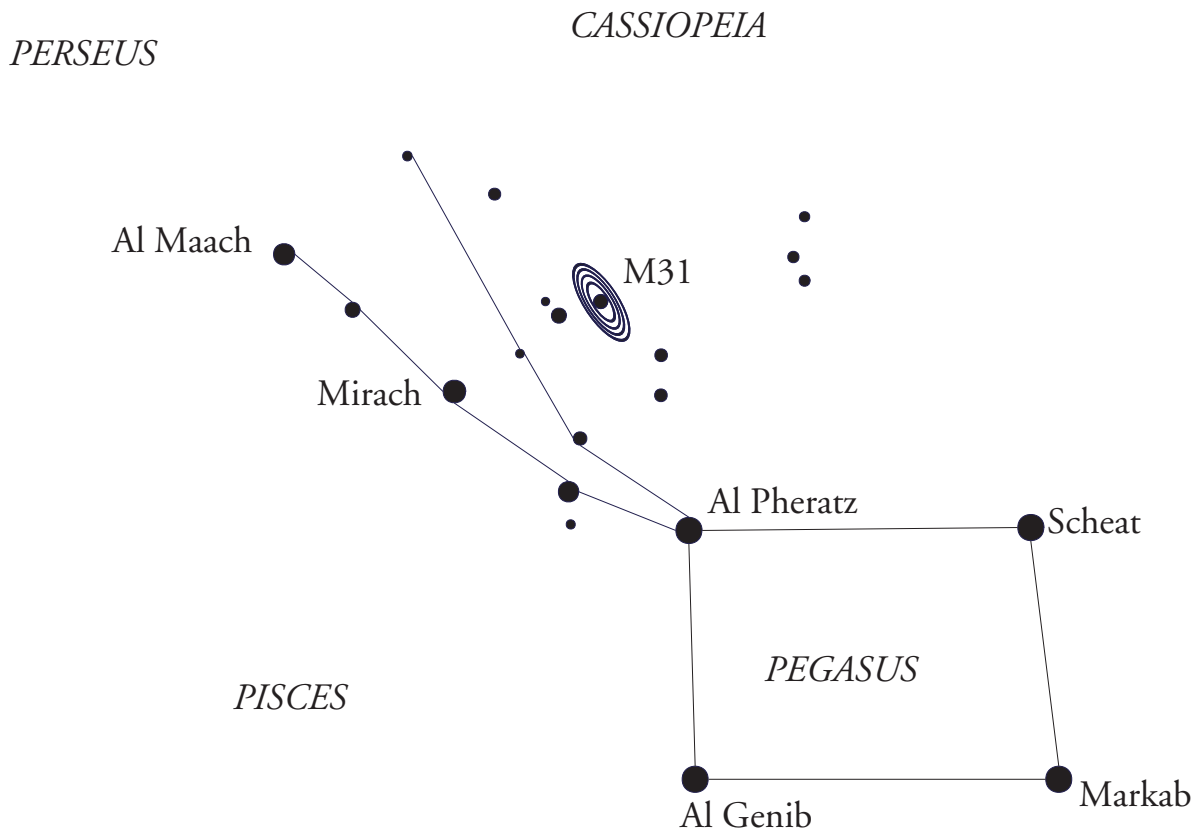


Lift Up Your Eyes on High

UNDERSTANDING THE STARS



TEACHER'S MANUAL

Revised Edition
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TABLE OF CONTENTS

