

Coverage Of Science: Human Population Growth



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف السابع ← علوم ← الفصل الثالث ← ملفات متنوعة ← الملف

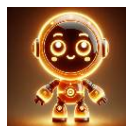
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المزيد من مادة
علوم:

إعداد: Elhddad Ahmed

التواصل الاجتماعي بحسب الصف السابع



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف السابع والمادة علوم في الفصل الثالث

مراجعة عامة للوحدتين الثانية والثالثة

1

مراجعة عامة للدروس الخمسة الأولى لمادة

2

مراجعة محلولة هيكلية

3

اختبار الوحدة الثالثة عشر حول المناخ وتغيراته غير محلول

4

اختبار الوحدة الثانية عشر غير محلول

5

(يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ)

Coverage Of Science



G7
ADV,ATS
T3

2025-2026

Mr. Ahmed Elhddad

"the first Bio – Sci teacher" 2025 – 2026



1	Students will learn how human population has increased over time. They will investigate the factors that affect the growth of human populations and engage in scientific arguments about the cause and-effect relationship between human population growth and increased consumption of resources.	Q 1 a	U3M2L1 : Human Population Growth
		Q 1 b	
2	Students will learn how human population has increased over time. They will investigate the factors that affect the growth of human populations and engage in scientific arguments about the cause and-effect relationship between human population growth and increased consumption of resources.	Q 2 a	U3M2L1: Human Population Growth
		Q 2 b	

✓ Key Idea

Human population growth is closely linked to resource availability. While technology can delay limits, **Earth's resources are finite**, and exceeding them leads to environmental and population challenges.

- **Population**: A group of individuals of the same species living in a specific area.
- **Natural Resources**: Environmental materials essential for life (e.g., food, water, shelter, clothing).
- **Carrying Capacity**: The maximum number of individuals an environment can support sustainably over time.
- **Human Population Growth**
 - **Past**: About 1,000 years ago, the human population was ~300 million.
 - **Present & Future**:
 - Now exceeds **7 billion**
 - Expected to reach **9+ billion by 2050**
 - Around **15,000 births per hour worldwide**
 - **Reasons for Growth**:
 - Advances in technology
 - Improved healthcare
 - Access to clean water
 → These factors increase lifespan and reproduction rates.

Resource Use & Environmental Limits

- **Unequal Consumption**:
 - Developed countries use **more resources per person** than developing countries.
- **Industrialization**:
 - Countries like India are growing fast and consuming more resources.
- **Carrying Capacity Limits**:
 - If exceeded → resource depletion → population decline.
- **Technology Feedback Loop**:
 - Resource shortages → new technologies → temporary increase in carrying capacity
 - However, this often causes **environmental damage**.

Population change depends on:

- Rate of Increase = (Births + Immigration) – (Deaths + Emigration)
- **Increase factors**: Births, Immigration
- **Decrease factors**: Deaths, Emigration

📊 Age Structure Diagrams

Populations are divided into: (Pre-reproductive) ----- Reproductive ----- Post-reproductive)

Shapes and meanings:

- **Triangle (wide base)** → Rapid growth (e.g., Kenya)
- **Bulged rectangle** → Slow growth (e.g., USA)
- **Even rectangle** → Stable/no growth (e.g., Germany)

Q1: A demographer is studying a nation where the birthrate is exactly equal to the death rate, and no individuals are moving into the country. However, the total population size is still steadily decreasing over time. Which of the following statements must be true about this population?

- A) The rate of immigration is greater than the rate of emigration.
- B) The rate of emigration is greater than the rate of immigration.
- C) The pre-reproductive population is larger than the reproductive population.
- D) The country has reached its maximum biological carrying capacity.

Q2: A team of ecological scientists publishes an age structure diagram for a specific country. The diagram features a very wide, broad base at the bottom that rapidly narrows into a sharp point at the top. What does this specific shape indicate about the country's future resource needs?

- A) Resource consumption will remain completely stable because the population is non-growing.
- B) Resource consumption will decrease because a large post-reproductive group is shrinking.
- C) Resource demands will rapidly increase because a massive pre-reproductive group will soon enter their reproductive years.
- D) Resource demands will fluctuate unpredictably because the diagram represents a middle bulge.

Q3: Country X is a highly industrialized nation with a small, stable population growth rate. Country Y is a developing nation that is currently undergoing rapid industrialization and has a very high population growth rate.

If a major global resource crisis occurs, how will the resource consumption patterns of these two countries most likely interact?

- A) Country X will automatically consume fewer resources per capita than Country Y because its population is smaller.
- B) Country Y will experience an intense surge in total resource consumption as it combines its high population growth rate with rising industrial resource demands.
- C) Both countries will immediately drop their resource usage to zero because human populations cannot expand carrying capacity.
- D) Country Y will instantly take on a rectangular age structure diagram to preserve its remaining clean water supplies.

Q4: What is the direct relationship between human technological advancements and Earth's carrying capacity for humans?

- A) Technology always reduces the carrying capacity because it destroys natural resources permanently.
- B) Technology has no effect on carrying capacity because carrying capacity is a fixed, unchangeable number.
- C) Technology can temporarily expand carrying capacity by developing alternative resources or finding new extraction methods.
- D) Technology eliminates the concept of carrying capacity entirely, allowing infinite human growth without costs.

Q5: In a regional ecosystem, an animal population experienced a massive increase in deaths due to unregulated commercial hunting by humans. Decades later, a strict environmental protection law was passed, completely banning the hunting of this species. What is the predicted long-term effect of this law on the animal population?

- A) The population will drop to zero because laws do not change environmental birthrates.
- B) The population will begin to recover and increase as the death rate from hunting drops.
- C) The population will instantly exceed its carrying capacity and deplete all food resources in one year.
- D) The population will switch from a triangular age structure to a rectangular shape to stop growing.

Q6: Which of the following describes the most immediate consequence of a human population growing entirely beyond Earth's natural carrying capacity?

- A) Resources will become instantly abundant, lowering the population density further.
- B) Technological advancements will stop happening completely because space is crowded.
- C) Earth will no longer have enough natural resources to support the population, leading to a population decrease.
- D) The rate of immigration will automatically equal the birthrate to stabilize the global environment.

Question 1 a

What is carrying capacity?

- A) The maximum number of individuals of a species that a particular environment can support sustainably over time.
- B) The total weight of all living organisms within a specific ecosystem or habitat.
- C) The rate at which a population grows when there are unlimited resources available.
- B) The movement of individuals into a population from a different geographic area.

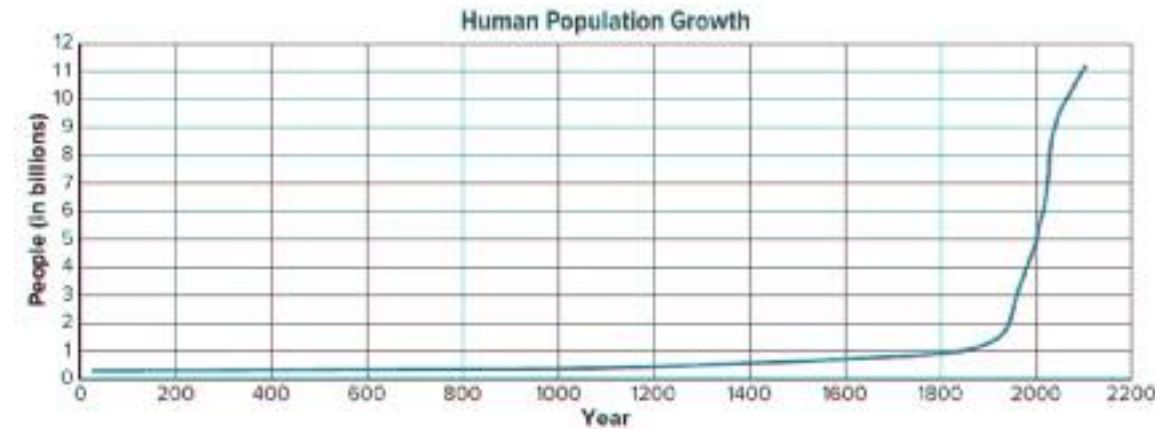
Question 1 b

Which of the following statements best explains the concept of carrying capacity and provides a correct real-life example of a population limited by its environment?

- A) It is the maximum population size an environment can sustain; for example, a forest can only support a certain number of deer based on available food and water.
- B) It is the total weight of all plants in an ecosystem; for example, a desert population increases when the temperature drops during winter.
- C) It is the maximum speed at which a population reproduces; for example, bacteria growing endlessly in a laboratory petri dish with unlimited nutrients.
- D) It is the movement of animals out of a habitat; for example, birds migrating south for the winter to find warmer weather.

Here We Grow Again

Analyze the information presented in the graph.

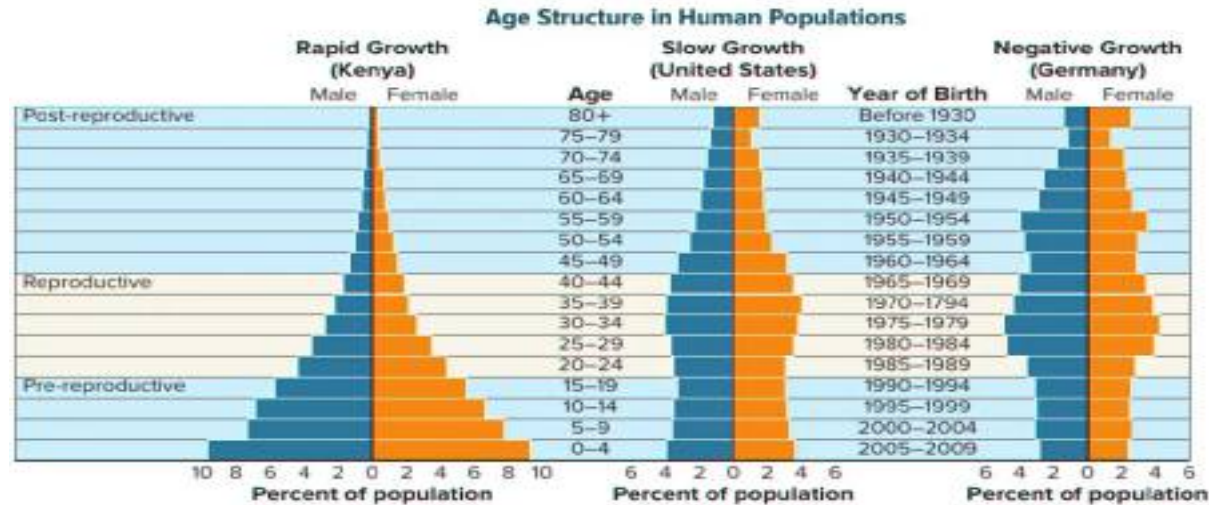


1. How does the rate of human population growth from years 200 to 1800 compare to the rate of growth from 1800 to 2000?

- A) The growth rate was **significantly faster** between 200 and 1800, showing a steep exponential J-curve, while it flattened out between 1800 and 2000.
- B) The growth rate was **relatively slow and stable** from years 200 to 1800, keeping the population under 1 billion, whereas from 1800 to 2000, it experienced **rapid, exponential growth**, surging toward 6 billion.
- C) The population grew at the **exact same constant linear rate** during both time periods, showing no major shifts in human history.
- D) The graph demonstrates a **severe population crash** between 1800 and 2000 due to environmental resistance and carrying capacity limits.

Increasing and Decreasing Populations

The diagram below shows the relative numbers of individuals in pre-reproductive, reproductive, and post-reproductive years for three countries: Kenya, the United States, and Germany.



2. **MATH Connection** Now, calculate the population growth rate (PGR) for each of these countries. Record this information in the table below. Use the following equation.

$$\frac{\text{birthrate} - \text{death rate} + \text{net migration rate}}{10} = \text{PGR (\%)}$$

Population Growth Rates					
Country	Population 2015 (millions)	Birthrate	Death Rate	Net Migration Rate	PGR (%)
*United States	321.2	13	8	3	
*Germany	81.1	8	11	5	
Brazil	204.5	15	6	0	
Indonesia	255.7	21	6	-1	
Nigeria	181.8	39	14	0	
India	1,314.1	21	7	-1	

Question 2a

How would you describe Kenya's population growth based on its age structure diagram?

- A) **Rapid growth**, because it has a very large percentage of the population in the pre-reproductive age groups, forming a wide base.
- B) **Slow growth**, because the number of individuals in the pre-reproductive and reproductive stages is nearly equal.
- C) **Negative growth**, because the older post-reproductive population is significantly larger than the younger generations.
- D) **Stable growth**, because the percentage of males and females is perfectly balanced across all age intervals.

Question 2b

Why does a chart like Germany's show negative growth?

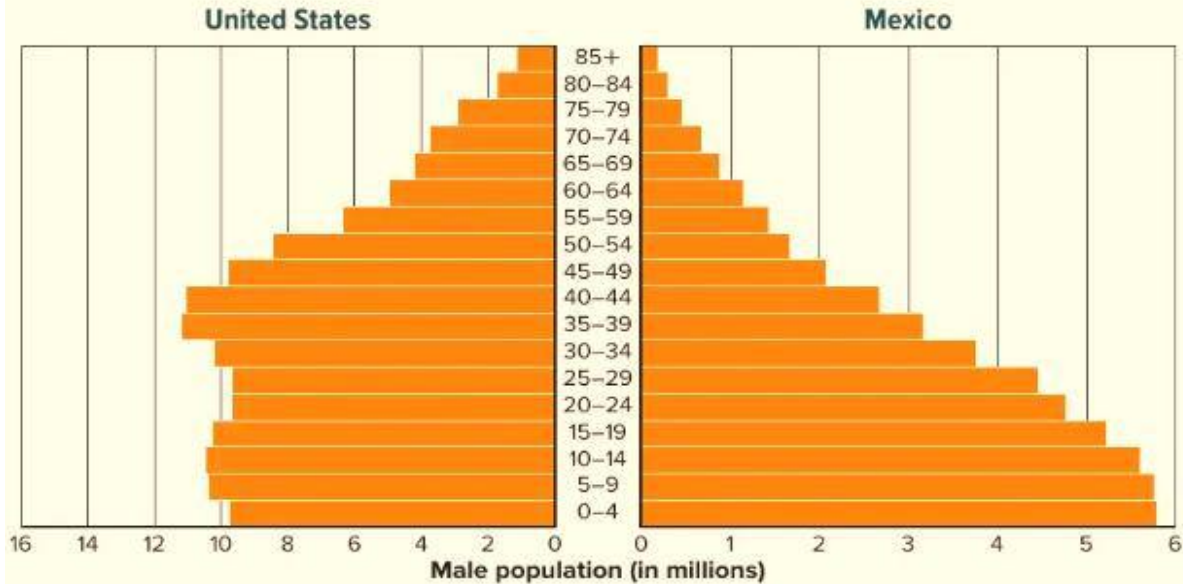
- A) The birth rate is much higher than the death rate, leading to an overpopulation of infants.
- B) The reproductive and post-reproductive age groups are significantly smaller than the pre-reproductive base.
- C) The pre-reproductive population is smaller than the reproductive population, meaning fewer individuals will enter their reproductive years in the future.
- D) There is a sudden and massive emigration of the elderly population to other geographic regions.

Question 2b

What can you determine about population dynamics from observing the top halves (post-reproductive years) of the three charts?

- A) Countries with rapid growth (like Kenya) have a higher life expectancy and a larger elderly population than countries with negative growth.
- B) Countries with negative or slow growth (like Germany and the US) have a larger percentage of their population surviving into older age groups compared to rapid-growth countries.
- C) The percentage of the population in post-reproductive years is exactly the same across all three countries regardless of growth rates.
- D) Post-reproductive individuals contribute the most to the ongoing, immediate birth rates of all three nations.

Demographers often use age structure diagrams to study human populations in different countries. The shapes of these diagrams provide clues about how quickly the populations are growing. Compare the age distribution of males in the United States and Mexico.



2. What can be concluded from the data displayed on the age structure diagrams above?
- A The male population of Mexico is growing at a slower rate than the United States because fewer children are being born in Mexico.
 - B The male population of Mexico is growing at a faster rate than the United States because the number of children being born in Mexico exceeds the rest of its population.
 - C The male population of Mexico is growing at a slower rate than the United States because there are fewer elderly males.
 - D The male population of Mexico is growing at a faster rate than the United States because there is a greater number of elderly males.

- USA:
- $\alpha 7.2$
- lbs (higher consumption)

- Allows more food **without expanding farmland.**



Q1: An environmental scientist notes that a rapidly expanding city has completely paved over a former wetland and forest area. Which terms best categorize this specific activity and its primary consequence on the biosphere?

- A) Urbanization, which increases the natural anchors for soil preservation.
- B) Sustainable development, which reduces the per-capita consumption of wood.
- C) Urbanization, which creates habitat loss and poses an extinction threat.
- D) Deforestation, which increases global photosynthesis rates via soybean crops.

Q2: A massive tropical valley undergoes a rapid shift. Hundreds of hectares of native trees are permanently cut down to plant a single type of agricultural crop. Two years later, the region experiences an unexpected period of low rainfall. What are the most likely immediate consequences observed within the geosphere and atmosphere of this valley?

