SCIENCE
ITEM SPECIFICATIONS
FOR THE
ALABAMA HIGH SCHOOL GRADUATION EXAM

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Montgomery, Alabama

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INTRODUCTION

This bulletin provides specific information about the *Alabama High School Graduation Exam,* Third Edition (AHSGE). Educators representing each state school board district as well as both city and county school systems served on the committees that determined the standards and objectives; determined the eligible content for the test; and reviewed, revised, and approved the actual items.

The standards and objectives for the AHSGE are also found in *Standards and Objectives* (*Reading Comprehension, Language, Mathematics, and Science*) *for the Alabama High School Graduation Exam,* Bulletin 1997, No. 16, and *Standards and Objectives* (*Social Studies*) *for the Alabama High School Graduation Exam,* Bulletin 1998, No. 13. The standards and objectives for science are specifically referenced in this document.

Teachers must be familiar with this document if they teach content that relates to the objectives measured on the graduation exam in the middle grades or in the high school grades. Further, teachers must use this document in focusing instruction for students who have demonstrated weaknesses on objectives measured on the pre-graduation examination and the AHSGE.

An item specification has a distinct purpose and provides essential information concerning the testing of an objective. Item specifications for science will follow this order:

STANDARD Broad area of content to be assessed

OBJECTIVE Specific skill within a standard to be assessed

ELIGIBLE CONTENT Clarification and elaboration of an objective (where applicable)

SAMPLE ITEMS Item formats to test each objective

The sample items in this bulletin will **not** be found on the pre-graduation examination or the AHSGE. The number of sample items in this bulletin does not necessarily reflect the weight of the content on the test. In order to identify the weight of the content, the following chart shows the number of items for each science objective.

OBJECTIVES		NUMBER OF ITEMS
I-1	Analyze the methods of science	7
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TOTAL		100

The content of the science subject-area test is approximately 70% biology and 30% physical science.

Each test booklet contains a periodic table for use during the test. The periodic table from the test booklet must be returned to the Test Administrator after the student has completed the test. Therefore, a copy of the periodic table is included on the following page in this bulletin which can be duplicated as needed.

PERIODIC TABLE OF THE ELEMENTS

KEY:

Atomic Number
Name
Symbol
Atomic Mass

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIII	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 Hydrogen H 1																	2 Helium He 4
2	3 Lithium Li 7	4 Beryllium Be 9											5 Boron B 11	6 Carbon C 12	7 Nitrogen N 14	8 Oxygen O 16	9 Fluorine F 19	10 Neon Ne 20
3	11 Sodium Na 23	12 Magnesium Mg 24											13 Aluminum Al 27	14 Silicon Si 28	15 Phosphorus P 31	16 Sulfur S 32	17 Chlorine Cl 35	18 Argon Ar 40
4	19 Potassium K 39	20 Calcium Ca 40	21 Scandium Sc 45	22 Titanium Ti 48	23 Vanadium V 51	24 Chromium Cr 52	25 Manganese Mn 55	26 Iron Fe 56	27 Cobalt Co 59	28 Nickel Ni 59	29 Copper Cu 64	30 Zinc Zn 65	31 Gallium Ga 70	32 Germanium Ge 73	33 Arsenic As 75	34 Selenium Se 79	35 Bromine Br 80	36 Krypton Kr 84
5	37 Rubidium Rb 85	38 Strontium Sr 88	39 Yttrium Y 89	40 Zirconium Zr 91	41 Niobium Nb 93	42 Molybdenum Mo 96	43 Technetium Tc (98)	44 Ruthenium Ru 101	45 Rhodium Rh 103	46 Palladium Pd 106	47 Silver Ag 108	48 Cadmium Cd 112	49 Indium In 115	50 Tin Sn 119	51 Antimony Sb 122	52 Tellurium Te 128	53 Iodine I 127	54 Xenon Xe 131
6	55 Cesium Cs 133	56 Barium Ba 137	6	72 Hafnium Hf 178	73 Tantalum Ta 181	74 Tungsten W 184	75 Rhenium Re 186	76 Osmium Os 190	77 Iridium Ir 192	78 Platinum Pt 195	79 Gold Au 197	80 Mercury Hg 201	81 Thallium Tl 204	82 Lead Pb 207	83 Bismuth Bi 209	84 Polonium Po 210	85 Astatine At 210	86 Radon Rn 222
7	87 Francium Fr 223	88 Radium Ra 226	7	104 Unnilquadium Unq 261	105 Unnilpentium Unp 262	106 Unnilhexium Unh 263	107 Unnilseptium Uns 262	108 Unniloctium Uno 265	109 Unnilennium Une 266									

6	57 Lanthanum La 139	58 Cerium Ce 140	59 Praseodymium Pr 141	60 Neodymium Nd 144	61 Promethium Pm (145)	62 Samarium Sm 150	63 Europium Eu 152	64 Gadolinium Gd 157	65 Terbium Tb 159	66 Dysprosium Dy 163	67 Holmium Ho 165	68 Erbium Er 167	69 Thulium Tm 169	70 Ytterbium Yb 173	71 Lutetium Lu 175
7	89 Actinium Ac 227	90 Thorium Th 232	91 Protactinium Pa 231	92 Uranium U 238	93 Neptunium Np 237	94 Plutonium Pu (244)	95 Americium Am (243)	96 Curium Cm (247)	97 Berkelium Bk (247)	98 Californium Cf (251)	99 Einsteinium Es (252)	100 Fermium Fm (257)	101 Mendelevium Md (258)	102 Nobelium No (259)	103 Lawrencium Lr (262)

ITEMS

BY

STANDARD AND OBJECTIVE

STANDARD I: The student will understand concepts dealing with the nature of science.

OBJECTIVE

1. Analyze the methods of science used to identify and solve problems.

ELIGIBLE CONTENT

- Use process skills to interpret data from graphs, tables, and charts.
- Identify and distinguish between controls and variables in a scientific investigation.
- Identify safe laboratory procedures when handling chemicals, using Bunsen burners, and using laboratory glassware.
- Identify and use appropriate Systeme International (SI) units for measuring dimensions, volume, and mass.
- Define and identify examples of hypotheses.
- Order the proper sequence of steps within the scientific process.
- Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an investigation.

SAMPLE ITEMS

1 The tools that would help you determine whether one liquid is more dense than another are

A Bunsen burner and scale balance

B metric ruler and graduated cylinder

* **C** graduated cylinder and scale balance

D mercury thermometer and Bunsen burner

2 The unit of measurement you should use to measure the amount of liquid in a glass is

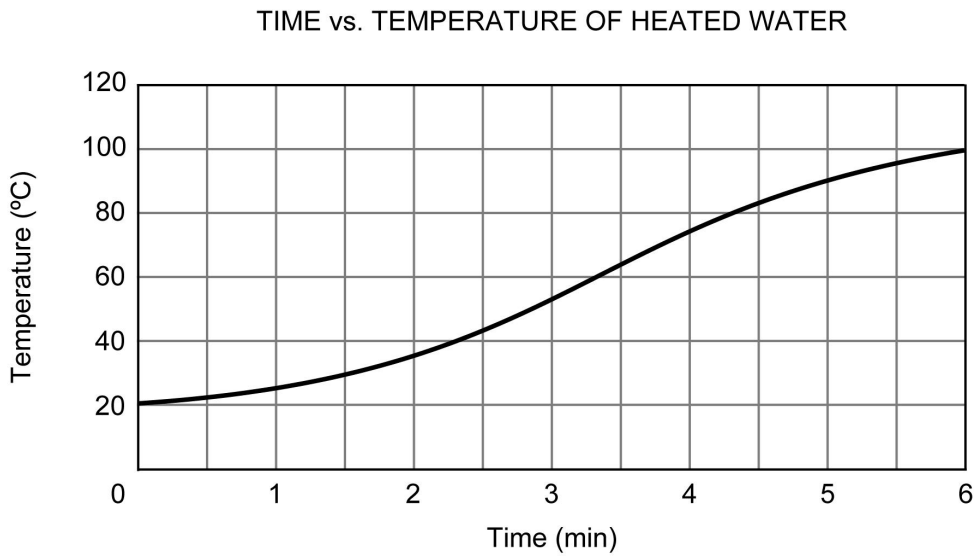
A grams

B kilograms

* **C** milliliters

D centimeters

3 Study the graph below.



One liter of water was heated and its temperature was recorded every minute for six minutes. The results are shown on the graph. According to the graph, between the second and fourth minutes, the temperature rose

A 20°

* **B** 40°

C 60°

D 80°

4 These are four of the steps in sequence for conducting a controlled experiment:

Step 1: Develop an experiment hypothesis.

Step 2: Develop an experiment plan.

Step 3: Set up the experiment materials.

Step 4: Record the experiment data.

At what point in the sequence should a controlling variable be selected?

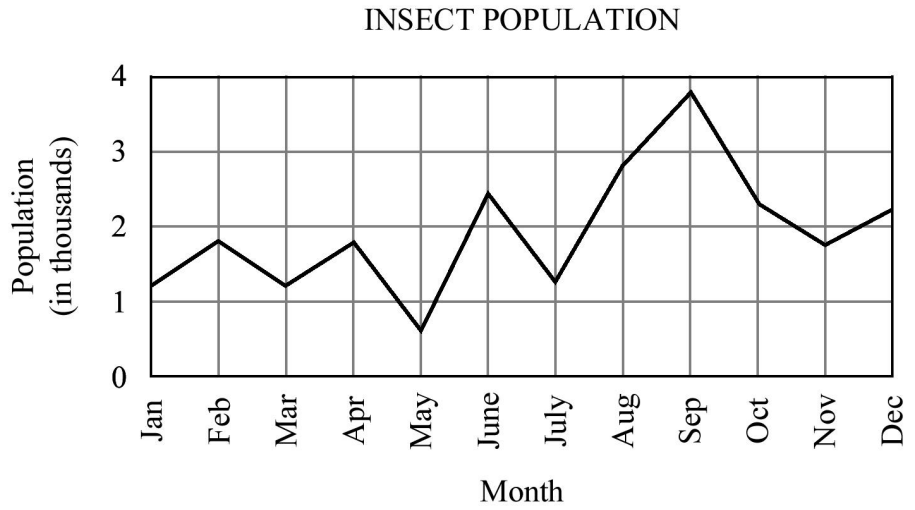
A during Step 1

* **B** during Step 2

C between Steps 1 and 2

D between Steps 3 and 4

5 Study the graph below.



The graph shows the seasonal change in the population of a certain species of insect. During which month did the population reach its peak?

