



Grade 12 Science

Sample Questions



This booklet contains sample Grade 12 Science items from the National Assessment of Educational Progress (NAEP). Additional NAEP items can be accessed at www.nces.ed.gov/nationsreportcard/itmrls.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics (NCES), National Assessment of Educational Progress (NAEP).

This Grade 12 Science Sample Questions Booklet and the corresponding answer booklet are posted at <http://www.fldoe.org/asp/naep/naep-pt.asp>.

NAEP GRADE 12 SCIENCE

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INTRODUCTION

The sample items included in this document are taken from previously administered, publicly released Grade 12 National Assessment of Educational Progress (NAEP) Science assessments. The answers to the sample items are included in a companion document. For the multiple-choice questions, the correct answers (indicated by an asterisk) and the distracters; the percentage of the Nation's¹ responses to each of the possible answers; and the Description, Difficulty, and Science Practice of each item are provided. Score descriptors are shown for short- and extended-constructed response items. All released NAEP items and sample responses can be found in the NAEP Questions Tool (NQT) at <http://nces.ed.gov/nationsreportcard/itmrlsx/default.aspx>.

The NQT is an interactive tool containing over 2000 released questions from NAEP assessments in all NAEP subject areas. The questions are an example of what NAEP asks students on the assessments and can be used as a supplement to classroom instruction. Also available are the scoring rubrics; sample student responses; and scoring results by subject, grade, item type, difficulty, content area, science practices, framework, year, and key words.

For more information about NAEP results, go to the NAEP Data Explorer (NDE) at <http://nces.ed.gov/nationsreportcard/naepdata/>. The NDE is an interactive tool that provides access to a wide variety of data about what students know and can do, as well as demographic and contextual factors that may affect their performance. The NDE produces charts, customized tables, and graphics based on NAEP results by year and jurisdiction; significance between jurisdictions, within variables, and across years; and gap analyses between jurisdictions or across years and between groups, between years, and between groups and years.

Additional information about the knowledge and skills the science assessment is designed to measure can be found in the 2011 Science Framework, <http://www.nagb.org/content/nagb/assets/documents/publications/frameworks/science-2011.pdf>. The current NAEP Science Framework was the basis of the NAEP 2009 and 2011 science assessments. The previous framework was the basis of the science NAEP assessments administered in 1996, 2000, and 2005.

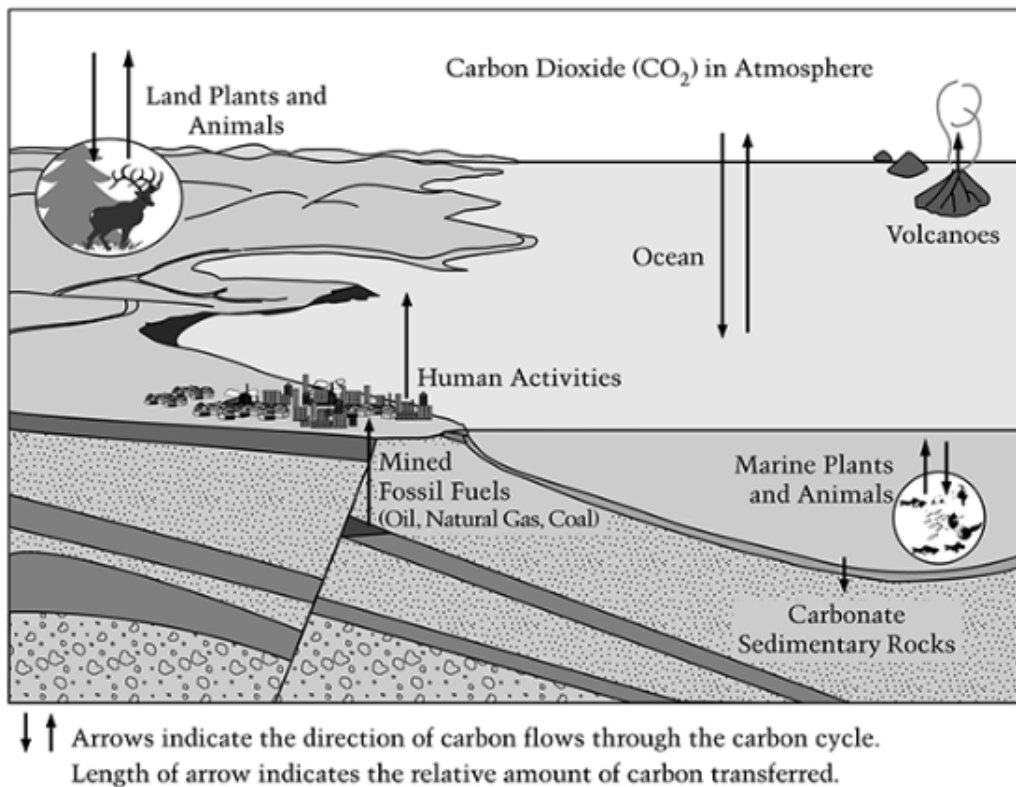
¹ State-level results for Florida are not available for grade 12 Science.

