# GRADE 6 UNIT 3: ASTRONOMY

## Scope & Sequence

Time Frame: 22 Days

### UNIT OVERVIEW

In the sixth grade Astronomy unit, the regular and predictable motions of the Earth and moon are explored and are used to explain various phenomena. The Earth is described as part of a larger star-planet system called the Solar System, which follows similar predictable patterns of motion. The Solar System is a small part of the Milky Way Galaxy, which in turn is a minute part of the universe. Topics include gravitation forces, the electromagnetic spectrum

### UNIT STANDARDS/OUTCOMES

 **NGSS Standards: (Performance Expectations)**

[MS- ESS1-1:](https://drive.google.com/file/d/1q7_PwhIEFeM0yyUOWNyg_rOHBCZQMfCT/view?usp=sharing) Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

[MS-ESS1-2:](https://drive.google.com/file/d/1hsdJOgsOhWlFRCq9zfJv8L5UtwBoOpsC/view?usp=sharing) Develop and use a model to describe the role of gravity in the motions within the galaxies and the solar system.

[MS-ESS1-3:](https://drive.google.com/file/d/1ng5mYo4vQMv8-oZq6pDblCE7eerhZbcz/view?usp=sharing) Analyze and interpret data to determine scale properties of objects in the solar system.

[MS-PS2-4:](https://drive.google.com/file/d/1BRwqkpwGhTPWejZPVvFamaGYZm00JIUw/view?usp=sharing) Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

[MS-PS4-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS4-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

### Science and Engineering Practices

*Students will use the following practices*…

Developing and Using Models

Planning and Carrying Out Investigations

Analyzing and Interpreting Data

Constructing Explanations and Designing Solutions

### Crosscutting Concepts

*Students will understand the crosscutting concept…*

Patterns

Cause and Effect

Scale Proportion and Quantity

Systems and System Models

Energy and Matter

Stability and Change

## UNIT ESSENTIAL QUESTIONS

**1. Explain the components of the universe.**

At the center of our solar system, the sun (a star) uses its gravity to hold 8 planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Neptune, and Uranus) in orbit. Many of these planets also have their own satellites or moons. Outside of the sun’s gravitational pull, other stars in various stages of their life cycle exist. Likewise, other solar systems and planets make up various types of galaxies all held together with gravitational pull. All of these components make up our universe.

**2. How do gravity and inertia influence time?**

Gravity is the force that pulls earth close to the sun. Inertia is the property of matter that keeps the earth moving in its gravitational orbit. Due to this, one year (365.25 days) will pass as the earth revolves around this orbit one complete time. Furthermore, one day will pass (23 hours, 56 minutes) as the earth rotates one complete time around its axis.

**3. How would the world's climates change if the earth's axis were not tilted?**

If the axis of the earth were not tilted, the Earth's poles would always be perpendicular to the sun. The sun would always be just on the horizon 24 hours a day, every day at the poles. Every day would be like what it currently is on the equinox since every location on Earth would have about a 12 hour sunlight days and the noon sun angle would be about the same every day. There would no longer be season as we know them. The temperature and precipitation patterns would not vary much. Across the Earth it would be like it is in the middle of fall or spring but it would last all year every year. Areas today that have wet, dry, warm and cold seasons would have a fairly constant weather all year whether it be wet, dry, warm and/or cold.

**4. How does the relationship between the earth, moon, and sun impact humans?**

The gravitational pull of the Earth acts upon our moon, keeping it in orbit around our planet. The phases of the moon are caused by the moon’s revolution around the earth and relative positions of these three celestial bodies. A solar eclipse occurs when earth passes into the moon’s shadow. A lunar eclipse occurs when the moon passes into the earth’s shadow. Furthermore the gravitational pull of the moon and sun also act on the earth. Tides on earth are caused by these gravitational forces. The regular rise and fall of the earth’s oceans exhibit a predictable patterns (i.e. spring and neap tides).

## VOCABULARY:

[**Link to vocabulary list with definitions**](https://docs.google.com/a/ccps.org/spreadsheets/d/1QxhFKjkPD6V-7qQZt2FwuGb6k-W2E9dr-9yy3CtN1D0/edit?usp=sharing)