A June

B July

C August

* **D** September

6 A controlled experiment is set up in duplicate. A single factor is changed in one setup but no change is made in the other setup. The factor to which NO change was made is known as the

* **A** control

B variable

C hypothesis

D observation

7 Read the paragraph and study the chart below.

Edward conducted an experiment to determine the concentration of fertilizer that will make his pea plants grow tallest. First he planted one pea in each of four identical pots. He then placed all four pots in the same room and made sure they all received the same amount of sunlight. He watered the pea plants twice a week for three months.

Plant	Amount of Fertilizer in Water
1	25ml of water with 0mg fertilizer
2	25ml of water with 5mg fertilizer
3	25ml of water with 10mg fertilizer
4	25ml of water with 20mg fertilizer

The chart shows how much water and fertilizer he gave to each plant. What is the independent variable?

A rate of growth of the pea plants

* **B** concentration of fertilizer in water

C number of peas the plants produced

D amount of sunlight the plants received

8 Two similar species of rodents live in the same forest. A biologist observes that one rodent population is much larger than the other. The biologist believes that the difference is due to better protective coloration in the larger population. A research project is set up to test this idea.

The biologist' s idea that the population numbers are influenced by coloration is called

A a fact

B an observation

* **C** the hypothesis

D the conclusion

9 A biologist believes that a certain chemical causes rapid growth in plants. Several plants will be divided into either an experimental group or a control group to test this hypothesis. Which of these is the BEST way for the biologist to design the experiment?

A One group should be given the chemical at full strength; the other group should be given the chemical in water.

* **B** One group should be given water containing the chemical; the other group should be given water without the chemical.

C One group should be given the chemical every day; the other group should be given the chemical every other day.

D One group should be given the chemical at nighttime; the other group should be given the chemical during the daytime.

10 A science student is asked to prepare a wet-mount slide for an experiment. Which of the following instruments should the student use with the wet-mount slide?

A Bunsen burner

B test tube clamp

C Erlenmeyer flask

* **D** compound microscope

11 Which of these MOST likely has a volume of about 60 cm^3?

A backpack

B television

C biology textbook

* **D** pocket calculator

12 Which of these is NOT a step that should be taken after finishing a laboratory activity?

A returning all materials to their proper places

* **B** returning unused chemicals to their original bottles

C cleaning the laboratory table and equipment thoroughly

D disposing of unused chemicals as instructed by the teacher

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

1. Trace the transfer of matter and energy through biological systems.

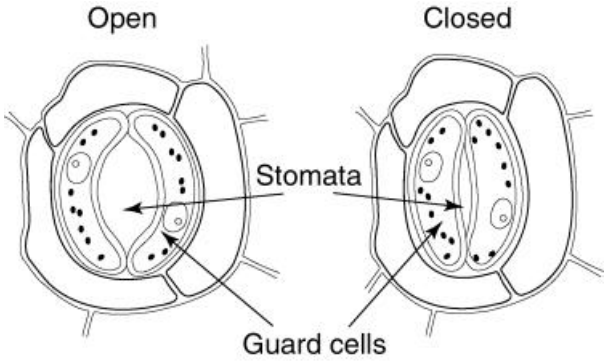
ELIGIBLE CONTENT

- Identify, define, and distinguish among producers (autotrophs), consumers, and decomposers (heterotrophs).
- Trace the flow of energy through food chains, food webs, and energy pyramids.
- Identify the reactants and products associated with photosynthesis and cellular respiration and the purpose of these two processes.
- Describe the carbon, nitrogen, and water cycles—including transpiration and respiration.

SAMPLE ITEMS

1 Read the paragraph and study the pictures below.

Plants lose water vapor to the environment through pores in their leaves. These pores are known as *stomata*. The stomata are surrounded by guard cells that regulate the size of these openings in the leaf.



On a very hot, dry day, the guard cells would most likely

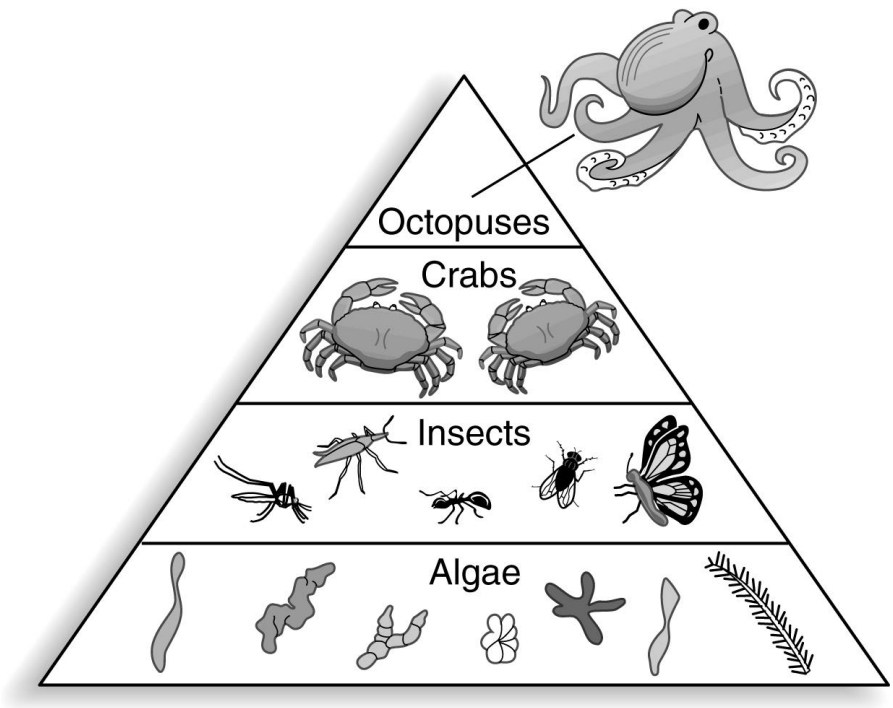
A divide and produce more guard cells

* **B** relax and cause the stomata to close

C fill up and transport water into the plant

D shrink and allow more water to escape

2 Study the pyramid below.



The pyramid represents the flow of energy through the organisms in an ecosystem.

According to this pyramid, which group of organisms has the LEAST available energy?

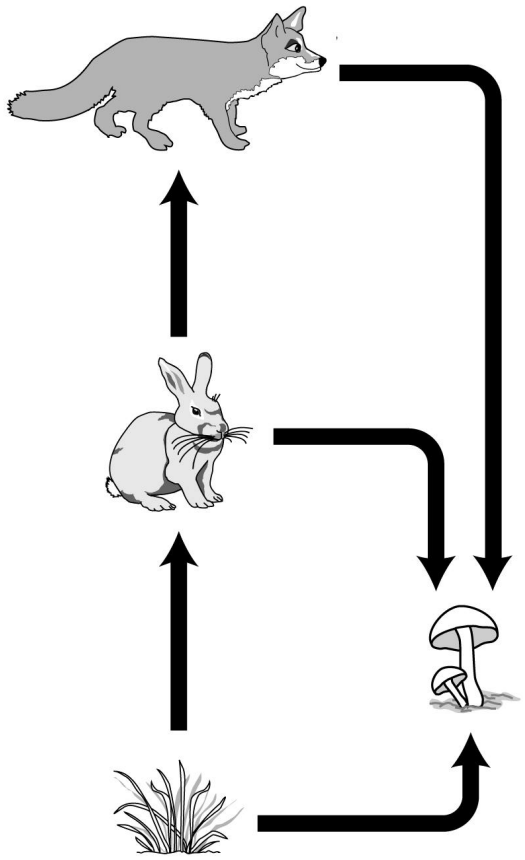
A algae

B crabs

C insects

* **D** octopuses

3 Study the food web below.



Which of these organisms is a primary consumer?

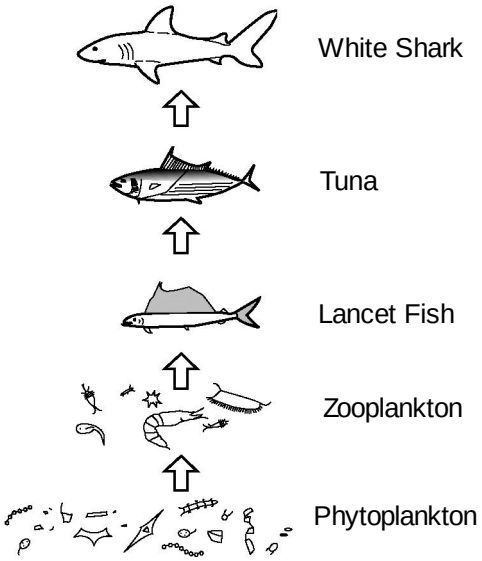
A fox

B grass

* **C** rabbit

D mushroom

4 Study the diagram below.



The tuna could be classified as a

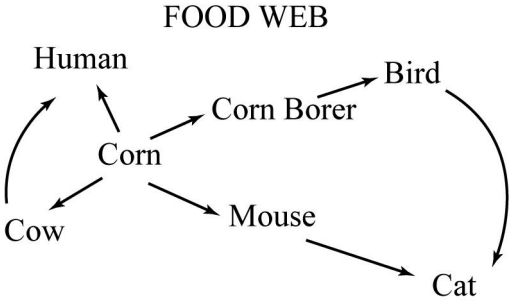
* **A** tertiary consumer

B secondary consumer

C primary consumer

D quaternary consumer

5 Study the diagram below.



How many primary (first-order) consumers does the food web include?