NAEP GRADE 12 EARTH AND SPACE SCIENCES

Question 1, Identify a portion of Earth's carbon cycle driven by an internal energy source

The diagram below shows some of the ways carbon moves through different parts of the Earth's environment.

CARBON CYCLE



Which portion of the carbon cycle is driven directly by Earth's internal heat energy?

- a. The movement of carbon between the ocean and the atmosphere
- b. The emission of carbon dioxide from oil-burning power plants
- c. The release of carbon dioxide during volcanic eruptions
- d. The exhalation of carbon dioxide by animals

Question 2, Identify a portion of Earth’s carbon cycle driven by an internal energy source

In the diagram shown in Question 1, which portion of the carbon cycle is driven directly by energy from the sun?

- a. The formation of coal beneath rock layers
- b. The release of carbon dioxide during volcanic eruptions
- c. The emission of carbon dioxide from oil-burning power plants
- d. The formation of sugars at Earth’s surface

Question 3, Indicate geologic event that explains rock formation

The picture below shows a rock formation with folded layers.



Which statement best explains how the rock layers folded?

- a. The rock melted and flowed downhill
- b. The rock was deformed by a meteorite impact
- c. The rock was suddenly pulled apart during an earthquake
- d. The rock was slowly compressed due to the tectonic plate movement

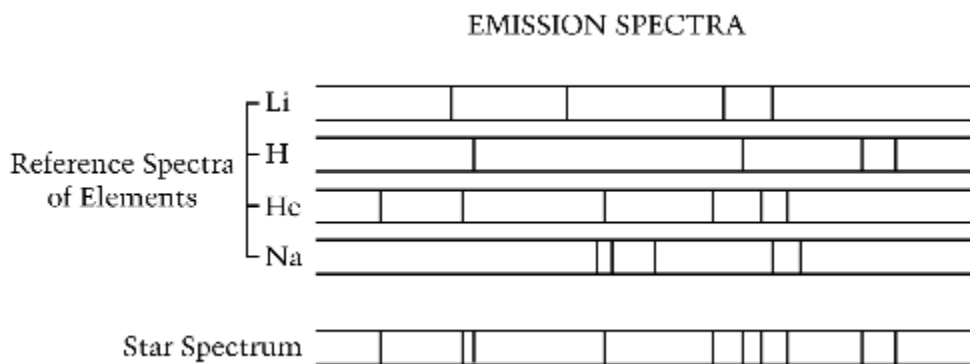
Question 4, Compare methods for determining age of Earth

Why does radioactive dating of meteorites give a more accurate age for Earth than radioactive dating of rocks at Earth's surface?

- a. Most rocks that first formed on Earth's surface have since undergone major geologic changes
- b. Most rocks found on Earth's surface are older than most meteorites
- c. Most meteorites contain minerals that are the same age as those found on Earth's surface
- d. Most meteorites are made of the same type of iron that is found in Earth's core

Question 5, Analyze emission spectra to determine elements present in a star

Scientists determine what elements a star is made of by studying the light it emits. They compare the spectrum of the starlight to reference spectra of known elements. The diagram below shows the characteristic spectral line patterns of four elements. Also shown is the spectrum of a star that contains two of these elements.