INTRODUCTION.....	v
A GUIDE FOR DAILY LESSON PLANS	vii
TEST PREPARATION.....	viii
NOTES REGARDING THE TEXT	viii
COURSE OUTLINE	x
CHAPTER 1 – INTRODUCTION	1
OBJECTIVES.....	1
OUTLINE OF CHAPTER.....	1
TEACHING IDEAS	1
LEARNING ACTIVITIES.....	2
SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY	3
CHAPTER 2 – NORTH CIRCUMPOLAR STARS.....	7
OBJECTIVES.....	7
OUTLINE OF CHAPTER.....	7
TEACHING IDEAS	7
LEARNING ACTIVITIES.....	8
SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY	10
CHAPTER 3 – STAR MOVEMENTS DURING THE NIGHT	15
OBJECTIVES.....	15
OUTLINE OF CHAPTER.....	15
TEACHING IDEAS	15
LEARNING ACTIVITIES.....	15
SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY	18
CHAPTER 4 – SEASONAL STARS	21
OBJECTIVE	21
OUTLINE OF CHAPTER.....	21
TEACHING IDEAS	21
LEARNING ACTIVITIES.....	21
SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY	24
CHAPTER 5 – THE ZODIAC CONSTELLATIONS	29
OBJECTIVES.....	29
OUTLINE OF CHAPTER.....	29
TEACHING IDEAS	30
LEARNING ACTIVITIES.....	30
SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY	30
USING THE TEXTBOOK GLOSSARIES	34
STAR NAME GLOSSARY AND PRONUNCIATION GUIDE	34
GLOSSARY OF ASTRONOMICAL AND RELATED TERMS.....	34
APPENDIX A: STAR CLOCK.....	35
APPENDIX B: STAR CHARTS.....	39
STAR CHART ANSWER KEY	46
APPENDIX C: THE RUSSIAN INVASION OF AFGHANISTAN, DECEMBER, 1979	47

INTRODUCTION

This guide assists a teacher or homeschool parent with ideas, solutions, resources, and learning activities for the book *Lift Up Your Eyes on High: Understanding the Stars*.

Grade 7–12 students should be able to understand the content and principles presented in the text. Mathematical principles have been kept to a minimum. The text appendices explore ideas that require some background in algebra, Euclidean geometry, and trigonometry. For more detailed mathematics, refer to the resources listed in the text’s bibliography.

To make the material come alive for the student, nightly stargazing is a must:

- For star watching, all you need is the naked eye, a flashlight¹ (with a red lens cover or red cellophane tied on with a rubber band to stabilize night vision), a planisphere or star finder (store-bought or handmade), and warm clothing for cold nights. A reclining lawn chair or heavy ground cloth might also be helpful to prevent a sore neck.
- Plan nightly star parties throughout the entire school year.
- Try to get away from city lights for your stargazing activities.
- Let your eyes get accustomed to the dark (10 to 30 minutes) before you begin. This is called dark adaptation.
- Make sure that every student knows how to use the planisphere or star finder to find his or her way in the sky (they come with easy to understand instructions).
- A pair of 7x50 binoculars will help you zero in on galaxies and double stars. For deep sky objects (nebulae, star clusters, etc.), a quality telescope is a necessity. Buy your telescope from a reputable dealer in optics. Try to buy a 3-inch reflector. It is the least expensive and provides the light gathering power to see the rings of Saturn and the moons of Jupiter. It is great for close up views of the moon, too.

Purchase some astronomy computer software (I use SkyGlobe, a shareware product produced by KlassM Software²). Make sure that the software has the ability to “go backward and forward in time” and can trace the pathway of the planets and the moon. This tool will help the student understand precession, retrograde motion, and moon phases; and see what the night (or day) sky looked like at the time of Abraham, at the birth of Christ, or at the crucifixion of Christ.

¹ If you plan to show the stars and constellations to a group of people, use a bright, unfiltered spotlight-style flashlight. The beam will act as a pointer to the region of the sky you want to investigate.

² Originally produced by KlassM Software around 1989, this DOS program is now available as downloadable Shareware. Search the Web for “SG4WIN” (be sure the site also references SkyGlobe) if you wish to use it. Note, however, that it may not operate on Windows systems beyond Windows XP.

