XII. Biology, Grade 10

Grade 10 Biology Pilot Test

The spring 2005 Grade 10 MCAS Biology Test was based on learning standards in the Biology content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2001). These learning standards appear on pages 49–51 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at www.doe.mass.edu/frameworks/scitech/2001/0501.pdf.

Because the Grade 10 Biology Test was administered as a pilot test this year, the reporting of results is limited to *Test Item Analysis Reports*. No scaled score or performance level results are available.

Test Sessions and Content Overview

The MCAS Grade 10 Biology Test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The Grade 10 Biology Test was designed to be taken without the aid of a calculator. Students were allowed to have calculators with them during testing, but calculators were not needed to answer questions. No other reference tools or materials were allowed.

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both test sessions.

Cross-Reference Information

The table at the conclusion of this chapter indicates the *Framework* learning standard that each item assesses. The correct answers for multiple-choice questions are also displayed in the table.

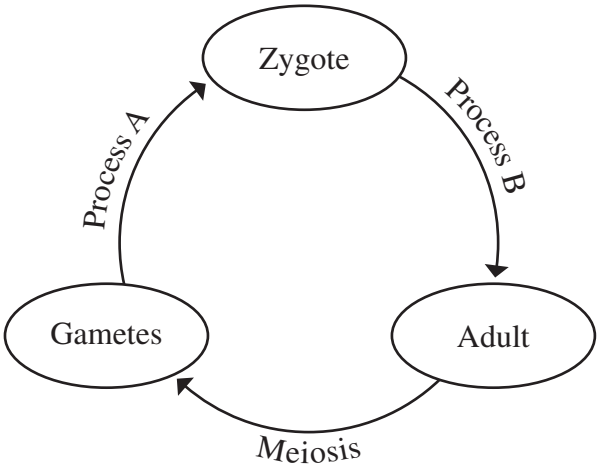
Biology

SESSION 1

DIRECTIONS

This session contains ten multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

1 The diagram below shows a generalized cycle in sexually reproducing animals.



What is Process A in this cycle?

A. fertilization

B. mitosis

C. osmosis

D. replication

2 In comparisons of the evolutionary relationships between four species of birds, which of the following would be **most** useful?

A. color of feathers

B. gene sequences

C. nesting behaviors

D. patterns of migration

3 Genetic information for a breed of chicken is shown below.

Frizzle Fowl 

Types of Chickens with Different Feathers	
Genotype	**Phenotype**
FF	Normal (Normal feathers)
Ff	Frizzle fowl (Curly feathers)
ff	Feather shedder (Loses feathers easily)

Which of the following crosses of chickens will produce **only** Frizzle fowl offspring?

A. Normal × Frizzle fowl

B. Frizzle fowl × Frizzle fowl

C. Normal × Feather shedder

D. Feather shedder × Feather shedder

4 Plants use many gallons of water every day. Almost all of the water used by plants is absorbed through the roots. Water leaves plants by which process?

A. infiltration

B. precipitation

C. runoff

D. transpiration

5 The table below shows the elemental composition of three different types of organisms.

Elemental Composition of Selected Organisms (percent by weight)

Element	Human	Alfalfa	*E. coli* Bacterium
O	65.0	77.9	73.7
C	18.5	11.3	12.1
H	9.5	8.7	9.9
X	3.3	0.8	3.0
P	1.0	0.7	0.6
S	0.3	0.1	0.3
Total	97.6%	99.5%	99.6%

The X in the table represents which of the following elements?

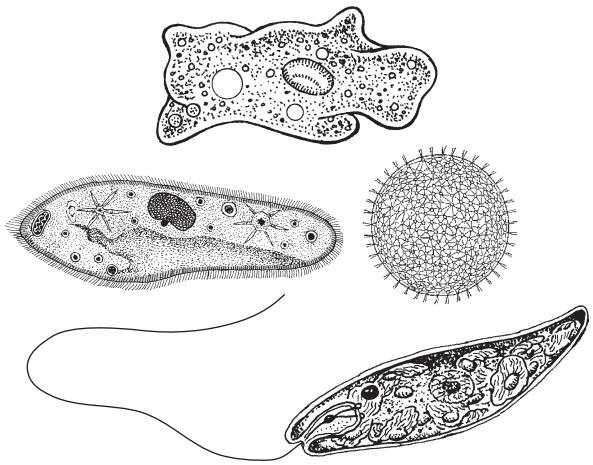
A. calcium (Ca)

B. iron (Fe)

C. nitrogen (N)

D. sodium (Na)

6 The diverse organisms shown in the diagram below belong to the same Kingdom.



To which Kingdom do these organisms belong?

