Chapter 1 The Solar System

May 11 - May 15

8th Grade Science Klinger & Sherman

Key Content/Modeling

Assignment 1. Use Packet #2 from April to complete Lessons 1.13, 1.14, 1.15, and 1.16 in the Science section, pages 151-164. (8th Grade Packet)

Assignment 2. Read and complete the probe How Do Planets Orbit the Sun?

Assignment 3. Complete a Frayer model for each of the vocabulary words. (You Try)

Assignment 4. Read the selections Jupiter, Saturn, Uranus, and Neptune then follow the directions and write Cornell notes on a separate paper or print the readings and practice Marking the Text.

You Try Create a Frayer model for each of the words. Remember to identify some of the characteristics and attributes of the word, give some examples, illustrate the word, and use the word in a sentence.

Jupiter Saturn Uranus Neptune Galilean Great Red Spot ring system hydrogen helium

Show me what you know (Proof of learning)

Email your teacher your completed work in whatever format you are comfortable with. We have been receiving your work in many different ways!

Self-Assessment

What do scientists learn by sending spacecraft to the outer planets?

SCIENCE STANDARD: DCI ESS1.B The solar system consists of the sun and a collection of objects, the planets, their moons, and asteroids that are held in orbit around the sun because of it’s gravitational pull on them. (MS-ESS1-2), (MS-ESS1-3)

What am I learning?

What are some of Jupiter’s distinctive features?

What are the rings of Saturn made of?

Why does Uranus have a blue-green color?

Why is Neptune’s weather so turbulent?

How do I know I learned?

Describe some of the unique features of the planet Jupiter.

Describe the composition of Saturn’s rings.

Explain why Uranus and Neptune are blue.

Explain why the winds on Uranus are the fastest in the solar system.

Extra Learning Opportunities: Go to this website and read about the newest space telescope.

What important questions may the JWST help us to answer?
DIRECTIONS: Read How Do Planets Orbit the Sun?, decide which student has the best idea, and explain your thinking and describe any evidence that supports your answer.

How Do Planets Orbit the Sun?

A teacher asked her students to name the planets in order from closest to farthest from the Sun. All of the students were able to do this by listing Mercury, Venus, Earth, Mars, Jupiter, Saturn Uranus, and Neptune.

Then the teacher surprised her students by asking them to draw the orbits of the first six planets, showing how they orbit around the Sun. Different students drew the orbits in different ways.

Which drawing do you think is most accurate? ____

Explain why you chose that drawing and not the others.
JUPITER

Jupiter is the fifth planet from our Sun and is, by far, the largest planet in the solar system—more than twice as massive as all the other planets combined. Jupiter's stripes and swirls are actually cold, windy clouds of ammonia and water, floating in an atmosphere of hydrogen and helium. Jupiter's iconic Great Red Spot is a giant storm bigger than Earth that has raged for hundreds of years.

Jupiter is surrounded by more than 65 known moons. Scientists are most interested in the Galilean satellites—the four largest moons discovered by Galileo Galilei in 1610: Io, Europa, Ganymede and Callisto. Jupiter also has several rings, but unlike the famous rings of Saturn, Jupiter’s rings are very faint and made of dust, not ice.

Jupiter is named for the king of the ancient Roman gods.

With a radius of 43,440.7 miles (69,911 kilometers), Jupiter is 11 times wider than Earth. If Earth were the size of a nickel, Jupiter would be about as big as a basketball.

From an average distance of 484 million miles (778 million kilometers), Jupiter is 5.2 astronomical units away from the Sun. One astronomical unit (abbreviated as AU), is the distance from the Sun to Earth. From this distance, it takes Sunlight 43 minutes to travel from the Sun to Jupiter.

Jupiter has the shortest day in the solar system. One day on Jupiter takes only about 10 hours (the time it takes for Jupiter to rotate or spin around once), and Jupiter makes a complete orbit around the Sun (a year in Jovian time) in about 12 Earth years (4,333 Earth days).

