

FOCUS ON

MIDDLE SCHOOL



3rd Edition

Preview Booklet



Rebecca W. Keller, PhD



Featuring Chapters from:

Student Textbook
Laboratory Notebook
Teacher's Manual
Lesson Plan
Study Notebook
Quizzes
Graphics Package

Introduction

Welcome to the *Focus On Middle School Astronomy 3rd Edition Preview Booklet* where you can take our one semester unit study program for a test run!

The materials sampled in this book are taken from a full semester course, with two chapters from each part of the curriculum:

- The *Focus On Middle School Astronomy Student Textbook–3rd Edition* provides foundational science concepts presented in a way that makes it easy for students to read and understand. The many colorful illustrations make each chapter fun to look at and reinforce concepts presented.
- With two science experiments for each chapter, the *Laboratory Notebook* helps young students learn how to make good observations, an important part of doing science. Open-ended questions help students think about what they are learning, and information is provided to assist students with understanding what they observed while performing their experiments.
- The *Teacher’s Manual* includes instructions for helping students conduct the experiments, as well as questions for guiding open inquiry. The commonly available, inexpensive materials used for all the experiments can be seen in the complete materials lists included in this booklet.
- Using the *Lesson Plan* makes it easy to keep track of daily teaching tasks. A page for each chapter in the *Student Textbook* has the objectives of the lesson and questions for further study that connect science with other areas of knowledge, such as history; philosophy; art, music, and math; technology; and language. Forms are included for students to use to do a review of material they’ve learned and to make up their own test for the chapter. Also included are icons that can be copied onto sticker sheets and used to help plan each day of the week.
- With the *Study Notebook* students learn to use critical and creative thinking while exploring their ideas about science. Thought questions are provided, and students are invited to take ownership of their learning by coming up with more questions and by doing research into their areas of interest.
- The one final and two midterm *Quizzes* are self-explanatory. For those who are not fans of quizzes, students can use the self-test at the end of the *Lesson Plan* instead.
- Another type of teaching aid is provided in the *Graphics Package*, which has two full-color images from each chapter of the *Student Textbook*. These graphics can be used to create additional teaching aids, such as flash cards, wall posters, PowerPoint lectures, or overhead projections.

FOCUS  **ON**

Grades 5-8

MIDDLE SCHOOL



3rd Edition



Rebecca W. Keller, PhD





Real Science-4-Kids

Illustrations: Janet Moneymaker

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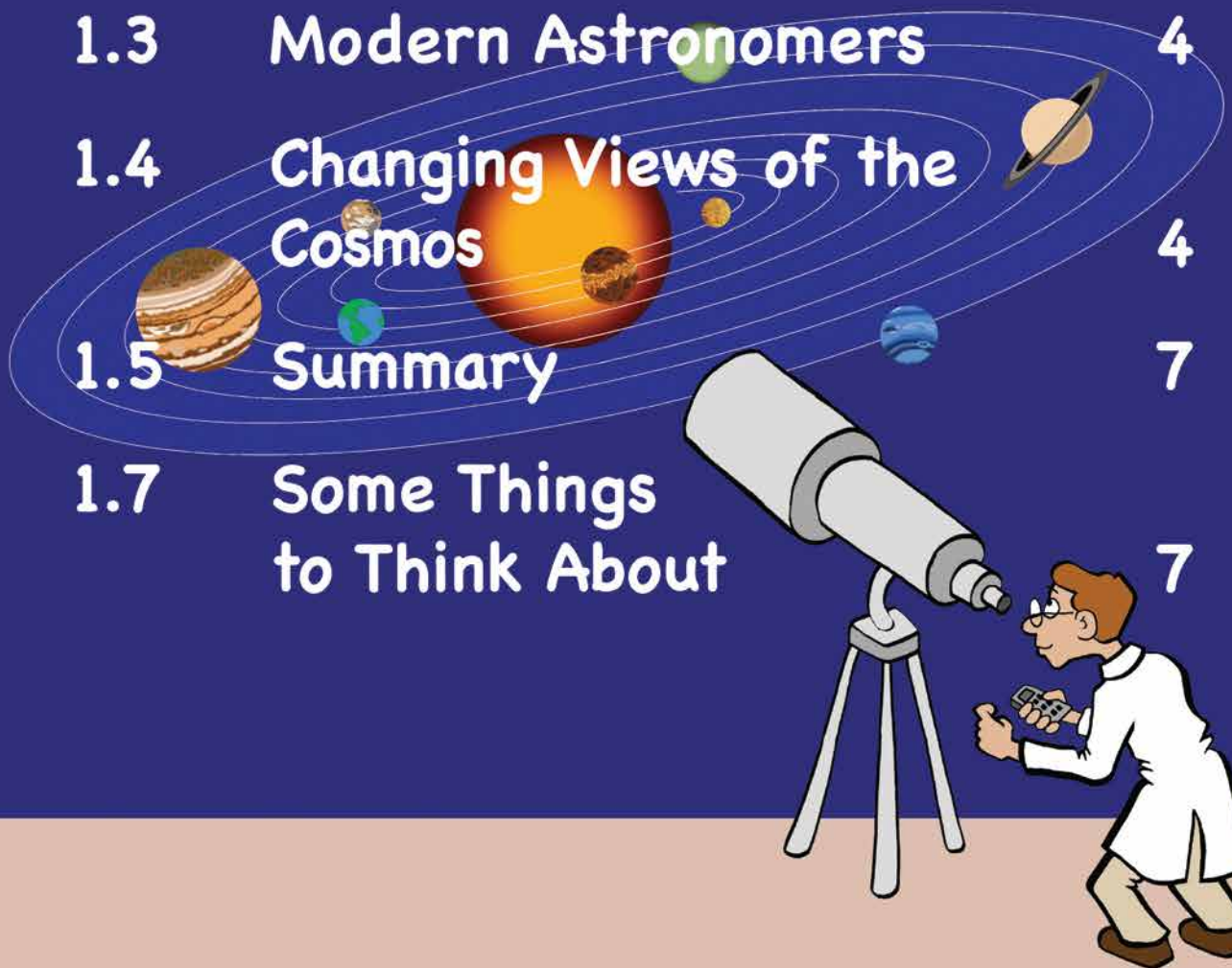
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1.1 Introduction

Astronomy is considered by many to be the oldest science. Since long before the invention of the telescope, human beings have been looking at the stars. The word astronomy comes from the Greek words *aster* which means “star” and *nomas* which means “to assign, distribute, or arrange.” The word astronomy literally means “to assign or arrange the stars.”

Astronomers are scientists who assign names to all the **celestial bodies** in space, including stars, and study how they exist and move in space.

1.2 Early Astronomers

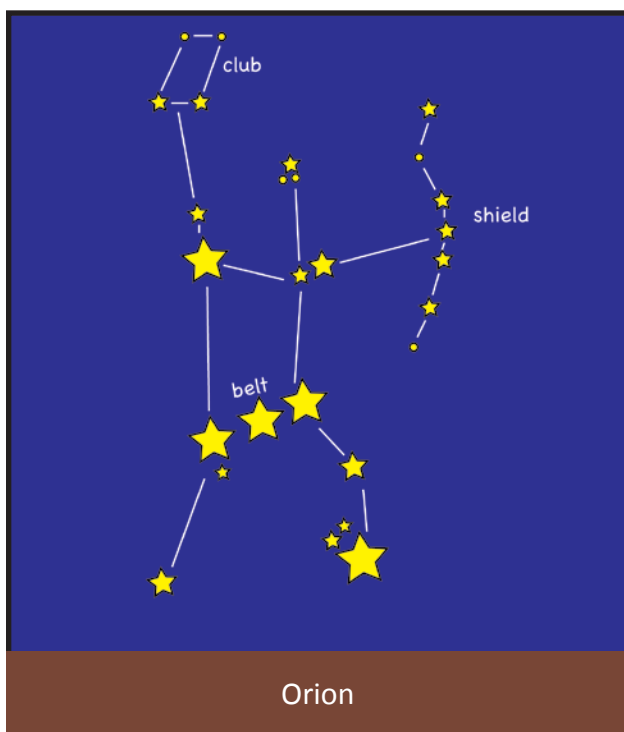
The earliest recorded history reveals an interest in the stars. Cave drawings show primitive humans recording observations from the skies, and later the Babylonians recorded detailed planetary positions, eclipses, and other astronomical observations. Egyptian and Greek observers expanded on the information collected by the Babylonians. Some people think that the pyramids in Egypt align with the stars of **Orion** and this suggests that the Egyptians acquired sophisticated abilities to observe the sky. The Ancient Greeks were the first astronomers to add mathematics to astronomy.



Many early civilizations used the stars and the movements of celestial bodies as tools to measure time. The Sumerians of Babylonia used the **phases of the Moon** to create the first lunar calendar, and the Egyptians, Greeks, and Romans copied and revised this calendar. Today our calendar is derived directly from the Sumerian calendar and is connected to the monthly and yearly orbits of the Moon and Earth.

On the other side of the ocean, the Incan and Mayan civilizations created sophisticated calendars by observing the planetary cycles. The Mayan calendar is circular and has aspects that relate the movement of the Sun, Moon, and planets.

Early astronomers named individual stars as well as groups of stars that form **constellations**. A constellation is any group of stars that fit together to form a pattern in the night sky. Some of the major constellations that come from Greek mythology are familiar to many people.



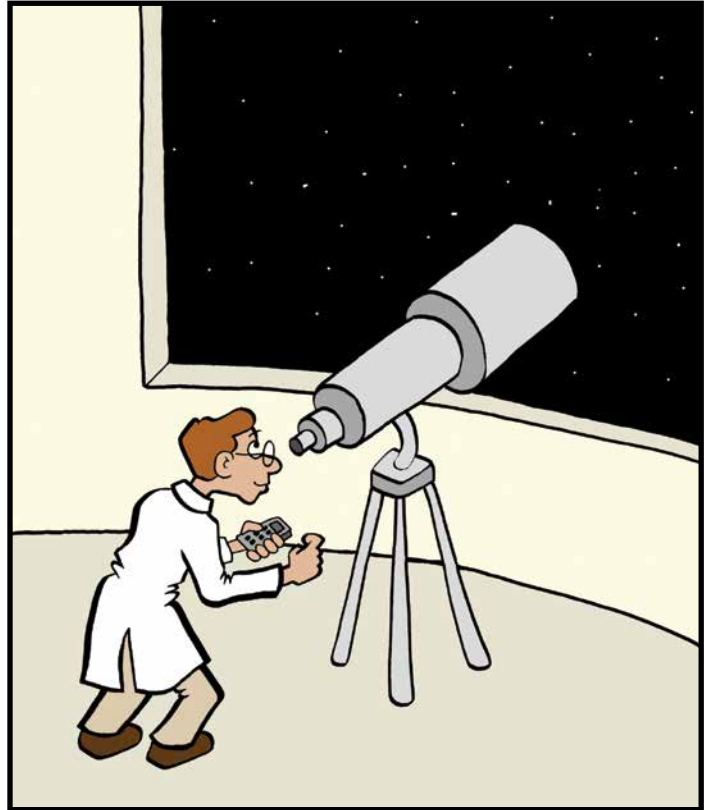
Orion the Hunter is a constellation of stars that can be seen from the **Northern Hemisphere** from December through March. Orion has a “belt” of three bright stars in a straight row. Once the “belt” is located, it is easy to find the “club” and “shield” by looking for neighboring stars.

The constellation names derived from Greek mythology have changed very little since 1000 BCE. There are currently 88 constellations that are recognized by the **International Astronomical Union (IAU)**, and over half of those were observed by the ancient Greeks!

1.3 Modern Astronomers

Today, astronomers can see many more stars than their ancient predecessors could. Modern astronomers can also see details about the planets and stars that were not visible in ancient times.

