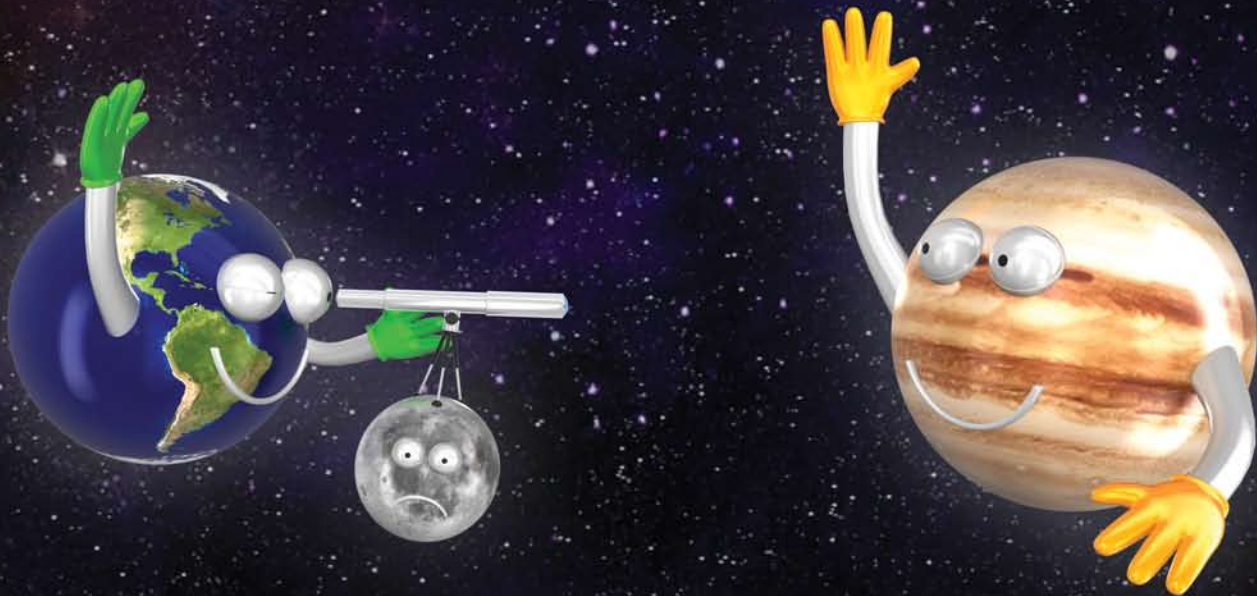


ASTRONOMY

Pre-Level 1

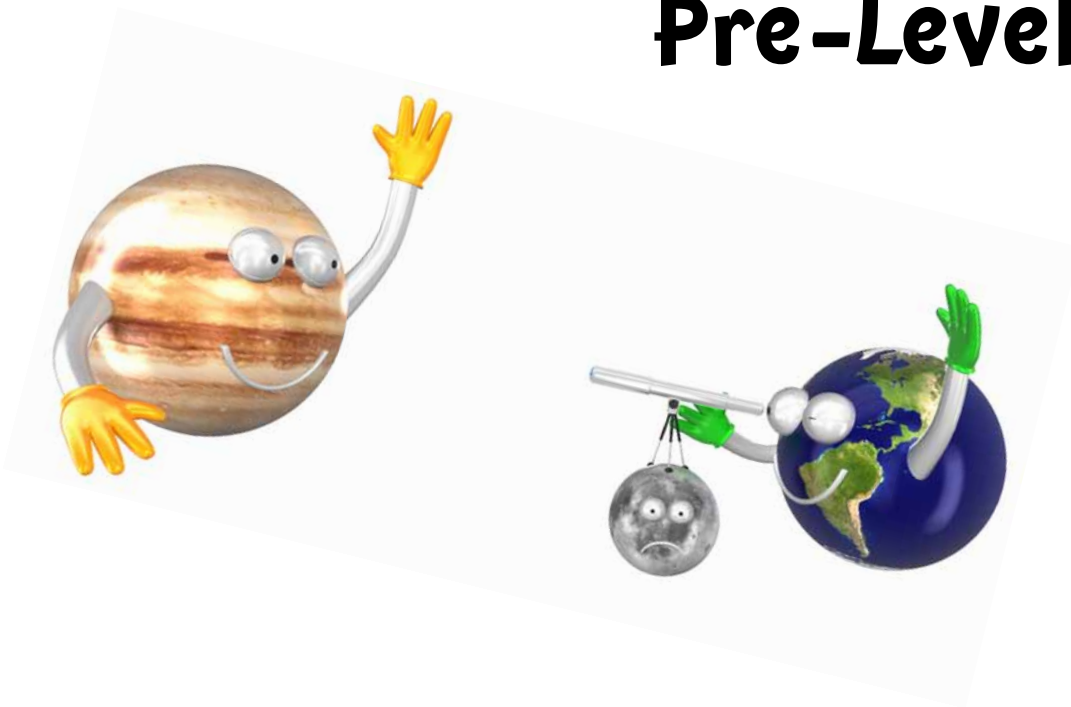


Rebecca W. Keller Ph.D.





Pre-Level 1



Rebecca W. Keller, Ph.D.





Text illustrations: Janet Moneymaker
Marjie Bassler

Copyright © 2011 Gravitas Publications, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. No part of this book may be reproduced in any manner whatsoever without written permission. This publication may be photocopied without permission from the publisher only if the copies are to be used for teaching purposes within a family.

Astronomy Pre-Level I Textbook-Softcover

ISBN # 978-1-936114-11-5

Published by Gravitas Publications, Inc.
4116 Jackie Road SE, Suite 101
Rio Rancho, NM 87124

www.gravitaspublications.com



CHAPTER 1 EXPLORING THE COSMOS	1
1.1 Introduction	2
1.2 Who Was the First Astronomer?	3
1.3 Famous Early Astronomers	5
1.4 Astronomers Today	8
1.5 Summary	9
 CHAPTER 2 THE TELESCOPE	 10
2.1 Introduction	11
2.2 What Is a Telescope?	12
2.3 Early Telescopes	13
2.4 Modern Telescopes	14
2.5 Summary	16
 CHAPTER 3 EARTH'S HOME IN SPACE	 17
3.1 Introduction	18
3.2 Earth Is a Planet	19
3.3 The Moon and Tides	21
3.4 The Sun and Weather	22
3.5 Eclipses	23
3.6 Summary	24
 CHAPTER 4 EARTH'S NEIGHBORS—MOON AND SUN	 25
4.1 Introduction	26
4.2 The Moon	26
