Lesson 1: Why God Loves Astronomy

God is the creator of the sun, moon, and all the stars in the sky. God gave us the lights in the sky to give us the rhythms of day and night, to help us mark the seasons of the year, and to give us light so we can see.

I. Creation Accounts

A. Babylonians believed the false god Marduk created the ordered world and established astrology
B. In Genesis 1:1-2, the writer, Moses, tells us the true God created the heavens and the Earth
C. Similarity between the creation accounts: both stories begin with the deep, dark, chaotic waters of the ocean
D. Differences between the creation accounts: Marduk's story was filled with chaos and battles, but the God of the Bible was able to create the world just by speaking

II. Astronomy vs. Astrology

A. Astrology: The belief that the sun, moon, and stars could give us hidden messages about the future
B. Astronomy: The scientific study of the lights in the sky

III. The Constellations

A. Official patterns of stars in the sky
B. There are 88 constellations in the sky

IV. Why Did God Give Us Lights in the Sky?

A. To separate day from night
B. To give us signs for navigation
C. To mark seasons of the year
D. Our calendar: to mark days and years
E. To give us light to see

Lesson 2: Who Moved the Sun?

God designed the earth to spin around on its axis. When the earth does this one time, we call this a day. To help us organize our lives, we've divided a day into 24 hours.

I. Does the Sun Move?

A. The Sun does not move
B. The Earth is spinning, making the sun appear to move

II. How Does the Earth Spin?

A. Axis: the imaginary line around which the earth turns
B. The Earth rotates on its axis one time each day (24 hours)

III. Telling Time

A. This motion of the sun through the sky is what helped ancient people tell time often using a shadow clock (or sundial)
B. We have different names for the times of day
    1. Sunrise: when the sun comes up in the East over the land and we first see it in the morning
    2. Sunset: when the sun goes down in the West below the ground and we can't see it anymore
    3. Twilight: either before the sun rises or after it sets when the sunlight is still lighting up the sky above us giving us a little bit of light
    4. Dawn: the time in the morning before the sun rises when there's a little sunlight
    5. Dusk: the time in the evening after the sun sets when there's a little bit of sunlight before it gets completely dark

Lesson 3: Blazing Summers, Freezing Winters

God designed the Earth to revolve around the Sun, which is our main source of light and heat. When the Earth goes around the Sun one time, we call this a year. Since the axis of the earth is tilted, there are times of year we get more sunlight and other times we get less sunlight, depending on where we are in our path around the Sun.

I. Introduction to the Earth's Motion

A. Two main motions of the earth
   1. Rotation
      a) Spinning around on its axis
      b) Giving us days and nights
      c) This is why the sun appears to rise in the East and set in the West each day
   2. Revolution
      a) Revolving around the sun in an elliptical orbit,
      b) Giving us our years; 1 year = 365 days

B. Tilt of the earth's Axis
   1. Tilted, not straight up and down
   2. The tilt is responsible for our seasons

II. Solstices

A. As the earth moves around the sun, the position of the sun in the sky changes, giving us solstices
B. Days when the sun rises as far south and as far north on the eastern horizon as it will go
C. Means "sun stands still"
D. Two solstices
   1. June 21st: Earth's northern hemisphere most tilted toward the sun
   2. December 21st: Earth's southern hemisphere most tilted toward the sun

Lesson 4: Spring Forward, Fall Back

As the Earth goes around the Sun, there are a couple of days every year when we have the same amount of daylight hours as we have nighttime hours. These days are called "equinoxes."

I. Equinoxes

A. The two days of the year when the sun rises directly in the east and sets directly in the west
B. Means "equal night"
C. The days we have an equal amount of daytime and nighttime
D. Two equinoxes
    1. March 20th: Earth's northern hemisphere most tilted toward the sun
    2. September 22nd: Earth's southern hemisphere most tilted toward the sun

II. Mayans & the Modern Calendar

A. Used the yearly cycle of the sun rising and setting in different places to create the calendar
B. The motions of the sun in the sky over time give us our modern calendar
C. God gave us the motions of the sun, moon, and stars to mark days and years

III. Impact on Earth's Seasons

A. Northern hemisphere
    1. Summer is during the June solstice
    2. Winter is during the December solstice
B. Southern hemisphere
    1. Winter is during the June solstice
    2. Summer is during the December solstice
C. Tropics: the sun is always high overhead and it stays warm year-round

Lesson 5: Hello, Moon!

God gave the earth a satellite we call the moon. As the moon revolves around the earth, we can see more or less of the side of the moon that is lit up by the sun. We call these different shapes of the moon "phases."