Join your local astronomy club, if you have one. If not, start one! Mastering this material will open many doors for planting seeds of the Gospel. For example, I regularly take my children on backpacking trips in coordination with a local conservation society. Out in the mountains, the night sky takes on outstanding clarity. While we master techniques of terrestrial navigation (orienteering,³ reading topographic maps, etc.), I casually mention the concept of celestial navigation. The result is that I am asked to give astronomy lectures at night!

A comment about the Questions for Review and Further Study: These questions range from basic definitions to full-fledged research projects. I hold a strong conviction about the necessity of requiring students to answer essay questions. Answering this type of question builds communication skills that will be used in real life. It also forces the student to put his thoughts together in a logical, coherent way. Because of these convictions, most of the assignment questions require essay answers. These are harder to correct than the simple definition questions. To guide you in grading, I will list principles that should be included in the answer. You, as a teacher, must master the material for yourself in order to evaluate the responses of your student. For the research project questions, I will list resource material that will help the student get started.⁴

A note on resource books: Every Christian school and home should be developing and budgeting for a library or have access to one. This guide will refer to books that are not listed in the text's bibliography. Some of these resources may be hard to find or out of print. You should be able to find most of these books using the Interlibrary Loan Service offered by your local public library. Internet searches may also help you locate these materials.

Many of the activity ideas used in this manual were modified and adapted from the following sources:

- *Astronomy for All Ages: Discovering the Universe Through Activities for Children and Adults*, second edition (The Globe Pequot Press, 2000), by Philip Harrington and Edward Pascuzzi.
- *New UNESCO Source Book for Science Teaching* (UNESCO, 1973).⁵

³ Orienteering is a sport in which competitors navigate unfamiliar terrain and locate checkpoints with the aid of a map and compass.

⁴ Because a book is recommended as a resource does not mean that I necessarily agree with all its underlying presuppositions and interpretations.

⁵ A free PDF copy of this product can be obtained from the UNESCO website at <<http://unesdoc.unesco.org/images/0000/000056/005641E.pdf>>.

A GUIDE FOR DAILY LESSON PLANS

For grade 7–10 students, allow three hours per week plus nightly star watching. You should be able to finish the book in about 10–12 weeks (30–36 classroom hours).

For grade 11–12, allow five hours per week (50–60 classroom hours) plus nightly star watching. You will need to add more material (e.g., mathematics) for students at these levels. You can assign one of the research projects and allow for one to two classroom hours per week for project work. Plan ahead and make sure that you can procure the required resource material for project work.

Review the chapter objectives, and quiz the student on these objectives after each chapter is completed. Photocopy and pass out the blank Star Charts (see Appendix B) at the end of this manual to help the student memorize key constellations and stars. Use these charts for pop quizzes. Make sure that each student knows how to use a star finder.

Follow this guideline for class work:

- **Day 1:** Introduce the course (provide the student with a copy of the Course Outline given on page *x* of this manual) and assign chapter reading as homework.⁶
- **Day 2:** Go over the assigned reading to make sure that the student understands the basic points. Assign homework (short sentence answers, short essay, and long essay) from the Questions for Review and Further Study based upon the assigned reading section. Do classroom activity or prepare for nightly stargazing. If you have astronomy software, use it to augment the lesson where appropriate.
- **Day 3:** Correct homework,⁷ continue classroom activity, and assign the next reading selection.
- **Day 4:** Repeat day 2.
- **Day 5:** Repeat day 3.
- And so on ...

For grade 11–12 students:

- Expect and demand more self-government; let the book be the primary teacher. You are there to guide and direct and to point the student toward resources that will answer his or her questions.

⁶ For planning purposes, divide the number of pages of text by the number of classroom days and use this figure as a reading guideline. Take into account holidays and test days.

⁷ Some of the long essay questions (that require research and extra reading) will take more time to discuss and correct. Encourage discussion at all times!