A one

B two

C three

* **D** four

6 Which of these statements describes these four organisms: bird, mushroom, cow, and grasshopper?

A They are all autotrophs.

* **B** They are all heterotrophs.

C Some are autotrophs and some are heterotrophs.

D Some are autotrophs and some are decomposers.

7 The amount of available energy in a food pyramid decreases from

A heterotrophs to autotrophs

B decomposers to carnivores

* **C** producers to tertiary consumers

D primary consumers to herbivores

8 What is a plant' s role in the carbon cycle during photosynthesis?

A It allows carbon to go back into the atmosphere.

* **B** It produces organic carbon compounds called carbohydrates.

C It makes carbon dioxide by combining oxygen with carbohydrates.

D It produces inorganic carbon compounds that are released during decomposition.

9 A type of cell structure found ONLY in producers is

A cytoplasm

* **B** chloroplast

C mitochondrion

D plasma membrane

10 Which of the following uses glucose ($C_6H_{12}O_6$) and oxygen (O_2) to produce energy, carbon dioxide (CO_2), and water (H_2O)?

A fermentation

* **B** respiration

C transpiration

D photosynthesis

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

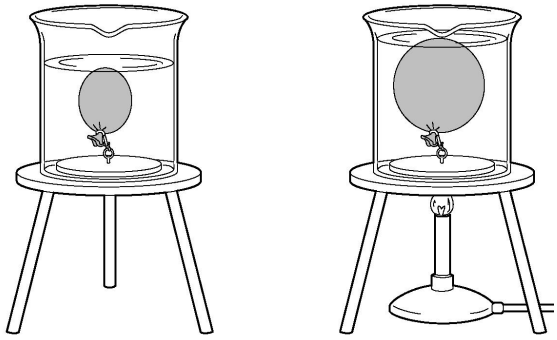
2. Relate particle motion to the states of matter (solids, liquids, and gases).

ELIGIBLE CONTENT

- Identify states of matter in terms of molecular (particle) movement, density, and kinetic energy associated with each phase/state of a given type of matter.

SAMPLE ITEMS

1 Study the pictures below.



These pictures show how a balloon that is submerged in water changes as the water is heated.

Which property of the air inside the balloon decreases as the water is heated?

A mass

B volume

* **C** density

D temperature

2 One difference between a kilogram of solid steel and a kilogram of liquid steel is that the kilogram of solid steel

A weighs more

* **B** takes up less space

C takes up more space

D has more kinetic energy

3 Atoms in a gaseous state have

A less weight than the same atoms in a liquid state

B less volume than the same atoms in a liquid state

* **C** more energy than the same atoms in a liquid state

D stronger atomic bonds than the same atoms in a liquid state

4 At the instant a liquid reaches its boiling point and changes into a vapor, which of these remains the same in both physical states?

A density

* **B** temperature

C volume

D kinetic energy

5 Which of the following describes the molecules of a liquid when compared to a gas?

A They are far apart and easily compressible.

B They are far apart and almost incompressible.

C They are close together and easily compressible.

* **D** They are close together and almost incompressible.

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

3. Apply information from the periodic table and make predictions using the organization of the periodic table.

ELIGIBLE CONTENT

- Determine the number of protons, neutrons, electrons, and mass of an element using the periodic table.
- Use the periodic table to identify and locate metals, nonmetals, metalloids, and noble gases.
- Use data about the number of electrons in the outer electron shell of an atom, including simple dot diagrams, to determine its stability/reactivity and be able to predict ionic charge resulting from reactions.

SAMPLE ITEMS

Use the periodic table on page 3 to answer Numbers 1 through 6.

1 When Na (sodium) reacts with Cl (chlorine), NaCl (sodium chloride) results. To form NaCl, what ionic charge must Na have?

A Na^{2-}

B Na^{1-}

* **C** Na^{1+}

D Na^{2+}

2 According to the periodic table, an example of a nonmetal is

A lithium (Li)

* **B** chlorine (Cl)

C tantalum (Ta)

D mercury (Hg)

3 Which of these electron dot diagrams represents an atom of carbon?

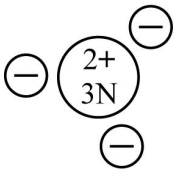
A 

B 

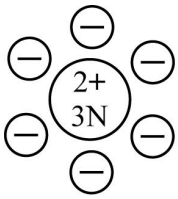
* **C** 

D 

4 Which of the following represents a typical neutral atom?

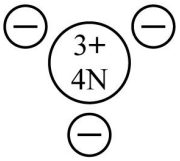


A



B

C



* **D**

Key:

+	= proton
—	= electron
N	= neutron

5 Which of these characteristics must be the same for all atoms of the same element?

* **A** number of protons
  B number of protons and neutrons
  C number of electrons and neutrons
  D number of neutrons

6 The number of neutrons that are normally present in an atom of oxygen is

  A 4
* **B** 8
  C 16
  D 24

7 Isotopes are atoms of the same element that differ in mass because they have the same number of

  A neutrons but different number of protons
  B electrons but different number of protons
  C protons but different number of electrons
* **D** protons but different number of neutrons

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

4. Identify how factors affect rates of physical and chemical changes.

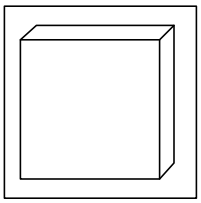
ELIGIBLE CONTENT

- Demonstrate knowledge that some factors and substances can affect the rate at which physical and chemical changes occur in living and nonliving systems—such as the digestive process.

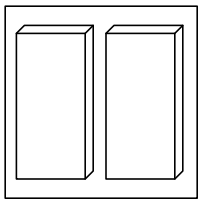
Note: Factors and substances include such things as temperature, concentration, surface area, and catalysts—including enzymes.

SAMPLE ITEMS

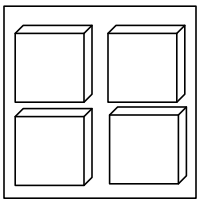
1 Which of the following pieces of ice, produced with equal volumes of water, would melt the slowest at the same room temperature?



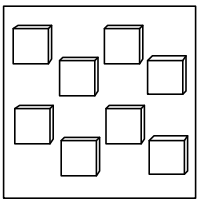
*A



B



C



D

2 Scientists discovered in the 1950s that plastics could be manufactured faster and at lower temperatures by adding special metal compounds to the petroleum mixture. This special metal compound is an example of a

* **A** catalyst

B solvent

C solute

D polymer

3 One important role of an enzyme in cell activities is to

A keep the acidity of the cell constant

* **B** lower the energy required to begin a reaction

C provide the energy for producing chemical bonds

D raise the temperature of the cell so molecules will react

4 An enzyme is present in a solution undergoing a reaction. The reaction occurs faster as the solution is heated. As the temperature of the solution continues to rise, the rate of the reaction levels off and then begins to decrease.

Why does this occur?

A The reaction has reached a state of equilibrium.

B The enzyme has begun to bind with the reactants.

C The solution has become saturated with the enzyme.

* **D** The extreme heat makes the enzyme lose its ability to function.

5 Which of these describes the reaction rate when a chemical mixture is heated?

A Kinetic energy increases and the reaction rate decreases.

B Kinetic energy decreases and the reaction rate decreases.

C Kinetic energy decreases and the reaction rate increases.

* **D** Kinetic energy increases and the reaction rate increases.

6 Which of the following will increase the rate of a chemical reaction?

A decreasing the pressure

B decreasing the surface area

C increasing the volume

* **D** increasing the temperature

7 Which of these will NOT speed up the rate at which sugar dissolves in water?

* **A** adding more sugar

B stirring the mixture

C increasing the temperature

D increasing the amount of water

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

1. Distinguish among the taxonomic groups by major characteristics.

ELIGIBLE CONTENT

- Recognize the correct sequence or taxonomic classification of organisms from the most inclusive level to the least inclusive level—may include use of a chart to compare two species and to identify the classification level at which one species no longer shares common characteristics with other species.
- Classify organisms into the five kingdoms based on recognizing two or more characteristics associated with organisms in a given kingdom.
- Recognize properly written scientific names using binomial nomenclature.

SAMPLE ITEMS

1 Which characteristic most clearly differentiates plants from fungi?

A cell wall

B presence of a nucleus

C multicellular structure

* **D** ability to carry out photosynthesis

2 Related phyla are grouped into a

A class

B genus

C family

* **D** kingdom

3 Study the taxonomic chart below.

	Human	Dog
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Mammalia	Mammalia
Order	Primates	Carnivora
Family	Hominidae	Canidae
Genus	Homo	Canis
Species	sapiens	familiaris

What is the LOWEST taxonomic level at which the dog and human share common characteristics?

* **A** class

B order

C family

D phylum

4 Insects, arachnids, millipedes, centipedes, and crustaceans are grouped together in the phylum Arthropoda because

A they all lack backbones and compound wings

* **B** they all have jointed legs

C they all reproduce sexually and give birth to live young

D they all have more than two legs

5 All of the following statements about the scientific name for an organism are true EXCEPT

A the genus name is listed first

* **B** the species name is listed first

C the genus name begins with a capital letter

D the species name does not begin with a capital letter

6 Which of these is the LEAST inclusive taxonomic group?

A genus

B family

* **C** species

D kingdom

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

2. Differentiate structures, functions, and characteristics of plants.

ELIGIBLE CONTENT

- Identify various plants as being vascular or nonvascular and describe the basic mechanisms by which vascular and nonvascular plants sustain themselves.
- Identify the distinguishing characteristics of angiosperms and gymnosperms in terms of their structures and reproduction.
- Identify reproductive structures and their functions in angiosperms.
- Demonstrate knowledge of which characteristics/traits would be best suited for plants growing in different environments and/or exposed to different pests.