- A) The soil becomes more firmly anchored by the new crops, and atmospheric carbon dioxide drops.
- B) The soil easily erodes away due to a lack of tree roots, and more carbon dioxide remains in the atmosphere.
- C) The land stores vastly more moisture to prevent drought, and regional photosynthesis rates double.
- D) The ecological footprint of the valley drops to zero because trees are no longer consuming natural resources.

Q3: Why did global food production manage to increase approximately fourfold since 1950 without requiring a matching fourfold increase in the destruction of Earth's natural forest lands?

- A) Human populations naturally stopped eating resource-intensive crops like soybeans.
- B) Agricultural expansion was completely replaced by conservation drones that feed cities.
- C) Advancements in irrigation, fertilizer use, and higher-yielding crop varieties increased efficiency on existing land.
- D) Urbanization naturally turned towns back into highly productive tropical grasslands.

Q4: An engineering firm is designing a new wildlife sanctuary but needs a way to track animal movements and detect illegal human logging activities across thousands of acres of dense mountains without building disruptive roads.

Which engineering solution best solves this problem?

- A) Increasing the per-capita consumption of wood products inside the mountain zone.
- B) Deploying conservation drones to safely monitor the area and minimize human impact.
- C) Initiating rapid urbanization along the borders of the sanctuary to harvest soy.
- D) Expanding the ecological footprint of each scientist to 7.2 gha using public transit.

Q5: What must happen for human resource use to be considered truly sustainable?

- A) Humans must consume natural resources at a rate that is twice as fast as nature can replenish them.
- B) The area of productive land used must always match the higher consumption level of 7.2 global hectares per person.
- C) Resources cannot be consumed faster than the natural rate at which ecosystems can replenish and renew them.
- D) Photosynthesis rates must be systematically decreased by converting tropical forests into urban cities.

Question 3 a



THREE-DIMENSIONAL THINKING

Outline an **argument** for how deforestation impacts Earth's **systems**. What are the short-term consequences of clearing land? Using your knowledge of the **cause-and-effect** relationships associated with deforestation, predict the long-term consequences of clearing entire forests.

- A) **Short-term:** Immediate habitat loss and increased soil erosion; **Long-term:** Disruption of the global carbon cycle leading to increased atmospheric CO_2 and climate change.
- B) **Short-term:** Increased local rainfall and cooler temperatures; **Long-term:** Permanent expansion of biodiversity in the cleared areas.
- C) **Short-term:** Rapid decrease in atmospheric oxygen levels overnight; **Long-term:** Complete solidification of Earth's crust.
- D) **Short-term:** Immediate decrease in soil erosion; **Long-term:** Total stabilization of global weather patterns.

Question 3 b

COLLECT EVIDENCE

How does deforestation impact Earth's systems?

- A) Cleared forests lead to decreased surface runoff, which completely stops rivers from flowing.
- B) Cutting down trees reduces transpiration, leading to less local atmospheric moisture and altered rainfall patterns.
- C) Deforestation increases the number of primary producers, which dramatically accelerates photosynthesis rates.
- D) Removing forest cover lowers global sea levels by preventing underground water from escaping.

Question 4 a



THREE-DIMENSIONAL THINKING

How can the ecological footprint **model** be used to predict how changes in resource consumption might **effect** Earth's **systems**?

- A) By calculating the exact age of Earth based on historical resource depletion rates.
- B) By measuring the total physical depth of footprints left by humans traveling across different ecosystems.
- C) By comparing human demand for natural resources against Earth's biocapacity to regenerate those resources and absorb waste.
- D) By predicting the exact location where new tectonic plates will form due to heavy urban construction.

Question 4 b

What is an 'ecological footprint' used to measure?

- A) The amount of land and water area required to produce the resources a population consumes and to absorb its generated waste.
- B) The total population density of a specific endangered species within a protected nature reserve.
- C) The percentage of carbon dioxide absorbed by a single tree during its entire lifespan.
- D) The geographical distance animals migrate annually due to seasonal climate shifts.

Falling Forests

1. **MATH Connection** In 1630 at the beginning of European settlement, about 425,000,000 hectares of the United States were forested. By 2017, the area of forested land had declined to 300,000,000 hectares. What is the percent decrease of forested land between 1630 and 2017?

2. **MATH Connection** The population of the United States in 1630 was around 4,500. In 2017, the population was around 326,500,000. What percent increase does this represent?

3. **MATH Connection** Only a small percentage of Americans owned cars before the 1940s. By 2017, there were nearly 250 million vehicles for 323 million people, greatly increasing the need for roadways. In 1960, the United States had about 16,000 km of interstate highways. Today, the interstate highway system includes 77,000 km of paved roadways. What percent increase does this represent?

- A 381 percent
- B 792 percent
- C 38 percent
- D 79 percent

Biologists report that habitat destruction, overexploitation, and pollution are eliminating species at a rate comparable to the great extinction that marked the end of the age of dinosaurs. The UN Environment Programme reports that, over the past century, more than 800 species have disappeared and at least 10,000 species are now considered threatened. This includes about half of all primates and around 10 percent of all plant species. At least half of the forests existing before the introduction of agriculture have been cleared, and much of the diverse "old growth" on which many species depend for habitat is rapidly being cut and replaced by ecologically impoverished forest plantations.

2. Which statement is a logical conclusion that can be drawn from information in the text?
- A Clean technology has helped eliminate pollution and protect endangered species.
 - B Natural resources are limited, and the biosphere has limited capacity to provide our food and water.
 - C Consuming forest resources interferes with the survival of other species.
 - D "Old-growth" forests supply food, energy, and other resources humans depend on.

5	Students will explore Earth's motion and the seasons. They will develop and use models to explain how earth's rotation, revolution, and tilted axis cause the patterns of the seasons, day and night, and the apparent motions of the sun, Moon, and stars in the sky.	Q 5 a	U1M1L1: Earth's Motion Around the Sun
		Q 5 b	
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		Q 6 b	

☑ Key Idea

- Rotation → Day & Night
- Revolution + Tilt → Seasons
- Sun angle → Temperature differences on Earth

🔄 Rotation

- Earth spins on its **axis** (imaginary line through its center).
- Direction: **West → East** (counterclockwise from the North Pole view).
- Time: **24 hours**
- **Effect:** Causes **day and night**.
- **Apparent Motion:**
 - Sun, Moon, and stars appear to move **East → West**.

🌐 Revolution

- Earth moves around the Sun in an **orbit**.
- Time: **365.24 days** (1 year).
- **Gravity's Role:**
 - Gravity keeps Earth in orbit.
 - Without it → Earth would move in a straight line into space.
- **Distance Changes:**
 - Closest to Sun: **Jan 3 (147 million km)**
 - Farthest: **July 4 (152 million km)**
 - **!** This does **NOT** cause seasons.

Seasons & Earth's Tilt

- Earth's axis is **tilted** and stays tilted in the same direction during orbit.
- This tilt + revolution = **seasons**

Temperature & Earth's Shape

- Earth's **curved surface** causes uneven heating.

🌡️ At the Equator

- Sunlight hits **directly (vertical angle)**
- Energy is **concentrated** → **hot temperatures**

❄️ At the Poles

- Sunlight hits at a **low angle**
- Energy spreads over a larger area → **colder temperatures**

🌞 Solstices

"When the tilt is at its maximum direction."

• June Solstice (June 20–21):

- Northern Hemisphere → **Summer** (longest day)
- Southern Hemisphere → **Winter**

• December Solstice (Dec 21–22):

- Northern Hemisphere → **Winter** (shortest day)
- Southern Hemisphere → **Summer**

🌅 Equinoxes

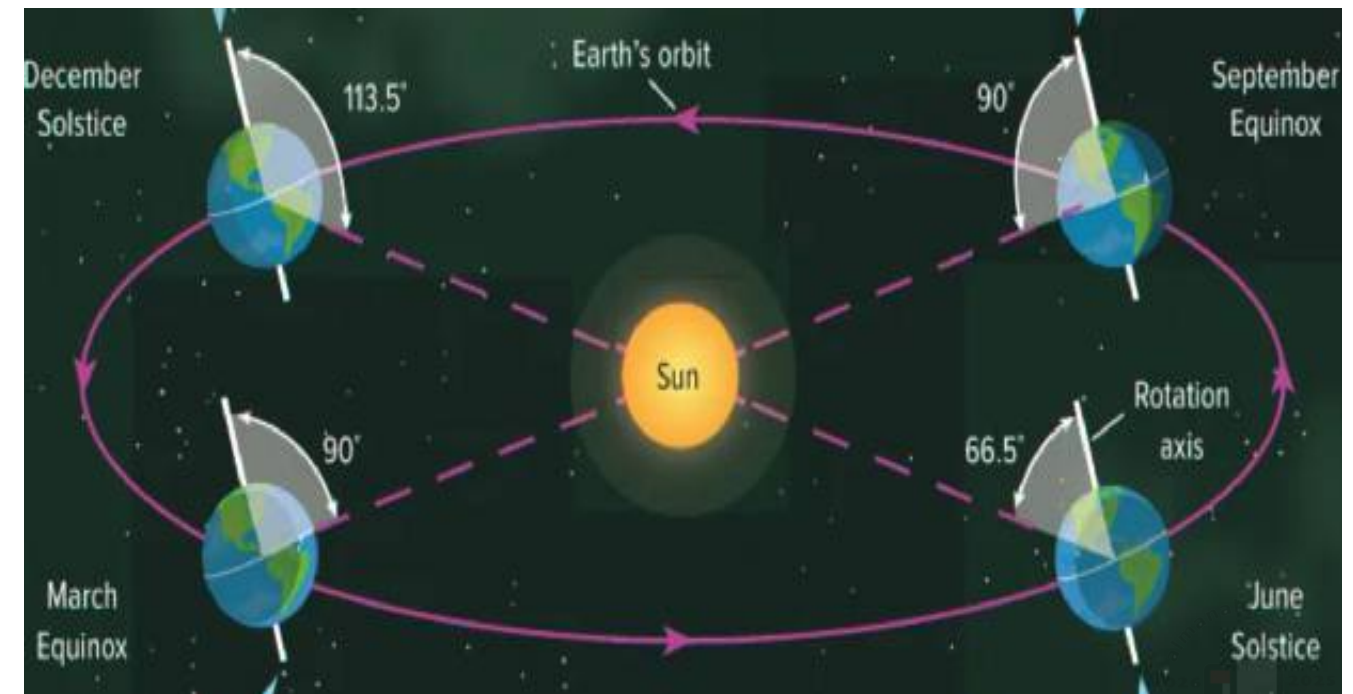
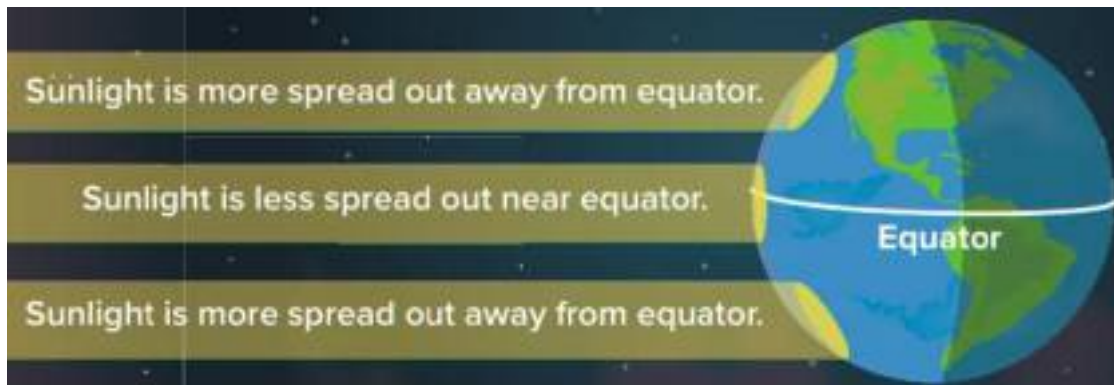
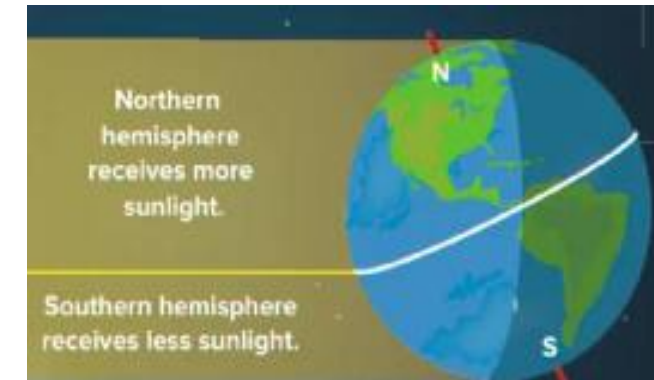
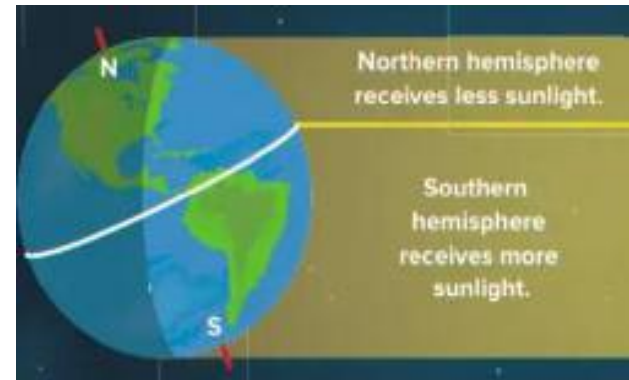
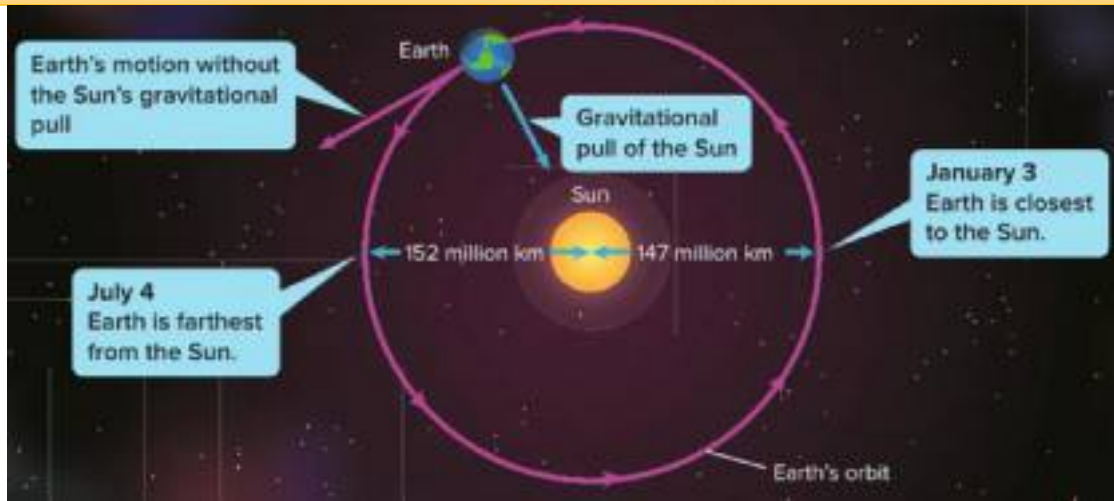
- Axis is **not tilted toward or away** from the Sun
- Day = Night (**12 hours each**) worldwide

• March Equinox (Mar 20–21):

- North → **Spring**
- South → **Autumn**

• September Equinox (Sep 22–23):

- North → **Autumn**
- South → **Spring**



Q1. What is the primary phenomenon produced directly by Earth spinning counterclockwise on its imaginary rotation axis once every 24 hours?

- A) The change of yearly seasons
- B) The cyclical pattern of day and night
- C) The monthly phase changes of the Moon
- D) The shifting physical distance between Earth and the Sun

Q2. Which term defines the specific path that Earth follows as it moves entirely around the Sun over a duration of 365.24 days?

- A) Axis
- B) Equinox
- C) Orbit
- D) Solstice

Q3. During which specific events does Earth experience exactly 12 hours of daylight and 12 hours of darkness everywhere across the planet?

- A) June and December Solstices
- B) Perihelion and Aphelion occurrences
- C) March and September Equinoxes
- D) When Earth is closest to the Sun in January

Q4. If you look at a clear sky on a dark night, stars appear to slowly migrate from east to west over time. What causes this apparent motion?

- A) The stars are physically revolving around the Sun.
- B) Earth rotates around its axis from west to east.
- C) The Sun's gravity pulls the stars in a circular string.
- D) Earth's orbit changes its orientation every 24 hours.

Q5. Why do regions located directly near Earth's equator experience consistently warm, high-temperature climates throughout the year?

- A) The equator is physically millions of kilometers closer to the Sun than the poles.
- B) Sunlight strikes the equator at a highly tilted angle, spreading the energy out.
- C) Sunlight strikes the equator vertically, concentrating the solar energy over a small area.
- D) Earth's rotation axis stops spinning when it reaches the equatorial boundary.

Q6. Based on the seasonal cycle, if the Northern Hemisphere is currently experiencing the March Equinox, what season is concurrently starting in the Southern Hemisphere?

- A) Spring
- B) Summer
- C) Autumn (Fall)
- D) Winter

Q7. What would happen to the climate of the Northern Hemisphere if Earth's axis were completely straight (0° tilt) instead of being tilted relative to its orbit?

