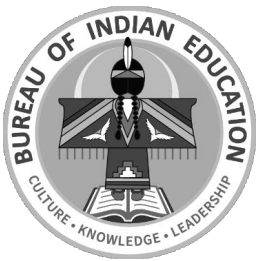




**BIE Science**  
**Practice Test**  
**Grade 8**



**cognia**<sup>™</sup>

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# Science Session 1

## DIRECTIONS

Read each question carefully. For each multiple-choice question, decide which is the best answer and be sure to mark your answer in your answer document. For each open-ended item, be sure to write your answer in the lined box provided in your answer document. Only answers and work written inside the answer boxes will be scored.

This question has two parts. Be sure to answer both parts of the question.

1. At a planetarium, Amy learns that Venus and Earth are sometimes called sister planets. To understand why, she begins to gather data on the planets. Some of the data on Venus are from observations that scientists made from Earth. Other data are from observations made by spacecraft sent to Venus beginning in the 1960s.

Amy decides to put the data into two tables, based on the source of the observations about Venus.

**Earth-Based Observations**

Data	Venus	Earth
Distance from Sun ( $10^8$ km)	1.1	1.5
Diameter (km)	12,100	12,700
Mass ( $10^{24}$ kg)	4.9	6.0
Density ( $\text{g/cm}^3$ )	5.2	5.5
Surface gravity ( $\text{m/s}^2$ )	8.9	9.8

**Space-Based Observations**

Data	Venus	Earth
Daily surface temperature ( $^{\circ}\text{C}$ )	465	10–20
Atmosphere	<ul style="list-style-type: none"><li>• 96.5% carbon dioxide</li><li>• 3.5% nitrogen</li></ul>	<ul style="list-style-type: none"><li>• 78% nitrogen</li><li>• 21% oxygen</li></ul>
Liquid water on surface	none	70% covered by oceans 4 km deep
Internal structure	<ul style="list-style-type: none"><li>• Core diameter 6,000 km</li><li>• Mantle 3,000 km thick</li><li>• Crust 10–20 km thick</li></ul>	<ul style="list-style-type: none"><li>• Core diameter 4,700 km</li><li>• Mantle 2,900 km thick</li><li>• Crust 5–30 km thick</li></ul>

SESSION  
**1**

**Part a**

Which data are evidence that Earth and Venus are similar enough to be called sister planets?

- A** diameter and density
- B** mass and surface water
- C** atmosphere and internal structure
- D** surface gravity and daily surface temperature

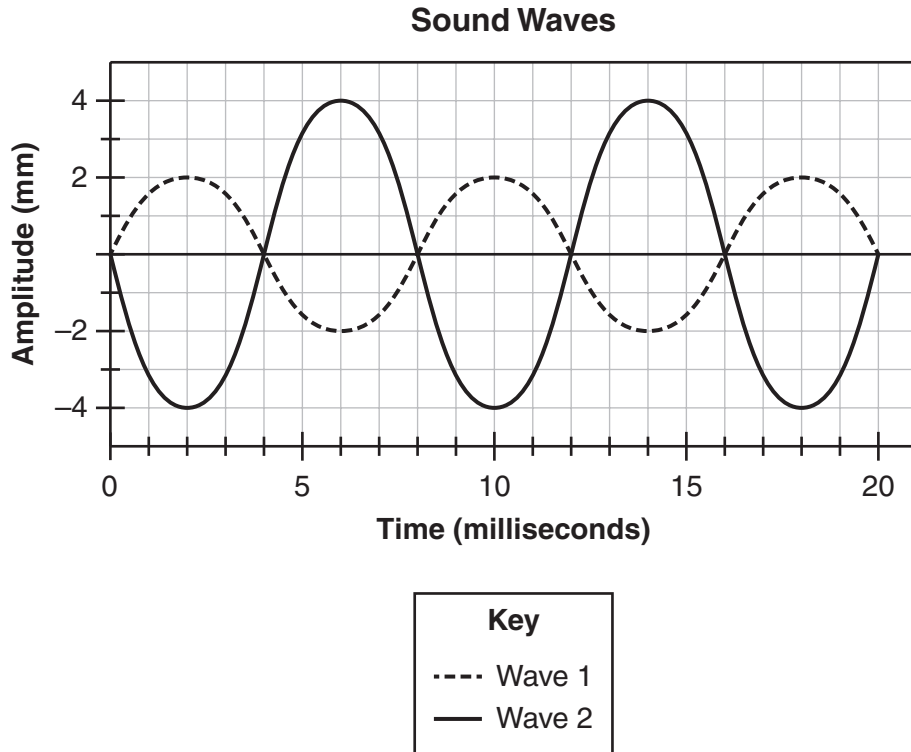
**Part b**

Which statement describes a reason that the differences between Earth and Venus have only been discovered since the 1960s?

- A** The differences can only be observed from distances close to Venus.
- B** The differences have developed since space-based observations began.
- C** The differences result from changes in the way the spacecraft collect data.
- D** The differences are caused by processes that recently began to occur on Venus.

This question has two parts. Be sure to answer both parts of the question.

2. Elaine is researching the characteristics of sound waves as she listens to music. She finds a diagram that shows two sound waves.

SESSION  
**1**

**Part a**

Which statement describes the sound waves in the diagram?

- A** Wave 1 has one-fourth the energy of Wave 2.
- B** Wave 1 has one-half the energy of Wave 2.
- C** Wave 1 has twice the energy of Wave 2.
- D** Wave 1 has four times the energy of Wave 2.

**Part b**

Elaine predicts that the energy in each sound wave would double if the frequency of the wave doubled.

Which statement describes her prediction?

- A** Her prediction is correct because the energy of a wave is proportional to the wave's frequency.
- B** Her prediction is incorrect because the energy of a wave is proportional to the square of the wave's frequency.
- C** Her prediction is correct because the energy of a wave is proportional to speed and a wave with twice the frequency has twice the speed.
- D** Her prediction is incorrect because the energy of a wave is proportional to the wavelength and a wave with twice the frequency has half the wavelength.

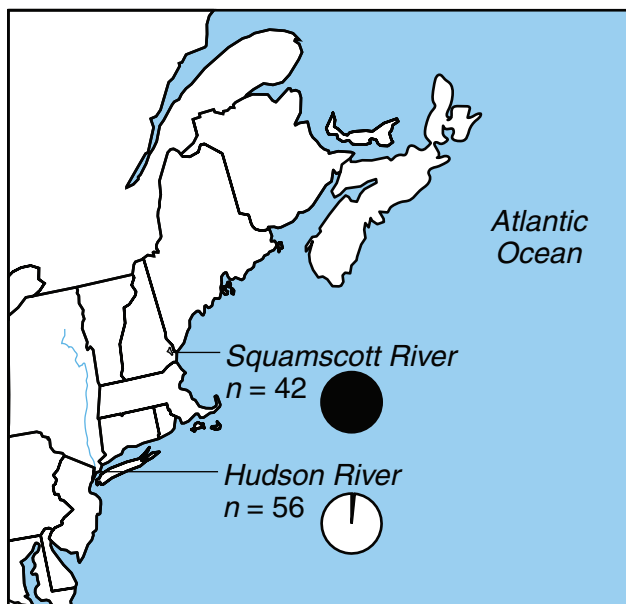
This question has two parts. Be sure to answer both parts of the question.

3. Sara learns about a fish called the tomcod. She learns that some tomcod have a genetic mutation that keeps PCB from entering the tomcod’s cells. PCB is a poison that can kill fish.

The tomcod lives in rivers near the Atlantic Ocean like the Hudson River and the Squamscott River. The Hudson River is polluted with the chemical PCB.

The map shows two tomcod populations in the Hudson and Squamscott Rivers and the relative number of fish with the mutation in each population.

**Genetic Traits in Tomcod Fish**



**Key**

- $n$  Number of tomcod studied
- Without the genetic mutation
- With the genetic mutation

**Part a**

Scientists are investigating how organisms become resistant to the harmful effects of PCB.

Based on the map, which statement describes the effects of the mutation on the Hudson River tomcod population?

- A** Over time, the mutation has become more common in the population because having the mutation helps tomcod survive.
- B** Over time, the mutation will move to the Squamscott tomcod population because that population also needs the mutation.
- C** Over time, the mutation will pass from tomcod to other fish because tomcod with the mutation will mate with other species of fish.
- D** Over time, the mutation has become less common in the population because the mutation does not produce more food for tomcod.

**Part b**

Scientists are considering transporting some of the Hudson River tomcod to the Squamscott River.

Which statement describes a possible effect on the Squamscott River tomcod population?