Its equator is tilted with respect to its orbital path around the Sun by just 3 degrees. This means Jupiter spins nearly upright and does not have seasons as extreme as other planets do.

Jupiter took shape when the rest of the solar system formed about 4.5 billion years ago, when gravity pulled swirling gas and dust in to become this gas giant. Jupiter took most of the mass left over after the formation of the Sun, ending up with more than twice the combined material of the other bodies in the solar system.

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The composition of Jupiter is similar to that of the Sun—mostly hydrogen and helium. Deep in the atmosphere, pressure and temperature increase, compressing the hydrogen gas into a liquid. This gives Jupiter the largest ocean in the solar system—an ocean made of hydrogen instead of water. Scientists think that, at depths perhaps halfway to the planet's center, the pressure becomes so great that electrons are squeezed off the hydrogen atoms, making the liquid electrically conducting like metal. Jupiter's fast rotation is thought to drive electrical currents in this region, generating the planet's powerful magnetic field. It is still unclear if, deeper down, Jupiter has a central core of solid material or if it may be a thick, super-hot and dense soup. It could be up to 90,032 degrees Fahrenheit (50,000 degrees Celsius) down there, made mostly of iron and silicate minerals (similar to quartz).

As a gas giant, Jupiter doesn't have a true surface. The planet is mostly swirling gases and liquids. While a spacecraft would have nowhere to land on Jupiter, it wouldn’t be able to fly through unscathed either. The extreme pressures and temperatures deep inside the planet crush, melt and vaporize spacecraft trying to fly into the planet.

Jupiter's appearance is a tapestry of colorful cloud bands and spots. The gas planet likely has three distinct cloud layers in its "skies" that, taken together, span about 44 miles (71 kilometers). The top cloud is probably made of ammonia ice, while the middle layer is likely made of ammonium hydrosulfide crystals. The innermost layer may be made of water ice and vapor.

The vivid colors you see in thick bands across Jupiter may be plumes of sulfur and phosphorus-containing gases rising from the planet's warmer interior. Jupiter's fast rotation—spinning once every 10 hours—creates strong jet streams, separating its clouds into dark belts and bright zones across long stretches.

With no solid surface to slow them down, Jupiter's spots can persist for many years. Stormy Jupiter is swept by over a dozen prevailing winds, some reaching up to 335 miles per hour (539 kilometers per hour) at the equator. The Great Red Spot, a swirling oval of clouds twice as wide as Earth, has been observed on the giant planet for more than 300 years. More recently, three smaller ovals merged to form the Little Red Spot, about half the size of its larger cousin. Scientists do not yet know if these ovals and planet-circling bands are shallow or deeply rooted to the interior.
Jupiter’s environment is probably not conducive to life as we know it. The temperatures, pressures and materials that characterize this planet are most likely too extreme and volatile for organisms to adapt to.

While planet Jupiter is an unlikely place for living things to take hold, the same is not true of some of its many moons. Europa is one of the likeliest places to find life elsewhere in our solar system. There is evidence of a vast ocean just beneath its icy crust, where life could possibly be supported.

With four large moons and many smaller moons, Jupiter forms a kind of miniature solar system. Jupiter has 53 confirmed moons, as well as 14 provisional ones. These newly discovered, provisional moons are reported by astronomers and acknowledged with a temporary designation by the International Astronomical Union. Once their orbits are confirmed, they are included in Jupiter's confirmed moon count.

Jupiter's four largest moons—Io, Europa, Ganymede and Callisto—were first observed by the astronomer Galileo Galilei in 1610 using an early version of the telescope. These four moons are known today as the Galilean satellites, and they're some of the most fascinating destinations in our solar system. Io is the most volcanically active body in the solar system. Ganymede is the largest moon in the solar system (even bigger than the planet Mercury). Callisto's very few small craters indicate a small degree of current surface activity. A liquid-water ocean with the ingredients for life may lie beneath the frozen crust of Europa, making it a tempting place to explore.

