

Coverage Of Science



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇨ المناهج الإماراتية ⇨ الصف السادس ⇨ علوم ⇨ الفصل الثالث ⇨ ملفات متنوعة ⇨ الملف

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ملفات اكتب للمعلم اكتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل
منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

المزيد من مادة
علوم:

إعداد: Elhddad Ahmed .Mr

التواصل الاجتماعي بحسب الصف السادس



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف السادس والمادة علوم في الفصل الثالث

مراجعة عامة للدروس الخمسة الأولى

1

مراجعة استعداداً لاختبار العلوم النهائي

2

ملخص وملزمة وفق الهيكل

3

أسئلة كمراجعة للهيكل

4

تلخيص كتاب العلوم

5

(يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ)

Coverage Of Science



G6
ADV,ATS
T3

2025-2026

Mr. Ahmed Elhddad

"the first Bio – Sci teacher" 2025 – 2026



1

Students will describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Water in the Atmosphere

Term 3: 8

- The water cycle (or hydrologic cycle):**

is the continuous movement of water across Earth's systems. It circulates among the oceans, atmosphere, and land, driven entirely by two forces: thermal energy from the sun and gravity.

Four friends noticed a large puddle on the sidewalk when they walked to school in the morning. When they walked home, the puddle was gone. They wondered what happened to the water that was in the puddle.

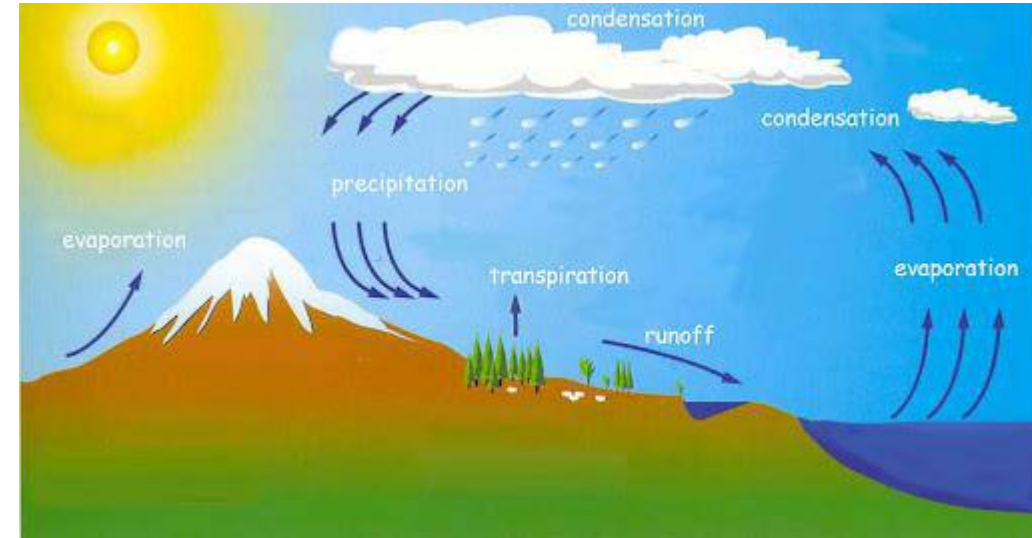
Desi: I think the water soaked into the bricks.

Trudi: I think the water went up into the clouds.

Max: I think the water is in the air around us.

Carli: I think the Sun changed it into something else.

Which friend do you most agree with? Explain why you agree. You will revisit your response to the Science Probe at the end of the lesson.



Q1: Which two primary forces continuously drive the cycling of water through Earth's systems and the atmosphere?

- A) Solar energy and gravity
- B) Wind patterns and Earth's magnetic field
- C) Geothermal heat and centrifugal force
- D) Atmospheric pressure and deep ocean currents

Q2: A farmer in a mountainous region notices that after a heavy rainfall, water flows rapidly down the slopes and collects in a nearby valley instead of soaking into the ground. Which process driven by gravity describes this scenario?

- A) Transpiration
- B) Surface runoff
- C) Condensation
- D) Infiltration

Q5: How does the force of gravity directly contribute to the formation of groundwater after a precipitation event?

- A) It pulls water downward through the spaces in soil and rocks during infiltration.
- B) It forces rising water vapor to compress into underground caves.
- C) It accelerates lake evaporation to decrease surface water pressure.
- D) It holds river water completely still to prevent it from reaching the oceans.

Q4: Which of the following processes in the water cycle relies directly on the *loss* of thermal energy (cooling) rather than *gaining* it?

- A) Condensation
- B) Evaporation
- C) Transpiration
- D) Sublimation



Q3: Examine a typical water cycle diagram. Arrow (A) represents water vapor rising from the ocean toward the sun, and Arrow (B) represents droplets falling from a cloud down toward a mountain forest. Identify processes (A) and (B) respectively:

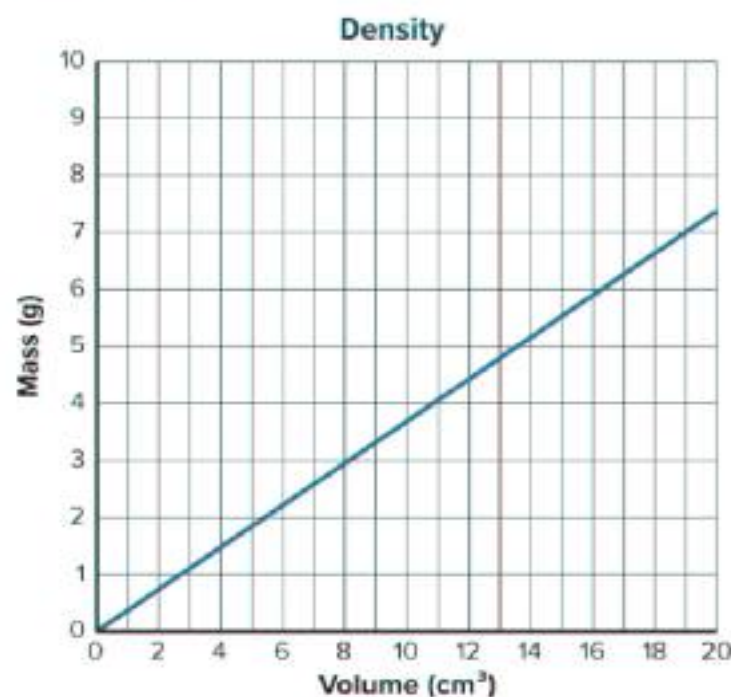
- A) (A) Condensation driven by gravity, (B) Transpiration driven by solar energy
- B) (A) Infiltration, (B) Sublimation
- C) (A) Evaporation driven by solar energy, (B) Precipitation driven by gravity
- D) (A) Sublimation, (B) Runoff

2	Students will identify physical and chemical properties of substances.	Collect Evidence	Term 2: 150
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How can a substance's mass and volume be used to identify the substance?

Think about the athlete's gold medal. If you want to increase the mass of the gold medal, you need more gold. This increases the volume of the gold medal. Is there a relationship between mass and volume? Let's find out!

Density The slope of a line represents a ratio between two variables. If the slope of the line is 2.7 g/cm^3 , this means there are 2.7 grams of mass in every 1 cm^3 of volume. This ratio between mass and volume is called density. **Density** is the mass per unit volume of a substance. Density is size-independent. This means no matter the size of the sample, the density will always be the same for the same substance. This can be seen on the slope of this graph. As the mass increases, the volume increases by an equivalent amount. Every substance has its own unique density. This makes density useful for identifying unknown substances.



Q1: A student has two solid blocks of aluminum: one small block with a mass of 10 g and one large block with a mass of 500 g. Which statement correctly describes the density of the two blocks?

- A) The large block has a higher density because it has more mass.
- B) The small block has a higher density because it takes up less volume.
- C) Both blocks have the exact same density because density is a size-independent property.
- D) The densities cannot be compared without knowing the temperature of the room.

Q2: An investigator finds an unknown silvery metal coin at a historical site. To identify whether the coin is pure silver, she measures its volume using water displacement and finds it is 4 cm^3 . She then measures its mass on a digital scale and records 42g. Given that the density of pure silver is 10.5 g/cm^3 , what can the investigator conclude?

- A) The coin is not pure silver because its density is 0.095 g/cm^3 .
- B) The coin is pure silver because its calculated density matches 10.5 g/cm^3 .
- C) The coin is made of aluminum because its mass is too high for silver.
- D) The identity cannot be determined because density changes with the shape of the coin.

Q3: Examine the provided mass vs. volume graph for an unknown substance. Based on the slope of the line, what is the density of this substance, and how much mass would a 20cm^3 sample have?

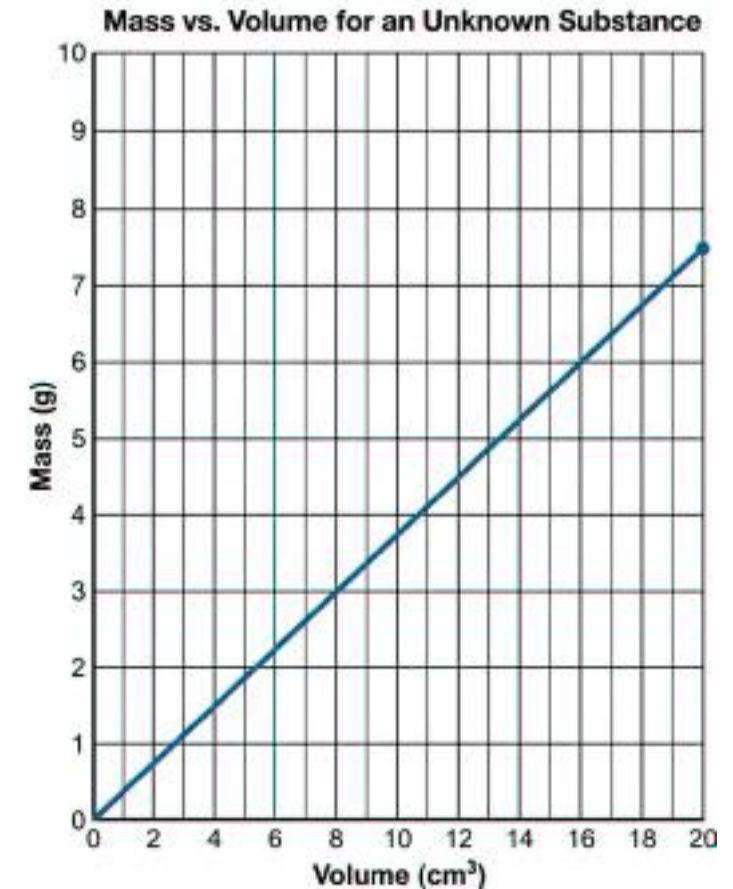
- A) Density is 2.7g/cm^3 ; a 20cm^3 sample has a mass of approximately 7.4g .
- B) Density is 0.37g/cm^3 ; a 20cm^3 sample has a mass of approximately 7.4g .
- C) Density is 7.4g/cm^3 ; a 20cm^3 sample has a mass of approximately 2.7g .
- D) Density is 1.0g/cm^3 ; a 20cm^3 sample has a mass of approximately 20g .

Q4: Which of the following is considered a chemical property of a substance rather than a physical property like density?

- A) The temperature at which a liquid freezes into a solid.
- B) The ability of a substance to react with oxygen and rust.
- C) The total volume of water displaced by an immersed object.
- D) The mass of a metallic sample measured on a triple-beam balance.

Q5: As the mass of a uniform copper wire increases during production, how does its volume change to maintain the characteristic density of copper?

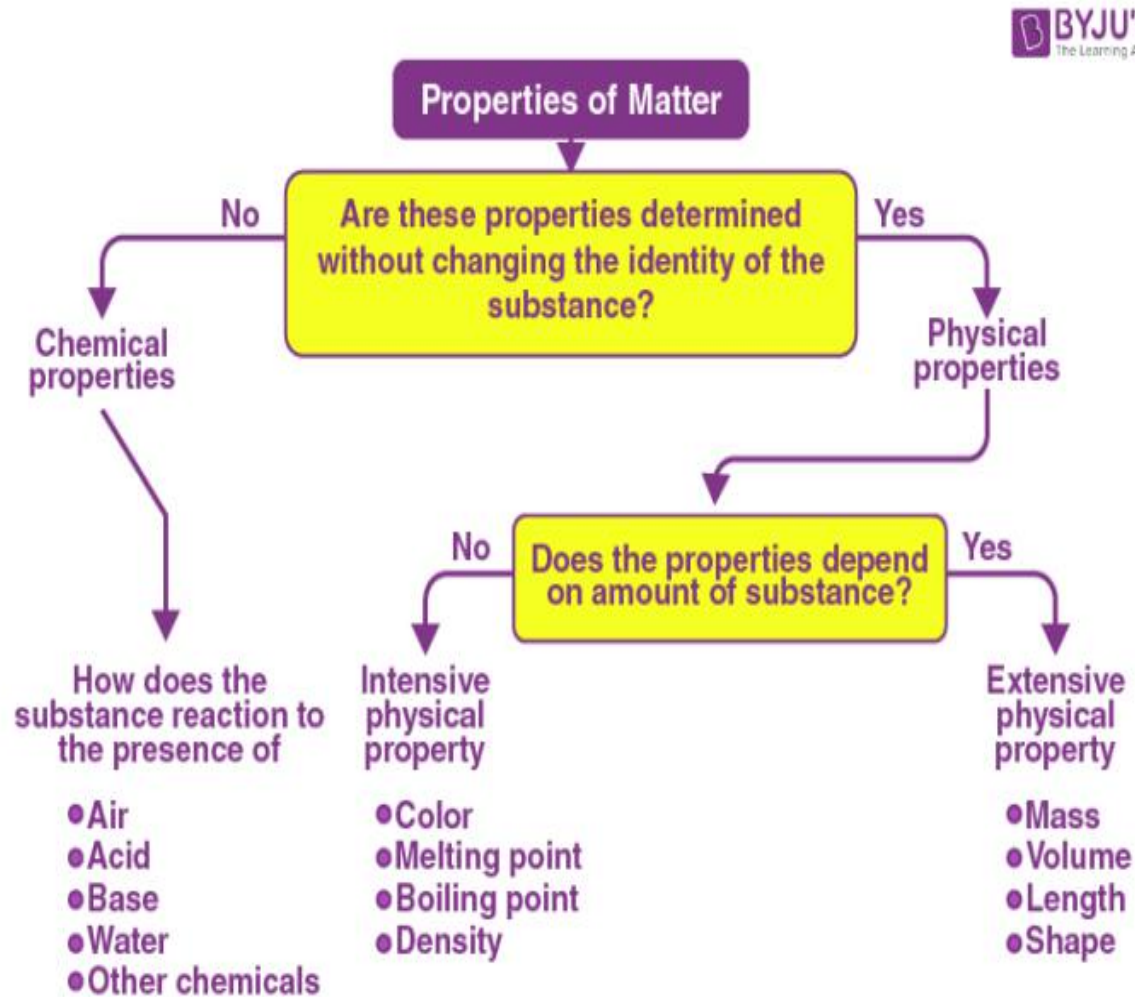
- A) The volume decreases proportionally to keep the total mass constant.
- B) The volume remains completely unchanged regardless of the mass added.
- C) The volume increases by an equivalent proportional amount to keep the mass-to-volume ratio identical.
- D) The volume fluctuates unpredictably because copper is a malleable physical metal.



3 Students will identify physical and chemical properties of substances.

Collect Evidence

Term 2: 157



PHYSICAL CHANGES

In a physical change, matter changes form but not chemical identity.



CHEMICAL CHANGES

In a chemical change, a chemical reaction occurs and new products are formed.



Intensive and Extensive properties

Intensive properties do not depend on the amount of matter in a sample.



Extensive properties depend on how much matter a sample contains.



In the figure below, identify any instances where you can observe chemical properties in action. Describe your observations in your Science Notebook.



COLLECT EVIDENCE

How can knowing a substance's chemical properties be used to determine if you had a piece of gold?

Q5: Why can chemical properties be definitively used to distinguish a piece of real gold from a piece of fake gold (like pyrite or "fool's gold")?

- A) Real gold will physically melt much faster when placed over a standard campfire.
- B) Fake gold has a much higher mass and volume when measured on a lab balance.
- C) Real gold is chemically unreactive with oxygen and most acids, whereas fake gold compounds will easily react or tarnish.
- D) Fake gold physically turns into a liquid gas as soon as it is exposed to open sunlight.

Q1: Which of the following is a physical property of gold rather than a chemical property?

- A) Its inability to react with oxygen or rust when exposed to air.
- B) Its high resistance to tarnishing or corroding in water.
- C) Its bright yellow metallic luster and high density.
- D) Its specific unreactivity with most strong acids.

Q2: A group of friends is camping in the woods and sets up a campfire using dry logs. As the wood burns, they notice bright flames, heat release, and smoke, leaving behind a pile of gray ash. How does this scenario describe a chemical property of wood?

- A) Wood has the physical ability to absorb heat from its surroundings.
- B) Wood has the chemical property of flammability, allowing it to react with oxygen and form new substances.
- C) Wood has a low density, which allows it to change its shape easily into ash.
- D) Wood has a specific melting point that turns solid cellulose into liquid smoke.

Q3: Examine the provided camping scene image. Look at the old metal bucket resting on the ground near the water. Which statement best explains the chemical property illustrated by the reddish-brown spots appearing on the bucket?

- A) The bucket is undergoing a physical change called melting due to the campfire's intense heat.
- B) The metal has the chemical property of reactivity with water and oxygen, leading to the formation of rust.
- C) The bucket is exhibiting a size-independent physical property by changing its texture.
- D) The metal is dissolving physically into the damp soil of the surrounding forest floor.

Q4: A student leaves a half-eaten apple on the ground. After an hour, she notices that the exposed flesh of the apple has turned brown. What does this observation indicate?

- A) A physical change occurred because the apple simply dried out.
- B) A chemical change occurred because substances in the apple reacted with oxygen in the air.
- C) A physical property was altered because the mass of the apple decreased.
- D) No change occurred since the identity of the internal apple cells remained identical.

4 Students will explore the impact of human activities on climate.

What are Greenhouse gases?

Term 3: 192

- **Human activities:**

- 1- Burning fossil fuels,
 - 2- Deforestation,
 - 3- Industrial agriculture.
- drive global climate change by releasing excess heat-trapping gases into the atmosphere.
 - This intensified "enhanced" greenhouse effect leads to rapidly rising temperatures, melting ice, and increasingly severe weather events worldwide.

