

MARKER CODE				



STUDENT ENROLMENT NUMBER (SEN)									

TONGA NATIONAL FORM SEVEN CERTIFICATE

2019

BIOLOGY

QUESTION AND ANSWER BOOKLET

Time allowed: 2 Hours + 15 minutes

INSTRUCTIONS:

1. Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this page.
2. This paper consists of **FOUR SECTIONS** and is out of 75 Weighted scores.

SECTIONS	TOPICS	TOTAL SKILL LEVEL
A	ANIMAL BEHAVIOUR	23
B	GENE EXPRESSION	24
C	BIOTECHNOLOGY APPLICATIONS	7
D	PROCESSES AND PATTERNS OF EVOLUTION	21
TOTAL		75

3. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
4. Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
5. If you need more spaces for answers, ask the supervisor for extra paper. Write your **Student Enrolment Number (SEN)** on each additional sheet, number the questions clearly and insert them in the appropriate places in this booklet.
6. Check that this booklet contains pages **2-23** in the correct order and that none of the pages is blank.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.

SECTION A:

ANIMAL BEHAVIOUR

QUESTION 1:

ECOLOGICAL NICHE

The female *Anopheles freeborni* mosquito feeds on human blood. The female mosquito feeds by piercing the skin and sucking blood through the proboscis (tube-shaped mouthpiece) and secreting saliva that contains biological substances, including anticoagulants that counteract the host's hemostatic response and prevent blood clotting during blood feeding.



Source: <https://scientistsagainstmalaria.net/vector/anopheles-freeborni>

- a. Mosquitoes have a special adaptation for feeding on human blood. Define adaptation.

Skill level 1	
1	
0	
NR	

- b. Describe the mosquito's features of physiological adaptations.

Skill level 2	
2	
1	
0	
NR	

- c. Mosquitoes have another niche in the ecosystem, which is pollinating flowers. Define ecological niche.

Skill level 1	
1	
0	
NR	

QUESTION 2: ORIENTATION AND NAVIGATION

Sharks have an acute sense of smell and a sensitive olfactory system that they can detect blood in the ocean from kilometres away. Its normal responses are to track the smell of blood.



Source: <https://www.natureaustralia.org.au/explore/australian-animals/sharks/>

1. Describe the orientation response of shark to blood in seawater.

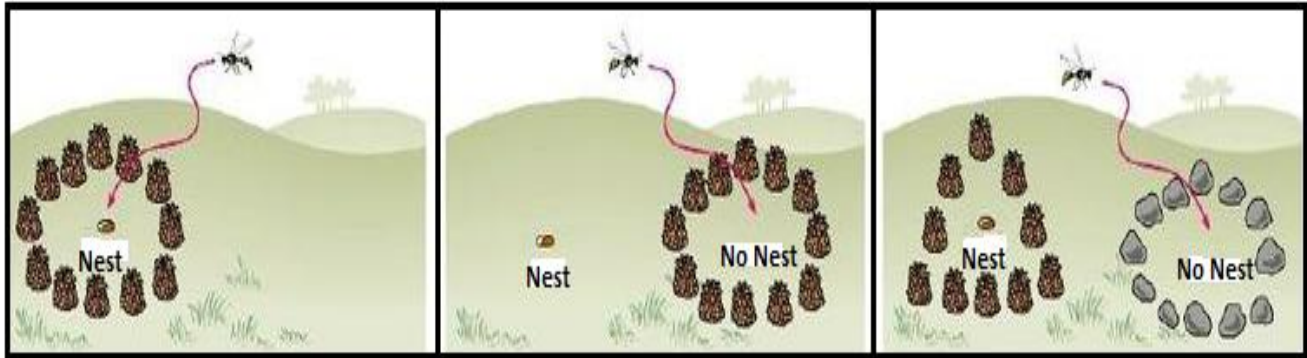
Skill level 2	
2	
1	
0	
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2. Honey bees can find an attractive flower patch located many miles away from their nest and to return to it repeatedly without missing it. They have evolved efficient strategies to recognize their food source and return to their nest successfully, as shown in **Diagram A**:

Diagram A

Diagram B

Diagram C



Source: <https://www.slideserve.com/esme/when-do-honey-bees-use-snapshots-during-navigation>

- a. Describe the navigation features of honey bees that enable them to search for food and return to their nest as shown by the diagram above.