Discovered in 1979 by NASA's Voyager 1 spacecraft, Jupiter's rings were a surprise, as they are composed of small, dark particles and are difficult to see except when backlit by the Sun. Data from the Galileo spacecraft indicate that Jupiter's ring system may be formed by dust kicked up as interplanetary meteoroids smash into the giant planet's small innermost moons.

**SATURN**

Saturn is the sixth planet from the Sun and the second largest planet in our solar system. Adorned with a dazzling system of icy rings, Saturn is unique among the planets. It is not the only planet to have rings, but none are as spectacular or as complex as Saturn's. Like fellow gas giant Jupiter, Saturn is a massive ball made mostly of hydrogen and helium.

Surrounded by more than 60 known moons, Saturn is home to some of the most fascinating landscapes in our solar system. From the jets of water that spray from Enceladus to the methane lakes on smoggy Titan, the Saturn system is a rich source of scientific discovery and still holds many mysteries.

The farthest planet from Earth discovered by the unaided human eye, Saturn has been known since ancient times. The planet is named for the Roman god of agriculture and wealth, who was also the father of Jupiter.

With a radius of 36,183.7 miles (58,232 kilometers), Saturn is 9 times wider than Earth. If Earth were the size of a nickel, Saturn would be about as big as a volleyball.

From an average distance of 886 million miles (1.4 billion kilometers), Saturn is 9.5 astronomical units away from the Sun. One astronomical unit (abbreviated as AU), is the distance from the Sun to Earth. From this distance, it takes sunlight 80 minutes to travel from the Sun to Saturn.

Saturn has the second-shortest day in the solar system. One day on Saturn takes only 10.7 hours (the time it takes for Saturn to rotate or spin around once), and Saturn makes a complete orbit around the Sun (a year in Saturnian time) in about 29.4 Earth years (10,756 Earth days).

Its axis is tilted by 26.73 degrees with respect to its orbit around the Sun, which is similar to Earth's 23.5-degree tilt. This means that, like Earth, Saturn experiences seasons.

Saturn took shape when the rest of the solar system formed about 4.5 billion years ago, when gravity pulled swirling gas and dust in to become this gas giant. About 4 billion years ago, Saturn settled into its current position in the outer solar system, where it is the sixth planet from the Sun. Like Jupiter, Saturn is mostly made of hydrogen and helium, the same two main components that make up the Sun.

Like Jupiter, Saturn is made mostly of hydrogen and helium. At Saturn's center is a dense core of metals like iron and nickel surrounded by rocky material and other compounds solidified by the intense pressure and heat. It is enveloped by liquid metallic hydrogen inside a layer of liquid hydrogen—similar to Jupiter's core but considerably smaller.

It's hard to imagine, but Saturn is the only planet in our solar system whose average density is less than water. The giant gas planet could float in a bathtub if such a colossal thing existed.
As a gas giant, Saturn doesn’t have a true surface. The planet is mostly swirling gases and liquids deeper down. While a spacecraft would have nowhere to land on Saturn, it wouldn’t be able to fly through unscathed either. The extreme pressures and temperatures deep inside the planet crush, melt and vaporize spacecraft trying to fly into the planet.

Saturn is blanketed with clouds that appear as faint stripes, jet streams and storms. The planet is many different shades of yellow, brown and grey.

Winds in the upper atmosphere reach 1,600 feet per second (500 meters per second) in the equatorial region. In contrast, the strongest hurricane-force winds on Earth top out at about 360 feet per second (110 meters per second). And the pressure—the same kind you feel when you dive deep underwater—is so powerful it squeezes gas into liquid.

Saturn's north pole has an interesting atmospheric feature—a six-sided jet stream. This hexagon-shaped pattern was first noticed in images from the Voyager I spacecraft and has been more closely observed by the Cassini spacecraft since. Spanning about 20,000 miles (30,000 kilometers) across, the hexagon is a wavy jet stream of 200-mile-per-hour winds (about 322 kilometers per hour) with a massive, rotating storm at the center. There is no weather feature like it anywhere else in the solar system.