- **Greenhouse gases (GHGs)**

- are atmospheric gases that absorb and re-emit infrared heat, acting like a thermal blanket to keep the Earth warm.
- While a natural layer is vital for survival, human-made emissions have thickened this blanket, trapping extra heat.

The primary greenhouse gases include:

Carbon Dioxide (CO₂): released by burning fossil fuels (coal, oil, natural gas).

Methane (CH₄): emitted during fossil fuel production, by agricultural livestock, and from decaying waste in landfills.

Nitrous Oxide (N₂O): Released heavily by agricultural fertilizers and industrial activities.

Water Vapor (H₂O): The most abundant greenhouse gas. It acts as a climate feedback loop: as the Earth warms, the atmosphere holds more water vapor, which amplifies warming further.



What are greenhouse gases and how do they affect climate?

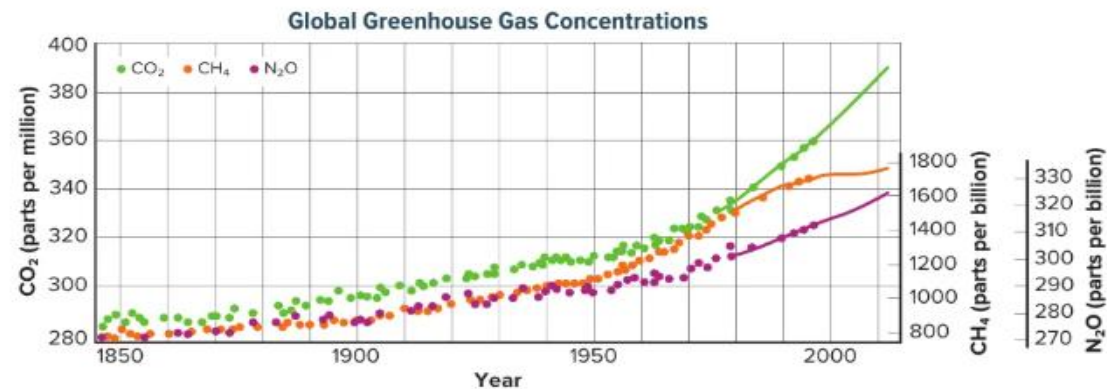
Gases in the atmosphere that absorb Earth's outgoing infrared radiation are called **greenhouse gases**. Carbon dioxide (CO_2) is an important greenhouse gas. Other greenhouse gases include methane (CH_4) and nitrous oxide (N_2O). What is happening to greenhouse gas concentrations in the atmosphere?



INVESTIGATION

Greenhouse Gases

Study the graph of atmospheric greenhouse gas levels determined from ice core data (dots) and from direct atmospheric measurements (lines).



1. What has happened to the levels of CO_2 , CH_4 , and N_2O in the atmosphere over the last century?

2. What is one question that you have about the data?

Q1. Which statement best defines a 'Greenhouse Gas'?

- A. Gases that reflect incoming solar radiation back into space, cooling the Earth.
- B. Gases in the atmosphere that absorb Earth's outgoing infrared (heat) radiation.
- C. Solid particles of soot and dust released directly into the stratosphere by volcanoes.
- D. The non-reactive nitrogen and oxygen gases that make up the majority of the air.

Q2. Water vapor is considered a 'climate feedback loop' gas. Which of the following best describes this process?

- A. Burning trees directly creates water vapor, which immediately forms clouds that block sunlight.
- B. Warmer Earth - less ice - less water vapor - cooler Earth.
- C. As Earth warms, the atmosphere can hold more water vapor, which amplifies further warming.
- D. High concentrations of water vapor destroy ozone, cooling the atmosphere.

Q3. A researcher identifies that a region has extremely high levels of Methane CH_4 emissions. Which of the following human activities is the most likely primary cause for this surge?

- A. Over-reliance on solar panel installations.
- B. Expansion of industrial-scale livestock farming.
- C. Overuse of chemical fertilizers for corn production.
- D. Deforestation to create new residential areas.

Q4. A global environmental report reveals that the temperature increase is caused not just by increased GHG production, but also by a significant reduction in natural carbon sinks. Based on the provided curriculum sources,

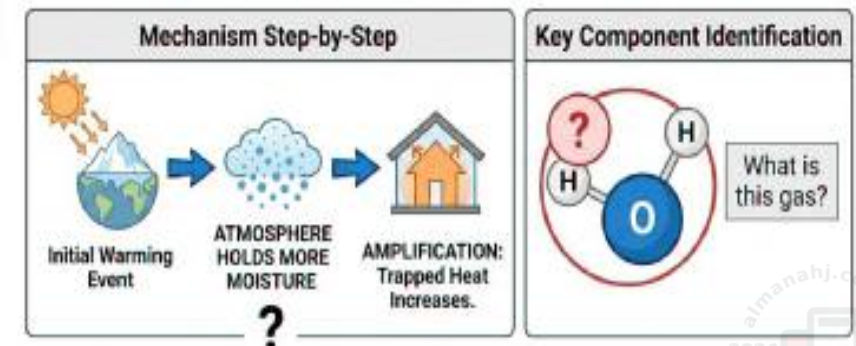
which of the following actions best illustrates this 'enhanced' greenhouse mechanism?

- A. Switching from coal-fired power to wind energy, reducing emissions.
- B. A severe volcanic eruption releasing soot into the high atmosphere.
- C. The large-scale clearance of old-growth forests to make way for new roads.
- D. Planting a new coastal mangrove forest to restore ecosystems.

Q5. Examine the diagram showing a typical sequence in a feedback loop. Based on the provided learning material on Greenhouse Gases, what sequence best fills in the missing step and identifies the key gas involved?

- A. Sequence: [Reduction in atmospheric moisture] / Gas: Vapor H_2O
- B. Sequence: [Atmosphere holds more moisture, amplification occurs] / Gas: Vapor H_2O
- C. Sequence: [Less ice formation leads to cooler air] / Gas: Methane CH_4
- D. Sequence: [Fossil fuels burn faster, making air thinner] / Gas: Carbon Dioxide CO_2

Q5: Climate Feedback Loop Mechanism.



5

Students will recognize various water reservoirs and will develop and use models about their concepts.

Where is water stored?

Term 3: 27

Where is water stored?

You discovered in the *Streaming By* investigation that gravity acts on precipitation, causing water on and below Earth's surface to continuously flow downhill toward the ocean. Although water is constantly moving through the water cycle, most water remains in certain storage areas for relatively long periods of time. A storage area is called a reservoir. Reservoirs can be oceans, lakes, glaciers and ice caps, and groundwater.

Water Under Your Feet Generally, water that lies below ground is called groundwater. There is an immense amount of water below our feet in **aquifers**—areas of permeable sediment or rock that hold significant amounts of water. As you observed in *Streaming By*, water seeps through soil and into tiny pores, or spaces, between sediment and rock. How do you think water moves underground?

Water on Earth is stored across the four major components of the hydrosphere. Earth's water reservoirs, in order of holding capacity, include:

Oceans: The largest water reservoir by far, holding roughly 97% of all Earth's water as saltwater.

Cryosphere: All frozen water on the planet, including ice sheets, glaciers, ice caps, and snow, storing about 2% of the total water.

Groundwater: Water stored beneath the Earth's surface in soil moisture and aquifers (permeable rock and sediment). This represents the largest reservoir of liquid *freshwater*.

Surface Water: Liquid water resting on the Earth's surface, stored in lakes, rivers, streams, and wetlands.

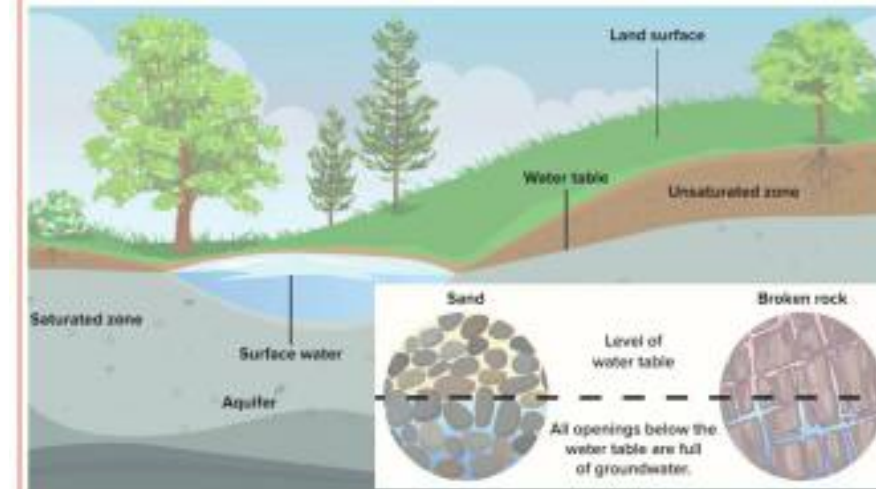
Atmosphere: Stores water in the form of water vapor and suspended water droplets in clouds.

Biosphere: Water stored inside the cells and tissues of all living organisms (plants and animals).



THREE-DIMENSIONAL THINKING

1. In your Science Notebook, draw a model that shows groundwater, surface water, and the water table. Use the figure below as an example. Use arrows to show which way water might flow.



2. Read the first paragraph on the following page and revise your arrows as needed.
3. What force **causes** groundwater to flow?

Q1: What is the scientific term used to describe areas where water remains stored for relatively long periods of time within the water cycle?

- A) Aqueduct
- B) Reservoir
- C) Atmosphere
- D) Condenser

Q2: Which of the following correctly describes an aquifer and its unique physical characteristic?

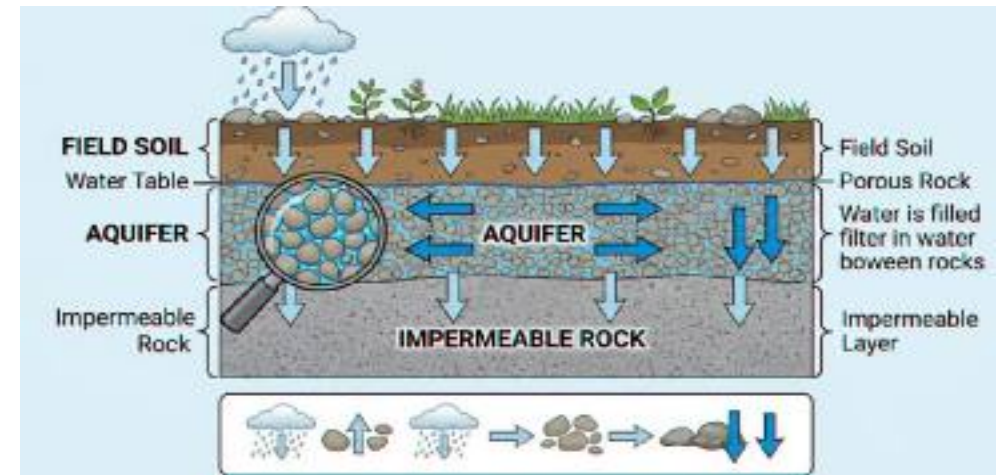
- A) An area of impermeable solid rock that completely blocks water from moving deeper underground.
- B) A surface lake formed strictly in high mountainous regions due to rapidly melting glaciers.
- C) An area of permeable sediment or rock below the ground that holds significant amounts of water.
- D) An atmospheric gas layer where water vapor expands without any liquid or solid interactions.

Q3: Based on the provided curriculum, how does gravity directly affect precipitation once it hits Earth's surface?

- A) It causes water on and below Earth's surface to continuously flow downhill toward the ocean.
- B) It heats up liquid water molecules, causing them to turn into vapor and rise into clouds.
- C) It prevents water from entering tiny pores or spaces between sediments and rocks.
- D) It stops the water cycle entirely by keeping all groundwater locked permanently inside lakes.

Q4: An environmental scientist is checking a field after a rainstorm. She observes that water is gradually disappearing from the surface by seeping into the soil through tiny spaces between rocks. Which geological process and storage system does this scenario demonstrate?

- A) Evaporation into an atmospheric reservoir.
- B) Glacier formation within a polar ice cap reservoir.
- C) Condensation driven by intense surface solar heating.
- D) Water seeping through pores to replenish underground groundwater aquifers.



Q5: Examine a conceptual diagram of an underground cross-section. Below a field of soil, there is a layer labeled with arrows showing liquid water filling up all the tiny pores and open spaces between rocks. What is the correct label for this underground water system?

- A) Atmospheric water vapor
- B) Groundwater stored in an aquifer
- C) Glacial ice cap reservoir
- D) Impermeable ocean floor sediment

6	Students will explore atmospheric and oceanic circulation.	What happens when air masses meet?	Term 3: 79
10	Students will look for patterns in the weather and explore how and why weather changes.	Air Mass Collision Course	Term 3: 79

What happens when air masses meet?

As you learned previously, air masses bring with them the characteristics of their source region as they move. As wind carries an air mass away from the area where it formed, the air mass will eventually collide with another air mass. A **front** is a boundary between two air masses. Recall that air masses can be warm or cool depending on the source region in which they form. Let's investigate what happens when different types of air masses meet.

When different air masses meet, they do not easily mix because of their varying temperatures and densities. Instead, they create a boundary zone called a **front**. The collision forces the warmer, less dense air to rise over the cooler, denser air, leading to cloud formation, precipitation, and often severe weather.

FRONT	CHART SYMBOL	DEFINITION
Cold Front		A front that moves in such a way that colder air replaces warmer air.
Warm Front		A front that moves in such a way that warmer air replaces colder air.
Stationary Front		A front which is stationary or nearly so.
Occluded Front		A composite of two fronts as a cold front overtakes a warm front or stationary front.

Note: Frontal symbols point in the direction of frontal movement.

Symbols for surface fronts and other significant lines shown on the surface analysis chart

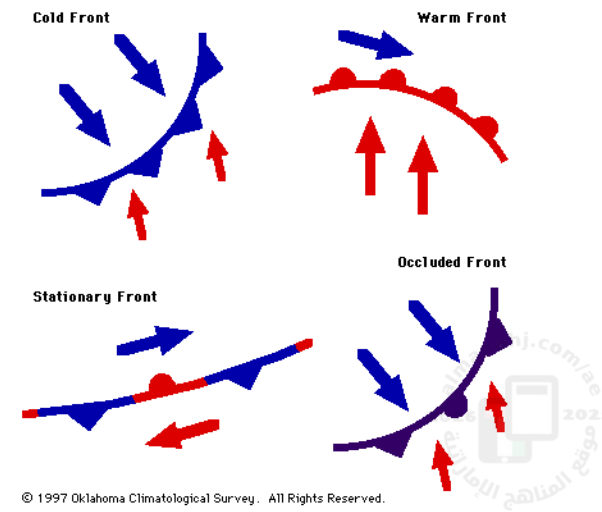
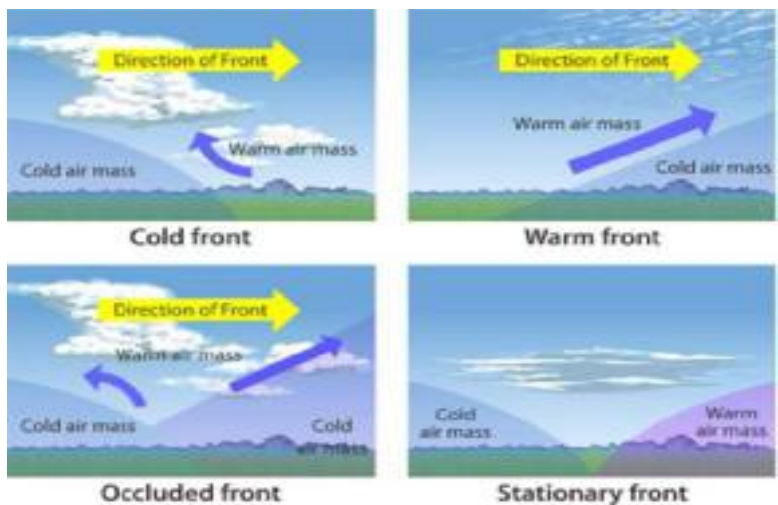
Warm front (red)*

Cold front (blue)*

Stationary front (red/blue)*

Occluded front (purple)*

* Note: Fronts may be black and white or color, depending on their source. Also, fronts shown in color code will not necessarily show frontal symbols.



Q1: What is the scientific term used to describe the boundary that forms when two different air masses collide?

- A) A jet stream
- B) A front
- C) An isobar
- D) A climate loop

Q2: An air mass settles over a cold, dry polar region for several weeks. When wind patterns eventually move this air mass away, what characteristics will it bring to new areas?

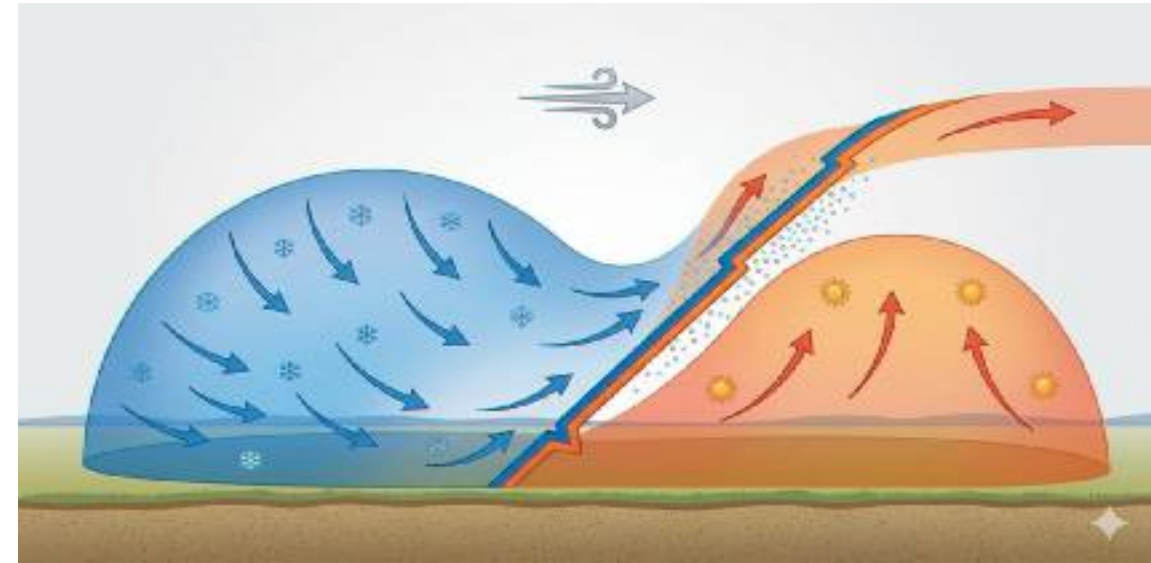
- A) It will bring the cold, dry characteristics of its source region.
- B) It will instantly become warm and humid due to atmospheric friction.
- C) It will completely lose its pressure properties and turn into a local breeze.
- D) It will maintain high solar energy regardless of where it settled.