Which two of these elements are present in the star?

- a. Lithium and helium
- b. Lithium and sodium
- c. Hydrogen and helium
- d. Hydrogen and sodium

Question 6, Identify a property of galaxies

What is a property of all galaxies?

- a. All galaxies have a spiral shape
- b. All galaxies are the same size
- c. All galaxies contain a large number of stars
- d. All galaxies rotate around a central star

Question 7, Identify how fossil fuels form

Coal, petroleum, and natural gas found underground in certain parts of Earth are primarily formed from which process?

- a. Decay of radioactive elements
- b. Collision of tectonic plates in earthquakes
- c. Transformation of dead plants and animals under heat and pressure
- d. Intrusion of water into the soil that breaks up rocks and minerals

Question 8, Explain alternative hypothesis about the effect of emissions released into the atmosphere

Emissions of greenhouse gasses from automobiles and factories are often cited as a cause of global warming. Automobiles and factories also emit solid particles such as smoke and ash.

Explain how emissions of these solid particles could cause global cooling.

Question 9, Compare methods of removing soil contamination

A city block of land will be developed into a park with a playground. The soil on this site is contaminated to a depth of 18 centimeters with lead, which is harmful to humans and other organisms. The lead must be reduced to safe levels before the land is developed. Three methods of removing lead from the soil are described in the table below.

Method	Description
Removing the Soil	<ul style="list-style-type: none">• Dig up the contaminated soil• Transport it to a landfill
Washing the Soil	<ul style="list-style-type: none">• Dig up the contaminated soil• Wash the soil on the site with a water solution containing nitric acid• Capture the wash solution containing the dissolved lead nitrate that is produced by the reaction of nitric acid and lead• Remove the lead nitrate from the water and dispose of it• Return the treated soil to the ground
Growing Mustard Plants in the Soil	<ul style="list-style-type: none">• Grow mustard plants that absorb lead from the contaminated soil• Harvest the plants, then dry and burn the plants on the site• Reclaim the lead from the ash produced by burning the plants• Grow and harvest six to eight crops of mustard plants until the lead is reduced to a safe level

Question 9, continued

All of the treatment methods described will successfully reduce lead to safe levels. Each method has environmental advantages and disadvantages.

In the table below, identify one environmental advantage and one disadvantage specific to each method.

Method	Environmental Advantage	Environmental Disadvantage
Removing the Soil		
Washing the Soil		
Growing Mustard Plants in the Soil		

NAEP GRADE 12 PHYSICAL SCIENCE

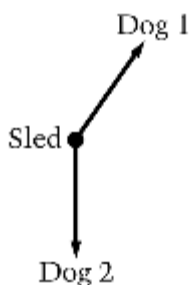
Question 1, Recognize atomic particles in an ion

What particle is a negatively charged ion?

- a. Hydrogen (H) with 1 proton, 0 neutrons, and 1 electron
- b. Sodium (Na) with 11 protons, 12 neutrons, and 10 electrons
- c. Chlorine (Cl) with 17 protons, 18 neutrons, and 18 electrons
- d. Magnesium (Mg) with 12 protons, 12 neutrons, and 12 electrons

Question 2, Predict motion when unbalanced forces are applied

Two dogs pull on a flat-bottom sled with forces of equal magnitude in the directions indicated by the arrows below. The dot represents the sled.