- Follow the guideline for class work with one change: assign the reading and homework based upon the reading at the same time. Go over the homework in class the next day.
- Require each student to choose a project by the end of the second week. List all of the research projects from the text. You might also include other ideas, such as making a spectroscope, sundial, elementary telescope, etc.

TEST PREPARATION

As mentioned above, blank Star Charts are included in Appendix B for use as pop quizzes. A test packet (sold separately) is also available for this course. It contains seven tests; one for each chapter (tests six and seven are a comprehensive final exam).

Many (though not all) of the test questions come from the material presented in the Questions for Review and Further Study, so make sure your student completes all of the assignments in these sections.

Appendices referenced in a chapter, either directly in the text or through this manual, are considered part of that chapter. Therefore, any material in those appendices—including footnotes—should be studied. (NOTE: when studying the appendices, grade 11–12 students should also understand the mathematical principles involved in them.) Review of glossary terms will also be beneficial, as many of the definitions given in the glossary are more detailed than those appearing in the chapter itself.

If you are using this course with grade 7–10 students, we recommend that you scan the chapter test prior to beginning the unit to understand the kind of material the student will need to know. The goal here is not to “teach the test,” but rather to ensure that you do not overlook a topic that you believe might only apply to grade 11–12 students. Some test questions assume the Research questions at the end of the chapter were completed. If these are overlooked, your student will not be fully prepared.

Finally, it should be noted that the final exam consists of two tests (six and seven) and is comprehensive, meaning that all material from the text, including all footnotes and appendices, is considered “fair game.”

NOTES REGARDING THE TEXT

This text presumes the student will be using the material over the course of an entire calendar year, and includes activities for all four seasons. Depending on when you start this course, you may find it prudent to complete some star-viewing activities “out of order” so that you do not have to wait a calendar year for the appropriate season to return. However, the constellations should still be memorized in the order they appear in the chapter outlines.

Also, this text is written from a northern hemisphere perspective, meaning that terminology and images are, for the most part, from that vantage point (*some*

southern hemisphere information has been provided, should you find yourself in that region of the world). If you are looking for a course written from the southern hemisphere perspective, see *The Heavens Declare: Understanding the Stars* by James Nickel (available from Light Educational Ministries, 200 Florey Drive, Charnwood ACT 2615, Australia; <<http://lem.com.au>>).

If you are using this text while traveling in the southern hemisphere, there are a few things to note:

- The seasons will be in reverse order. References to winter need to be changed to summer, spring changed to autumn, summer to winter, and autumn to spring.
- The constellations will all appear “upside down” because they are being viewed in reference to the South Circumpolar stars, instead of the North. This different perspective will engender other asterisms, such as “the saucepan” in the constellation Orion.
- When looking toward the south pole, the stars will rotate in a clockwise direction around the pole. This is opposite to the rotation around the north pole, where the stars rotate in a counter-clockwise direction.

COURSE OUTLINE

Chapter One

- I. What is a star?
- II. How many stars?
- III. How far away are they?
- IV. Where did God place the stars?
- V. What are the purposes of the heavenly bodies?
 - A. Lights
 - B. Signs
 - C. Seasons
 - D. Days and Years
 - E. Governing the Day and the Night
- VI. How are the stars and earthly rulers connected?
- VII. Why study the stars?

Chapter Two

- I. Big and Little Dippers
 - A. Ursa Minor
 - B. Ursa Major
 - C. The Big Dipper Clock
- II. Two “Naked-eye” Galaxies
- III. The Milky Way
- IV. Facts and Faith
- V. Earth in Space by Design
- VI. More North Circumpolar Constellations
 - A. Cassiopeia
 - B. Draco
 - C. Cepheus
- VII. What is the message of these stars?