I. The Nature of the Moon

A. Moon is a satellite that goes around the earth
B. The moon is smaller than the Earth (about ¼ the size)
C. The moon is about 238,000 miles away from earth
D. Does not produce its own light, but reflects the sun's light

II. The Moon Phases

A. The moon goes through different phases depending on its position relative to the Earth and Sun
    1. The phases are caused by its orbit around Earth, which causes us to see different portions of the sunlit half
    2. As the moon revolves around Earth, we see more or less of its lit-up side
    3. Creates the changing phases over a period of about 29 1/2 days
B. Five main phases of the moon
    1. New moon - can not be seen
    2. Crescent moon
        a) Just a small sliver of light from the moon can be seen
        b) Light makes a crescent shape
    3. Quarter moon - half a circle
    4. Gibbous moon
        a) From an old Latin word that means "hunchback"
        b) Looks like a quarter moon with a little hunch on its back
    5. Full moon - the full circle of the moon
C. Waxing moon
    1. Means increasing or growing
    2. A moon that is getting brighter and brighter night after night
D. Waning moon
    1. Means: decreasing or getting smaller

2. A moon that is getting dimmer and dimmer each night

Lesson 6: There Are Giants in the Sky!

On a dark night, you can see thousands of stars in the sky! For thousands of years, people have imagined the stars make shapes or pictures in the sky. We call these pictures "constellations."

I. Great Pyramid at Giza & Cardinal Directions

A. Builders tried to line up the four sides with the four cardinal directions
B. North, south, east, west: the four cardinal (important) directions
C. Shafts in King's Chamber point out into space, to specific stars in the sky
    1. One pointed to Polaris
    2. One pointed to Orion

II. Constellations & Stars

A. Patterns of stars that form pictures in the sky
B. Orion - "a warrior" or "giant"
C. Stars
    1. Huge balls of gas
    2. Very far away, but have varying distances
    3. Stars closest to the axis don't appear to move
    4. Fixed stars, like Polaris, remain relatively stationary while other stars appear to move

III. The Celestial Globe

A. "Relating to the sky"
B. A round map of the sky with all of its brightest stars
C. Earth spins eastward; stars look like they're spinning westward

Lesson 7: From North Star to Southern Cross

God gave us the stars in the sky to serve as signs to help us find our way. Using certain stars in the sky, people can easily find north, south, east, and west.

I. Navigation by Using Stars

A. Sailors used the sky for navigation, especially when they couldn't see land
B. Constellations helped sailors navigate by recognizing patterns in the sky

II. Circumpolar Stars

A. Stars that, due to the earth's rotation, go around in the sky and never rise or set
B. Always visible in the sky
C. Help provide directions

III. Using Circumpolar Stars for Navigation

A. Ursa Major, the Big Bear
    1. Stars in Ursa Major never set below the horizon in the northern hemisphere
    2. Four brightest stars make a "bowl"
    3. Using Ursa Major to find the north star
        a) Draw a line up from the two stars at the end of the bowl until you come to the North Star (Polaris)
        b) If you can find the North Star, you can always find north
B. Southern Cross (Crux)
    1. In the southern hemisphere, the southern cross helps to find south
    2. Smallest constellation in the sky
    3. Using the Southern Cross to find the south
        a) Draw a line using the long pole of the cross about three and a half cross lengths. This is close to where the south pole points.

b) If you can find the Southern Cross, you can always find south

Lesson 8: Stories in the Sky

In modern times, astronomers count 88 constellations, but many of these constellations go back to ancient times. There were many groups of people from long ago who told mythological stories about these shapes in the sky.

I. Introduction to Constellations

A. Planisphere: a tool for locating constellations in the night sky
B. The sky is divided into 88 regions, each named after one of the 88 official constellations

II. The Four Brightest Stars & Their Constellations

A. Sirius - the brightest star
    1. In the constellation Canis Major, many cultures saw it as a dog or wolf
    2. Visible from most places on Earth, northern or southern hemisphere
B. Canopus - second brightest star
    1. In the constellation Carina
    2. Used to be part of three constellations, making up a larger constellation (Argo)
C. Alpha Centauri - third brightest star
    1. In the constellation, many cultures saw it as a mythological half-man, half-dog creature called a Centaur
    2. Looks like one star in the sky, but it's actually 3 that are very, very close together
D. Arcturus - fourth brightest star
    1. In the constellation Boötes, representing the hunter Arcas in mythology
    2. Shaped sort of like a kite or an ice cream cone

Lesson 9: More Stories in the Sky

There's a special group of 12 constellations called the Zodiac. These are special because, when standing on the earth, these constellations seem to line up with the sun in the sky at different times of the year as the earth makes its way around the sun.