- A) The Northern Hemisphere would experience permanent, unchanging winter.
- B) Seasonal changes would cease entirely, and temperatures would stay constant year-round.
- C) The cycle of day and night would expand to last 365 days instead of 24 hours.
- D) The Sun would begin rising in the west and setting in the east.

Q8. Refer to the orbital data diagram. A student argues that summer in the Northern Hemisphere is caused by Earth being physically closer to the Sun. Which data point from the diagram provides the strongest scientific evidence to disprove this student's claim?

- A) Earth is closest to the Sun (147 million km) on January 3, when the Northern Hemisphere is in winter.
- B) Earth is farthest from the Sun (152 million km) on July 4, when the Southern Hemisphere is in winter.
- C) The Sun's gravitational pull keeps Earth moving in a perfect, unchanging circular orbit.
- D) Earth moves counterclockwise, which pushes it closer to the Sun during summer months.

Q9. Regarding the June Solstice. Which of the following conditions correctly details the state of the Northern Hemisphere on June 20 or 21?

- A) The north end of the rotation axis is leaning away from the Sun, making nights longer.
- B) The north end of the rotation axis leans toward the Sun, resulting in the longest daylight hours of the year.
- C) Sunlight is highly spread out away from the equator, causing temperatures to drop drastically.
- D) There are exactly 12 hours of daylight and 12 hours of darkness across the North

Q10. Imagine an experimental scenario where Earth's speed of revolution around its orbit doubles, but its speed of rotation remains completely unchanged. How would this alter calendar calculations on Earth?

- A) A day would last 48 hours, but a year would stay 365 days.
- B) A day would still last 24 hours, but a year would only last about 182.6 days.
- C) The cycle of seasons would take two full years to complete once.
- D) The Sun would no longer appear to rise or set across the horizon.

Question 6 b



THREE-DIMENSIONAL THINKING

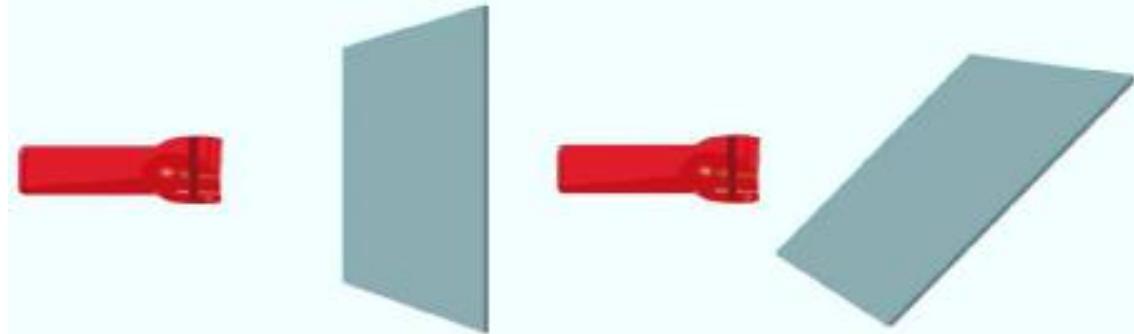
How does the varying amount of the Sun's solar energy **cause** the seasons? What **effects** does the tilt of Earth's rotation axis have on the seasons?

- A) The tilt causes the Earth to physically drift closer to the Sun during winter, reducing the global solar concentration evenly across both hemispheres.
- B) The tilt changes the chemical composition of the upper atmosphere every six months, which filters out solar radiation during autumn.
- C) The tilt forces the Sun to emit more intense solar flares toward the equator, creating permanent summer conditions globally regardless of the orbital position.
- D) The tilt causes solar energy to strike the Earth at different angles throughout its orbit; when a hemisphere tilts toward the Sun, it receives more direct sunlight and longer daylight hours, causing summer.

2. Which best explains why Earth is colder at the poles than at the equator?

- A Earth is farther from the Sun at the poles than at the equator.
- B Earth's orbit is not a perfect circle.
- C Earth's rotation axis is tilted.
- D Earth's surface is more tilted at the poles than at the equator.

Use the figure to answer question 3.



3. Predict the pattern of the light that will appear on each sheet of paper when the flashlight is turned on.

- A The pattern on the vertical paper will be a circle, the pattern that will appear on the tilted paper will be elongated and spread out.
- B The pattern on the papers will change because the light will fluctuate.
- C The pattern that will appear on both pieces of paper is the same—a circle of light.
- D The pattern that will appear on both pieces of paper is the same—elongated and spread out.

Question 5 a

Why does the view of the sky change over time?

Have you ever looked up at the sky on a clear, dark night and seen stars? If you look at a clear night sky for a long time, what do you notice about the stars?



- A) Because stars are constantly orbiting the Earth at a very high speed every few hours.
- B) Due to Earth's **rotation** on its axis (causing changes during a single night) and Earth's **revolution** around the Sun (causing different constellations to appear across seasons).
- C) Because the Earth's atmosphere constantly reflects and blocks different stars depending on changes in global temperature.
- D) Because stars burn out and disappear, while completely new stars form in different places every night.

Question 6 a

Why do Earth's seasons change as Earth orbits the Sun?

- A) Because the Earth gets significantly closer to the Sun during the summer months and much farther away during the winter months.
- B) Due to the **tilt of Earth's axis** as it revolves around the Sun, which causes different hemispheres to receive varying amounts of direct sunlight throughout the year.
- C) Because the Sun's internal temperature fluctuates predictably every few months, changing the amount of heat energy released to space.
- D) Due to the speed of Earth's rotation on its axis accelerating in the summer and slowing down in the winter.

Question 5 b

A student notices that the Moon's position in the sky at **9:00 PM** is very different from its position at **midnight**.

- Why does the Moon appear to have moved across the sky?

- A) Because the Moon completes a full orbit around the Earth every 24 hours.
- B) Due to the **rotation of the Earth on its axis**, which causes celestial objects to appear to move from east to west during the night.
- C) Because the Moon is moving faster than the Earth's speed of revolution around the Sun.
- D) Due to cloud movements and changing atmospheric pressure reflecting the Moon's light at different angles.

- Is the Moon actually moving, or is something else causing this? Explain your answer.

- A) The Moon is **not moving at all** in space; it is completely stationary, and its apparent movement is 100% caused by Earth's revolution around the Sun.
- B) Although the Moon does orbit the Earth, its rapid apparent movement across the night sky over a few hours is primarily caused by the **Earth rotating on its axis**, creating an apparent motion.
- C) The Moon is **actually moving** fast enough to complete several full trips around the Earth each night, which is why it changes position so quickly.
- D) The apparent movement is entirely an optical illusion caused by the gravitational pull of the ocean tides shifting the observer's horizon.

Students will explore the phases of the Moon. They will develop and use models to explain how the Moon's revolution relates to the pattern of lunar phases.

☒ Key Idea

- Moon shines by **reflecting sunlight**
- **Same side always faces Earth** due to equal rotation & revolution
- Phases change based on **Moon's position relative to Earth and Sun**
- Moon's motion causes **daily time shifts in rising and setting**

3. Lunar Phases Cycle

- A **phase** = the visible portion of the Moon's lit side from Earth
- The Moon is always **half-lit by the Sun**, but what we see changes
- **Cycle Length:**
 - Orbit: 27.3 days
 - Phases cycle: **29.5 days** (because Earth also moves)

Waxing Phases (Increasing Light)

- Light grows each night.
- **First Quarter (Week 1):**
 - Half of the Moon (western side) is lit.
- **Full Moon (Week 2):**
 - Entire near side is fully illuminated.

Waning Phases (Decreasing Light)

- Light decreases each night.
- **Third Quarter (Week 3):**
 - Half of the Moon (eastern side) is lit.
- **New Moon (Week 4):**
 - No visible light → Moon appears dark.

1. How We See the Moon

- The Moon **does not produce its own light**.
- It is visible because it **reflects sunlight**.
- **Reflectivity (Albedo):**
 - Reflects only about **12% of sunlight**
 - Still appears very bright → brightest object in the night sky.

2. Lunar Motion (Synchronous Rotation)

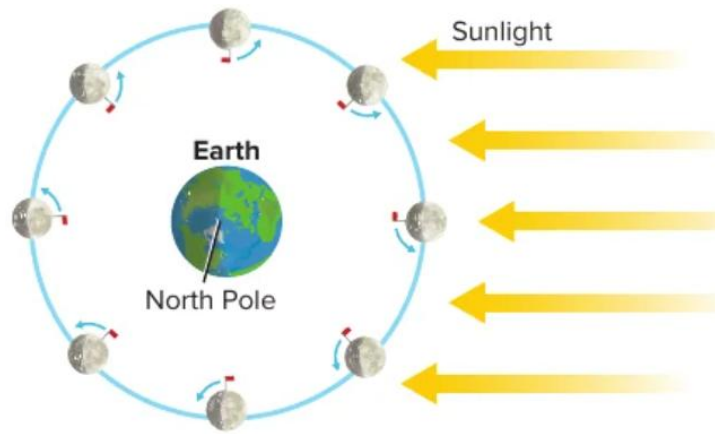
- **Revolution (Orbit around Earth):**
 - Takes **27.3 days**
- **Rotation (Spinning on axis):**
 - Also takes **27.3 days**
- ☒ **Result (Synchronous Rotation):**
 - Same side of the Moon always faces Earth
- **Near Side:** Always visible from Earth
- **Far Side:** Never visible from Earth

4. Daily Motion of the Moon

- **Daily Delay:**
 - Moon rises **~50 minutes later each day**.

Midnight Positions

- **First Quarter** → Setting in the west
- **Full Moon** → Highest point in the sky
 - Rises at sunset, sets at sunrise
- **Third Quarter** → Rising in the east



First Quarter Moon



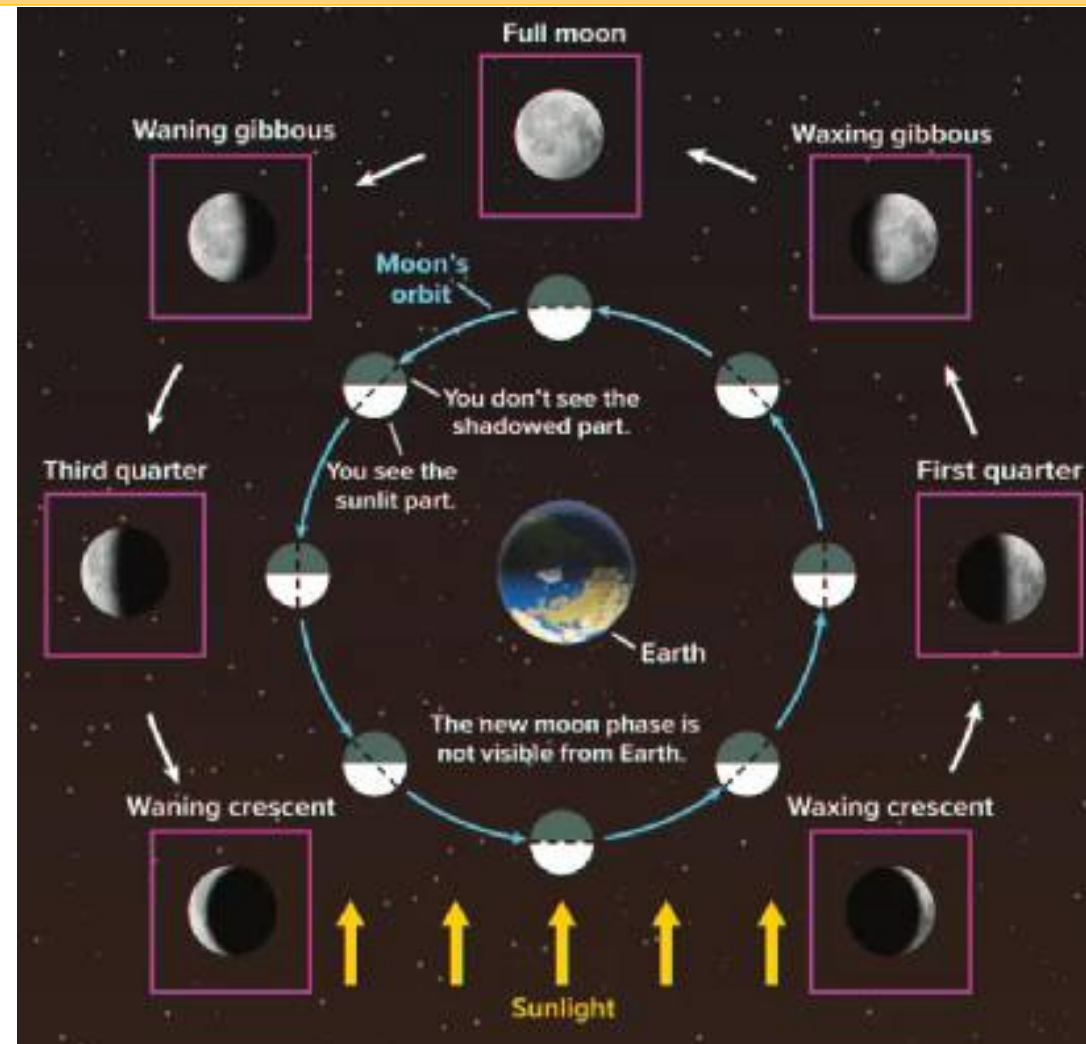
Full Moon



Third Quarter Moon



New Moon



At midnight, the first quarter moon is setting. It rises during the day at about noon.



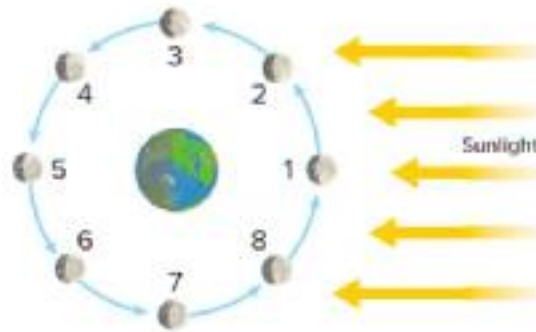
The full moon is highest in the sky at about midnight. It rises at sunset and sets at sunrise.



The third quarter moon rises at about midnight, about six hours later than the full moon rises.

2. A new moon occurs once every 29.5 days. Why must the Sun, Earth, and the Moon be aligned in order for the new moon to occur?
- No sunlight is reflected off Earth at this point.
 - Sunlight directed toward Earth is blocked by the Moon.
 - The Moon does not orbit in the same plane as Earth.
 - The Moon is not directing any light toward Earth at this point.

Use the image to answer questions 3 and 4.



3. Predict the locations when the Moon is in a waxing phase.
- 1, 5
 - 2, 3, 4
 - 7, 8
 - 3, 7
4. Predict which location is the phase seen from Earth at the end of the second week of the lunar cycle.
- 1
 - 3
 - 5
 - 7

Q1. Why are people on Earth able to see the Moon shining in the night sky?

- The Moon converts gravitational energy from Earth into visible light waves.
- The Moon is a solid object that generates and emits its own brilliant light.
- The Moon's surface reflects light that originates from the Sun.
- The Moon is composed of burning gases similar to a small star.

Q2. What percentage of the sunlight that strikes the Moon's surface is actually reflected back into space?

- 100 percent
- 50 percent
- 27.3 percent
- 12 percent

Q3. Which term refers to the portion of the Moon or a planet reflecting light as seen from Earth's perspective?

- Orbit
- Phase
- Rotation
- Axis

Q4. How long does it take for the Moon to complete one full cycle of lunar phases (from New Moon to New Moon)?

- 12 hours
- 24 hours
- 27.3 days
- 29.5 days

Q5. If the Moon requires exactly 27.3 days to complete one full revolution around Earth, how long does it take to complete one full rotation on its own axis?

- 24 hours
- 27.3 days
- 29.5 days
- 50 minutes

Question 7 a

Explain how the Moon can be rotating if the same side of the Moon is always facing Earth.

- A) The Moon does not rotate on its axis at all; its appearance is solely due to the Earth's rapid magnetic field shifting the viewing angle.
- B) The Moon rotates at twice the speed of Earth's rotation, causing the back side to always remain invisible to space satellites.
- C) The Moon rotates on its axis at the **exact same rate** that it revolves around the Earth, which keeps the same side facing Earth at all times.
- D) The Moon's core is liquid, which stops the outer crust from spinning while the rest of the celestial body moves around the Sun.

Question 7 b

The Moon makes one revolution around Earth in the same amount of time that it makes one rotation on its axis. Choose the correct statement regarding this fact:

- A) **True**, this synchronous rotation is the reason why we always see the same face of the Moon from Earth.
- B) False, the Moon rotates much faster on its axis than it completes its orbital revolution around Earth.
- C) False, the Moon only rotates when it passes through the Earth's shadow during a lunar eclipse.
- D) False, the orbital revolution takes 365 days, while a single rotation on its axis takes only 24 hours.

Q8. An astronomer goes outside precisely at midnight and observes that the Moon is located at its highest point in the night sky. Which lunar phase is the astronomer looking at?

- A. New Moon B. First Quarter Moon C. Full Moon D. Third Quarter Moon

Q9. What would happen to our view from Earth if the Moon stopped rotating on its axis entirely but continued to revolve around Earth normally?