SAMPLE ITEMS

1 For which type of habitat are plants with very large, flat leaves best suited?

A cold, dry, and shady

B warm, dry, and sunny

C cold, humid, and sunny

* **D** warm, humid, and shady

2 Which of the following is NOT directly involved in the reproduction of angiosperms?

A style

B pistil

C anther

* **D** sepal

3 In which type of habitat are prop roots (roots half in soil and half in air) an important adaptation?

A desert

* **B** swamp

C alpine

D grassland

4 Study the chart below.

Plant Parts	Plant 1	Plant 2	Plant 3
Flowers	X		
Seeds	X		X
Spores		X	
Roots	X	X	X
Leaves	X	X	X
Water transport tubes	X	X	X

This chart shows the characteristics of three different plants. Plant 3 on the chart could be a

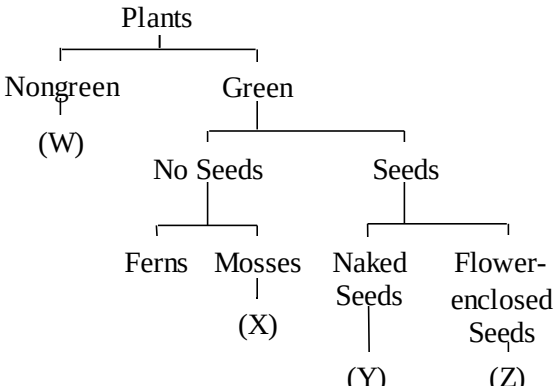
A moss

B fungus

* **C** pine tree

D fruit tree

5 Study the diagram below.



In the diagram, a pine tree should be placed at which of the following positions?

A (W)

B (X)

* **C** (Y)

D (Z)

6 All of these are part of the female reproductive organ in angiosperms EXCEPT the

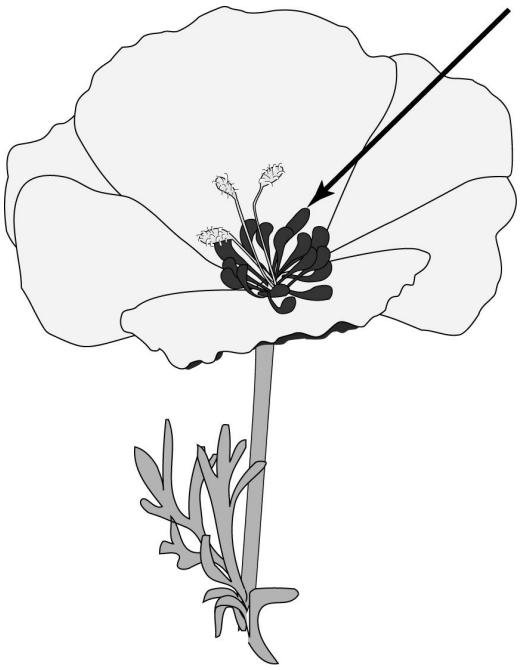
A style

B ovary

* **C** anther

D stigma

7 Study the drawing below.



The pollen-producing structure indicated by the arrow is the

A style

B pistil

* **C** anther

D sepal

8 Mosses rarely grow more than a few inches high and tend to occupy moist habitats on or near the ground. This is because mosses do not have

A a method for pollination far from the ground

B a method to spread their spores far from the ground

C chlorophyll, so they need to be near a source of decaying organic matter

* **D** a vascular system to allow transport of water and nutrients to upper branches

9 Mosses lack rigid supporting tissue and are most common in damp habitats. Mosses are classified as

A angiosperms

B gymnosperms

C vascular plants

* **D** nonvascular plants

10 Many plants have pores in their leaves through which they exchange gases with the environment. These pores are called *stomata*. Some plants have their stomata buried deep in their leaves to protect the plant from excessive transpiration.

The environment in which plants with this adaptation would most likely be found is a

A taiga

* **B** desert

C marsh

D rain forest

11 Dutch elm disease is caused by a parasitic fungus. The fungus invades the water-conducting vessels of a tree. In response, the tree produces gums and resins that clog its own transport system and cause the tree to die. The dead tree becomes a breeding site for elm-bark beetles. The beetles then carry the parasite to a nearby tree, and the process starts again.

What is the cause of tree death in Dutch elm disease?

A root rot

B leaf destruction

C decreased growth

* **D** inadequate water flow

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

3. Differentiate structures, functions, and characteristics of animals.

ELIGIBLE CONTENT

- Distinguish characteristics of vertebrates and invertebrates in terms of a broad but basic range of physical and reproductive traits.
- Explain how animals are adapted to their environment—such as protective coloration, mimicry, claws, beaks, etc.

SAMPLE ITEMS

1 Each of these can occur in the reproductive processes among mammals, EXCEPT

A laying of eggs

* **B** stages of metamorphosis

C embryonic development in uterus

D continued development in mother' s pouch

2 The ladybug' s red color and black dots keep birds and other predators away. This adaptation is an example of

A cryptic coloration

B adaptive radiation

C aggressive mimicry

* **D** warning coloration

3 Which of these processes enables insects to eat different types of food and thrive in different environments at different life stages?

A molting

B meiosis

C mutation

* **D** metamorphosis

4 Which of these animals would be LEAST affected by extremely high daytime temperatures in a desert environment?

A a bird with large white feathers

* **B** a mammal that burrows underground

C an amphibian with smooth, moist skin

D a reptile that must move from place to place

5 Which of these BEST explains why a rattlesnake' s heart is more efficient than a lobster' s heart?

A The lobster' s complex segmented body makes it more difficult for the heart to pump blood.

B The rattlesnake' s warmer environment provides more energy for its heart to circulate blood.

* **C** Unlike the lobster, the rattlesnake' s heart is able to separate oxygen-rich and oxygen-poor blood during circulation.

D Unlike the rattlesnake, the lobster' s exoskeleton makes it harder for it to pump blood because of increased body pressure.

6 Study the picture of the praying mantis with broad, leaf-like wings.

Which of these is this an example of?

* **A** protective resemblance

B symbiosis

C metamorphosis

D warning coloration

7 At great ocean depths, it is very dark because most of the sunlight has been absorbed. Some animals have special adaptations such as *bioluminescence*, which enables the animals to produce their own light. The midwater jellyfish has bioluminescence in its tentacles. If disturbed, the bioluminescent tentacles break off and the jellyfish swims rapidly away in darkness.

The midwater jellyfish probably loses its bioluminescent tentacles to

A attract prey

B attract mates

* **C** distract predators

D camouflage itself

8 Although it lays eggs closely resembling those of reptiles, the *echidna*, or spiny anteater, is considered a mammal. Which two characteristics have scientists used to justify classifying it as a mammal and not as a reptile?

* **A** It possesses hair and produces milk for its young.

B It has an internal skeleton and breathes through lungs.

C It has a central nervous system and reproduces sexually.

D It possesses a highly developed sense of smell and hunts for its food.

STANDARD IV: The student will understand concepts of heredity.

OBJECTIVE

1. Recognize heritable characteristics of organisms.

ELIGIBLE CONTENT

- Identify physical traits that are passed from parents to offspring.
- Recognize how genetic traits including diseases and disorders are passed from one generation to the next—may include family pedigrees and monohybrid Punnett squares.
- Identify what happens to the DNA code when a mutation occurs and identify the major causes of mutations.
- Recognize and evaluate the harms and benefits that result when mutations occur.

SAMPLE ITEMS

1 Study the Punnett square below.

		Male	
Female	**WW**	**Ww**	**W = dominant**
	Ww	**ww**	**w = recessive**

Two hamsters with white fur produced an offspring with brown fur. If "W" represents the gene for white fur and "w" represents the gene for brown fur, which of these combinations of parents will yield offspring with brown fur (ww)?

A WW and ww

B WW and Ww

* **C** Ww and Ww

D WW and WW

2 A mutation may be passed along to human offspring

A through the process of mitosis only

* **B** through the process of meiosis only

C by the process of either mitosis or meiosis

D by a process other than mitosis or meiosis

3 What is the minimum number of point mutations that can cause DNA to code for a different amino acid?

* **A** one

B two

C three

D four

4 Compared to a small leaf, a large leaf size increases the surface area needed for capturing sunlight for photosynthesis but also increases evaporative water loss. A series of mutations that eventually results in narrow, needle-like leaves would MOST often be

A harmful in both desert and tropical areas

B beneficial in both desert and tropical areas

* **C** beneficial in desert areas but harmful in tropical areas

D harmful in desert areas but beneficial in tropical areas

5 A very low rate of mutation in a population will probably be

A harmful to the population in both rapidly changing and stable environments

B beneficial to the population in both rapidly changing and stable environments

C beneficial to the population in a rapidly changing environment but harmful in a stable environment

* **D** harmful to the population in a rapidly changing environment but beneficial in a stable environment

6 In one year, a small town experienced a flood, several tornadoes, a chemical spill into the river, and an outbreak of food poisoning from tainted milk. The next year, several newborn calves were found to have serious birth defects.

Of the disasters from the previous year, which is the MOST likely to have contributed to the birth defects?

A flood

B tornadoes

* **C** chemical spill

D food poisoning

7 Chromosomes are made up of many genes. These genes consist of a specific sequence of bases. Which of these statements correctly describes what ALWAYS happens to the DNA code when a mutation occurs?

* **A** The base sequence within a given gene is changed.