I. Astronomy vs. Astrology

A. Astronomy is the scientific study of the sun, moon, and stars
B. Astrology is the belief that the positions of the stars and planets can predict or influence the future
    1. This is not scientifically supported
    2. The Bible discourages the practice of astrology

II. The Zodiac

A. Means "circle of little animals"
B. A group of 12 constellations that the sun passes through as the earth orbits the sun throughout the year
C. 12 constellations of the zodiac
    1. Sagittarius the Archer - January
    2. Capricornus the Sea Goat - February
    3. Aquarius the Water Bearer - March
    4. Pisces the Fish - April
    5. Aries the Ram - May
    6. Taurus the Bull - June
    7. Gemini the Twins - July
        a) Easy to see constellation
        b) Two very bright stars in it: Pollux and Castor
    8. Cancer the Crab - August
    9. Leo the Lion - September
    10. Virgo the Virgin - October
    11. Libra the Scales - November
    12. Scorpius the Scorpion
        a) December
        b) Orion and Scorpius are never seen in the sky at the same time

Lesson 10: Watch Out for Wandering Stars!

In ancient times, they were called the wandering stars—dots of light that moved differently than all the other stars in the sky. Today, we call these dots of light "planets," and we know they are not stars but large objects revolving around our star, the Sun.

I. The Ancient View of Planets I

A. Tower of Babel (Genesis 11)
   1. Believed to be built like a ziggurat
   2. 7 levels dedicated to seven special lights in the sky

B. In ancient times, planets appeared as "wandering stars" to people because they moved differently than fixed stars

C. "Planet" comes from the Greek word meaning "wandering star"

D. Genesis, chapter 11

II. Lights in the Sky

A. Planets: large objects that revolve around a star

B. Seven Special lights
   1. Sun: the greater light
   2. Moon: the lesser light
   3. Planets visible to the naked eye: Mercury, Venus, Mars, Jupiter, and Saturn
   4. Uranus and Neptune were not visible without a telescope, so they were unknown to ancient astronomers

C. Planets: a big object that revolves around a star
   1. Mercury: smaller than Earth and very hot
   2. Venus: similar in size to Earth and extremely hot
   3. Earth: our planet
   4. Mars: smaller and cooler than Earth
   5. Jupiter: the largest planet
   6. Saturn: very large and famous for its rings
   7. Uranus: icy giant
   8. Neptune: another icy giant

Lesson 11: Around the World

At first, people believed the world was flat, like a disk floating in the air. But hundreds of years before Christ, people started to believe the world is actually a sphere, like a ball. They knew this because as they traveled north or south, they saw new stars in the sky, showing they were not traveling on a flat surface but a curved surface.

I. How We Know the Earth Is Round

A. Earth's shadow is round during a lunar eclipse
   1. Lunar means "relating to the moon"
   2. A lunar eclipse happens when the earth gets in the way of the sun's light as it hits the moon, casting a shadow on the moon
B. We can now see the shape of the earth from space
C. Circumference is the measurement of how big around the earth is
D. The earth is 24,874 miles in circumference

II. Ancient Evidence That the Earth Is a Sphere

A. People have known the earth was round for over 2,000 years
B. People used to believe the earth was flat and surrounded by water
C. Star visibility changes with location
D. Ships disappeared over the horizon
E. Sun shone straight to the bottom of the well in Syrene during the June solstice
   1. Did not happen any other time of year
   2. The sun was perfectly overhead of the well on that day of the year

III. Eratosthenes & the Circumference of the Earth

A. Eratosthenes (b. 270 B.C.) performed an experiment to measure Earth's circumference comparing shadows in Alexandria and Syene on solstice
B. Estimated the earth to be 250,000 stadia
C. Used angles and distance to calculate Earth's size

Lesson 12: Blackout

Solar eclipses are some of the most amazing events to witness in the sky. They happen when the moon comes between the sun and the earth, blocking the sun's light.

I. The Science of Solar Eclipses

A. Solar eclipse occurs when the moon covers up the sun for a short time
B. Sun and moon appear the same size from Earth
C. Solar eclipses don't occur each month because the moon's orbit is slightly tilted relative to Earth's orbit, and most new moons do not align perfectly with the sun

II. Types of Solar Eclipses

A. Types of shadows in an eclipse
    1. Umbra: total shadow where all sunlight is blocked
    2. Penumbra: partial shadow where some sunlight is blocked
B. Partial solar eclipse
    1. Moon covers only part of the sun
    2. Sunlight is dimmed but not completely blocked
C. Total solar eclipse
    1. Moon completely covers the sun
    2. The sun's corona becomes visible
    3. Totality only lasts a few minutes
    4. Rare and requires being in the right location

III. Observing a Solar Eclipse

A. Safety precautions during a solar eclipse
    1. Wear protective eyewear
    2. Don't look directly at the sun
B. Sky darkens, temperature drops
C. Animals react as if nighttime is approaching

Lesson 13: Bye Bye, Moon

Lunar eclipses are wonderful nighttime events to witness. Lunar eclipses happen when the sun's light is blocked from hitting the moon for a short time because the earth gets in the way. The shadow of the earth falls on the moon.