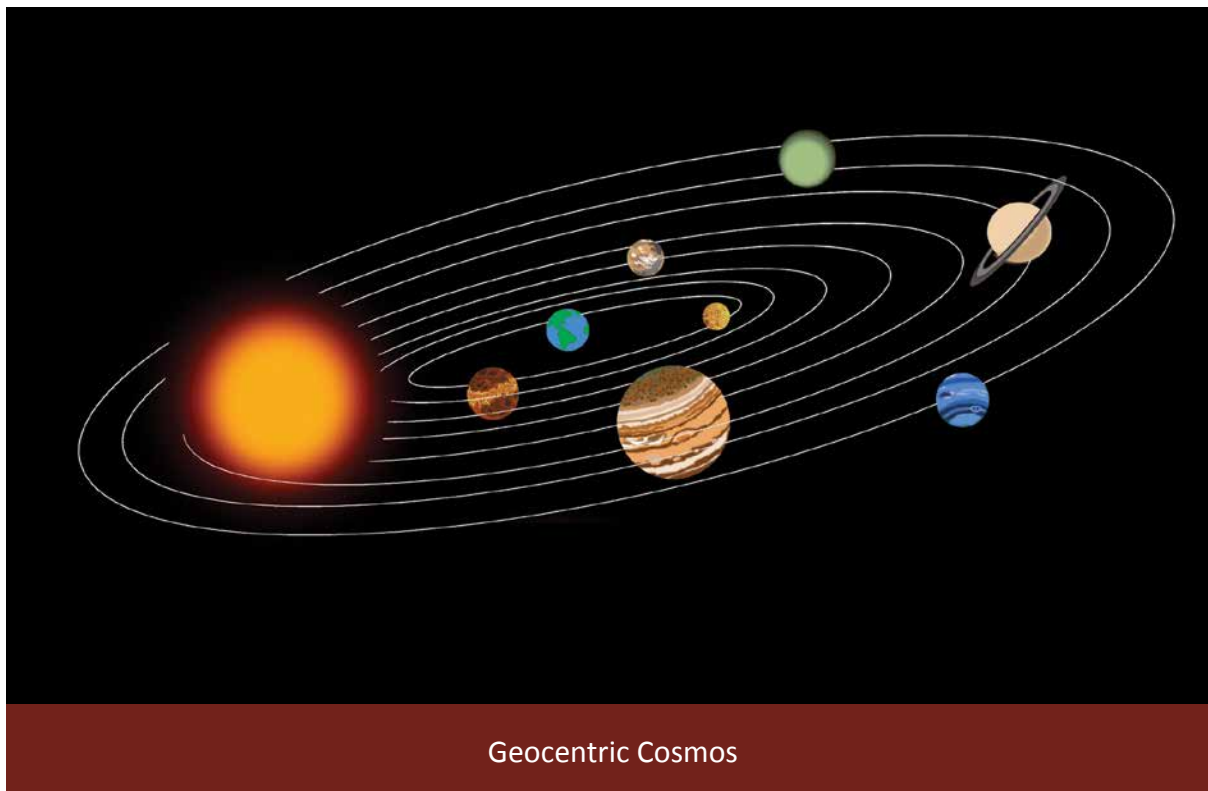
Telescopes, radios, and cameras are just some of the tools astronomers use when studying the planets and stars. Modern astronomers also use **chemistry** and **physics** to understand astronomical data. Understanding how planets move requires knowing the physics behind **gravity**, **inertia**, and **mass**. Understanding how stars give off heat and light energy requires knowing the chemistry behind nuclear reactions. And understanding how the Sun affects our weather requires knowledge of **magnetic and electric fields**. Modern astronomers not only have sophisticated tools to explore the universe, they also have centuries of complicated mathematics, chemistry, and physics to help them understand how the universe works.



1.4 Changing Views of the Cosmos

The practice of astronomy changed dramatically after the invention of the **telescope**, a scientific tool that uses lenses to magnify distant objects. In the 1600's **Galileo Galilei**, an Italian scientist considered to be the first modern astronomer, used the telescope to look at the planets. Galileo was also able to see the moons of Jupiter and the rotation of the Sun. Based on his observations, Galileo confirmed a radical new view of the **cosmos**. The cosmos, or **solar system**, includes our Sun and the planets around it.

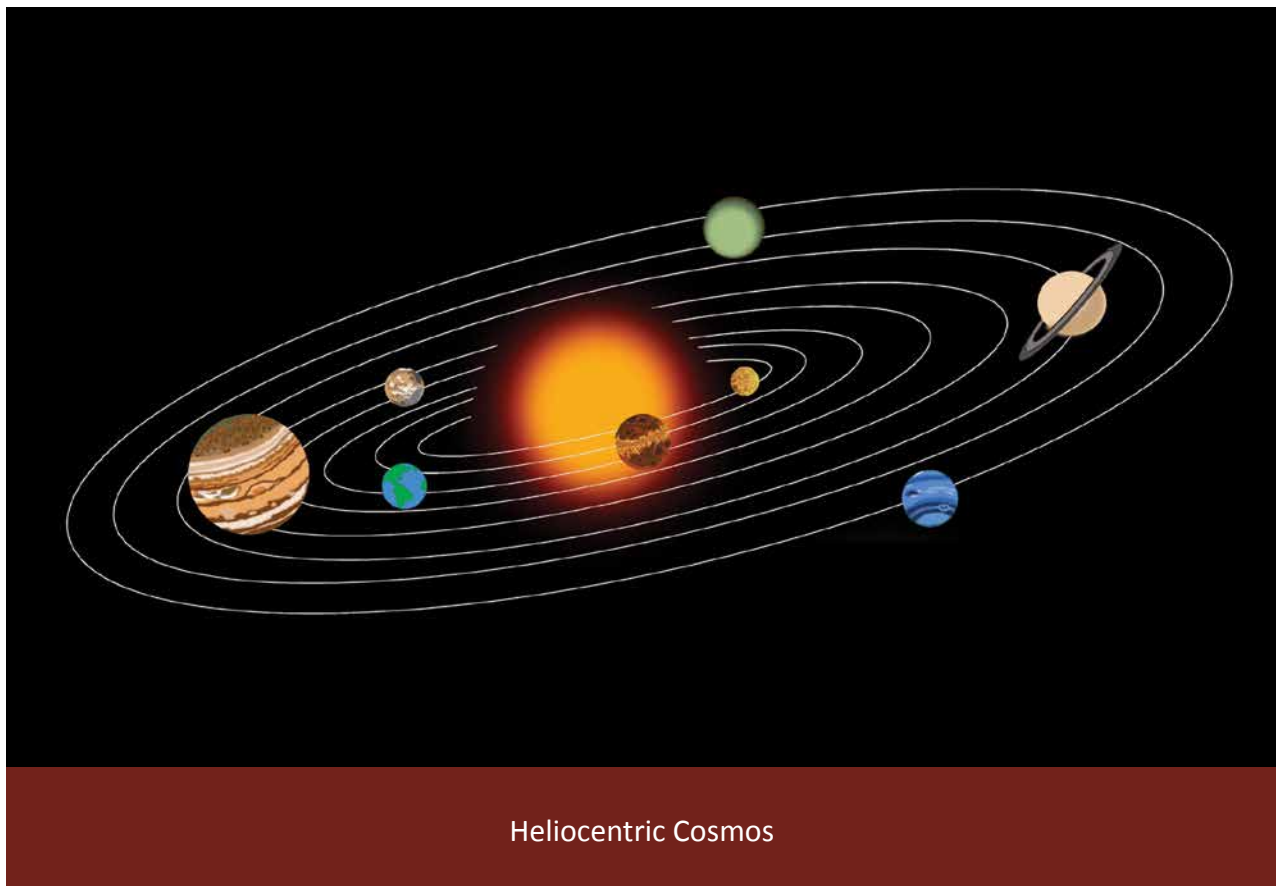
In ancient times most people believed that the Earth was the center of the universe. These ancients believed that the planets and the Sun moved in a circular **orbit**, or path, around the Earth. This view of the world is called **geocentric**. Geo comes from the Greek word *ge* which means “earth” or “land” and centric comes from the Greek word *kentron* which means “point” or “center.” A geocentric view is one that considers the Earth as the true center of the universe.



It is not hard to understand why this view was held. Stepping outside at any given time of the day and observing the motion of the Sun, it looks like the Sun rotates around the Earth. A geocentric view of the universe was first proposed by **Aristotle** (384-322 BCE) and was the dominant belief held by most people for many centuries.

However, not everyone agreed with Aristotle. **Aristarchus of Samos**, who lived from 310-230 BCE, was an expert Greek astronomer and mathematician who did not believe that the Sun and planets revolved around the Earth. He was the first to propose a **heliocentric cosmos**. The word **heliocentric** comes from the Greek word *helios* which means “sun.” A heliocentric cosmos is a view of the universe with the Sun as the central point and the Earth and planets orbiting the Sun.

Although today we know that Aristarchus was right, his proposal was rejected by his colleagues because it seemed to contradict everyday observation. If the Earth was not stable (central and not moving), how did everything not bolted down keep from flying off the Earth as it rotated around the Sun? The physics of Aristotle was the scientific consensus view during Aristarchus' lifetime and that meant that a heliocentric cosmos would have violated the laws of physics! It was almost 2000 years before the idea of a heliocentric cosmos was reintroduced by **Nicolaus Copernicus** (1473-1543 CE) and confirmed by the scientific observations of Galileo.



Today, astronomers do not believe in a geocentric cosmos and know that our Earth orbits the Sun and that we live in a heliocentric solar system. Modern technologies, a deeper understanding of physics, and a willingness to challenge prevailing scientific theories were needed before the geocentric view could be replaced by the more accurate heliocentric view of the cosmos.

1.5 Summary

- **Astronomy** is the field of science that studies **celestial bodies** and how they exist and move in space.
- Early **astronomers** were able to map the movements of the planets and stars and used celestial motions to create calendars.
- Modern astronomers use **chemistry** and **physics** together with modern technologies to study the universe.
- Ancient peoples once believed in a **geocentric cosmos**, or Earth-centered universe. Today we know that we live in a **heliocentric solar system** with the Sun at the center.

1.6 Some Things to Think About

- What do you think would make it likely that astronomy is the oldest science?
- When it gets dark, go outside and look at the stars. How many do you think you can see?
- Find a group of stars that reminds you of an object—maybe an animal. This can be your own personal constellation. What name would you give to it?
- Now that astronomers have advanced telescopes and spacecraft, do you think they have discovered everything there is to know about the stars? Why or why not?
- Why do you think it was difficult for people to accept the idea of a heliocentric cosmos?
- Do you think that as we explore space, we might find new ideas that would change the way we look at the cosmos? Why or why not?

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7.1 Introduction

In a previous chapter we examined the eight planets of our solar system. We saw that the planets are divided into two broad categories: **terrestrial planets** and **Jovian planets**. We discovered that the four planets closest to the Sun are terrestrial planets made mostly of rock, like Earth, and the four outer planets are Jovian planets made mostly of gases, like Jupiter.

In this chapter we will take a closer look at our **solar system**. A solar system is a group of celestial bodies and the one or more suns they orbit. Our solar system has eight planets orbiting a single sun.

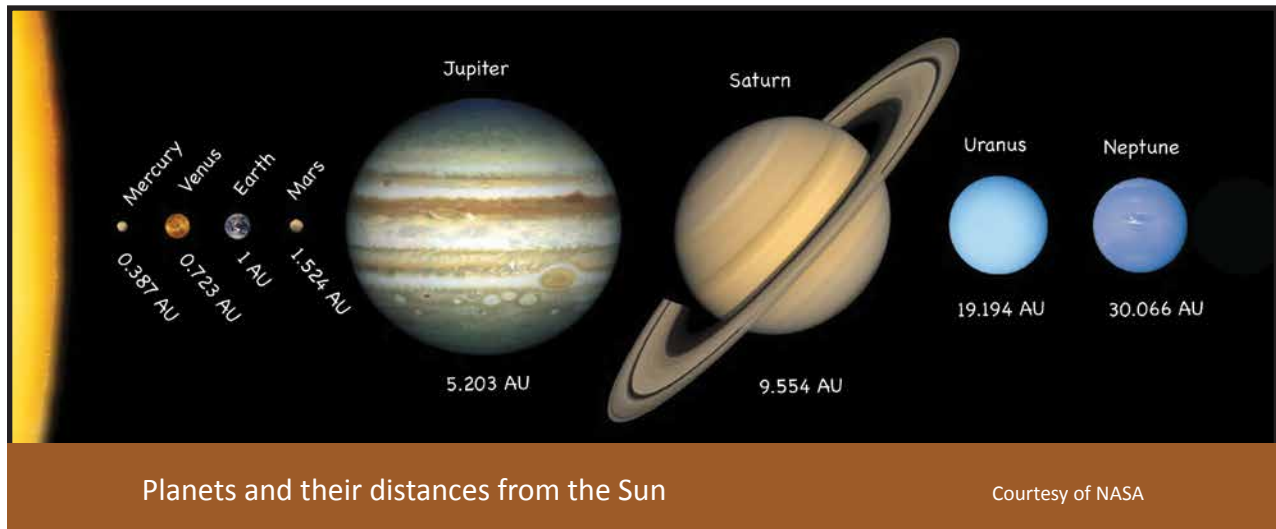
7.2 Planetary Position

If we look at our entire system of planets, we see that the Sun is in the center of the solar system with the planets orbiting the Sun in a particular order. Mercury orbits closest to the Sun followed by Venus, Earth, Mars, Jupiter, Saturn, Uranus, and finally Neptune.

Because the distance from the Sun to the planets is very large, astronomers measure planetary distances in units called **astronomical units**, or **AU**. One AU is equal to 149,597,870.7 kilometers (92,955,801 miles). To get an idea of just how far one AU is, imagine that you had to drive from the Earth to the Sun (1 AU) in your car going 97 kilometers per hour (60 miles per hour). To get to the Sun this way, it would take 1,549,263 hours or 64,552 days, or about 177 years!



Using AU to measure the distance of the planets from the Sun, you can see that the four terrestrial planets are relatively close together. All of the terrestrial planets are less than 2 AU from the Sun, with Mercury the closest at 0.387 AU and Mars the farthest at 1.524 AU.



In between the terrestrial planets and the Jovian planets is a huge 4 AU space. Jupiter, the closest of the Jovian planets, is 5.2 AU from the Sun, and Neptune, the farthest of the Jovian planets, is an incredibly far 30 AU from the Sun!