B A portion of a chromosome is repeated.

C A gene is removed from a chromosome.

D A dominant allele is changed to a recessive allele.

8 Study the Punnett square below.

		Male T	Male t
Female	**T**	**TT**	**Tt**
	t	**Tt**	**tt**

T = dominant
t = recessive

The gene for tallness (T) is dominant. What heights will the offspring of two pea plants have?

A 25% will be tall, 75% will be short

* **B** 75% will be tall, 25% will be short

C 50% will be tall, 50% will be short

D 25% will be tall, 50% will be medium, and 25% will be short

9 A mutation results in a condition known as albinism, in which animals have pink eyes and white fur and skin. Which of these BEST explains why a mouse with albinism would be at a disadvantage for survival in the wild?

A White fur is difficult to keep clean.

B White fur dries much more slowly than dark fur.

C White fur does not retain heat as well as dark fur.

* **D** White fur makes it difficult to hide from predators.

10 Study the Punnett square below.

		Father B	Father b
Mother	**B**	**BB**	**Bb**
	b	**Bb**	**bb**

B = dominant
b = recessive

If "B" represents offspring with brown eyes, and "b" represents offspring with blue eyes, how many brown-eyed and how many blue-eyed offspring can be expected with four children?

A 2 brown-eyed, 2 blue-eyed

B 1 brown-eyed, 3 blue-eyed

* **C** 3 brown-eyed, 1 blue-eyed

D 4 brown-eyed, 0 blue-eyed

STANDARD IV: The student will understand concepts of heredity.

OBJECTIVE

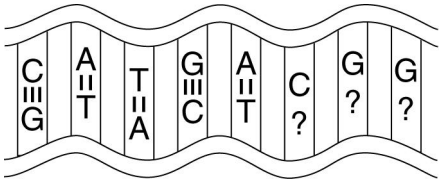
2. Explain how the DNA molecule transfers genetic information from parent to offspring.

ELIGIBLE CONTENT

- Describe the relationships among DNA, genes, and chromosomes.
- Describe in basic terms the structure and function of DNA.
- Define the genetic purpose for meiosis from generation to generation.
- Define and distinguish between dominant and recessive genes and how each is expressed in parents and offspring.

SAMPLE ITEMS

1 Study the picture below.



This drawing shows a segment of DNA with the four bases adenine (A), thymine (T), guanine (G), and cytosine (C). What is the correct order for the three bases represented by question marks?

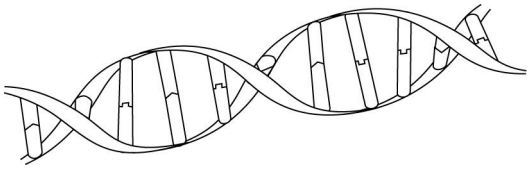
A ATT

B CAG

* **C** GCC

D ACA

2 Study the picture below.



This picture most likely represents

* **A** DNA

B RNA

C ATP

D NAD

3 The long, thin, string-like molecules located primarily in the nucleus of eukaryotic cells are known as

* **A** DNA

B RNA

C genes

D chromosomes

4 The process of meiosis

* **A** enables each parent to contribute genes to the offspring

B reduces the total number of chromosomes present in the offspring

C increases the chance of beneficial mutations being passed to the offspring

D prevents harmful mutations in the parents from being passed to the offspring

5 Which of these describes a recessive gene trait?

A one that causes a mutation

* **B** one that can be masked by a dominant gene trait

C one that can appear only if it is heterozygous

D one that will not express itself if it is homozygous

6 In what percentage of heterozygous individuals will a dominant allele be expressed?

A 0%

B 25%

C 50%

* **D** 100%

7 Each chromosome is composed of which of the following?

A one very long gene molecule

B thousands of protein molecules

* **C** one very long DNA molecule

D thousands of RNA molecules

8 A student is studying the genetics of fruit flies. She crosses two fruit flies that have red eyes and discovers that 7 out of 28 offspring have white eyes. What is the most likely conclusion she reached?

A Only one of the parents must have had an allele for the white-eyed trait.

* **B** The white eye trait is recessive and that both parents must have been heterozygous for this trait.

C The white eye trait is a new dominant trait that will eventually replace the red eye trait.

D The white-eyed offspring resulted from careless procedures used during the experiment.

9 Which of these is an active region of DNA?

A a cell

* **B** a gene

C a gamete

D a chromosome

10 Variation is important to the survival of any species. Which of the following processes BEST ensures variation from generation to generation?

* **A** meiosis

B mitosis

C cellular replication

D cellular respiration

STANDARD V: The student will understand concepts of cells.

OBJECTIVE

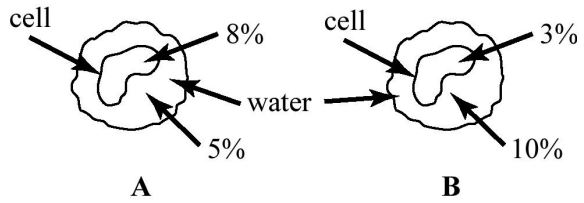
1. Distinguish relationships among cell structures, functions, and organization in living organisms.

ELIGIBLE CONTENT

- Define and identify representations of diffusion and osmotic systems and what substances are transported by these processes—may include graphic representations.
- Recognize differences between active and passive transport of substances and the energy requirements associated with these transport systems.
- Identify and define similarities and differences between plant and animal cells.
- Classify organisms as prokaryotic or eukaryotic; identify and define similarities and differences between prokaryotic and eukaryotic cells.
- Describe cell locomotion by means of cilia and flagella and recognize some organisms that depend on one or the other of these means of locomotion.
- Identify cell organelles and define functions of cell organelles—may include graphic representations.
- Distinguish and identify examples of cellular organization at the cell, tissue, organ, system, and organism level.

SAMPLE ITEMS

1 The percentages in these diagrams show the concentration of salt in two cells and in the water around each cell.



What will happen in cell A and cell B?

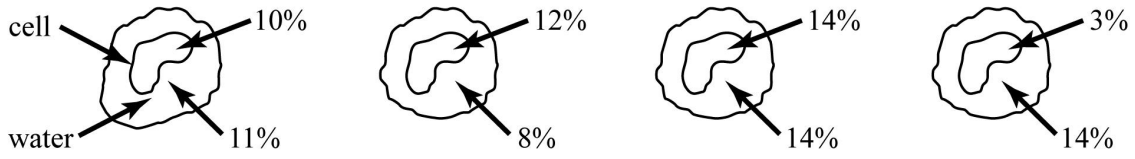
A Water will leave cell A and water will enter cell B.

* **B** Water will enter cell A and water will leave cell B.

C Water will leave both cells A and B.

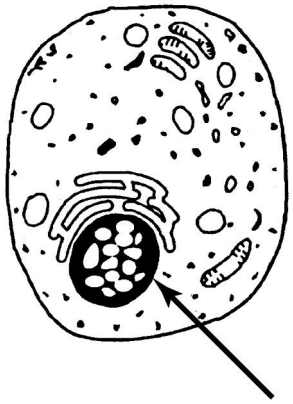
D Water will leave cell A but will remain unchanged in cell B.

2 The percentages in these diagrams show the concentration of salt in four cells and in the water around each cell. In which diagram will water enter the cell?



A * **B** **C** **D**

3 Study the drawing below.



What is the arrow pointing to in this drawing?

A vacuole

* **B** nucleus

C cell membrane

D mitochondrion

4 When comparing human cells to bacteria, which of these statements is true?

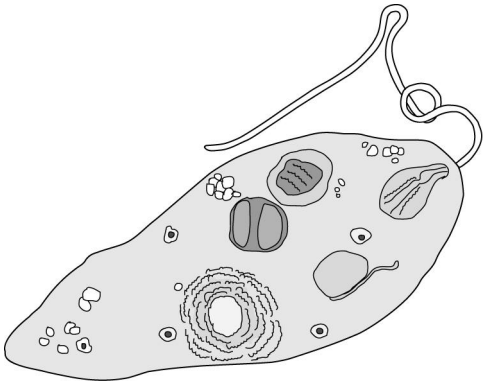
A Human cells and bacteria both have nuclei.

B Human cells and bacteria both have cell walls.

* **C** Human cells have membrane-bound nuclei; bacteria do not.

D Human cells do not have membrane-bound nuclei; bacteria do.

5 Study the picture below.



The part of this euglena that enables it to move is its

* **A** flagella

B cytoplasm

C cilia

D contractile vacuole

6 Cellulose fibers are present in

A both plant and animal cells

B neither plant nor animal cells

C animal cells but not plant cells

* **D** plant cells but not animal cells

7 If a blood cell is placed in pure water it will die because

A water diffusing out will dehydrate it

* **B** water diffusing in will cause it to burst

C carbon dioxide will be unable to diffuse out

D cell organelles will diffuse through the membrane

8 Which of these are found in plant cells but not in animal cells?

A vacuoles

B ribosomes

* **C** starch grains

D mitochondria

9 Study the list below.

1. cell

2. tissue

3. organ

4. system

What is the correct order for these body structures from least inclusive to most inclusive?

A 1, 3, 4, 2

B 3, 2, 1, 4

* **C** 1, 2, 3, 4

D 4, 3, 2, 1

10 The difference between a eukaryotic and a prokaryotic organism is in its

A function

B environment

* **C** cell structure

D feeding habits

11 A cell with a low concentration of iodine is placed into a water solution with a high concentration of iodine. Which of these should occur?

* **A** Iodine will move into the cell, increasing the solution concentration inside the cell.

B Iodine will move out of the cell, decreasing the solution concentration inside the cell.

C Iodine will be produced inside the cell until concentrations are equal inside and outside the cell.

D Iodine movement is constant, and concentrations will remain the same inside and outside the cell.