I. Understanding Lunar Eclipses

A. Lunar means "relating to the moon"
B. A lunar eclipse happens when the earth blocks light from hitting the moon
    1. There must be a full moon for there to be a lunar eclipse
    2. The two parts of the shadow
        a) Umbra: darkest the part of a shadow. It's that part of the shadow that completely covers the light, the entire moon can fall within this shadow
        b) Penumbra: part of the shadow that covers only part of the light

II. Types of Lunar Eclipses

A. Penumbral eclipse
    1. Moon passes through the earth's penumbra
    2. Slight dimming of the moon
B. Partial eclipse
    1. Part of the moon enters the earth's umbra
    2. Some of the moon is in darkness, some is dimmed
C. Total eclipse (blood moon)
    1. Entire moon is in the earth's umbra
    2. The moon appears red due to atmospheric refraction

III. Frequency & Visibility of Lunar Eclipses

A. Lunar eclipses occur about twice a year
B. There will be about 85 lunar eclipses in the 21st century

Lesson 14: Falling Rocks & Shooting Stars

Meteors are sometimes called "shooting stars," but they aren't stars at all. Instead, they are bits of rock that are slamming into the earth's atmosphere and burning up, creating big streaks of light in the sky. Sometimes, parts of these rocks make it all the way to the earth's surface.

I. Defining Meteoroid, Meteor, & Meteorite

A. Meteoroid: a rock floating in space varying in size from grains of sand to several feet across
B. Asteroids: large meteoroids
C. Meteors: occur when a meteoroid enters Earth's atmosphere
    1. The atmosphere is the thick layer of gas surrounding Earth
        a) Some planets like Earth have a very thick atmosphere
        b) Some planets like Mercury have a very thin atmosphere
    2. Atmospheric friction causes intense heating
    3. Burns up, creating a streak of light or "shooting star"
D. Meteorite: when a space rock survives the atmosphere and reaches the ground

II. Meteor Showers

A. Showers happen when there are a high frequency of meteors visible in the sky
B. Caused by Earth moving through clusters of meteoroids
C. Best time to view is early morning before sunrise or late at night
D. Major meteor showers
    1. Quadrantids (early January): short peak period
    2. Lyrids (late April): visible for thousands of years
    3. Eta aquarids (early May): several nights of activity
    4. Perseids (mid-August): one of the biggest, up to 60 meters per hour
    5. Orionids (late October): up to 20 per hour
    6. Leonids (mid-November): sometimes has meteor storms
    7. Geminids (mid-December): over 120 per hour in peak years

Lesson 15: Galileo's Head Was on the Block

Astronomers in the 1500s and 1600s made some very important discoveries about the earth. They helped to show others the earth is not the center of everything. Instead, the earth and all the other planets revolve around the sun.

I. What Is the Solar System?

A. Solar means "related to the sun"

B. The solar system consists of the sun, planets orbiting the sun, moons orbiting planets, meteoroids, comets, and other celestial objects

II. Two Views of the Universe

A. The earth-centered view (geocentric model)

1. Ancient belief that everything revolves around Earth
2. Sky appears to rotate around us: sun, moon, stars, planets rise in the east and set in the west
3. Constellations appear fixed in place while planets move differently
4. Dominant belief for most of human history

B. The space perspective (heliocentric model)

1. Earth rotates on its axis, creating day and night
2. Earth revolves around the sun, creating years and changing constellations
3. Axis tilt causes solstices, equinoxes, and seasons

Lesson 16: Earth—Baby Bear's Porridge

What makes the earth so special? Why do we find life on Earth, but we don't find life in other places in the solar system? This lesson explores some of the things that make the earth so unique.