- A) We would gradually see both the near side and the far side of the Moon over the course of a month.
- B) The Moon would remain stuck permanently in the Full Moon phase without changing shape.
- C) Only the far side of the Moon would be visible to observers on Earth.
- D) The length of the lunar phase cycle would instantly drop from 29.5 days down to 12 days.

Q10. Why is the Moon completely invisible to observers on Earth during the New Moon phase?

- A) The Moon has traveled completely behind Earth and sits inside Earth's deep shadow.
- B) The unlit, shadowed half of the Moon's near side is facing directly toward Earth.
- C) The Moon is positioned directly behind the Sun, blocking all incoming solar rays.
- D) Earth's atmosphere becomes too dense to allow the 12 percent reflected light to pass through.

Q11. During which specific week of the lunar cycle does the illuminated portion of the Moon's near side shrink until only the eastern half is visible?

- A) Week 1 (First Quarter) B) Week 2 (Full Moon) C) Week 3 (Third Quarter) D) Week 4 (New Moon)

Q12. An observer notices that the Moon is rising approximately 50 minutes later tonight than it did last night. What is the direct cause of this daily delay?

- A) Earth slowing down its rotation axis speed.
- B) The shifting distance between the Sun and Earth.
- C) The physical orbital motion of the Moon as it revolves around Earth.
- D) The absorption of light by the dark far side of the Moon.

8

Students will explore eclipses of the Sun and the Moon. They will develop and use models to explain how the motions of Earth and the Moon relate to the pattern of solar and lunar eclipses.

Q 8 a

Q 8 b

U1M1L3: Eclipses

☑ Key Idea

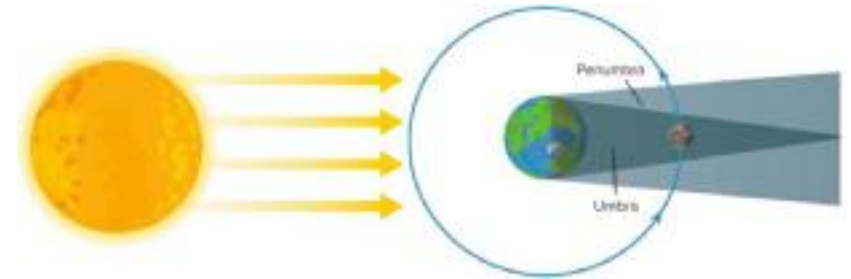
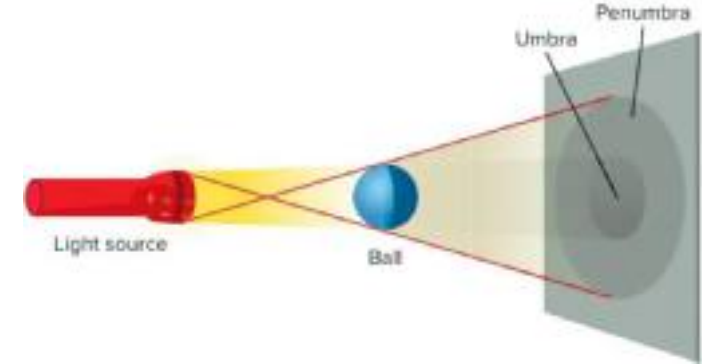
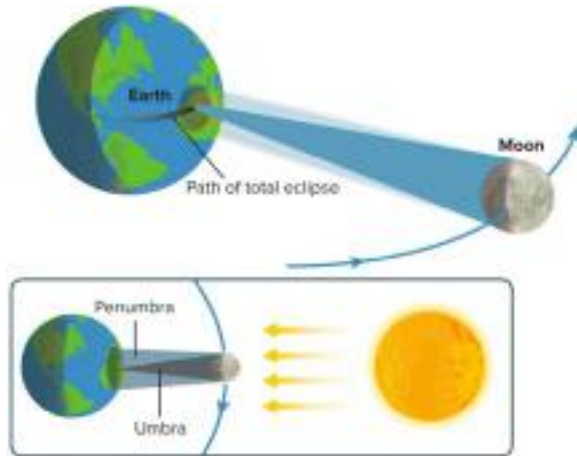
Eclipses happen when **shadows form due to alignment of the Sun, Earth, and Moon** 🌍 ☾ 🌑

1. Shadow Parts

- **Umbra**: Dark center → no light at all
- **Penumbra**: Lighter outer part → partial light

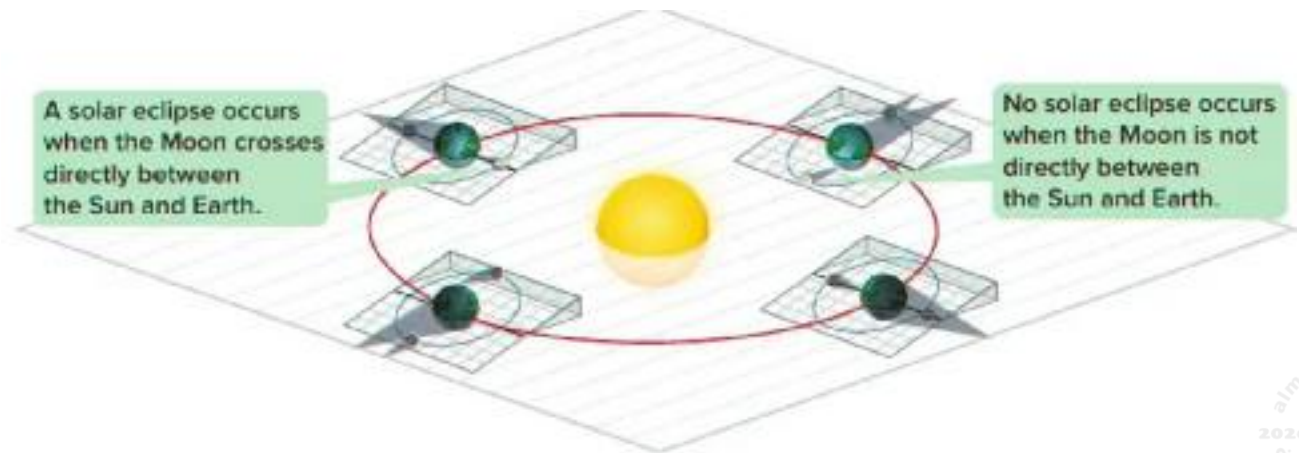
2. Solar Eclipse (New Moon)

- Moon is between **Earth and Sun**
- **Total Solar Eclipse**:
 - Seen in **umbra**
 - Sun completely blocked (few minutes only)
- **Partial Solar Eclipse**:
 - Seen in **penumbra**
 - Sun partially covered



3. Lunar Eclipse (Full Moon)

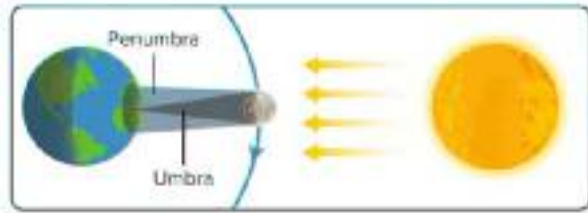
- Earth is between **Sun and Moon**
- **Total Lunar Eclipse**:
 - Moon fully in Earth's shadow (umbra)
 - Appears **red** (due to Earth's atmosphere)
- **Partial Lunar Eclipse**:
 - Only part of Moon is dark



4. Why Eclipses Are Rare

- Moon's orbit is **tilted**
- Alignment doesn't happen every month
- Eclipse occurs only with **perfect alignment**

Use the figure to answer questions 2 and 3.



2. What is occurring in this figure?

- A lunar eclipse
- B lunar and solar eclipse
- C partial lunar eclipse
- D solar eclipse

3. Why would someone in North America not be able to view this eclipse?

- A Because this is a lunar eclipse and Earth casts a very small shadow.
- B Because this is a lunar eclipse and North America is experiencing day.
- C Because this is a solar eclipse and North America is experiencing night.
- D Because this is a solar eclipse and the Moon casts a very small shadow.

4. Where do you have to be located to be able to see a total eclipse?

- A anywhere on the continent where the eclipse is occurring
- B within the penumbra
- C within the penumbra and umbra
- D within the umbra

Q1. What is the central, darker part of a shadow where light is totally blocked?

- A) Penumbra
- B) Umbra
- C) Orbit
- D) Axis

Q2. A solar eclipse can only take place when the Moon is in which phase?

- A) Full moon
- B) First quarter
- C) New moon
- D) Third quarter

Q3. What is the maximum duration for a total solar eclipse?

- A) 7 seconds
- B) 7 minutes
- C) 50 minutes
- D) 24 hours

Q4. Why does the Moon exhibit a distinct reddish tint during a total lunar eclipse?

- A) The lunar surface rocks overheat inside the shadow.
- B) Earth's atmosphere deflects and bends some sunlight toward the Moon.
- C) Stars in the night sky reflect their light off the dark surface.
- D) Combustible gases ignite due to the lack of solar wind.

Q5. What will an observer on Earth see if they are standing entirely within the Moon's penumbra?

- A) A total solar eclipse
- B) A partial solar eclipse
- C) A total lunar eclipse
- D) A partial lunar eclipse

Q6. Why don't solar and lunar eclipses occur every 29.5 days?

- A) The Earth changes its orbital speed unexpectedly.
- B) The Moon's orbit is tilted relative to Earth's orbit.
- C) The distance between the Sun and Earth changes daily.
- D) The Moon's rotation stops during specific times of the year.

Q7. Which structural alignment causes a lunar eclipse?

- A) Sun — Moon — Earth
- B) Earth — Sun — Moon
- C) Sun — Earth — Moon
- D) Moon — Sun — Earth

Question 8 a

A solar eclipse can only happen during the new moon phase, and a lunar eclipse can only occur during a full moon. Since both phases occur every 29.5 days, why don't we have eclipses every single month?

- A) Because the Moon's orbital speed changes drastically depending on whether it is a full moon or a new moon, passing the alignment too fast.
- B) Due to Earth's thick atmosphere absorbing the Moon's shadow before it can physically reach the surface or align correctly.
- C) Because **the Moon's orbit is tilted at about 5 degrees** relative to Earth's orbit around the Sun, meaning the Sun, Earth, and Moon do not perfectly line up most of the time.
- D) Because the Sun moves completely out of the ecliptic plane every two weeks, preventing any alignment with the lunar path.

Question 8 b

6) Why don't solar eclipses occur every new moon?

- A) The Moon's orbit around Earth and Earth's orbit around the Sun are not the same speed, so the three bodies only line up during the full moon.
- B) The Moon's orbit around Earth and Earth's orbit around the Sun are not in the same plane, so the three bodies only line up occasionally.
- C) The Moon's orbit around the Sun and Earth's orbit around the Sun are not in the same plane, so the three bodies only line up occasionally.
- D) The Moon's orbit around Earth and the Sun's orbit around Earth are not in the same plane, so the three bodies only line up occasionally.

9	Students will develop and use models to describe the role of gravity in the formation of stars and the solar system. They also develop and use models to describe how gravity affects the motions of objects in the solar system, and they learn how galaxies are classified.	Q 9 a	U1M2L1: Gravity and the Universe
		Q 9 b	
10	Students will develop and use models to describe the role of gravity in the formation of stars and the solar system. They also develop and use models to describe how gravity affects the motions of objects in the solar system, and they learn how galaxies are classified.	Q 10 a	U1M2L1: Gravity and the Universe
		Q 10 b	

- Gravity = **force of attraction between objects with mass.**
- Depends on:
 - **Mass** $\uparrow \rightarrow$ gravity $\uparrow$ **Distance** $\downarrow \rightarrow$ gravity $\uparrow$
- Earth's gravity is strong because it has **large mass.**

★ Stars

- Form inside **nebulae** (gas + dust clouds)
- Gravity pulls material inward $\rightarrow$ heat increases
- When hot enough $\rightarrow$ **nuclear fusion** $\rightarrow$ star forms

☉ Solar System

- Formed from a **rotating disk**
- Sun formed at the center
- planets, moons, asteroids, comets $\rightarrow$ باقي المواد

- Sun's gravity keeps planets in orbit
- Orbits are **elliptical (not perfect circles)**

• Models:

- Geocentric $\rightarrow$ Earth at center ✗
- Heliocentric $\rightarrow$ Sun at center ✓

• Kepler's Law:

- Planets move faster when closer to the Sun.

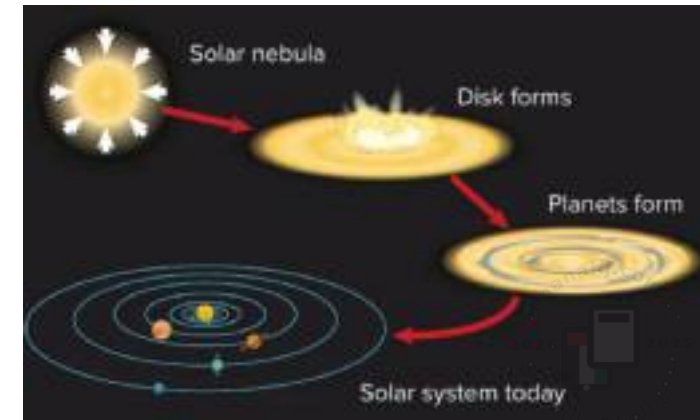
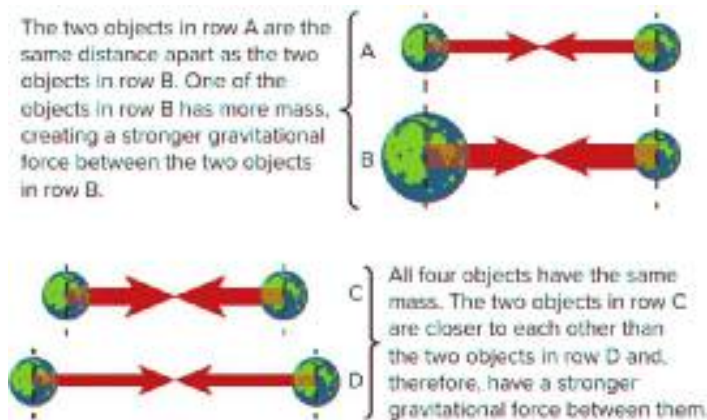
- Galaxy = huge system of **stars, gas, and dust held by gravity**

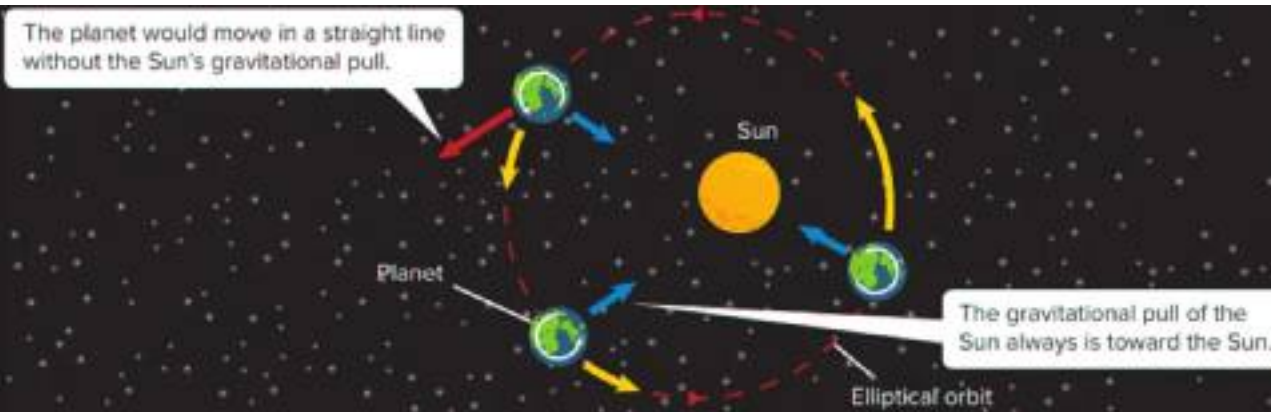
• 🌌 Milky Way:

- Contains ~200 billion stars
- Part of the **Local Group**

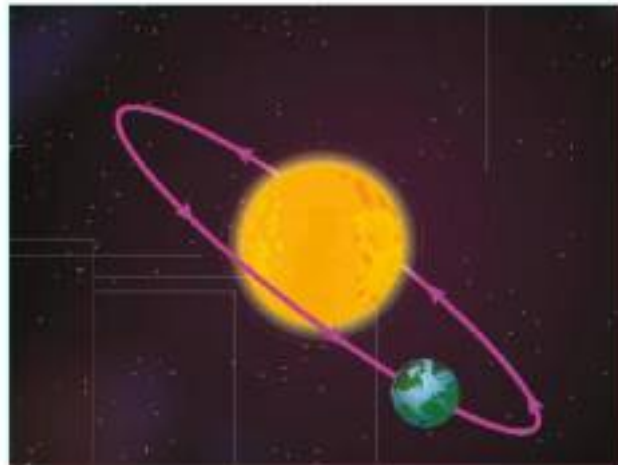
Types of Galaxies:

- **Spiral** $\rightarrow$ arms + central bulge
- **Elliptical** $\rightarrow$ round, old stars
- **Irregular** $\rightarrow$ no clear shape, active star formation





It was once thought that Earth was the center of the universe. Eventually, it was proven that the planets orbit around the Sun. The illustration shows the path of Earth's orbit around the Sun.