4.3 The Sun	28
4.4 The Sun's Energy	30
4.5 Summary	30
 CHAPTER 5 EARTH'S NEIGHBORS—PLANETS	 31
5.1 Introduction	32
5.2 Planets	32
5.3 Two Types of Planets	33
5.4 Where's Pluto?	36
5.5 Summary	38

CHAPTER 6	Earth's Neighborhood	39
6.1	Introduction	40
6.2	Our Solar Neighborhood	40
6.3	Orbits	44
6.4	Why Is Earth Special?	45
6.5	Summary	47
CHAPTER 7	Beyond the Neighborhood	48
7.1	Introduction	49
7.2	Nearest Star	49
7.3	Brightest Star	51
7.4	Biggest Star	52
7.5	Stars With Planets	53
7.6	Summary	54
CHAPTER 8	The Milky Way	55
8.1	Introduction	56
8.2	A Solar City	56
8.3	Our Galaxy	57
8.4	Where Are We?	59
8.5	Summary	61
CHAPTER 9	Beyond Our Galaxy	62
9.1	Introduction	63
9.2	More Spiral Galaxies	64
9.3	Other Types of Galaxies	65
9.4	The Local Group of Galaxies	66
9.5	Summary	67
CHAPTER 10	Other Stuff in Space	68
10.1	Introduction	69
10.2	Comets and Asteroids	70
10.3	Exploding Stars	71
10.4	Collapsed Stars	72
10.5	Nebulae	73
10.6	Summary	74



Chapter 1: Exploring the Cosmos



1.1 Introduction	2
1.2 Who Was the First Astronomer?	3
1.3 Famous Early Astronomers	5
1.4 Astronomers Today	8
1.5 Summary	9



1.1 Introduction

When you look up at the sky at night, what do you see? If the sky is free of clouds and there are not too many lights around, you might see the Moon, stars, planets, and if you are lucky, a comet!