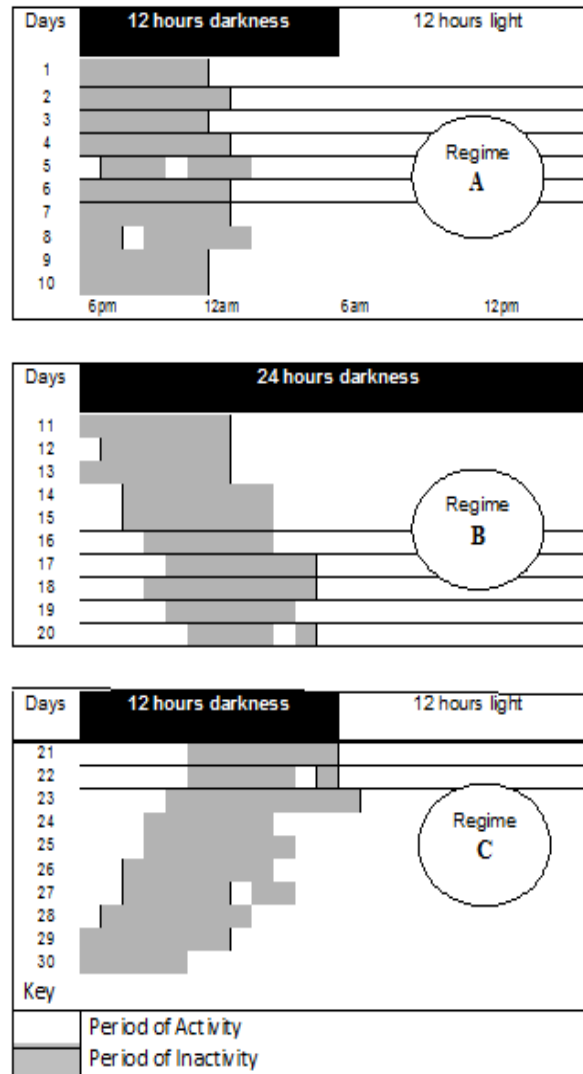
Skill level 2	
2	
1	
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NR	

- b. Discuss how honey bees use different types of navigation to gauge the direction in which to fly to reach it, and convey this information to their nest mates to build up the colony's food reserve.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 3: TIMING RESPONSES

The following actogram shows the activity of a single hunting spider kept in a cage where prey was always available. All conditions were kept constant, except light. During the 30 consecutive days of this experiment the spider was subjected to 3 different light regimes as shown:



Source: https://www.researchgate.net/figure/Representative-actogram-of-an-animal-entrained-under-LD-12-12-with-a-light-intensity-of_fig2_261629849

- a. Describe the period of rhythm and activity of the hunting spider shown by the actogram above.

Skill level 2	
2	
1	
0	
NR	

- b. Discuss how the timing responses of the hunting spider will help it to survive and thrive in its habitats.

[illegible]

Skill level 4	
4	
3	
2	
1	
0	
NR	

QUESTION 4: RESPONSES TO BIOTIC ENVIRONMENTAL FACTORS: INTRASPECIFIC AND INTERSPECIFIC INTERACTIONS.

The chicken is a social bird that enjoys the company of its flock. Chickens get its resources according to their ranking in the group called social hierarchy. Chickens peck each other to show their rank. This ordered social structure in chickens is called the Pecking Order.



Source: <https://www.backyardchickens.com/articles/a-guide-to-understanding-the-chicken-pecking-order.64752/>

- a. Explain the advantages and disadvantages of intraspecific interactions in terms of this ordered social structure in chicken.

[illegible]

Skill level 3	
3	
2	
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NR	

- b. The interaction of chickens is an example of intraspecific interaction.
Define intraspecific interactions.