2. Describe the path of Earth if the Sun's gravity were to suddenly stop.

- A Earth would continue to move within its orbit.
- B Earth would move in a straight line towards the Sun.
- C Earth would move in a straight line instead of a curved line.
- D Earth would stop moving and become suspended in one spot.

Halley's Comet orbits the Sun and can be seen from Earth about every 76 years. However, before the work of Sir Isaac Newton and Edmond Halley, comets were thought to pass in a straight line through the solar system. In 1705, Edmond Halley used Newton's laws to determine the gravitational effects of Jupiter and Saturn on a comet that he observed in 1682. Using this information and historical records, he determined that comets seen in 1531 and 1607 were the same comet. Halley correctly calculated the orbit of the comet and predicted its return in 1758.

3. Newton's laws state that all objects exert gravitational force and that objects with more mass exert more force. Which system of objects has the greatest effect on the orbit of Halley's comet?

- A Earth, the Sun, and the Moon
- B the Sun, Jupiter, and Saturn
- C asteroids, meteoroids, and dwarf planets
- D Earth, the Sun, and Saturn

Question 9 a

How are galaxies classified?

- A) By the total number of solar eclipses that occur within their boundaries annually.
- B) By their physical size and the average surface temperature of their outer planets.
- C) By their visual shape and structure, which categorizes them into distinct cosmic forms.
- D) By the exact speed at which they rotate around the Earth's geographic poles.

Question 9 b

2) Spiral, elliptical, and irregular are three types of _____ in the universe.

- A) Galaxies B) solar systems C) constellations D) tectonic plates

Question 10 a

What is gravity?

- A) A magnetic field produced exclusively by the frozen iron at the Earth's geographic north pole.
 B) An atmospheric pressure that pushes down on objects from upper layer clouds.
 C) A chemical reaction that occurs when solar radiation hits a planet's surface crust.
 D) An attractive force that exists between all objects with mass in the universe.

Question 10 b

COLLECT EVIDENCE

What factors affect gravitational force?

- A) The atmospheric temperature of the objects and their axial tilt relative to the sun.
 B) The total volume of liquid water on their surfaces and their rotational velocity.
 C) The masses of the objects and the distance between them.
 D) The chemical composition of their crusts and the number of orbiting moons.

Q1. Two identical space probes are placed in space. Probe X is close to a planet, while Probe Y is very far away. Which probe experiences a stronger gravitational pull?

- A) Probe X
 B) Probe Y
 C) Both are equal
 D) Neither probe

Q2: An astronaut travels from Earth to a small asteroid. What happens to the gravitational force acting on the astronaut?

- A) It increases
 B) It decreases
 C) It stays identical
 D) It drops to zero

Q3: Scientists observe a gas cloud in space. The cloud particles are colliding faster, and the core temperature is rapidly spiking. What will form next?

- A) A new planet
 B) A new star
 C) A new comet
 D) An elliptical galaxy

Q4: What caused the rotating nebula to flatten into a disk shape during the formation of the solar system?

- A) Freezing ice
 B) Central gravity
 C) Magnetic fields
 D) Solar winds

Q5: According to Johannes Kepler, what happens to a planet's speed as it moves closer to the Sun?

- A) It increases
- B) It decreases
- C) It stops completely
- D) It stays constant

Q6: If the Sun's gravitational pull suddenly disappeared, how would Earth move?

- A) In a circle
- B) In a straight line
- C) In a spiral
- D) It would stop

Q7: A galaxy has no spiral arms, contains almost no gas, and is made of old, red stars. What type of galaxy is it?

- A) Spiral galaxy
- B) Irregular galaxy
- C) Elliptical galaxy
- D) Nebula galaxy

Q8: Which force is responsible for holding galaxies together in clusters?

- A) Friction
- B) Magnetism
- C) Gravity
- D) Fusion

11

Students will learn about the different types of objects in the solar system. They will analyze and interpret data to explore the technology scientists use to study the solar system. They will develop and use models to determine the scale properties of objects in the solar system.

Q 11 a

Q 11 b

U1M2L2: The Solar System

The solar system is made of many objects held together by **gravity**, with the Sun at the center ☉

1. Composition

- Solar system = **Sun + all objects orbiting it.**
- Includes: planets, moons, asteroids, comets.
- Only the **Sun produces light** → others reflect it.

2. Observation Tools

- Ancient people saw **5 planets** only
- Telescope → discovery of more objects
- Modern tech:
 - Telescopes detect **different waves**
 - **Probes** (e.g., New Horizons) explore space
 - **ISS** supports experiments
- Space tech improved life on Earth (e.g., insulation, medical imaging)

3. Distance & Motion

- **1 AU** = distance Earth – Sun
- **Rule:** Farther planet → **longer orbit time**
- No relation between **planet size & distance**

4. Other Space Objects

- **Moons:** some are captured objects
- **Dwarf planets:** small, don't clear orbit (e.g., Pluto)
- **Asteroids:** rocky leftovers (between Mars & Jupiter)
- **Comets:** ice + dust, long orbits
- **Meteoroids → Meteors → Meteorites:**
 - Meteoroid = in space
 - Meteor = burns in atmosphere
 - Meteorite = reaches Earth

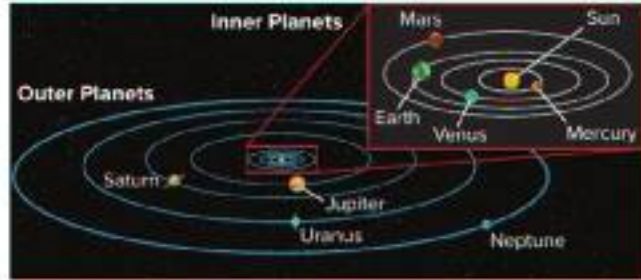


Ceres

Pluto



NASA has been sending exploration missions to Mars for almost 50 years. The length of time it has taken the different spacecraft to reach Mars ranges from 150 days to 360 days. In order to make it possible for humans to travel to Mars, the travel time must be reduced.



2. Assume the different spacecraft were using the same amount of fuel at the same rate. Why are there such long differences in travel time?
- The distance of Mars from the Sun changes.
 - The distance from Earth to Mars changes.
 - The position of Earth from the Sun changes.
 - The shape of the planet's orbit changes.

The chart below shows the surface temperatures of the outer planets.

Planet	Surface Temperature
Neptune	-214°C
Uranus	-216°C
Jupiter	-148°C
Saturn	-178°C

3. What can you conclude about the outer planets based on the data table?
- If Neptune were closer to the Sun, it would be cooler.
 - Saturn is closer to the Sun than any of the other outer planets.
 - The coldest planet is Uranus.
 - The surface temperature of Earth is between that of Neptune and Jupiter.

Question 11 a

Graphing Characteristics

Scientists collect and analyze data and draw conclusions based on data. Scientists know that some properties of the planets are related. Graphing data makes the relationships easy to identify. Graphing allows different types of data to be seen in relation to one another.

Scientists use different units of measurements for distance within the solar system. One of those units is the astronomical unit (AU). One AU is equal to the average distance between the Sun and Earth, about 149,600,000 km.

Planet	Average Distance from the Sun (AU)	Orbital Period (yr)	Radius of Planet (km)
Mercury	0.39	0.24	2,440
Venus	0.72	0.62	6,051
Earth	1.00	1.0	6,378
Mars	1.52	1.9	3,397
Jupiter	5.20	11.9	71,492
Saturn	9.58	29.4	60,268
Uranus	19.2	84.0	25,559
Neptune	30.1	164.0	24,764

Examine the data table showing planetary characteristics. Which of the following statements best describes the relationship between a planet's average distance from the Sun (AU) and its orbital period (years)?

- Farther planets orbit much faster.
- Distance does not affect the orbital period.
- Farther planets take longer to orbit the Sun.
- Closer planets have a longer orbital period.

Question 11 b

Mercury is the closest planet to the Sun, while Neptune is the farthest.

- Which planet do you think takes longer to complete one full orbit around the Sun?

- A) Neptune
- C) Mercury
- D) Both take the exact same time.
- B) It changes every year.

- Why do you think distance from the Sun affects how long a planet takes to orbit?

- A) The planet's size grows larger.
- B) The planet's atmosphere becomes denser.
- C) The planet rotates faster on its axis.
- D) The orbital path is longer and gravity is weaker.

Q6. What prevented the rocky pieces in the asteroid belt from clumping together to form a planet?

- A) Jupiter's strong gravity
- B) Freezing space temperatures
- C) Earth's atmosphere
- D) Slow particle speeds

Q7. A small rock in space enters Earth's atmosphere, makes a flash of light, and lands on the ground. What is it called after it hits the ground?

- A) Meteoroid
- B) Meteor
- C) Meteorite
- D) Asteroid

Q1. Non-stellar objects like planets and asteroids do not produce their own light. Why can we see them through a telescope?

- A) They produce heat
- B) They reflect sunlight
- C) They absorb radiation
- D) They contain ice

Q2. Planet X is discovered at 45 AU from its star, while Planet Y is at 5 AU. What is true about Planet X?

- A) Larger radius
- B) Smaller radius
- C) Longer orbital period
- D) Shorter orbital period

Q3. Why did scientists originally develop high-performance insulation materials for space probes?

- A) To collect radio waves
- B) To resist extreme temperatures
- C) To make scale models
- D) To spin faster

Q4. Saturn has a small, potato-shaped moon that follows an unusual orbit. How is this moon classified?

- A) Regular spherical moon
- B) Captured asteroid
- C) Melting comet
- D) Dwarf planet

Q5. Why is Pluto classified as a dwarf planet rather than a full-sized planet?

- A) It lacks a sphere shape
- B) It orbits a moon
- C) It has shared orbit
- D) It is made of gas

Q8. Why do astronomers use radio and microwave telescopes in addition to visual telescopes?

- A) Stars emit different waves
- B) Visual tools fail in space
- C) Probes only use radio
- D) To change orbital paths

Q9. A science class is studying a data table of the eight planets. When comparing a planet's distance from the Sun to its physical radius, what pattern or relationship will the students find?

- A) A direct relationship
- B) An inverse relationship
- C) No structural relationship
- D) A perfectly circular relationship

Q10. A spacecraft is designed to intercept a celestial object that is a loose mixture of rock, dust, and ice. The object travels along a highly elongated, looping elliptical path around the Sun. What type of object is the spacecraft targeting?

- A) An asteroid
- B) A comet
- C) A moon
- D) A meteorite

Q11. How has the historical transition from traditional naked-eye observations to modern space-based telescopes changed our understanding of the solar system?

- A) It proved Earth is stationary.
- B) It eliminated the need for scale models.
- C) It revealed many hidden space objects.
- D) It slowed down planetary orbital periods.

Q12. Why do planetary scientists build reduced-size scale models of the solar system in their laboratories?

- A) To change actual distances in space
- B) To make massive sizes reasonable to study
- C) To stop planets from leaving their orbits
- D) To speed up nuclear fusion processes

12	Students will explore how to describe the position and motion of an object. They will analyze data including graphs to help construct and present arguments about the changes over time in the motions of objects.	Q 12 a	U1M1L1: Position and Motion
		Q 12 b	
13	Students will explore how to describe the position and motion of an object. They will analyze data including graphs to help construct and present arguments about the changes over time in the motions of objects.	Q 13 a	U1M1L1: Position and Motion
		Q 13 b	

1. Position

- Described using: **distance + direction + reference point**
- Changing the reference point changes the description, not the actual location
- In 2D → use directions like **north/south/east/west**

2. Motion

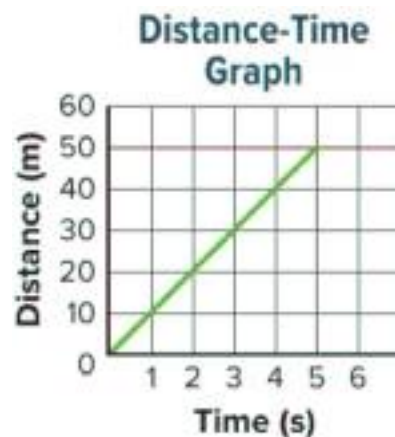
- Motion = change in position over time
- Distance**: total path traveled
- Displacement**: shortest straight-line change
- If object returns to start → displacement = 0

3. Speed & Velocity

- Speed** = distance ÷ time
- Constant speed**: same distance every second
- Velocity** = speed + direction
- Velocity changes if speed OR direction changes

4. Distance-Time Graphs

- X-axis = time, Y-axis = distance
- Straight line → constant speed
- Steeper line → higher speed
- Changing slope → changing speed



Q1: A student analyzes a distance-time graph for a moving toy car. The graph shows a perfectly straight line slanting upward from the origin. What does this line indicate about the car's motion?

- A) It is accelerating.
- B) It has stopped moving.
- C) It travels at a constant speed.
- D) It is returning to the start.

Q2: An engineer alters the flight settings of a drone so that it maintains a steady speed of 15 m/s while turning from heading north to heading east. What happens to the drone's velocity during this turn?

- A) It remains constant.
- B) It changes completely.
- C) It drops to zero.
- D) It matches the speed.

Q3: A swimmer completes exactly one full lap in a 50 meter pool, starting at the shallow end, swimming to the deep end, and returning back to the exact starting block.

What is the swimmer's total distance and final displacement?

- A) Distance: 50 m, Displacement: 50 m
- B) Distance: 100 m, Displacement: 100 m
- C) Distance: 100 m, Displacement: 0 m
- D) Distance: 0 m, Displacement: 100 m

Q4: A tracking device records a vehicle's motion every second. The records show the vehicle covers 12 m in the first second, 12 m in the second second, and 12 m in the third second. How is this motion classified?

- A) Changing velocity
- B) Constant speed
- C) Increasing acceleration
- D) Zero displacement

Q5: A teacher places a small box at the 40 cm mark of a meterstick while using the 50 cm mark as the reference point. If the teacher changes the reference point to the 10 cm mark, what happens to the box?

- A) Its position description changes.
- B) Its actual location changes.
- C) Its displacement turns negative.
- D) Its reference direction disappears.

Q6: A delivery worker starts at a main entrance and is given a single instruction: "Walk exactly 15 m to find the package." Why is this instruction incomplete for establishing the package's position?

- A) It lacks an SI unit.
- B) It lacks a reference point.
- C) It lacks a specific direction.
- D) It lacks an average speed.

Q7: A fishing boat sits in the ocean. An observer says the boat is completely stationary relative to the fishing pole held by the fisherman, but it is in motion relative to a nearby fixed buoy.

Why are both descriptions correct?

- A) Distance is always equal to displacement.
- B) Motion depends on the chosen reference point.
- C) Velocity cannot be measured without a graph.
- D) Constant speed prevents direction changes.

Q8: A security robot moves along a straight warehouse aisle. It travels a total distance of 80 m in a timeframe of 20 s. What is the average speed of the security robot?

- A) 0.25 m/s
- B) 4.0 m/s
- C) 60 m/s
- D) 1600 m/s

Question 12 a

Question 13 a



THREE-DIMENSIONAL THINKING

Analyze the data on the plot below. Determine the speed of the hawksbill sea turtle during each interval listed below.

Hawksbill Sea Turtle Tracking Data



Day 0 to day 2: _____

Day 2 to day 3: _____

Day 3 to day 4: _____

Day 4 to day 6: _____

Analyze the "Hawksbill Sea Turtle Tracking Data" graph. During which time interval did the sea turtle remain completely stopped (speed = 0 km/day)?

- A) Day 0 to day 2 B) Day 2 to day 4
C) Day 4 to day 6 D) The turtle never stopped moving.

Question 12 b

A distance-time graph line becomes steeper over time. What does this mean?

- A) The object is speeding up.
B) The object is slowing down.
C) The object has stopped moving.
D) The object is moving backward.

Start from Here

- Put a sticky note at the 50-cm mark of a meterstick. This is your reference point.
- Place a small object at the 40-cm mark. It is 10 cm in the negative direction from the reference point.
- Continue moving the object and recording its distance, its reference direction, and its position to complete the table below.

Position of Object		
Distance (cm)	Reference Direction	Position (cm)
10 cm	negative	40 cm
40 cm	positive	
15 cm	positive	
	positive	75 cm
		30 cm

- How would the data in the table change if the positions were the same, but the reference point was at the 40-cm mark? Complete the table below with the new information.

Position of Object		
Distance (cm)	Reference Direction	Position (cm)

Question 13 a

Based on the activity, if the reference point on a meterstick is at the 50-cm mark, what is the exact position of an object placed 10 cm in the negative direction?

- A) 60 cm
- B) 50 cm
- C) 40 cm
- D) 10 cm

Question 13 b

If the reference point is at the 50-cm mark and an object is placed at the 75-cm mark, what are its distance and reference direction?

- A) 25 cm, positive
- B) 75 cm, negative
- C) 15 cm, positive
- D) 25 cm, negative

Question 13 c

An object is located at the 30-cm mark on a meterstick. If you change the reference point from the 50-cm mark to the 40-cm mark, how does the object's distance from the reference point change?

- A) It changes from 10 cm to 20 cm.
- B) It remains exactly the same.
- C) It changes from 30 cm to 40 cm.
- D) It changes from 20 cm to 10 cm.