Astronomy is the study of the cosmos. The term **cosmos** refers to Earth and everything that extends beyond Earth, including other planets, stars, nebulae, comets, asteroids, and even black holes.



Because astronomers can't fly to far away planets or ride asteroids to study them, astronomers use various tools and

techniques to find out more about the objects in the cosmos. We will learn more about these tools in Chapter 2. However, even before the use of modern tools, people could learn a great deal about the cosmos by studying the night sky.

1.2 Who Was the First Astronomer?

It's hard to say who was the first astronomer. Many early people studied the planets and stars and even without modern tools discovered a great deal about the cosmos.

Early Egyptian, Babylonian, and Mayan people observed the sky in great detail. Noting when the Moon was full or when the Sun sank lower on the horizon, early observers were able to learn about how the planets and the Moon moved. From their observations they produced calendars and were even able to predict eclipses. We will learn more about eclipses in Chapter 3.

One of the questions early astronomers asked was, "Does the Earth move around the Sun, or does the Sun move around the



4 Pre-Level I Astronomy

Earth?" In other words, do we live in a "Sun-centered" cosmos or an "Earth-centered" cosmos? It appears, from simple observation, that we live in an Earth-centered cosmos. When the Sun rises and sets each day, it has the appearance of moving around the Earth. However, as we will see, sometimes how things move isn't always easy to figure out.



One of the very first astronomers to propose that the Earth moves around the Sun was **Aristarchus of Samos**. Aristarchus was a Greek astronomer and mathematician who lived from 301-230 BCE. He studied the planets and said that the Earth has two different movements.

One movement is that Earth travels around the Sun, and the other movement is that Earth revolves around its own axis. We now know that he was right! But during his time no one believed him. It would be almost 2000 years before astronomers would look closely at his ideas.

1.3 Famous Early Astronomers

Nicolaus Copernicus was a famous astronomer who also thought that the Earth moved around the Sun. Copernicus was born in 1473 in the ancient Polish city of Torun. During the time Copernicus lived, most scientists believed that the Sun revolved around the Earth. They believed that the Earth was the center of the universe and everything revolved around it.

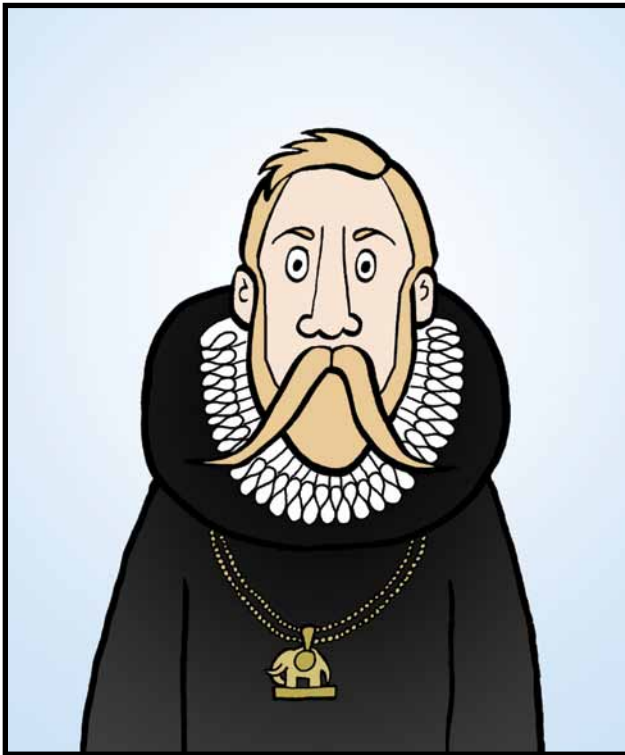


Copernicus did not agree with the scientists of his day. His ideas would eventually change the whole science of astronomy! Unlike Aristarchus, Copernicus was able to use mathematics to show that the Earth moves around the Sun and that the Sun remains fixed in one location. However, Copernicus was not outspoken about his ideas. Because he knew his ideas might upset people, he didn't talk about them. When Copernicus did publish his work, a few people got upset, but most people just ignored

6 Pre-Level I Astronomy

his hard work. Another 100 years passed before people took his ideas seriously.