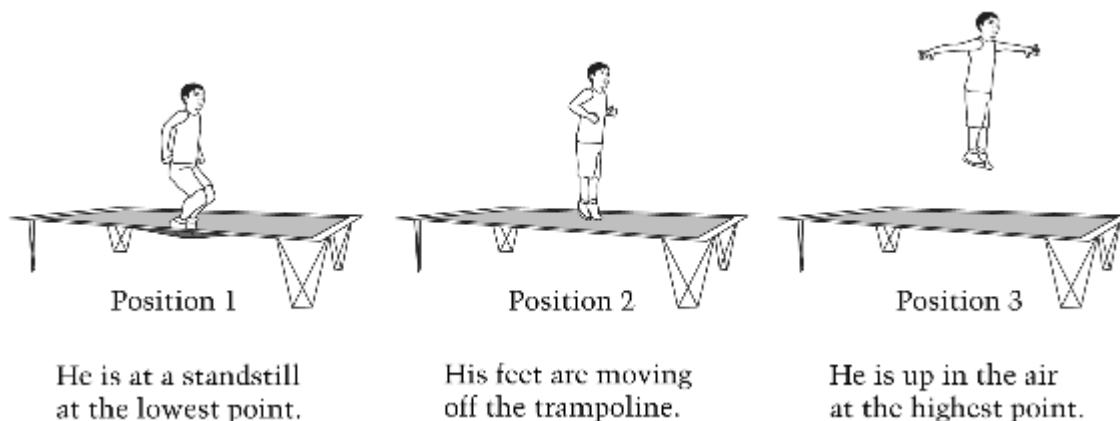


Which arrow best represents the direction of motion of the sled?

- A. Direction of Motion
- B. Direction of Motion
- C. Direction of Motion
- D. Direction of Motion

Question 3, Relate motion to conversion of kinetic energy to potential energy

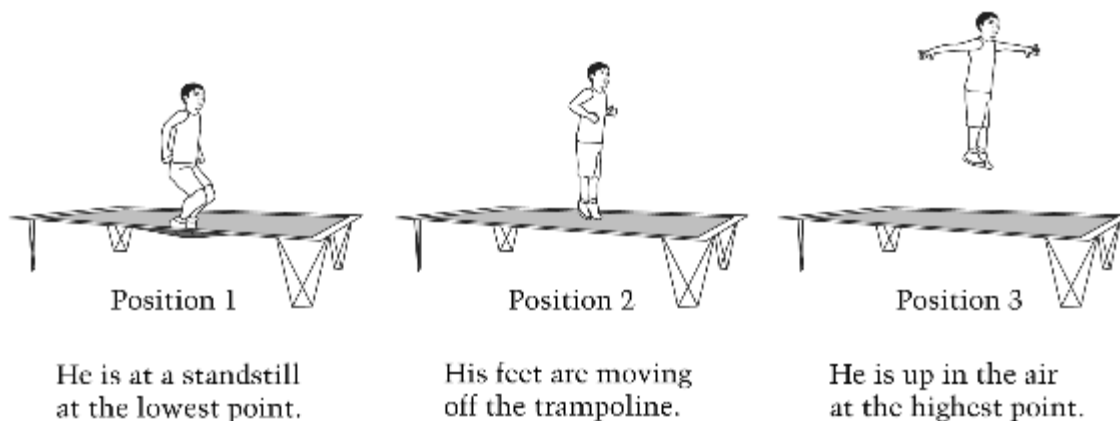
Which statement best explains the energy transfer as the boy moves from Position 1 to Position 2?



- a. The boy's kinetic energy is transferred to the elastic potential energy of the trampoline.
- b. The boy's gravitational potential energy is transferred to the elastic potential energy of the trampoline.
- c. The gravitational potential energy of the trampoline is transferred to the boy's kinetic energy.
- d. The elastic potential energy of the trampoline is transferred to the boy's kinetic energy.

Question 4, Relate motion to conversion of kinetic energy to potential energy

Which statement best explains the energy transfer as the boy moves from Position 2 to Position 3?



- a. The boy's kinetic energy is transferred to the boy's gravitational potential energy.
- b. The boy's gravitational potential energy is transferred to the boy's kinetic energy.
- c. The boy's gravitational potential energy is transferred to the kinetic energy of the air molecules around him.
- d. The kinetic energy of the air molecules around the boy is transferred to the boy's kinetic energy.

Question 5, Recognize the relationship between solubility and molecular properties

What is the main reason that water has the ability to dissolve many different substances?

- a. Water has a lower molecular mass than many substances
- b. Water molecules attract ions and the charged parts of molecules
- c. Water molecules are larger than the ions or molecules they dissolve
- d. Water is more dense in the liquid phase than in the solid phase

Question 6, Recognize the example of a chemical change

Which equation represents a chemical change?