7.3 Planetary Orbits

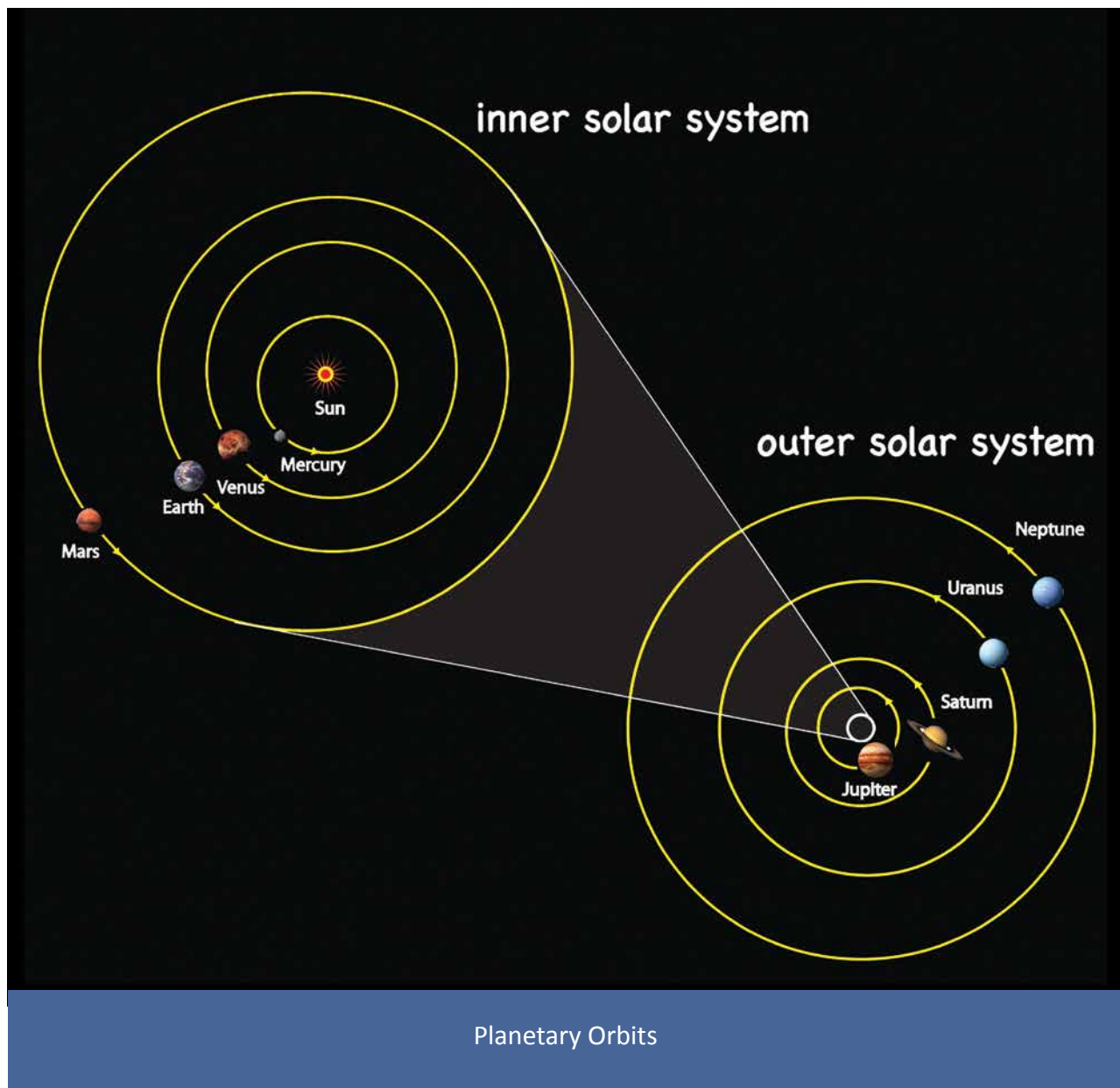
An **orbit** is defined as the gravitational curved path of one celestial body moving around another celestial body. In other words, the orbit is the “road” a planet travels as it circles the Sun, and the Sun’s gravity is what holds the planet in its orbit.

All of the planets orbit the Sun in a counterclockwise direction, and if we take a look straight down at the planetary orbits, we discover that the orbits look almost circular. They are not fully circular and so are technically **elliptical**, but they are not as elliptical as many people think they are.

One common misconception about Earth’s seasons is that it is Earth’s orbit that gives us the summer and winter months. However, by examining Earth’s orbit it’s easy to see that the difference between Earth’s farthest and closest distance from the Sun is very small. In other words, as Earth orbits the Sun, Earth’s closest position to the Sun is not significantly

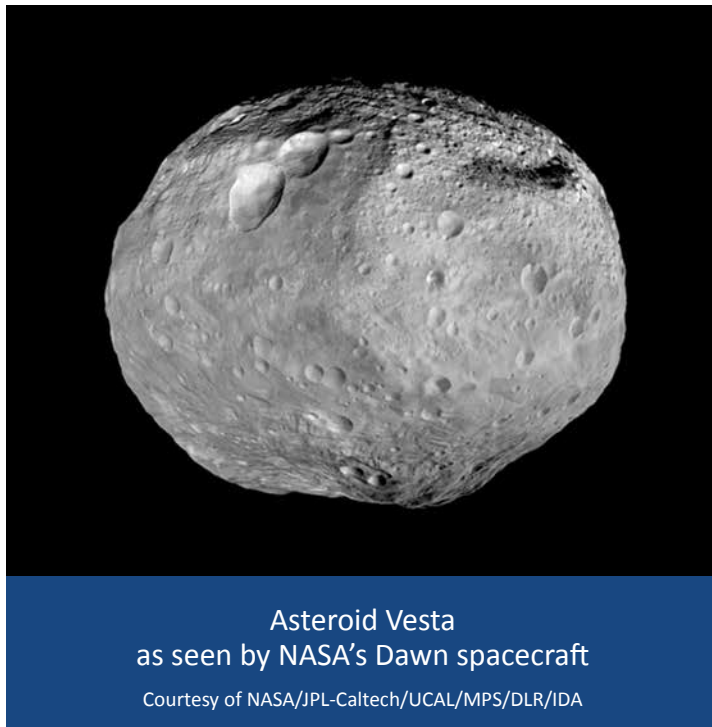
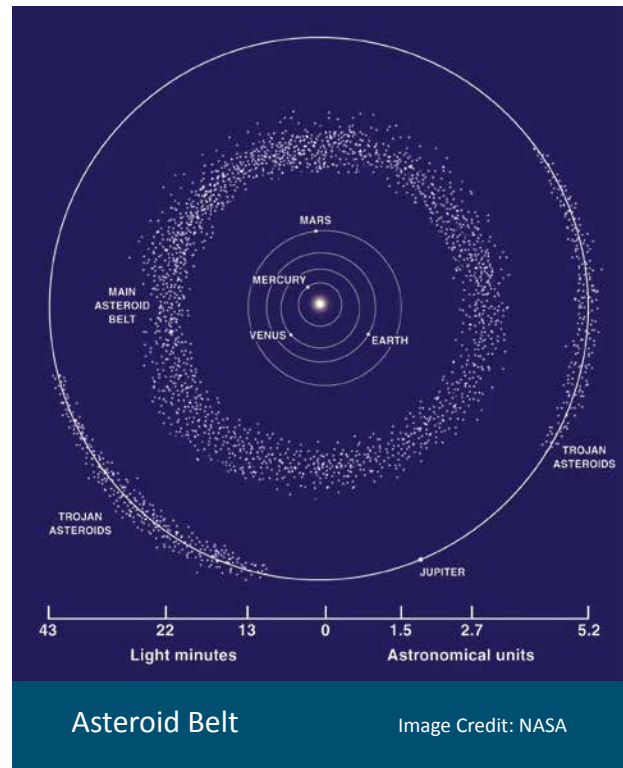
different from its farthest position from the Sun. The seasons are determined by Earth's tilt on its **axis**, not its distance from the Sun. One pole of the Earth is tilted toward the Sun in the summer months and away from the Sun in the winter months.

Because there is such a large gap between Mars and Jupiter, astronomers place the planets in two groups. The terrestrial planets make up the **inner solar system** and the Jovian planets make up the **outer solar system**.



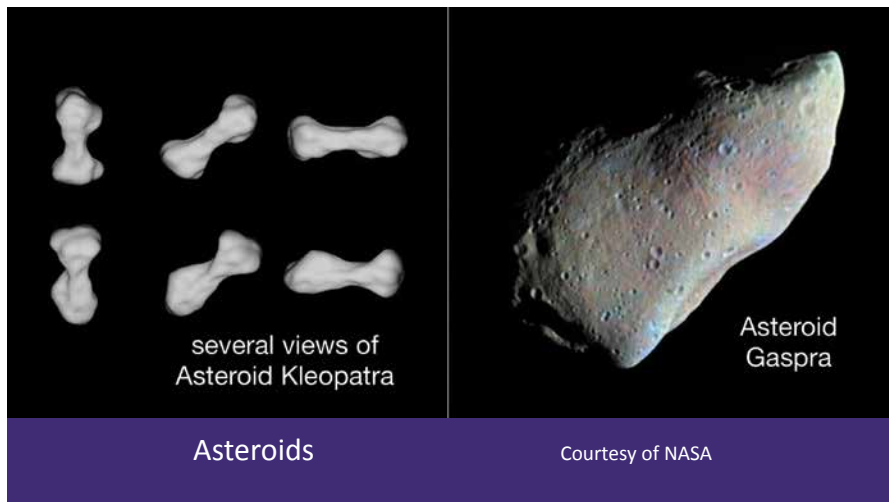
7.4 Asteroids, Meteorites, and Comets

The gap between Mars and Jupiter is not empty space but instead is home to millions of **asteroids**. The word asteroid comes from the Greek word *aster* which means “star.” An asteroid is a small celestial body made mostly of rock and minerals, but when an asteroid is viewed in the sky, it can resemble a small star. However, asteroids are not real stars like our Sun because they are only reflecting light from the Sun rather than emitting their own light. The asteroids between Mars and Jupiter occupy an area known as the **Asteroid Belt**. Asteroids also exist outside the Asteroid Belt.



Asteroid Vesta
as seen by NASA's Dawn spacecraft
Courtesy of NASA/JPL-Caltech/UCAL/MPS/DLR/IDA

Scientists estimate that there are 1-2 million asteroids in the Asteroid Belt that are more than 1 km (.62 mi.) in diameter and millions more that are smaller. A few are much larger, like **Asteroid Lutetia** which is 100 km (62 mi.) in diameter and **Asteroid Vesta** which is about 525 kilometers (326 mi.) in diameter. Asteroids often have irregular shapes and some have small moons orbiting them.

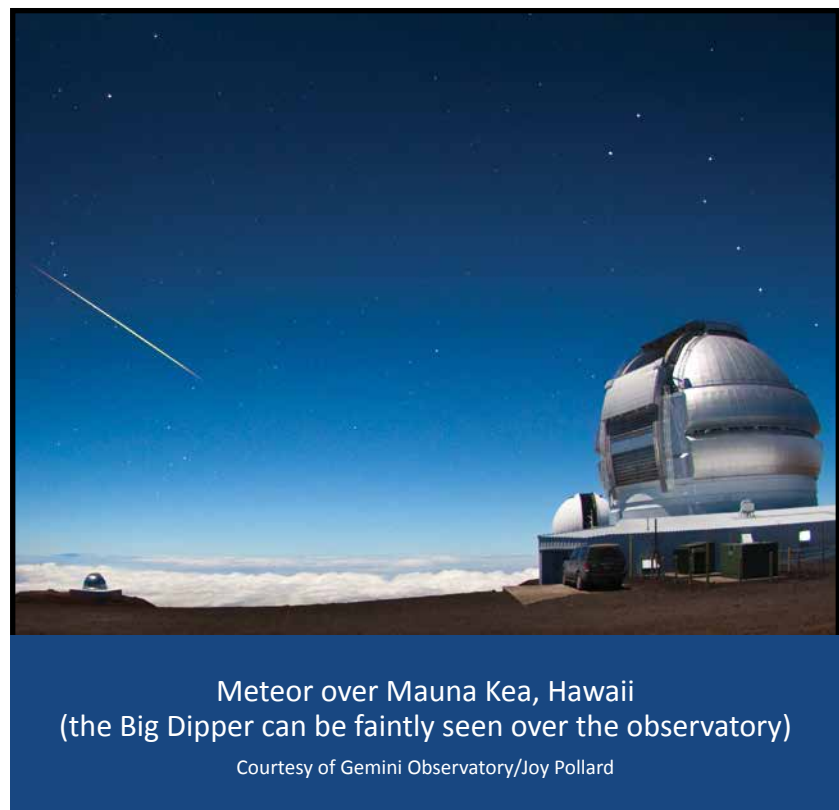


Asteroid Gaspra is an asteroid with an elongated body, and **Asteroid Kleopatra** has a dog bone shape.

Although there are great distances between asteroids in the Asteroid Belt, asteroids sometimes collide. Because

asteroids are moving at great speeds, when they collide, the force of the impact is more than sufficient to shatter rock. Many asteroids have craters on their surface as a result of these high impact collisions.

Asteroids are also found outside the Asteroid Belt and do occasionally impact Earth. Small asteroids, if they cross into the Earth's atmosphere, are called **meteors**. They often break up into smaller pieces and burn up before reaching the surface of the Earth. Meteors that reach the Earth's surface are called **meteorites**. Depending on their composition, meteorites are called "stones" or "stony irons."