A. Animalia

B. Fungi

C. Plantae

D. Protista

7 Along the Pacific coast of North America, there are at least seven subspecies of *Ensatina eschscholtzii* salamanders. All of them descended from a common ancestral population. As the species spread, subpopulations adapted to their local environments.

Which of the following **must** have increased as a result of these adaptations?

A. the number of chromosomes in each salamander

B. the size of each salamander in the total population

C. the biodiversity of the total salamander population

D. the number of offspring produced by each salamander

Question 8 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 8 in the space provided in your Student Answer Booklet.

8 The box below shows a list of supplies that are available in a laboratory.

- four flasks with stoppers
- floodlight
- tap water
- graduated cylinders
- small aquarium plants
- four small fish
- bromthymol blue (a chemical indicator that changes color from blue to yellow as the level of carbon dioxide in a solution increases)

The class sets up an experiment with the four flasks as shown.

Flask 1: 100 mL water, 1 mL bromthymol blue, plant
Flask 2: 100 mL water, 1 mL bromthymol blue, 2 small fish
Flask 3: 100 mL water, 1 mL bromthymol blue, 2 small fish, plant
Flask 4: 100 mL water, 1 mL bromthymol blue

Flask 1 Flask 2 Flask 3 Flask 4

All four flasks are stoppered and placed under the floodlight.

a. What color would the solution in **each** flask be after a few hours?

b. Explain how the processes that have occurred in **each** flask result in the observed color of the bromthymol blue solutions.

Mark your answers to multiple-choice questions 9 through 11 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

9 DNA and RNA are similar because they both contain

A. deoxyribose.

B. nucleotides.

C. thymine.

D. double helices.

10 Four students attempted to classify organisms into the Plant and Animal Kingdoms. Their classifications are shown in the table below.

	Plants	**Animals**
Student 1	Eukaryotic cells	Prokaryotic cells
Student 2	Multicellular	Unicellular
Student 3	Cells have cell walls	Cells do not have cell walls
Student 4	Heterotrophic by absorption	Heterotrophic by ingestion

Which student's classification correctly separates organisms into these two Kingdoms?

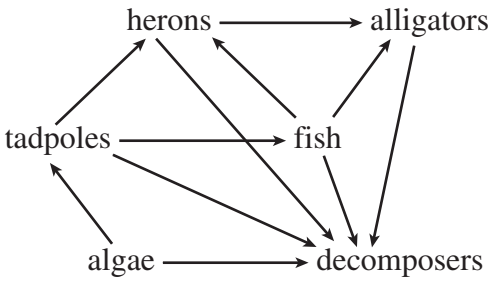
A. Student 1

B. Student 2

C. Student 3

D. Student 4

11 The diagram below shows a food web.



Which population would **probably** increase if the tadpole population decreased?

A. herons

B. alligators

C. fish

D. algae

Biology

SESSION 2

DIRECTIONS

This session contains ten multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

12 Many animals have internal or external skeletons that provide support and structure. Which of the following parts of plant cells play a similar role?

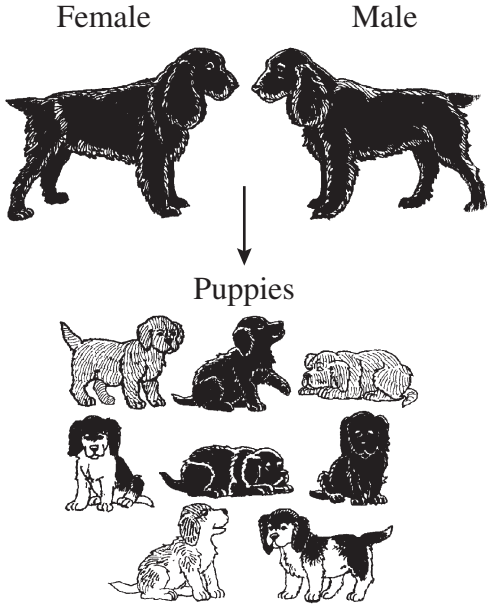
A. cell membranes

B. cell walls

C. chloroplasts

D. cytoplasm

13 The picture below shows two dogs and their puppies.



The parent dogs are each heterozygous for two traits: fur color and white spotting. Both parent dogs are solid black. Their puppies, however, have four different phenotypes as listed below.