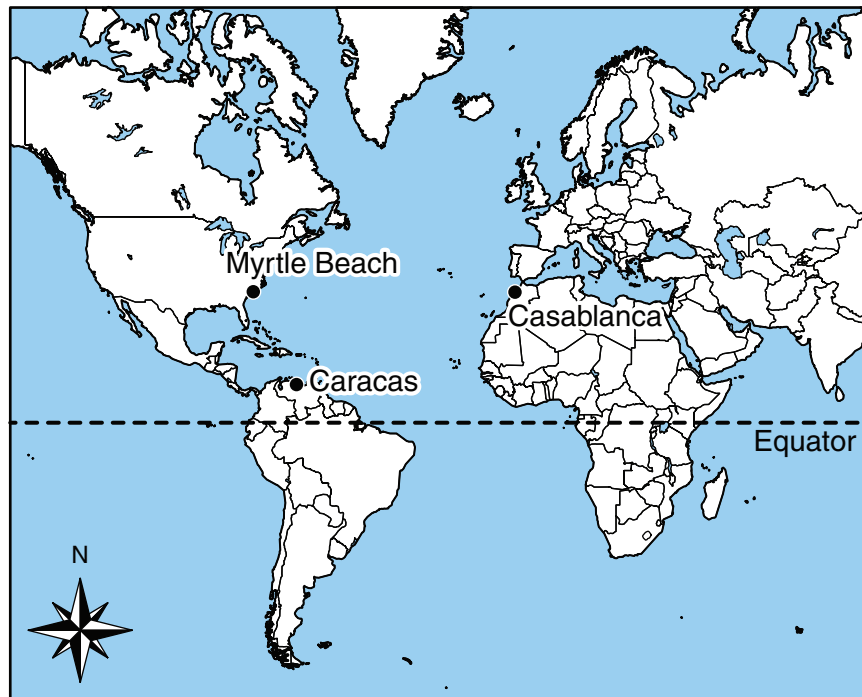
- A** Over time, more Squamscott tomcod will have the mutation if there are low levels of PCB in the Squamscott River.
- B** Over time, more Squamscott tomcod will have the mutation if there are high levels of PCB in the Squamscott River.
- C** Over time, fewer Squamscott tomcod will have the mutation if there are low levels of PCB in the Squamscott River.
- D** Over time, fewer Squamscott tomcod will have the mutation if there are high levels of PCB in the Squamscott River.



This question has three parts. Be sure to answer all three parts of the question.

4. Rosanna's family is planning a vacation to a city on the ocean. Three places they are interested in visiting are Caracas, Venezuela; Myrtle Beach, South Carolina; and Casablanca, Morocco. The locations of these cities are shown on the map.

**Possible Vacation Locations**



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1

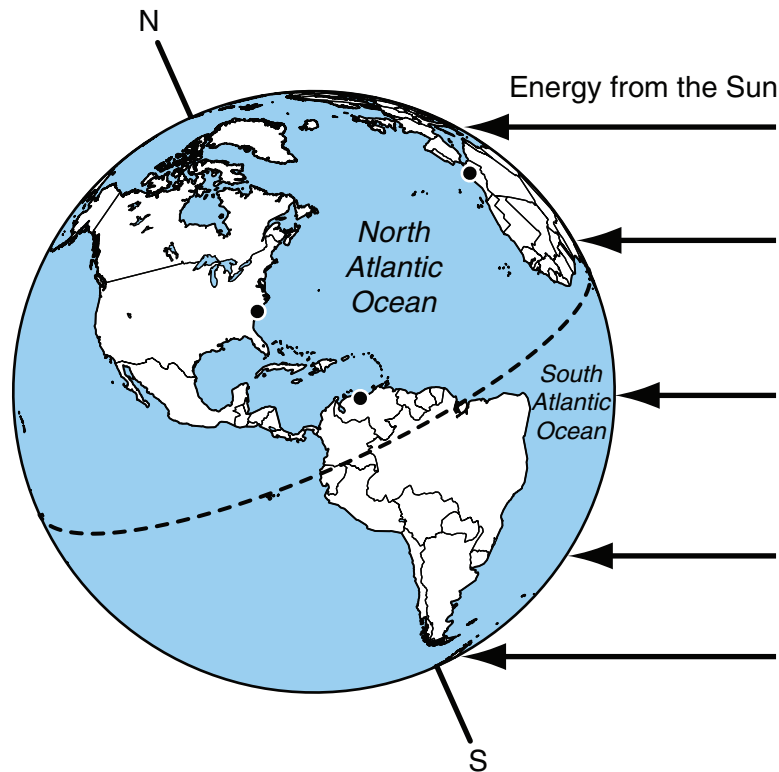
Rosanna begins researching the climate in each city. The table shows the average high and low temperatures for each city.

**Average Yearly Temperatures**

City	High Temperature (°C)	Low Temperature (°C)
Caracas	28.1	23.3
Myrtle Beach	24.5	13.1
Casablanca	20.2	13.6

Rosanna wonders why three cities on the ocean have different average temperatures. She knows that energy from the Sun is a major factor that determines climate. She studies a model that shows energy from the Sun reaching Earth's surface. The model also shows the locations of the three cities.

**Sun-Earth Model**



- a. Use the model to explain **one** reason for the difference in temperature between Caracas and Myrtle Beach.

Rosanna thinks that adding ocean current information to the model would help explain the temperature differences between the three cities.

- b. Describe ocean currents that could be added to the model to provide another reason for the differences in temperature between the cities. Be sure to include the direction and temperature of the currents near Caracas, Myrtle Beach, and Casablanca.
- c. Use the model to describe how energy from the Sun causes the ocean currents described in the answer to Part (b).

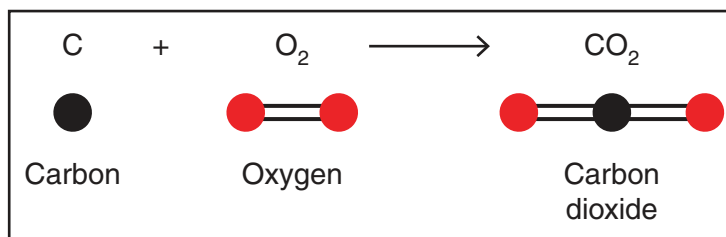
Read the information. Then answer the questions that follow.

### Carbon Chemistry

Nico is surprised to learn that many substances with very different properties contain carbon atoms. He wonders how substances made only of carbon can be as different as the soft, gray graphite inside his pencil and the hard, shiny diamonds in jewelry.

He also wonders how adding oxygen can change carbon into colorless, odorless carbon dioxide gas. Nico's teacher gives him a model to help him understand how carbon dioxide forms from carbon and oxygen.

#### Formation of Carbon Dioxide Model



Nico wants to use this model to understand how carbon can form substances as different as graphite, diamond, and carbon dioxide.

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1

5. Which statement is supported by the model?
- A Two carbon atoms and one oxygen molecule can form two carbon dioxide molecules.
  - B One carbon dioxide molecule can form from one carbon atom and one oxygen molecule.
  - C One carbon atom and one oxygen molecule have more mass than one carbon dioxide molecule.
  - D Two carbon dioxide molecules have less mass than two carbon atoms and two oxygen molecules.

*This question has two parts. Be sure to answer both parts of the question.*

**6. Part a**

How does the model show that matter is conserved in chemical reactions?

- A** There are groups of atoms before and after the reaction.
- B** The reaction produces a new substance with new properties.
- C** The substances in the reaction form naturally from other substances.
- D** The same number of each type of atom is present before and after the reaction.

**Part b**

Based on the model, which statement describes a reason that carbon and carbon dioxide have different properties?

- A** The reaction produces new combinations of atoms.
- B** Carbon and oxygen are needed to form carbon dioxide.
- C** The properties of atoms change during a chemical reaction.
- D** Carbon dioxide is made of atoms that formed during the reaction.

- 7.** Nico and his classmates want to use the model to understand why graphite, diamond, and carbon dioxide have different properties.

Which statement **best** describes how a model could help Nico understand why the substances have different properties?

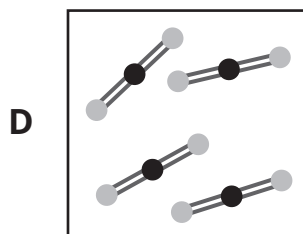
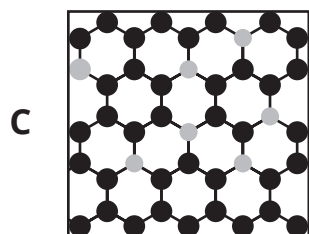
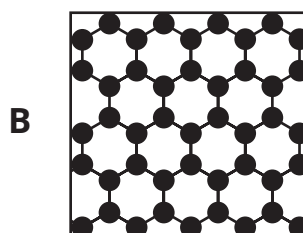
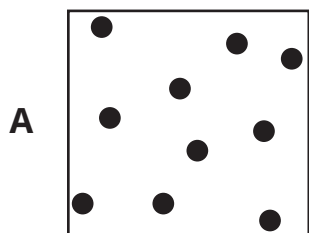
- A** The properties of substances change over time.
- B** A substance is made of different kinds of atoms.
- C** The atoms in substances are too small to be seen.
- D** A model has the same properties as the substances.