Skill level 1	
1	
0	
NR	

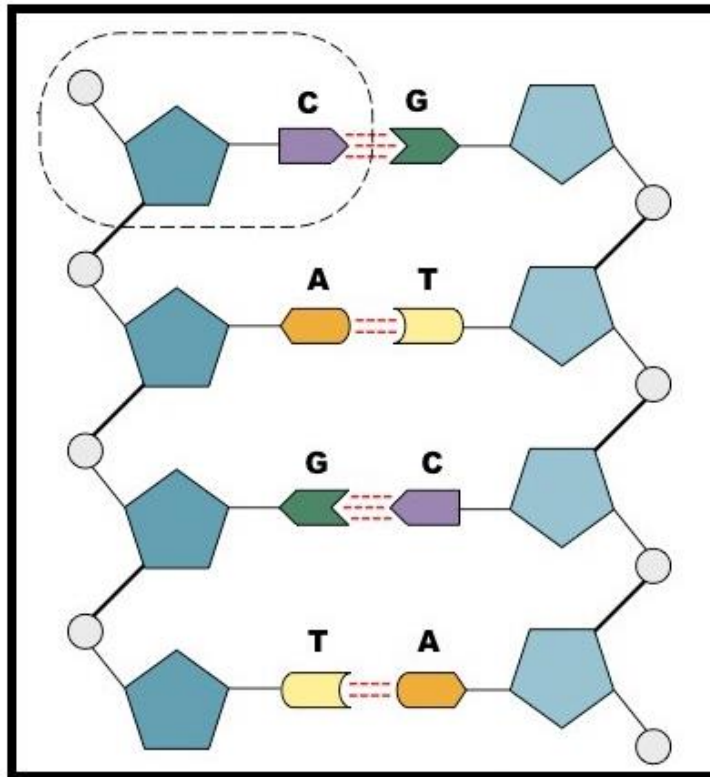
- c. Describe the reproductive behaviour of chickens.

Skill level 2	
2	
1	
0	
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SECTION B: GENE EXPRESSION

QUESTION 1: DNA STRUCTURE AND REPLICATION

The diagram below shows the structure of a DNA molecule:



Source: <https://ib.bioninja.com.au/standard-level/topic-2-molecular-biology/26-structure-of-dna-and-rna/dna-structure.html>

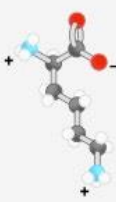
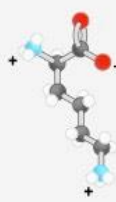
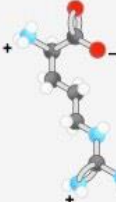
Describe the structure of the DNA molecule.

Skill level 2	
2	
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Skill level 3	
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1	
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NR	

QUESTION 3: MUTATIONS

The table below shows how a DNA code is being transcribed and translated into a protein. When a mutation occurs, it is either a silent, nonsense and missense genetic mutation. Use the information in the table below to answer the following questions:

	No mutation	Point mutations		
		Silent	Missense	Nonsense
DNA	TTC	TTT	TCC	ATC
mRNA	AAG	AAA	AGG	UAG
Protein	Lys	Lys	Arg	STOP
				

Source: https://en.wikipedia.org/wiki/Point_mutation

a. Define genetic mutation.

Skill level 1	
1	
0	
NR	

b. Describe the features of genetic mutation shown above.

Skill level 2	
2	
1	
0	
NR	

Discuss possible causes of the type of gene mutation above.

[illegible]

Skill level 3	
3	
2	
1	
0	
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QUESTION 5: GENE – GENE INTERACTION AND SEX LINKAGE

Polygenic inheritance is defined as a single characteristic being controlled by multiple genes and gives continuous variations in the phenotype such as skin colour in human. Skin colour is controlled by four separate genes, each with different alleles represented by A, a, B, b. The more melanin concentration, the darker the skin colour.

White	Light	Medium	Dark	Black
				
aabb	aaBb Aabb	AAbb AaBb aaBB	AaBB AABb	AABB

Source: <https://www.slideserve.com/kapono/human-skin-colour-an-example-of-polygeny>

- a. Describe the skin colour or phenotype produced by AABB and aabb gene – gene interaction.

