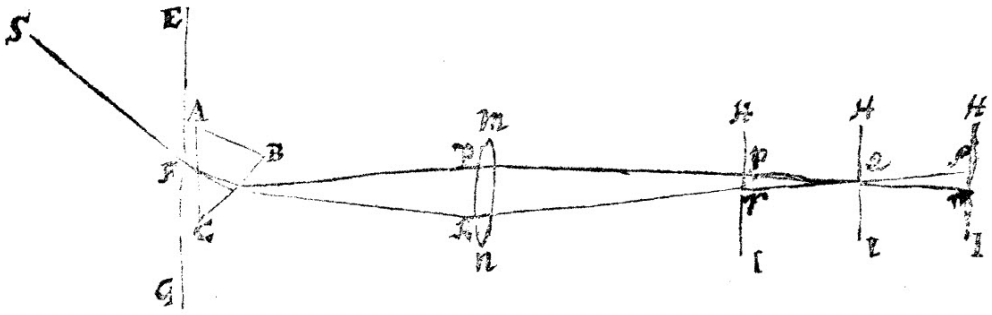
Physics 103: Light, Color and Vision, Winter 2015



Time: 9:00-12:15, Monday-Friday **Location:** TCCW 251

Texts: *Light, Color and Vision Workbook,* Fall 2014 edition, by Scott Bonham (required)
Seeing the Light by Falk, Brill and Stork (optional)
Additional readings on the web

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Driving Questions for course

1. What is our current understanding of the nature of light, color and vision, and how did it develop?

a. What happens to light as it travels through a medium and interacts with a surface/boundary?
b. What models are/have been used to describe light, color and vision? Why are some still used and others discarded?
c. What is color, how is it produced, and how is it perceived?
d. How does vision occur in humans, and how is it different in other creatures?
e. How do we perceive depth? What distance clues do we utilize?
f. What is the nature of scientific exploration and communication, and some of the history of its development?

2. How can we use/design optical instruments composed of different optical elements to capture, make visible, or project images?

a. What are the important optical components of an optical instrument and how are they arranged in relationship to each other?
b. What are the focal lengths and other critical parameters of the optical elements?
c. What is the relationship between distance of objects and size of images?
d. How do lenses and mirrors shape the path of light to form real and virtual images?
e. What is the spectrum of the light captured/utilized/modified in an optical instrument?

Learning Objectives

By the end of the course, students will: (goals and standards references at end of document)

1. Use ray diagrams and mathematical expressions to describe light passing through a medium, reflecting off mirror surfaces, passing from one medium to another and going through a lens. [CP-2, CP-3, SP-5, SP-6, SP-7, MS-PS4-2]
2. Describe several current and historical models used to explain light, color and vision, their development, and the evidence they do or do not explain well. [CP-1, CP-2, SP-2, SP-7, SP-8, HS-PS4-3]
3. Use spectral diagrams to describe light from a source and how objects like filters modify the light. [CP-2, SP-5, SP-8]
4. Identify the biological structures that enable vision and compare/contrast human vision with that of other creatures. [CP-2, CP-4, SP-8]
5. Identify and apply different distance clues to produce the appearance of depth. [CP-4, SP-5, SP-6]
6. Describe some of the developments that lead to modern science and writing, and identify elements that make an argument scientific or non-scientific. [CP-4, SP-7, SP-8]
7. Identify and characterize the important optical elements in an optical instrument and explain how they work together to perform its function. [CP-3, CP-4, SP-3 to SP-6, SP-8, HS-PS4-5.]
8. Plan and carry out a scientific investigation, analyze data and compare results. [CP-1, CP-2, SP-1, SP-3, SP-4, SP-5, SP-8]
9. Work effectively with other students to produce quality products.

Essential skills

The following are skills you will need to be successful in this class. Some you should already have from previous courses; some will be developed during this course.

A. Measure and record sizes, distances and angles.
B. Identify important elements in a system and make a scale diagram of it.
C. Make ray diagrams of light passing around/through objects and optical elements.
D. Find the focal length of lenses and curved mirrors.
E. Make and interpret spectral diagrams.
F. Identify the appropriate mathematical expression for a situation and solve it to obtain a value of a single unknown value.
G. Find information from one or more sources about a particular topic and restate it for one's purpose.
H. Read technical texts, identify the claims, the evidence/justification provided, and critique the argument.
I. Construct an argument using evidence to support claims.
J. Communicate information and explanations through written, verbal, pictorial and other means.
K. Work effectively with other people in small and large groups to accomplish a common goal.