- A. $\text{H}_2\text{O}(\text{liquid}) \longrightarrow \text{H}_2\text{O}(\text{gas})$
- B. $\text{Cu}(\text{solid}) \longrightarrow \text{Cu}(\text{liquid})$
- C. $\text{C}(\text{solid}) + \text{O}_2(\text{gas}) \longrightarrow \text{CO}_2(\text{gas})$
- D. $\text{O}_2(\text{gas}) + \text{H}_2\text{O}(\text{liquid}) \longrightarrow \text{O}_2(\text{aqueous}) + \text{H}_2\text{O}(\text{liquid})$

Question 7, Describe possible advantages of fusion power compared to fission power

Although nuclear **fusion** power plants are not currently used for power generation, people want to develop fusion power. Nuclear **fusion** power plants in the future are expected to solve some of the technological problems of existing nuclear **fission** power plants.

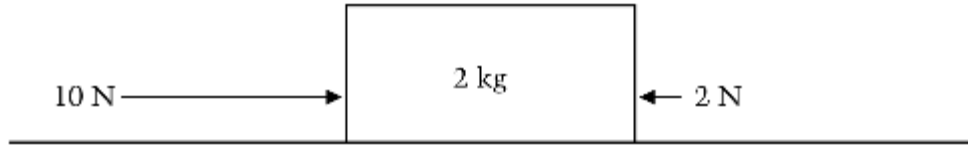
Describe two advantages nuclear **fusion** power would have when compared with nuclear **fission** power. (Do not include economic factors.)

1.

2.

Question 8, Calculate the acceleration of an object

The figure below shows a 2-kilogram (kg) object. A 10-newton (N) force pushes the object horizontally across a level flat surface. The frictional force that results from contact with the surface produces a 2-N force that opposes the direction of the object's movement.

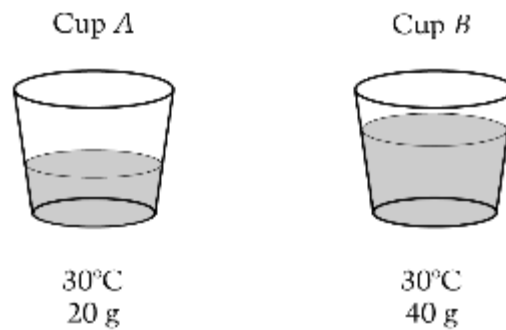


Calculate the net force on the object in newtons (N). Show your calculations.

Calculate the acceleration of the object in meters per second squared (m/s^2). Show your calculations.

Question 9, Compare the thermal energy released when cooling

Two identical cups contain water at 30°C . Cup A contains 20 grams (g) of water, and Cup B contains 40 grams of water, as shown in the diagram below.



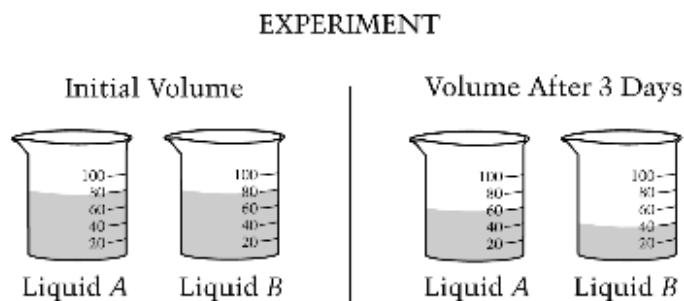
Which cup of water will release more thermal energy when it is allowed to reach the room temperature of 25°C ?

- a. Cup A
- b. Cup B
- c. Both cups will release the same amount of thermal energy

Explain your reasoning

Question 10, Relate rate of evaporation to boiling point and molecular motion

A student placed two identical beakers on a windowsill. One beaker contained 80 milliliters (mL) of Liquid A, and the other beaker contained 80 mL of Liquid B. The student left the beakers uncovered and undisturbed. After three days, both beakers contained less liquid. However, there was less of Liquid B than Liquid A. The diagram below shows the volume of liquid in each beaker at the start of the experiment and after three days.