Saturn’s environment is not conducive to life as we know it. The temperatures, pressures and materials that characterize this planet are most likely too extreme and volatile for organisms to adapt to.

While planet Saturn is an unlikely place for living things to take hold, the same is not true of some of its many moons. Satellites like Enceladus and Titan, home to internal oceans, could possibly support life.

Saturn is home to a vast array of intriguing and unique worlds. From the haze-shrouded surface of Titan to crater-riddled Phoebe, each of Saturn's moons tells another piece of the story surrounding the Saturn system. Currently Saturn has 53 confirmed moons with nine additional provisional moons awaiting confirmation.

Saturn's rings are thought to be pieces of comets, asteroids or shattered moons that broke up before they reached the planet, torn apart by Saturn's powerful gravity. They are made of billions of small chunks of ice and rock coated with another material such as dust. The ring particles mostly range from tiny, dust-sized icy grains to chunks as big as a house. A few particles are as large as mountains. The rings would look mostly white if you looked at them from the cloud tops of Saturn, and interestingly, each ring orbits at a different speed around the planet.

Saturn's ring system extends up to 175,000 miles (282,000 kilometers) from the planet, yet the vertical height is typically about 30 feet (10 meters) in the main rings. Named alphabetically in the order they were discovered, the rings are relatively close to each other, with the exception of a gap measuring 2,920 miles (4,700 kilometers) wide called the Cassini Division that separates Rings A and B. The main rings are A, B and C. Rings D, E, F and G are fainter and more recently discovered.

Starting at Saturn and moving outward, there is the D ring, C ring, B ring, Cassini Division, A ring, F ring, G ring, and finally, the E ring. Much farther out, there is the very faint Phoebe ring in the orbit of Saturn's moon Phoebe.

**URANUS**

The seventh planet from the Sun with the third largest diameter in our solar system, Uranus is very cold and windy. The ice giant is surrounded by 13 faint rings and 27 small moons as it rotates at a nearly 90-degree angle from the plane of its orbit. This unique tilt makes Uranus appear to spin on its side, orbiting the Sun like a rolling ball.

The first planet found with the aid of a telescope, Uranus was discovered in 1781 by astronomer William Herschel, although he originally thought it was either a comet or a star. It was two years later that the object was universally accepted as a new planet, in part because of observations by astronomer Johann Elert Bode.

William Herschel tried unsuccessfully to name his discovery Georgium Sidus after King George III. Instead the planet was named for Uranus, the Greek god of the sky, as suggested by Johann Bode.

With a radius of 15,759.2 miles (25,362 kilometers), Uranus is 4 times wider than Earth. If Earth was the size of a nickel, Uranus would be about as big as a softball.
From an average distance of 1.8 billion miles (2.9 billion kilometers), Uranus is 19.8 astronomical units away from the Sun. One astronomical unit (abbreviated as AU), is the distance from the Sun to Earth. From this distance, it takes sunlight 2 hours and 40 minutes to travel from the Sun to Uranus.

One day on Uranus takes about 17 hours (the time it takes for Uranus to rotate or spin once). And Uranus makes a complete orbit around the Sun (a year in Uranian time) in about 84 Earth years (30,687 Earth days).

Uranus is the only planet whose equator is nearly at a right angle to its orbit, with a tilt of 97.77 degrees—possibly the result of a collision with an Earth-sized object long ago. This unique tilt causes the most extreme seasons in the solar system. For nearly a quarter of each Uranian year, the Sun shines directly over each pole, plunging the other half of the planet into a 21-year-long, dark winter.

Uranus is also one of just two planets that rotate in the opposite direction than most of the planets (Venus is the other one), from east to west.

Uranus took shape when the rest of the solar system formed about 4.5 billion years ago, when gravity pulled swirling gas and dust in to become this ice giant. Like its neighbor Neptune, Uranus likely formed closer to the Sun and moved to the outer solar system about 4 billion years ago, where it is the seventh planet from the Sun.