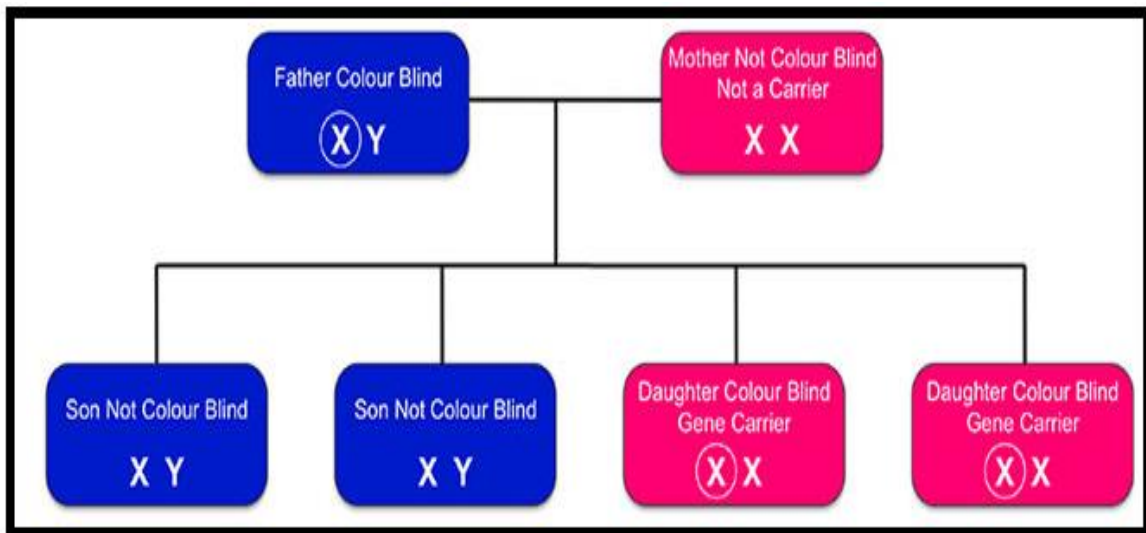
Skill level 2	
2	
1	
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NR	

- b. Fair skinned people have a stronger tendency to develop skin cancer than dark skin people.

Discuss skin cancer as a genetic and environmentally influenced disease.

Skill level 4	
4	
3	
2	
1	
0	
NR	

- c. Colour blindness is a common hereditary condition which means it is usually passed down from the parents to the offsprings. This is illustrated in the diagram below:



Source: <https://www.slideshare.net/qaisersethi9/colour-blindness-ppt-by-meera-qaiser>

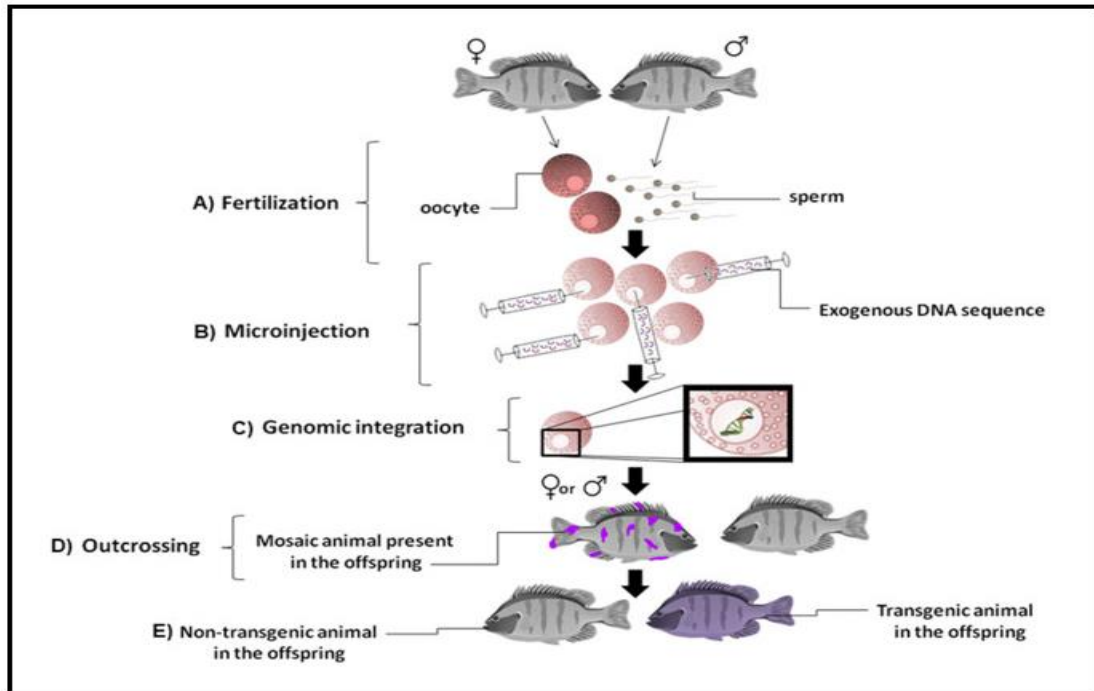
Describe the process of inheritance of red-green colour blindness illustrated in the above diagram.