Meteor over Mauna Kea, Hawaii
(the Big Dipper can be faintly seen over the observatory)

Courtesy of Gemini Observatory/Joy Pollard

Scientists are researching asteroids to find out if they contain materials that could be mined in the future. In 2005 the Japan Aerospace Exploration Agency (JAXA) spacecraft Hayabusa landed on the asteroid Itokawa, and in 2010 Hayabusa brought back to Earth a small sample of asteroid dust for analysis. It appears that rather than being solid rock, Itokawa consists of a group of rocks held together by gravity. There are also missions being planned by several countries to see if it is possible to use a controlled impact to change the orbit of an asteroid, the idea being that if an asteroid is headed toward a collision with Earth, it could be deflected so it would miss Earth.

A **comet** is another type of celestial body found in our solar system. Comets are large chunks of dirty ice. Some comets have an orbit that brings them close to the Sun. When this happens, the Sun's heat **vaporizes** some of the ice, changing the frozen water and frozen gases directly from the solid state to the gaseous state and creating long tails of gas and dust particles that are visible when the particles reflect light from the Sun.

Two famous comets that can be easily seen when their orbits bring them close to Earth are **Halley's Comet** and the **Hale-Bopp Comet**. In 1986 as Halley's Comet passed close to Earth, several spacecraft were able to get close enough to gather information about it. Halley's Comet has a potato-shaped center about 15 kilometers (9 miles) long and a long tail made of various frozen gases such as carbon dioxide, methane, and ammonia. In 1997 Hale-Bopp Comet passed by Earth, displaying a beautiful fluorescent blue-white tail made of ionized carbon monoxide molecules.



In 2004 the European Space Agency (ESA) launched the **Rosetta spacecraft** whose mission was to orbit Comet 67P/Churyumov-Gerasimenko and send data back to Earth. It took ten years for Rosetta to arrive at the comet, and Rosetta orbited the comet until the mission ended in 2016. Rosetta also released a lander to the comet's surface, but when it landed, it didn't work. Rosetta collected data as the comet's orbit took it closer to the Sun, enabling scientists to observe the comet as it was "activated" by energy from the Sun, causing the frozen gases to begin to vaporize.



7.5 Habitable Earth

Within our solar system, as far as we know, there are no other planets, moons, or other celestial bodies that can support life as we know it. Scientists have long been searching for other planets like Earth that could be home to extraterrestrial life — life that exists outside the Earth's system. But so far, science fiction novels are the only place extraterrestrial life exists.

What makes Earth uniquely habitable?

One unique feature of Earth is our atmosphere. Our transparent atmosphere helps maintain the necessary balance of water, gas, and energy. No other atmosphere like Earth's has yet been found to exist.

All known life is dependent on liquid water, and the Earth is located at just the right distance from the Sun for liquid water to exist. A little too close and our oceans would boil, leaving no water for life. A little too far away and Earth and our oceans would freeze and be too cold to support life.

The Moon stabilizes Earth's tilt, and the large planets, Jupiter and Saturn, shield the inner solar system from receiving too many impacts by comets. So both the Moon and the planets help stabilize Earth's habitability.

Scientists are using many different space telescopes, probes, and landers to look for planets outside our solar system that are at the right distance from their sun to have liquid water and that might have the other conditions necessary for life as we know it. Within our solar system, scientists think they may have discovered liquid water below the ice on a moon of Jupiter called Europa and a moon of Saturn called Enceladus, but it is not yet known if some form of life exists on either moon. Some scientists think that microbes such as archaea might be able to live in the extreme conditions on these moons.

7.6 Summary

- The **terrestrial planets** (Mercury, Venus, Earth, and Mars) make up the **inner solar system** and are “close” to the Sun (less than 2 **AU**).
- The **Jovian planets** (Jupiter, Saturn, Uranus, and Neptune) make up the **outer solar system**, and are “far” from the Sun (more than 5 **AU** from the Sun).
- Each of the eight planets has a slightly **elliptical orbit** (very close to circular).
- **Asteroids** exist throughout the solar system, but most are found in the **Asteroid Belt** between Mars and Jupiter.
- Earth is the only known habitable celestial body in our solar system and is uniquely suited for life.

7.7 Some Things to Think About

- What do you remember about the planets?
- What is an AU?
Where does the measurement come from?
Why do astronomers use it?
- Do you think there's a reason why the terrestrial planets are grouped together and the Jovian planets are grouped together?

Do you think there's a reason why the small planets are close to the Sun and the big planets are farther away?

What do you think these reasons might be?

- What is the difference between a comet, an asteroid, a meteor, and a meteorite?
- Why do you think people would want to have a mine on an asteroid?
- What kinds of information do you think scientists learned from the Rosetta mission?
- Do you think if a moon of another planet had liquid water covered by a shell of ice, some kind of life might exist there? Why or why not?

If so, do you think it would be the same kind of life as on Earth? Why or why not?

- If you were an astronomer looking for life in the universe, where would you look? What would you look for? How would you know if you had found a life form?

FOCUS  **ON**

Grades 5-8

MIDDLE SCHOOL



Laboratory Notebook

3rd Edition

Rebecca W. Keller, PhD





Real Science-4-Kids

Illustrations: Janet Moneymaker

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Keeping a Laboratory Notebook

A laboratory notebook is essential for the experimental scientist. In this type of notebook, the results of all the experiments are kept together along with comments and any additional information that is gathered. For this curriculum, you should use this workbook as your laboratory notebook and record your experimental observations and conclusions directly on its pages, just as a real scientist would.

The experimental section for each chapter is pre-written. The exact format of a notebook may vary among scientists, but all experiments written in a laboratory notebook have certain essential parts. For each experiment, a descriptive but short *Title* is written at the top of the page along with the *Date* the experiment is performed. Below the title, an *Objective* and a *Hypothesis* are written. The objective is a short statement that tells something about why you are doing the experiment, and the hypothesis is the predicted outcome. Next, a *Materials List* is written. The materials should be gathered before the experiment is started.

Following the *Materials List*, the *Experiment* is written. The sequence of steps for the experiment is written beforehand, and any changes should be noted during the experiment. All of the details of the experiment are written in this section. All information that might be of some importance is included. For example, if you are to measure 236 ml (1 cup) of water for an experiment, but you actually measured 300 ml (1 1/4 cup), this should be recorded. It is hard sometimes to predict the way in which even small variations in an experiment will affect the outcome, and it is easier to track down a problem if all of the information is recorded.

The next section is the *Results* section. Here you will record your experimental observations. It is extremely important that you be honest about what is observed. For example, if the experimental instructions say that a solution will turn yellow, but your solution turned blue, you must record blue. You may have done the experiment incorrectly, or you might have discovered a new and interesting result, but either way, it is very important that your observations be honestly recorded.

Finally, the *Conclusions* should be written. Here you will explain what the observations may mean. You should try to write only valid conclusions. It is important to learn to think about what the data actually show and what cannot be concluded from the experiment.

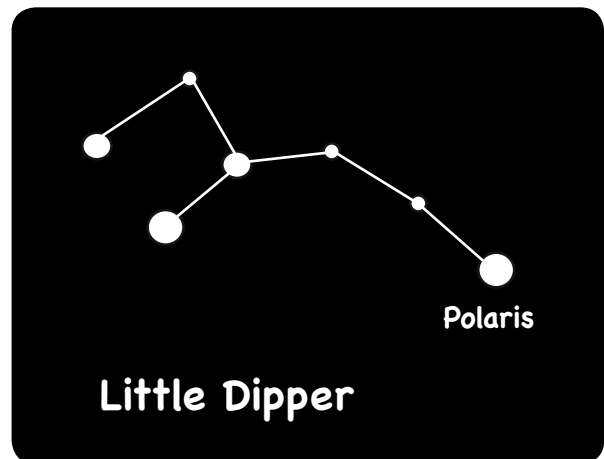
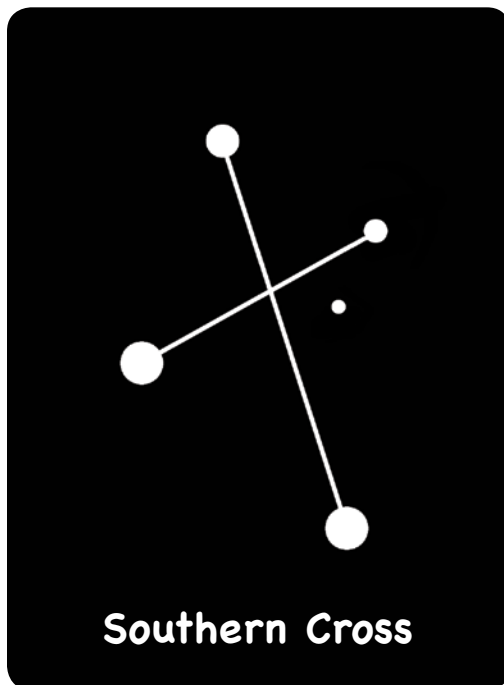
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Experiment 1

Constellations



Introduction

Find some constellations and see if you can use the stars to tell which direction you are going.

I. Think About It

- ❶ Do you think it was important for ancient people to be able to recognize different stars? Why or why not?

- ❷ Why do think a star is in a different place in the sky in the morning than at night?

- ❸ Do you think stars move from one constellation into another? Why or why not?



- ④ Do you think people are discovering new constellations all the time? Why or why not?

- ⑤ If you are in the Northern Hemisphere and you use the North Star to find north, how would you find south?

- ⑥ Do you think sailors were able to find their way at sea before compasses were invented? Why or why not?



II. Experiment 1: Constellations

Date _____

Objective _____

Hypothesis _____

Materials

pencil
flashlight
compass

A clear night sky away from bright lights is needed.

EXPERIMENT

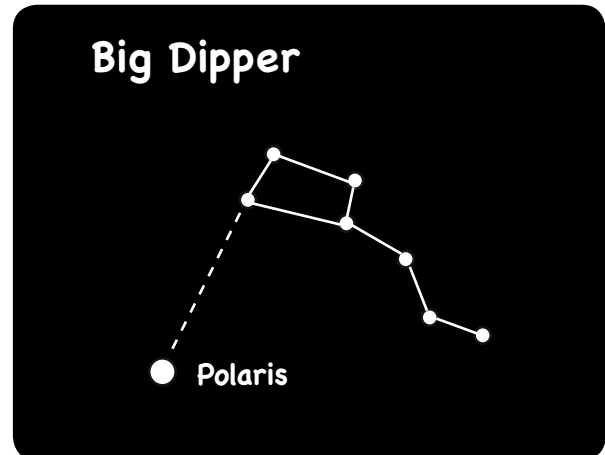
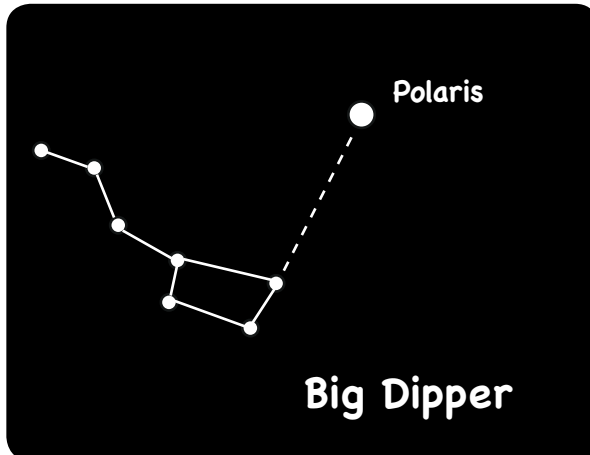
Record your physical location, city, state, or country, whether you are in the Northern or Southern Hemisphere, and the month.

Northern Hemisphere

Location	
Hemisphere	
Month	



- 1 In the evening on a clear night away from city lights go outside and, without using a compass, locate “north.” To do this you will need to find the Big Dipper. The Big Dipper is a set of stars that form the shape of a “dipping spoon.” (The Big Dipper is not an official constellation but is called an *asterism* — a small group of stars.) The two stars on the end of the dipping spoon point to the star Polaris.

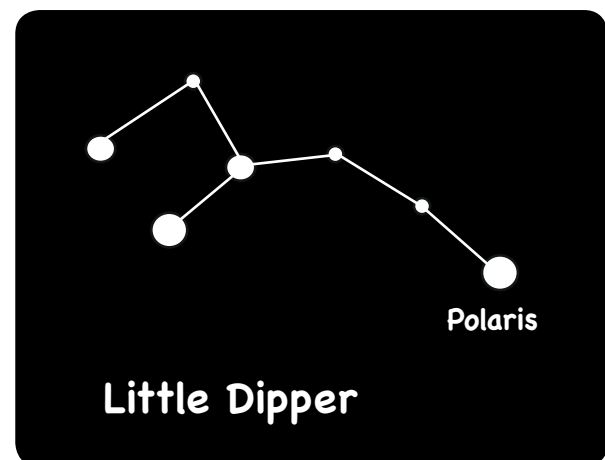


Polaris is the “North Star,” and when you turn towards Polaris, you are pointing “north.” It doesn’t matter how the Big Dipper is oriented in the sky, the two end stars always point to the North Star. The North Star is the only star in the sky that doesn’t move (much). All of the constellations appear to move around the North Star. Once you find the North Star you can find nearby constellations.

- 2 Now that you have found the North Star, try to find the constellation called the “Little Dipper.”