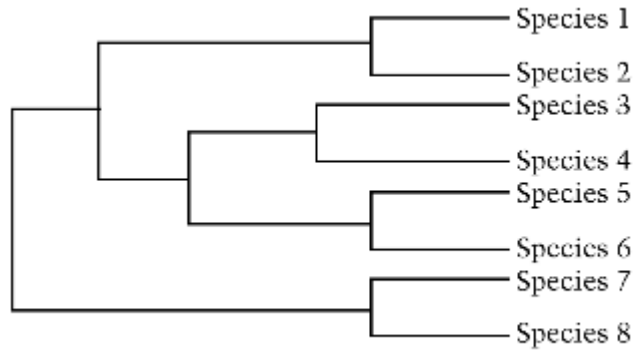
Why is there less liquid in both beakers after three days?

Which liquid has the lower boiling point, Liquid A or Liquid B?

NAEP GRADE 12 LIFE SCIENCE

Question 1, Determine relationships between species based on evolutionary tree

Scientists are studying the evolutionary history of a group of plants in the United States, and they developed an evolutionary tree, as shown below.

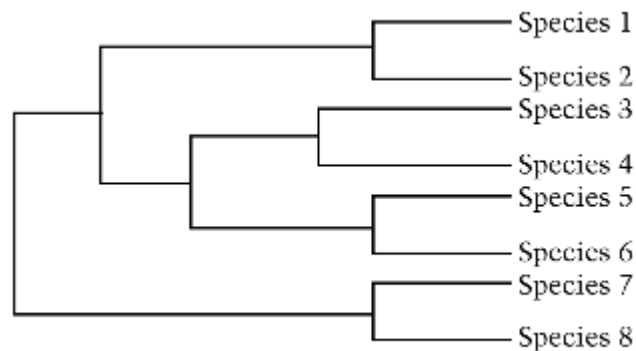


Which statement can be inferred from the evolutionary tree?

- a. Species 1 is most closely related to Species 8.
- b. Species 2 is most closely related to Species 3.
- c. Species 3 is most closely related to Species 7.
- d. Species 5 is most closely related to Species 6.

Question 2, Identify information used to determine evolutionary relationship

Scientists are studying the evolutionary history of a group of plants in the United States, and they developed an evolutionary tree, as shown below.

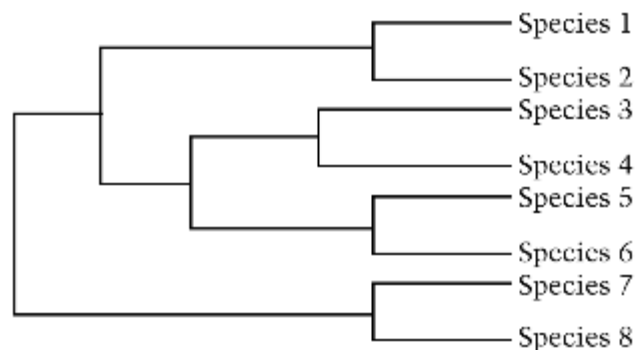


What information about the organisms best helps the scientists to determine the evolutionary relationships among them?

- a. DNA sequences
- b. Anatomical features
- c. Habitat types
- d. Reproductive strategies

Question 3, Design experiment to test hypothesis about relatedness of species

Scientists are studying the evolutionary history of a group of plants in the United States, and they developed an evolutionary tree, as shown below.



Question 3, continued

Additional data indicated that Species 8 shares a similar thorny leaf structure with a different plant species found in Madagascar (an African country), as shown below. The scientists hypothesized that different plant species can have similar leaf structures but not be closely related.

DIFFERENT PLANT SPECIES WITH SIMILAR LEAF STRUCTURES



Species 8

© Frans Lanting/CORBIS #42-19901286



Species from Madagascar

© Kevin Schafer/CORBIS #AF005235

Explain how to test the scientists' hypothesis.