Q3: Meteorologists in a coastal city note that a fast-moving, dense air mass originating from the North Atlantic is tracking directly toward a stationary, warm, and humid air mass sitting over the plains. What structural feature should the meteorologists map out to track the exact collision line between these two systems?

- A) An underground aquifer boundary
- B) An atmospheric weather front
- C) A size-independent density slope
- D) A solar radiation feedback path

Q4: Why do air masses eventually leave the original geographic areas where they were formed?

- A) They are pulled downward by the structural force of gravity.
- B) They are carried away to new locations by the wind.
- C) They undergo a chemical change that alters their mass.
- D) They sink into underground rock pores during precipitation.



Q5: Examine the conceptual diagram of two meeting air masses. Air Mass (X) is warm and rising, while Air Mass (Y) is cool and wedging underneath. What does the thick dividing boundary line marked with the question mark (?) represent?

- A) A water table reservoir line
- B) A chemical oxidation interface
- C) An atmospheric weather front
- D) A solar insulation cycle

Human activities

- The most significant human impacts on land manifest in several interconnected ways:

1- Deforestation & Land-Use Change: Converting forests and natural habitats into agricultural land or urban areas eliminates vital carbon sinks, accelerates soil erosion, and drives massive habitat loss.

2- Soil Degradation: Intensive farming, overgrazing, and the overuse of synthetic fertilizers strip the soil of essential nutrients, leading to desertification and reduced agricultural productivity.

3- Pollution: Industrial waste, improper disposal of toxic chemicals, and agricultural runoff introduce heavy metals and synthetic pollutants into the soil, posing direct threats to terrestrial ecosystems and public health.

4- Urbanization: The expansion of cities paves over fertile soil, replaces natural landscapes with impermeable surfaces, and alters local microclimates and stormwater runoff patterns.

5- Biodiversity Loss: Habitat destruction and fragmentation divide continuous ecosystems, isolating animal and plant populations and severely reducing global biodiversity.



Positive Actions Governments, societies, and individuals can work together to reduce the impact of human activities on land resources. For example, many cities use green spaces to create natural environments in urban settings. Green spaces are areas that are left undeveloped or lightly developed. They include parks within cities and forests around suburbs. Protected forests and parks, such as Yellowstone National Park, shown to the right, are important habitats for wildlife.



THREE-DIMENSIONAL THINKING

Complete the chart by filling in the **effects** of each positive action.

Positive Action	Effects
Governments preserve land.	
Logging company reforests an area.	
City creates urban park.	
Girl recycles paper.	
Farmer composts food scraps.	

Q1: Which of the following is an example of an urban green space solution designed to support wildlife habitats within developed areas?

- A) Clearing a local suburban forest to build a large shopping mall.
- B) Leaving designated city areas undeveloped or lightly developed as public parks.
- C) Paving open land resources with asphalt to prevent rainfall erosion.
- D) Increasing the chemical treatment of soil in heavily populated zones.

Q2: A logging company cuts down a section of a forest for timber production. To minimize their negative footprint, they immediately initiate a plan to reforest the cleared area by planting hundreds of new saplings. What is the direct positive effect of this action?

- A) It entirely eliminates the urban need for paper recycling.
- B) It restores the lost tree canopy and preserves the land's natural resources over time.
- C) It converts the forest into an industrial agricultural crop field.
- D) It forces local wildlife to permanently migrate into nearby city centers.

Q3: Which group or entity holds the primary power to preserve massive, large-scale tracts of natural land resources like Yellowstone National Park?

- A) Individual girls recycling paper at home.
- B) Local farmers managing small food compost piles.
- C) National or regional governments.
- D) Private urban landscape businesses.

Q4: A student wants to practice a personal positive action at home that directly protects land resources by reducing the number of trees that need to be cut down. Which action should she take?

- A) Composting plastic water bottles.
- B) Collecting organic food scraps for commercial fertilizer.
- C) Sorting and recycling used notebook paper.
- D) Requesting the city to build a new concrete urban center.

Q5: Examine the "Positive Actions" chart from your curriculum. A farmer decides to collect organic kitchen leftovers and crop wastes instead of throwing them into a standard trash bin. What is the intended environmental effect of this composting action?

- A) It creates artificial commercial building materials for urban expansion.
- B) It recycles nutrients naturally back into the soil, reducing waste and improving land health.
- C) It expands government control over national park preservation borders.
- D) It encourages logging corporations to expand their clear-cutting operations.



- Human activities drastically alter Earth's land environments through urbanization, deforestation, and agricultural expansion.
- These actions lead to critical consequences, including severe soil degradation, the loss of natural habitats, and accelerated biodiversity loss.
- Explore the following primary ways humanity reshapes the terrestrial environment:**

1- Agriculture and Deforestation: Expanding land for crops and livestock requires large-scale clearing of forests. This removes natural carbon sinks, accelerates soil erosion, and destroys vital habitats.

2- Urbanization: The construction of cities and infrastructure replaces natural landscapes with impermeable surfaces, changing local drainage patterns and altering regional climates.

3- Mining and Extraction: Removing minerals and fossil fuels strips the topsoil, scars the landscape, and can release toxic chemicals into the surrounding soil and groundwater.

4- Pollution: Industrial runoff, landfill waste, and agricultural pesticides introduce toxins into the soil, disrupting natural nutrient cycles and poisoning local ecosystems

- Q1: What is a critical ecological consequence of large-scale clearing of forests for crops and livestock?**
- A) Decreasing the amount of impermeable concrete surfaces.
 - B) The removal of natural carbon sinks and acceleration of soil erosion.
 - C) An immediate reduction in industrial agricultural pollution.
 - D) The natural restoration of vital wildlife habitats.

Q2: Urbanization drastically alters local environments. What specific physical change occurs when cities and infrastructure are constructed over natural landscapes?

- A) Natural landscapes are replaced with highly permeable underground aquifers.
- B) Industrial chemicals are naturally filtered and removed from the regional topsoil.
- C) Landscapes are replaced with impermeable surfaces, changing local drainage patterns.
- D) Forest ecosystems expand rapidly to create a global thermal blanket.

Q3: A biological survey near a heavy extraction site notes that the regional topsoil has been completely stripped away, the landscape is severely scarred, and toxic chemicals have seeped into the surrounding groundwater. Which human activity caused these environmental changes?

- A) Urban paper recycling programs
- B) Mining and extraction
- C) Livestock pasture management
- D) Organic food waste composting

Q4: How do agricultural pesticides and industrial runoff directly damage land ecosystems?

- A) They increase the natural percentage of global forest cover.
- B) They introduce toxins into the soil, disrupting natural nutrient cycles.
- C) They convert impermeable urban roads into fertile organic crop fields.
- D) They accelerate the formation of subterranean porous rock layers.

Q5: Examine the generated land-use pie chart. If a state government wants to minimize the creation of "impermeable surfaces" that disrupt regional drainage, which section of land use from the chart represents the built-up infrastructure responsible for this specific structural impact?

- A) The section representing the 29% largest share.
- B) The section representing the 28% forest share.
- C) The section representing the 17% crop share.
- D) The section representing the 3% urban share.



9

Students will explore the impact of human activities on the atmosphere.

Three-Dimensional Thinking

Term 3: 128

THREE-DIMENSIONAL THINKING

Summarize your understanding of the **cause-and-effect** relationships between human activities and the environmental impacts on land in the table below.



Type	Causes	Effects
Deforestation		
Agriculture		
Urbanization		
Waste Disposal		

Human activities severely degrade global water resources through chemical contamination, physical alteration, and resource depletion. impacts include:

Industrial & Agricultural Runoff: Toxic chemicals, heavy metals, and fertilizers (containing nitrogen and phosphorus) enter water bodies, severely altering aquatic chemistry and triggering toxic algal blooms.

Plastic Pollution: Non-biodegradable debris accumulates in rivers and oceans, degrading water quality and physically endangering marine life.

Overuse & Extraction: Massive extraction for agriculture and urban development depletes groundwater aquifers and reduces river flow, disrupting natural ecosystems.

Mining: Artisanal and commercial mining generate particulates and toxic constituents that alter the physical and chemical profiles of rivers.



Three-Dimensional Thinking

Read the passage below. Then answer the question that follows.

Estuaries form where rivers containing freshwater flow into the salty waters of an ocean. The mixture of fresh and salt water stays balanced as long as both the river and ocean tides continue to mix at the river's mouth. Estuaries are usually calm and often contain many food sources. Because of this, many species of fish and other organisms breed and raise their offspring in estuaries. These organisms are adapted to life in brackish estuary waters.

2. **LIFE SCIENCE Connection** A new recreation area is being built upstream from an estuary that is known for its abundance of fish and turtles. A dam will be built across the river and a large lake will form behind it. What effect will the dam have on the organisms living in the estuary?
- A Organisms adapted to living only in brackish water will survive.
 - B Organisms adapted to living in brackish water will move to live in the open ocean.
 - C Some of the organisms will die because the water will be less salty.
 - D Some of the organisms will die because the water will be more salty.

The table lists a family's average water usage per day for several activities.

Daily Activity	Water Used
Taking a short shower	95 L
Taking a bath	150 L
Running the dishwasher	38 L
Watering lawn and plants	30 L

3. **MATH Connection** The family wishes to reduce their weekly water usage as much as possible. Here are three proposals for how to do this. Which will save the most water?
- A Proposal 1: Five times a week substitute a short shower for bath.
 - B Proposal 2: Run the dishwasher five times a week instead of seven times a week.
 - C Proposal 3: Water the plants three times a week instead of five times a week.

5. Describe two ways you can personally help minimize human impact on Earth's water.

Q1: Which of the following personal actions directly contributes to minimizing human impact on Earth's freshwater resources by reducing chemical pollution?

- A. Turning off the faucet while brushing teeth to conserve municipal water supplies.
- B. Using biodegradable household cleaners and reducing synthetic fertilizer use.
- C. Disposing of unused liquid medications and motor oil directly down the kitchen sink.
- D. Increasing the usage of single-use plastic water bottles to ensure drinking purity.

Q2: A coastal town experiences a sudden explosion of algae growth (algal bloom) in its local lagoon, leading to a massive die-off of fish due to depleted oxygen levels. Investigators trace the issue back to human activities upstream.

Based on environmental science principles, which human activity is the most likely cause of this ecological imbalance?

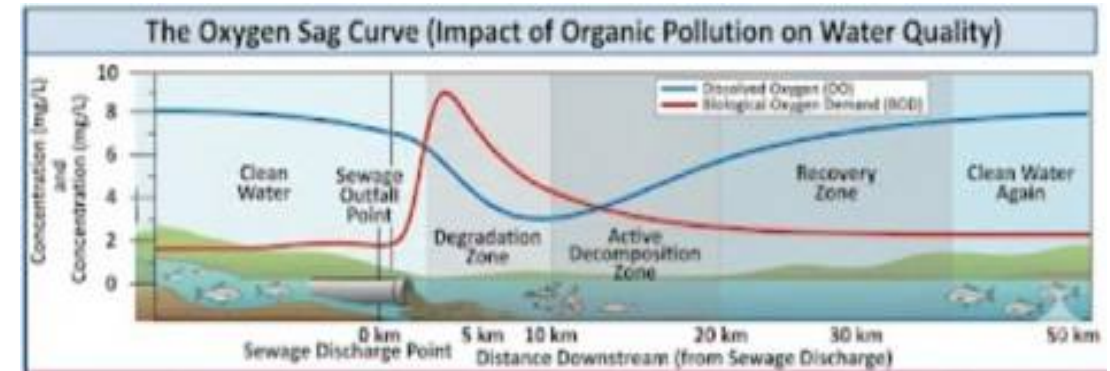
- A. Excessive runoff of nitrogen- and phosphorus-rich fertilizers from nearby agricultural fields.
- B. Thermal pollution caused by a nearby power plant releasing warm, clean water into the river.
- C. The construction of a hydroelectric dam upstream that alters the river's natural flow rate.
- D. An accidental oil spill from a commercial vessel near the mouth of the lagoon.

Q3: Which of the following is considered a non-point source of water pollution, making it much more challenging for communities to manage and minimize?

- A. A distinct discharge pipe releasing chemical effluents from a textile factory directly into a river.
- B. An active leak from a specific municipal sewage treatment plant's primary holding tank.
- C. Rainwater washing oil, litter, and pet waste off suburban streets and lawns across an entire watershed.
- D. A broken valve on an offshore oil drilling rig leaking petroleum directly into the sea.

Q4: An individual wants to practice water conservation to reduce the burden on local freshwater aquifers. Which daily habit would result in the greatest direct reduction of domestic water consumption volume?

- A. Sweeping the driveway with a broom instead of washing it down with a water hose.
- B. Installing low-flow showerheads and fixing leaky household pipes immediately.
- C. Running the dishwasher only when it is halfway full to keep a steady supply of clean dishes.
- D. Watering an outdoor garden during the hottest peak hours of the afternoon sun.



Q5: Examine the standard environmental graph model below detailing the relationship between urban human activities and aquatic health:

•**X-axis:** Distance downstream from a human sewage discharge point (moving left to right).

•**Y-axis:** Concentration levels of **Dissolved Oxygen (DO)** and **Biological Oxygen Demand (BOD)**.

Immediately after the discharge point, the **BOD** line spikes sharply upward, while the **Dissolved Oxygen (DO)** line drops significantly into a "sag curve."

What is the most accurate scientific interpretation of this graphic trend?

- A. The high input of organic waste stimulates rapid decomposition by aerobic bacteria, which rapidly consumes the available dissolved oxygen.
- B. Human population centers directly extract dissolved oxygen gas from the water to use for industrial cooling.
- C. The drop in dissolved oxygen is completely temporary because human waste contains chemicals that automatically aerate the water downstream.
- D. The spike in BOD indicates that aquatic plants are producing excess oxygen during the daytime.

Students will explore how the transfer of thermal energy drives processes of the water cycle, including evaporation, condensation, and crystallization.

- Thermal energy transfer drives the water cycle by changing the state of water.
- The absorption of thermal energy causes liquid water to evaporate and ice to sublime into gas.
- Conversely, as thermal energy is released into the surrounding environment, water vapor condenses into liquid or crystallizes into solid ice.

The fundamental changes of state are powered by the transfer of thermal energy as follows:

1. Evaporation (Gaining Thermal Energy)

- Liquid water absorbs thermal energy (typically from the sun or warm air) and becomes water vapor (gas).

2. Condensation (Losing Thermal Energy)

- Water vapor rises, cools, and transforms back into liquid water droplets.

3. Crystallization (Losing Thermal Energy)

- Also known as freezing or deposition, this occurs when water vapor or liquid water undergoes a further drop in temperature and freezes into solid ice crystals.



Q1: During which processes of the water cycle is thermal energy released from water molecules into the surrounding environment?

- A. Evaporation and Melting
- B. Condensation and Crystallization
- C. Evaporation and Condensation
- D. Crystallization and Melting

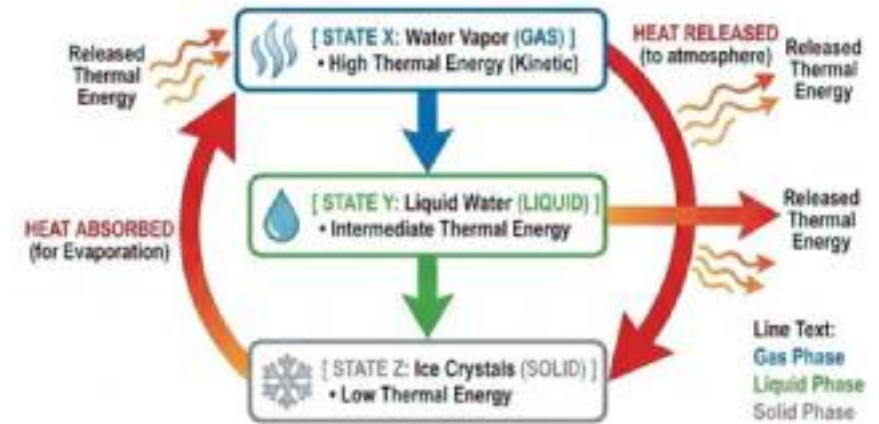
Q2: On a cold winter morning, a student notices that their breath forms a visible foggy cloud as they exhale into the air. Later, they observe a thick layer of fog completely blanketing a nearby suspension bridge over the water.

Which statement best explains the thermodynamic process responsible for both of these observations?

- A. Warm water vapor absorbs thermal energy from the cold air, causing it to rapidly expand into a gas.
- B. Warm, moist air loses thermal energy as it encounters cooler temperatures, causing water vapor to change state into liquid droplets.
- C. Liquid water droplets absorb thermal energy from the atmosphere, turning into crystalline solids that reflect sunlight.
- D. Water vapor undergoes crystallization directly from a gas to a solid state due to high atmospheric pressure.

Q3: As warm air containing water vapor rises higher into Earth's atmosphere, what happens to its altitude, temperature, and thermal energy that drives cloud formation?

- A. Altitude increases, temperature increases, and thermal energy is absorbed.
- B. Altitude decreases, temperature decreases, and thermal energy is released.
- C. Altitude increases, temperature decreases, and thermal energy is lost/released.
- D. Altitude increases, temperature remains constant, and kinetic energy doubles.



Q4: Examine the phase change and energy transfer diagram above: Based on the diagram and your understanding of the water cycle, which row in the table correctly identifies **Process 1, **Process 2**, and how clouds/fog become visible to the human eye?**

Option	Process 1	Process 2	Why they are visible
A	Evaporation	Condensation	They absorb all wavelengths of light
B	Condensation	Crystallization	They block and reflect light
C	Crystallization	Condensation	They refract light into a rainbow
D	Condensation	Evaporation	They release kinetic light energy

13

Students will explore the impact of human activities on the land and how humans cause changes to Earth's land environments.

