The Physics of Light and Color

(2 credits)

Class Time: Tuesdays 8:30am – 12:10pm (1st 7 weeks)

Me
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Office Hours: Wednesdays 9:30am-11am, Thursdays 1pm-2:30pm, ***or by appointment***

Text: *Light Science: Physics and the Visual Arts, 2e*, by Rossing & Chiaverina
Openstax Astronomy, 2e, by Fraknoi, Morrison, & Wolff

Course Homepage: Course material will be posted at http://crowl.bennington.edu/light/ Make sure to regularly check our course page there to ensure you get all of the relevant information.

Course Overview: The physics of light and color initially appears simple: light is a wave and the wavelength of light determines color. While this basic physical description of light is easy to state, going deeper quickly opens up large range of questions. How do different wavelengths of light combine to make colors? How does light from different sources interfere? How does light change path when it travels through different materials? How do humans sense light both in and outside of the visible spectrum? How does our perception of color affect how we interpret our world? Each question reveals a deeper level of detail and more complexity. While the fundamentals of this course will address the underlying physics of light and color, student interest will drive experimental projects in a variety of areas that extend the ideas of the course. Students with an artistic interest in light and/or color who are interested in developing a deeper understanding of the physics that underlies our visual perception should find this class particularly interesting.

Course Goals: After this course is completed, I hope you will have developed an understanding of:

- The physical nature of light
- How light moves and interacts with matter
- How colors are created, perceived, and interpreted

While this course is grounded in the **physics** of light and color, my hope is that what you learn in this class will be broadly applicable to the work you do in your own areas of focus.

Problem Sets: You will be assigned problem sets regularly throughout the term. These problem sets will take different forms, but will usually contain a mix of qualitative questions, quantitative problems. On the quantitative problems, you are required to ***show your work*** and state any assumptions you make. This will help me to understand your reasoning and, where appropriate, award partial credit. They will be due on the date indicated on the set (usually within about a week of being assigned). ***In general, I do not accept late problem sets.*** Please see me in extraordinary circumstances.

Collaboration on problem sets is welcome and, in fact, encouraged. One of the best ways to learn something difficult is to work through it with others. However, you should ensure that the work you turn in is your own. One rule of thumb is to work together to get to the right answer, but then write up the problem set on your own, using your own words. It may take some extra time, but it's a way to minimize the chance of plagiarism and also gives you another chance to really understand the material.

Labs: We will use part of class time to work through laboratory experiments, designed to help you understand and construct knowledge of the physical phenomena we examine in class. You will **not** be expected to create formal write-ups, but you **will** be expected to carefully carry out the experiments and keep a neat, insightful lab notebook.

Project: As a capstone project for this class, you will be expected to conduct some sort of project that takes the work that we've done in this class and extends it beyond what we did. This could be some form of research paper, a lab project, some piece of creative work, or something else entirely. As long as the project is grounded in the physics of light and color, it is an appropriate project for this class. More details to follow.

Class Participation: There is a large amount of educational research showing that lecture alone is ineffective in instilling a deep understanding. In the last couple decades, interactive lecturing has found its way into large lecture classrooms. We're really lucky here at Bennington that we don't need to figure out how to teach and learn in 200-person classes, but we can use what they have learned to help us here.

Voting Cards
I will give you a card at the beginning of the term, which allows you to represent one of four choices. Most days, there will be opportunities to vote and confer with your neighbors. These discussions and participating in class voting are an important part of your class participation grade.

Lecture Tutorials
There will be several points throughout the term where you will, in class, work through conceptual exercises designed to help you gain a fuller understanding of the material. These serve as a good "check" of your understanding and allow you to more fully engage with the material. *These will **not** be graded, but part of your class participation grade is based on you working seriously these exercises.*

Active Participation in Class
This is a small, seminar-based class. I expect everyone in class to ask questions, participate in discussions, help to work on problems, and generally contribute to a positive classroom environment. I recognize that some students are more comfortable doing this than others, but my expectations are that you will contribute to the best of your ability.

Please note that ***class attendance is mandatory***. As a once-a-week class with only seven (!) meetings, it is critically important that you attend all classes. Missing even one class can seriously affect your class participation grade. Missing two or more classes during the semester may lead to you failing the class. Please see me in extraordinary circumstances.

Resources for Help: Building a quantitative understanding of physical principles can prove challenging. It is likely you will need help. There are a number of options for getting help:

- *Work with a classmate*: To better your understanding of the ideas of the class, I expect you will collaborate (with one another, and with me!). You are strongly encouraged to work on the problem sets together in small groups (2-4 people tends to work best) and ask questions of me and/or of the larger class group when your smaller group gets stuck.
- *Ask questions in class:* I am more than happy to dedicate class time to discussing assigned problem sets.
- *Come to Office Hours*: If you have further questions or would just like to talk, make a plan to attend my office hours (in Dickinson 104). I have set office hours for Wednesday mornings & Thursday afternoons, but I am happy to meet with you at other times that work for both of us.
- *Go to the Math Tutors*: There are (free!) Math Tutors that are happy to help you with any troubles you've been having with the more mathematical side of things. While any of the tutors can help you with mathematical questions, at least some of the math tutors are also physics & astronomy students who will be particularly adept at helping with more physics-central things. Details to follow (but they're usually available on weekday evenings). You can contact them to set up appointments by emailing them at mathtutors@bennington.edu

Academic Accommodations: Bennington College provides reasonable accommodations to students with documented disabilities when such accommodations are requested and necessary to ensure equal access to College programs and facilities. If you believe you are entitled to an accommodation, contact the Director of Student Accessibility Services (accommodations@bennington.edu) about any disability-related needs. If

approved, you will receive a memo detailing your specific accommodations; it is your responsibility to provide me with the memo and discuss the implementation of accommodations. Note that I will not be aware of your needs if you do not share this memo with me. Accommodations are not retroactive, so the sooner we meet to discuss your needs, the better. Also, students experiencing mental and/or physical health challenges that are significantly impacting their academic work are encouraged to speak with their faculty advisor and a member of Academic Services (academicservices@bennington.edu or 802-440-4400) about the impact and to connect with resources through health and psychological services (440-4426 or 440-4451).

Evaluation/Grading:

35% Problem Sets 15% Labs 20% Class Participation 25% Project

Tentative Schedule (likely to change)

	Topic
February 17	Foundations and Light Fundamentals
February 24	Spectra and Emission Mechanisms
March 3	Optics
March 10	Optics (cont.) and Interference
March 17	Polarization and Sensing Light
March 24	Communicating with Color
March 31	Wrap Up + Projects