I. Facts About the Earth

A. Earth is the third planet from the sun
B. Earth orbits at 67,000 mph, taking 365 days per orbit
C. 93 million miles from the sun
D. Over 70% covered in water
E. Five major oceans: Pacific, Atlantic, Indian, Arctic, and Southern

II. Earth's Climate Zones

A. Tropical climates: warm all year
B. Arid climates: very dry regions
C. Temperate climates: experience seasonal variations
D. Polar climates: cold regions

III. Earth Is Uniquely Suited To Support Life

A. Earth's suitability is referred to as the Goldilocks zone or the habitable zone
B. Life on earth includes plants, animals, fungi, and microscopic life
C. All known life depends on water for survival
D. Earth has perfect conditions for water to be liquid
    1. If the earth was closer to the sun, water would evaporate
    2. If the earth was further from the sun, water would freeze

IV. Earth's Protective Features

A. The atmosphere is a layer of gases that blankets
B. Gravity holds everything together
C. Magnetosphere: Earth's invisible shield protecting the Earth from harmful solar radiation

Lesson 17: The Man on the Moon

The moon is Earth's only natural satellite—close enough we can see what the surface looks like with just our eyes. This rocky world looks like a good place to set up a colony, but just how easy would it be?

I. Basic Facts About the Moon

A. A spacecraft traveling at 24,000 miles per hour would take 2-3 days to reach the moon
B. The moon is 2,159 miles wide
C. The moon is bright because it reflects sunlight and is relatively close to Earth (238,000 miles away)
D. The moon is Earth's only natural satellite
E. The same side of the moon always faces Earth because its rotation matches its orbit
F. The moon lacks a strong magnetic field, making it vulnerable to harmful solar radiation (energy from the sun)
G. It takes 27 days for the moon to complete one rotation

II. Lunar Features

A. Highlands: lighter, bright, hilly areas covered with craters caused by meteor impacts
B. Maria: dark flat plains once thought to be oceans but are actually smooth, less cratered regions
C. The near side of the moon (facing Earth) has more maria than the far side

III. The Moon's Gravity

A. Gravity: the force that attracts one object to another object
B. The moon's gravity pulls on Earth, affecting ocean tides and causing sea levels to rise and fall
C. The moon's gravity is ⅙ that of Earth

Lesson 18: Mr. Golden Sun

At the center of the solar system is a star that has 600 times more mass in it than all the planets combined! We call it the sun. Every second it puts out a lot of energy—and the secret to its energy is deep down in the core.

I. Basic Facts About the Sun

A. If the sun disappeared, Earth would go dark after 8 minutes, and temperatures would drop rapidly, making life impossible
B. The sun has a huge amount of gravity due to its enormous mass
    1. Gravity is the force that attracts one object to another
    2. The more massive an object, the more gravitational force it has
C. A ball of glowing gas, not a solid or fire
D. Composed mostly of hydrogen plasma
E. Deep in the sun, nuclear fusion occurs
    1. Atoms of hydrogen smash into one another, fusing together
    2. Releases a huge amount of energy
F. Radiation travels outward, taking thousands of years to reach the surface

II. Solar Features

A. Corona: outer layer, 900,000 degrees
B. Photosphere: boiling plasma surface with rising jets (spicules)
C. Sunspots: darker, cooler magnetic areas that follow an 11-year cycle
D. Solar prominences: huge plasma loops
E. Coronal mass ejections: plasma bursts traveling up to 7 million mph
F. Solar wind: plasma steam from the corona moving at 2 million mph

Lesson 19: Mercury—the Swift Messenger

Close to the sun is a barren rocky world we call Mercury. The smallest of all the planets, Mercury is covered in big cliffs, deep craters, blazing hot days, and freezing cold nights. Could we set up a colony in such an extreme place?

I. Basic Facts About Mercury

A. Closest planet to the sun
B. Orbits the sun in 88 Earth days
C. Rotates slowly–59 Earth days per spin
D. One full day (sunrise to sunset) lasts 176 Earth days

II. Features of Mercury

A. 3,032 miles wide, Mercury is the smallest planet in the solar system
B. Terrestrial planet: earth-like planets
    1. Planets with a rocky surface
    2. The terrestrial planets include: Mercury, Venus Earth, Mars
C. Surface is covered in craters, highlands, and smooth plains
D. Rupes: huge cliffs stretch for miles
E. Temperature and atmosphere
    1. Extreme temperature: 700 degrees daytime, -290 degrees nighttime
    2. No significant atmosphere; exposed to solar wind and radiation

III. Mercury's Harsh Conditions

A. Gravity is ⅓ of Earth's gravity
B. Weak magnetosphere offers limited radiation protection
C. Bright sun, 2.5 times larger in the sky than from Earth
D. No breathable air, no liquid water, and long periods of darkness

Lesson 20: Venus—Earth's Fiery Sister

The second planet from the sun—nearly the same size as the earth—is covered in bright clouds, but beneath those clouds is a mysterious, terrifying world. If we drop beneath those clouds, will we find a planet suitable for a human colony?