Question 13 b

1) Knowing an object's position requires which of the following?

- ☐ A) speed
- ☐ B) time
- ☐ C) displacement
- ☐ D) reference point

Analyze the data table below. Use the table to answer questions 2 and 3.

Green Sea Turtle's Distance and Time Data

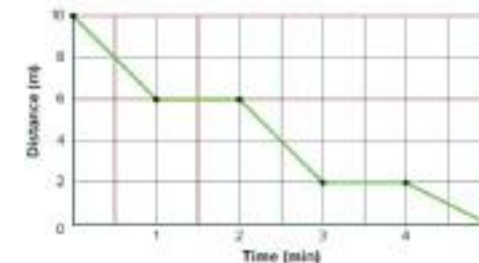
Time (days)	Distance (km)
0	0
1	16
2	32
3	48
4	64
5	80
6	96

2. The data in the table above shows how far a sea turtle travels over several days. What would the line on a plot of this data look like?

- A The line would curve upward and to the right.
- B The line would go up and down.
- C The line would point straight upward to the right.
- D The line would point upward then downward.

Interpret Data: Look at the graph showing the motion of an elevator. During which time intervals did the elevator stop moving completely?

- A) From 0 to 1 min and from 2 to 3 min.
- B) The elevator never stopped moving.
- C) From 1 to 2 min and from 3 to 4 min.
- D) From 4 to 5 min only.



Calculate: A driver travels 55 km in 1 hour. He then drives at a speed of 35 km/h for 2 hours. Next, he drives 175 km in 3 hours. What was his average speed for the entire trip?

- A) 50 km/h
- B) 35 km/h
- C) 55 km/h
- D) 60 km/h

14	Students will explore how force affects motion. They will plan and carry out investigations to enhance their understanding of the changes in motion caused by a net force.	Q 14 a	U1M1L2: Force and Acceleration
		Q 14 b	
15	Students will explore how force affects motion. They will plan and carry out investigations to enhance their understanding of the changes in motion caused by a net force.	Q 15 a	U1M1L2: Force and Acceleration
		Q 15 b	
16	Students will explore how force affects motion. They will plan and carry out investigations to enhance their understanding of the changes in motion caused by a net force.	Q 16 a	U1M1L2: Force and Acceleration
		Q 16 b	

1. Changes in Motion & Acceleration

- Velocity changes when an object's speed, direction, or both change.
- Acceleration is the rate of change of velocity over time.
- It is a vector quantity → has magnitude and direction.
- Represented by an arrow (length = size, direction = اتجاه).
- SI unit: meters per second squared (m/s^2).

2. Forces & Newton's Second Law

- A force is a push or pull acting on an object.
- Forces are also vector quantities.
- Contact force happens when objects physically touch (e.g., pulling a rope).
- Newton's Second Law:
 - Acceleration depends on net force and mass.

$$a = \frac{F}{m}$$

- This means:
 - More force → more acceleration
 - More mass → less acceleration

3. Friction & Free-Body Diagrams

- Friction is a force that resists motion between touching surfaces.
- It happens بسبب microscopic bumps and dips on surfaces.
 - Lubricants (oil, soap) → reduce friction
 - Rough materials (like sandpaper) → increase friction
- Free-body diagram:
 - A simple drawing showing all forces on an object
 - Object = circle (with mass)
 - Forces = arrows showing direction and size

4. Net Force & Types of Forces

- Net force = مجموع كل القوى المؤثرة على الجسم
 - Same direction → add
 - Opposite directions → subtract
- ✓ **Balanced Forces**
 - Net force = 0 N
 - No change in motion:
 - Object at rest → stays at rest
 - Moving object → continues at constant speed (straight line)

✗ Unbalanced Forces

- Net force ≠ 0
- Causes acceleration
- Object moves in the direction of the net force
- No net force → no change in motion
- Net force exists → acceleration happens

Acceleration Equation

$$\text{acceleration (in } m/s^2) = \frac{\text{force (in N)}}{\text{mass (in kg)}}$$

$$a = \frac{F}{m}$$

Newton's first law of motion states that an object in motion will stay in motion, and an object at rest will stay at rest unless acted on by a force.

An object has a force acting on it to the right and has a frictional force to the left as shown below. Use the model below to answer questions 2 and 3.



2. What change in motion will result from the forces modeled?

- A There will be no change in motion because the forces are in opposite directions.
- B The object will slow down because of the friction force.
- C The object will accelerate to the right.
- D The object will accelerate to the left.

3. What would a model of the net force look like?

- A The arrow would be to the right at the same length as before, because friction is a different force.
- B The arrow would be to the right but shorter than before to account for the friction force.
- C There would be no net force because the two forces are in opposite directions.
- D The arrow would be to the left because friction is slowing the object down.

4. A train moves at a constant speed down a straight track. Which of the following scientific explanations is true?

- A No forces act on the train as it moves.
- B The train moves because no forces are acting against it.
- C The forces of the train's engine balance the force of friction opposing it.
- D An unbalanced force keeps the train moving.

Question 14 a

How does friction affect the motion of an object?

- A) It always increases the speed of the object.
- B) It acts in the opposite direction of motion to slow down or resist movement.
- C) It has no effect on the motion of objects.
- D) It causes objects to accelerate indefinitely.

Question 14 b

If you change the types of surfaces between two touching objects, how will the friction most likely be affected?

- A) Friction will always decrease regardless of the surface material.
- B) Friction will always drop to zero.
- C) The friction will change depending on the roughness or smoothness of the new surfaces.
- D) Changing the surfaces has no impact on the frictional force.

Question 15 a

How can forces act on an object that is not changing its motion (stationary or moving at a constant velocity)?

- A) The forces acting on the object must be completely absent.
- B) The object is only acted upon by a single, unbalanced force.
- C) The forces acting on the object are balanced, meaning their net force equals zero.
- D) Gravity is the only force that stops acting on the object.

Question 15 b

Forces that are equal in size but opposite in direction are called _____ forces.

- A) Unbalanced
- B) Balanced
- C) Friction
- D) Gravitational

Question 16 a

MATH Connection: In a PhET interactive simulation, a net force of 100 N is applied to a wrapped present, giving it an acceleration of 2 m/s^2 . What is the mass of the object?

- A) 200 kg
- B) 50 kg
- C) 0.02 kg
- D) 100 kg

Question 16 b

What is the acceleration when a net force of 2.0 N is applied to a ball that has a mass of 0.60 kg?

- A) 1.2 m/s^2
- B) 0.30 m/s^2
- C) 3.33 m/s^2
- D) 4.0 m/s^2

Q1: A rocket engine fires, providing a constant forward force. If the rocket suddenly enters a region of space where it experiences a change in direction while keeping the exact same speed, what can be concluded about its motion?

- A) The rocket is not accelerating because its speed is constant.
- B) The rocket is accelerating because its velocity has changed.
- C) The net force acting on the rocket must be zero.
- D) The mass of the rocket must have increased.

Q2: A force of 15 N is applied to a laboratory cart, causing it to accelerate at a rate of 3 m/s^2 . What is the mass of the laboratory cart?

- A) 0.2 kg
- B) 5 kg
- C) 12 kg
- D) 45 kg

Q3.

A free-body diagram shows a block with a force arrow of 25 N pointing to the right (F_2) and a force arrow of 10 N pointing to the left (F_1). What is the net force acting on the block?

- A) 15 N to the left
- B) 15 N to the right
- C) 35 N to the right
- D) 0 N

Q4.

A skier is being pulled up a mountain side by a motorized ski-lift rope at a perfectly constant speed in a straight line. Which statement correctly describes the forces acting on the skier?

- A) The pulling force of the rope is greater than the friction and gravitational resistance forces combined.
- B) The net force acting on the skier is zero because the forces are completely balanced.
- C) The skier is accelerating upward because an unbalanced force is acting on them.
- D) There are no contact forces acting on the skier as they move up the mountain.

Q5.

Why does adding engine oil between two sliding metal machine parts make it much easier for them to move past one another?

- A) The oil completely eliminates the mass of both metal parts.
- B) The oil changes the sliding forces from contact forces into non-contact forces.
- C) The oil fills in the microscopic dips and bumps, reducing the surface resistance.
- D) The oil increases the net force by pulling the two surfaces closer together.

Q6.

A heavy box is sliding across a rough floor to the right. A student starts pushing the box to the right with a force F that is exactly equal in size to the kinetic friction force f acting to the left. What will happen to the motion of the box?

- A) The box will instantly stop moving.
- B) The box will slow down gradually until it stops.
- C) The box will continue moving to the right at a constant speed.
- D) The box will speed up and accelerate to the right.

Q7.

An object is observed moving through a liquid with an acceleration of 0 m/s^2 . What must be true about the forces acting on this object?

- A) There are absolutely no forces acting on the object.
- B) The sum of all forces acting on the object equals zero.
- C) The force of gravity is the only active force on the object.
- D) The applied forward force is larger than the fluid resistance.

Q8.

If the net force acting on a moving toy car is cut exactly in half while its total mass is kept constant, how will the car's acceleration change?

- A) The acceleration will double.
- B) The acceleration will remain exactly the same.
- C) The acceleration will drop to half of its original value.
- D) The acceleration will drop to one-quarter of its original value.

17

Students will explore how the force exerted by one object on a second object is equal in strength and opposite in direction to the force that the second object exerts on the first. They will use models of the systems of objects to construct explanations to illustrate these force pairs and their effects on motion.

Q 17 a

Q 17 b

U1M1L3: Force Pairs

1. Newton's Third Law of Motion

- **Law:** When one object applies a force on another, the second object applies an **equal force in the opposite direction**.
- Known as: **Action = Reaction**
- The two forces:
 - Have **equal magnitude**
 - Have **opposite directions**
 - Act on **different objects**
- ♦ Example:
 - A drone pushes air **downward** → air pushes the drone **upward**.

2. Force Pairs vs. Balanced Forces

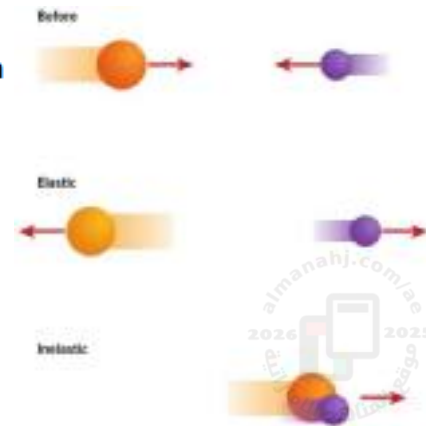
- **Force Pair:**
 - Two forces between **two different objects**
 - Always **equal and opposite**
 - **Do NOT cancel out** (because they act on different objects)
- **Balanced Forces:**
 - Forces acting on the **same object**
 - Equal and opposite → **cancel out**
 - Net force = **0 N**
- ♦ **Key Idea:**
 - Same object → can cancel
 - Different objects → never cancel

3. Normal Force

- A **support force** exerted by a surface
- Always acts **perpendicular (90°)** to the surface
- ♦ Example:
 - When you push a wall → the wall pushes back on you with a **normal force**

4. Collision Forces & Types

- During a **collision**, both objects:
 - Apply **equal and opposite forces** (Newton's Third Law)
 - Experience changes in **motion or acceleration** depending on mass
- ♦ **Types of Collisions:**
- **Elastic Collision:**
 - Objects **bounce off** each other
 - Example: billiard balls
- **Inelastic Collision:**
 - Objects **stick together** after collision
 - Example: football players tackling



A person is applying a force to the right on an object as shown.
Use the model below to answer questions 2 and 3.



2. What forces are acting on the person?
 - A a slightly smaller force to the left because the object is accelerating
 - B a force equal to the force applied going to the left
 - C a force to the right to apply the force to the object
 - D a force to the right because the object is accelerating
3. The person is standing on ice with little to no friction. What will be the motion of the person applying the force to the object?
 - A begin to move to the right because that is the direction of the push
 - B no change in motion because the person is pushing the object
 - C begin to move to the left because the object pushes on the person
 - D begin to move to the right with the object
4. Which of the following systems does NOT represent a force pair?
 - A When you push on a bike's brakes, the friction between the tires and the road increases.
 - B When a diver jumps off a diving board, the board pushes the diver up.
 - C When an ice skater pushes off a wall, the wall pushes the skater off of the wall.
 - D When a boy pulls a wagon, the wagon pulls back on the boy.

Question 17 a

Question 1

Your friend says action-reaction forces cancel each other out. Why is this **incorrect**?

- A) They act on different objects.
- B) They are unequal in size.
- C) They act in the same direction.
- D) They only happen at rest.

Question 2

Which law applies to action-reaction forces, and how do they differ from balanced forces?

- A) Newton's 1st Law; they act on the same object.
- B) Newton's 3rd Law; they act on different objects, while balanced forces act on the same object.
- C) Newton's 2nd Law; they always cause acceleration.
- D) Newton's 3rd Law; they always cancel out.

Question 17 b

Question 3

A swimmer pushes water **backward** and moves **forward**. Why don't these forces cancel out?

- A) The water doesn't push back.
- B) The backward force is on the water, and the forward force is on the swimmer.
- C) The swimmer's strength overcomes the reaction force.
- D) The forces cancel, but momentum keeps the swimmer moving.

Q1. A heavy truck collides head-on with a small, lightweight sedan. Which statement correctly describes the forces during the crash?

- A) The heavy truck exerts a much larger force on the sedan.
- B) The small sedan exerts a much larger force on the truck.
- C) Both vehicles experience a force of exactly the same strength.
- D) Neither vehicle exerts a force; the damage is caused by speed.

Q2. A fully loaded delivery drone is hovering completely still in mid-air. What must be true about the forces involved?

- A) The downward force of the blades on the air equals the weight of the drone.
- B) The drone does not experience a force pair because it is not moving horizontally.
- C) The air pushes up on the blades with more force than the blades push down on the air.
- D) The force pair between the drone and the air has cancelled out to make the net force zero.

Q3. A textbook rests motionlessly on top of a flat school desk. Why do the gravitational force pulling the book down and the normal force pushing the book up not form a Newton's third law force pair?

- A) Because the two forces are equal in strength.
- B) Because both forces are acting simultaneously on the exact same object.
- C) Because normal force is always weaker than gravitational force.
- D) Because the book is stationary and not accelerating.

Q4. A student stands on a skateboard and pushes horizontally against a concrete wall with a force of 50 N. Which of the following describes the resulting normal force?

- A) The wall pushes back horizontally with 50 N perpendicular to its surface.
- B) The wall pushes upward vertically with 50 N to balance gravity.
- C) The wall pushes back horizontally with 100 N because concrete is rigid.
- D) The wall pushes back with 0 N because the skateboard reduces friction.

Q5. Two identical ice skaters, Skater X and Skater Y, face each other on frictionless ice. Skater X gently pushes Skater Y forward. What happens immediately after the push?

- A) Only Skater Y moves backward away from the interaction.
- B) Skater X moves backward with a much higher acceleration than Skater Y.
- C) Both skaters move away from each other in opposite directions at the same speed.
- D) Skater X stays in place while Skater Y moves away at a constant velocity.

Q6. A swimmer uses their hands to push water backward to accelerate forward through a pool. If the swimmer wants to double their forward acceleration, what must they do according to the laws of motion?

- A) Push twice as much water backward with twice the force.
- B) Hold their breath to decrease their overall body mass.
- C) Push the water downward instead of backward.
- D) Reduce the surface area of their hands against the water.

Q7. During a science lab experiment, two rolling carts move toward each other on a track. They collide, a Velcro strip couples them together, and they continue moving forward as a single combined unit. How should this specific interaction be classified?

- A) An elastic collision
- B) An inelastic collision
- C) A balanced force pair
- D) A zero-net-force collision

Q8. A tennis player swings a racket and strikes an incoming ball. The ball flies over the net. Which explanation correctly describes the system using force pairs?

- A) The racket applies a temporary force to the ball, but the ball cannot apply a force to the racket.
- B) The racket applies a force to the ball, and the ball applies an equal, opposite force to the racket.
- C) The racket applies a larger force because it has more mass and velocity than the tennis ball.
- D) The force of the racket cancels out the force of the ball, resulting in a net force of zero.

