



### Course goals and content

My goal is to change how you "see": you will gain a deeper understanding of light and vision that you can apply to your interests and to your experience.

Light is essential to most people's experience of the world. It is both a central tool in science and an object of study by science. Together we will study questions in light and vision: How has our concept of color changed over the past 2500 years? Why are peacock feathers and DVDs iridescent? What makes a moon halo? How do 3D movie glasses work? Why can nothing go faster than the speed of light? During the class, we will read about these subjects, have frequent extensive discussions, and carry out experiments.

### First things to do

1. Read this syllabus
2. Acquire two lab books

### Instructor

Prof. Alan Middleton  
 Physics Building Rm. 213  
<http://physics.syr.edu/~aam>  
[aam@syr.edu](mailto:aam@syr.edu)

Office phone: (315)443-2408  
 Home phone: (315)423-0321 (before 9 PM)

Office hours: 1:30-2:30 PM Mondays and Thursdays; I am often free at other times for drop-by discussions. Please do visit.

### Course web page

You can find course information, including assignment descriptions and records of your course grades, at

<http://blackboard.syr.edu>

Log in, using your SU NetID, to access the course.

## Should you be taking this course?

This course has no advanced science prerequisites. We will use some algebra, use a bit of trigonometry, and frequently use scientific notation (powers of 10), but this course does not require a calculus course. We will concern ourselves with a broad range of topics, from the history of science through color vision through technological applications of light through the wave nature of light and the nature of space and time. If you meet the prerequisites and are interested in getting a deeper understanding of light and vision, then this course should be of interest to you.

This 3-credit course is listed as an Honors (HNR) course and with a grade of "B" or higher can be used to satisfy the breadth and quantitative/creative expression Honors requirements. It is also listed as a PHY course and can therefore count towards the lower division portion of a degree in Physics. This course counts as a lab science course for Arts & Sciences and may also satisfy lab requirements in other colleges.

## You will ...

- Study how notions of light and vision have evolved over the last 2500 years. People in many parts of the world have had some crazy ideas about light and vision, at least from our current viewpoint. But study of these ideas will show how scientific theories evolve and understand light better. The elaboration and refinement of scientific knowledge by experiment, both historically and through your lab experiments, will be a central theme of the course.
- Study the geometric aspects of light: you will review how it can be described both by rays and by waves.
- Learn about color. We will study the spectrum of visible light and properties of light sources, objects, and how our eyes function. This will allow us to understand the richness of perceived color (even though it is only a coarse description of light), color blindness, color reproduction, and related applications.
- Learn about atmospheric optical effects (rainbows, halos, the color of the sky). Review the science behind photography and display technologies (including 3D displays). We will see how light tells us almost everything we know about the Universe outside of our solar system and what it tells us about the early history of the Universe
- Review what experiments over the last century have told us about the quantum mechanical nature of light: light is a "wavicle" (combination of wave and particle; a photon) whose behavior is fundamentally unpredictable! We will review the recent application of this to secure communications. We will also see how light tells us that space and time are deeply connected, through Einstein's theory of special relativity.

## Reading

I have decided not to assign a required textbook, as there is no text that has sufficient overlap with the course content. I will provide a large number of handouts and links for reading outside of class.

## Books and resources

Here is a list of books that I use as resources for this course; some are available in the SU library:

- *Light*, by Michael Sobel (1989). This is a concise overview of the properties of light.
- *Empire of Light*, by Sidney Perkowitz (1998). This is a modern overview of light by an experimental physicist.
- *Color: Why the World Isn't Gray*, by Hazel Rossotti (1985). The focus of this book is, not surprisingly, how light is affected by objects and how the composition of light gives perception of color.

- *Color and Light in Nature*, by Lynch and Livingston (2001). This book has beautiful examples of natural phenomena, including a huge variety of rainbow/halo phenomena, aurora, twinkling stars, and other atmospheric effects.
- *The Fire Within the Eye: A Historical Essay on the Nature and Meaning of Light*, by David Park, whose title says it all.
- *Colour: Art & Science*, edited by Trevor Lamb and Janine Bourriau. This is a collection of essays on color and its role in art.
- *Light and Color in Nature and Art*, by Samuel J. Williamson and Herman Z. Cummins (1983).
- *Introduction to Light: The Physics of Light, Vision, and Color*, by Gary Waldman (1983).
- *A Natural History of Seeing*, by Simon Ings (2007).

There is a lot of information on light, color, and vision available on-line, of course. Two types of resources that will be of particular interest are primary source material, such as essays by Plato on light, and simulations of the behavior of light and color. These links will be made available through BlackBoard (<http://blackboard.syr.edu/>).