This question has two parts. Be sure to answer both parts of the question.

8. Nico draws a model of the graphite in his pencil.

**Part a**

Which model shows the carbon atoms in graphite?



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**Part b**

Which statement supports the model that Nico drew of the graphite in his pencil?

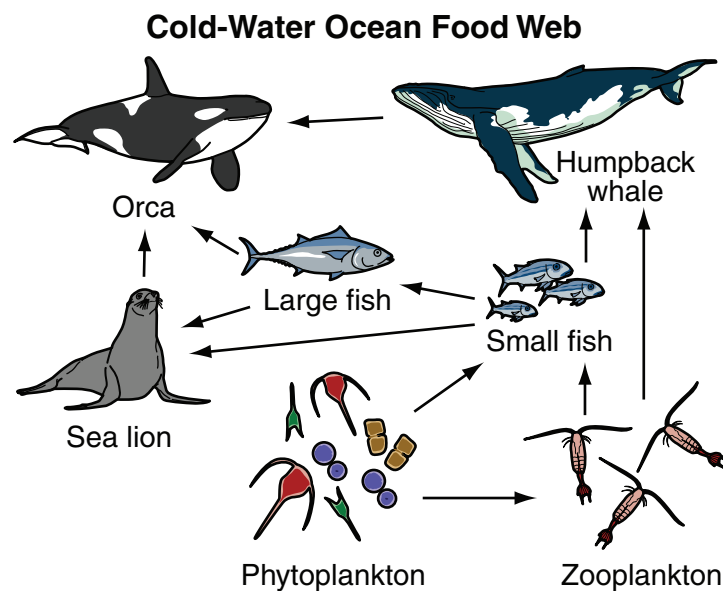
- A The model shows that graphite is made of carbon and oxygen.
- B The model shows that graphite was produced from other substances.
- C The model shows that graphite is made of small structures in a repeating pattern.
- D The model shows that graphite can be made into a long, thin shape inside a pencil.

Read the information. Then answer the questions that follow.

### Whales in Hot Water

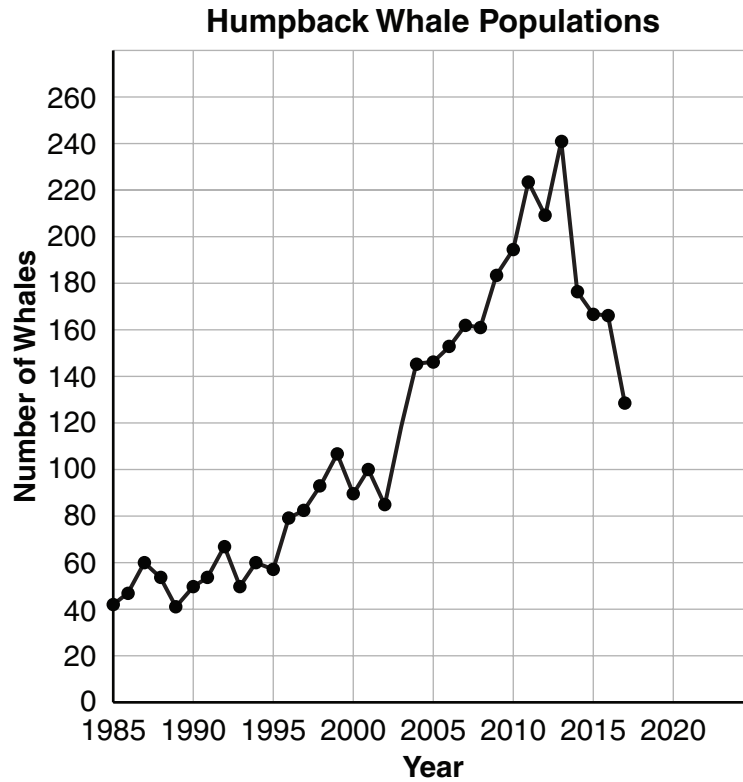
Elias reads an article about the sudden deaths in 2016 of many different types of ocean organisms, including fish and marine mammals like sea lions and whales, along the west coast of the United States and Canada. He learns that in 2016, scientists observed a large zone of unusually warm water in the Pacific Ocean. The warm water caused uncommon species of plant-like phytoplankton to reproduce so quickly that their populations suddenly became very large. Some of the warm-water phytoplankton are toxic to organisms that live in cold ocean water, while others are less nutritious than the normal cold-water species of phytoplankton.

Although scientists are not certain of the specific cause of the sudden deaths, the feeding and reproductive cycles of cold-water ocean organisms were disrupted by the zone of unusually warm water. The diagram shows a cold-water ocean food web.



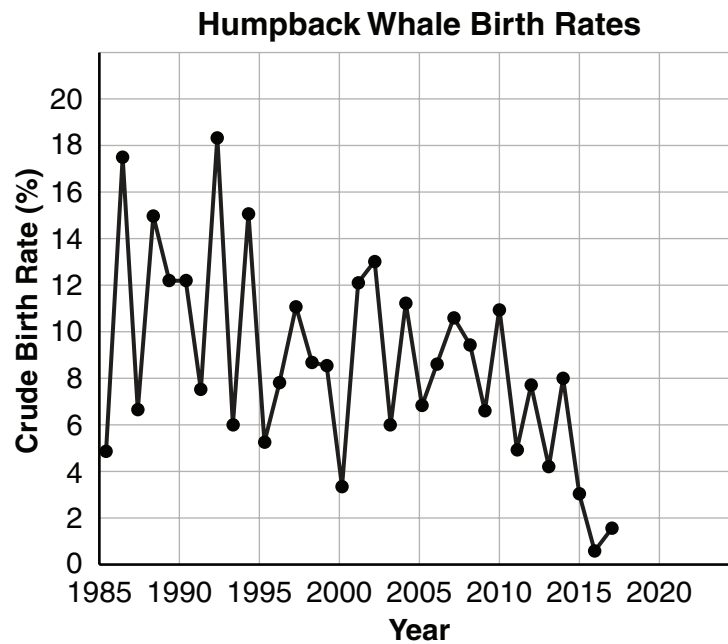
Elias goes whale watching in Alaska and observes a group of humpback whales feeding on a school of fish. The boat captain explains that humpback whales used to be hunted in oceans around the world. The whales were nearly extinct before they were protected in 1970 as an endangered species.

After the whale-watching trip, Elias finds a graph that shows the size of the humpback whale population in Glacier Bay and Icy Strait, Alaska, between 1985 and 2017.



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**1**

Elias learns that scientists use crude birth rate to analyze humpback whale populations. Crude birth rate is the total number of whale calves divided by the total number of whales and is reported as a percentage. He finds a graph that shows the crude birth rates in the whale populations in Glacier Bay and Icy Straight, Alaska, between 1985 and 2017.



*This question has two parts. Be sure to answer both parts of the question.*

**9. Part a**

Which statement describes how humpback whales depend on photosynthesis to survive?

- A** Humpback whales use photosynthesis to provide energy to perform cellular functions.
- B** Phytoplankton use photosynthesis to produce sugars that are passed on to the prey of humpback whales.
- C** Photosynthesis in humpback whales uses solar energy to produce matter that phytoplankton need to grow.
- D** Humpback whales use photosynthesis to produce sugars that other organisms in the food web use for energy.

**Part b**

Which evidence from the food web diagram supports the answer to Part (a)?

- A** Humpback whales prey on large fish and sea lions.
- B** Humpback whales and sea lions are prey for orcas.
- C** Humpback whales eat large fish that eat zooplankton.
- D** Humpback whales eat small fish that eat phytoplankton.

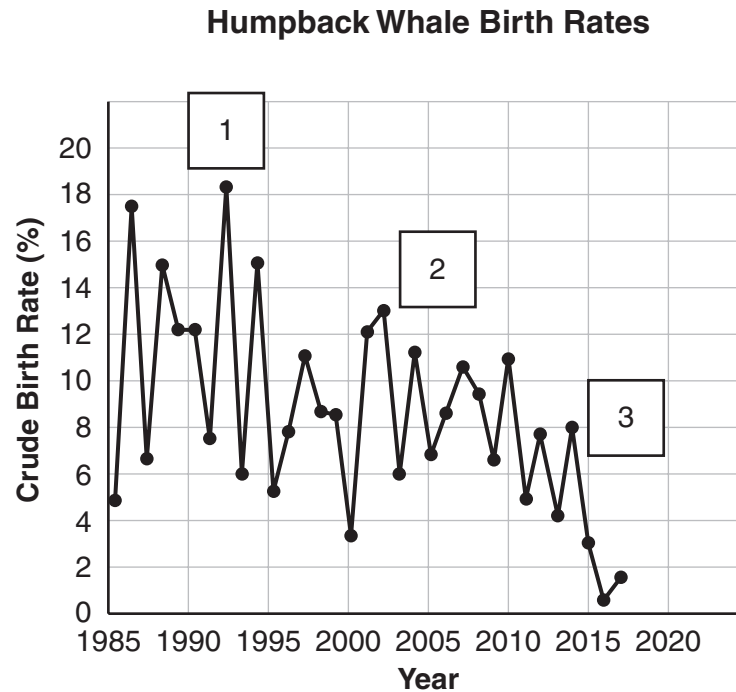
**10.** Based on the diagram, which **two** statements explain how warm-water phytoplankton disrupt the food web?