12 In the lungs, oxygen is present in higher concentration in the alveoli than in the blood. Carbon dioxide is present in higher concentration in the blood than in the alveoli. The exchange of oxygen and carbon dioxide between the alveoli and blood is accomplished through

A endocytosis

B exocytosis

C energy transport

* **D** passive transport

13 Which of these is NOT a characteristic of a euglena?

* **A** It has cilia.

B It is unicellular.

C It moves by means of flagella.

D It is found mostly in fresh water.

STANDARD V: The student will understand concepts of cells.

OBJECTIVE

2. Differentiate between mitosis and meiosis.

ELIGIBLE CONTENT

- Define, contrast, and compare mitosis and meiosis—may include events needed to prepare the cell for these processes.
- Describe the purpose of mitotic and meiotic divisions during different life stages of organisms—such as asexual and sexual reproduction and growth and repair.

SAMPLE ITEMS

1 The process of meiosis

A creates only two cells

B makes diploid cells

C is used for asexual reproduction

* **D** makes haploid cells

2 The action of meiotic cell division in a human can

* **A** determine sex-related traits in an offspring

B increase by one-half the number of genes in an offspring' s cells

C reduce by one-half the number of genes in an offspring

D double the number of chromosomes in an offspring' s cells

3 Which of these produces spores by sexual reproduction?

A mitosis

* **B** meiosis

C symbiosis

D transpiration

4 Which of these is NOT true about meiosis?

A disjunction occurs

B crossing over occurs

C chromosomes separate twice

* **D** chromosomes separate only once

STANDARD VI: The student will understand concepts of interdependence.

OBJECTIVE

1. Demonstrate an understanding of factors that affect the dynamic equilibrium of populations and ecosystems.

ELIGIBLE CONTENT

- Describe the harmful/beneficial consequences of introducing a non-native species into an ecosystem.
- Identify species that are competing for resources and predict outcomes of that competition.
- Identify and define biotic and abiotic components of different environments.
- Determine how viruses, bacteria, and parasites affect the dynamic equilibrium of populations.
- Identify human activities that affect the dynamic equilibrium of populations and ecosystems.
- Identify factors and relationships—such as predator/prey—that affect population dynamics and ecosystems.
- Explain why diversity within a species is important and how heritable traits ensure survival.

SAMPLE ITEMS

1 Gypsy moths in the eastern United States occasionally reproduce in large numbers and cause great damage to the hardwood forests. A certain parasitic wasp paralyzes the gypsy moth caterpillar and lays its eggs on the caterpillar' s body. After the eggs hatch, the wasp larvae eat the caterpillar. Soon, few gypsy moths remain. What does this demonstrate?

A Parasitic wasps are better adapted to their environment than the gypsy moths.

B Gypsy moths are better adapted to their environment than the parasitic wasps.

* **C** Parasitic wasps and gypsy moths represent an example of population equilibrium.

D Gypsy moths are an example of the risks of introducing non-native species into hardwood forest environments.

2 An African snail brought to Hawaii became a plant-eating pest. To control the African snails, 19 snail-eating species were imported to Hawaii from all over the world. One of the imports, the cannibal snail, has nearly destroyed the native Hawaiian tree snail population.

What is the MOST important conclusion suggested by the passage above?

A Snails eat plants.

B Snails eat each other.

C Imported species usually cannot survive.

* **D** Imported species may upset biological balances.

3 In the 1970s, it was found that small concentrations of pesticides in the water resulted in large concentrations of pesticides in organisms at the top of some food chains. The BEST explanation for this is that organisms at higher levels in a food chain

* **A** eat large numbers of organisms from lower levels

B generate more offspring

C are more sensitive to pesticides

D live longer than those at lower levels so they have more pesticide exposure

4 Which of these will happen in a forest ecosystem when the number of fungi and bacteria in the food web decreases?

A Decomposition occurs at a faster rate.

* **B** Fewer nutrients are returned to the soil.

C More matter cycles through the ecosystem.

D The amount of energy in the ecosystem increases.

5 In cold, hard winters when prey are diminished, only the best-adapted wolves are able to obtain food and live to reproduce. This illustrates which of the following concepts?

* **A** The fitness of an organism will determine its survival.

B Living organisms are necessary to produce other living organisms.

C The physical traits of an individual can be transmitted to its offspring.

D Organisms that migrate to new environments are less likely to survive.

6 An ecological system is best defined as

A a large region of Earth that has similar kinds of organisms

B a classification system that groups living things according to common characteristics

C a theory that attempts to explain how groups of organisms change to become better suited to their environment

* **D** a combination of living and nonliving parts of an environment that is self-supporting when considered as a whole

7 A sharp drop in the numbers of one consumer population in an ecosystem would most likely be caused by a

A falling birth rate

* **B** bacterial disease

C change in eating habits

D decrease in secondary consumers

8 Which of these is NOT an inherited trait that could help a species survive over time?

A the shape of a finch' s beak

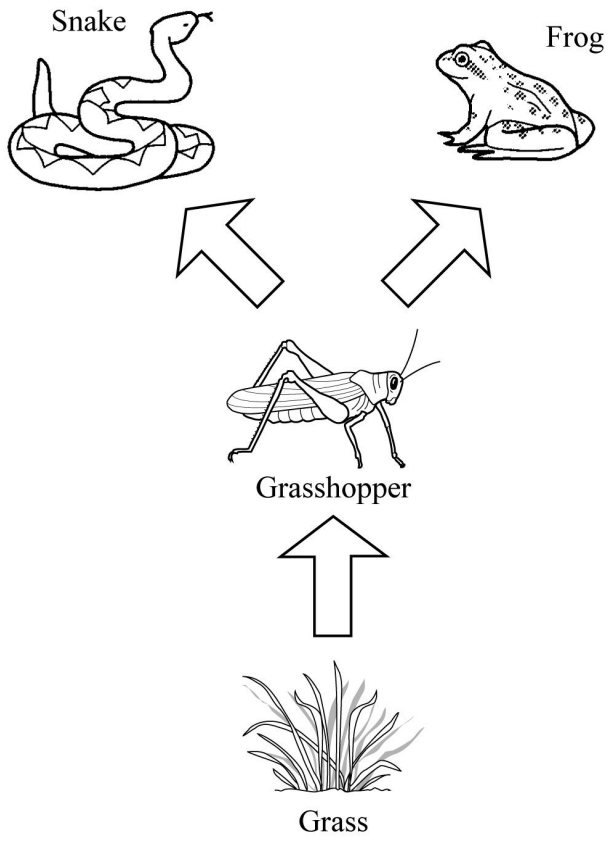
B the thickness of a bear' s fur

C a rabbit' s instinct for avoiding predators

* **D** a human' s resistance to disease by vaccination

9 Read the paragraph and study the drawing below.

Grasshoppers feed off plants and may eventually kill them. Snakes and frogs eat grasshoppers to survive. A farmer is growing crops and has grasshoppers, snakes, and frogs living among these crops.



If the population of frogs doubles, which of the following will probably happen?

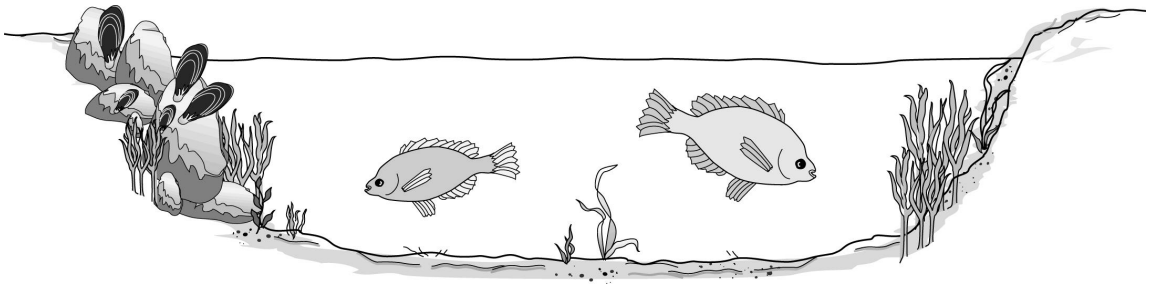
A The population of grasshoppers will increase.

* **B** The population of grasshoppers will decrease.

C The population of grasshoppers will remain the same.

D The populations of grasshoppers and snakes will increase.

10 Study the picture below.



Which of these is NOT a biotic factor of a marine environment?

A fish

B seaweed

* **C** water

D mussels

11 Which of these factors is the MOST important in limiting plant growth under the canopy of a tropical rain forest?

* **A** light

B fungi

C water

D insects

STANDARD VII: The student will understand concepts of energy.

OBJECTIVE

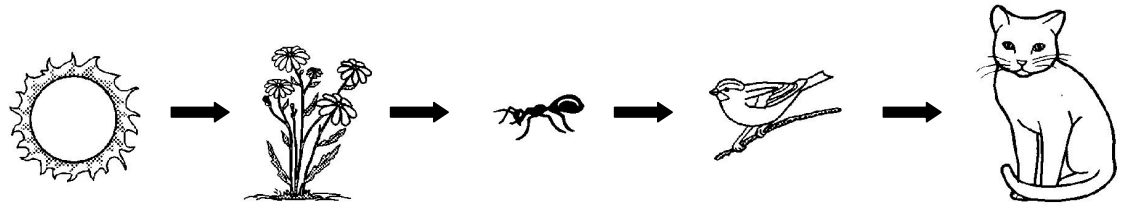
1. Relate the Law of Conservation of Energy to energy transformations.

ELIGIBLE CONTENT

- Describe how energy—mechanical, electrical, chemical, light, sound, and heat—can be transformed from one form to another.
- Show understanding that energy transformations result in no net gain or loss of energy, but that in energy conversions less energy is available due to heat loss during the transformations.
- Apply the concept of conservation and transformation of energy within and between organisms and the environment—such as food chains, food webs, and energy pyramids.