I. Basic Facts About Venus

A. Second planet from the sun, about 67 million miles away
B. Brightest object in the sky, other than our sun and moon
C. Orbital and rotational characteristics
    1. Orbits the sun in 225 days
    2. Spins in the opposite direction from Earth
    3. Very slow rotation: takes 243 days for one full spin (its day is longer than its year)

II. Venus' Atmosphere & Climate

A. Completely covered by thick clouds made of sulfur dioxide and sulfuric acid
B. Intense greenhouse effect caused by large amounts of carbon dioxide, trapping heat
C. The hottest planet in the solar system due to its thick atmosphere trapping heat
D. Very little water because solar wind strips it away

III. Features of Venus

A. Terrestrial planet with a solid, rocky surface
B. Thousands of volcanoes, with more than 1,600 identified, some possibly still active
C. Magma, hot liquid rock beneath the surface fuels volcanic activity

Lesson 21: Mars—The Red Planet

Named after the Roman god of war, the planet Mars looks like a drop of blood in the sky. But as we get closer, we see this rusty, red planet is home to some record-setting surprises. Would this desert world be a good place to set up a home base?

I. Basic Facts About Mars

A. 142 million miles from the sun
B. If a creature lived on Mars, it would be called a Martian
C. Terrestrial planet, or “earth-like”
D. Second smallest planet, about half the width of Earth
E. Spins one time on its axis in 24 hours, 38 minutes

II. Mars’ Atmosphere & Climate

A. Thin atmosphere, mostly carbon dioxide, almost no oxygen
B. Does not have much of a magnetic shield to protect it from solar radiation
C. Surface has iron oxide, giving Mars its red color
D. Temperatures range from 70 degrees to -190 degrees

III. Features of Mars

A. Northern hemisphere is smooth
B. Southern hemisphere is cratered
C. Largest volcano is Olympus Mons (13.5 miles tall) and is the tallest mountain in the solar system
D. Network of canyons called Valles Marineris (5x deeper and 10x longer than the Grand Canyon)
E. Mars has two moons, Phobos and Deimos
F. Sunsets appear blue, while daytime is pink

Lesson 22: Space Rock 'n' Roll

For many years, astronomers wondered why there was such a big space between Mars and Jupiter. It looked like a perfect place for a planet. Finally, astronomers started seeing not just one planet but many, many space rocks. Today, we call it the asteroid belt.

I. Basic Facts About Asteroids

A. Very large meteoroids are called asteroids
B. Asteroids are irregular in shape and often covered in craters
C. Features:
    1. Made of rock and metals like iron, nickel, platinum, and gold
    2. Very weak gravity, no atmosphere
    3. No magnetic shield with high exposure to radiation
    4. Limited sunlight, very low solar power
    5. The more mass an asteroid has, the more gravity it has

II. The Asteroid Belt

A. Contains about 200 million asteroids
B. Located between Mars and Jupiter in a thick ring around the sun
C. Asteroids range from tiny rocks to over 300 miles wide

III. Notable Asteroids

A. Hygiea: over 310 miles wide, dark surface, and slow rotation
B. Pallas: about 300 miles wide, tilted on its side, with long sunlit seasons
C. Vesta: 326 miles wide, one of the brightest asteroids, and is the largest asteroid in its family
D. Ceres: largest asteroid, 587 miles wide, classified as a dwarf planet due to its round shape

Lesson 23: Jupiter—By Jove, It's a Giant!

Ancient people named Jupiter after the king of the gods. Little did they know that Jupiter is the king of the planets in the solar system. It is the largest, fastest spinning planet—having more mass than all the other planets combined times two!

I. Basic Facts About Jupiter

A. Fifth planet from the sun, 484 million miles away
B. Largest planet, over 11 times wider than Earth, 88,846 miles wide
C. More than 1,300 Earths could fit inside Jupiter
D. Spins the fastest of all planets, less than 10 hours per rotation
E. Strong gravity, more than 2x that of Earth
F. Classified as a gas giant, a big ball of gas

II. Jupiter's Atmosphere & Climate

A. Thick cloud layers with bands of cream, brown, red, and blue
B. Violent storms, including the Great Red Spot (a massive, 300-year-old storm)
C. Strong magnetic field
D. Deep within the planet, the hydrogen becomes thick and hot and is called metallic hydrogen
    1. Acts like a liquid
    2. It's really good at moving electricity around

III. Moons of Jupiter

A. Surrounded by over 60 moons
B. Notable moons:
    1. Io: covered in volcanoes, ejects sulfurous lava, exposed to strong radiation
    2. Europa: icy surface with a possible underground ocean but high radiation
    3. Ganymede: largest moon in the solar system, made of ice and rock

4. Callisto: icy, heavily cratered, far enough from Jupiter to have less radiation (potential for colonization)

Lesson 24: Saturn—Put a Ring on It

Ancient people believed Saturn was the planet furthest away from the earth as it moved slowly through the sky. But what they couldn't see was all of Saturn's beautiful rings that make it the most recognizable planet in the solar system.