- A** Warm-water phytoplankton add matter and energy that are available in the system for cold-water phytoplankton.
- B** Warm-water phytoplankton outcompete cold-water phytoplankton for carbon dioxide and nutrients needed for growth.
- C** Large fish and sea lions receive more matter and energy from warm-water phytoplankton than from cold-water phytoplankton.
- D** Zooplankton and small fish receive less matter and energy from warm-water phytoplankton than from cold-water phytoplankton.
- E** Harmful warm-water phytoplankton consume cold-water phytoplankton instead of using photosynthesis to produce matter and energy for the ecosystem.



This question has two parts. Be sure to answer both parts of the question.

11. Elias wants to make a model that shows some of the interactions between humpback whales and their environment. An incomplete model is shown in the diagram.



**Part a**

Which labels **best** complete the model?

- A** 1 = increase in prey  
2 = decrease in prey  
3 = increase in warm-water phytoplankton
- B** 1 = decrease in prey  
2 = increase in warm-water phytoplankton  
3 = decrease in warm-water phytoplankton
- C** 1 = increase in warm-water phytoplankton  
2 = decrease in warm-water phytoplankton  
3 = increase in prey
- D** 1 = decrease in warm-water phytoplankton  
2 = increase in prey  
3 = decrease in prey

**Part b**

Which relationship between environmental factors and humpback whale birth rates is supported by the model in Part (a)?

- A** A decrease in warm-water phytoplankton caused whale reproduction to stop completely.
- B** An increase in warm-water phytoplankton caused more male whale deaths than female whale deaths.
- C** An increase in prey caused faster growth, so younger whales were able to leave the area to find more food.
- D** A decrease in prey caused more competition, so whales had less energy to find mates and produce healthy offspring.

- 12.** Elias wonders what would happen if warm water became the normal condition in this cold-water ocean ecosystem.

Which prediction is supported by the food web diagram and graph?

- A** The whale population would increase because warm water increases the amount of food available for cold-water species.
- B** The whale population would decrease because warm water decreases the amount of nutrient-rich food available for cold-water species.
- C** The whale population would increase because prey species are better able to survive and reproduce when water temperatures are warmer.
- D** The whale population would decrease because prey species are better able to survive and reproduce when water temperatures are normal.





**DO NOT  
TURN PAGE**

# Science Session 2

## DIRECTIONS
















Read each question carefully. For each multiple-choice question, decide which is the best answer and be sure to mark your answer in your answer document. For each open-ended item, be sure to write your answer in the lined box provided in your answer document. Only answers and work written inside the answer boxes will be scored.

*This question has two parts. Be sure to answer both parts of the question.*

- 13.** While Vanessa helps her grandmother feed the chickens, she notices a chicken embryo inside a broken egg. Vanessa observes that the chicken embryo has a long tail. She asks her grandmother why the embryo has a long tail, but an adult chicken does not. Her grandmother encourages her to learn more about how chickens develop.

Vanessa finds a table that shows how the embryos of several types of animals change before birth. The table also shows an adult of each type of animal.

**Embryos and Adults**

Stage	Organism		
	Fish	Chicken	Pig
1–Fertilized egg			
2–Embryo			
3–Embryo			
4–Embryo			
5–Adult			

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**2**

**Part a**

Vanessa observes similarities and differences in the organisms' patterns of growth at different stages of development.

Which **two** patterns are supported by the information in the table?

- A** The organisms look most similar just before birth.
- B** All the organisms have large heads in stage 2 and stage 3.
- C** The organisms become smaller between stage 3 and stage 4.
- D** All the organisms have relatively long tails in stage 2 and stage 3.
- E** Differences among the organisms increase from stage 1 to stage 5.

**Part b**

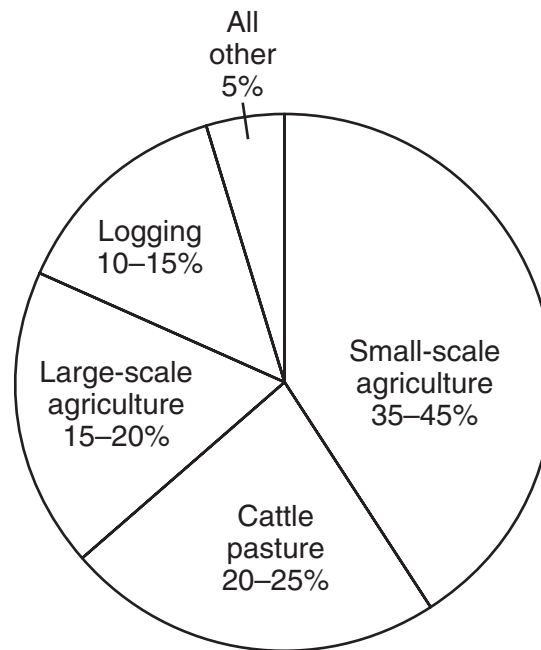
Which relationship among the organisms is supported by the patterns in Part (a)?

- A** The organisms have a common ancestor.
- B** The embryos of larger animals develop slowly.
- C** The organisms appeared on Earth at about the same time.
- D** The embryos spend different amounts of time at each stage of development.

This question has two parts. Be sure to answer both parts of the question.

14. While reading a book about rain forests, Becca learns that many of the zoo animals are from tropical areas on Earth, but that the animals' natural habitats are disappearing. After some research, Becca finds that these tropical areas used to have very large rain forests, but that the rain forests are disappearing as humans begin to use the land. The table and graph show types of human activities and their effects on the deforestation of tropical areas.

Human Activity	Estimated Effects
Small-scale agriculture	35–45%
Cattle pasture	20–25%
Large-scale agriculture	15–20%
Logging	10–15%
All other	5%



### Part a

Based on the table and the graph, which change could cause the **most** positive impact on the forests in tropical areas?

- A eating less meat from cattle
- B growing crops that need less fertilizer
- C encouraging more families to own farms
- D building homes from materials other than wood

**Part b**

The human population is increasing quickly in tropical areas. Which solution could help reduce deforestation in these areas without hurting people?

- A** Bring small farms together to form larger farms in the forest.
- B** Teach people how to safely cook and store meat from cattle.
- C** Require that houses be built on land where forests are cut down.
- D** Find ways to use less farmland to grow the same amount of food.

*This question has two parts. Be sure to answer both parts of the question.*

- 15.** In class, Henry learns that all bees gather food and nesting materials from plants. He learns that orchid bees and orchid plants have a special relationship. Henry made a list of information about the relationship.
- The orchids that orchid bees visit do not make nesting materials or food that bees can eat.
  - Male orchid bees choose to visit orchid plants that have flowers that produce fragrant oils with strong scents.
  - Male orchid bees collect these fragrant oils and store them on their bodies.
  - Female orchid bees are attracted to the scent of the fragrant oils on male orchid bees.
  - Male and female orchid bees do not live together in a large hive. Female orchid bees mate with male orchid bees only once in their lifetime.
  - Orchid plants are pollinated when male orchid bees carry pollen from flower to flower.
- a. Construct an argument that the behavior of individual orchid bees affects reproduction in the orchid bee population. Be sure to use information that Henry learned to support your argument.
- One scientist argues that orchid plants have evolved to produce the specific scents that attract female orchid bees.
- b. Support the scientist's claim with evidence that explains how the oil produced by an orchid plant affects the reproduction of the orchid species.