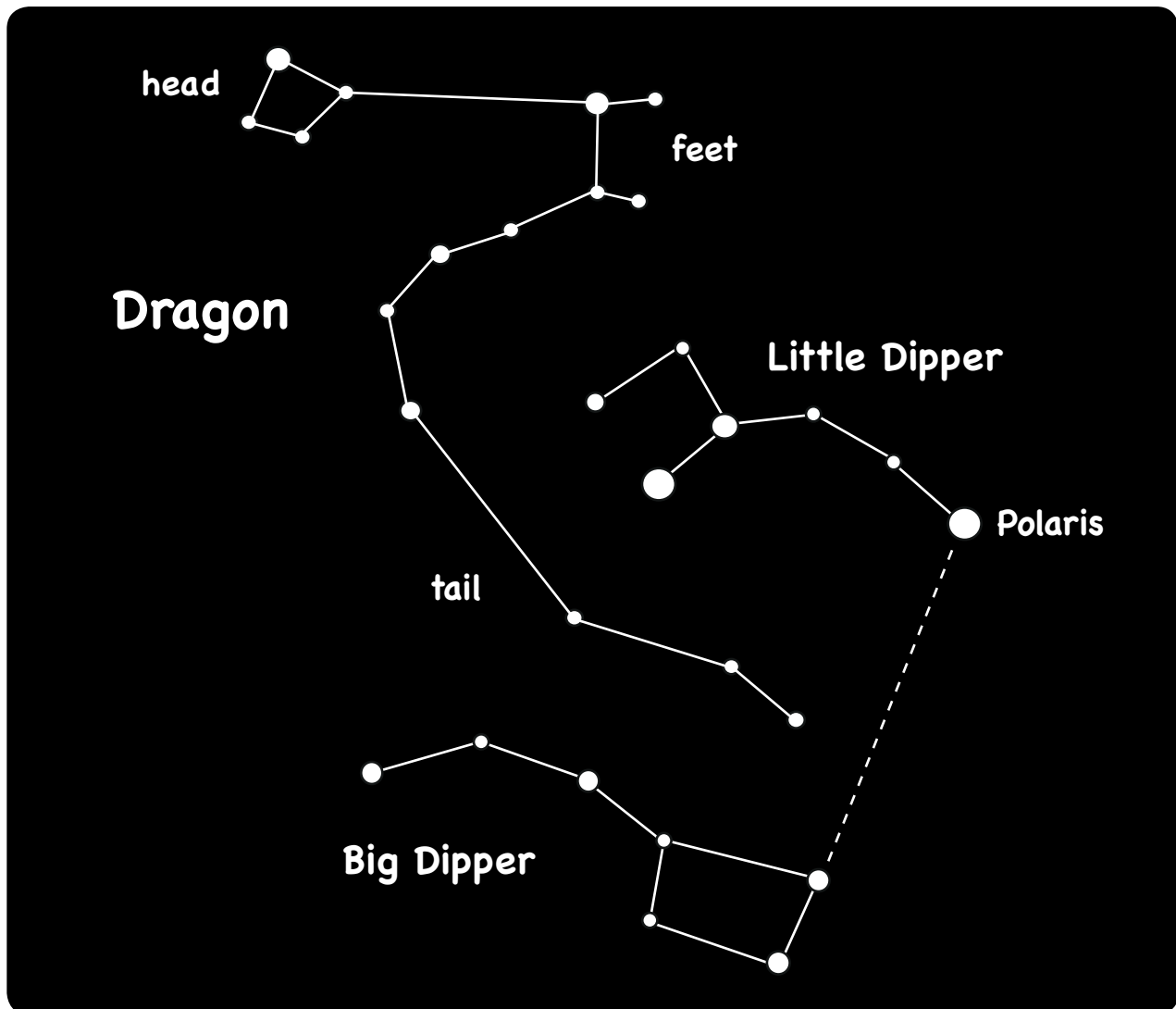
Polaris forms the end of the handle of the Little Dipper.

- 3 In the following box, draw the Little Dipper as it looks to you.



Little Dipper

- 4 Try to locate the “Dragon.” The Dragon constellation is between the Big Dipper and Little Dipper.



- 5 On the following page, draw the Dragon constellation as you see it.



Draw the Dragon constellation as you observe it.

- ⑥ Count the stars in the Dragon constellation in the image on the previous page. Compare this number with the number of stars you've recorded for the Dragon. Are they the same? Why or why not?

- ⑦ Find the North Star again and use your compass to see if the North Star really is above the North Pole.

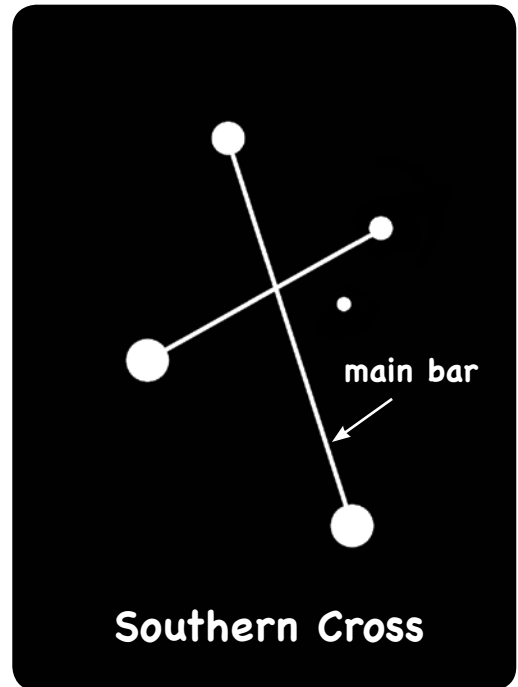


EXPERIMENT

Southern Hemisphere

The South Pole doesn't have a star directly over it like the North Pole does, but you can still find south using the stars.

- ❶ In the evening on a clear night away from city lights go outside. Look toward the south to find the Southern Cross constellation, also called Crux. It is a small, bright constellation of four stars that are close together. You may see two crosses near each other. The Southern Cross is smaller and has brighter stars. It also has a dimmer fifth star tucked in between two of its arms. The larger, dimmer cross is called the False Cross and is an asterism rather than a constellation.
- ❷ While looking at the Southern Cross, follow with your eyes the main bar of the cross (the line between the two stars that are farthest apart).
- ❸ Now imagine you are extending the main bar downward and adding 4 1/2 times to its length. By doing this you will arrive at a point in the sky called the South Celestial Pole which is directly above the South Pole.
- ❹ From the South Celestial Pole, lower your eyes straight down to the horizon. The point you are looking at will be south.
- ❺ Using your compass, see how close you came to finding south.
- ❻ Record your results on the next page.



Results - Finding south by using the Southern Cross

- ⑦ See if you can find both the Southern Cross and the False Cross and then draw them as you see them.

The Southern Cross and the False Cross



III. Conclusions

Summarize how easy or difficult it was to find the constellations you were looking for. Do you think you could use these stars for navigation? What role, if any, does your physical location and the month you made these observations have on your results? What did you observe about the night sky that you hadn't noticed before?

[illegible]

IV. Why?

In ancient times people were very observant of the world around them. There were no city lights, so they could see the stars very clearly. They noticed that there was one star that didn't seem to change position over the course of the night and that all the other stars seemed to rotate around it. This star is now called the North Star.

Before the invention of the compass, people in the Northern Hemisphere were able to determine in which direction they were traveling at night by looking at the position of the North Star. If it was directly in front of them, they were going north; directly behind them, they were going south; to the right of them, they were going west; and to the left of them, they were going east.

Although the Southern Cross is not directly over the South Pole, ancient people discovered how it could be used in a similar manner to determine which way was south. Then the other directions could be found.

The International Astronomical Union (IAU) is an organization that holds meetings where astronomers from all over the world can get together to share ideas and research. The IAU is also the organization that gives official names to celestial bodies that are discovered. The IAU decided that it would be helpful to have an official set of constellations and in 1930 came up with the current list of 88 constellations. Half of these constellations come from the ancient Greeks who described them long ago.



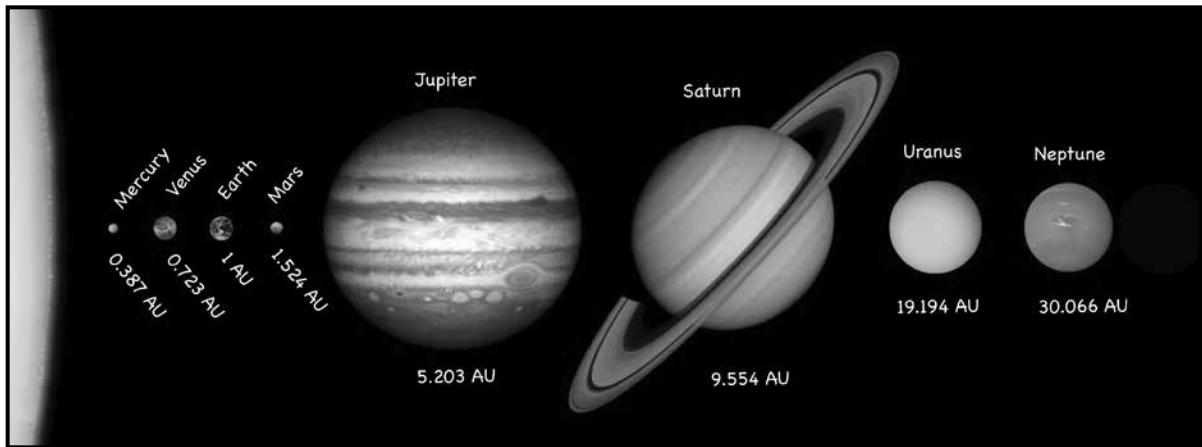
V. Just For Fun

Use online or library resources to find more constellations that you can see from the area where you live. Pick your favorite three constellations. Go outside on a clear night, find the constellations, and draw them as you see them.

Favorite Constellations

Experiment 7

Modeling Our Solar System



Introduction

Make a model of the planetary orbits of our solar system.

I. Think About It

- ❶ What do you think Earth would be like if it were in Mercury's orbit?

- ❷ Do you think life as we know it could exist on Jupiter? Why or why not?

- ❸ What do you think life on Earth would be like if it orbited two suns at the same time?



- ④ What do you think it would be like if Earth's orbit was long and narrow instead of being almost round?

- ⑤ What do you think would happen if some planets orbited the Sun in a clockwise motion and others moved counterclockwise?

- ⑥ Why do you think planetary orbits are almost circular?



II. Experiment 7: Modeling Our Solar System

Date _____

Objective _____
_____**Hypothesis** _____

_____**Materials**

8 objects of different sizes to represent the planets
ruler (in centimeters)
marker
large flat surface for drawing — 1 x 1 meter (3 x 3 feet), such as a
large piece of cardboard or several sheets of construction paper
large open space at least 3 meters (10 feet) square
push pin
piece of string one meter (3 feet) long
tape

EXPERIMENT

- ❶ Find eight objects to represent the planets. Refer to the textbook illustration for the relative size of the planets and choose your objects to represent these sizes.
- ❷ Take the cardboard and mark the center with a marker. This represents the position of the Sun.
- ❸ Using the push pin, fix the string to the center mark of the cardboard.
- ❹ Measure 10 cm from the center and put a mark there. Wrap the loose end of the string around the marking pen so when the string is stretched out, the marking pen will be at the 10 cm mark. With the marker point touching the cardboard, draw a circle around the center mark. This is the orbital path for Earth.



- 5 Draw concentric circles for the first 5 planetary orbits (Mercury through Jupiter) using the distances listed below. You will need to adjust the length of the string for each orbit.

Planet	Distance from Center
Mercury	4 cm
Venus	7 cm
Earth	10 cm
Mars	15 cm
Jupiter	50 cm
Saturn	90 cm (3 ft)
Uranus	190 cm (6 ft)
Neptune	300 cm (10 ft)

- 6 Place the objects you have chosen as your planetary models for the first 5 planets at their corresponding orbital distance from the center.
- 7 For the last three orbits, measure the correct distance away from the center. Place the appropriate planetary model at the distance of its orbit.

Results

Observe your model of the solar system and compare it with the illustration in your *Student Textbook*. On the following page, note any similarities or differences between your model of the solar system and the illustration. What else can you observe about the solar system?



Similarities

Differences

[illegible]

[illegible]

IV. Why?

In this experiment you explored the orbital paths of the planets and how the planets are ordered in the solar system. An orbit is defined as the curved path that one celestial body follows as it travels around another celestial body. Although at one time it was thought that the Earth was the center of the universe and all the other celestial bodies orbited Earth, we now know that the Sun is the center of our solar system, making it a heliocentric system.

Basic physics tells us that bodies of mass have gravitational force, or gravity. The larger the body of mass, the more gravitational force it will have. The Sun is a very large body of mass and therefore has very strong gravitational force. Gravitational force keeps the planets in orbit around the Sun. The motion of the planets and the fact that the gravitational force of the Sun is constant are the things that keep the planetary orbits from collapsing towards the center of the solar system. The orbits of the planets are elliptical, but only slightly.