SAMPLE ITEMS

1 Study the food chain below.



The relationship between the energy emitted by the sun and the energy received by the cat in this system is

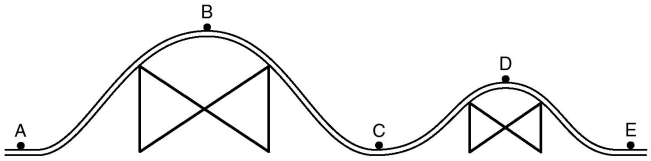
A the cat receives the same amount of energy that was emitted by the sun

B none of the energy emitted by the sun will be transmitted through the food chain to reach the cat

* **C** the sun emits more energy than is transmitted through the food chain, but the cat receives some energy

D the cat receives more energy than the energy emitted by the sun because the amount of energy increases as it moves through the food chain

Use the diagram below to answer Numbers 2 and 3.



2 A roller coaster starts at point A and is pulled to a stop at point B, where it falls freely toward point C. At what point on the track will the roller coaster have the GREATEST potential energy?

A point A

* **B** point B

C point C

D point D

3 A roller coaster starts at point A and is pulled to a stop at point B, where it falls freely toward point C. Which equation correctly describes the transformation of the roller coaster' s energy from point C to point D?

A kinetic energy at point C = potential energy at point D

B potential energy at point C = potential energy at point D

* **C** kinetic energy at point C = potential energy at point D + heat

D potential energy at point C + heat = kinetic energy at point D

4 All food chains involve the transfer of energy from one level to another. The organisms at each level store energy. The organisms at the level which store the greatest amount of energy are

* **A** producers

B herbivores

C carnivores

D decomposers

5 In all ecosystems there are fewer organisms at the top of a food pyramid than at the bottom. For example, fewer hawks than mice inhabit wildlife areas. Why is this the case?

* **A** Only a small percentage of the consumer' s food is stored as living tissue.

B Producers depend on a wider variety of food sources for their nutrition.

C The use of pesticides has caused more of the organisms at the top to die out.

D Humans have encroached on the habitats of organisms at the top of the food pyramid.

6 Which of these processes involves the transformation of light energy into chemical energy?

A digestion

B respiration

C perspiration

* **D** photosynthesis

7 Energy is transferred through organisms in each step of a food chain. Suppose there are 5000 calories available at the producer level in a food chain. Only approximately 10% of the energy from one level can be utilized by the next level. How many calories would be available for a secondary consumer (3^{rd} level)?

* **A** 50

B 500

C 5000

D 50,000

8 Which of these can NOT be directly transformed into mechanical energy?

A light

* **B** matter

C sound

D electricity

9 In any energy transformation, the greatest amount of energy is lost through

* **A** heat

B light

C mechanical inefficiency

D endothermic reactions

10 Which of these energy transformations occurs when music causes the human eardrum to vibrate?

A Heat energy is converted to electrical energy.

B Kinetic energy is converted to potential energy.

* **C** Sound energy is converted to mechanical energy.

D Mechanical energy is converted to chemical energy.

STANDARD VII: The student will understand concepts of energy.

OBJECTIVE

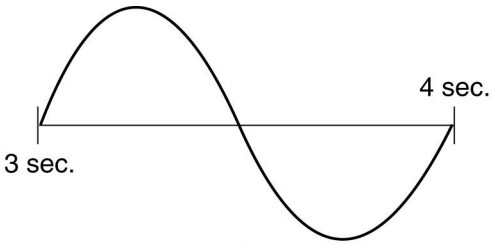
2. Relate waves to the transfer of energy.

ELIGIBLE CONTENT

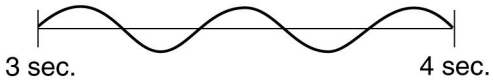
- Relate wavelength to energy.
- Describe how waves travel through different kinds of media.
- Describe how waves—earthquake waves, sound waves, water waves, and electromagnetic waves—can be destructive/beneficial due to the transfer of energy.

SAMPLE ITEMS

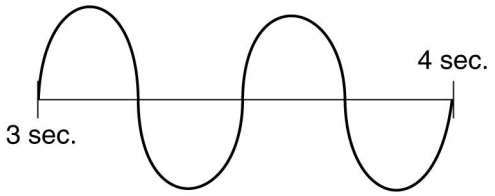
1 Which of these electromagnetic waves has the least amount of energy?



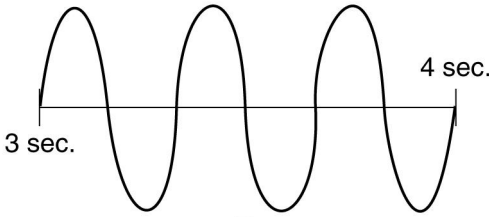
***A**



C



B



D

2 Study the table below.

Substance	Speed of Sound at 20°C
Water	1500 m/s
Iron	5130 m/s
Glass	5500 m/s
Air	344 m/s
Mercury	1407 m/s
Carbon dioxide	277 m/s

Through which of these media does sound travel the fastest?

A gas

* **B** solid

C liquid

D plasma

3 Water waves move up and down because

A their frequency is changing

* **B** energy is passing through them

C water pressure is building in them

D water molecules expand and contract

4 Which of the following BEST describes the principle by which an x-ray machine works?

A High-frequency sound waves pass through both teeth and bones.

B High-frequency sound waves pass through skin and muscle but not bones.

* **C** More electromagnetic waves pass through skin and muscle than pass through bones and teeth.

D More electromagnetic waves pass through bones and teeth than pass through skin and muscle.

5 Each of these statements about the speed of different kinds of waves is true EXCEPT that

A sound waves depend on air temperature

* **B** radio waves depend on atmospheric pressure

C water waves depend on the depth of the water

D waves in a rope depend on the tension of the rope

6 Which of these does NOT happen as a wave travels through water in the middle of a pond?

A Energy is transferred.

B A disturbance travels through the water.

* **C** The water molecules travel with the wave.

D The arrangement of water molecules changes as the wave travels.

7 At 20°C, through which of these materials does sound move the slowest?

* **A** air

B iron

C water

D alcohol

8 Electromagnetic radiation produces beneficial visible light, but it can also be destructive. High energy electromagnetic waves can burn skin or ionize water molecules. Which of these electromagnetic waves can be the MOST damaging to humans?

A x-rays

* **B** gamma rays

C infrared rays

D ultraviolet rays

STANDARD VIII: The student will understand concepts of force and motion.

OBJECTIVE

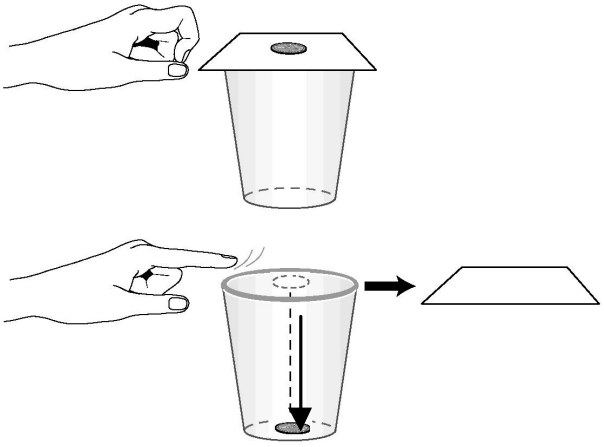
1. Relate Newton' s three laws of motion to real-world applications.

ELIGIBLE CONTENT

None specified.

SAMPLE ITEMS

1 Study the pictures below.



There is a coin on top of a piece of paper covering a glass. When the paper is quickly flicked from under the coin, the coin drops to the bottom of the glass.

Which law is demonstrated by the behavior of the coin in the pictures?

A For every action there is an equal and opposite reaction.

* **B** Objects at rest tend to remain at rest unless acted upon by an outside force.

C Energy can be changed from one form to another but cannot be made or destroyed.

D The net force applied to an object determines the rate of acceleration of that object.

2 As a football play begins, a lineman from one team pushes the opposing lineman backward. This is an example of

A a balanced force

B the force of gravity

C the force of friction

* **D** an unbalanced force

3 What property of a stalled car determines how much effort is required to move it?

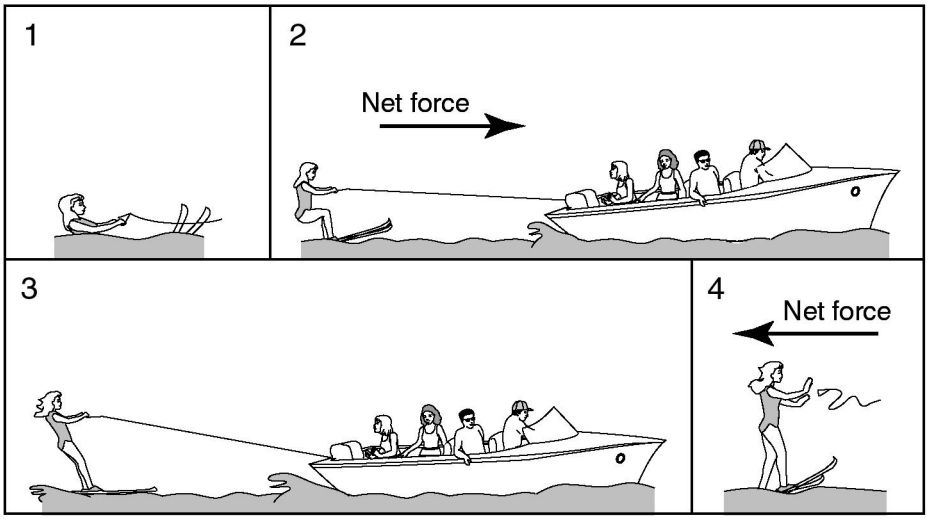
* **A** mass

B height

C volume

D density

4 The following drawing shows a water skier at different stages. Picture 1 shows the skier floating still in the water. Picture 2 shows the skier being pulled out of the water as the boat begins to move. Picture 3 shows the skier being pulled at a constant velocity. Picture 4 shows the skier letting go of the ski rope.