Impacts of Agriculture.

Term 3: 122

Impacts of Agriculture

Pesticide Usage

To feed the growing world population, some farmers use higher-yielding seeds and chemical fertilizers. These methods help increase the amount of food grown on each km² of land. Herbicides and pesticides also are used to reduce weeds, insects, and other pests that can damage crops. However, runoff containing these fertilizers can seep into groundwater supplies, polluting drinking water. They can also run off into streams and rivers, affecting aquatic organisms.



Soil Quality

Whenever vegetation is removed from an area, such as tilled farmland, soil is exposed. Without plant roots to hold soil in place, nothing prevents the soil from being carried away by running water and wind. High rates of soil erosion can lead to desertification. Desertification is the development of desertlike conditions due to human activities and/or climate change. A region of land that undergoes desertification is no longer useful for food production.



Space

Today, about one-fifth of U.S. land is used for growing crops and about one-fourth is used for grazing livestock. Animals such as cattle eat vegetation and then are used as food for humans. About sixty-five percent of the land in Texas is used for grazing cattle. Other regions of the United States such as the west and Midwest also set aside land as pasture. Other land is used to grow crops to be fed to cattle. Many farmers raise corn and hay for this purpose.



Question 1

When vegetation is cleared and soil is tilled for farming, the risk of desertification increases significantly. Which structural component of the ecosystem is missing, and what is its primary protective function?

- A. Leaves that block intense solar radiation from drying out the topsoil.
- B. Plant roots that physically anchor and hold the soil particles in place against wind and water erosion.
- C. Stems that absorb excess groundwater to prevent flooding.
- D. Flowers that attract pollinators to maintain regional biodiversity.

Question 2

An agricultural company transitions a large regional forest into a monoculture cornfield to meet the food demand of a growing population. They apply heavy amounts of chemical fertilizers and synthetic pesticides. A few months later, a nearby rural community reports a severe decline in freshwater fish populations and chemical traces in their well water.

Based on the provided text, what is the specific pathway of this pollution?

- A. Overgrazing by livestock compacted the soil, forcing chemicals into the atmosphere.
- B. Agricultural runoff containing fertilizers and pesticides seeped into groundwater supplies and ran off into local streams.
- C. The corn plants directly released toxic chemical vapors during transpiration.
- D. Soil erosion blocked the sunlight, preventing the chemicals from breaking down.

Question 4

what is a primary reason that raising cattle for human food consumption requires such an immense amount of land space?

- A. Cattle require large areas of paved land to prevent soil erosion.
- B. Land must be set aside both for grazing livestock and for growing specific feed crops like corn and hay.
- C. Cattle must be kept away from water sources to prevent groundwater pollution.
- D. Pasture land must undergo constant desertification to be useful for livestock.

Question 5

what is the primary reason some farmers utilize higher-yielding seeds alongside synthetic chemical fertilizers?

- A. To decrease the overall rate of global climate change.
- B. To increase the total amount of food grown on each square kilometer of land.
- C. To naturally anchor topsoil and prevent wind erosion without roots.
- D. To eliminate the need for livestock pastures entirely.

Question 6

A tropical region undergoes massive deforestation where all natural trees and ground vegetation are stripped away to till the land for seasonal crop production. During the following monsoon season, heavy rainstorms completely wash away the loose topsoil into a nearby river valley, leaving the farmland rocky and barren.

Which ecological progression described this scenario illustrate?

- A. High pesticide usage leading directly to global warming.
- B. Vegetation removal causing soil erosion, which can lead to desertification.
- C. Intensive livestock grazing resulting in immediate groundwater purification.
- D. Industrial space expansion converting desert-like conditions into fertile pastures.

Question 7

What are herbicides and pesticides specifically designed to do in modern agricultural practices, and what is their negative environmental trade-off?

- A. They reduce weeds and insects to protect crops, but their runoff can pollute drinking groundwater and harm aquatic organisms.
- B. They anchor the soil to prevent desertification, but they cause a decrease in food production per \$km².
- C. They are used to feed grazing cattle, but they accelerate the rate of wind erosion.
- D. They purify drinking water supplies, but they destroy high-yielding crop seeds.

Question 8

When a region completely undergoes desertification due to human activities or climate change, what is the ultimate consequence for human food security?

- A. The land automatically transitions into an ideal pasture for grazing cattle.
- B. The region can only be utilized to grow specific high-yielding crops like corn and hay.
- C. The region is no longer useful or productive for any form of food production.
- D. The soil quality increases because it is no longer exposed to running water and wind.

All chemical reactions involve energy changes. Energy is absorbed to break chemical bonds in the reactants, and released when new bonds form in the products. Based on the net energy transferred to or from the surroundings, reactions are classified as either exothermic (releasing heat) or endothermic (absorbing heat).

The Two Types of Energy Changes

Exothermic Reactions:

- Release energy to the surroundings, usually in the form of heat or light. Because more energy is released when bonds are formed than was used to break the original bonds, the temperature of the surroundings increases.

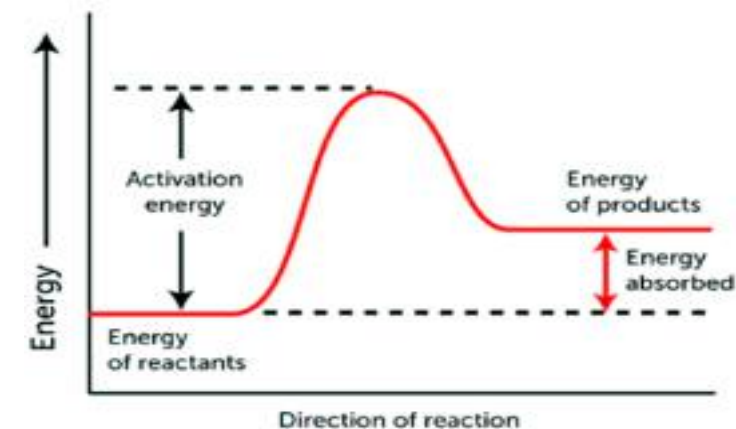
- *Examples:* Combustion (burning fuels like wood or natural gas), neutralization reactions, and cellular respiration.

Endothermic Reactions:

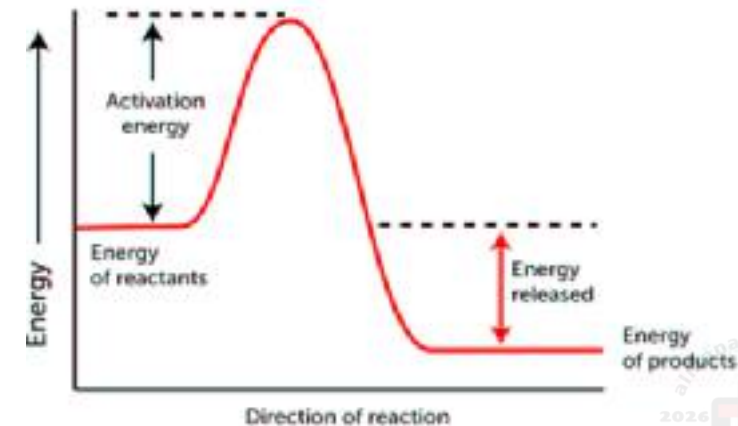
- Absorb energy from the surroundings. Because it takes more energy to break the bonds of the reactants than is released when the product bonds form, the surrounding temperature drops.

- *Examples:* Photosynthesis, thermal decomposition (e.g., baking a cake), and chemical cold packs used for sports injuries.

Endothermic Reaction



Exothermic Reaction





Three-Dimensional Thinking

Mayra poured about 10 mL of vinegar into a small plastic cup. Then she recorded the initial temperature of the vinegar as 22°C. While the thermometer was in the cup, she added about ½ teaspoon of baking soda to the cup. Mayra noticed the baking soda dissolved into the vinegar and bubbles started to form. She watched the thermometer for a change in temperature. After the fizzing stopped and the temperature had stopped changing, Mayra recorded the final temperature as 15°C.

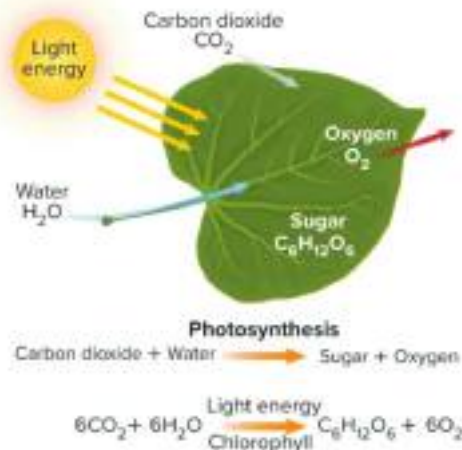
3. Which model most accurately represents the overall change that occurred in the cup?

- A vinegar + baking soda → sodium acetate + carbon dioxide + water
- B energy + vinegar + baking soda → sodium acetate + carbon dioxide + water
- C vinegar + baking soda → sodium acetate + carbon dioxide + water + energy
- D energy + vinegar + baking soda → sodium acetate + carbon dioxide + water + energy

Examine the image to the right.

4. What happens to the energy from the Sun in the leaf?

- A The light energy is consumed by the leaf and can no longer be used.
- B The light energy is used to create energy that the plant uses.
- C The light energy is used to break the bonds in the carbon dioxide and water molecules.
- D The light energy is used to break the bonds in the sugar and oxygen molecules.



Q1: During a chemical reaction, what energy change is required to break the chemical bonds in the reactants?

- A) Energy is released to the surroundings.
- B) Energy is absorbed from the surroundings.
- C) No energy change occurs during bond breaking.
- D) Energy is completely destroyed.

Q2: Which of the following correctly describes an exothermic reaction?

- A) The temperature of the surroundings decreases during the reaction.
- B) The energy of the products is higher than the energy of the reactants.
- C) More energy is released when bonds are formed than was used to break the original bonds.
- D) It absorbs net thermal energy from the environment.

Q3: Which biological process is classified as an endothermic reaction based on its energy profile?

- A) Cellular respiration
- B) Combustion of natural gas
- C) Photosynthesis
- D) Acid-base neutralization

Q4: When analyzing an energy diagram for an endothermic reaction, which feature would be observed?

- A) The potential energy line of the products is higher than that of the reactants.
- B) The activation energy arrow points downward.
- C) The curve drops sharply below the initial reactant energy level.
- D) No activation energy is required to start the reaction.

Q5: What is the function of "activation energy" in both endothermic and exothermic reactions?

- A) It represents the total net energy released to the surroundings.
- B) It is the minimum amount of energy needed to initiate the chemical reaction.
- C) It determines whether a reaction is endothermic or exothermic.
- D) It is the energy released specifically during bond formation.

Q6 :A student mixes two clear aqueous solutions in a test tube. Within seconds, the test tube feels significantly warm to the touch, and a digital thermometer shows a temperature increase from 21°C to 34°C.

Which statement best analyzes this scenario?

- A) The reaction is endothermic because it absorbed heat from the student's hand.
- B) The reaction is endothermic because the energy of the products must be higher than the reactants.
- C) The reaction is exothermic because it released energy into the surroundings, causing the temperature to rise.
- D) The reaction is thermal decomposition because heat was required to break the initial bonds.



THREE-DIMENSIONAL THINKING

How can **patterns** in properties of substances provide evidence that a chemical change has taken place?

Changes in the physical properties of color, state of matter, and odor are just some of the signs that a chemical change might have occurred. Another sign of a chemical reaction is a change in energy. If substances become warmer or cooler or if they give off light or sound, it is likely that a chemical change has occurred. However, these signs are not proof of a chemical change. For example, a cloth changes color when it is dyed, which is a physical change. But, when leaves change color in the fall, it is because of a chemical change.

Q1: Which of the following physical property changes can serve as an initial sign or evidence that a chemical reaction might have occurred?

- A) Changes in color, state of matter, and odor.
- B) Changes in mass and total volume only.
- C) When a substance remains completely unchanged.
- D) A change in the shape of a container holding the substance.

Q2: What type of energy changes can indicate that a chemical reaction is likely occurring?

- A) Only when the substance vanishes completely.
- B) When substances become warmer/cooler, or if they give off light or sound.
- C) When the mass of the substances doubles unexpectedly.
- D) When a substance reflects light like a mirror without absorbing it.

Q3: Why are signs like a change in color or state of matter NOT considered absolute, definitive proof of a chemical change?

- A) Because these signs only happen during nuclear reactions.
- B) Because these changes can also occur during purely physical processes, such as dyeing a cloth.
- C) Because physical properties can never be altered during a chemical reaction.
- D) Because these signs are completely invisible to the human eye.

Q4: Which of the following examples a true chemical change resulting in a property alteration?

- A) Dyeing a white cloth to make it blue.
- B) Slicing a piece of wood into smaller blocks.
- C) Leaves changing color in the fall (autumn).
- D) Freezing liquid water into solid ice cubes.

Q5: Complete the following scientific statement:

"Patterns in the properties of substances provide evidence of a chemical change because..."

- A) The original substances always retain their exact original physical properties.
- B) New substances with entirely different properties are formed during the process.
- C) The mass of the atoms changes completely.
- D) Chemical changes only occur in solid states of matter.

Q6: A student drops a solid white tablet into a beaker of clear, room-temperature water. Immediately, intense bubbling is observed, a faint sharp odor is detected, and the digital thermometer shows that the water temperature has dropped by 4°C.

How should the student analyze these patterns of evidence?

- A) It is a physical change because the tablet simply dissolved like sugar in water.
- B) It is a chemical change because the production of gas (bubbling), a new odor, and a temperature change indicate new substances were formed.
- C) It is a physical change because a change in the state of matter or temperature can never happen in chemical reactions.
- D) No change occurred because the water remained clear throughout the process.

Students use a model to describe how the total number of each type of atom is conserved, which explains the conservation of matter.

HISTORY Connection You might have noticed that the mass remained the same before and after the chemical change. This discovery was documented by Antoine Lavoisier (1743–1794), a French chemist. Lavoisier carefully measured the masses of materials before and after chemical reactions inside closed containers to maintain a system. He found that the total mass of the matter before the reaction always equaled the total mass of the matter after the reaction. His results led him to understand that, in a closed system, mass is conserved. His discovery is so universal it is now a scientific law. **The law of conservation of mass** states that the total mass before a chemical reaction is the same as the total mass after the chemical reaction.

COLLECT EVIDENCE

How does conservation of mass explain what happened when the two liquids combined to form a solid?

Q1: What does the Law of Conservation of Mass state regarding a chemical reaction?

- A) The total mass after a chemical reaction is always double the starting mass.
- B) The total mass before a chemical reaction is the same as the total mass after the chemical reaction.
- C) Mass is completely lost or destroyed during intense chemical changes.
- D) The mass of the products depends entirely on the size of the container used.

2- Why did Antoine Lavoisier carefully measure the masses of materials inside "closed containers"?

- A) To make the chemical reaction happen much faster.
- B) To prevent gas or other matter from escaping or entering the system, ensuring an accurate measurement.
- C) To lower the activation energy required for the substances to react.
- D) Because chemical reactions cannot take place in open air.

3- When two liquids combine to form a solid precipitate, how does the conservation of mass explain the total weight of the final mixture?

- A) The total mass remains the same because the total number and types of atoms do not change.
- B) The solid is much heavier, so the total mass of the system increases.
- C) Some mass is destroyed when the liquid transforms into a solid state.
- D) The mass decreases because solids have tightly packed chemical bonds.

4- From a molecular perspective, why is mass conserved during a chemical change?

- A) Because atoms are broken down into smaller subatomic particles.
- B) Because the total number of each type of atom remains completely conserved.
- C) Because new atoms are created to replace the ones that react.
- D) Because reactants turn entirely into pure energy.

5- Which of the following scientists is historically credited with documenting and establishing the universal Law of Conservation of Mass?

- A) Charles Darwin
- B) Antoine Lavoisier
- C) Gregor Mendel
- D) Albert Einstein

6- A student conducts an experiment by mixing 10g of baking soda with 20g of vinegar inside an open beaker. The mixture fizzes intensely, producing carbon dioxide gas bubbles. When the student weighs the final solution in the open beaker, the scale reads 28g.

How can the student best explain this missing 2g based on the Law of Conservation of Mass?

- A) The Law of Conservation of Mass failed because 2g of matter was completely destroyed by the acid.
- B) The open beaker allowed 2g of produced carbon dioxide gas to escape into the surrounding air before it could be weighed.
- C) The chemical bonds in the liquid products are lighter than the original reactant bonds.
- D) Mixing baking soda and vinegar causes an endothermic drop in mass.

17

Students will develop and use a model to show how the atoms that make up the original substances are regrouped into different molecules.

Collect Evidence

Term 2: 172

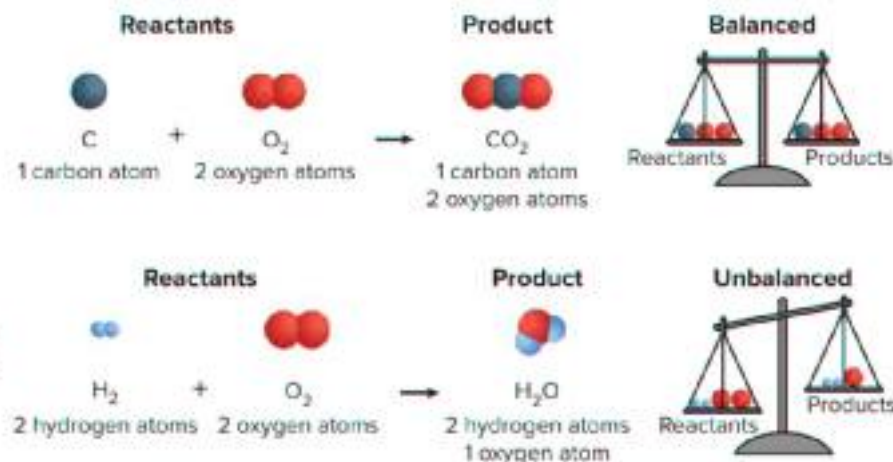
Chemical Equations One way to model a chemical reaction is by writing a chemical equation. A chemical equation includes both the reactants and the products in a chemical reaction. The general structure for an equation is:



The reactants are written to the left of the arrow, and the products are written to the right of the arrow. Two or more reactants or products are separated by a plus sign. Chemical formulas are used to easily describe the reactants and the products.

