

# Physics

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This course combines traditional physics instruction with the modern quantum theories of the nature of the universe. The subject is taught at an introductory level, which will allow the average student to grasp the concepts of Newton's laws, statics, dynamics, thermodynamics, optics, DC circuits, waves, electro-magnetics, and special relativity. The following books are required for this course:

- The Oak Meadow Physics Syllabus
- *Saxon Physics: An Incremental Development* by John H. Saxon, Jr., Saxon Publishers, 1999
- *Coming of Age in the Milky Way*, by Timothy Ferris, Doubleday, 1988

## Outline of the Physics Syllabus:

<b>Lesson 1:</b>	The Power of the Word and the Importance of the Story: Creation	<b>Lessons 19-20:</b>	Heat, Time, and Thermodynamics
<b>Lesson 2:</b>	Ancient Cosmological Thought	<b>Lessons 21-22:</b>	Waves, Stars, and Atomic Theory
<b>Lessons 3-4:</b>	The Discovery of the Earth and the Sun	<b>Lessons 23-24:</b>	Circular Motion, Harmonic Motion, and Gases and Fluids
<b>Lessons 5-6:</b>	Galileo and an Introduction to Force	<b>Lessons 25-26:</b>	Electricity
<b>Lessons 7-8:</b>	Heat and Energy	<b>Lessons 27-28:</b>	Magnetism, Radioactivity, and the Special Theory of Relativity
<b>Lessons 9-10:</b>	Newton's Forces	<b>Lessons 29-30:</b>	More Relativity
<b>Lessons 11-12:</b>	The Sun and Simple Machines	<b>Lessons 31-32:</b>	Quantum Physics and Symmetry
<b>Lessons 13-14:</b>	Celestial Space and Heat	<b>Lessons 33-34:</b>	The Story of Creation and the Origin of the Universe
<b>Lessons 15-16:</b>	The Meaning of Light and Higher Mathematics	<b>Lessons 35-36:</b>	Mind, Matter, and Mystery
<b>Lessons 17-18:</b>	More About Gravitation and Light		

# Physics ~~~~~ Lessons 21-22

## *WAVES, STARS AND ATOMIC THEORY*

### *PART ONE*

Read: Timothy Ferris, *Coming of Age in the Milky Way*, Chapter 14, “The Evolution of Atoms and Stars,” pages 255-282.

Answer the following questions:

1. In 1911 Rutherford, Geiger and Mardsen shot alpha particles of helium nuclei at thin foils of different metals, and found that while most passed through the foils, a few bounced back.
  - a) What was the conclusion as to why this happens?
  - b) Why then are heavy elements heavier than light elements?
2. Noels Bohr established that an *electron shell*, which consists of many different orbits of different electrons, surrounds the protons in an atom’s nucleus. Explain what occurs between these orbits that allows a *spectroscopist* to know what type of chemical elements make up the stars.
3. What were the first *computers*?
4. What is the *Coulomb barrier*? What allows it to be breached and for nuclear fusion to power the stars?
5. While nuclear fusion powers both the sun and thermonuclear weapons, the sun is not a bomb. Why does a chain reaction in the sun normally not result in further ones occurring as they do in a bomb?

6. The lowest mass of a star is about 1 per cent the mass of our sun and the largest stars are about 60 times its size. What would happen if it were smaller? What would happen if it were bigger?
7. In terms of matter, what is the “primary” business of stars?
8. How did Paul Merrill’s discovery of technetium-99 in S stars show stars could build elements heavier than iron?
9. What is the cosmic element *abundance curve*?
10. 96% of all visible matter in the universe is composed of what two elements?
11. Explain the origins of the gold and silver that exists on Earth.
12. How do we know that the stars at a galactic center of a galaxy are older than the stars in the spiral arms?

## *PART TWO*

Read and Study: Saxon, *Physics*, Lesson 34, pages 219-222; Lesson 40, pages 264-267; Lesson 44, pages 293-297; Lesson 73, pages 518-522; Lesson 78, pages 552-558.

Answer the following questions:

1. Explain how the white light from the sun causes a red fire engine to look red.
2. Explain the difference between *additive* primary colors and *subtractive* primary colors.
3. Draw two pictures of waves, one from a top view and one from a side view. In each, show the locations of the crests and the troughs of the wave.
4. Explain what happens to the frequency, the wavelength and the speed of light as it passes through air and then through water.

5. What is a sound wave? On what two variables does the speed of sound depend?
6. On what properties does the speed of a wave along a string depend?
7. Why does a boat whistle sound different when it is stationary, when the boat is moving towards you, and when it is moving away from you?
8. Explain what is meant by a *resonance frequency*.
9. What is *damping*? Explain why all real-world systems have damping.
10. In a pendulum clock, what keeps the clock moving at a constant speed?
11. All of the strings of a guitar are the same length. If the guitar is “in tune” why does each string sound a different note?

### *PART THREE*

In your Saxon Home Study Packet, do problem 6 in Test 9, problem 10 in Test 10, problem 6 in Test 19, and problem 8 in Test 20. Be sure to show all your work and computations.