18	Students will explore the attractive nature of gravitational force, the factors that affect it, and how it affects the motion of objects. They will model systems of objects to compose arguments from evidence about these forces.	Q 18 a	U1M1L4 : Gravitational force
		Q 18 b	
19	Students will explore the attractive nature of gravitational force, the factors that affect it, and how it affects the motion of objects. They will model systems of objects to compose arguments from evidence about these forces.	Q 19 a	U1M1L4: Gravitational force
		Q 19 b	
23	Students will explore the attractive nature of gravitational force, the factors that affect it, and how it affects the motion of objects. They will model systems of objects to compose arguments from evidence about these forces.	Q 23 a	U1M1L4 : Gravitational force
		Q 23 b	

1. Noncontact Forces & Fields

- A **noncontact force** acts **without physical touching**.
 - Examples: **gravitational**, **magnetic**, **electric forces**
- Gravitational field**:
 - A **region of space** where **gravity acts on objects**
 - Every object with **mass** creates a **gravitational field** around it

2. Factors Affecting Gravitational Force

- Mass (Direct Relationship)**:
 - More mass → **stronger gravitational force**
 - If mass increases → gravity increases proportionally
- Distance (Inverse Relationship)**:
 - Greater distance → **weaker gravitational force**
 - Gravity decreases **rapidly** as distance increases

3. Gravitational Acceleration vs. Weight

- Gravitational acceleration (g)**:
 - Near Earth = 9.8 m/s^2 downward
 - All objects fall with the **same acceleration** (if no air resistance)
- Mass vs. Weight**:
 - Mass**: amount of matter (constant)
 - Weight**: force of gravity acting on an object (measured in Newtons)

- This means:

- More mass → **greater weight**
- Weight depends on **gravity**, mass does not

4. Gravity Between Small Objects

- All objects (even small ones) **attract each other gravitationally**
- But the force is **extremely weak** and usually **unnoticeable**



5. Cosmic Role of Gravity

- Formation of the Solar System**:
 - Gravity pulled together **gas, dust, and ice**
 - As mass increased → gravity increased → more material attracted
- Orbital Motion**:
 - Planets move around the Sun بسبب **gravitational pull**
 - If gravity disappeared:
 - Planets would move in **straight lines** into space

Weight Equation

$$\text{weight (N)} = \text{mass (kg)} \times \text{gravitational acceleration (m/s}^2\text{)}$$

$$W = mg$$

Q1: A meteor moves through empty space toward a planet. What allows the planet to pull the meteor without touching it?

- A) Atmospheric pressure
- B) A gravitational field
- C) Magnetic attraction
- D) Friction in space

Q2: Scientists double the mass of an orbiting satellite. How does Earth's gravitational pull on this satellite change?

- A) It stays the same.
- B) It decreases by half.
- C) It doubles in strength.
- D) It increases by four times.

Q3: An astronaut drops a hammer and a feather inside a vacuum chamber on the Moon. What happens?

- A) The hammer hits the ground first.
- B) The feather hits the ground first.
- C) Both hit the ground at the same time.
- D) The feather floats and never falls.

Q4: An object has a mass of 5 kg on Earth. On a distant moon with half of Earth's gravity, what happens to its mass and weight?

- A) Both mass and weight decrease.
- B) Mass stays 5 kg, weight decreases.
- C) Weight stays the same, mass decreases.
- D) Both mass and weight stay the same.

Q5: A pencil and a textbook sit next to each other on a desk but do not move together. Why?

- A) They do not have gravity.
- B) Desk normal force blocks them.
- C) Friction is stronger than their tiny gravity.
- D) Gravity only acts on gases.

Q6: A planet orbits the Sun. What happens to the planet's path if the Sun's gravity instantly vanishes?

- A) It flies off in a straight line.
- B) It stops moving completely.
- C) It spirals into the center.
- D) It continues orbiting normally.

Q7: As two spaceships fly farther away from each other, what happens to the gravitational force between them?

- A) It decreases sharply.
- B) It decreases at a constant rate.
- C) It increases.
- D) It stays stable.

Q8: How did gravity turn small dust particles into planets during the early solar system?

- A) It pushed particles apart.
- B) Particles gathered and stuck, increasing their gravity.
- C) It melted dust into liquid.
- D) It did not act on dust particles.

Question 18 a

A boy is standing still on the floor. Gravity pulls him downward. What is the name of the upward force stopping him from falling through the floor?

- A) Friction force
- B) Normal force
- C) Air resistance
- D) Magnetic force

Question 18 b

A pencil is sitting still on a table. Which two forces are acting on it?

- A) Gravity and Friction
- B) Friction and Normal force
- C) Gravity and Normal force
- D) Air resistance and Gravity

For a pencil sitting still on a table, in which directions do the two forces act?

- A) Gravity acts downward, Normal force acts upward.
- B) Gravity acts upward, Normal force acts downward.
- C) Both forces act downward.
- D) Both forces act horizontally.

Question 19 a

Gravitational force increases with increasing _____ and decreases with increasing _____.

- A) Mass / Distance
- B) Distance / Mass
- C) Velocity / Time
- D) Size / Weight

On the figure below, add arrows to **model** the size and direction of the force of gravity for the missing forces in each **system** below.

**Question 19 b (Change in Mass)**

Based on the "Change in Mass" model, what happens to the gravitational pull when the mass of the objects increases?

- A) The force decreases.
- B) The force stays the same.
- C) The force increases.
- D) The force disappears.

Question 19 b (Change in Distance)

Based on the "Change in Distance" model, what happens to the gravitational pull as two objects move further apart?

- A) The gravitational force becomes stronger.
- B) The gravitational force becomes weaker.
- C) The mass of the objects increases.
- D) The objects start to repel each other.

MATH Connection

For each of the systems below, calculate the weight of the object. Then, apply scientific understanding to draw a free-body diagram of the system.

A. A book with a mass of 2 kg is at rest on top of a desk.

B. A pencil with a mass of 0.0075 kg is falling toward the floor.

If an astronaut moves away from Earth toward the Moon, how do the gravitational forces change?

- A)** Earth's pull increases; Moon's pull decreases.
- B)** Earth's pull decreases; Moon's pull increases.
- C)** Both gravitational forces increase.
- D)** Both gravitational forces decrease.

Someone claims the gravity between two 50 kg objects is less than between a 50 kg and a 5 kg object. What is the best question to challenge this?

- A)** "Does the shape of the objects matter?"
- B)** "Is the distance between the objects the same in both cases?"
- C)** "Which object is moving faster?"
- D)** "Are the objects in a vacuum?"

Why would the gravitational force between two 50 kg objects be larger than between a 50 kg and a 5 kg object (at the same distance)?

- A)** Gravity decreases as mass increases.
- B)** Gravity is not affected by mass.
- C)** Gravity increases as the product of the masses increases.
- D)** Gravity only depends on the larger mass.

Coverage Of SCIENCE		G7 ADV, ATS	T3	2025-2026	Mr. Ahmed Elhddad	0544557773
20	Students will explore how the potential energy of an object is affected by distance from Earth and mass. They will develop and use models and analyze systems and system models to compare the potential energy of different objects.	Q 20 a			U1M2L2: Potential Energy	
		Q 20 b				
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		Q 22 b				

Definition of Potential Energy

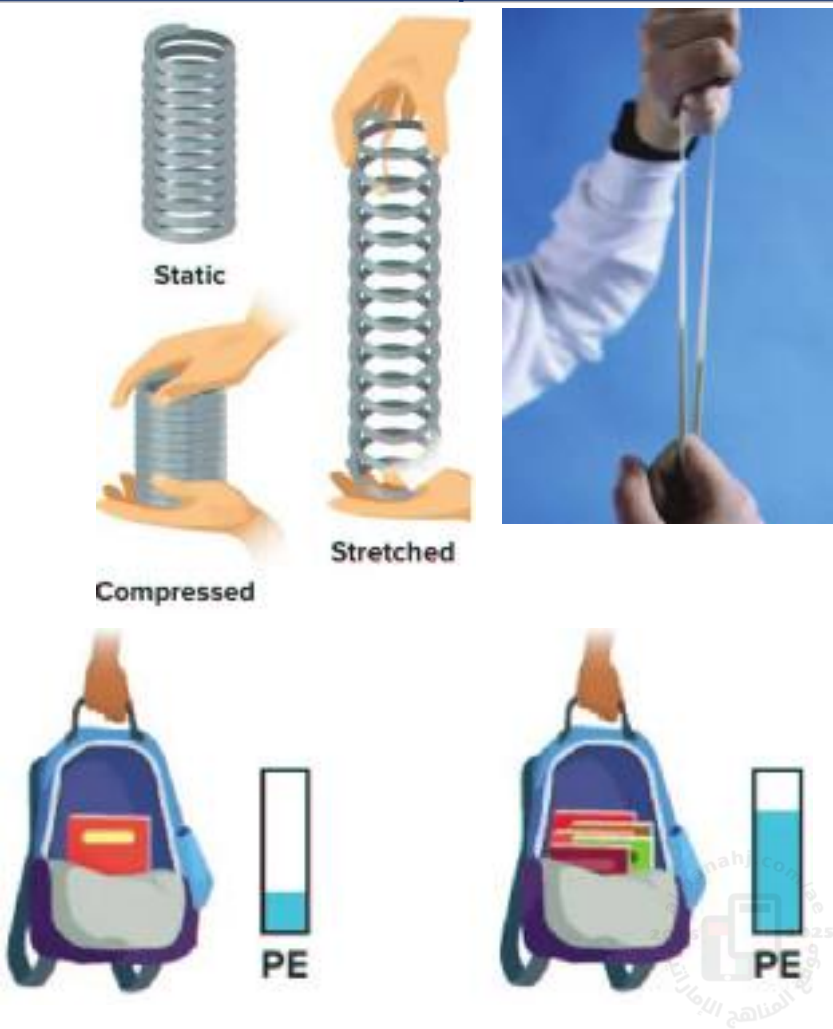
- **Potential Energy:**
 - Stored energy due to the interactions between objects or particles when their distance or positions change.
 - Energy is often studied within a system (e.g., a rubber band and a nickel).
 - A system can be **open** (interacts with the environment) or **closed** (isolated).

Types of Potential Energy

- **Gravitational Potential Energy (GPE):**
 - Energy stored between an object and Earth.
 - It depends on the object’s **mass** and its **height** (distance from Earth).
- **Elastic Potential Energy:**
 - Energy stored in objects that are compressed or stretched, such as springs or rubber bands.
- **Other Types:** Includes chemical, nuclear, magnetic, and electric potential energy, often due to fields.

Factors Affecting Gravitational Potential Energy

- **Mass:**
 - There is a proportional relationship. If the mass of an object increases, its GPE increases.
- **Distance (Height):**
 - The farther an object is from Earth's center (the higher it is), the greater its GPE.
- To increase GPE, a force must be applied to move objects farther apart.



Q1: What is defined as stored energy due to the interactions between objects or particles?

- A) Kinetic energy
- B) Potential energy
- C) Thermal energy
- D) Electrical energy

Q2: A girl lifts a backpack from the floor to a high shelf. What happens to the potential energy of the system?

- A) It decreases.
- B) It stays the same.
- C) It increases.
- D) It vanishes.

Q3: A student stretches a thick rubber band to launch a paper clip. How can the student increase the elastic potential energy in the system?

- A) Use a thinner rubber band.
- B) Stretch the rubber band farther back.
- C) Release the rubber band slowly.
- D) Use a lighter paper clip.

Q4: Two balls are at the same height. Ball A has a mass of 2 kg and Ball B has a mass of 5 kg. Which statement is true?

- A) Ball A has more GPE.
- B) Ball B has more GPE.
- C) Both have the same GPE.
- D) Neither has GPE.

Q5: Which type of energy is stored when a person holds a ball in the air before dropping it?

- A) Magnetic
- B) Elastic
- C) Gravitational
- D) Chemical

Q6: A spring is compressed by a heavy box. What happens to the energy stored in the spring?

- A) It becomes kinetic energy.
- B) It increases as elastic potential energy.
- C) It decreases to zero.
- D) It turns into gravitational energy.

Q7: If you remove half of the books from a backpack while keeping it at the same height, what happens to its GPE?

- A) It doubles.
- B) It stays the same.
- C) It decreases by half.
- D) It increases slightly.

Q8: A basketball is flying upward toward the hoop. As the distance between the ball and Earth increases, what happens to its GPE?

- A) It increases.
- B) It decreases.
- C) It stays constant.
- D) It becomes negative.

Question 20 a

A student says, "A spring only has energy when it is moving, not when it is being held compressed." Do you agree or disagree? Use what you know about potential energy to explain your answer.

- A) A compressed spring stores elastic potential energy.
- B) Energy only exists when there is friction.
- C) Springs only have kinetic energy.
- D) Energy is lost when a spring is compressed.

Question 20 b

What is elastic potential energy?

- A) Energy stored due to an object's height.
- B) Energy an object has due to its motion.
- C) Energy stored in objects that are compressed or stretched.
- D) Energy produced by chemical reactions.

Question 21 a

5. **Explain** You overhear someone say that two objects with the same mass must have the same gravitational potential energy. Do you agree? Explain.

- A) Yes, because mass is the only factor.
- B) No, it also depends on their height above the ground.
- C) Yes, if they are moving at the same speed.
- D) No, it depends on their temperature.

Differences in gravitational potential energy depend on an object's ____.

- A) mass and speed
- B) mass and height
- C) height and speed
- D) mass only

Question 22 a

COLLECT EVIDENCE

How does changing the distance between an object and Earth's surface help explain how you can increase the potential energy of a ball?

- A) By decreasing its mass.
- B) By increasing its distance (height) from the surface.
- C) By decreasing its distance (height) from the surface.
- D) By rolling it faster on the ground.

Question 22 b

7) Name two ways you could decrease the potential energy of a bucket full of water sitting on a bench.

- A) Increase its height and add more water.
- B) Lower its height and remove some water.
- C) Keep it on the bench and add more water.
- D) Move it to a higher bench and remove water.

Use the diagram below to answer questions 2–3.



2. In the rack there are two basketballs. Which basketball has more energy?
- A The top basketball has more energy because it is farther away from surface of Earth.
 - B The bottom basketball has more energy because it is closer to surface of Earth.
 - C Both basketballs have the same amount of energy because they have the same mass.
 - D Both basketballs have the same amount of energy because they are not moving.
3. In the rack there is a bike helmet and a pair of roller skates. The mass of the bike helmet is 550 g and the mass of a roller skate is 2,000 g. Which item has more energy?
- A The bike helmet has more energy because it has less mass.
 - B The roller skate has more energy because it has more mass.
 - C Both items have the same amount of energy because they are the same distance from the surface of Earth.
 - D Both items have the same amount of energy because they are not moving.

How could you increase the gravitational potential energy between yourself and Earth?

- A) By climbing to a higher position above the ground.
- B) By lying down flat on the ground.
- C) By decreasing your body mass.
- D) By moving faster horizontally.

Two objects have the same mass. Must they have the same gravitational potential energy?

- A) Yes, because potential energy only depends on mass.
- B) No, because it also depends on their height.
- C) Yes, if they are placed at different heights.
- D) No, because it only depends on their speed.

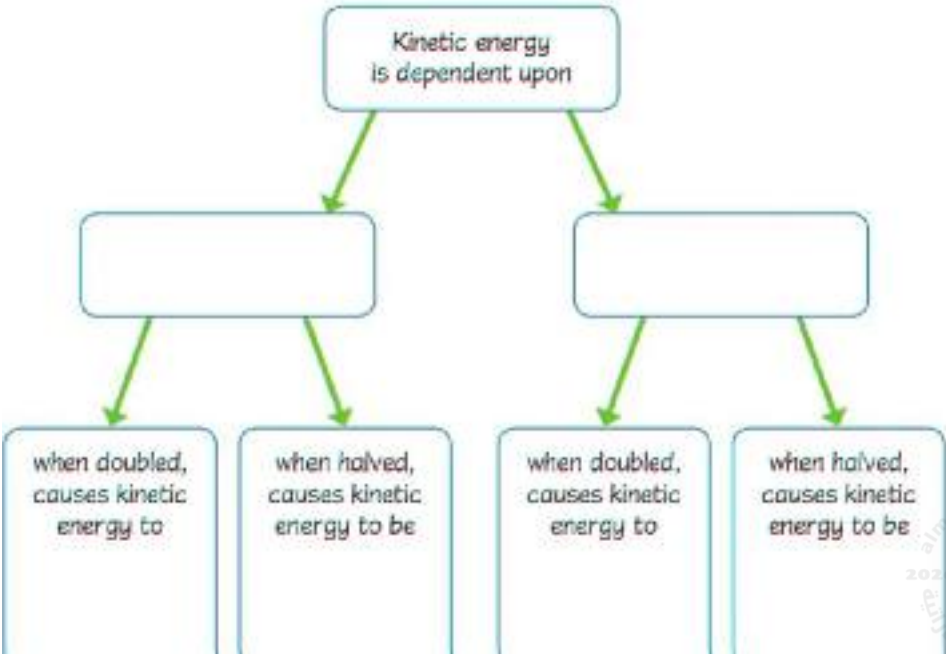
24	Students will explore the definition of kinetic energy by analyzing and interpreting the data they gather as they investigate proportional relationships between kinetic energy, mass, and speed.	Q 24 a	U1M2L1: Kinetic Energy
		Q 24 b	
25	Students will explore the definition of kinetic energy by analyzing and interpreting the data they gather as they investigate proportional relationships between kinetic energy, mass, and speed.	Q 25 a	U1M2L1: Kinetic Energy
		Q 25 b	

Kinetic Energy: The energy an object has due to its motion. All moving objects, from massive planets to tiny air particles, possess kinetic energy.

Mass (Linear Relationship): Kinetic energy depends directly on the mass of a moving object. If you double the mass of an object while keeping its speed the same, its kinetic energy will exactly double.

Speed (Square Relationship): Kinetic energy is highly sensitive to changes in speed. If you double the speed of an object, its kinetic energy increases by a factor of four ($2^2 = 4$).

$$KE = \frac{1}{2}mv^2$$



Q1: Which type of energy does an object possess solely due to its motion?

- A) Gravitational energy
- B) Elastic energy
- C) Kinetic energy
- D) Chemical energy

Q2: Two trucks travel down a road at the exact same speed. Truck A has a mass of 2,000 kg and Truck B has a mass of 4,000 kg.