Question 4, Identify a characteristic of sexual reproduction

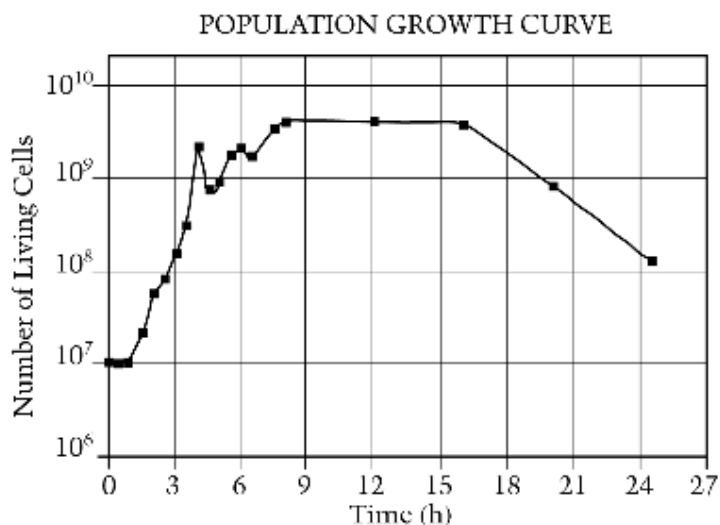
Which statement about the offspring that result from sexual reproduction is generally true?

- e. The offspring show genetic variation from the parents
- f. The offspring have genetic material identical to that of one another
- g. The offspring have genetic material identical to that of one of the parents
- h. The offspring have twice as much genetic material as each parent

Question 5, Draw conclusion about population growth based on data

A scientist studied the growth rate of a species of bacterium. The scientist introduced some of the bacteria into a flask of nutrient-rich solution and monitored the growth of the bacterial population by measuring the number of living cells in the solution.

The graph below shows the growth of the bacterial population over time in hours (h).



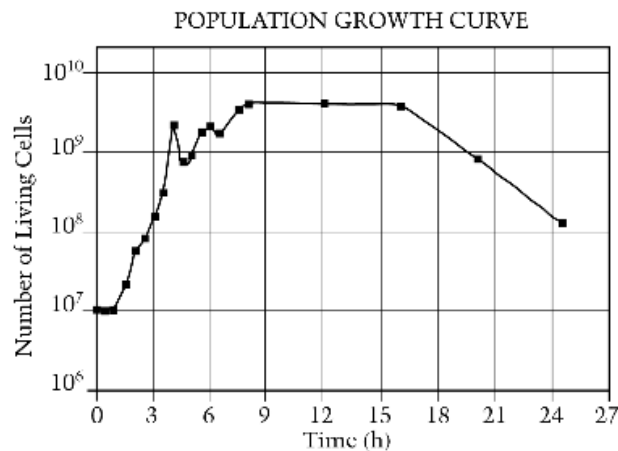
Over which time period did the number of living bacteria increase at the greatest rate?

- e. Between hours 0 and 1
- f. Between hours 1 and 8
- g. Between hours 8 and 16
- h. Between hours 16 and 24

Question 6, Relate patterns in data to cellular processes

A scientist studied the growth rate of a species of bacterium. The scientist introduced some of the bacteria into a flask of nutrient-rich solution and monitored the growth of the bacterial population by measuring the number of living cells in the solution.

The graph below shows the growth of the bacterial population over time in hours (h).



Explain why the growth rate of the bacteria changed as it did during the following time periods. Refer to the data and your understanding of cellular processes and their regulation by internal and external environments.

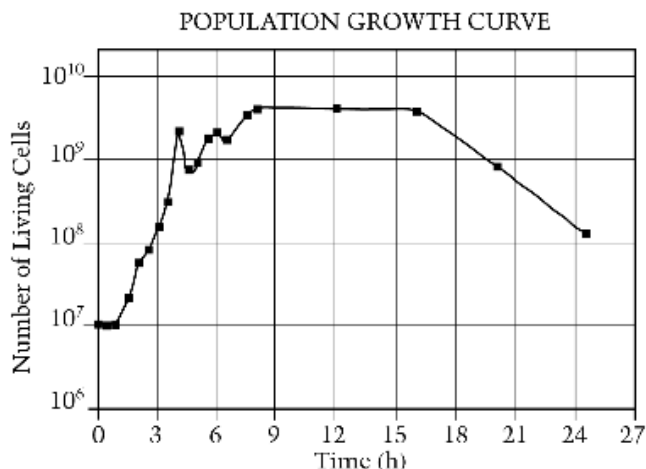
Between hours 6 and 12

Between hours 16 and 24

Question 7, Relate evidence to natural selection

A scientist studied the growth rate of a species of bacterium. The scientist introduced some of the bacteria into a flask of nutrient-rich solution and monitored the growth of the bacterial population by measuring the number of living cells in the solution.