When writing chemical equations, it is important to use correct chemical formulas. Examine the formation of carbon dioxide below. The product carbon dioxide is written as CO_2 and not as CO . CO is the formula for carbon monoxide, which is not the same compound as CO_2 . A subscript describes the number of atoms of an element in a compound.

You might think a balanced equation happens automatically when you write the symbols and formulas for reactants and products. However, this usually is not the case. For example, the reaction between hydrogen (H_2) and oxygen (O_2) that forms water (H_2O) is shown on the right.

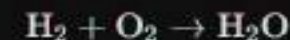


Because the numbers of each type of atom are not equal, this equation is not balanced. To accurately represent this reaction, the equation needs to be balanced. When you balance a chemical equation, you count the atoms in the reactants and the products and then add coefficients to balance the number of atoms. A **coefficient** is a number placed in front of an element symbol or chemical formula in an equation.

COLLECT EVIDENCE

How does the arrangement of atoms explain what happened when the two liquids combined to form a solid?

Scenario: A student is analyzing a model of a chemical reaction where hydrogen gas and oxygen gas react to form liquid water. The student writes down the following initial model:



The teacher points out that this model is incorrect because it violates the principle that atoms are conserved during a rearrangement. Which of the following is the correct balanced equation that the student should write?

- A) $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$
- B) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- C) $\text{H}_4 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- D) $2\text{H} + 2\text{O} \rightarrow \text{H}_2\text{O}$

1- What does a small "subscript" number such as the 2 in CO₂ describe in a chemical formula?

- A) The number of atoms of that specific element in a compound.
- B) The total number of molecules participating in the entire reaction.
- C) The speed at which the chemical reaction takes place.
- D) The temperature required to break the chemical bonds.

2- Why is writing the chemical formula for carbon dioxide as CO scientifically incorrect?

- A) Because CO represents carbon dioxide in a solid state.
- B) Because CO is the formula for carbon monoxide, which is an entirely different compound.
- C) Because chemical formulas must always contain at least three elements.
- D) Because the letter O must always have a coefficient before it.

3- What is a "coefficient" in a chemical equation, and where is it placed?

- A) A small number written below an element symbol to show the number of bonds.
- B) A number placed in front of an element symbol or chemical formula to balance the number of atoms.
- C) A symbol placed over the arrow to show that heat was added to the reaction.
- D) The total mass of the reactants measured before mixing.

4- When the reaction between hydrogen H₂ and oxygen O₂ forms water H₂O, the initial raw equation is unbalanced. What does an "unbalanced" equation represent on a conceptual scale?

- A) The types of atoms on the reactant side are completely different from the product side.
- B) The numbers of each type of atom are not equal on both sides of the equation.
- C) The reaction is exothermic and releases mass as light energy.
- D) The atoms have successfully regrouped into identical original molecules.

5- In a standard chemical equation, where are the reactants and products located relative to the chemical arrow?

- A) Both reactants and products are written to the left of the arrow.
- B) Reactants are written to the left of the arrow, and products are written to the right.
- C) Reactants are written to the right of the arrow, and products are written to the left.
- D) Products are written above the arrow, and reactants are written below it.



THREE-DIMENSIONAL THINKING

WRITING Connection Make an **argument** about the following claim: Exothermic reactions only release thermal **energy**.

Q1: A student argues that exothermic reactions only release thermal energy (heat). Based on the textbook standards, why is this claim incorrect?

- A) Because exothermic reactions do not release any form of energy at all.
- B) Because exothermic reactions can also release energy in the form of light or sound.
- C) Because exothermic reactions only store energy inside the chemical bonds.
- D) Because thermal energy is only converted into mass during a reaction.

Q2: Which of the following scientific terms describes a chemical process where net energy is actively stored or absorbed from the surroundings?

- A) Exothermic reaction
- B) Endothermic reaction
- C) Balancing reaction
- D) Mechanical digestion

Q3: When looking at the provided energy graphs, why does the temperature of the surroundings increase during an exothermic process?

- A) More energy is absorbed to break the reactant bonds than is released later.
- B) The products have a higher chemical potential energy than the initial reactants.
- C) More energy is released when new bonds form in the products than was used to break original bonds.
- D) The activation energy barrier is completely eliminated during the reaction.

Q4: Which of the following processes is a real-world example of an exothermic reaction that releases energy used by living organisms?

- A) Photosynthesis
- B) Cellular respiration
- C) Thermal decomposition of cakes
- D) Melting ice cubes

Q5: What happens to the immediate surroundings during an endothermic process, such as using a sports chemical cold pack?

- A) The surrounding temperature increases because light energy is released.
- B) The surrounding temperature drops because the reaction absorbs thermal energy from the environment.
- C) The surrounding mass doubles because atoms are being stored.
- D) The surroundings stay at the exact same temperature throughout the process.

19

Students will develop and use models to describe energy changes.

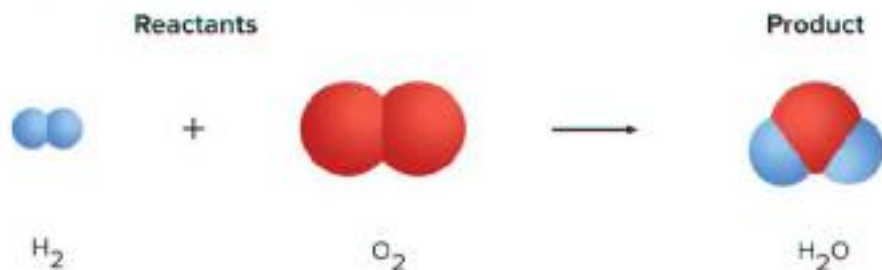
Three-Dimensional Thinking

Term 2: 179

Energy Transfers All matter is constantly in motion. The more energy particles have, the more they move and collide with one another. When they collide with each other with the right amount of force, the bonds between the atoms break. The breaking of chemical bonds requires energy. When individual atoms collide and form bonds, the opposite happens. Forming bonds releases energy. The atoms release this energy to the environment as light or heat. **Chemical potential energy** is the energy released when atoms form bonds. The chemical potential energy is dependent on the arrangement and strength of the bonds.

**THREE-DIMENSIONAL THINKING**

Copy the diagram below into your Science Notebook. Add arrows to the **model** of the formation of water to show where **energy** is absorbed and where energy is released in a chemical reaction.

**COLLECT EVIDENCE**

What happens to energy when bonds break and bonds form in the cold and hot packs?

Q1: What scientific condition must be met for chemical bonds between atoms to break during a collision?

- A) The particles must be completely frozen and stationary.
- B) The particles must collide with each other with the right amount of force.
- C) The particles must belong to the exact same element.
- D) The particles must lose all of their chemical potential energy before colliding.

Q2: What is "Chemical Potential Energy" as defined in this lesson?

- A) The kinetic energy of particles moving in a straight line.
- B) The energy released or stored when atoms form chemical bonds, which depends on their arrangement.
- C) The thermal energy that escapes only when a substance changes its state from liquid to solid.
- D) The external energy provided exclusively by a digital thermometer.

Q3: When individual atoms collide and successfully form new chemical bonds, what happens to the energy?

- A) Energy is absorbed from the environment to build the atoms.
- B) Energy is completely destroyed to make the atoms stable.
- C) Energy is released to the environment as light or heat.
- D) No energy change occurs during bond formation.

Question 4

In the provided diagram showing the formation of water ($\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$), at which stage is energy actively absorbed?

- ☐ A) When the product water molecule (H_2O) is fully formed and drops in temperature.
- ☐ B) When the bonds within the reactant molecules (H_2 and O_2) are being broken.
- ☐ C) When the arrow indicates that the reaction has reached total equilibrium.
- ☐ D) Energy is never absorbed at any stage in this specific model.

Question 5

Why do particles move faster and collide with one another more frequently?

- ☐ A) Because they have less chemical potential energy.
- ☐ B) Because they are trapped inside a closed container.
- ☐ C) Because the more energy particles have, the more they move and collide.
- ☐ D) Because they are converting their mass into light energy.

20

Students will explain how gravity drives the movement of water through Earth's systems, including groundwater flow.

Collect Evidence.

Term 3: 28

LIFE SCIENCE Connection

Oases—fertile lands in the desert—are usually formed when underground water gets close to the surface. When this happens, springs turn a normally arid place into an area where plants can thrive. In low-lying areas at Earth's surface, groundwater might eventually seep out of the ground and into a stream, a lake, or a wetland. In this way, groundwater can become surface water. Likewise, surface water can seep into the ground and become groundwater. This is how groundwater is replenished.

**COLLECT EVIDENCE**

How does water become groundwater and where else is water stored?

Q1: how are oases usually formed in desert environments?

- A) When heavy rain falls continuously for several months over the sand dunes.
- B) When underground water gets close to the surface of the Earth.
- C) When ocean water is transported through strong surface winds.
- D) When solid ice caps melt completely due to high desert temperatures.

Q2: What happens when groundwater eventually seeps out of the ground in low-lying areas?

- A) It instantly evaporates into the upper atmosphere.
- B) It turns into solid glaciers on the surface.
- C) It can turn into a spring, or seep into a stream, a lake, or a wetland.
- D) It causes the gravity of the Earth to decrease.

Q3: Which of the following describes the correct relationship between surface water and groundwater replenishment?

- A) Surface water and groundwater are completely separated and never mix.
- B) Surface water can seep into the ground and become groundwater, which replenishes it.
- C) Groundwater can only be replenished by melting saltwater glaciers.
- D) Gravity prevents surface water from moving downward into the soil.

Q4: What primary natural force drives the downward movement of surface water into the ground to become groundwater?

- A) Magnetic force
- B) Atmospheric pressure
- C) Gravity
- D) Ocean currents

Q5: An oasis turns a normally arid (dry) place into an area where...

- A) Plants can thrive because of accessible water.
- B) Sand storms happen much more frequently.
- C) Liquid water completely disappears due to high heat.
- D) Only deep ocean fish can survive.

Q6: A student creates a model of a landscape using sand and gravel in a plastic tray. The student pours water onto a high hill of sand on one side. After a few minutes, the student notices that the water sinks into the sand hill, travels invisibly beneath the surface, and emerges at the lowest point of the tray, forming a small pool of water surrounded by damp sand.

How does this model relate to Earth's actual water systems?

- A) It shows that water only moves from low-lying areas back up to the mountains.
- B) It models how gravity pulls surface water down into the ground as groundwater, which then flows to low-lying areas and emerges as surface water or an oasis.
- C) It proves that groundwater can never be replenished once it goes beneath the surface.
- D) It shows that sand completely destroys water molecules through a chemical rearrangement.

Q7: A student is designing a diagram in their Science Notebook to model what happens in an instant hot pack used by athletes. The hot pack works because when a barrier is broken, two substances mix, and the temperature shoots up.

How should the student correctly explain the energy transfers occurring inside the pack on a molecular level?

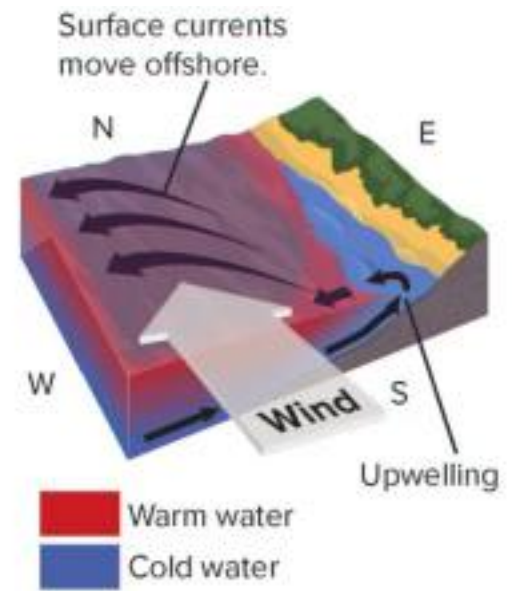
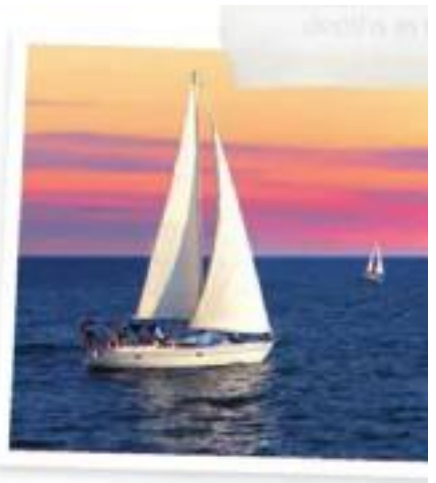
- A) The pack gets hot because breaking the original bonds released more energy than forming the new bonds.
- B) The pack gets hot because the chemical potential energy of the new bonds formed is greater than the energy required to break the original bonds, releasing excess heat to the environment.
- C) The pack gets hot because the particles completely stopped moving, turning all kinetic energy into cold packs.
- D) The pack gets hot because it is an endothermic reaction that stores environmental heat.

21	Students will explore atmospheric, oceanic circulation, and what causes global patterns of winds and ocean currents.	Surface Currents	Term 3: 63
23	Students will develop and use a model to explain how upwelling affects the availability of nutrients and organisms in the ocean.	Upwelling	Term 3: 64

Surface Currents Ocean currents flow at different ocean. You've learned that density currents move water downward. They carry water from the surface to deeper parts of the ocean. So what causes surface waters to flow?

PHYSICAL SCIENCE Connection As you just discovered, a **surface current** is a wind-driven current that carries ocean water horizontally across the ocean's surface. As wind blows over ocean water, it transfers energy to the water. The moving air particles drag on the surface of the water and cause the top portion of the ocean to move.

Upwelling As surface currents move toward the poles, they cool and sink. Cold, dense water is brought back up to the surface through upwelling. **Upwelling** is the vertical movement of water toward the ocean's surface. Upwelling occurs when wind blows across the ocean's surface and pushes water away from an area. Deeper, colder water is then forced to the surface. This deeper, colder water is nutrient-rich and supports large populations of algae, fish, and other ocean organisms.



- Q1: Which of the following best describes the primary movement of a surface current?**
- A) It moves water vertically from the surface to the deeper ocean.
 - B) It carries ocean water horizontally across the ocean's surface.
 - C) It flows downward due to changes in water temperature.
 - D) It circulates water only in deep, enclosed underwater caves.
- Q2: What is the primary driving force behind the formation of surface currents?**
- A) Earthquakes and volcanic activity on the ocean floor.
 - B) Differences in water density and salinity levels.
 - C) Global wind patterns blowing over the ocean water.
 - D) The gravitational pull of the moon and the sun.
- Q3: When wind blows over ocean water, how does it initiate a surface current?**
- A) It cools the surface water, causing it to sink rapidly.
 - B) It transfers energy to the water through friction and drag.
 - C) It increases the salt concentration at the water's surface.
 - D) It creates massive underwater waves that push the deep water upward.

Q4: How do density currents differ fundamentally from surface currents?

- A) Density currents carry water horizontally, while surface currents only move water downward.
- B) Density currents are driven by wind particles, while surface currents are driven by deep-sea organisms.
- C) Density currents move water downward toward deeper parts of the ocean, while surface currents move water across the surface.
- D) Density currents only occur near the equator, while surface currents only occur near the polar regions.

Q5: What physical mechanism causes the top portion of the ocean to move when air particles pass over it?

- A) Atmospheric pressure forces the water to expand and spread.
- B) Moving air particles drag on the surface of the water.
- C) High evaporation rates pull the surface water forward.
- D) Magnetic interactions between the air and saltwater molecules.

Q6: A marine research vessel is studying a specific region of the Atlantic Ocean. The scientists observe that despite a sudden increase in water density in the deeper layers, the topmost layer of water continues to flow steadily in a consistent horizontal direction, aligned with the strong, prevailing trade winds of the region. Based on the provided text, which type of ocean current is responsible for this horizontal top-layer movement, and what is causing it?

- A) A density current caused by the downward movement of cold water.
- B) A surface current caused by moving air particles dragging on the water's surface.
- C) A density current caused by the wind transferring chemical energy to the salt particles.
- D) A surface current caused by the vertical circulation of deep ocean water.

Q7: What is the primary definition of upwelling in the ocean?

- A) The horizontal movement of warm water from the equator toward the poles.
- B) The vertical movement of cold, deep water toward the ocean's surface.
- C) The downward sinking of highly saline water near coastal areas.
- D) The rapid evaporation of surface water due to extreme solar heating.

Q8: Which of the following atmospheric conditions triggers the process of upwelling?

- A) High humidity levels causing dense fog over the coastal zones.
- B) Extreme temperature drops causing the surface water to freeze instantly.
- C) Wind blowing across the ocean's surface and pushing surface water away from an area.
- D) Heavy rainfall adding large amounts of freshwater to the open ocean.

Q9: What characteristics best describe the water that is brought to the surface during an upwelling event?

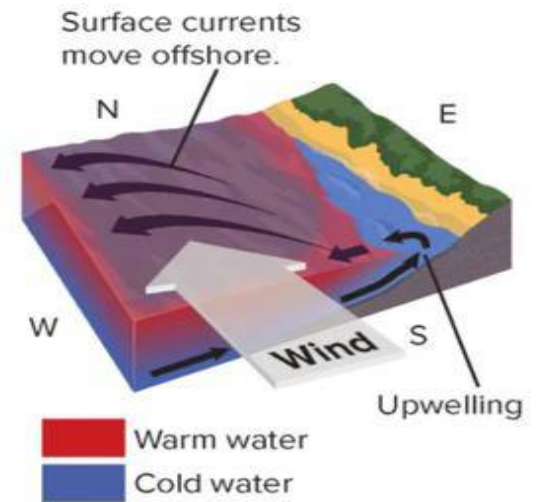
- A) Warm, oxygen-depleted, and low in salinity.
- B) Cold, nutrient-rich, and originating from deeper parts of the ocean.
- C) Highly polluted, warm, and dangerous for marine organisms.
- D) Shallow, fast-moving, and carrying high amounts of sand particles.

Q10: Why does an upwelling zone usually support massive populations of marine life such as algae and fish?

- A) The colder temperature forces fish to gather closely together for warmth.
- B) The rising water brings essential nutrients that fertilize and support the marine food web.
- C) It creates strong horizontal waves that help fish migrate faster.
- D) It eliminates all predators by driving them into deeper ocean trenches.

Q11: According to the ocean circulation model, what happens to surface currents as they move toward the poles?