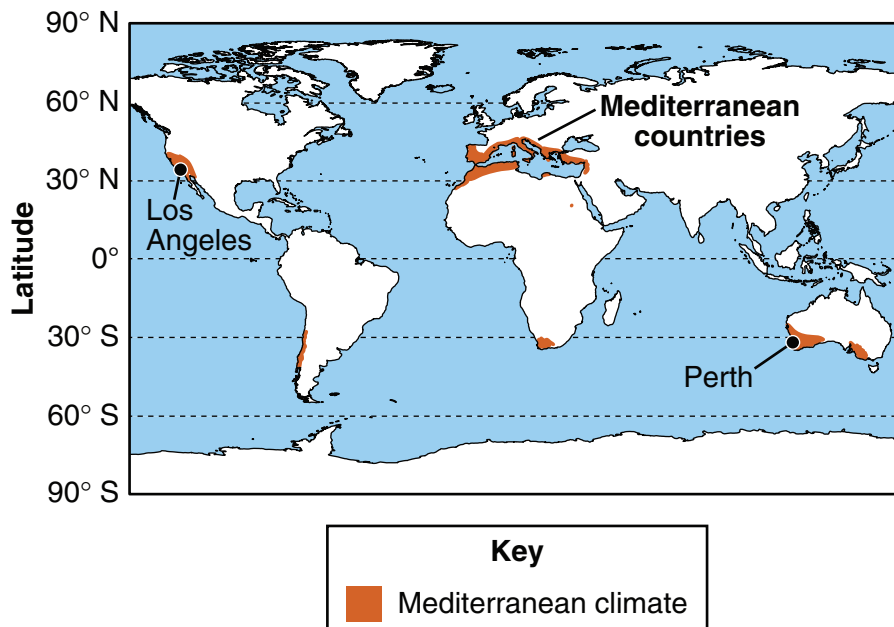
Read the information. Then answer the questions that follow.

### Mediterranean Climate

Kevin lives in Los Angeles, California. When he visits a botanical garden, he sees that plants from all over the world are growing in the garden, including plants from Perth, Australia, where his uncle lives. The guidebook explains that Los Angeles has a Mediterranean climate and plants that grow well in Los Angeles also grow well in other locations with the same climate.

In the guidebook, Kevin finds a map that shows locations with a Mediterranean climate. He marks the locations of Los Angeles and Perth on the map.

**Locations with a Mediterranean Climate**



When he gets home, Kevin does some research. He finds that locations at similar latitudes have similar climates. For a Mediterranean climate, these locations are near a sea or ocean, and usually have warm, dry summers and mild, rainy winters.

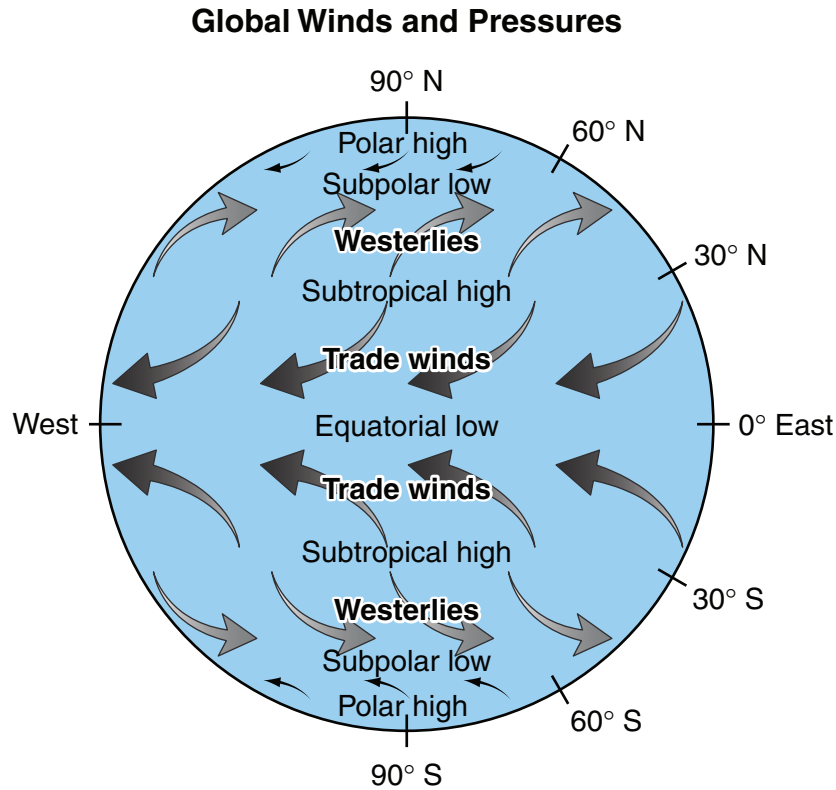
Kevin learns that wind direction helps determine the weather, especially in locations like Los Angeles and Perth. Uneven heating of Earth's surface causes differences in air pressure. These pressure differences cause winds to blow.

Between 30° latitude and 60° latitude, pressure differences cause winds to blow toward the poles, but Earth's rotation causes the winds to curve and blow from west to east. These winds are called westerlies.

Below 30° latitude, pressure differences cause winds to blow toward the equator, but the winds are curved to blow from east to west by Earth's rotation. These winds are called trade winds.



The diagram shows the directions of these winds and locations of high and low pressure.

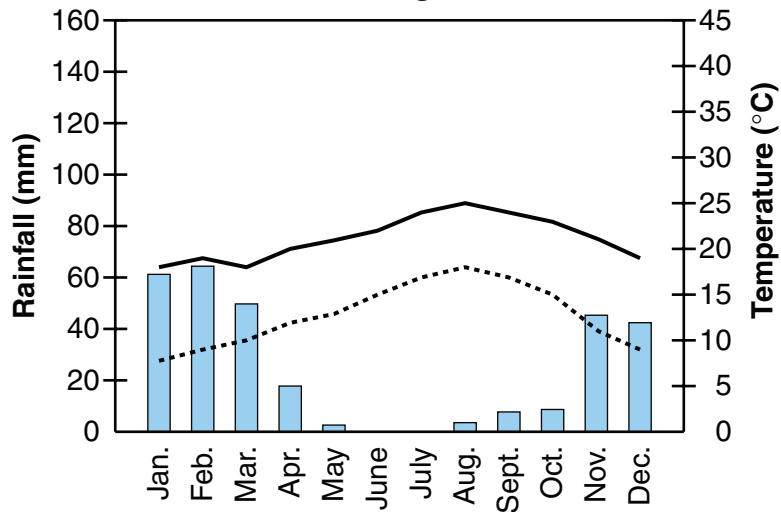


Kevin learns that during the winter, the westerlies bring rain and storms from the ocean to areas along the coast. During the summer, the subtropical highs move toward the poles and keep westerlies from reaching these areas.

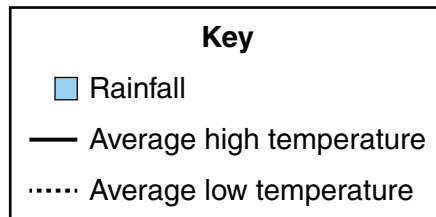
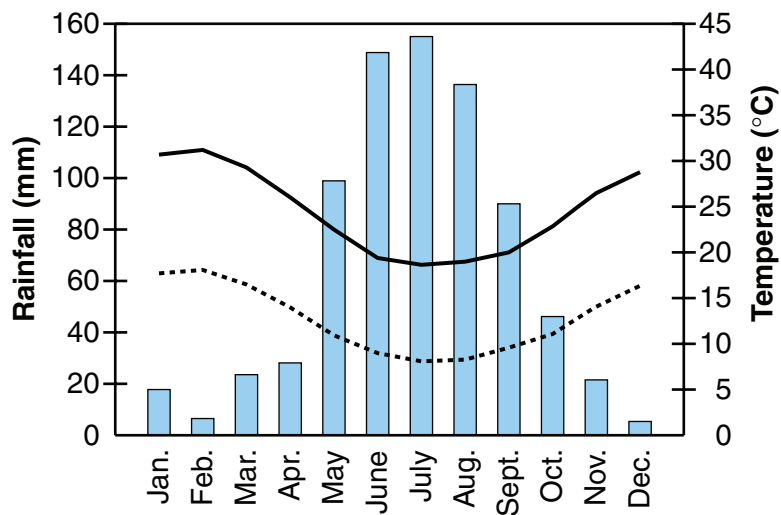
Finally, to learn more about weather conditions in locations with a Mediterranean climate, Kevin finds graphs that show weather data for Los Angeles and Perth.

### Mediterranean Climate Weather Data

#### Los Angeles



#### Perth



- 16.** The winter months in Perth are June, July, and August. Like other locations with a Mediterranean climate, Perth has mild, rainy winters.

Which weather data could provide evidence that the rainy season will soon begin in Perth?

- A** rising air temperatures
  - B** rising ocean temperatures
  - C** winds blowing from the northwest
  - D** decreasing levels of humidity in the air
- 17.** In some areas with a Mediterranean climate, mountains rise just beyond the coastline. During the rainy winter, rainfall varies greatly with distance from the ocean. Locations that are high on the slopes of mountains and face the ocean receive the most rainfall.
- Which statement describes why these locations receive the most rain?
- A** Air at these locations causes changes in weather and precipitation.
  - B** Air that has risen to these locations is cooler and releases more precipitation.
  - C** Air that has risen to these locations has faster winds during rainstorms.
  - D** Air at these locations receives enough sunlight to become warm enough for rain to fall.