Skill level 2	
2	
1	
0	
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SECTION C: BIOTECHNOLOGY APPLICATIONS

QUESTION 1: TRANS-GENESIS

The first transgenic fish was developed in 1984, and since then, continuing technological advancements to improve gene transfer have led to more rapid, accurate, and efficient generation of transgenic animals. Among the established methods of transgenesis is microinjection, as illustrated below:



Source: <https://www.sciencedirect.com/science/article/abs/pii/S0734975017300617>

a. Define trans-genesis.

Skill level 1	
1	
0	
NR	

b. Describe the process of producing transgenic fish using the pro-nuclear (micro) injection method.

Skill level 2	
2	
1	
0	
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QUESTION 2: GENE CLONING

- a. Discuss the potential advantages and disadvantages of gene cloning using the example above with sound arguments.

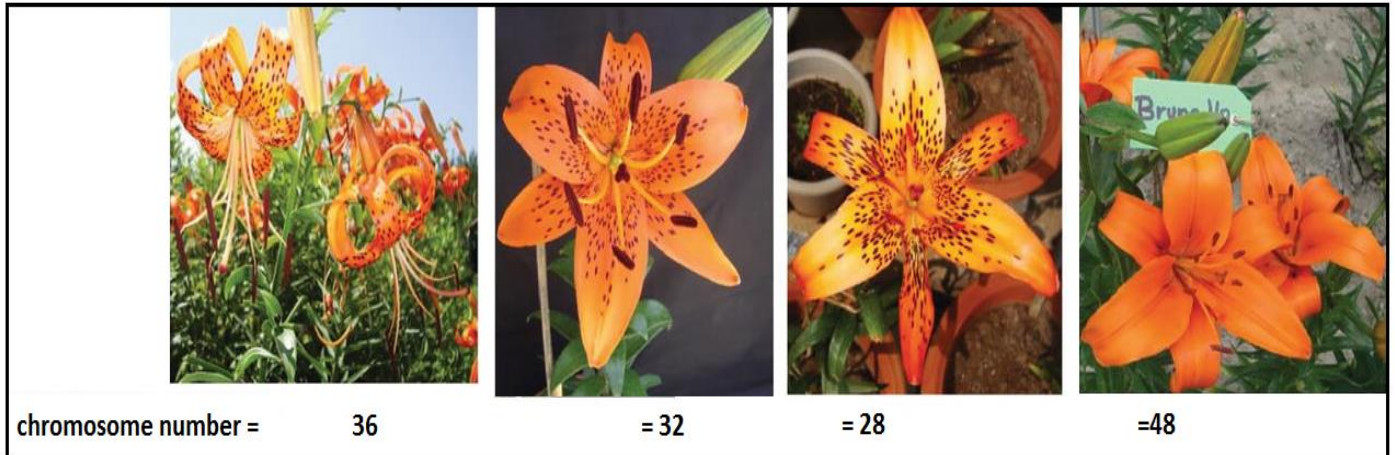
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Skill level 4	
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SECTION D: PROCESSES AND PATTERNS OF EVOLUTION

QUESTION 1: VARIATION

Lillies have 24 diploid number of chromosomes. Sometimes, through an accident in nature or human intervention, lilies have a mutation and results in 36, 32, 28 or 48 chromosomes.



Source: https://en.wikipedia.org/wiki/List_of_plant_hybrids

- a. Describe the role of mutation in producing new alleles in lilies.

Skill level 2	
2	
1	
0	
NR	

- b. Explain the possible advantages and disadvantages of mutation for producing new varieties of lilly plants.

Skill level 3	
3	
2	
1	
0	
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QUESTION 2: NATURAL SELECTION AND GENE POOL AND ALLELE FREQUENCY

In heavily polluted areas of Birmingham, United Kingdom, the melanin (black) *Biston betularia* moths shown in the diagram below, account for 87% of the population. The allele leading to melanism, B, is dominant. Use this information to answer the questions that follow:



Source: <https://forresthumphrey.wordpress.com/2014/09/20/biston-betularia/>

- a. Calculate the allele frequency of the black and non-black moths using the Hardy-Weinberg equilibrium.

Skill level 2	
2	
1	
0	
NR	

- b. Explain 'fitness' in terms of the black moths and the white moths' gene frequency.