Chapter Three

- I. Geocentricity or Heliocentricity?
- II. The Celestial Sphere
 - A. Coordinates
 - B. Star Revolution
- III. Finding Directions from the Stars
 - A. Northern Hemisphere
 - B. Southern Hemisphere

Chapter Four

- I. The Winter Stars
 - A. Orion
 - B. The Great Winter Triangle
 - C. The Twins of Gemini
 - D. The Good Shepherd
 - E. Taurus, the Bull
- II. The Spring Stars
 - A. Leo
 - B. Virgo
 - C. Coma Berenices
 - D. Boötes
 - E. Corona Borealis
 - F. Corvus

III. The Summer Stars

- A. Scorpio
- B. The Summer Triangle

IV. The Autumn Stars

- A. Piscis Australis
- B. Pegasus
- C. Andromeda

Chapter Five

- I. The Ecliptic
- II. Astrology
 - A. Cush, Son of Ham
 - B. Nimrod, Son of Cush
- III. The Federation of Twelve
- IV. The Federation and their Decans
- V. The Zodiac by Season
 - A. Winter
 1. Aries
 2. Taurus
 3. Gemini
 - B. Spring
 1. Cancer
 2. Leo
 3. Virgo
 - C. Summer
 1. Libra
 2. Scorpio
 3. Sagittarius
 - D. Autumn
 1. Capricorn
 2. Aquarius
 3. Pisces
- VI. Zodiac Summary
 - A. Aries – Christ, the Lamb of God
 - B. Taurus – Christ, the Good Shepherd
 - C. Gemini – Christ, the God-man
 - D. Cancer – Christ, the Refuge
 - E. Leo – Christ, the Lion of the Tribe of Judah
 - F. Virgo – Christ, the Branch of the Lord
 - G. Libra – Christ, the Propitiation for Man’s Sin
 - H. Scorpio – Christ, the Victor over Satan
 - I. Sagittarius – Christ, the Archer of God’s Judgments
 - J. Capricorn – Christ, the Goat of Atonement
 - K. Aquarius – Christ, the Water-bearer
 - L. Pisces – Christ, the Upholder of God’s People
- VII. Responding to God’s Glory

CHAPTER 1 – INTRODUCTION

OBJECTIVES

- ◆ Define basic scientific facts about the stars
- ◆ Present a biblical view of the origin and placement of the stars
- ◆ Reveal what the Bible says about the purposes of the stars
- ◆ Provide a biblical rationale for studying the stars

OUTLINE OF CHAPTER

- I. What is a star?
- II. How many stars?
- III. How far away are they?
- IV. Where did God place the stars?
- V. What are the purposes of the heavenly bodies?
 - A. Lights
 - B. Signs
 - C. Seasons
 - D. Days and Years
 - E. Governing the Day and the Night
- VI. How are the stars and earthly rulers connected?
- VII. Why study the stars?

TEACHING IDEAS

Refer to Appendix Seven in the text for a discussion of mathematics of parallax.

Refer to Appendix Eleven in the text for a discussion of precession.

As background to the concepts taught in section VI (How are the stars and earthly rulers connected?), the student needs to understand the following (you might want to teach these truths as a lesson in conjunction with this portion of the text):

- God rules over the minds of men—even His enemies (see Proverbs 16:1, 9; 19:21; 20:24; Isaiah 40:23).
- Study carefully Isaiah 10:5–16. Assyria thought that it conquered by its own initiative, but in reality it was sent and commissioned by God.
- Study Jeremiah 25:8–9. Nebuchadnezzar was a godless king but, in spite of that, he is called God’s servant. He did God’s will whether he liked it or not. Daniel recognizes this as he sees his city falling into Nebuchadnezzar’s hand by God’s plan (Daniel 1:2).
- Study Habakkuk 1:5–11. God says that He is raising up the Chaldeans to achieve His purpose. The Chaldeans were a wicked and idol-worshipping people, yet God said He would send them. Verses 12–17 are the horror that Habakkuk has at the thought of God using wicked people for His purposes.