- A) They become warmer and expand across the surface.
- B) They stop moving completely due to the Coriolis effect.
- C) They cool down, increase in density, and sink.
- D) They evaporate entirely into the upper atmosphere.



Q12: A team of marine biologists noticed a sudden, dramatic increase in the commercial fish catch and a massive bloom of green algae along a specific coastline. Satellite data revealed that strong, steady offshore winds had been blowing across that region for several consecutive days.

Based on the provided scientific text, which geological or oceanographic phenomenon best explains this sudden boom in the local marine ecosystem?

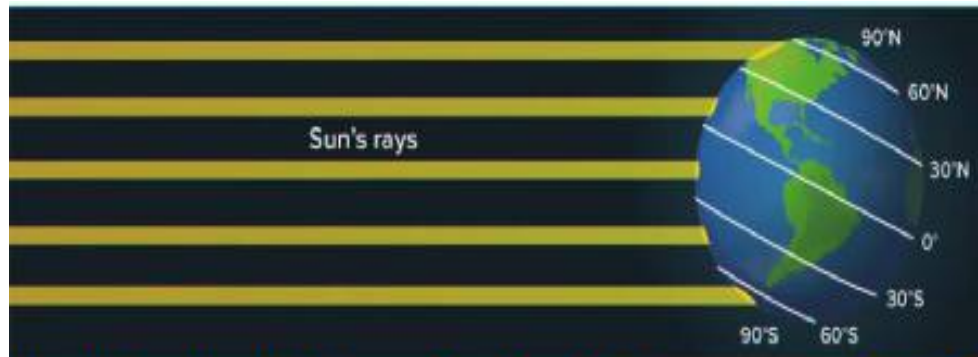
- A) The sinking of cold water near the poles drawing fish away from coastal areas.
- B) Coastal upwelling, where wind pushed surface water away, forcing deep, nutrient-rich water to the surface.
- C) A severe drop in surface water density that caused algae to multiply without nutrients.
- D) The formation of warm surface currents that isolated the area from the deeper parts of the ocean.

22

Students will understand the role of specific heat in energy transfer, particularly with regard to Earth's water systems.

Collect Evidence.

Term 3: 94

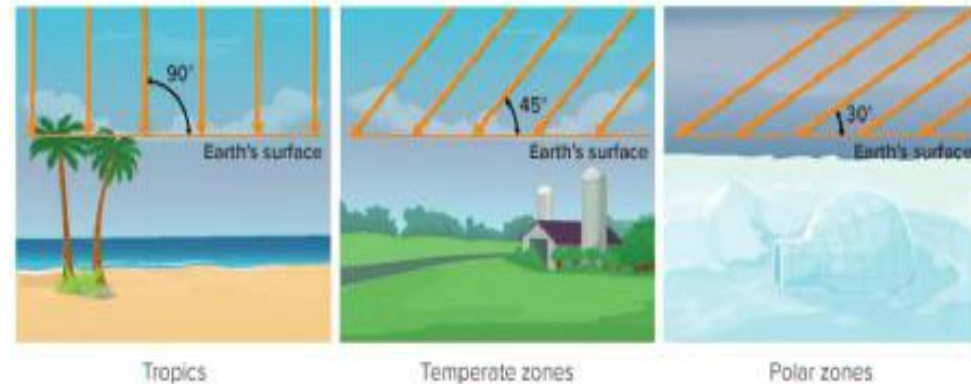
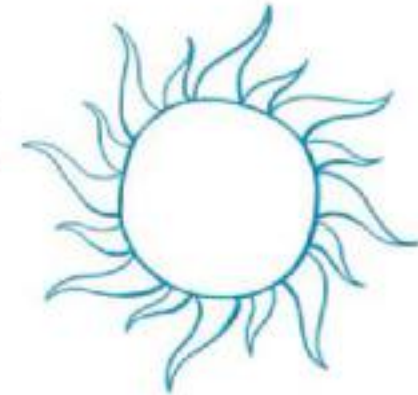


Solar Energy on Earth You just determined that the Sun is the most important influence on climate. Recall that because Earth is a sphere, different areas receive different amounts of solar energy. As a result, locations near the equator tend to have warmer climates than locations at higher latitudes.

Polar regions are colder because annually they receive less solar energy per unit of surface area. The snow and ice in these regions also contributes to the climate. Recall that ice has a very high albedo and reflects 75 to 90 percent of the solar energy it receives.

In the middle latitudes, between 30° and 60°, summers are generally hot and winters are usually cold. Thus, latitude—the distance north or south of the equator—largely determines the climate of most regions.

Additionally, when exposed to a similar amount of solar energy, the soil and rocks of the land warm to higher temperatures than the oceans. This means that temperatures are more extreme on continents and vary over a smaller range in the oceans.



COLLECT EVIDENCE

How does the distribution of solar energy affect climate?

Q1: Why do locations near the equator tend to have warmer climates than locations at higher latitudes?

- A) The equator is physically closer to the Sun during the entire year.
- B) Because Earth is a sphere, different areas receive different amounts of solar energy, with equatorial regions receiving more concentrated rays.
- C) Equatorial regions have lower atmospheric pressure, which traps heat permanently.
- D) The oceans near the equator do not absorb any solar radiation.

Q2: Polar regions are colder because annually they receive less solar energy per unit of surface area. What additional factor contributes significantly to their cold climate?

- A) The heavy industrial activity that blocks incoming sunlight.
- B) Continuous volcanic eruptions that release cooling ash into the sky.
- C) The presence of snow and ice, which has a very high albedo and reflects 75 to 90 percent of the received solar energy.
- D) The absence of any large oceans or water bodies surrounding the poles.

Q3: What is the primary factor that largely determines the climate of most regions, especially in the middle latitudes between 30° and 60°?

- A) The specific type of vegetative cover and trees growing in the area.
- B) Latitude—the distance north or south of the equator.
- C) The seasonal migration patterns of local animal populations.
- D) The frequency of underwater earthquakes in nearby ocean basins.

Q4: When exposed to a similar amount of solar energy, how does the heating of land (soil and rocks) compare to the heating of oceans?

- A) Soil and rocks warm to higher temperatures than the oceans.
- B) Oceans warm to much higher temperatures than soil and rocks.
- C) Both land and oceans warm to the exact same temperature at identical rates.
- D) Neither land nor oceans absorb solar energy, as it is entirely reflected.

Q5: Which of the following statements about global temperature ranges is true?

- A) Temperatures are more stable on continents and vary over a larger range in the oceans.
- B) Temperatures are more extreme on continents and vary over a smaller range in the oceans.
- C) Ocean temperatures fluctuate wildly every hour while continents remain constant.
- D) Polar zones experience the exact same temperature ranges as tropical zones.

Q6: A climatologist is analyzing weather data from two different regions located at the exact same latitude of 45°N. Region X is located deep within the interior of a massive continent, surrounded by soil and rocks. Region Y is an island located in the middle of a large ocean. During the summer, Region X records scorching high temperatures, while during the winter, it experiences extreme freezing drops. Meanwhile, Region Y maintains a much milder and smaller temperature range throughout the year.

Based on the provided text, what explains the extreme temperature variation observed in Region X compared to Region Y?

- A) Region X receives 90-degree direct sun rays all year round, while Region Y receives 30-degree slanted rays.
- B) The snow and ice in Region X have a low albedo, whereas the water in Region Y has a high albedo and reflects 90 percent of heat.
- C) When exposed to a similar amount of solar energy, soil and rocks warm to higher temperatures than oceans, causing more extreme temperature ranges on continents.
- D) Region Y is closer to the equator than Region X, which prevents the ocean water from changing temperature.

24

Students will explore how different surfaces absorb solar energy at varying rates.

Three-Dimensional Thinking

Term 3: 41

**THREE-DIMENSIONAL THINKING**

Models can be used to represent **systems** and their interactions. How did this demonstration **model** energy transfer between the Sun and Earth? Support your reasoning by describing a real-life example in your Science Notebook.

- Darker, rougher, and conductive materials absorb more solar energy and heat up faster, while lighter and reflective surfaces stay cooler by reflecting sunlight.
- Different surfaces absorb solar energy at varying rates due to their **albedo** (reflectivity) and **material properties**. Darker, rougher, and more conductive materials absorb up to 90% of incoming sunlight and convert it into heat, while lighter, smoother, and highly reflective surfaces bounce most of it back.

1. Color and Albedo (Reflectivity)

- **Albedo** = how much sunlight a surface reflects.
- **Low albedo (dark surfaces):**
 - Absorb **80–95%** of sunlight
 - Heat up quickly (e.g., asphalt, oceans, dark roofs)
- **High albedo (light/reflective surfaces):**
 - Reflect **70–90%** of sunlight
 - Stay cooler (e.g., snow, sand, white roofs)

2. Texture and Material

- **Rough surfaces:**
 - Trap light → absorb more energy
- **Smooth/polished surfaces:**
 - Reflect more light
- **Material type:**
 - **Metals (e.g., aluminum):** conduct heat quickly
 - **Brick/stone:** absorb heat and release it slowly (good for insulation)

3. Thermal Mass & Specific Heat Capacity

- Determines how much a material's temperature changes after absorbing energy
- **Low heat capacity (land):**
 - Heats up quickly
- **High heat capacity (water):**
 - Heats slowly and stores energy longer

4. Angle of Sunlight (Angle of Incidence)

- **Direct angle (90°):**
 - Maximum energy absorption
- **Slanted angle:**
 - Energy spreads out → less absorption, more reflection

🌐 Real-World Applications

- **Urban planning:**
 - Use reflective materials ("cool roofs") to reduce heat in cities
- **Solar energy:**
 - Panels are designed to **maximize absorption** using coatings and optimal angles

Q1: What does the term "albedo" measure regarding Earth's surfaces?

- A) The amount of geothermal energy released from the ocean floor.
- B) How much sunlight a surface reflects back into space.
- C) The depth to which solar energy can penetrate water.
- D) The speed of wind moving across dark and rough surfaces.

Q2: Which type of surface is characterized by a low albedo and absorbs 80–95% of incoming sunlight?

- A) Smooth, polished aluminum sheets.
- B) Fresh snow layers and white rooftop coatings.
- C) Dark, rough surfaces like asphalt and dark roofs.
- D) Dry desert sand and light-colored stones.

Q3: How does the texture of a rough surface specifically affect its interaction with solar energy?

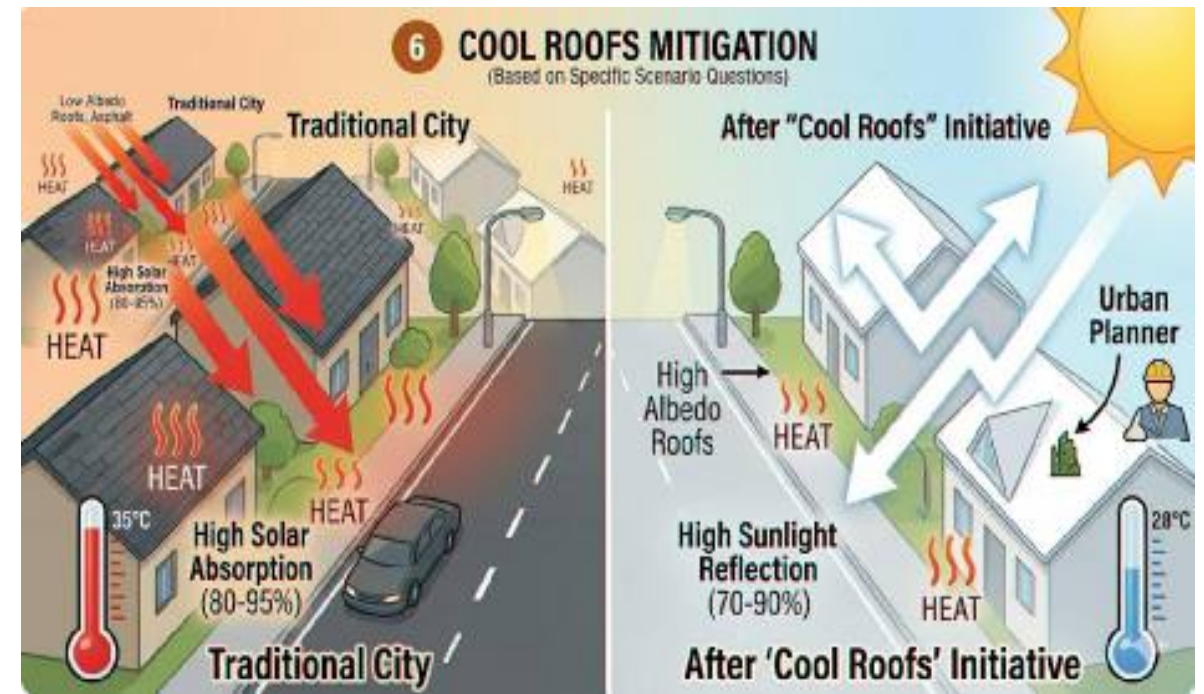
- A) It flattens the sun's rays, causing them to bounce off instantly.
- B) It traps light, which causes the surface to absorb more energy.
- C) It lowers the temperature of the material by converting light into wind.
- D) It shields the material beneath it from absorbing any heat.

Q4: A material with a high heat capacity, such as liquid water, behaves in which of the following ways when exposed to sunlight?

- A) It heats up extremely quickly and releases all its energy instantly.
- B) It reflects 100% of incoming sunlight and never changes its temperature.
- C) It heats slowly and stores energy for a longer period of time.
- D) It evaporates completely before any thermal energy can be stored.

Q5: How does the angle of sunlight (angle of incidence) influence energy absorption on Earth's surface?

- A) A slanted angle results in maximum energy absorption per unit area.
- B) A direct 90° angle spreads the energy out, leading to more reflection.
- C) A direct 90° angle provides the maximum energy absorption.
- D) The angle of sunlight has absolutely no impact on energy absorption rates.



Q6: An urban planner in a rapidly growing city notices that downtown areas covered in dark asphalt and dark roofing materials suffer from extreme heat during summer days. To mitigate this issue, the planner proposes a city-wide initiative called "Cool Roofs," which requires building owners to paint their roofs white and use highly reflective materials.

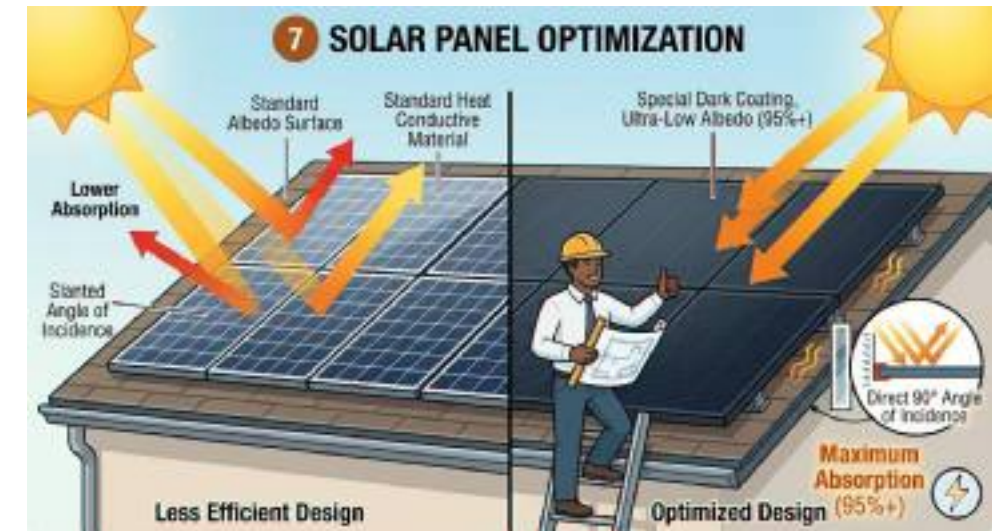
Based on the provided text, why is this strategy effective?

- A) White roofs have a high albedo, reflecting 70–90% of sunlight and keeping the buildings cooler.
- B) White roofs have a low heat capacity, allowing them to store heat energy much longer.
- C) Highly reflective materials conduct heat into the building faster than dark asphalt.
- D) Smooth white surfaces trap light, converting it into clean electrical energy.

Q7: An engineer is designing a new solar panel system to be installed on a residential property. To ensure that the solar panels generate the maximum possible amount of electricity, the engineer uses specialized dark coatings on the panel surfaces and adjusts the mounting brackets to face the sun at a direct 90° angle during peak hours.

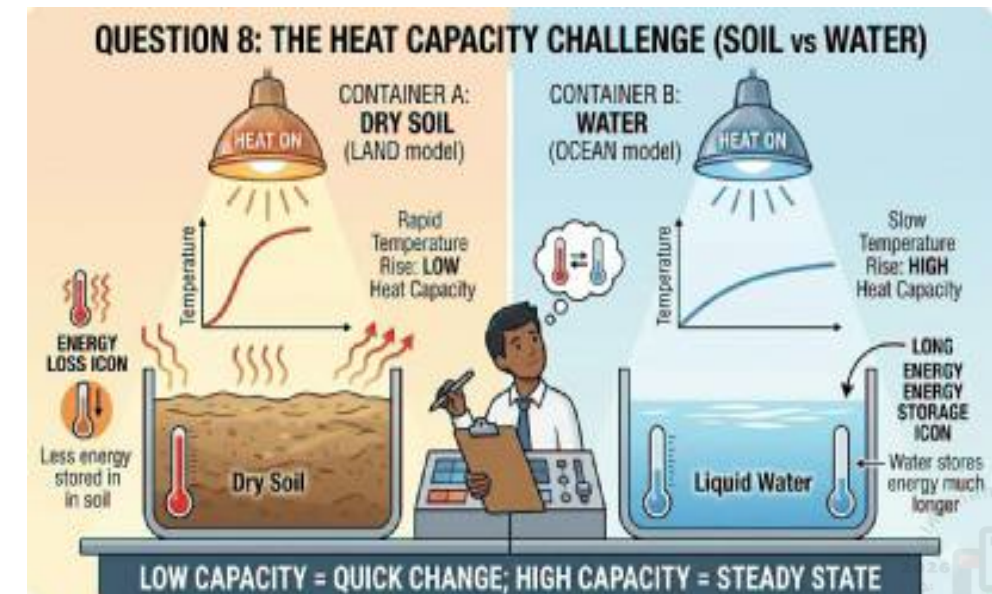
According to the text, which principles of energy transfer is the engineer utilizing?