Mercury is in orbit closest to the Sun, and Neptune is farthest from the Sun. Measuring planetary distances is challenging because these distances are huge, and to show the distances in kilometers or miles results in very big numbers. To make it easier, astronomers use a unit of measure called the astronomical unit (AU) when talking about planetary distances. The distance from the Earth to the Sun is defined as 1 AU and the other planetary distances are some fraction or multiple of 1 AU. An AU is defined as the distance from Earth to the Sun because the distance of a planet from the Sun can be calculated using triangulation methods that require Earth's distance from the Sun as part of the calculation. Triangulation, or parallax, is still used as a method to arrive at distances and was used by ESA's Hipparcos satellite to accurately map the distances of over 100,000 stars. Radar and other methods are now also used to calculate distances.

The solar system can be divided into two different groups of planets according to their distance from the Sun. These groups are called the inner solar system and the outer solar system. There is a huge 4 AU gap between Mars (the outer planet of the inner solar system) and Jupiter (the inner planet of the outer solar system), and the Asteroid Belt is found in this gap.



V. Just For Fun

Expand the features of your solar system model.

Find additional items to add the Asteroid Belt to your model. Would there also be asteroids outside the Asteroid Belt? Would you see comets somewhere? Would you see moons or any artificial satellites orbiting any planets? Would you see any space probes or landers? What would they be looking for? What else might you add to your solar system model?

Expanded Solar System Model



FOCUS  **ON**

Grades 5-8

MIDDLE SCHOOL



Teacher's Manual

3rd Edition

Rebecca W. Keller, PhD





Real Science-4-Kids

Illustrations: Janet Moneymaker

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www.realscience4kids.com



A Note from the Author

This curriculum is designed to engage middle school level students in further exploration of the scientific discipline of astronomy. The *Focus On Middle School Astronomy Student Textbook—3rd Edition* and the accompanying *Laboratory Notebook* together provide students with basic science concepts needed for developing a solid framework for real science investigation into astronomy.

The experiments in the *Laboratory Notebook* allow students to expand on concepts presented in the *Student Textbook* and develop the skills needed for using the scientific method. This *Teacher's Manual* will help you guide students through the laboratory experiments.

There are several sections in each chapter of the *Laboratory Notebook*. The section called *Think About It* provides questions to help students develop critical thinking skills and spark their imagination. The *Experiment* section provides students with a framework to explore concepts presented in the *Student Textbook*. In the *Conclusions* section students draw conclusions from the observations they have made during the experiment. A section called *Why?* provides a short explanation of what students may or may not have observed. And finally, in each chapter an additional experiment is presented in *Just For Fun*.

The experiments take up to 1 hour. Materials needed for each experiment are listed on the following pages and also at the beginning of each experiment.

Enjoy!

Rebecca W. Keller, PhD

Materials at a Glance

Experiment 1	Experiment 3	Experiment 4	Experiment 5	Experiment 6
pencil flashlight compass A clear night sky away from bright lights is needed.	basketball ping-pong ball flashlight empty toilet paper tube tape scissors a dark room student-selected objects	modeling clay in the following colors gray white brown red butter knife or sculptor's knife ruler Materials other than clay can be used, such as Styrofoam balls or plaster of Paris and paint.	modeling clay in the following colors: gray white brown red blue green orange butter knife or sculptor's knife colored pencils	computer with internet access printer and paper flashlight Optional binoculars or telescope star map app and mobile device
Experiment 2				
two sticks (used for marking locations) two rulers tape string, several meters long (several yards) protractor				

Experiment 7	Experiment 8	Experiment 9	Experiment 11	Experiment 12
8 objects of different sizes to represent the planets ruler (in centimeters) marking pen large flat surface for drawing—1 x 1 meter (3 x 3 feet), such as a large piece of cardboard or several sheets of construction paper large open space at least 3 meters (10 feet) square push pin piece of string one meter (3 feet) long additional objects of students' choice to represent asteroids, etc.	imagination pencil colored pencils Optional several sheets of blank paper	computer internet connection	computer or tablet internet connection	computer internet connection
		Experiment 10		
		computer internet connection		

Materials

Quantities Needed for All Experiments

Equipment	Materials	Other
basketball compass computer with internet access flashlight knife, butter or sculptor's ping-pong ball printer protractor ruler (in centimeters) rulers, 2 scissors Optional binoculars or telescope star map app and mobile device tablet	modeling clay in the following colors gray white brown red blue green orange objects of different sizes to represent the planets, 8 objects, student-selected paper for printer pen, marking pencil pencils, colored push pin sticks, 2 (used for marking locations) string, one meter (3 feet) long string, several meters long (several yards) surface for drawing— 1 x 1 meter (3 x 3 feet), such as a large piece of cardboard or several sheets of construction paper tape toilet paper tube, empty Optional materials other than clay for models, such as Styrofoam balls or plaster of Paris and paint objects of students' choice to represent asteroids, etc.	clear night sky away from bright lights dark room imagination open space at least 3 meters (10 feet) square

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Experiment 1

Constellations

Materials Needed

- pencil
- flashlight
- compass

A clear night sky away from bright lights is needed.

Objectives

In this experiment students will become more familiar with the night sky, finding constellations, and navigating by the stars.

The objectives of this lesson are to have students:

- Locate a constellation.
- Observe how stars can be used for navigation.

Experiment

I. Think About It

Read this section of the *Laboratory Notebook* with your students.

Ask questions such as the following to guide open inquiry.

- *Before the compass was invented, do you think people were able to tell which direction they were going in at night? Why or why not?*
- *Do you think you could tell which way you are going at night if you don't have a compass? Why or why not?*
- *Do you think astronomers today keep making up new constellations? Why or why not?*
- *Do the constellations stay in the same position in the sky all night long? Why or why not?*
- *Do you think knowing the constellations could help you tell what time of night it is? Why or why not?*

II. Experiment 1: Constellations

This experiment has a section for the Northern Hemisphere and one for the Southern Hemisphere. At different times of year, students close to the equator may be able to observe all the constellations in this experiment.

Students will need to be away from bright lights to see the stars clearly.

Have the students read the entire experiment.

Objective: Have the students write an objective. Some examples:

- *To find a constellation.*
- *To find north (or south) by using the stars.*

Hypothesis: Have the students write a hypothesis. Some examples:

- *Finding a constellation will help me learn more about the stars.*
- *Finding the North Star (or Southern Cross) will help me figure out where I am at night.*

EXPERIMENT

In the table provided in the *Laboratory Notebook*, have the students record the information requested about their location.

Northern Hemisphere

- 1-2 Take the students outside and have them bring along a flashlight to use while reading and making drawings and notes. Students will follow the instructions in the *Laboratory Notebook* to find the Big Dipper, the North Star (Polaris), and the Little Dipper.
- 3 Have the students draw the Little Dipper as they observe it.
- 4-6 Students will follow the instructions to find the Dragon constellation, draw it, and answer the questions.
- 7 Have the students locate the North Star again and use the compass to verify that the North Star is above the North Pole.

Southern Hemisphere

Take the students outside and have them bring along a flashlight to use while reading and making drawings and notes. Students will locate the Southern Cross and follow the instructions in the *Laboratory Notebook* to find south. Since the Southern Cross is not directly over the South Pole, students will attempt to locate the South Celestial Pole, which is the point in the sky directly above the South Pole. There is no pole star in the Southern Hemisphere.

- 1 Take the students outside on a clear night and away from city lights. Have them look toward the south to find the Southern Cross constellation, also called Crux. It is a small, bright constellation of four stars that are close together. They may see two crosses near each other. The Southern Cross is smaller and has brighter stars. It also has a dimmer fifth star tucked

in between two of its arms. The larger, dimmer cross is called the False Cross and is an asterism rather than a constellation.

- ② While looking at the Southern Cross, have the students follow with their eyes the main bar of the cross (the line between the two stars that are farthest apart).
- ③ Have them imagine extending the main bar downward and adding 4 1/2 times to its length. By doing this they will arrive at a point in the sky called the South Celestial Pole which is directly above the South Pole.
- ④ Students will lower their eyes from the South Celestial Pole straight down to the horizon. Have them note a landmark at that spot.
- ⑤ Have the students point their compass at the landmark they've noted and see if they have found south by using the Southern Cross as a pointer. They probably will not have accurately found south but should observe that by using this method they found a direction that is close to south.
- ⑥ Have the students record their results.
- ⑦ Have the students locate both the Southern Cross and the nearby False Cross and draw what they see.

III. Conclusions

Have the students review the results they recorded for the experiment. Have them answer the questions, drawing conclusions based on the data they collected.

IV. Why?

Read this section of the *Laboratory Notebook* with your students.
Discuss any questions that might come up.

V. Just For Fun

Have the students look online or in the library to find three additional constellations that can be seen from their area and that they would like to look for in the sky. Have them go outside and locate the constellations and then draw them as they see them.

Experiment 7

Modeling Our Solar System

Materials Needed

- 8 objects of different sizes to represent the planets
- ruler (in centimeters)
- marking pen
- large flat surface for drawing—1 x 1 meter (3 x 3 feet), such as a large piece of cardboard or several sheets of construction paper
- large open space at least 3 meters (10 feet) square
- push pin
- piece of string one meter (3 feet) long
- additional objects of students' choice to represent asteroids, etc.

Objectives

In this experiment students will make a model of our solar system.

The objectives of this lesson are to have students:

- Observe the planetary orbits.
- Gain a basic understanding of distances between the planets.

Experiment

I. Think About It

Read this section of the *Laboratory Notebook* with your students.

Ask questions such as the following to guide open inquiry.

- *Why do you think the Sun and the planets around it are called a solar system?*
- *Do you think other planets could come to join our solar system? Why or why not?*
- *Do you think our solar system could join another solar system to make one big solar system? Why or why not?*
- *How accurate do you think planetary distance measurements are? Why?*
- *Do you think the Sun's gravitational field extends beyond our solar system? Why or why not?*
- *Why do you think the planets' orbits are almost circular?*
- *What do you think would happen if the planets' orbits were long ellipses? Why?*

II. Experiment 7: Modeling Our Solar System

Have the students read the entire experiment before writing an objective and a hypothesis.

Objective: Have the students think of an objective for this experiment (What will they be learning?).

Hypothesis: Have the students write a hypothesis. The hypothesis can restate the objective in a statement that can be proved or disproved by their experiment.

EXPERIMENT

- ❶ Help the students find 8 objects of about the right size to represent the different planets. They can use the illustration in the *Student Textbook* to see the relative sizes of the planets. Ask them how big the object representing Jupiter would need to be compared to the size of Mercury, etc.
- ❷-❸ Have the students use a marking pen to put a dot at the approximate center of the cardboard to represent the Sun. Then have them put a push pin securely in the spot they have marked and fasten one end of the piece of string to the push pin.
- ❹ Have them measure 10 cm from the push pin and put a mark there. Then they will take the marking pen, wrap the free end of the string around it so the marker tip is at the 10 cm mark when the string is tight, and draw a circle around the push pin at the 10 cm distance. This will represent Earth's orbital path.
- ❺ Have the students use the chart in the *Laboratory Notebook* to measure and draw the orbits for the first 5 planets (Mercury through Jupiter). They will be adding 4 orbits since they have already drawn Earth's.
- ❻ For the first 5 planets from the Sun, have the students place the objects they've chosen in the appropriate orbit for the planet being represented.
- ❼ For the last three orbits, have the students measure the distance of the orbit from the center and place the appropriate object at the orbital distance for the planet. Since these orbits are so far from the center, orbits don't need to be drawn for the outer three planets.

Results

Have the students analyze their model, comparing it to the illustration in the *Student Textbook*. What similarities and differences can they observe? Ask what other observations they can make about our solar system. Have them record their observations.

III. Conclusions

Have them draw conclusions based on the data they collected. How easy or difficult was it for them to create a model of the solar system? How did the different distances affect their model?

IV. Why?

Read this section of the *Laboratory Notebook* with your students.
Discuss any questions that might come up.

V. Just For Fun

Have the students add to their model by finding additional items to represent the objects in the Asteroid Belt, comets, spacecraft, etc. Have them note whether the objects are to scale.

FOCUS ON

Grades 5-8

MIDDLE SCHOOL



Lesson Plan

3rd Edition



Rebecca W. Keller, PhD





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Focus On Middle School Astronomy Lesson Plan—3rd Edition

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LESSON PLAN INSTRUCTIONS

This *Lesson Plan* accompanies *Focus On Middle School Astronomy Student Textbook*, *Laboratory Notebook*, and *Teacher's Manual—3rd Edition*. It is designed to be flexible to accommodate a varying schedule as you go through the year's study. And it makes it easy to chart weekly study sessions and create a portfolio of your student's yearlong performance. The PDF format allows you to print pages as you need them.

This Lesson Plan file includes:

- Weekly Sheets
- Self-Review Sheet
- Self-Test Sheet
- Sticker Templates

Materials recommended but not included:

- 3-ring binder
- Indexing dividers (3)
- Labels—24 per sheet, 1.5" x 1.5" (Avery 22805)

Use the Weekly Sheets to map out daily activities and keep track of student progress. For each week you decide when to read the text, do the experiment, explore the optional connections, review the text, and administer tests. For those families and schools needing to provide records of student performance and show compliance to standards, there is a section on the Weekly Sheets that shows how the content aligns to the National Science Standards.

To use this Lesson Plan:

- Print the Weekly Sheets
- Print Self-Review Sheets
- Print Self-Test Sheets
- Print the stickers on 1.5" x 1.5" labels
- Place all the printed sheets in a three-ring binder separated by index dividers

At the beginning of each week, use the squares under each weekday to plan your daily activities. You can attach printed stickers to the appropriate boxes or write in the daily activities. At the end of the week, use the *Notes* section to record student progress and performance for that week.