When does the water skier experience zero acceleration?

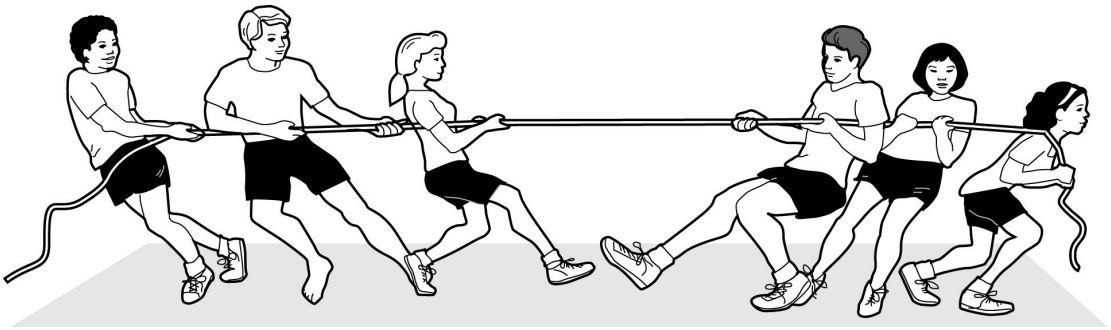
A at point 1 only

* **B** at points 1 and 3

C at point 4 only

D at points 2 and 4

5 Study the picture below.



Two groups of three people are playing a game of tug-of-war, pulling each end of a rope in opposite directions. Group X pulls with a force of 800 N in the western direction; Group Y pulls 1000 N in the eastern direction.

This tug-of-war game illustrates

A the force that gravity exerts on each group of people

B that one group of people is in equilibrium with the other

* **C** that each group of people is experiencing a form of acceleration

D the reaction forces that one group of people is exerting on the other group

6 Susie is driving along a road when a cat suddenly jumps out in front of her car. Susie slams on the brakes and lunges forward in her seatbelt.

Why did Susie lunge forward when she hit the brakes?

A The car' s momentum was transferred to Susie.

* **B** The brakes stopped the car' s inertia but not Susie' s.

C The seat of the car pushed Susie forward in the seatbelt.

D Gravity helped stop the heavy car faster than it stopped Susie.

7 A car moves along a road at a high speed. The driver pushes the gas pedal down farther, generating a forward force of 3000 N on the car. A strong gust of wind hits at the exact moment the driver pushes the gas pedal, exerting a backward force of 2500 N on the car. The road also applies a backward force of 500 N due to friction.

What is the acceleration of the car at the exact moment the gust of wind hits the car?

* **A** 0 m/s^2

B 500 m/s^2

C 2500 m/s^2

D 3000 m/s^2

STANDARD VIII: The student will understand concepts of force and motion.

OBJECTIVE

2. Relate force to pressure in fluids.

ELIGIBLE CONTENT

- Relate force to pressure in fluids. (Note: Formulas will be provided, where needed, to calculate fluid force in closed systems.)
- Apply the concept of fluid pressure to biological systems—such as in strokes, aneurysms, the bends, blood pressure, lung function, equalization of pressure on the eardrum, and turgor pressure.

SAMPLE ITEMS

1 If the turgor pressure in a plant cell is lowered, the cell will

* **A** shrink

B grow

C burst

D stay the same

2 Which of these plays a role in making it possible for water to rise 300 feet inside giant redwood trees?

A intense sunlight

B nutrient-rich soil

* **C** transpiration pull

D lack of competitors

3 Smoking and high cholesterol diets can increase the risk of atherosclerosis, which is the buildup of fatty deposits that clog the insides of arteries.

What effect could atherosclerosis have on the human circulatory system?

$$Pressure = \frac{Force}{Area}$$

* **A** increase blood pressure

B increase the inside diameter of arteries

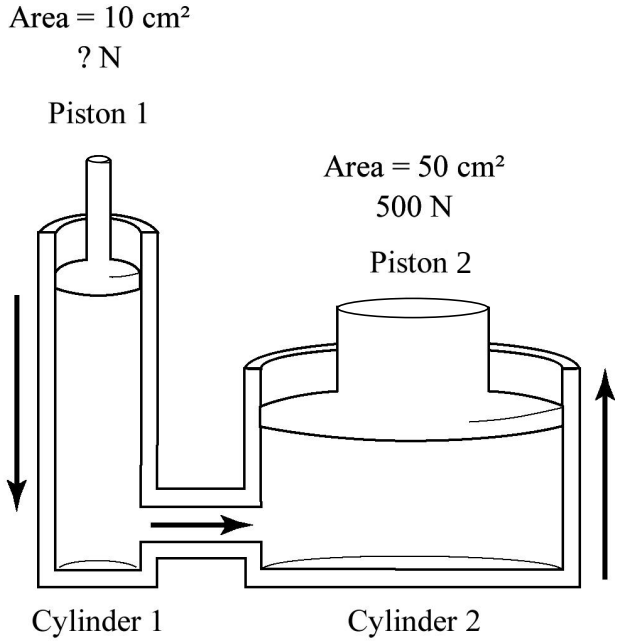
C decrease volume of blood in the body

D decrease force of blood pumped from the heart

4 Read the paragraphs and study the diagram below.

A hydraulic lift is a machine used to raise heavy loads. In this type of machine, a fluid is contained within two cylinders that are connected. The fluid can flow freely between the two cylinders. There is a piston in each cylinder that moves up and down.

In the diagram below, Cylinder 1 of the hydraulic lift has a cross-sectional area of 10 cm^2 while Cylinder 2 has a cross-sectional area of 50 cm^2. Since the cylinders are connected in a closed system, a downward force applied to Piston 1 will result in an upward force on Piston 2.



If an unknown force is applied to Piston 1, which of these statements is true?

A The pressure inside the cylinders will remain unchanged.

* **B** The pressure on Piston 1 is equal to the pressure on Piston 2.

C The pressure on Piston 2 is greater than the pressure on Piston 1.

D The force that Piston 2 applies will be smaller than the unknown force.

5 Deep sea divers may experience ear problems because as the divers descend,

A the pressure within the ear decreases to compensate for the increasing water pressure

B the pressure within the ear becomes greater than the surrounding water pressure

* **C** the surrounding water pressure becomes greater than the pressure within the ear

D the surrounding water pressure and the pressure within the ear begin to fluctuate rapidly

6 A stroke occurs when an artery in the brain becomes blocked. In the case of a stroke, the section of artery located before the point of blockage will

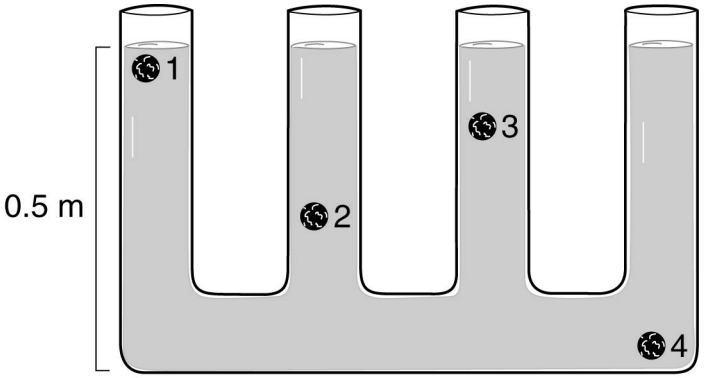
A have less blood pressure

B initiate the production of red blood cells

C initiate the production of clotting factors

* **D** have greater blood pressure

7 Study the drawing below.



Which marble is under the greatest pressure?

A marble 1

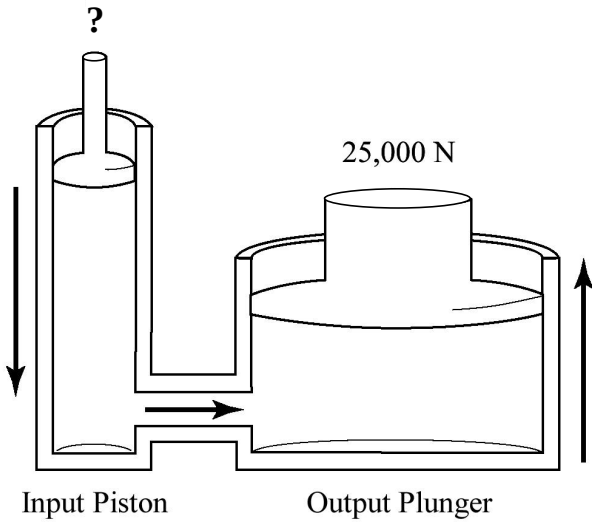
B marble 2

C marble 3

* **D** marble 4

8 Read the paragraph and study the diagram below.

In a hydraulic car lift, the Input Piston has a surface area of 0.01 m^2. The Output Plunger has a surface area of 0.5 m^2. A downward force at the Input Piston creates pressure in the fluid-filled cavity, causing an upward force on the Output Plunger.



What force must be applied to the Input Piston to generate a force of 25,000 N on the Output Plunger?

$$\frac{F_1}{F_2} = \frac{A_1}{A_2}$$

A 2.5 N

B 125 N

* **C** 500 N

D 2500 N

9 Which of these is sometimes caused by high blood pressure?

* **A** the wall of an artery dilates and forms a sac

B more blood vessels develop to supply the tissues

C oxygen-rich and oxygen-poor blood become mixed in the blood

D an increase in the total amount of fluid in the circulatory system