Course elements

Class: Almost every day there will be classroom activities and class discussion of materials. Some days will be fairly structured, others will be fairly unstructured to allow you and your group to work on projects. Many days will used activities that are in your workbook, so bring it to class regularly. The focus will be on developing solid understanding of important topics and the ability to apply them to real-life situations**.**

Pre-class questions: Each day there will be a few open-ended questions to answer on the web before you come to class, due at 8 am. These will be graded on a basis of effort, not correctness, and often will not have a single correct answer. These will often be related to the upcoming class, and I will look at the class's responses and use them in the class. Some will require you to do readings, so plan enough time. Doing this is very important to being prepared, so you must do this before you come to class.

Readings: In additional to looking up information for pre-class questions, there will be several selections from important historical writings on light, color and vision which can be found in the appendix of the workbook. You will be expected to read and discuss these.

Essays and Report: You will write two essays during the semester mainly based on the historical readings relating to your understanding of developing and communicating scientific knowledge. You will also work with students to analyze a disposable camera and prepare a descriptive report about that.

Homework: There will periodically be homework assignments, usually with the aim of building or evaluating basic skills. Some of these are Exercises in the work book for your own practice (do not look at answers at the end of the chapter before starting it.) Others will be handed out in class and checked in subsequent classes.

Mini-Tests: In order to check and evaluate basic skills and knowledge, there will be short tests (approx.. 30 minutes) about every two days. These will involve problems to be solved using drawings and/or calculations, short answer and free-response questions.

Supplies needed

Drawing materials

- Ruler
- Protractor
- Colored pencils or markers
- Drawing paper (quad ruled recommended)

Electronic/computer resources

- Digital camera (camera phones and web cameras are adequate).
- Vector drawing software.[1]
- Basic photo editing software [2]

Grading

Grades will be based on pre-class questions, mini-tests, essays and reports. The official grade book will be kept on Blackboard; you should periodically check to ensure that all your grades are correctly

[1] Some common vector drawing software packages are Adobe Illustrator, CorelDraw, Macromedia Freehand, AutoCAD and OpenOffice Draw. The last is a free, open-source package available at http://www.openoffice.org/.
[2] There are many such packages, including Adobe Photoshop (available in campus student labs) and GIMP, an open source package available at http://www.gimp.org/downloads/.

recorded and keep your graded work in case there are any discrepancies. It is anticipated that there will be a little more than 400 points available to earn over the semester. Anticipated grade breaks are:

A: >340	B: 300-339	C: 260-299	D: 220-259	F: <220

Late policy: I reserve the right to refuse to accept any late assignments or allow quizzes or exams to be made up without a documented, valid excuse. However, in most cases I will allow it with an appropriate late penalty on the score. It is your responsibility to ask.

Disability statement: In compliance with university policy, students with disabilities who require academic and/or auxiliary accommodations for this course must contact the Office for Student Disability Services in Downing University Center, A-200. The phone number is 270-745-5004. Please DO NOT request accommodations directly from the professor or instructor without a letter of accommodation from the Office for Student Disability Services.

Standards referred to in Learning Objectives

Western Kentucky University Colonnade Program (Fall 2014)

Students will demonstrate the ability to:

CP-1. Demonstrate an understanding of the methods of science inquiry.
CP-2. Explain basic concepts and principles in one or more of the sciences.
CP-3. Apply scientific principles to interpret and make predictions in one or more of the sciences.
CP-4. Explain how scientific principles relate to issues of personal and/or public importance.

Scientific practices from *A Framework for K-12 Science Education* (National Research Council)

SP-1. Asking questions
SP-2. Developing and using models
SP-3. Planning and carrying out investigations
SP-4. Analyzing and interpreting data
SP-5. Using mathematics and computational thinking
SP-6. Constructing explanations
SP-7. Engaging in argument from evidence
SP-8. Obtaining, evaluating, and communicating information

Selected items from the *Next Generation Science Standards*

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Expectation acknowledgement and grading contract

In the past, I have had students who did not seem to understand expectations in this class until it was too late to do well. In order to ensure that does not happen, please initial each statement in the first part, select the grading method you want to apply to you, print and sign your name below.

_____ I understand that coming to class and actively participating in activities and discussions is an important part of learning science in this class, and I will make my best effort to attend class.

_____ I understand that there will normally be pre-class questions on Blackboard due before each class, and that completing these is an important part of the learning in helping be prepared for class and helping Dr. Bonham understand where the class is in understanding topics.

_____ I understand that not all the information I need for this class will be presented during class time, and that I will need to complete readings outside of class.

_____ I understand that science is an enterprise that is carried out by groups of people, and that I will need to work with other students to develop my scientific understanding in this class. I will make my best effort to work well with all people, including any groups the Dr. Bonham may assign me to.

_____ I understand that I am ultimately responsible for my learning in this class. I will make my best effort to learn and apply the material, and seek assistance from Dr. Bonham or others to help clear up things I do not understand.

_____ I understand that grades will be kept on Blackboard, that I am responsible for informing Dr. Bonham of any discrepancies between it and my records, and that I should regularly check my progress on it.

_____	_____	_____
Signature	Printed name	Date