WEEKLY LESSON PLAN SAMPLES

LESSON PLAN—Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Monday	Tuesday	Wednesday	Thursday	Friday
READ	EXPERIMENT	CONNECTIONS	REVIEW	TEST

Objectives To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.

Educational Standard* Content Standard A: Science as Inquiry—Grade K-4
Scientists experiment to investigate and develop explanations.

*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☒ Laboratory Experiment 1
☐ Other _____

Connections
☐ History Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☒ Art, Music, Math Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use points that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☒ Self-review
☒ Self-test
☐ Other _____

Notes
 This week we decided to explore the art connection. We looked up the chemistry of red paint and found out what makes it red. This was a great week - lots of fun!

Here is a sample of a normal week.

The recommended sequence is

- 1 - Read the student textbook on the first day.
- 2 - Do the laboratory experiment on the second day.
- 3 - Pick one or more connections to explore on the third day.
- 4 - Do the self-review sheet on the fourth day.
- 5 - Administer the self-test or another exam on the fifth day.



Here is a sample of a week with other activities

- 1 - Find at least one day to READ the text.
- 2 - Find a day to perform the EXPERIMENT.
- 3 - Find a day to do the REVIEW or TEST.

Any activity that is missed can be rescheduled for the following week. However, keep to the main sequence of reading the text, doing the experiment, and reviewing what has been covered. If an activity needs to be missed, choose the CONNECTIONS or SELF-TEST.



LESSON PLAN—Exploring the BUILDING BLOCKS of SCIENCE BOOK 1
CHAPTER 1: WHAT IS SCIENCE?

Monday	Tuesday	Wednesday	Thursday	Friday
READ	BIRTHDAY	EXPERIMENT	FIELD TRIP	REVIEW

Objectives To introduce students to the basic building blocks of science: chemistry, biology, physics, geology, and astronomy.

Educational Standard* Content Standard A: Science as Inquiry—Grade K-4
Scientists experiment to investigate and develop explanations.

*From the National Science Educational Standards (1996) and the Framework for K-12 Science Education (2012) National Academies Press

Activity
☒ Laboratory Experiment 1
☐ Other _____

Connections
☐ History Ask your child about their own history. When were they born? Where were they born? What time were they born? Explain that this is their "history" and that science also has a history.
☐ Philosophy Look up the word "philosophy" in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word "philosophy."
☐ Art, Music, Math Pick one area and discuss how science is connected to art, music, or math. For example, scientists use math to understand data, artists use points that are made with chemistry, understanding sound helps us make music, and so on.
☐ Technology Discuss how the understanding of science helped people invent the airplane, computer, or cell phone.
☐ Language Look up the word science in a dictionary, encyclopedia, or online resource. Discuss the meaning of the word science.

Assessment
☒ Self-review
☒ Self-test
☐ Other _____

Notes
 We had a birthday this week and decided to go on the field trip. We did the self-review and I had the kids take an oral quiz in the car on the way home from the field trip.

Week _____

CHAPTER 1: WHAT IS ASTRONOMY?

Monday

Tuesday

Wednesday

Thursday

Friday

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☒ **Objectives** To introduce students to the science of astronomy.

☒ **Educational Standard*** **Content Standard MS-ESS1.A**
 Patterns of the apparent motion of the sun, moon, and stars can be observed.

*From the Next Generation Science Standards (NGSS)

Activity

- ☐ Laboratory Experiment 1
- ☐ Other _____

Connections

- ☐ **History** Look up the history of astronomy and discuss how our ideas about the cosmos have changed over time.
- ☐ **Philosophy** Discuss how we went from a geocentric understanding of the cosmos to a heliocentric understanding.
- ☐ **Art, Music, Math** Explore how astronomy inspires modern movies.
- ☐ **Technology** Discuss how science and technology enable us to study the cosmos.
- ☐ **Language** Look up the word *astronomy* in a dictionary or encyclopedia and and discuss its meaning.

Assessment

- ☐ Self-review
- ☐ Self-test
- ☐ Other _____

Notes

CHAPTER 7: OUR SOLAR SYSTEM

Friday

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*From the Next Generation Science Standards (NGSS)

☐ Laboratory Experiment 7

☐ Other _____

- ☐ **History** Discuss how ancient people understood the features of our solar system.
- ☐ **Philosophy** Discuss how philosophical ideas about our solar system have changed over time.
- ☐ **Art, Music, Math** Explore how art and math are used to model our solar system.
- ☐ **Technology** Explore the types of technology used to study the solar system.
- ☐ **Language** Look up the word *elliptical* in a dictionary or encyclopedia and and discuss its meaning.

☐ Self-review

☐ Self-test

☐ Other

Notes



SELF-REVIEW

Think about all of the ideas, concepts, and facts you read about in this chapter. In the space below, write down everything you've learned.

Date _____ Chapter _____

[illegible]

SELF-TEST

Imagine you are the teacher and you are giving your students an exam. In the space below, write 5 questions you would ask a student based on the information you learned in this chapter.

Date _____ Chapter _____

[illegible]

READ



READ



READ



READ



REVIEW



REVIEW



REVIEW



REVIEW



EXPERIMENT



EXPERIMENT



EXPERIMENT



EXPERIMENT



CONNECTIONS



CONNECTIONS



CONNECTIONS



CONNECTIONS



TEST



TEST



TEST



TEST



READ



READ



READ



READ



HOLIDAY



HOLIDAY



HOLIDAY



HOLIDAY



FIELD TRIP



FIELD TRIP



FIELD TRIP



FIELD TRIP



BIRTHDAY



BIRTHDAY



BIRTHDAY



BIRTHDAY



REST DAY



REST DAY



REST DAY



REST DAY



REST DAY



REST DAY



REST DAY



REST DAY



SICK DAY



SICK DAY



SICK DAY



SICK DAY



FOCUS  **ON**

Grades 5-8

MIDDLE SCHOOL



Study Notebook **3rd Edition**



Rebecca W. Keller, PhD





Illustrations: K. Keller

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Focus On Middle School Astronomy Study Notebook

Published by Gravitas Publications Inc.

Real Science-4-Kids®

www.realscience4kids.com

www.gravitaspublications.com



Welcome to your study notebook

This notebook is your place to record anything you want as you learn about Earth and the Sun and Moon, stars, planets, solar systems, galaxies, exploding stars, and all the other amazing facts and concepts we call astronomy.

There are questions and suggestions. Some are serious and some are whimsical. If you don't like them, cross them out and create your own.

Just explore what you think about all the topics you are learning and try not to get too worried about writing down the "right" answers. This is an opportunity for you to explore what YOU like.

There are places in this notebook that are unscripted and have little instruction. There are also questions that just dangle on the edges of the page. That's OK. Just record, draw, or paste images that you think apply. Add extra pages as you like. Answer the questions and suggestions in a way that makes the most sense to you. Most of real science is unscripted and making discoveries has no set of instructions. Just play with it. You'll be fine and you might find out something unexpected and amazing.

This notebook is not meant to be graded. So parents and teachers, just let it go. Don't grade this notebook or make your student "turn it in." If your student wants to share all they are learning, great! If not, let that be OK too.

day

month

year

CHAPTER I

How does the world **appear**?

[illegible]

Research Nicolaus Copernicus.

Copernicus:

draw pictures!

Why did Copernicus succeed in convincing his peers of the heliocentric model where Aristarchus of Samos failed?

day

month

year



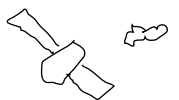
CHAPTER VII

Write a story about a comet moving through space.

As you understand the relationship between the Sun and the Earth, how do you think a planet like Uranus is affected by the Sun when it is so far away?



Look up the Rosetta Mission and write about the most interesting facts.





Name _____

Date _____

Focus On Middle School Astronomy 3rd Edition - Midterm 1

Chapters 1-6, 18 questions, 10 points each

1. Confirming the theory that Earth and the planets revolve around the Sun required... (10 points)
 - ☐ Using ancient lunar calendars.
 - ☐ Watching the sun rise and set every day.
 - ☐ Modern technologies, a deeper understanding of physics, and a willingness to challenge prevailing scientific theories.
 - ☐ Astronomers to have a closed mind.
 - ☐ Studying the ancient cave paintings.
2. Astronomy has advanced so much since the time of the early Greek astronomers because today's astronomers have... (Check all that apply.) (10 points)
 - ☐ Kept all their knowledge and experimental results a secret.
 - ☐ Sophisticated tools to explore the universe.
 - ☐ Advancements in physics that allow them to understand gravity, inertia, and mass.
 - ☐ An unwillingness to challenge prevailing scientific theories.
 - ☐ New knowledge in chemistry that helps them understand how stars give off heat and light energy and how nuclear reactions occur.
3. The idea of a geocentric cosmos was first proposed by Aristarchus of Samos, reintroduced by Nicolaus Copernicus, and confirmed by Galileo. (10 points)
 - ☐ True
 - ☐ False

Focus On Middle School Astronomy 3rd Edition - Midterm 2

Chapters 7-12, 18 questions, 10 points each

1. The Asteroid Belt... (Check all that apply.) (10 points)
 - ☐ Contains tiny stars.
 - ☐ Is found between Mars and the Sun.
 - ☐ Contains millions of small, rocky celestial bodies.
 - ☐ Is found between Mars and Jupiter.
 - ☐ Is found beyond Neptune.
2. Because distances between celestial bodies in the solar system are so great... (10 points)
 - ☐ Astronomers use the AU as a measure of distance.
 - ☐ We will never have a spacecraft able to travel to an asteroid.
 - ☐ The Sun's light cannot reach all the objects in the solar system.
 - ☐ These distances cannot be measured.

3. Earth's orbit is... (Check all that apply.) (10 points)

- ☐ Exactly circular.
- ☐ The right distance from the Sun for Earth to have the conditions needed to support life.
- ☐ Its path around the Sun.
- ☐ Very elongated.
- ☐ Responsible for the seasons depending on whether Earth is closer to or farther away from the Sun.
- ☐ Only slightly elliptical.

Focus On Middle School Astronomy 3rd Edition - Final Quiz

Chapters 1-12, 24 questions, 10 points each

1. Because modern astronomers have sophisticated tools to explore the universe, they don't need to use mathematics, chemistry, or physics. (10 points)

- ☐ True
- ☐ False

2. A heliocentric cosmos is a view of the universe in which... (10 points)

- ☐ The Earth is the central point and the Sun and planets orbit Earth.
- ☐ Most of space is made of helium.
- ☐ Telescopes are used to view far distant suns.
- ☐ The Sun is the central point and the Earth and planets are orbiting around it.
- ☐ Chemistry and physics are used.

13. Match the term with its description. (10 points)

- | | |
|--------------------------|--|
| _____ Asteroid | a. Made mostly of rock. |
| _____ Jovian planet | b. The gravitational curved path of one celestial body around another. |
| _____ Solar system | c. A group of celestial bodies and the one or more suns they orbit. |
| _____ Comet | d. Made mostly of gases. |
| _____ Terrestrial planet | e. A dirty ice ball. |
| _____ Orbit | f. A small, rocky celestial body. |

14. Earth is habitable because... (Check all that apply.) (10 points)

- ☐ It has liquid water.
- ☐ The Moon destabilizes it.
- ☐ It is the right distance from the Sun.
- ☐ It is often hit by large meteorites.
- ☐ It has the right atmosphere.



Answer Sheet

Focus On Middle School Astronomy 3rd Edition - Midterm 1

Chapters 1-6, 18 questions, 10 points each

1. Modern technologies, a deeper understanding of physics, and a willingness to challenge prevailing scientific theories.
2. Sophisticated tools to explore the universe., Advancements in physics that allow them to understand gravity, inertia, and mass., New knowledge in chemistry that helps them understand how stars give off heat and light energy and how nuclear reactions occur.
3. True

Focus On Middle School Astronomy 3rd Edition - Midterm 2

Chapters 7-12, 18 questions, 10 points each

1. Contains millions of small, rocky celestial bodies., Is found between Mars and Jupiter.
2. Astronomers use the AU as a measure of distance.
3. The right distance from the Sun for Earth to have the conditions needed to support life., Its path around the Sun., Only slightly elliptical.

Focus On Middle School Astronomy 3rd Edition - Final Quiz

Chapters 1-12, 24 questions, 10 points each

1. False
2. The Sun is the central point and the Earth and planets are orbiting around it.
13. f, d, c, e, a, b
14. It has liquid water., It is the right distance from the Sun., It has the right atmosphere.