I. Basic Facts About Saturn

A. Saturn is the second-largest planet in the Solar System, over 74,000 miles wide
B. Saturn is 888 miles from the sun
C. Saturn takes nearly 30 years to orbit the sun once
D. More than 700 Earths could fit inside Saturn
E. Classified as a gas giant

II. Saturn's Atmosphere & Climate

A. The atmosphere consists of mostly hydrogen and helium with bands of cloud layers
B. Winds reach speeds of over 1,000 mph
C. Extreme cold: the cloud tops are -290 degrees
D. Deep in Saturn's atmosphere, hydrogen turns into metallic liquid hydrogen, making Saturn a giant magnet

III. Features of Saturn

A. Rings of Saturn
    1. Composed of trillions of ice chunks, some the size of houses
    2. Shepherd moons
        a) Small moons inside the rings
        b) Use their gravity to keep the small rocks that make up Saturn's rings in place
    3. Rings are very thin, only about a mile thick in some areas
B. Moons of Saturn
    1. Over 60 moons, including many large ones
    2. Enceladus: a bright, snowy moon with geysers that shoot ice and water into space
    3. Titan: Saturn's largest moon, even bigger than Mercury

a) The only moon with a thick atmosphere
b) Has lakes of liquid methane and rain of ethane
c) Contains frozen ice water

Lesson 25: Uranus—A Topsy Turvy World

No one in the ancient world knew about Uranus. It's so dim in the sky, no one paid any attention to it. But when people saw it through their telescopes for the first time, they knew it was no ordinary light in the sky, but a new planet going around our sun.

I. Basic Facts About Uranus

A. Discovery
   1. William Herschel discovered Uranus in 1781
   2. Herschel believed the universe's order pointed to a Creator, saying "The undevout astronomer must be mad."

B. Orbit and size and rotation
   1. Uranus is about 1.8 billion miles away
   2. It takes 84 years to orbit the sun
   3. Uranus is 31,000 miles wide (more than 50 Earths could fit inside)
   4. Rotates once every 17 hours

C. Classified as an ice planet

II. Uranus' Atmosphere & Climate

A. Atmosphere made mostly of methane gas, giving it a blue-green color
B. Winds reach 300 mph
C. Coldest atmosphere in the solar system at -371 degrees
D. Below the atmosphere, a slushy ice ocean covers a hot core (9000 degrees)
E. Diamond rain occurs due to intense pressure in the atmosphere
F. Receives very little heat from the sun due to its distance

III. Features of Uranus

A. Faint, dark rings made of frozen methane chunks
B. Uranus has over 25 moons, named after characters from English literature
C. Some of its major moons include: Miranda, Oberon, and Titania

Lesson 26: Neptune—The Blue Ice Giant

At first, Neptune might look like a boring blue ball. But don't get too close because Neptune is home to the fastest winds in the whole solar system. This frozen world is full of surprises.

I. Basic Facts About Neptune

A. Neptune is about 2.8 billion miles from the sun
B. It takes 165 years for Neptune to travel around the sun once
C. It is over 30,000 miles wide: four times wider than Earth but smaller than Jupiter, Saturn, and Uranus
D. It is slightly more massive than Uranus, even though it is smaller

II. Neptune's Atmosphere & Climate

A. Neptune's atmosphere contains methane, giving it a blue color
B. The planet has the fastest winds in the solar system, reaching 1,300 mph
C. Neptune is an ice giant, with layers of methane and ethane gases and ices
D. It is extremely cold, with an average temperature of -350 degrees
E. The pressure inside Neptune creates diamond raindrops

III. Features of Neptune

A. Neptune once had a massive storm called the Great Dark Spot, a hurricane-like storm
B. Unlike Jupiter's Great Red Spot, Neptune's storms eventually disappear, even though the violent winds never do
C. Neptune has dark rings made of frozen methane chunks
D. The planet has many moons
    1. The largest moon is Triton
    2. Triton orbits opposite of Neptune's rotation and will eventually be destroyed or absorbed

Lesson 27: Ice Ice Baby (Too Cold)

Beyond Neptune are millions of little (and big) chunks of ice in a region called the Kuiper Belt. This is an area full of dwarf planets, comets, and things called "cubewanos." It's an icy, cold place that will take us a long time to explore.