- solid black
- black with white spots
- solid red
- red with white spots

Which of the following explains how these parent dogs can produce puppies with these four phenotypes?

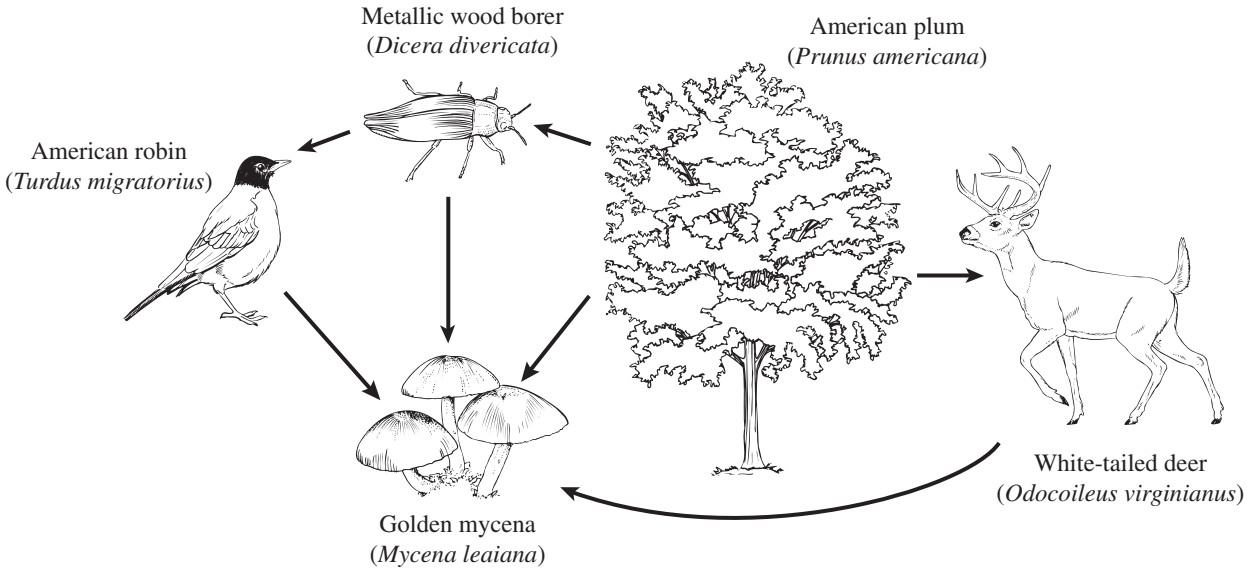
A. The genes for these traits are sex-linked.

B. The genes for these traits mutate frequently.

C. The genes for these traits assort independently.

D. The genes for these traits are on the same chromosome.

14 A food web is shown below.



Which organism in this food web is a decomposer?

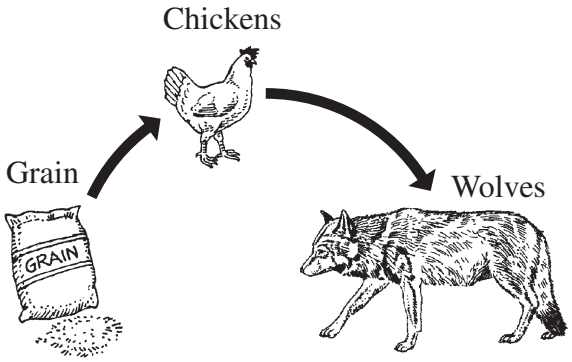
A. American plum

B. golden mycena

C. metallic wood borer

D. white-tailed deer

15 The figure below represents the flow of food energy through a system.



In an experiment, chickens were fed grain that contained a chemical marker in its proteins. The presence of the marker can be detected in organisms.

Which of the following is the **most** reasonable prediction from this experiment?

A. The marker will only be found in the grain.

B. Both chickens and wolves will have the marker.

C. Wolves will have the marker, but chickens will not.

D. The marker will only be found in the animals' wastes.

16 Cyanide is a powerful poison because it inhibits an enzyme in mitochondria, preventing the transfer of energy during one of the steps in cellular respiration. This poison would **directly** affect the production of which of the following molecules?