FOCUS **ON**

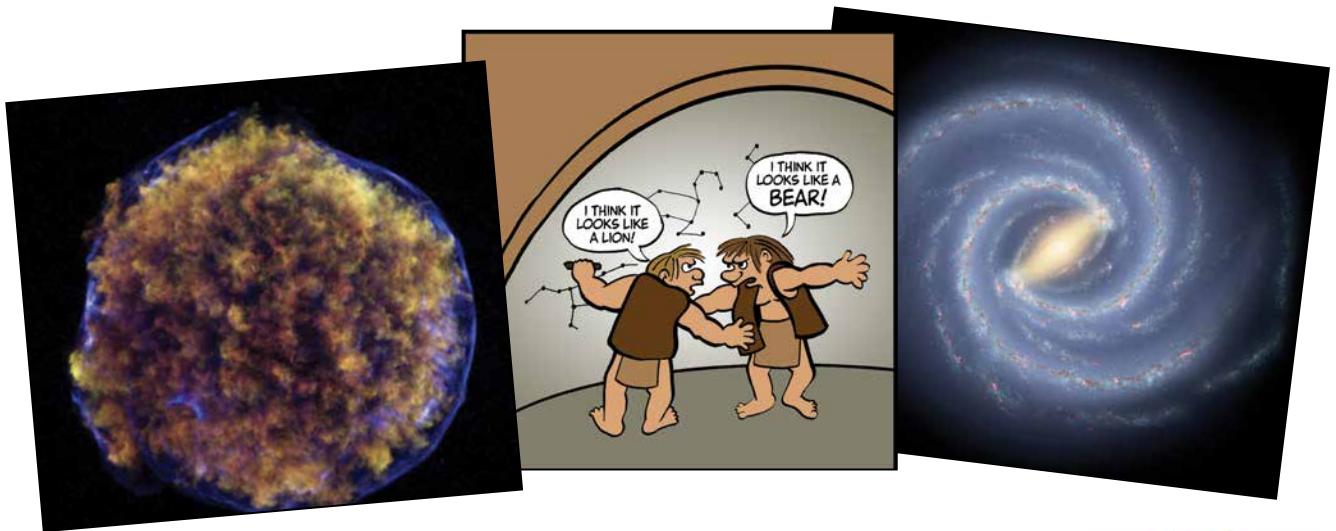
Grades 5-8

MIDDLE SCHOOL



GRAPHICS

3rd Edition





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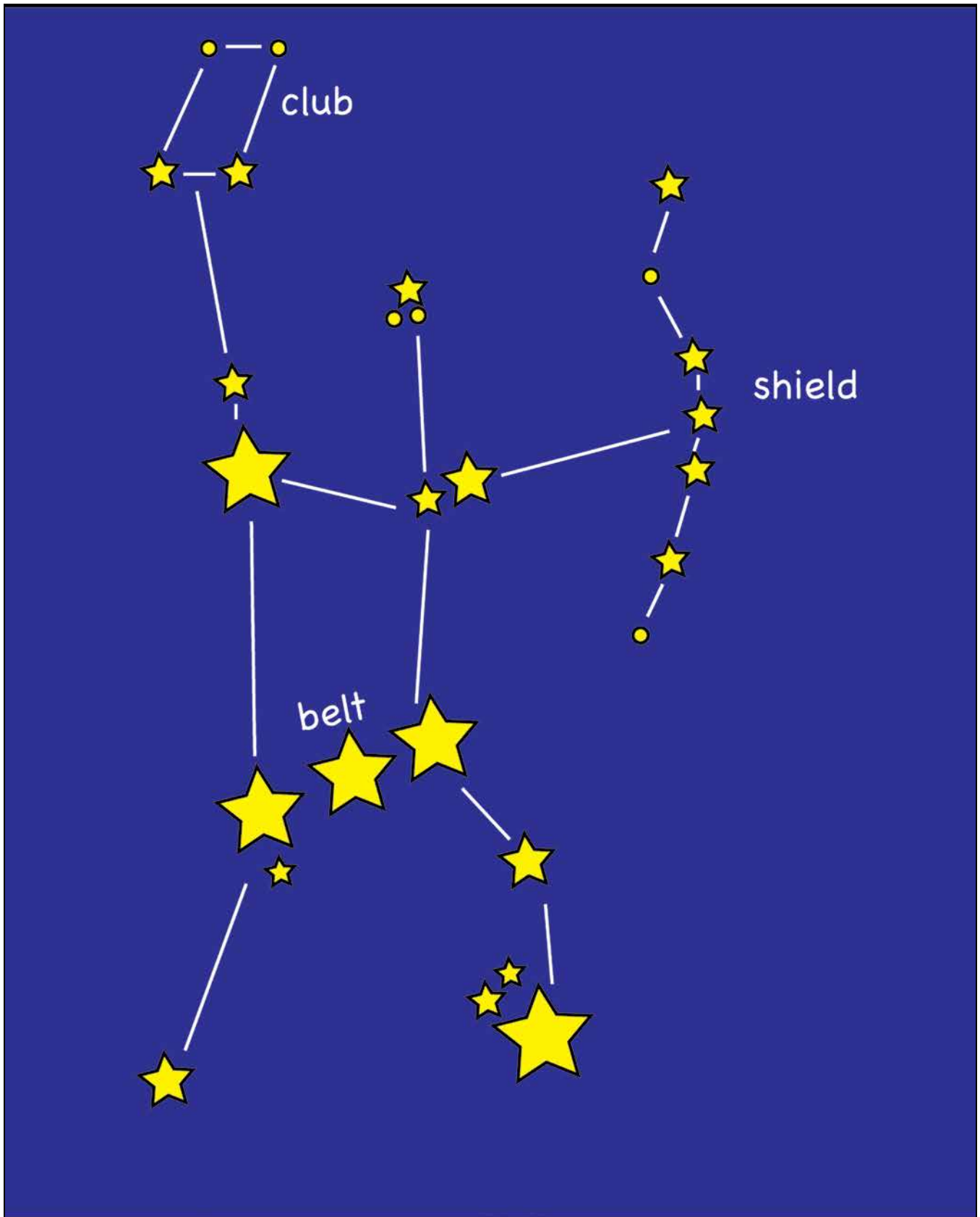
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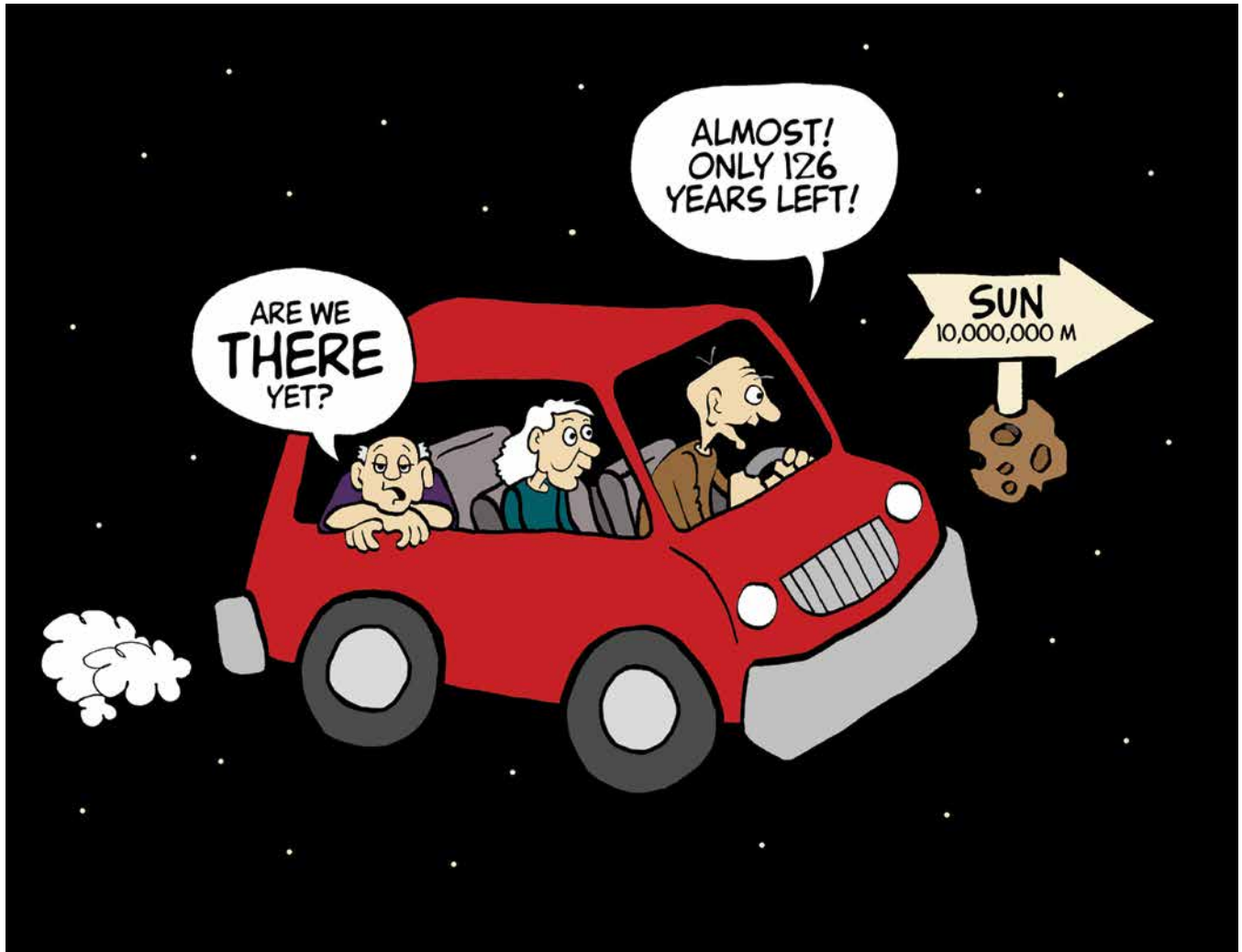
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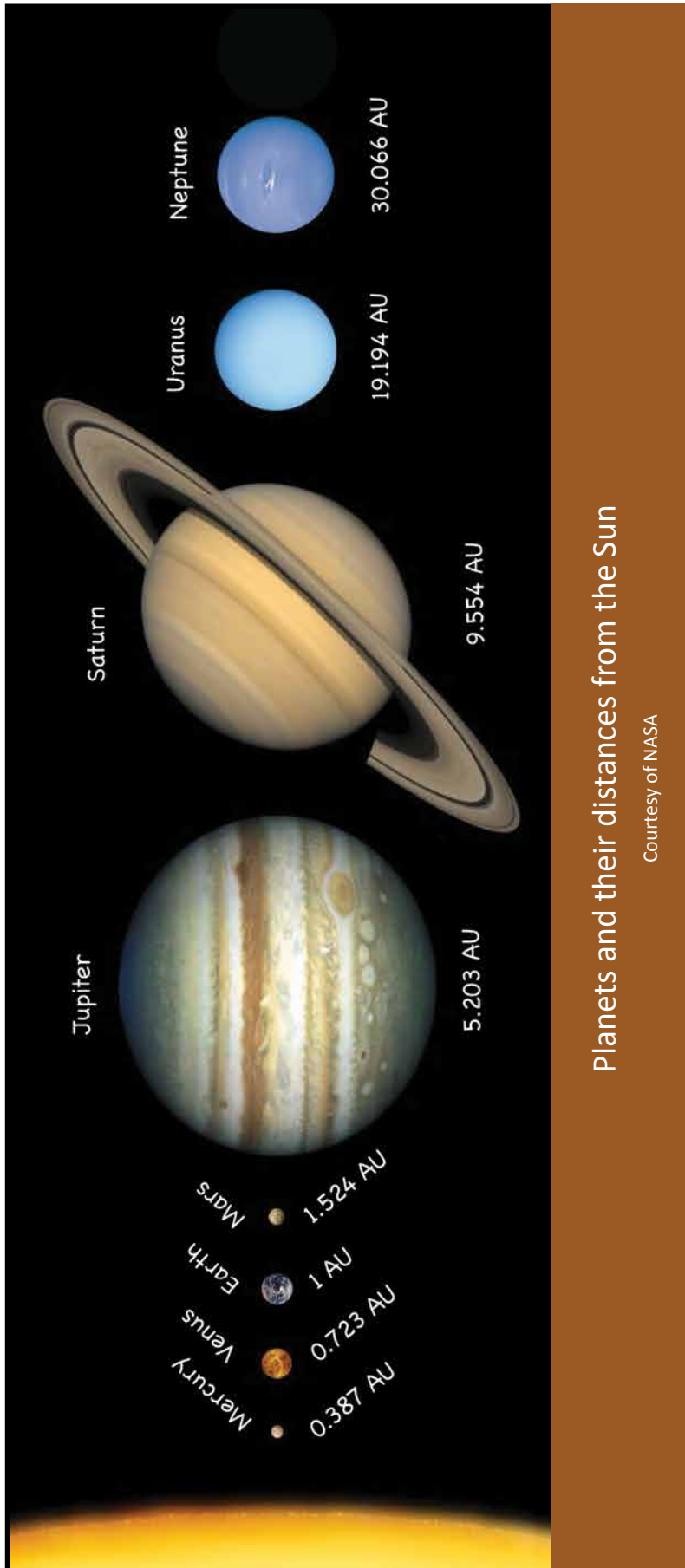
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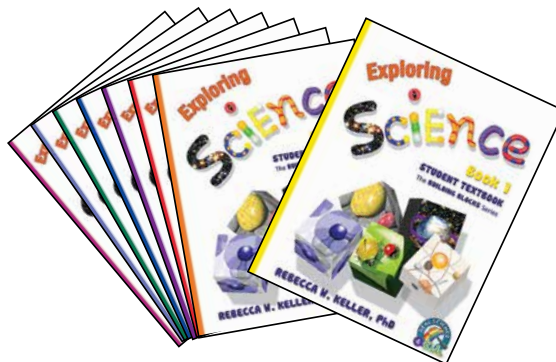




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