### Assessment of your work

I use the course grade to indicate how well I believe you have comprehended and applied the ideas developed in this course. Your active participation in class discussions is important to this evaluation. Records of your experiments will be submitted in lab notebooks. Most of your other written work can be submitted digitally via Blackboard. These files must be submitted in a form I can read! The safest format for this is PDF. There will also be written in-class exams. If your submitted work and participation indicate that you understand and can apply the ideas developed in the course, you will receive a grade of "A". If you can mostly apply the ideas and submit almost all of your work, but don't demonstrate a complete grasp of what was developed in the course, you will receive a grade of "B". My estimate of how well you understand and apply the ideas will be based on the following assessments:

- [12%] Reading logs: For each reading assignment, you are to use BlackBoard to submit a short summary (a page or more) of what you read and a list of two or more questions about the content of the reading, at least one hour before class starts. These logs will form the starting point for our discussions and help with exam review. [Late reading logs receive zero credit; I will drop the lowest two reading log grades.]
- [25%] Lab notebooks. Purchase any style of book you like - the "Marble Cover" books are easy to carry around, though they have small pages. Large traditional lab books are fine. It is your choice as to which to buy, but I do require that you maintain two lab books. The lab books are independent of your own class notebook. The lab notebooks will be a record of the experiments that we carry out in class and those that are assigned for out-of-class completion. When I collect one notebook for review, you can use the other. The guiding principle is that your notes should be a clear record of what activity you carried out, with diagrams of equipment and observations, instructions (procedures and motivation), and a discussion of your results. The more drawings that you have and the more complete your notes, the more likely it is that your lab grade will be high. Note dates and times of observations. A lab notebook is a log of what you do, written in a way that others (or you at a later time) can reconstruct and follow what you did. [Lab scores are reduced 20% per day late.]
- [25%] In-class exams. I will give a mid-term and final exam, which will ask you to discuss concepts developed in class, supported by examples and diagrams. The mid-term and final exams will be of equal weight and will be designed to be completed in about one hour. [I need a valid medical excuse or true emergency to reschedule an exam and rescheduled exams will be oral exams, where I interview you about the course material.]
- [28%] Course project. This project will consist of writing a paper to support your research into a particular topic of light and vision. This project should include some demonstration of physical principles or involvement in activ-

ity where the understanding of light plays a central role. The grade for this work will be based on a proposal [5%], a draft [9%], and a final project [14%], developed throughout the second half of the semester. I strongly recommend that you spread out the work for your project as much as possible. [Course project components are reduced by one grade level (e.g., A- to B+) for each late day, with the first grade reduction taking place at the time they are due.]

- [10%] Participation in class activities is important to learning. If you actively participate in most of the class discussions, you will receive full credit here. If you miss a noticeable fraction of class meetings, this will be reduced.

### Collaboration, sources, and academic honesty

I encourage you to share ideas with your peers both in and out of class by active discussion. I wish to emphasize that science and knowledge in general advance by discussion and sharing and bouncing ideas off of one another and by reading a wide variety of sources.

The key principle for academic honesty, then, is that you should *properly acknowledge* all of your sources in written or online work. Sources include web pages, books, articles, television shows, and people. For example, if you learn something from someone, you should credit them in your paper or lab notebook. Examples:

- “Jes Katt suggested that I try this out, which worked well because I saw a new color at the edge of the sample.”
- “The principle of pair production (Ref. 23) means that colliding light beams can create matter.” [Or, alternately, “The principle of pair production [Sniffler, 1986] means that colliding light beams can create matter.”]
- “This figure is a screen capture of a tutorial simulation of light reflection that can be seen at <http://www.microscopy.fsu.edu/primer/java/reflection/reflectionangles/>.” (please be cautious, using only reliable and persistent web pages).

Such acknowledgement allows the reader to track down the sources of information to learn more, to evaluate the reliability of the information, and to see that others are properly credited for their efforts. A consequence of this principle is that *quotations from sources should be clearly indicated as such*, by offsetting long quotes and including short quotations in quote marks. Except for properly acknowledged quotations, all work that you submit should be in your own words. Frequent acknowledgement avoids plagiarism and makes your work more useful.

Please do not share your written work in any manner, even by e-mailing your work to another student, as you will be held responsible for contributing to academic dishonesty if someone else turns in your work.

Please also be aware of the details of University and College policies on academic dishonesty: the Syracuse University Academic Integrity Policy holds students accountable for the integrity of the work they submit, including citations in written work, exams, and any other assignments. More information and the complete policy can be found at <http://academicintegrity.syr.edu>. I hope never to have to enforce this policy in this course, but if needed, I will give a failing assignment grade for any academic dishonesty and in serious cases will additionally lower the course grade by one level. Excessive carelessness with references and quotations will reduce your project grades.

### Accommodations

Students who are in need of disability-related academic accommodations must register with the Office of Disability Services (ODS), 304 University Avenue, Room 309, 315-443-4498. Students with authorized disability-related accommodations should provide a current Accommodation Authorization Letter from ODS to the instructor and review those accommodations with the instructor. Accommodations, such as exam administration, are not provided retroactively; therefore, planning for accommodations as early as possible is necessary. For further information, see the ODS website, <http://disabilityservices.syr.edu/>.