*This question has two parts. Be sure to answer both parts of the question.*

- 18.** Kevin claims that all locations with a Mediterranean climate do not have exactly the same climate. He claims that the geography of the land can influence climate.

**Part a**

Which evidence could support Kevin's claim?

- A** Two cities at different latitudes are the same distance from the ocean and have the same climate.
- B** Two cities at the same latitude are different distances from the ocean and have the same climate.
- C** Two cities at different latitudes are at the same elevation above sea level and have different climates.
- D** Two cities at the same latitude are at different elevations above sea level and have different climates.

**Part b**

Which other factor could cause the climates in these locations to be **slightly** different?

- A** the average monthly wind speed at each location
- B** the average daily high and low temperatures at each location
- C** the amount of vegetation that covers the land at each location
- D** the amount of precipitation during each season at each location

*This question has two parts. Be sure to answer both parts of the question.*

- 19.** Kevin studies the graph of weather data for Los Angeles and all that he learned during his research.

**Part a**

How do the data in the graph support the claim that subtropical highs move toward the poles during the summer?

- A** During the summer, Los Angeles has very little rain because westerlies do not bring rain and storms to the city.
- B** During the summer, Los Angeles has warm temperatures because high pressure brings high temperatures to the city.
- C** During the summer, Los Angeles has very little rain because low pressure causes rain to fall in the mountains outside the city.
- D** During the summer, Los Angeles has warm temperatures because trade winds blow warm air from Los Angeles toward the equator.

**Part b**

Which additional data could support the claim that air movements change weather conditions in Los Angeles?

- A** changes in air pressure before rainstorms
- B** changes in air temperature during rainstorms
- C** changes in wind direction before the Sun rises
- D** changes in wind speed as elevation increases

Read the information. Then answer the questions that follow.

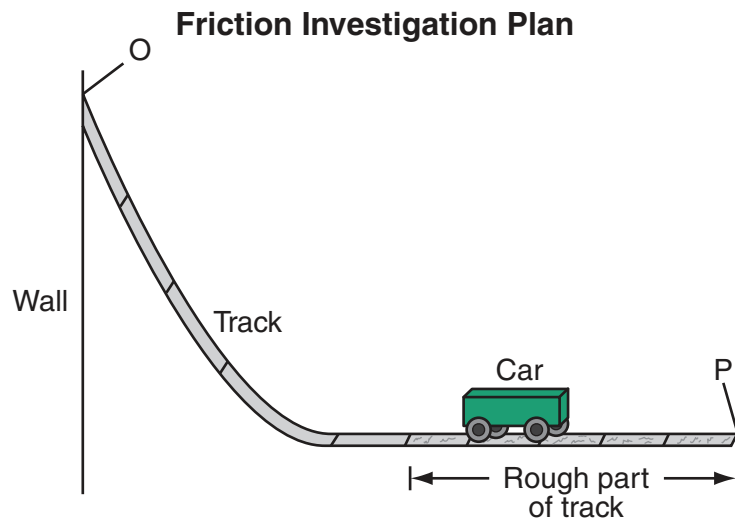
### Roller Coasters

Edith and Andy enjoy going to an amusement park. Their favorite ride is the roller coaster because of all the changes in speed, direction, and height. They know that every change in speed is also a change in kinetic energy and that every change in height is also a change in gravitational energy.

They are fascinated that the roller coaster has enough energy at the top of the first hill to reach the end of the ride. They know that an engine applies the force needed to pull the roller coaster car to the top of the first hill. Then, at the end of the ride, a force stops the roller coaster car so that the riders can get off.

Andy and Edith wonder whether friction is the force that causes the roller coaster car to stop. They decide to use a toy car and pieces of track that have different amounts of friction to investigate how friction affects the car's motion.

They decide that Edith will hold one end of the track against the wall and put a toy car on the track at point O. When she lets go, the car will move down the track and across the rough part of the track. Andy will measure the time for the car to reach point P at the end of the track. The diagram shows their investigative setup.



*This question has two parts. Be sure to answer both parts of the question.*

- 20.** As Edith and Andy consider how to collect data to investigate how friction affects motion, they think about how to carry out their investigation.

**Part a**

Which list correctly describes the variables in their investigation?

- A** independent variables: height of track, length of track, mass of car  
dependent variable: time to reach P  
controlled variable: friction on track
- B** independent variable: friction on track  
dependent variable: time to reach P  
controlled variables: height of track, length of track, mass of car
- C** independent variables: friction on track, time to reach P  
dependent variables: height of track, length of track  
controlled variable: mass of car
- D** independent variables: height of track, length of track  
dependent variable: friction on track  
controlled variables: mass of car, time to reach P

**Part b**

Which statement **best** describes what Edith and Andy must do in order to collect data to answer their investigative question?

- A** repeat the procedure with cars that are larger and smaller
- B** repeat the procedure with cars that move faster and slower
- C** repeat the procedure with tracks that start higher and lower on the wall
- D** repeat the procedure with tracks that exert more and less friction force on the cars

- 21.** As Andy and Edith discuss possible outcomes of their investigation, they make different claims about what will happen.

Which claim will likely be supported by data collected during Andy and Edith's investigation?

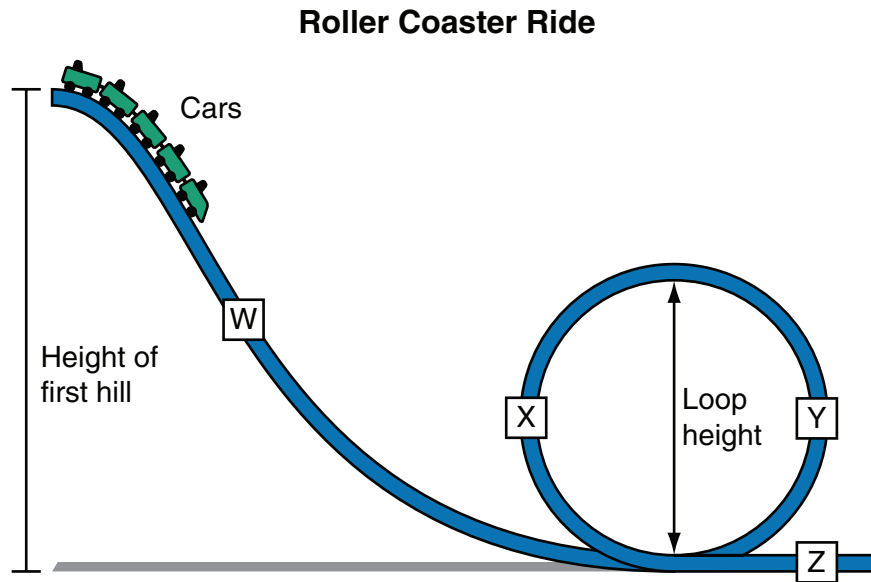
- A** As the force of friction on the track increases, the time for the car to reach point P will decrease because the car's speed will decrease more quickly.
- B** As the force of friction on the track increases, the time for the car to reach point P will decrease because the car's speed will increase more quickly.
- C** As the force of friction on the track increases, the time for the car to reach point P will increase because the car's speed will decrease more quickly.
- D** As the force of friction on the track increases, the time for the car to reach point P will increase because the car's speed will increase more quickly.



This question has two parts. Be sure to answer both parts of the question.

## 22. Part a

Edith and Andy know that the kinetic energy of the roller coaster cars changes during the ride. They draw a diagram to show part of a roller coaster ride.



Which **two** locations on the diagram show where energy was being transferred to the roller coaster car?

- A Y and Z
- B Y and X
- C W and X
- D W and Z

## Part b

Which evidence supports the answer in Part (a)?

- A At those locations, the mass of the roller coaster car was increasing.
- B At those locations, the force on the roller coaster car was increasing.
- C At those locations, the height of the roller coaster car was decreasing.
- D At those locations, the speed of the roller coaster car was decreasing.

- 23.** During their investigation, immediately after the car reaches the end of the track, Andy picks up the car and observes that the car feels warm.

Which energy conversion explains Andy's observation?

- A** Kinetic energy was converted to thermal energy by friction.
- B** Thermal energy was converted to kinetic energy by gravity.
- C** Gravitational potential energy was converted to thermal energy by gravity.
- D** Thermal energy was converted to gravitational potential energy by friction.



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# Science Session 3

## DIRECTIONS

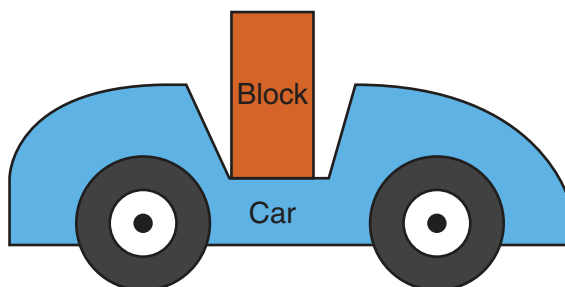
Read each question carefully. For each multiple-choice question, decide which is the best answer and be sure to mark your answer in your answer document. For each open-ended item, be sure to write your answer in the lined box provided in your answer document. Only answers and work written inside the answer boxes will be scored.