Another famous astronomer also changed the way we see the cosmos. His name was **Tycho Brahe**. Tycho was



born in 1546 in the Danish town of Scania, and he was raised by his uncle. Like Copernicus, Tycho was curious about astronomy. His uncle wanted him to be a lawyer or a politician, but Tycho studied mathematics and slipped away at night to look at the sky. When his uncle died, Tycho was free to pursue his interests in astronomy.

Telescopes were not yet invented (see Chapter 2), so Tycho used **sighting tubes**, which are just hollow tubes with no lenses. Tycho discovered that stars do not always stay the same but are constantly changing. Based on his observations, Tycho decided to rewrite the map of the stars and spent his life working on his ideas.

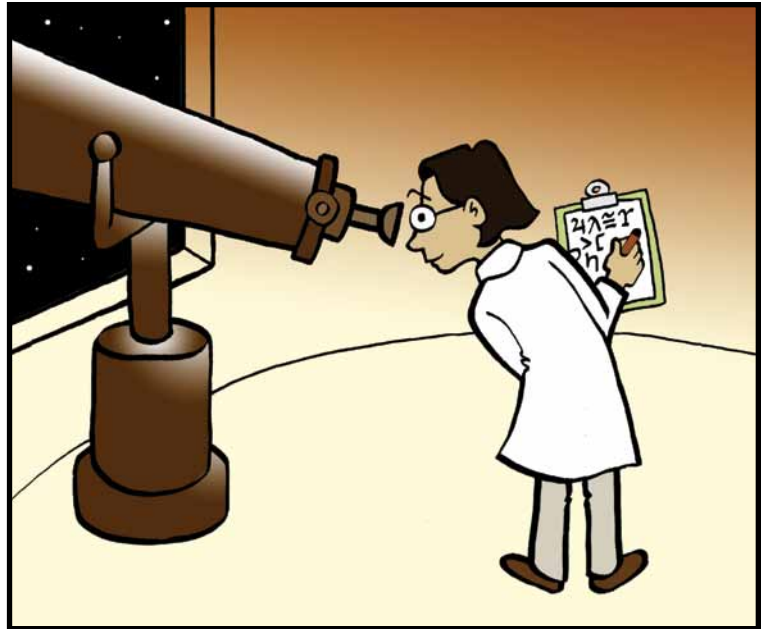
Galileo Galilei was also a famous early astronomer. He was interested in trying to find out how the planets move. Galileo was born in 1564 in Pisa, Italy. He studied many different subjects, such as mathematics and physics, and he loved to look at the stars. Galileo used his knowledge of math and physics to better understand how the planets and the Moon move.



Like Copernicus, Galileo was an independent thinker, and he didn't believe in an Earth-centered universe. Galileo did experiments because he wanted to show how things moved rather than just coming up with ideas about it. By doing experiments and by using mathematics and physics, Galileo was able to **prove** that we live in a Sun-centered **solar system** that is made up of the Sun and the objects traveling around it. Being able to prove an idea by using experiments, math, and physics was the beginning of astronomy as a science.

1.4 Astronomers Today

Today many scientists study the stars and planets. Astronomy is a science, and modern astronomers are scientists who use a variety of scientific tools and scientific techniques to learn about the



universe. In Chapter 2 we will learn more about the tools astronomers use.

However, even with new tools, modern astronomers must use the same basic skills that Copernicus, Tycho, and Galileo used.

Today's astronomers must make good observations and must train themselves to see the details, like Copernicus did. Astronomers must also study math and physics like Tycho and Galileo did. Math and

physics are essential for understanding how the stars and planets move in space. Most importantly, astronomers must always be curious and willing to argue to defend their ideas like Copernicus, Tycho, and Galileo did.

1.5 Summary

- **Astronomy** is the study of space and all the objects found in space.
- Early **astronomers** were able to discover a great deal about the stars and planets by using observation.
- **Nicolaus Copernicus, Tycho Brahe, and Galileo Galilei** were three early astronomers who changed the way we understand the universe.
- Modern astronomers still use observation, math and physics to study space.