Physics in the news**: Four times throughout the semester you will read and write a summary responding to a recent article in physics. The article should be from an accessible but readable source. The topic should in some way be related to physics. If you are unsure, please ask. Some examples of reputable sources include:

- American Physical Society spotlight: https://physics.aps.org/
- The New York Times science section: https://www.nytimes.com/section/science
- The Washington Post science section: https://www.washingtonpost.com/science/
- Wall Street Journal: https://www.wsj.com/news/science

**Commented [14]:** Examples:
https://physics.aps.org/articles/v15/14

https://www.nytimes.com/2022/01/08/science/james-webb-telescope-nasa-deployment.html

Other sources are acceptable, but please ask if you are unsure. There is a tremendous amount of poor reporting on scientific issues.

**Response essays**: You will be given several examples of articles that discuss the impact of science in an area. Typically, these will be articles that discuss the impact of science. You may agree with the article, or you may not. Your task in the assignment will be to respond to the article, articulating a summary of the relevant science, any potential issues you may have identified, and in the case of the impacts on society discuss whether you agree with the implications and why.

**Commented [BC15]:** Example:
https://www.nytimes.com/2021/10/01/opinion/climate-change-geoengineering.html

**Team project**: You will work with several of your colleagues in the class to propose a research question and summarize the results. The project should integrate your knowledge of physical principles with a topic of importance to society in your community. You must propose a project by fall break. Some examples include:

- Identifying the sources of energy in your community, and quantifying the total amount of energy. Determine the total fraction of energy from carbon neutral sources, and estimate the total carbon dioxide emissions.
- Measure total energy consumption from a solar energy demonstration at Westmont. Compare to typical sources around Westmont.

**Commented [16]:** To be purchased

**Exams**: There will be two mid-term exams and a final exam. The final exam will be cumulative and cover all the material discussed in the course, with additional emphasis on any material not included in the second midterm.

**Commented [BC17]:** For the review committee: there are some sample exams from Prof. Muller available on his website. Obviously could not use them exactly, but I plan to structure them in a similar way. https://muller.lbl.gov/teaching/Physics10/PffP.html

**Grading policy:** Participation (5%), Assignments (20%), Team project (20%), Response essays (10%), Physics in the News (10%), Midterm exams (10% each), Final exam (15%).

**Letter grades**: Based on the average of the above percentage, your final letter grade will be at least the grade given below.
> 93% A, > 90% A-, > 86% B+, > 82% B, > 78% B-, >74% C+, >70% C, > 68% C-, >64% D+, > 60 D, > 58% D-, < 58 F.

**Academic Integrity:** Collaboration is encouraged on homework, but it is important your discussions focus on general themes. Your responses should be your own conclusions in your own words (where appropriate). Collaboration of any kind is not permitted on exams and will also be considered a violation of academic integrity policies (although you are welcome to ask the instructor questions during an exam).

You are not allowed to obtain solutions to any assignment questions (e.g., you are not allowed to try to find solutions to a question online). You may of course use outside resources for research projects and other assignments as directed.

You are not allowed to upload material (such as homework solutions) that you are given in this course to any public website, including websites such as Chegg.

Further details on Westmont's Academic Integrity Policy may be found at https://www.westmont.edu/office-provost/academic-program/academic-integrity-policy.

**Emergencies**: If you have a family or health related emergency, please contact me immediately, so we can make arrangements for any rescheduling that needs to happen. Emergencies include illness (in which case you are asked not to attend class).

**Late policy**: I will not accept late assignments.

**Special accommodations:** It is the policy of Westmont College to provide reasonable accommodations to students with disabilities as stated in the Americans with Disabilities Act (ADA) and Section 504 of the Rehabilitation Act. Students who have been diagnosed with a disability (learning, physical or psychological) are strongly encouraged to contact the Office of Disability Services (ODS) as early as possible to discuss appropriate accommodations for this course. Formal accommodations will only be granted for students whose disabilities have been verified by the Office of Disability Services. These accommodations may be necessary to ensure

your equal access to this course. Please contact Sheri Noble, Director of Disability Services (310A Voskuyl Library, 805--565--6186, snoble@westmont.edu), or visit https://www.westmont.edu/disability-services-welcome.

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**Course schedule** (Tentative)
Unless otherwise indicated, chapter numbers refer to Muller.

| Week | Topic | Reading |
|---|---|---|
| August 30 | A historical and philosophical introduction to science | Pearcey & Thaxton Ch3, Hempel Ch 2-3, Kuhn Ch 2. |
| September 6 | Energy and power | 1 |
| September 13 | Atoms and Heat | 2 |
| September 20 | Gravity, Force & Space | 3, Kuhn Ch 3 |
| September 27 | Nuclei and Radioactivity | 4 |
| October 4 | Chain reactions, nuclear reactors and atomic bombs | 5 |
| October 11 | Exam I<br>*Fall break* | 6 |
| October 18 | Electricity and magnetism | 6 |
| October 25 | Light | 8 |
| November 1 | Invisible light | 9, Kuhn Ch 5 |
| November 8 | Quantum physics | 11, Pearcey & Thaxton Ch 9 |
| November 15 | Relativity | 12, Pearcey & Thaxton Ch 8 |
| November 22 | Exam II<br>*Thanksgiving* | - |
| November 29 | Climate change | Swanson 7 |
| December 6 | Climate change<br>Team Project due | Swanson 9 |
| December 13 | Study day, final exam | - |