These Scriptures show the intrepid faith of the men of the Bible. They saw all men knowingly or unknowingly participating in the unfolding plan of God. This understanding is the only anchor in the storm of international upheaval.

LEARNING ACTIVITIES

Making a pocket solar system

One way to understand the tremendous distances in space is to construct a simple model of the Solar System. For this activity you will need a blank register tape (obtain from a stationery store) at least 40 yards long, crayons or magic markers, a tape measure, and an area at least 40 yards long.

The pocket solar system will represent, in proportion, the planetary distances on the register tape. Let one astronomical unit (1 AU) be equal to 1 yard (If you let 1 AU = one inch, then you could hang your model on a wall).

Use the following table for marking your register tape.

CELESTIAL OBJECT	AVERAGE DISTANCE FROM THE SUN (IN MILES)	AVERAGE DISTANCE FROM THE SUN (IN AU)	DISTANCE FROM THE SUN ON REGISTER TAPE	DISTANCE FROM THIS OBJECT TO THE NEXT ON REGISTER TAPE
Sun				14 inches
Mercury	36 million	0.38	14 inches	12 inches
Venus	67 million	0.72	26 inches	10 inches
Earth	93 million	1.00	36 inches	1 inch
Moon	93,238,000	1.04	37 inches	18 inches
Mars	142 million	1.52	55 inches	11 feet
Jupiter	256 million	5.20	15.6 feet	13 feet
Saturn	885 million	9.59	28.6 feet	29 feet
Uranus	1,787 million	19.2	57.6 feet	33 feet
Neptune	2,800 million	30.1	90.3 feet	29 feet
Pluto	3,699 million	39.5	119 feet	152 miles
Alpha Centauri	24,863 billion	268,000	152 miles	

To make the pocket solar system, unravel about 1 yard of the register tape. At the end, draw a large Sun. Now use the “Distance From This Object to the Next on Register Tape” column of the table and draw Mercury 14 inches from the Sun. Measure the other celestial objects in like manner (except Alpha Centauri—you cannot buy a register tape long enough to record its distance!).

SOLUTIONS FOR QUESTIONS FOR REVIEW AND FURTHER STUDY

Short sentence answers

1. Define the following words:

- a. **Star**—a gigantic atomic furnace where heat is generated by the conversion of hydrogen into helium.
- b. **Lucid star**—a star that can be seen with the naked eye.
- c. **Radio star**—a star that give no visible light but can be detected by radio telescopes.
- d. **Scientific notation**—a shorthand notation for writing large numbers (e.g., 3,000,000,000 in scientific notation is 3×10^9).
- e. **Parallax**—a method whereby astronomers can measure stellar distances.
- f. **Astronomical unit**—a unit of measure defined as the distance between Earth and the Sun.
- g. **Light-year**—the distance that light travels in one year.
- h. **Galactic redshift**—a calculated shift to the red side of the electromagnetic spectrum that is proportional to the distance that a remote galaxy is from us.
- i. **Gravitational time dilation**—the force that causes clocks and all physical processes to tick at different rates in different parts of the universe.
- j. **Cosmogony**—the study of ideas about the origin and generation of the universe.
- k. **Cosmology**—the study of the nature and workings of the observable universe.
- l. **Solstice**—occurs when the Sun is at its greatest distance from the Celestial Equator; the shortest day of winter and the longest day of summer.
- m. **Equinox**—occurs when the path of the Sun crosses the Celestial Equator; the beginning of spring and autumn.
- n. **Chiasm**—a Hebraic grammatical form in which ideas are presented in a “sandwiched” fashion instead of logical order.

2. List the five purposes of the heavenly bodies according to Genesis 1:14–16:

(1) lights, (2), signs, (3) seasons, (4) days and years, and (5) governing the day and the night.

Long Essay

1. How would you respond to the following statement: “How can you believe in a recent act of creation, some 6,000 to 10,000 years ago, when science has shown that some galaxies are more than one million light-years distant from Earth?”