I. The Kuiper Belt

A. A vast region beyond Neptune
B. Made up of hundreds of thousands of icy chunks and several dwarf planets
C. Starts right after Neptune's orbit and extends over 7 billion miles from the sun
D. Contains a variety of icy objects, including methane ice, ammonia ice, and water ice

II. Pluto: The First Discovered Kuiper Belt Object

A. Classified as a dwarf planet
B. 3.06 billion miles from the sun
C. Takes 248 years to travel around the sun once
D. Rocky with a lot of ice
E. About 1,500 miles wide
F. Average temperature is -382 degrees
G. Five moons, with Charon being the largest

III. Other Objects in the Kuiper Belt

A. Haumea: a fast-spinning, egg-shaped dwarf planet
B. Makemake: a smaller dwarf planet originally nicknamed "Easter bunny"
C. Eris: the most massive dwarf planet
D. Comets: bright, icy objects with long tails when close to the sun

Lesson 28: Planets Galore

When you think of planets, you probably think of the ones going around our sun. But there are thousands and thousands of other planets out there orbiting other stars. And we are discovering new "exoplanets" every year.

I. What Are Exoplanets?

A. Exoplanets are planets outside our solar system, orbiting other stars
B. Astronomers believe almost every star has at least one planet
C. Thousands of exoplanets have been discovered since the 1990s

II. How Do Astronomers Find Exoplanets?

A. Wobble method: detecting small movements in a star caused by a planet's gravitational pull
B. Transit method: observing a star's light dimming when a planet passes in front of it
C. Microlensing: using bent light caused by gravity to detect planets

III. Magnetospheres & Exoplanets

A. The magnetosphere is an invisible magnetic shield protecting Earth
B. Planets with strong magnetospheres: Jupiter, Saturn
C. Planets with weak magnetospheres: Venus, Mars
D. We do not yet know if exoplanets have magnetospheres

IV. Types of Exoplanets

A. Hot Jupiters: gas giants close to their stars, very hot (e.g., 51 Peg b)
B. Hot Neptunes: Neptune-sized planets close to their stars
C. Super Jupiters: larger than Jupiter (e.g., TrES-4b)
D. Super Earths: larger than Earth but smaller than ice giants

V. The Habitable Zone or Goldilocks Zone

A. The region around a star where conditions might be just right for liquid water
B. Some exoplanets, like those around TRAPPIST-1, might be in this zone

Lesson 29: The Immeasurable Heavens

We can see over 9000 stars in the night sky without using a telescope. When we use powerful telescopes, we can see beyond these stars to see not just more stars but whole galaxies full of billions of stars. It's hard to imagine just how big the universe is.

I. The Milky Way & Its Structure

A. A galaxy is a group of stars held together by gravity
B. The Milky Way is our home galaxy and is shaped like a spiral
C. The Milky Way contains at least 100 billion stars
D. From Earth, in dark areas, we can see part of the Milky Way as a milky white band in the sky

II. The Universe Beyond the Milky Way

A. The Milky Way is not the only galaxy in the universe
B. Our galaxy is part of the local group, which includes about 50 galaxies
C. A collection of galaxy clusters is called a supercluster
D. Our supercluster is called Laniakea, a Hawaiian word meaning "immeasurable heavens"
E. The universe contains millions of superclusters, each with thousands of galaxy clusters, each with hundreds of galaxies, each with millions or billions of stars

III. Intelligent Life & the Bible

A. Many planets exist, but they're too far for us to reach
B. The Bible does not mention intelligent life on other planets
C. The Bible's focus is on God's relationship with humans and our role on Earth

Lesson 30: The Heavens Are the Lord's Heavens

Psalm 115:16 says, "The heavens are the Lord's heavens, but the earth he has given to the children of man." As amazing as the rest of the universe is, the more we explore it, the more we learn: there is no place like home.

I. Earth as a Habitable Planet

A. Earth is a terrestrial planet, it has a solid, rocky surface
B. Other terrestrial planets include Mercury, Venus, and Mars
C. Earth is uniquely suited for life, having the right conditions:
    1. Stable atmosphere
    2. Protective magnetosphere
    3. Liquid water
    4. The right amount of gravity

II. Comparison to Other Terrestrial Bodies

A. The eight largest moons in our solar system are:
    1. Earth's moon
    2. Ganymede (Jupiter)
    3. Callisto (Jupiter)
    4. Io (Jupiter)
    5. Europa (Jupiter)
    6. Titan (Saturn)
    7. Titania (Uranus)
    8. Triton (Neptune)
B. While terrestrial planets and moons exist, none matches Earth's habitability

III. Conditions for Colonization Outside of Earth

A. Landing and building structures require solid ground only found on terrestrial surfaces
B. The most viable locations for a future colony would be the moon or Mars

IV. Biblical Perspective

A. Psalm 115:16 states, “The heavens are the Lord’s heavens, but the earth he has given to the children of men.”
B. Earth is a special creation, designed by God to be our perfect home