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| --- | --- | --- |
| RotationRevolutionOrbitAxisTiltTropic of CancerTropic of CapricornSeasonsPhases of the moon | TidesSpring tideNeap tide GalaxyUniverseSpiralEllipticalIrregularSolar System | EclipseLunar EclipseSolar EclipseSunGravityInertiaPeriodicPlanetary System |

| STANDARDS(Performance Expectations) | KNOW(Disciplinary Core Ideas) | UNDERSTAND(Content - Observable Features) | DO(Lesson plans) |
| --- | --- | --- | --- |
| [MS-ESS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf). Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.[MS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf). Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. [MS-PS4-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS4-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. | ***ESS1.A: The Universe and Its Stars****Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.* ***ESS1.B: Earth and the Solar System****The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.****PS2.B: Types of Interactions*** *Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g****PS4.B: Electromagnetic Radiation****A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media* | The **UNIVERSE** is all of space and everything in it. It is estimated to be over 10 billion years old and contains billions and billions of galaxies.Gravity and inertia are responsible for the pattern of motion of celestial objects. These forces are also credited with the origin and expansion of our universe and have been measured and recorded through observations made from spectrograph readings (light waves). | [**Lesson 1 - Structure of the Universe**](https://drive.google.com/drive/folders/1Ta56WFdbwb6CrTdAlwtOZoZAml9TpYad)**(5 days)** |
| [MS-ESS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf). Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. | ***ESS1.A: The Universe and Its Stars****Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.*  | 1. A **GALAXY** is a giant structure that contains hundreds of billions of stars.

2. Galaxies have been classified into three main categories based mainly on shape: spiral, elliptical, and irregular.**SPIRAL** galaxies have flattened arms of young stars, gas, and dust that spiral around a nucleus of bright stars.**ELLIPTICAL** galaxies have shapes that vary from nearly spherical to football-shaped. They contain mostly older, dimmer stars.**IRREGULAR** galaxies do not have a particular shape and tend to be smaller and fainter than other types of galaxies.Our solar system is a very small part of the Milky Way Galaxy. The Milky Way is a spiral galaxy that contains about 200 billion stars in a diameter of about 100,000 light-years. Our sun is 30,000 light-years from the center of the galaxy. | [**Lesson 2 - Galaxies**](https://drive.google.com/drive/folders/1UVC9UwVnfcM68JnBuGjP2CYTbCLCJRT_)**(2 Days)** |
| [MS-ESS1-3:](https://drive.google.com/file/d/1ng5mYo4vQMv8-oZq6pDblCE7eerhZbcz/view?usp=sharing) Analyze and interpret data to determine scale properties of objects in the solar system. | ***ESS1.B: Earth and the Solar System****The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.*  | All stars are huge spheres of glowing gas that produce or have produced energy by fusion. The amount of light a star gives off and its distance from Earth determine how bright it appears to an observer.   | [**Lesson 3 - Stars**](https://drive.google.com/drive/folders/1iV3NKF_HhoFHJNG3FahacbRnygm2KgFk)**(2 Days)** |
| [MS-ESS1-3:](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf) Analyze and interpret data to determine scale properties of objects in the solar system.[MS-ESS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf). Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.[MS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.  | ***ESS1.B: Earth and the Solar System****The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.* ***PS2.B: Types of Interactions*** *Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small, except when one or both of the objects have large mass—e.g., Earth and the sun.*  | Identifying Relationships: (MS-ESS1-3) A. Students use quantitative analyses to describe\* similarities and differences among solar system objects by describing\* patterns of features of those objects at different scales, including: i. Distance from the sun. ii. Diameter.  iv. Structure. v. Composition (e.g., ice versus rock versus gas). Interpreting data:(MS-ESS1-3)B. Students use patterns in data as evidence to describe\* that two objects may be similar when viewed at one scale (e.g., types of surface features) but may appear to be quite different when viewed at a different scale (e.g., diameter or number of natural satellites). c Students use the organization of data to facilitate drawing conclusions about the patterns of scale properties at more than one scale, such as those that are too large or too small to directly observeComponent of the Model (MS-ESS1-2)1. To make sense of a given phenomenon, students develop a model in which they identify the relevant components of the system, including: i. Gravity

Relationships (MS-ESS1-2)1. Students describe\* the relationships and interactions between components of the solar and galaxy

systems, including:i. Gravity as an attractive force between solar system and galaxy objects that:1. Increases with the mass of the interacting objects increases.2. Decreases as the distances between objects increases.Connections (MS-ESS1-2)1. Students use the model to describe\* that gravity causes a pattern of smaller/less massive objects orbiting around larger/more massive objects at all system scales in the universe, including that: i. Gravitational forces from planets cause smaller objects (e.g., moons) to orbit around planets.