- A) High albedo properties and a slanted angle of incidence to maximize reflection.
- B) Low albedo properties to absorb 80–95% of light, combined with a direct angle for maximum absorption.
- C) Smooth surface textures to reflect light toward the sky, combined with low heat capacity.
- D) Highly conductive aluminum properties to store heat energy without altering the panel's temperature.



Q8: During a field trip, science students set up an experiment using two identical containers. Container A is filled with dry soil (representing land), and Container B is filled with water. Both containers are placed under a high-intensity heat lamp for 30 minutes. The students observe that the temperature of the soil in Container A rises much faster than the water in Container B. When the lamp is turned off, the soil cools down rapidly, while the water remains warm for a much longer time. Which concept from the text explains the students' observation?

- A) Soil has a higher albedo than water, causing it to bounce light back.
- B) Water has a low heat capacity, meaning it heats up quickly and stores energy longer.
- C) Soil has a low heat capacity and heats quickly, while water has a high heat capacity, heating slowly and storing energy longer.
- D) Smooth polished water surfaces conduct heat more quickly than rough brick or stone surfaces.



25

Students will apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Collect Evidence.

Term 3: 161

Management Solutions Legislation is an effective way to reduce water pollution. The U.S. Clean Water Act legislates the reduction of water pollution. This act established the basic procedures for regulating wastewater and setting pollution controls. While the Clean Water Act has greatly helped reduce pollution, water pollution in the U.S. still exists.

The Safe Drinking Water Act legislates the protection of drinking water supplies. By reducing pollution, these laws help ensure that all living things have access to clean water.

What You Can Do An easy way for you to make an impact on water conservation is to use less. This could be as simple as taking shorter showers or turning off the water while you brush your teeth. You can have an even bigger impact by getting others to conserve with you.

To reduce pollution, you could recycle. By recycling your plastic drinking bottles, you can ensure they won't end up floating in the ocean. Another approach is to stop it before it starts—by reducing! If you reduce your plastic use there will be less in the garbage or even the recycling.

You also can help reduce water pollution by properly disposing of harmful chemicals so that less pollution runs off into rivers and streams. You can volunteer to help clean up litter from a local stream. You also can conserve water so there is enough of this resource for you and other living things in the future.



In 1969, the Cuyahoga River caught on fire, prompting the Clean Water Act.



COLLECT EVIDENCE

What are ways in which we can monitor or minimize human impact on Earth's water?

Q1: Which piece of legislation specifically establishes basic procedures for regulating wastewater and setting water pollution controls?

- A) The Safe Drinking Water Act
- B) The Environmental Species Act
- C) The Clean Water Act
- D) The Marine Mammal Protection Act

Q2: What is the primary objective of the Safe Drinking Water Act mentioned?

- A) To completely ban the usage of plastic bottles worldwide.
- B) To legislate the protection of drinking water supplies and ensure clean water access.
- C) To regulate the flow of ocean currents near industrial harbors.
- D) To clean up oil spills using advanced biological methods.

Q3: What historical event occurred in 1969 that prompted the creation of the Clean Water Act?

- A) A severe drought caused a local river to completely dry up.
- B) The Cuyahoga River caught on fire due to heavy pollution.
- C) A massive ocean current carried thousands of tons of plastic to the poles.
- D) An underwater earthquake contaminated the deep groundwater supplies.

Q4: Which of the following actions is an easy individual approach to stop plastic pollution before it even starts?

- A) Burying plastic containers deep under the soil.
- B) Burning plastic bottles in local community backyards.
- C) Reducing the initial use of plastic materials.
- D) Collecting seawater and filtering it through synthetic screens.

Q5: How does properly disposing of harmful chemicals help protect local aquatic ecosystems?

- A) It increases the evaporation rate of rivers and streams.
- B) It ensures that less pollution runs off into rivers and streams.
- C) It helps human communities consume less clean water daily.
- D) It converts toxic waste into natural food sources for algae.

Q6: A coastal town is experiencing a significant rise in plastic debris floating near its beaches, which is harming local marine wildlife. The town council wants to implement a solution.

Which of the following strategies would be the most effective immediate action for the community to reduce this specific pollution and protect the ocean?

- A) Encouraging citizens to take shorter showers and turn off the tap while brushing teeth.
- B) Volunteering to clean up litter from local streams and recycling plastic drinking bottles so they do not end up in the water.
- C) Relying entirely on the Safe Drinking Water Act to monitor deep underground water wells.
- D) Increasing the usage of single-use plastic bags to keep trash separated from municipal landfills.

1) The atmosphere and the hydrosphere overlap.

☐ True

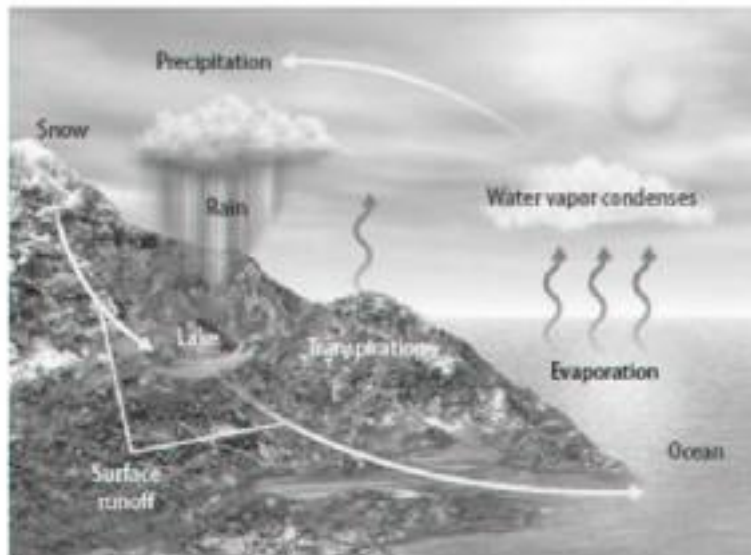
☐ False

2) Water leaves the plant life of biosphere and enters the atmosphere by way of transpiration.

☐ True

☐ False

3) The wavy vertical arrows represent the movement of water into which of Earth's systems?



☐ A) atmosphere

☐ B) biosphere

☐ C) geosphere

☐ D) hydrosphere

4) When water vapor loses thermal energy it _____, and millions of droplets come together to form clouds.

7) The process of liquid changing to a gas at the surface of the liquid is called ____.

☐ A) condensation

☐ B) melting

☐ C) boiling

☐ D) evaporation

8) How does the energy from the Sun cause evaporation?

☐ A) It breaks the bond between the water and the ground.

☐ B) It breaks the bond between the water molecules.

☐ C) It attracts the water molecules.

☐ D) It causes transpiration from streams.

9) A _____ is made up of water droplets or ice crystals that are so small they remain suspended in the air.

10) Clouds form when _____ rises, cools, and condenses into tiny droplets that join together.

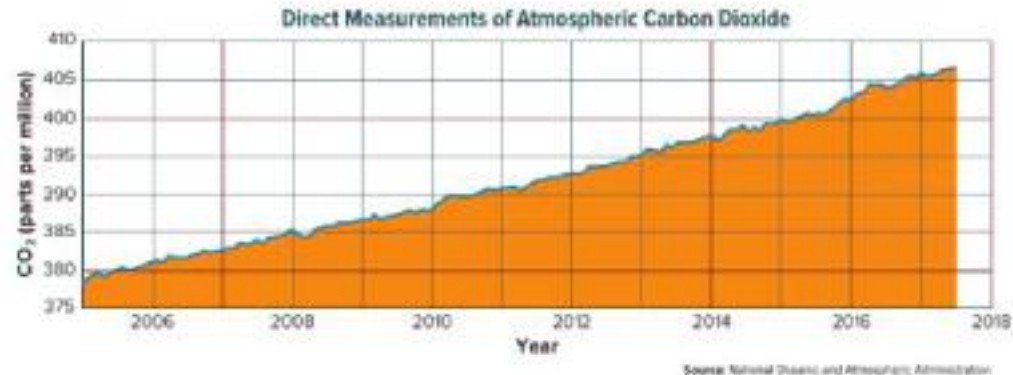
☐ A) snowflakes

☐ B) water vapor

☐ C) smog

☐ D) smoke

Analyze the graph below. Then answer the questions that follow.



2. **MATH Connection** What is the approximate rate of change in atmospheric carbon dioxide from 2007 to 2017?
- 2.3 ppm per year
 - 1.5 ppm per year
 - 0.7 ppm per year
 - 4.6 ppm per year
3. Which of the below conclusions can you draw from the data?
- Carbon dioxide is an important greenhouse gas that leads to global warming.
 - When the amount of greenhouse gases increases, Earth's surface temperature rises.
 - Direct measurements of carbon dioxide show a yearly increase since at least 2005.
 - Human and natural activities have caused the rise in atmospheric carbon dioxide.

Jorge wanted to model two processes that cycle water in the atmosphere for a class project. He began by filling a self-sealing plastic bag half-full of water. After sealing the bag, he taped it to a sunny window. After a few hours, water beaded along the inside of the bag.

2. Which processes are represented by Jorge's model?

- transpiration and respiration
- condensation and crystallization
- respiration and evaporation
- evaporation and condensation

3. Which statement best describes the transfer of energy in the photo?

- When water changes state from a liquid to a solid, thermal energy is absorbed.
- When water changes state from a solid to a liquid, thermal energy is absorbed.
- When water changes state from a liquid to a solid, thermal energy is released.
- When water changes state from a solid to a liquid, thermal energy is released.



- 1) What is true of the water cycle?

- ☐ It begins when the Sun evaporates water from oceans, rivers, and lakes.
- ☐ It begins when groundwater flows into oceans.
- ☐ It ends when water falls from clouds to Earth's surface.
- ☐ It has no beginning or end.

Four friends are walking along the bank of a stream. They each have differing opinions of why the stream moves along Earth's surface.



2. Which person do you agree with the most?

- A Marco: Wind drags water particles along in the stream.
- B Selma: Gravity causes water in the stream to move downhill.
- C Brock: The Sun warms the stream causing it to flow.
- D Chen: The stream moves because of its velocity.

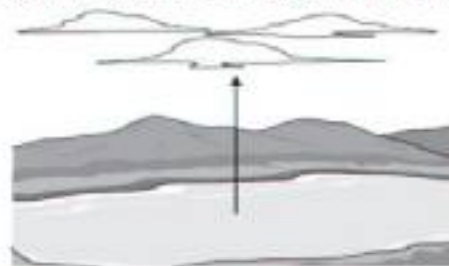
3. Which pathway of processes would explain how a water molecule from the stream could end up in an ice sheet?

- A evaporation, transpiration, condensation, crystallization
- B evaporation, crystallization, precipitation, condensation
- C evaporation, respiration, crystallization, transpiration
- D evaporation, condensation, crystallization, precipitation

5) Which is NOT a type of precipitation?

- ☐ A) rain
- ☐ B) snow
- ☐ C) erosion
- ☐ D) sleet

6) A student is drawing a model that shows the role of surface runoff in the water cycle. This picture shows the beginning of her model.



How can the student complete her model to include surface runoff?

- ☐ A) by drawing an arrow from the clouds back to the lake
- ☐ B) by adding in an underground cave and drawing an arrow from the lake to the underground cave
- ☐ C) by drawing one arrow from the clouds to the mountains and another arrow from the mountains toward the lake
- ☐ D) by adding in soil and plants and drawing an arrow from the lake to the soil and another arrow from the soil to the plants

Use the weather map to answer question 3.

3. An Arctic air mass is approaching Lake Huron. Identify how this mass will affect the weather in the area.



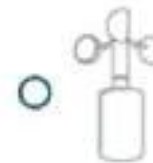
- A The area will experience high air pressure and clear skies.
 - B The area will experience high air pressure and cloudy skies.
 - C The area will experience low air pressure and clear skies.
 - D The area will experience low air pressure and cloudy skies.
4. How will the weather change in an area if a cold air mass meets a warm air mass?
- A The humidity will rise.
 - B Temperatures will suddenly drop.
 - C Air pressure will increase.
 - D Winds will shift to the south.
5. The weather forecast predicts a 10 percent chance of rain when you leave for school in the morning. However, at the end of your school day it's raining. What reasoning can you provide for why this error occurred?
- A A high pressure system moved into the area quickly.
 - B A warm air mass and a cold air mass moved apart.
 - C Weather forecasts can only be predicted hourly.
 - D Weather forecasts can only be predicted probabilistically.

1) Water that falls from the atmosphere is called ____.

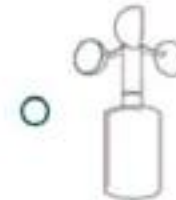
- ☐ precipitation
- ☐ temperature
- ☐ wind
- ☐ air pressure

2) Precipitation, wind, and air pressure are all ways to describe the ____.

3) Which measures precipitation?



4) Which tool is used to measure temperature?



6) What temperature (in degrees Fahrenheit) does the thermometer show?



- ☐ 20°F
- ☐ 40°F
- ☐ 60°F
- ☐ 80°F

8) Which would be used to measure air pressure?

- ☐ weather vane
- ☐ thermometer
- ☐ anemometer
- ☐ barometer

9) Which is a type of precipitation?

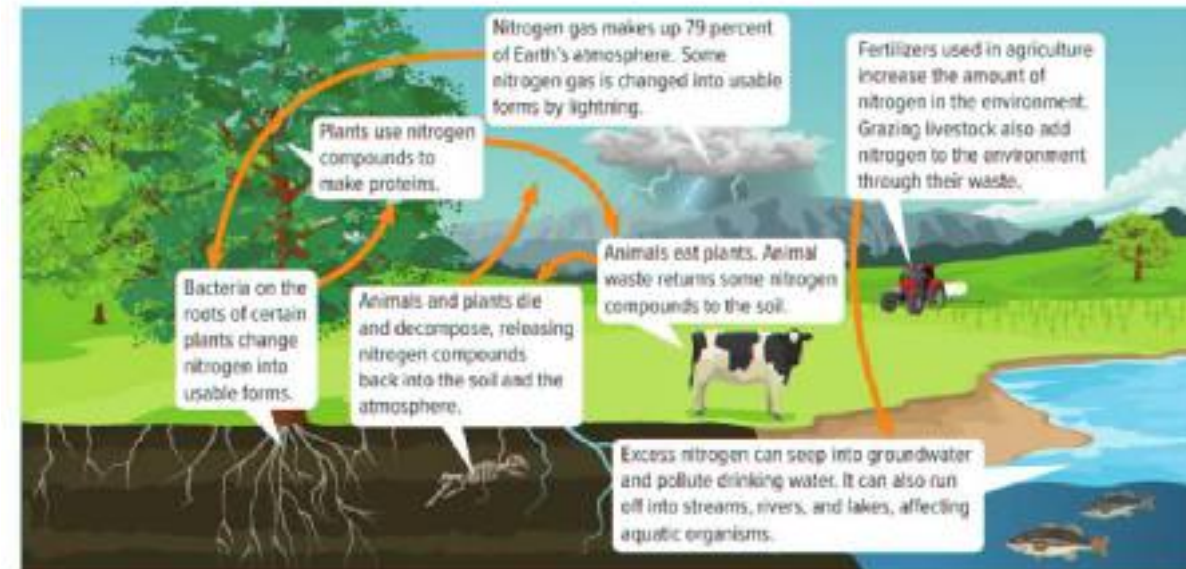
- ☐ wind
- ☐ hot temperatures
- ☐ rain
- ☐ tornadoes

Read the passage below. Then answer the question that follows.

Estuaries form where rivers containing freshwater flow into the salty waters of an ocean. The mixture of fresh and salt water stays balanced as long as both the river and ocean tides continue to mix at the river's mouth. Estuaries are usually calm and often contain many food sources. Because of this, many species of fish and other organisms breed and raise their offspring in estuaries. These organisms are adapted to life in brackish estuary waters.

2. **LIFE SCIENCE Connection** A new recreation area is being built upstream from an estuary that is known for its abundance of fish and turtles. A dam will be built across the river and a large lake will form behind it. What effect will the dam have on the organisms living in the estuary?
- A Organisms adapted to living only in brackish water will survive.
 - B Organisms adapted to living in brackish water will move to live in the open ocean.
 - C Some of the organisms will die because the water will be less salty.
 - D Some of the organisms will die because the water will be more salty.

Study the nitrogen cycle shown in the figure below. Nitrogen is an element that cycles naturally through ecosystems. Living things use nitrogen to make proteins. When these living things die and decompose or produce waste, they release nitrogen into the soil or the atmosphere. Scientists estimate that human activities have doubled the amount of nitrogen cycling through ecosystems.



2. How does the use of fertilizers affect the environment?

- A Fertilizers decrease the amount of nitrogen in the environment. A decrease in nitrogen can cause an increase in lightning and storms.
- B Fertilizers increase the amount of nitrogen in the environment. Excess nitrogen can pollute groundwater and surface water.
- C Fertilizers decrease the amount of nitrogen in the environment. This affects the rate at which plants and animals decompose.
- D Fertilizers increase the amount of nitrogen in the environment. An increase in nitrogen disrupts plant processes.

The table lists a family's average water usage per day for several activities.

Daily Activity	Water Used
Taking a short shower	95 L
Taking a bath	150 L
Running the dishwasher	38 L
Watering lawn and plants	30 L

3. **MATH Connection** The family wishes to reduce their weekly water usage as much as possible. Here are three proposals for how to do this. Which will save the most water?

- A** Proposal 1: Five times a week substitute a short shower for bath.
B Proposal 2: Run the dishwasher five times a week instead of seven times a week.
C Proposal 3: Water the plants three times a week instead of five times a week.

Pollution - acid rain - recycle - algal bloom - reuse

	Keyword	Definition
1		uses old products in new ways.
2		A rapid growth of algae caused by too much fertilizer
3		using water for something else or more than once.
4		Sulfur dioxide and nitrogen oxide mix with water in the air.
5		harmful substance that affects earth's resources of water .

7- Which of the following is a way of conserving water?

- A. Leave the tap running while brushing teeth
 B. Use a hose to wash the car
 C. Leave the shower running while soaping day long
 D. Use the washing machine and wash full loads of clothes

8- What will happen if lake water becomes polluted by humans?

- A) The pollution will not hurt the plants or animals in the water.
 B) It will change the soil around the lake into pebbles.
 C) Animals in the lake will die.
 D) There will be more fish in the lake.

Q2 : Miatha notices that people throw trash on the ground around the pond by her house. The ducks and fish that live in the pond can be harmed by this trash. Miatha wants to come up with a plan to clean up the pond and keep it clean.

