

NS 544 Concepts in Physics V: Waves and Geometric Optics Course Schedule

N.B.: The schedule below has not yet been adapted to the blended schedule of online and in-class meetings. Course readings may vary between course offerings.

Session 1: Harmonic Motion.

Readings from Cutnell & Johnson: 10.1 – 10.3, 10.9

Laboratory experiment: Simple Harmonic Motion

Waves and Optics Pre-Tests

ONLINE Session 2: Springs; Pendulums.

Readings from Cutnell & Johnson: 10.4 – 10.6

Web assignment 1

Reading assignment for online sessions 2 and 3:

Galileo, G. (1954). *Dialogues concerning two new sciences*. Section 127 – 150.

Session 3: Waves on Strings.

Readings from Cutnell & Johnson: 16.1 – 16.3

ONLINE Session 4: Transverse and Longitudinal Waves

Readings from Cutnell & Johnson: 16.4 – 16.6

Web assignment 2

Reading assignment for online sessions 4 and 5:

- Matthews, M. (1994). History and philosophy in the classroom: the case of the pendulum motion. In. *Science teaching. The role of history and philosophy of science*. New York: Routledge.

Session 5: Waves in Air Columns -- Sound.

Readings from Cutnell & Johnson: 17.1 – 17.8

Laboratory experiment: Sound

Philosophy/History/Education Research: A critical appraisal of Galileo's account of pendulum motion including Matthews discussion.

Home Project Due: Pendula or other oscillators.

ONLINE Session 6: Doppler effect

Readings from Cutnell & Johnson: 16.7 – 16.10

Web assignment 3

Reading assignment for online sessions 6 and 7:

- Wittmann, M.C. (2002). The object coordination class applied to wavepulses: analyzing student reasoning in wave physics. In. *J. of Sci. Ed.* (24) 1, 97 –118.
- Wittmann, M.C., Steinberg, R.N., and Redish, E.F (1999). Making sense of how student's make sense of mechanical waves. *Physics Teacher.* 37, 15-21.
- Chi, M.T.H. and Slotta, J.D. (1993). The Ontological Coherence of Intuitive Physics. *Cognition and Instruction*, 10, 249-260.

Session 7: Midterm Test

Midterm test on Harmonic Motion and Waves

Philosophy/History/Education Research: Discussion of Chi's ontological categories and Wittmann's object analysis of students' misconceptions.

ONLINE Session 8: Reflection, spherical mirrors, ray diagrams.

Readings from Cutnell & Johnson: Chapter 25

Web assignment 4

Computer-Based Activities: Virtual optical bench.

Reading assignment for online sessions 8 and 9:

- Goldberg, F.M., McDermott, L.C. (1986). Student difficulties in understanding image formation by a plane mirror. *Physics Teacher*, 24, 472-480.
- Goldberg, F.M., McDermott, L.C. (1987). An investigation of student understanding of the real image formed by a converging lens or concave mirror. *Am. J. Phys.* 55 (2) 108 – 119.

Session 9: Refraction and total internal reflection.

Readings from Cutnell & Johnson: 26.1 – 26.5

Laboratory experiment: Geometrical optics.

Philosophy/History/Education Research: Discussion of misconceptions literature on optics.

ONLINE Session 10: Lenses and ray diagrams.

Readings from Cutnell & Johnson: 26.6 – 26.9

Web assignment 5

Session 11: Optical instruments.

Readings from Cutnell & Johnson: 26.9 – 26.10, 26.15

Take home exam handed out

Applications: The human eye and the camera.

Home Project Due: Home made telescope or microscope.

ONLINE Session 12: Light, color, and shadows.

Readings from Cutnell & Johnson: 26.11 – 26.14

Applications: Rods and cones in the human eye.

Session 13: Review of Light

Waves and Optics Post-tests.

Session 14: Wrap-up

Student presentations.

Take home exam due

Bibliography

Selections from primary sources

Galileo, G. (1954). *Dialogues concerning two new sciences*. (Sections 127 – 150). Translation Crew and De Savio. New York: Dover Pub.

This text is now available online from

<http://books.google.com/books?q=Galileo+Two+New+Sciences&btnG=Search+Books>

Selections from secondary sources

Matthews, M. (1994). History and philosophy in the classroom: the case of the pendulum motion. In *Science teaching. The role of history and philosophy of science*. New York: Routledge.

Selections from Education Research Literature

Goldberg, F.M., McDermott, L.C. (1986, November). Student difficulties in understanding image formation by a plane mirror. *Physics Teacher*, 24, 472-480.

Goldberg, F.M., McDermott, L.C. (1987). An investigation of student understanding of the real image formed by a converging lens or concave mirror. *Am. J. Phys.* 55 (2) 108 – 119.

Wittmann, M.C. (2002). The object coordination class applied to wavepulses: analyzing student reasoning in wave physics. *Int. J. of Sci. Ed.* 24, 97 –118.

Wittmann, M.C., Steinberg, R.N., and Redish, E.F (1999). Making sense of how student's make sense of mechanical waves. *Physics Teacher*. 37, 15-21.

Chi, M.T.H. and Slotta, J.D. (1993). The Ontological Coherence of Intuitive Physics. *Cognition and Instruction*, 10, 249-260.

Chi, M.T.H. (1997) Creativity: Shifting Across Ontological Categories Flexibly. In T.B. Ward, S.M. Smith and J. Vaid (eds.), *Creative Thought: An Investigation of Conceptual Structures and Processes*. Washington, D.C.: American Psychological Association. pp. 209 – 234.