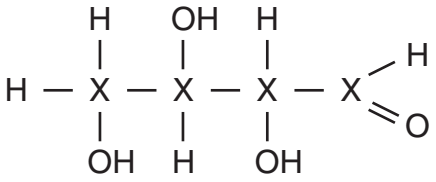
A. ATP

B. glucose

C. oxygen

D. RNA

17 The structure of an organic molecule is represented below.



In this organic molecule, which element is identified by each X?

A. iron

B. carbon

C. sodium

D. phosphorus

Question 18 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 18 in the space provided in your Student Answer Booklet.

18 The chart below shows some triplets from a DNA sequence (codons) and their corresponding amino acids.

DNA Codon	Amino Acid
AGA	Arginine
AGG	Arginine
AGC	Serine
AGT	Serine
GGA	Glycine
GGT	Glycine
GGC	Glycine
GGG	Glycine
TTG	Leucine
TGG	Tryptophan
TCG	Serine
TCT	Serine

A sequence of DNA in a gene reads **GGT TCG AGA**.

a. What is the sequence of amino acids that is produced when this gene is translated?

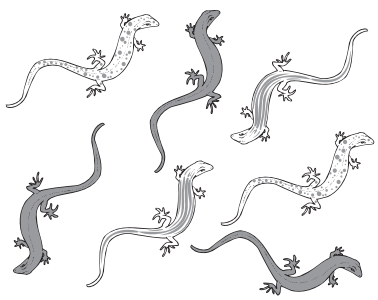
b. If the DNA is mutated to read **GGT TGG AGC**, what will the sequence of amino acids be?

c. Rewrite the original DNA sequence with a single mutation that would **not** change the sequence of amino acids.

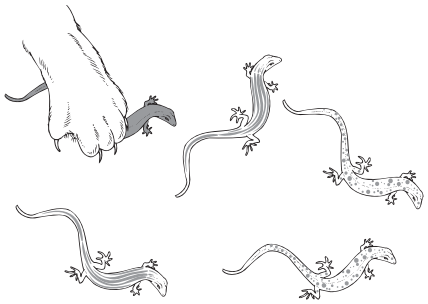
d. Explain how a mutation can change the DNA but not change the amino acid sequence.

Mark your answers to multiple-choice questions 19 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

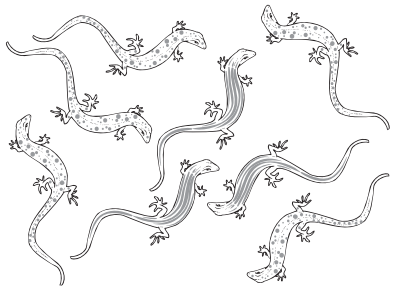
19 The diagrams below show changes in a desert lizard population.



1. Population with variety of inherited traits



2. Predation of individuals with particular traits



3. Reproduction of survivors

Which biological concept is illustrated?

A. polygenic traits

B. natural selection

C. sex-linked inheritance

D. silent mutations

20 Which of the following is an example of a prokaryotic organism?

A. bacterium

B. celery

C. horse

D. mushroom

21 The natural cycling of oxygen between organisms and their environment is **most** directly accomplished through which of the following pairs of processes?

A. fermentation and oxidation

B. transpiration and evaporation

C. precipitation and condensation

D. photosynthesis and respiration

22 The reaction catalyzed by the bacterial enzyme ß-galactosidase forms a dark-colored end-product when the cells are grown on a particular agar medium. As more product is formed, the cells become darker.

Students performed an experiment to determine the optimum pH for activity of this enzyme. Their results are shown in the illustration of bacterial colonies below.

Bacterial Colony Color as a Function of pH

Based on these data, the students should conclude that ß-galactosidase functions **best** at which pH?

A. 5

B. 7

C. 9

D. 11

Grade 10 Biology
Spring 2005 Released Items:
Standards and Correct Answers

Item No.	Page No.	Standard	Correct Answer (MC)*
1	275	3.8	A
2	275	5.1	B
3	276	3.7	C
4	277	6.1	D
5	277	1.2	C
6	278	5.3	D
7	278	5.2	C
8	279	2.9	
9	280	1.3	B
10	280	5.3	C
11	280	6.2	D
12	281	2.1	B
13	282	3.6	C
14	283	6.2	B
15	284	2.7	B
16	284	2.8	A
17	284	1.1	B
18	285	3.4	
19	286	5.2	B
20	287	2.2	A
21	287	6.1	D
22	287	1.5	B

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.