The graph below shows the growth of the bacterial population over time in hours (h).



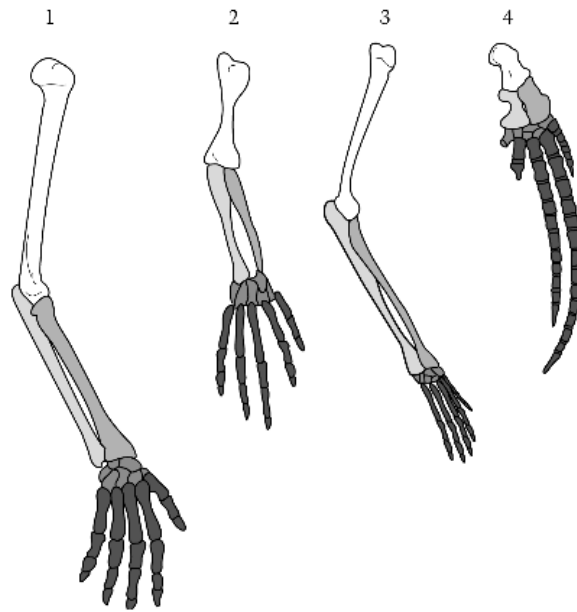
The scientists wanted to determine the effect of an antibiotic on the growth of bacterium. To a second flask of nutrient-rich solution with the bacterial cells, he added the antibiotic and monitored the growth of the bacterial population.

The data showed that most of the bacteria in the solution died, but some survived. The scientist concluded that some of the bacteria were resistant to the antibiotic.

Explain why some of the bacteria were resistant to the antibiotic based on the theory of evolution.

Question 8, Relate anatomical structure to habitat

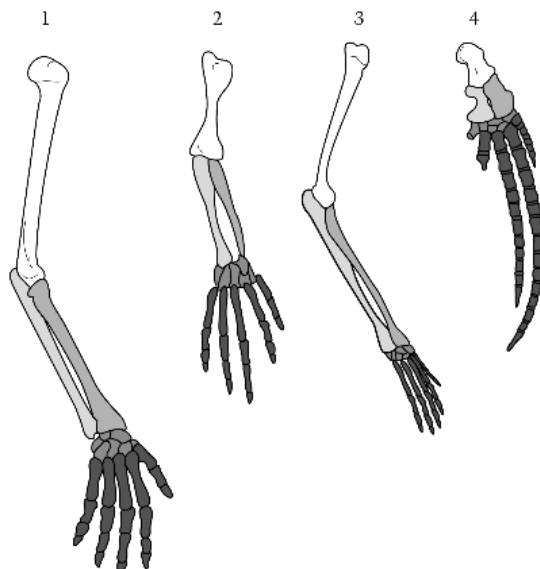
Based on the anatomical structure of the forelimbs shown below, which animal most likely evolved to live only in an aquatic (water) environment?



- a. 1
- b. 2
- c. 3
- d. 4

Question 9, Explain variations in development of anatomical features

Based on the anatomical structure of the forelimbs shown below, which statement best helps to explain how these different structures could arise from a common precursor?



- a. Mutations in the genes regulating limb development led to gradual changes in structure, which provided a selective advantage to the organisms.
- b. A single mutation in the genes regulating limb development resulted in a change in structure, which led to the modified limbs in offspring.
- c. Changes in the environment caused mutations in the genes regulating limb development, which provided a means to thrive under new conditions
- d. Limbs changed in response to the changing needs of the organisms, which led to the modified limbs in offspring.

Question 10, Order levels of organization in living systems

What is the correct order for the levels of organization in living systems from the simplest to the most complex? (Note that all levels of organization are included.)

- a. Elements → molecules → cells → tissues → organs
- b. Molecules → tissues → cells → organs → organisms
- c. Molecules → elements → tissues → organs → organisms
- d. Cells → organs → tissues → organisms → molecules