Reasoning & Synthesis (MS-PS2-4)a Students use reasoning to connect the appropriate evidence about the forces on objects andconstruct the argument that gravitational forces are attractive and mass dependent. Studentsdescribe\* the following chain of reasoning:i. Systems of objects can be modeled as a set of masses interacting via gravitational forces.ii. In systems of objects, larger masses experience and exert proportionally larger gravitationalforces.iii. In every case for which evidence exists, gravitational force is attractive.b To support the claim, students present their oral or written argument concerning the direction of gravitational forces and the role of the mass of the interacting objects. | [**Lesson 4 - Solar System/Planets & Gravitational Pull**](https://drive.google.com/drive/folders/1GFw8qi33KaXVB4b-ovBzO-8chz_t8EAF)**(4 Days)** |
| [MS-ESS1-3:](https://drive.google.com/file/d/1ng5mYo4vQMv8-oZq6pDblCE7eerhZbcz/view?usp=sharing) Analyze and interpret data to determine scale properties of objects in the solar system.[MS-PS2-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-PS2-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.  | ***ESS1.B: Earth and the Solar System****The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.* *The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.* | 1. Students use the model to describe\* that objects too far away from the sun do not orbit it because the sun’s gravitational force on those objects is too weak to pull them into orbit.
 | [**Lesson 5 - Gravity’s Effect on the Universe**](https://drive.google.com/drive/folders/1gcte-mwFUvClXo9h5yPZxDsm0ZhQcx3V)**(2 Days)** |
| [MS- ESS1-1:](https://drive.google.com/file/d/1q7_PwhIEFeM0yyUOWNyg_rOHBCZQMfCT/view?usp=sharing) Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. | ***ESS1.B: Earth and the Solar System****This model of the solar system can explain eclipses of the sun and moon. Earth’s spin axis is fixed direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.* ***ESS1.A: The Universe and Its Stars****Patterns of the apparent motion of the sun, the moon and stars in the sky can be observed, described, predicted, and explained.*  | 1. Planets and moons constantly exhibit two main types of motion: rotation and revolution.
2. The **PERIOD OF ROTATION** is the time it takes a celestial body to spin once on its axis. The axis is an imaginary line that runs through the body from pole to pole.
3. The rotation of a planet determines the length of its solar day. On Earth, the solar day is equal to 23 hours 56 minutes.
4. The **PERIOD OF REVOLUTION** is the time it takes a celestial body to orbit once around another object.
5. The revolution of a planet determines its solar year. A planet’s period of revolution depends on its distance from the sun. Earth’s solar year lasts 365.25 days.
6. The axis of the Earth is tilted at 23.5˚. The axis is tilted in the same direction (towards the North Star, also called Polaris) at all times.
7. The tilt of the Earth’s axis causes changes in the angle of the sun’s rays in the sky during the year. This causes uneven heating of the Earth’s surface, resulting in seasons.
8. The sun’s most direct rays fall between 23.5˚N latitude and 23.5˚S latitude. These lines are called the Tropic of Cancer and the Tropic of Capricorn respectively.
9. Areas north of the Tropic of Cancer and areas south of the Tropic of Capricorn never receive direct rays of the Sun.
10. Maryland has 4 distinct seasons that are caused by the tilt of the Earth.
 | [**Lesson 6 - Earth (revolution/rotation/seasons)**](https://drive.google.com/drive/folders/11XWQr0-aZcS65cn4y2RZ7hwsqJNH3UR2)**(3 Days)** |
| [MS- ESS1-1:](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/MS-ESS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf) Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. | ***ESS1.A: The Universe and Its Stars****Patterns of the apparent motion of the sun, the moon and stars in the sky can be observed, described, predicted, and explained.* ***ESS1.B: Earth and the Solar System****This model of the solar system can explain eclipses of the sun and moon. Earth’s spin axis is fixed direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.*  | 1. The moon’s surface is illuminated as sunlight is reflected off the surface.
2. Moon phases are caused by the moon’s revolution around the earth and relative positions of the sun, the moon and the earth.
3. A **SOLAR ECLIPSE** occurs when Earth passes into the moon’s shadow. A total solar eclipse is viewed on only a small portion of the earth.
4. A **LUNAR ECLIPSE** occurs when the moon passes into the Earth’s shadow.
5. Describe how the shape and location of the orbits of asteroids and comets affect their periods of revolution.
6. A **TIDE** is the regular rise and fall of Earth’s oceans.
7. Tides on the Earth are caused by the gravitational forces acting between the Sun, the moon and the Earth. On a daily basis, the tides exhibit a predictable pattern.
8. The periodic variation in tidal heights is caused by the position of the sun and moon relative to the earth. (**SPRING TIDE and NEAP TIDE**)
 | [**Lesson 7 - Moon (phases, eclipses, tides)**](https://drive.google.com/drive/folders/1C3qGc7jbrmle2UGvMGbWnjPjc0CWuOgS) |