How do their kinetic energies compare?

- A) Truck A has twice the kinetic energy of Truck B.
- B) Truck B has twice the kinetic energy of Truck A.
- C) Both trucks have the exact same kinetic energy.
- D) Truck B has four times the kinetic energy of Truck A.

Q3: A race car is traveling at a constant speed. If the driver accelerates and doubles the speed of the car, what happens to its kinetic energy?

- A) It stays the same.
- B) It doubles.
- C) It triples.
- D) It quadruples.

Q4: A goalkeeper fields a low, slow-rolling soccer ball. To stop the ball completely, what must the goalkeeper do to its kinetic energy?

- A) Increase it to maximum.
- B) Transfer it entirely to potential energy.
- C) Reduce it to exactly zero.
- D) Maintain its current value.

Q5: An object has a kinetic energy of 100 J. If its mass is cut exactly in half while its speed remains unchanged, what is its new kinetic energy?

- A) 25 J
- B) 50 J
- C) 100 J
- D) 200 J

Q6: When a liquid is heated, its individual particles begin to move much faster. What happens to the kinetic energy of these particles?

- A) It increases.
- B) It decreases.
- C) It drops to zero.
- D) It turns into elastic energy.

Q7: A textbook is dropped from a high shelf. As the book falls toward the floor and accelerates, how are its potential and kinetic energies changing?

- A) Both potential and kinetic energy increase.
- B) Both potential and kinetic energy decrease.
- C) Potential energy increases, kinetic energy decreases.
- D) Potential energy decreases, kinetic energy increases.

Q8: If you plot a graph of kinetic energy versus mass for an object moving at a constant speed, what will the trend line look like?

- A) A straight horizontal line at zero.
- B) A straight, upward-sloping linear line.
- C) A downward curve that flattens out.
- D) A steep exponential curve.

Question 24 a

4) Which would increase the kinetic energy of a wagon? Select all that apply.

- ☐ A) Add mass to the wagon.
☐ B) Decrease the mass of the wagon.
☐ C) Increase the speed of the wagon.
☐ D) Decrease the speed of the wagon.

Question 24 b

8) Which indicates what happens to the kinetic energy when the mass of a moving object increases?

- ☐ A) The kinetic energy does not change.
☐ B) The kinetic energy increases by the same factor as the mass increase.
☐ C) The kinetic energy increases by the square of the same factor as the mass increase.
☐ D) The kinetic energy decreases by the same factor as the mass increase.

Question 25 b

9) Which indicates what happens to the kinetic energy of an object when its speed increases?

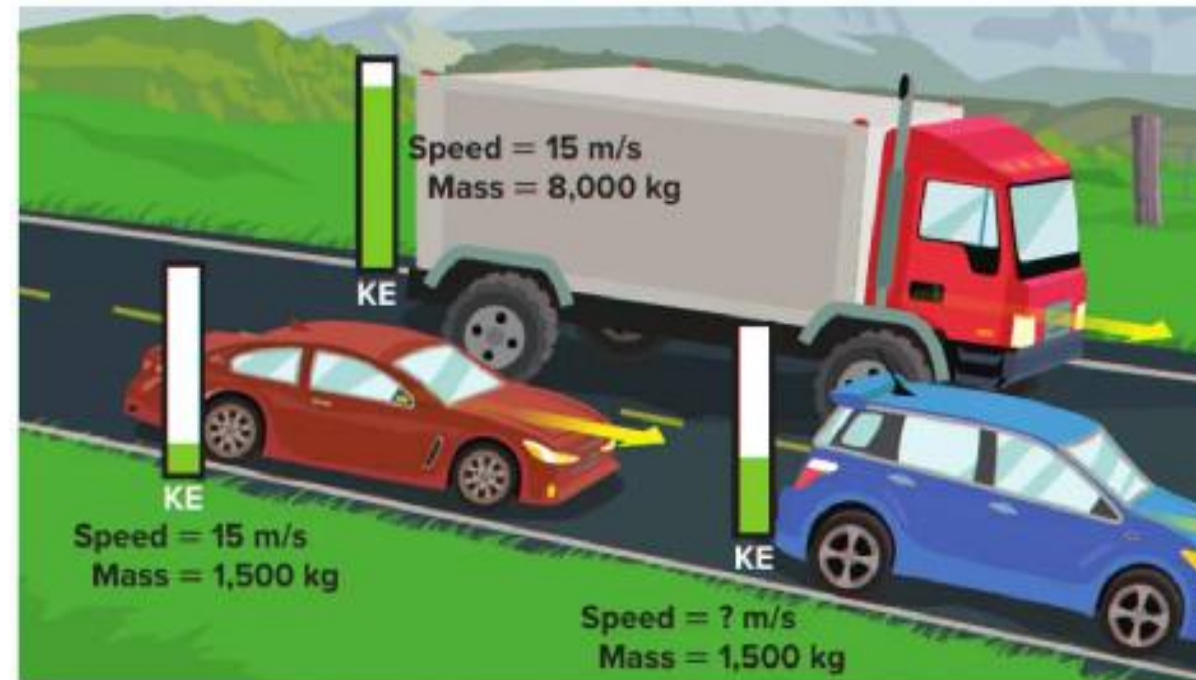
- ☐ A) The kinetic energy does not change.
☐ B) The kinetic energy increases by the same factor as the speed increase.
☐ C) The kinetic energy increases by the square of the same factor as the speed increase.
☐ D) The kinetic energy decreases by the same factor as the speed increase.

2. Aiden collected canned goods for a neighborhood service project. He pulled a plastic wagon behind him to put the items in. From the time Aiden began until he finished collecting, the mass of the wagon tripled. The walk back to Aiden's house was downhill and the speed of the wagon tripled. What happened to the kinetic energy when the mass tripled? What happened to the kinetic energy when the speed tripled?

- A When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 3.
 B When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 9.
 C When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 3.
 D When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 9.

Question 25 a

The figure below shows mass and relative kinetic energy in energy bars for three vehicles.



3. What can you determine about the speed of the blue car?

- A The blue car's speed is the same as the red car's speed.
 B The blue car's speed is less than the truck's speed.
 C The blue car's speed is equal to the truck's speed.
 D The blue car's speed is greater than the red car's speed.

Thermal Energy & Temperature

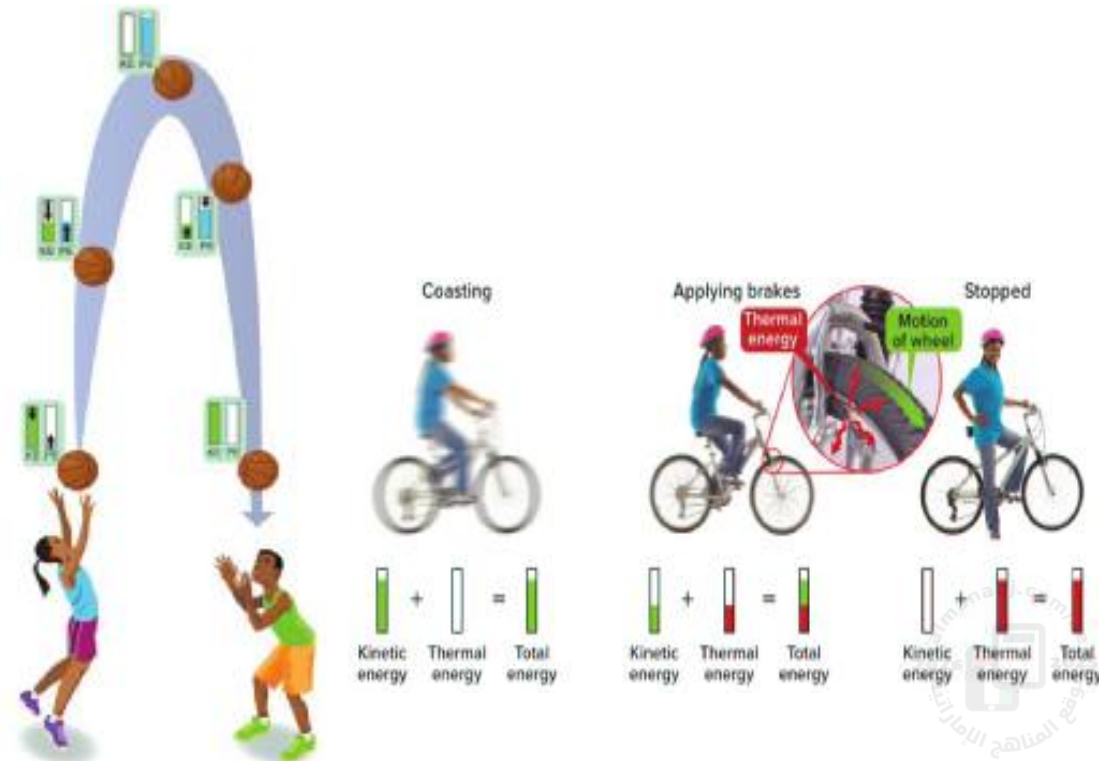
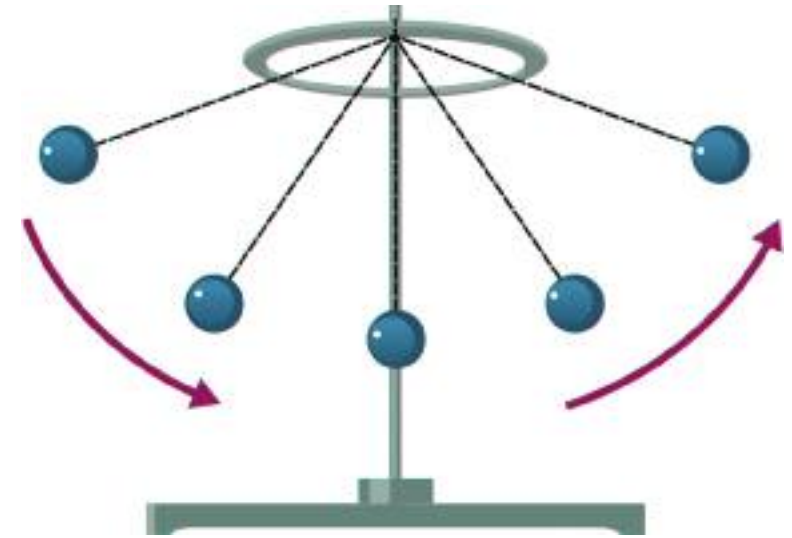
- **Thermal Energy:** The sum of the kinetic energy and potential energy of all the particles that make up an object.
- **Temperature:** The measure of the average kinetic energy of the particles in a material.
- **The Difference:** Temperature only measures the *average kinetic energy*, while thermal energy depends on *both* the total energy and the total mass/amount of particles.

Heat & Thermal Energy Transfer

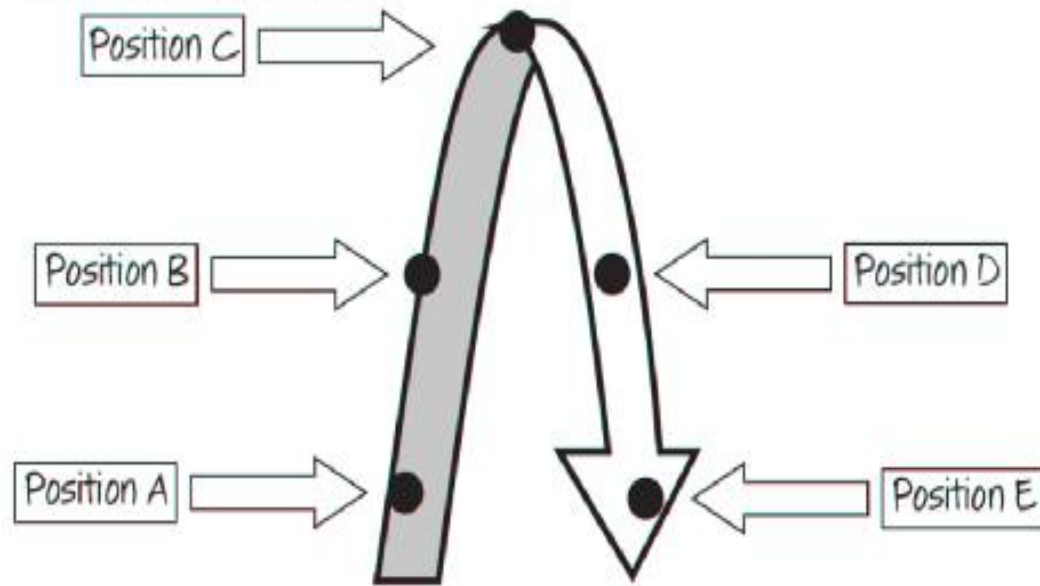
- **Heat:** The movement (transfer) of thermal energy from a region of higher temperature to a region of lower temperature.
- **Direction of Flow:** Heat always flows naturally from a **warmer** object to a **cooler** object.
- This transfer continues until both objects reach the exact same temperature.

Methods of Thermal Energy Transfer

- **Conduction:** The transfer of thermal energy between materials by the direct collision of particles. It occurs best in solids (especially metals).
- **Convection:** The transfer of thermal energy by the movement of particles from one part of a material to another. It only occurs in fluids (liquids and gases).
- **Radiation:** The transfer of thermal energy from one material to another by electromagnetic waves. It is the only method that can travel through empty space (vacuum), such as sunlight reaching Earth.

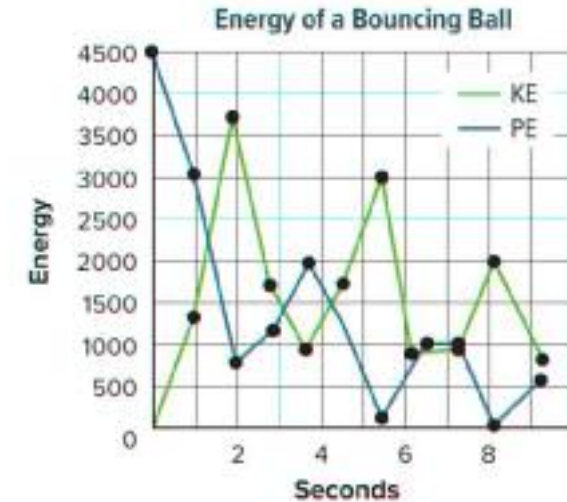


1. **Describe** how energy changes as a ball is thrown in the air. Compare the kinetic and potential energy of the ball at each position shown in the model of the system shown below.



Position	Kinetic Energy	Potential Energy
A		
B		
C		
D		
E		

The graph shows the kinetic energy (KE) and potential energy (PE) of a bouncing ball over a period of 9 seconds. Use the graph to answer questions 2–3.



2. When does the ball have the most kinetic energy?
- At the start, because it is the highest off the ground.
 - At the end, because it is moving fastest as it approaches the ground for the final bounce.
 - At second 2, because it is moving fastest as it approaches the ground for the first bounce.
 - At second 4, because it has reached its second highest bounce.
3. What statement best describes what happens to the total mechanical energy of the ball as it bounces?
- The total amount of energy remains the same because the law of conservation of energy says energy is conserved.
 - The total amount of energy goes down because some energy becomes thermal energy due to the force of friction acting on the ball.
 - The total amount of energy goes up because energy is gained from the force of gravity every time the ball bounces.
 - The total amount of energy remains the same because work is being done on the ball by the force of gravity every time the ball bounces.

Q1.Which scientific term describes the total sum of the kinetic and potential energy of all the particles in an object?

- A) Temperature
- B) Thermal energy
- C) Specific heat
- D) Conduction

Q2. A large bucket of water and a small cup of water both have a temperature of 80 C. Which statement is true?

- A) Both have the same thermal energy.
- B) The small cup has more thermal energy.
- C) The large bucket has more thermal energy.
- D) Neither object contains thermal energy.

Q3. An ice cube is dropped into a glass of warm water. Which statement correctly describes the natural transfer of heat?

- A) Coldness moves from the ice into the water.
- B) Thermal energy moves from the warm water into the ice.
- C) Energy moves back and forth equally between both.
- D) No energy transfers because the system is open.

Q4.A student places a metal spoon into a hot bowl of soup. After a few minutes, the handle of the spoon becomes hot. Which method of energy transfer caused this?

- A) Conduction
- B) Convection
- C) Radiation
- D) Insulation

Q5.Why does warm air rise above a heater while cool air sinks toward the floor inside a room?

- A) Warm air is more dense than cool air.
- B) Cool air carries more electromagnetic waves.
- C) Convection currents drive less dense fluid upward.
- D) Radiation forces the cool air down.

Q6.How does thermal energy travel from the Sun through the empty vacuum of space to reach Earth?

- A) Through direct molecular conduction
- B) Through atmospheric convection currents
- C) Through electromagnetic radiation waves
- D) Through gravitational particle collisions

Q7.If the average kinetic energy of the particles inside a block of iron increases, what else must increase?

- A) Its mass
- B) Its temperature
- C) Its volume
- D) Its chemical stability

Q8.Two metal blocks at different temperatures are placed in direct contact. When will the transfer of heat between them completely stop?

- A) When one block runs out of potential energy.
- B) When both blocks reach the same temperature.
- C) When the cooler block becomes hotter than the first.
- D) When convection currents change to radiation.