*This question has two parts. Be sure to answer both parts of the question.*

- 24.** Eric wants to understand how wearing seat belts in a car can keep people safe during collisions.

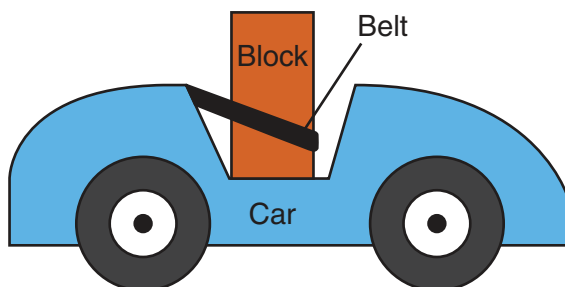
To investigate how a seat belt works, he puts a wooden block inside a toy car as shown in the diagram.

**Block without Seat Belt**



He pushes the car into a wall and observes that the block falls out of the car. Then he attaches a belt around the block as shown in the diagram.

**Block with Seat Belt**



He pushes the car into the same wall with the same force and observes that the block does not fall out of the car.

**Part a**

Which statement describes how the belt keeps the block from falling out of the car?

- A** The belt pushes the car forward before the collision.
- B** The belt pushes the block backward during the collision.
- C** The belt increases the stopping force on the block after the collision.
- D** The belt changes the direction of the force on the car during the collision.

**Part b**

Forces act in pairs that are equally strong but in opposite directions. Which force pair occurs during the collision with the wall?

- A** how hard the car pushes the block and how hard the car pulls on the belt
- B** how hard the wall pushes the car and how hard the belt pulls on the block
- C** how hard the belt pushes the block and how hard the block pulls on the belt
- D** how hard the block pulls on the belt and how hard the block pushes on the car

This question has two parts. Be sure to answer both parts of the question.

- 25.** Jessica's dog just had puppies. The parent dogs both have black fur, but some of the puppies have brown fur. Jessica wonders how that can happen. She learns that the gene that controls brown or black fur color in dogs has two alleles: dominant B and recessive b. If a dog has one or two dominant B alleles, the dog has black fur. If a dog has two recessive b alleles, the dog has brown fur.

Jessica wants to make a model to show how parents with black fur can have puppies with brown fur.

**Part a**

Which model could Jessica make to **best** represent how parents with black fur can have puppies with brown fur?

**A**

		<b>B</b>	<b>b</b>
<b>B</b>		BB	Bb
<b>b</b>		Bb	bb

**B**

		<b>B</b>	<b>B</b>
<b>B</b>		BB	BB
<b>b</b>		Bb	Bb

**C**

		<b>B</b>	<b>B</b>
<b>b</b>		Bb	Bb
<b>b</b>		Bb	Bb

**D**

		<b>b</b>	<b>b</b>
<b>B</b>		Bb	Bb
<b>b</b>		bb	bb

**Part b**

If the two parent dogs described in Part (a) have a litter of four puppies, what is the **most likely** number of puppies with brown fur?



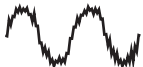



- A** two, because both parents have one B allele and one b allele  
**B** two, because there is a 50% chance of a puppy with Bb alleles  
**C** one, because there is a 25% chance of a puppy with bb alleles  
**D** one, because there is a 25% chance of a puppy with BB alleles

This question has two parts. Be sure to answer both parts of the question.

- 26.** Bruce tells his grandparents that a new cell phone has much better sound quality than an old telephone. A phone with better sound quality produces sounds that are close to the original sounds. Sound quality is poor when sounds are distorted and are different from the original sounds.

To learn more, Bruce finds that both cell phones and old telephones convert sound information into signals that are transmitted from one phone to another. He finds that telephones use analog signals and cell phones use digital signals. Information about analog and digital signals is shown in the table.

**Telephone and Cell Phone Signals**

Information	Analog Signals	Digital Signals
Signal that leaves speaker's phone		
Signal with distortion that reaches listener's phone		
Signal that listener's phone converts back to sound		

The table shows that the amplitude of analog signals varies smoothly, while the amplitude of digital signals does not. The table also shows the signals when they reach the listener's phone and after they have been converted to sound in the listener's phone.

**Part a**

Which claim is supported by data in the table?

- A** Noise does not affect digital signals.
- B** Information cannot be carried by analog signals.
- C** Analog signals are more distorted than digital signals.
- D** Digital signals are easier to transmit than analog signals.

**Part b**

Which statement is supported by the information Bruce found?

- A** Digital signals are easier to store than analog signals.
- B** Digital signals can be transmitted over longer distances than analog signals.
- C** Digital signals can be converted back to sound with all of the original characteristics.
- D** Digital signals contain more information about the original sound than analog signals.

*This question has three parts. Be sure to answer all three parts of the question.*

- 27.** It is a very cold day in the middle of January and twin sisters Sara and Kara are excited to celebrate their birthday. They decide to buy helium-filled balloons for their birthday party. When they arrive at the store, they choose several large balloons.

As the girls walk home through the snow, they notice that the balloons shrink and become smaller even though there are no leaks in the balloons. However, after the girls take the balloons inside their home, the balloons return to their original size.

The girls wonder whether the change in the balloons was caused by the change in temperature. They find out that the temperature of the cold air outside their home is  $-2^{\circ}\text{C}$  and the temperature of the warm air inside their home and the store is  $21^{\circ}\text{C}$ . They decide to use a model to show how temperature affects the size of a helium-filled balloon.

- a. Draw models to compare a helium-filled balloon in three locations: inside the store, outside during the walk home, and inside the home. In each model, be sure to include:
  - the arrangement and spacing of the helium particles inside the balloon.
  - the temperature of the helium-filled balloon.
- b. Describe how the motion of the helium particles inside each balloon changes when the girls take the balloons out of the store to walk home. Be sure to include the reason for the change in motion.
- c. Use your models and the motion of the helium particles to explain why the balloons become smaller during the walk home.



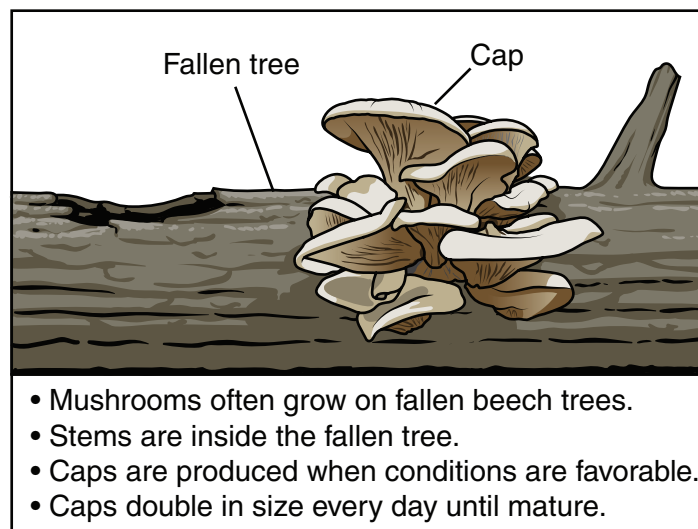
Read the information. Then answer the questions that follow.

### Mushroom Matters

Xavier recently moved to a house near a forest. One day he notices large mushrooms growing on a fallen tree at the edge of the forest. He thinks this is strange because the mushrooms were not there the day before. He wonders how the mushrooms grew so quickly. He walks into the forest and observes many mushrooms that are growing on other fallen trees. He also observes a squirrel eating a mushroom. Xavier wonders about the role of mushrooms in the forest ecosystem.

Xavier researches mushrooms and learns that the mushrooms he observed are oyster mushrooms. He records some information about oyster mushrooms in the diagram.

#### Oyster Mushrooms



Xavier has many questions: How do mushrooms get energy from the fallen tree? How did the tree get the energy and mass to grow so tall? More generally, how do matter and energy move in this ecosystem near his new house?

*This question has two parts. Be sure to answer both parts of the question.*

**28.** Xavier wants to make a model that shows how matter moves in the forest ecosystem.

**Part a**

Which model could Xavier make to **best** represent the movement of matter in the forest ecosystem?

- A tree → air → soil → mushroom
- B squirrel → air → mushroom → soil
- C air → tree → mushroom → squirrel
- D mushroom → air → squirrel → tree

**Part b**

Which statement **best** describes matter in the forest ecosystem?

- A As matter moves through the ecosystem, the amount of matter gets larger.
- B As matter moves through the ecosystem, the amount of matter gets smaller.
- C As matter moves through the ecosystem, the number of atoms remains the same.
- D As matter moves through the ecosystem, the types of atoms are constantly changing.