Uranus is one of two ice giants in the outer solar system (the other is Neptune). Most (80 percent or more) of the planet's mass is made up of a hot dense fluid of "icy" materials—water, methane and ammonia—above a small rocky core. Near the core, it heats up to 9,000 degrees Fahrenheit (4,982 degrees Celsius).

Uranus is slightly larger in diameter than its neighbor Neptune, yet smaller in mass. It is the second least dense planet; Saturn is the least dense of all.

Uranus gets its blue-green color from methane gas in the atmosphere. Sunlight passes through the atmosphere and is reflected back out by Uranus' cloud tops. Methane gas absorbs the red portion of the light, resulting in a blue-green color.

As an ice giant, Uranus doesn’t have a true surface. The planet is mostly swirling fluids. While a spacecraft would have nowhere to land on Uranus, it wouldn’t be able to fly through its atmosphere unscathed either. The extreme pressures and temperatures would destroy a metal spacecraft.

Uranus' atmosphere is mostly hydrogen and helium, with a small amount of methane and traces of water and ammonia. The methane gives Uranus its signature blue color.

While Voyager 2 saw only a few discrete clouds, a Great Dark Spot and a small dark spot during its flyby in 1986, more recent observations reveal that Uranus exhibits dynamic clouds as it approaches equinox, including rapidly changing bright features.

Uranus' planetary atmosphere, with a minimum temperature of 49K (-224.2 degrees Celsius) makes it even colder than Neptune in some places.

Wind speeds can reach up to 560 miles per hour (900 kilometers per hour) on Uranus. Winds are retrograde at the equator, blowing in the reverse direction of the planet’s rotation. But closer to the poles, winds shift to a prograde direction, flowing with Uranus' rotation.

Uranus' environment is not conducive to life as we know it. The temperatures, pressures and materials that characterize this planet are most likely too extreme and volatile for organisms to adapt to.

Neptune has 27 known moons. While most of the satellites orbiting other planets take their names from Greek or Roman mythology, Uranus' moons are unique in being named for characters from the works of William Shakespeare and Alexander Pope.

All of Uranus' inner moons appear to be roughly half water ice and half rock. The composition of the outer moons remains unknown, but they are likely captured asteroids.

Uranus has two sets of rings. The inner system of nine rings consists mostly of narrow, dark grey rings. There are two outer rings: the innermost one is reddish like dusty rings elsewhere in the solar system, and the outer ring is blue like Saturn's E ring.

In order of increasing distance from the planet, the rings are called Zeta, 6, 5, 4, Alpha, Beta, Eta, Gamma, Delta, Lambda, Epsilon, Nu and Mu. Some of the larger rings are surrounded by belts of fine dust.
NEPTUNE

Dark, cold and whipped by supersonic winds, ice giant Neptune is the eighth and most distant planet in our solar system. More than 30 times as far from the Sun as Earth, Neptune is the only planet in our solar system not visible to the naked eye. In 2011 Neptune completed its first 165-year orbit since its discovery in 1846.

Neptune is so far from the Sun that high noon on the big blue planet would seem like dim twilight to us. The warm light we see here on our home planet is roughly 900 times as bright as sunlight on Neptune.

The ice giant Neptune was the first planet located through mathematical calculations. Using predictions made by Urbain Le Verrier, Johann Galle discovered the planet in 1846. The planet is named after the Roman god of the sea, as suggested by Le Verrier.

With a radius of 15,299.4 miles (24,622 kilometers), Neptune is about four times wider than Earth. If Earth were the size of a nickel, Neptune would be about as big as a baseball.

From an average distance of 2.8 billion miles (4.5 billion kilometers), Neptune is 30 astronomical units away from the Sun. One astronomical unit (abbreviated as AU), is the distance from the Sun to Earth. From this distance, it takes sunlight 4 hours to travel from the Sun to Neptune.

One day on Neptune takes about 16 hours (the time it takes for Neptune to rotate or spin once). And Neptune makes a complete orbit around the Sun (a year in Neptunian time) in about 165 Earth years (60,190 Earth days).