Which of these should be part of Miatha plan? **put true or false**

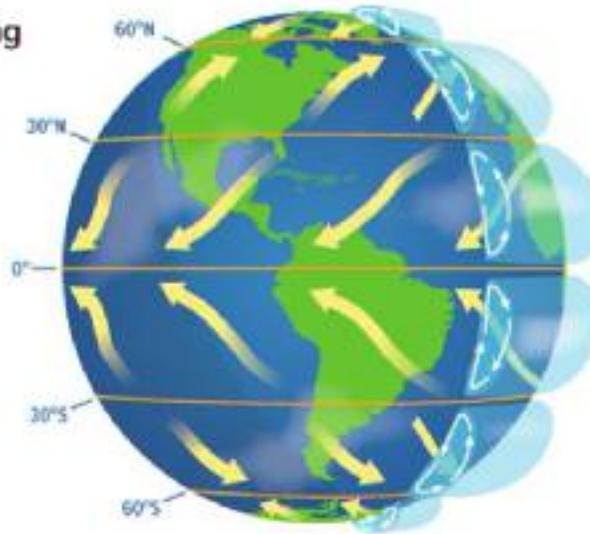
1. () Use nets to get the existing trash out of the water.
 2. () Put trash cans around the pond for people to use.
 3. () Put up signs that ask people not to litter.
 4. () Move the ducks and fish to a new pond.
 5. () Ask more people to come fish in the pond.

1-what number is considered neutral and safe to drink on the pH scale? A. 4 B. 7 C. 12 D. 14	2-Which is a way to conserve water? A. collect rain water B. Plant only one type of plant like grass C. Discard all water collected in your gutters D. All of the above
3-What are causes of water pollution? A. water and air B. fertilizers and oil spills C. pollution and sand D. food and plant	4-Most of the gases that cause acid rain come from _____. A. Water B. natural sources C. fossil fuels D. dirt
5-Which of the following is <u>not</u> a <u>natural</u> cause of water pollution ? pick Three A. Volcanoes B. Sewage C. Oil spills D. Oxygen E. Factories	6- _____ means using less water A. recycle B. B. reuse C. reduce



Three-Dimensional Thinking

2. The diagram models convection cells and wind patterns over the globe. Which best summarizes what you can infer about their causes?



A	Cause of Convection Cell	Cause of Wind Patterns
	At the poles, ice caps reflect heat back into space. The air stays cold and sinks down under warmer air. At the equator, land and water absorb heat, which makes the air rise.	Earth's rotation produces the Coriolis effect, which makes the air move. At the same time, air in the upper atmosphere moves from low-pressure to high-pressure areas.
B	The Sun heats Earth's surface most at the poles. Here, warm air sinks down under cold air. At 60°N latitude and 60°S latitude, the air warms and rises into the upper atmosphere.	Air moves along Earth's surface in all directions from high-pressure areas. Earth's rotation produces the Coriolis effect, which bends the path of the moving air toward the south.
C	The Sun heats Earth's surface most at mid-latitudes. Here, warm air rises and cooler air moves in to replace it. At 30°N latitude and 30°S latitude, air in the upper atmosphere cools and sinks.	Air moves along Earth's surface from low-pressure areas to high-pressure areas. Earth's motion around the Sun produces the Coriolis effect, which makes the path of the moving air curve.
D	The Sun heats Earth's surface unevenly. At the equator, warm air rises and cooler air moves in to replace it. At the poles, cold air sinks down under warmer air.	Air moves along Earth's surface from high-pressure areas to low-pressure areas. Earth's rotation produces the Coriolis effect, which makes the path of the moving air curve.

- 2) The Coriolis Effect helps distribute heat around the surface of Earth.
- ☐ True
- ☐ False
- 3) Which sentence about an ocean current is correct?
- ☐ A) Upwelling is caused by winds that blow on the ocean's surface.
- ☐ B) Upwelling moves water horizontally.
- ☐ C) Surface currents are caused by differences in water density.
- ☐ D) Surface currents move vertically through the water.
- 4) When cool, dense air from over the water flows inland, it's called a ____.
- ☐ A) land breeze
- ☐ B) polar easterly
- ☐ C) jet stream
- ☐ D) sea breeze
- 5) The _____ is the wind system responsible for the movement of weather from west to east across most of the continental United States.
- 6) Steady winds between the equator and 30° latitude north or south are known as the ____.
- ☐ A) prevailing westerlies
- ☐ B) jet stream
- ☐ C) polar easterlies
- ☐ D) trade winds

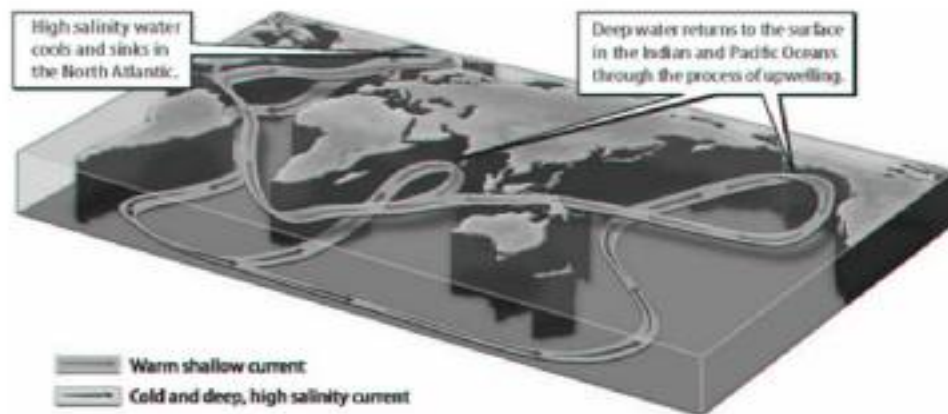
7) An increase in ocean salinity can change _____ and create a current.

- ☐ A) the temperature near the poles
- ☐ B) the density of water
- ☐ C) the Coriolis Effect
- ☐ D) the wind speed across the surface

8) Which of the following occurs when wind blows across the ocean's surface, pushing water away from an area?

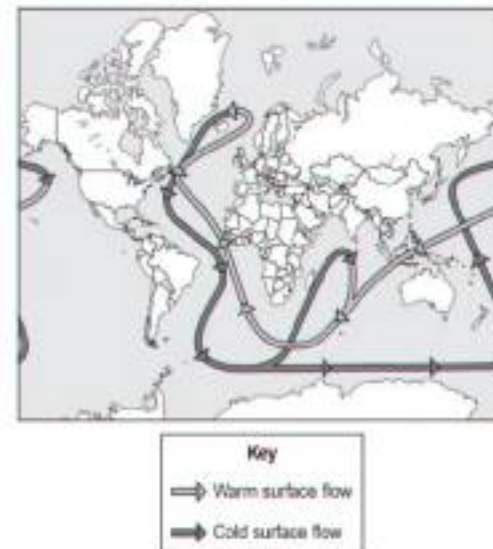
- ☐ A) upwelling
- ☐ B) surface current
- ☐ C) density current
- ☐ D) salinity current

9) The figure shows the Great Ocean Conveyor Belt. Which best describes what this model represents?



- ☐ A) how the density of water differs between the North Atlantic and other parts of the ocean
- ☐ B) how ocean currents change the salinity of water
- ☐ C) how ocean currents move heat energy around Earth
- ☐ D) how the salinity of water affects its density

10) The map shows the global circulation pattern of ocean currents.



Elliot wants to set up a model that best represents how this type of pattern is created in the ocean. Which model should he use?

- ☐ A) Add red food coloring to one end of a tank of water and blue food coloring to the other. Then allow a fan to blow across the surface.

Rationale: The global movement of ocean water shown in the diagram does not result from local winds. It results from the unequal heating of Earth.

- ☐ B) Add several drops of red food coloring and several drops of blue food coloring to water in a jar. Then place the lid on and shake the jar.

Rationale: The water will not move simply because of the addition of food coloring. In addition, the convective motion of ocean water is not initiated by a shaking motion.

- ☐ C) Slowly pour hot water that has red food coloring into a tank of water that is at room temperature. Then quickly pour cold water that has blue food coloring into the tank.

Rationale: The different temperatures of water will create different density layers in the water; however, a heat source is needed to initiate and continue the convective motion. In addition, pouring the water at different speeds will not create the convective motion and maintain it.

- ☐ D) Pour hot water that has red food coloring and cold water that has blue food coloring into a tank of water that is at room temperature. Then have a heat lamp shine on the water.

Rationale: The pattern of ocean water movement exists because cold Arctic waters sink and warm waters from the equator move in to take their place. This same movement would be observed by this model.

One of the major currents in Pacific Ocean is the California Current. The California Current and its direction of flow are shown on this map.



2. Which weather and climate conditions are most likely to occur in the land areas near the California Current as compared to the land areas near the Gulf Stream?

- ☐ A cooler with more frequent rains
- ☐ B cooler and relatively dry
- ☐ C warmer with more frequent rains
- ☐ D warmer and relatively dry

3. Which statement accurately describes why the above phenomenon occurs?

- ☐ A The California Current releases more thermal energy and moisture to the air.
- ☐ B The California Current releases more thermal energy and less moisture to the air.
- ☐ C The California Current releases less thermal energy and moisture to the air.
- ☐ D The California Current releases less thermal energy and more moisture to the air.

1) The weather of a region describes the region's average temperature and precipitation over a long period of time.

- ☐ True
- ☐ False

2) Which of these is NOT an influence on climate?

- ☐ A) large bodies of water
- ☐ B) large cities
- ☐ C) ocean currents
- ☐ D) weather

4) Which of the following does NOT affect the climate of an area?

- ☐ A) latitude
- ☐ B) altitude
- ☐ C) longitude
- ☐ D) being in a city rather than in a rural area

3) Look at the figure. Considering the information given regarding Leadville and Burlington, why is it colder in Leadville?



- ☐ A) Leadville is farther west.
- ☐ B) Burlington has a lower latitude.
- ☐ C) Leadville has a higher elevation.
- ☐ D) Burlington has a greater difference between its average high and low.

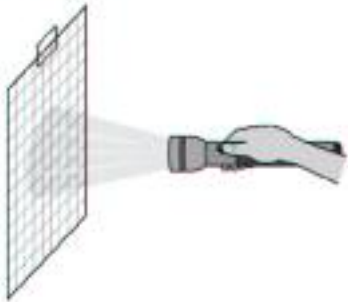
7) A climate classification system divides regions according to ____.

- ☐ A) temperature
- ☐ B) the amount of precipitation
- ☐ C) vegetation
- ☐ D) all of the above

2) When Earth receives energy from the Sun, ____.

- ☐ A) some energy is reflected back into space
- ☐ B) some is absorbed by the atmosphere
- ☐ C) some is absorbed by land and water on Earth's surface
- ☐ D) all of the above

3) Julie and Devon are modeling how the Sun heats Earth. Julie hangs a sheet of graph paper on a wall. Devon holds a flashlight and shines it in a straight line toward the graph paper while Julie dims the lights in the classroom. The diagram shows their model of the Sun heating Earth at the equator.



How can the students change their model to represent how the Sun heats Earth in places where the climate is cold all year?

- ☐ A) They can tilt the angle of the graph paper.

Rationale: Because Earth is tilted, sunlight reaches the equator directly but reaches the poles at an angle.

- ☐ B) They can use graph paper with larger squares.

Rationale: The students should use the same graph paper so they can compare the number of squares lit by the flashlight.

- ☐ C) They can use a flashlight with a narrower beam of light.

Rationale: The students should use the same flashlight because it is supposed to represent the Sun.

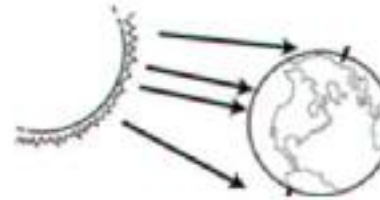
- ☐ D) They can move the flashlight farther away from the graph paper.

Rationale: The distance between the graph paper and the flashlight represents the distance between Earth and the Sun. This distance does not change.

4) Which sentence correctly compares temperatures in rural and urban areas?

- ☐ A) Rural areas are usually cooler because trees and water absorb more sunlight than concrete surfaces.
- ☐ B) Rural areas are usually warmer because grasses and other plants absorb sunlight to grow.
- ☐ C) Urban areas are usually cooler because buildings absorb sun light before it reaches the ground.
- ☐ D) Urban areas are usually warmer because streets have surfaces that absorb sunlight.

5) The Sun's energy hits the surface of Earth most directly at the poles.



☐ True

☐ False

6) The specific heat of water is higher than the specific heat of sand. That is why water heats up more slowly than sand.

☐ True

☐ False

8) Use the map below to answer the following questions.



Which statement is supported by evidence from the map?

- ☐ A) The further north a city is, the milder its climate.
- ☐ B) The altitude of a city has an effect on its temperature.
- ☐ C) Larger cities have colder climates than smaller cities.
- ☐ D) Oceans have an effect on the climate in coastal cities.

1) A snow-covered mountain has a _____ albedo than a dark-colored corn field. Therefore, it will reflect _____ solar energy than the field.

Natia set up an investigation to model heat absorption and release for soil and water. She began by filling one container with water and one container with soil. She measured the initial temperature of the water and the soil. She then exposed both the water and the soil to a heat lamp for 2 minutes. After the time was up, she turned off the light and measured the temperature of both the water and the soil. Her results are indicated in the table below.

Surface Type	Temperature Before	Temperature After
Soil	25°C	27°C
Water	24°C	32°C

2. Are Natia's results valid?

- ☐ A No. Soil absorbs heat faster than water and therefore the temperature of the soil after exposure to the light should be higher than the water.
- ☐ B No. The temperature of the soil and water should be the same after exposure to the light.
- ☐ C Yes. Water absorbs heat faster than soil and therefore her temperature readings are accurate after exposure to the light.
- ☐ D Yes. Molecules in water are more compact and therefore retain heat better than soil.

3. How is conduction related to cold air temperatures at the poles, which are covered with ice and snow?

- ☐ A Ice and snow cannot conduct as much thermal energy to the atmosphere because the particles that make up ice and snow are more compacted and therefore they absorb and retain little thermal energy.
- ☐ B Ice and snow cannot conduct as much thermal energy to the atmosphere because they reflect most solar radiation and therefore they absorb and retain little thermal energy.
- ☐ C The absorption rate of ice and snow allows for a great amount of solar energy to be conducted to the atmosphere.
- ☐ D The reflectivity of snow and ice allows for a greater amount of solar energy to be conducted to the atmosphere because more solar radiation is exposed to the air particles.

Property	Description	Qualitative or Quantitative	Can it be used to identify matter?
Color			
Melting point			
Mass			
Density			
Solubility			
Reaction to acid			
Flammability			

A white, powdery substance is tested for flammability, its reaction to acid, and its reaction to the substance iodine. The following results were collected:

Unknown substance:

- when burned, it turned black.
- had no reaction to acid.
- had no reaction to iodine.

Material	Flammability	Reaction to Iodine	Reaction to Acid
Baking soda	none	no change	bubbles form
Sugar	burns black	no change	no change
Ascorbic acid	none	no change	no change
Cornstarch	burns black	turns purplish-black	no change

Use the information from the table to answer questions 2–3.

2. What is the identity of the unknown substance?

- A** baking soda **C** ascorbic acid
B sugar **D** cornstarch

3. What property helped you identify the unknown substance?

- A** flammability **C** reaction to acid
B reaction to iodine **D** color

1) Forming a chemical bond _____.

- ☐ **A)** absorbs energy from the surroundings
☐ **B)** releases energy into the surroundings
☐ **C)** creates energy that did not previously exist
☐ **D)** uses up energy that then no longer exists

2) Endothermic reactions _____.

- ☐ **A)** release more energy than they absorb
☐ **B)** absorb more energy than they release
☐ **C)** release and absorb exactly the same amount of energy
☐ **D)** can either release more energy than they absorb or absorb more energy than they release, depending on the reaction

3) A chemical bond _____ energy when it breaks.

5) Energy is needed to break bonds in chemical reactions.

- ☐ True
☐ False

6) A chemical reaction in which more energy is absorbed than is released is endothermic.

- ☐ True
☐ False

7) A change in _____ is a sign of energy being used in a chemical reaction.

- ☐ A) temperature
- ☐ B) color
- ☐ C) odor
- ☐ D) texture

11) Jesse is studying a new device that consists of a sealed plastic bag that contains two substances separated by a thin membrane. When the device is struck, the membrane breaks and the two substances mix within the plastic bag. Jesse measures the temperature of the device before and after striking it. The results are shown in the table.

Temperature of Device

	Temperature (°C)
Before striking	25
After striking	-5

Which problem could be solved by using this device?

- ☐ A) the need for astronauts to cook food in outer space

Rationale: Although a chemical reaction sometimes absorbs or releases energy, this conclusion is not fully supported without additional observations.

- ☐ B) the need to keep meat products cold during shipping

Rationale: Absorption of energy when the substances are mixed makes the device feel cold.

- ☐ C) the need to keep skiers warm when the weather is very cold

Rationale: Based on the data table, the device absorbs energy so it feels cold. In order to warm skiers, the device would need to release energy.

- ☐ D) the need for campers to generate electricity in the wilderness

Rationale: Although changing state sometimes absorbs or releases energy, this conclusion is not fully supported without additional observations.

A scientist is conducting an investigation in the lab. Her lab notes and observations are shown below.

First, I added potassium iodide, a white solid, to 100 mL of water. The potassium iodide dissolved, leaving a clear liquid solution. Next, in another beaker, I added lead nitrate, a white solid, to 100 mL of water. The lead nitrate also dissolved, leaving a clear liquid solution. Then, I poured the lead nitrate solution into the flask containing potassium iodide. A bright yellow solid formed in the flask.

2. What conclusion can you draw from the scientist's observations?

- A A new substance was formed, because the formation of a precipitate is evidence that a chemical reaction took place.
- B A physical reaction took place, because the physical properties of the substances changed.
- C The lead nitrate froze when it was added to the potassium iodide, because solids form as a result of freezing.
- D The potassium iodide crashed out of solution, because the solution became supersaturated, and no reaction occurred.

3. Which model shows that atoms are conserved in the reaction?

- A $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- B $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- C $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- D $2\text{CH}_4 + \text{O}_2 \rightarrow 2\text{CO}_2 + \text{H}_2\text{O}$