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**29.** As Xavier thinks about the forest ecosystem, he claims that matter and energy move between living and nonliving parts of the ecosystem.

Which **four** pieces of evidence support Xavier's claim?

- A Plants take in matter from the air.
- B Plants take in energy from the Sun.
- C Animals use energy from food to survive.
- D Plants and animals need water to survive.
- E Animals release waste matter as they grow.

30. Which statement describes how trees get the matter that makes them so tall?
- A Trees use carbon dioxide from the soil to make air and water molecules that are stored in the trees.
  - B Tree roots take in soil molecules that are used to make carbon dioxide molecules that are stored in the trees.
  - C Tree leaves take in oxygen and water molecules that are used to make new molecules that are stored in the trees.
  - D Trees use carbon dioxide from the air and water from the soil to make new molecules that are stored in the trees.

*This question has two parts. Be sure to answer both parts of the question.*

31. Xavier thinks about energy and other parts of the forest ecosystem.

**Part a**

Which statement **best** describes how animals depend on plants for energy?

- A Plants give off energy that animals use for protection.
- B Plants take in energy that animals use for reproduction.
- C Plants store energy in molecules that animals use for growth.
- D Plants release energy in molecules that animals use for warmth.

**Part b**

Which statement describes a reason for the answer in Part (a)?

- A Plants get their energy directly from food, and animals get their energy directly from sunlight.
- B Plants get their energy directly from sunlight, and animals get their energy directly from food.
- C Plants get their energy directly from food, and animals get their energy directly from food.
- D Plants get their energy directly from sunlight, and animals get their energy directly from sunlight.

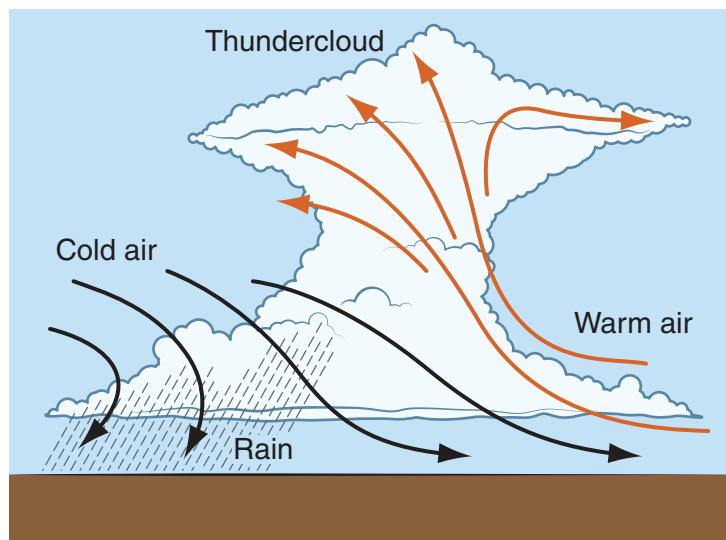
Read the information. Then answer the questions that follow.

### Severe Weather

Brian hears on the radio that a powerful thunderstorm is predicted to arrive in his neighborhood. His family prepares for the storm by making sure they have flashlights with new batteries, fresh water, and a first aid kit. Shortly after the thunderstorm arrives, Brian's neighborhood loses electrical power for several hours because of tree branches that were blown onto power lines. Brian wonders how scientists were able to predict that a thunderstorm was going to occur. When the power returns, Brian researches how thunderstorms form.

He finds out that a thunderstorm can happen when a cold air mass and a warm air mass collide. The warm air rises over the cold air, as shown in the diagram.

### Thunderstorm Formation



Brian decides to investigate the weather changes that cause different types of storms. He finds a table with weather maps and information about different types of weather changes.

**Weather Changes**

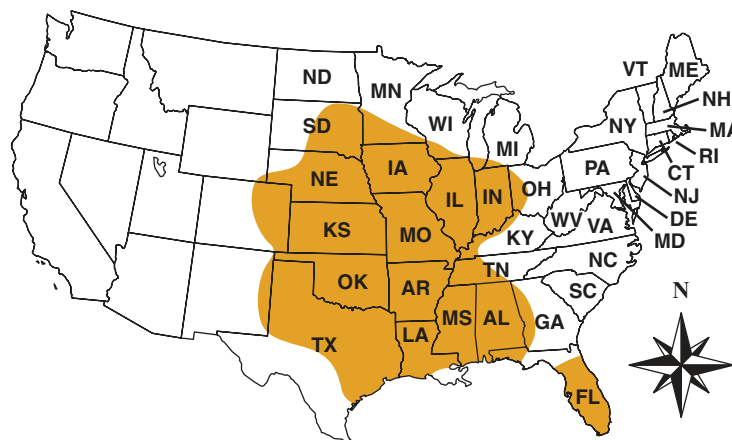
Cause	Type of Change	Weather Map
Cold front	<ul style="list-style-type: none"> <li>• Lower temperature after the front</li> <li>• Thunderstorm</li> </ul>	
Warm front	<ul style="list-style-type: none"> <li>• Warmer temperature after the front</li> <li>• Light rain</li> </ul>	

**Key**

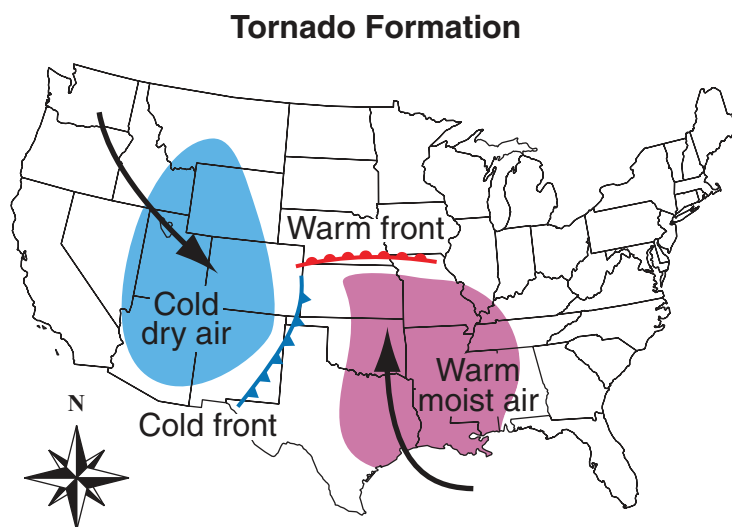
Cold front  
 Warm front

The next day, Brian travels to Oklahoma to visit a friend and finds that his friend’s city is under a tornado warning. Brian’s friend tells him that Oklahoma is part of “Tornado Alley” and that tornadoes are air masses that can be a few kilometers wide and have very strong winds rotating at very high speeds. Tornado Alley, the region of the United States with the most tornadoes, is shaded on the map.

**Tornadoes in the United States**



Tornadoes often happen in areas with thunderstorms, but not all areas that have thunderstorms have tornadoes. Air masses that move in opposite directions across the United States frequently meet in Tornado Alley. The diagram shows how colliding air masses can form tornadoes.



32. Which description of thunderstorm formation is supported by the diagram?
- A As warm air moves over cold air, the air cools and holds less water.
  - B As warm air moves over cold air, the air warms and becomes a cloud.
  - C As cold air moves under warm air, the air cools and moves more slowly.
  - D As cold air moves under warm air, the air warms and falls toward the ground.

- 33.** After visiting his friend in Oklahoma during a tornado warning, Brian wants to be able to predict the likelihood of a tornado forming on a given day.

Based on the Tornado Formation diagram, which **three** weather conditions could Brian use to predict that a tornado might form?

- A** low humidity
- B** high humidity
- C** cool temperatures
- D** warm temperatures
- E** cold air mass moving in
- F** moist air mass moving out

*This question has two parts. Be sure to answer both parts of the question.*

**34. Part a**

Which factor causes air masses to move?

- A** differences in rainfall
- B** differences in humidity
- C** differences in pressure
- D** differences in wind speed

**Part b**

Which data could Brian collect to support the answer to Part (a)?

- A** data showing the speeds of warm and cold air masses
- B** data showing that the air is more humid after a rainstorm
- C** data showing the amount of rainfall when air masses collide
- D** data showing that warm air and cold air have different pressures

*This question has two parts. Be sure to answer both parts of the question.*

**35.** High-resolution radar technology is used to detect thunderstorms and tornadoes.

**Part a**

Which statement describes a possible impact of high-resolution radar technology on communities?

- A** The technology can give people more time to move to a shelter.
- B** The technology can provide communities more resources to build shelters.
- C** The technology can decrease the number of people who live near the storms.
- D** The technology can increase the sizes of the air masses involved in the storms.

**Part b**

Which state could benefit the **most** from high-resolution radar technology?

- A** Ohio (OH)
- B** Arkansas (AR)
- C** Tennessee (TN)
- D** North Dakota (ND)





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