Sometimes Neptune is even farther from the Sun than dwarf planet Pluto. Pluto's highly eccentric, oval-shaped orbit brings it inside Neptune's orbit for a 20-year period every 248 Earth years. This switch, in which Pluto is closer to the Sun than Neptune, happened most recently from 1979 to 1999. Pluto can never crash into Neptune, though, because for every three laps Neptune takes around the Sun, Pluto makes two. This repeating pattern prevents close approaches of the two bodies.

Neptune’s axis of rotation is tilted 28 degrees with respect to the plane of its orbit around the Sun, which is similar to the axial tilts of Mars and Earth. This means that Neptune experiences seasons just like we do on Earth; however, since its year is so long, each of the four seasons lasts for over 40 years.

Neptune took shape when the rest of the solar system formed about 4.5 billion years ago, when gravity pulled swirling gas and dust in to become this ice giant. Like its neighbor Uranus, Neptune likely formed closer to the Sun and moved to the outer solar system about 4 billion years ago.

Neptune is one of two ice giants in the outer solar system (the other is Uranus). Most (80 percent or more) of the planet's mass is made up of a hot dense fluid of "icy" materials—water, methane and ammonia—above a small, rocky core. Of the giant planets, Neptune is the densest.

Scientists think there might be an ocean of super hot water under Neptune's cold clouds. It does not boil away because incredibly high pressure keeps it locked inside.

Neptune does not have a solid surface. Its atmosphere (made up mostly of hydrogen, helium and methane) extends to great depths, gradually merging into water and other melted ices over a heavier, solid core with about the same mass as Earth.

Neptune's atmosphere is made up mostly of hydrogen and helium with just a little bit of methane. Neptune's neighbor Uranus is a blue-green color due to such atmospheric methane, but Neptune is a more vivid, brighter blue, so there must be an unknown component that causes the more intense color.

Neptune is our solar system's windiest world. Despite its great distance and low energy input from the Sun, Neptune's winds can be three times stronger than Jupiter's and nine times stronger than Earth's. These winds whip clouds of frozen methane across the planet at speeds of more than 1,200 miles per hour (2,000 kilometers per hour). Even Earth's most powerful winds hit only about 250 miles per hour (400 kilometers per hour).

In 1989 a large, oval-shaped storm in Neptune's southern hemisphere dubbed the "Great Dark Spot" was large enough to contain the entire Earth. That storm has since disappeared, but new ones have appeared on different parts of the planet.
Neptune's environment is not conducive to life as we know it. The temperatures, pressures and materials that characterize this planet are most likely too extreme and volatile for organisms to adapt to.

Neptune has 13 known moons and one provisional moon that is awaiting official confirmation. Neptune's largest moon Triton was discovered on October 10, 1846, by William Lassell, just 17 days after Johann Gottfried Galle discovered the planet. Since Neptune was named for the Roman god of the sea, its moons are named for various lesser sea gods and nymphs in Greek mythology.

Triton is the only large moon in the solar system that circles its planet in a direction opposite to the planet's rotation (a retrograde orbit), which suggests that it may once have been an independent object that Neptune captured. Triton is extremely cold, with surface temperatures around minus 391 degrees Fahrenheit (minus 235 degrees Celsius). And yet, despite this deep freeze at Triton, Voyager 2 discovered geysers spewing icy material upward more than 5 miles (8 kilometers). Triton's thin atmosphere, also discovered by Voyager, has been detected from Earth several times since, and is growing warmer, but scientists do not yet know why.

Neptune has five known rings. Starting near the planet and moving outward, they are named Galle, Leverrier, Lassell, Arago and Adams. The rings are thought to be relatively young and short-lived.

Neptune's rings also have peculiar clumps of dust called arcs. Four prominent arcs named Liberté (Liberty), Egalité (Equality), Fraternité (Fraternity) and Courage are in the outermost ring, Adams. The arcs are strange because the laws of motion would predict that they would spread out evenly rather than stay clumped together. Scientists now think the gravitational effects of Galatea, a moon just inward from the ring, stabilizes these arcs.