[illegible]

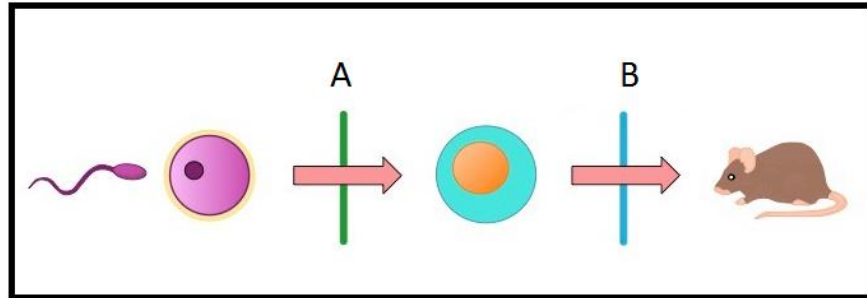
Skill level 3	
3	
2	
1	
0	
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- c. Explain how genetic drift influences changes in the population gene pool.

Skill level 3	
3	
2	
1	
0	
NR	

QUESTION 3: SPECIATION

A reproductive isolating mechanism is a barrier that prevents two organisms from differing species from mating and producing fertile offspring.



Source: <https://ib.bioninja.com.au/higher-level/topic-10-genetics-and-evolu/103-gene-pools-and-speciati/isolation-barriers.html>

- a. Identify the **TWO** (2) types of reproductive isolation mechanisms represented by labels **A** and **B**.

Skill level 1	
1	
0	
NR	

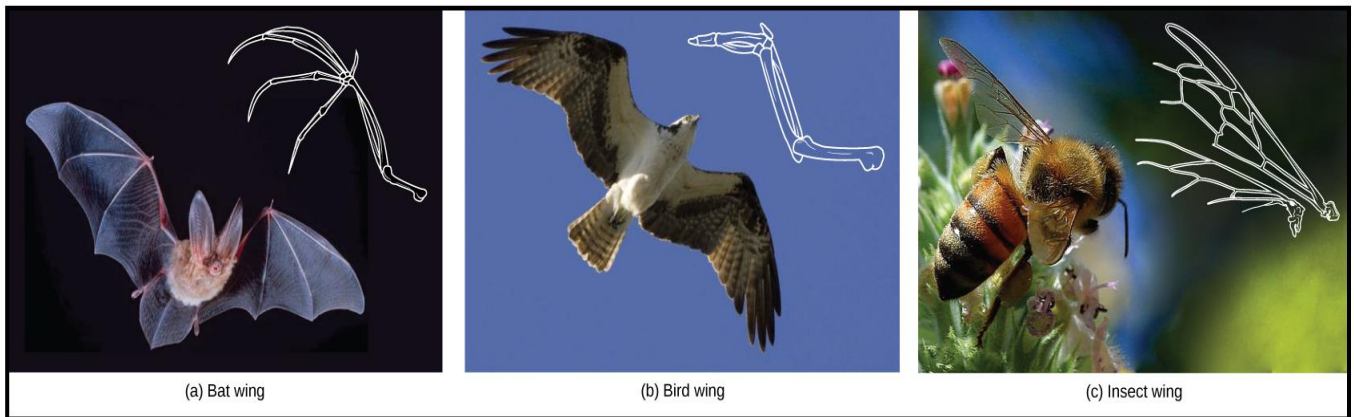
- b. Explain the effect of hybrid inviable, hybrid sterile, hybrid breakdown on post-zygotic isolating mechanism.

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Skill level 3	
3	
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QUESTION 4: PATTERNS OF EVOLUTION

Some organisms may be very closely related, however, a minor genetic change can cause a major morphological difference to make them look quite different. Similarly, unrelated organisms may be distantly related, but appear very much alike. This usually happens because both organisms have common adaptations that evolved within similar environmental conditions. When similar characteristic occur because of environmental constraints and not due to a close evolutionary relationship, it is referred to as analogous structure, as shown in the diagram below.



Source: <https://courses.lumenlearning.com/wm-biology2/chapter/homologous-and-analogous-traits/>

a. Define Analogous structures.

Skill level 1	
1	
0	
NR	

Explain how the forelimbs of bats and birds illustrate convergent evolution.

[illegible]

Skill level 3	
3	
2	
1	
0	
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