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Science

Quarter 3 – Module 7:
Occurrence of Evolution

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Science

Quarter 3 – Module 7:
Occurrence of Evolution

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

Evolution is a term used to describe the slow and gradual changes in an organism. It can be defined as change in the frequency of alleles. It is also the process through which the characteristics of a species undergo changes over several generations through the process of natural selection. In addition, evolution is the changes in an organism to suit the condition of their habitats or environment. It involves the struggle and adaptation that lead the change within the given population.

This module will help you learn the occurrence of evolution. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of learners. The learning activities are arranged to follow the standard sequence of the course.

After going through this module, you are expected to:

1. explain the occurrence of evolution (**S10LT-IIIg-40)**.

Going through this module can be a meaningful learning experience. All you need to do is make use of your time and resources efficiently. To do this, here are some tips for you:

1. **Take the pretest** before reading the rest of the module.
2. **Take time** in reading and understanding the lesson. Follow instructions carefully. Do all activities diligently. This module is designed for independent or self-paced study. It is better to be slow but sure than to hurry and miss the concepts you are supposed to learn.
3. Always **use a clean sheet of paper** for your answers in the activities or assessments. Do not forget to write your name and label them properly.
4. Try to **recall and connect the ideas** about the Earth that you had in the lower years. Use the concept discussed in the lesson to explain the results of activities or performance task. You may answer in English or a combination of your vernacular and English.
5. **Be honest.** When doing the activities, record only what you have really observed. Take the self-assessments after each activity, but do not turn to the Answer Key page unless you are done with the entire module.
6. **Do not hesitate to ask.** If you need to clarify something, approach or contact your teacher or any knowledgeable person available to help you. You may also look into other references for further information. There is a list of reference at the back part of this module.
7. **Take the posttest** prepared at the end of the module, so you can assess how much you have learned from this module.

8. You can **check your answers** in the activities, self-assessments, and posttest after you finished the entire module to know how much you have gained from the lesson and the activities.

Before you proceed in studying this module, let us check how much do you know about this topic. Answer the pretest. Use a separate sheet for your answer. An answer key is provided at the end of the module. But do not try to look at it while answering. You can check your answer after you are done with the pretest.

What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following causes of evolution states that sexual selection is not merely by chance?
   A. Non-random mating
   B. Genetic Drift
   C. Gene Flow
   D. Mutation

2. What is genetic drift?
   A. The formation of new species.
   B. A change in gene pool due to chance alone.
   C. Any change in the structure of chromosomes and gene composition.
   D. The migration of individuals from one population to another.

3. During the process of speciation, a species is first isolated _____.
   A. genetically
   B. behaviorally
   C. geographically
   D. reproductively

4. The following are statements that describe Darwin's theory of natural selection **except_____.**
   A. Members of a population will compete.
   B. Populations tend to reproduce in small numbers.
   C. Members of a population have heritable variations.
   D. Some members of a population have adaptive traits.

5. Which of the following mechanisms will cause the gene pool of two populations to change?
   A. Mutation
   B. Gene Flow
   C. Genetic Drift
   D. Natural Selection

6. Which of the following describes mutation?
   A. A result of inbreeding.
   B. Any change in the structure of chromosomes.
   C. Change in gene pool due to migration.
   D. Differential survival and reproduction of organisms.

7. What agent of evolutionary change can result to a population with limited variation due entirely to chance?
   A. Mutation
   B. Gene flow
   C. Genetic drift
   D. Inbreeding

8. What do you call the process that results to the formation of new species because of evolution?
   A. Speciation
   B. Mutation
   C. Reproduction
   D. Migration

9. Who is the first evolutionist to believe that organisms change?
   A. Jean Baptiste de Lamarck
   B. Richard Dawkins
   C. Charles Darwin
   D. Steve Jones

10. It is commonly observed in plants and in some kinds of animals and a very good example of non-random mating.
   A. Genetic drift
   B. Inbreeding
   C. Gene flow
   D. Mutation

11. It is a rare genetic **disorder** characterized by short limb dwarfism, additional fingers and/or toes, abnormal development of fingernails.
   A. Ellis-van Creveld Syndrome
   B. Gigantism
   C. Shortness
   D. Polydactyly

12. The temporary movement of organisms to other geographic locations that allows for interbreeding is referred to as _____.
    A. Genetic drift
    B. Inbreeding
    C. Gene flow
    D. Mutation

13. It refers to the group of organisms interbreeding successfully and producing fertile offspring.
    A. Animals
    B. Species
    C. Human
    D. Genes

14. Who suggested the Theory of Natural Selection after his voyage to the Galapagos Island aboard the HMS Beagle?
    A. Jean Baptiste de Lamarck
    B. Richard Dawkins
    C. Charles Darwin
    D. Steve Jones

15. Which of the following statements **best** explains the Theory of Natural Selection?
    A. Acquired characteristics of parents can be passed on to offspring.
    B. Organisms develop desirable structures to survive in a given environment.
    C. Organs that are not used may disappear while organs that are constantly used may develop.
    D. In nature, the organisms with desirable characteristics may survive while those with weaker traits may not as controlled by the environment.

Key to answers on page 25

How did you find the pretest? What was your score? If you got 15 items correctly, you may skip the module. But if your score is 14 and below, you must proceed with the module.

Lesson 7 Occurrence of Evolution

There are different mechanisms to explain the occurrence of evolution. These include the theories of evolution of Jean Baptiste de Lamarck and Charles Darwin and other modern theories; genetic basis for evolution which includes studies in mutation, population genetics, allele frequencies, synthetic theory and Hardy-Weinberg equilibrium and evolutionary patterns which involves migration, genetic drift, natural selection, speciation, punctuated equilibrium, convergent evolution, adaptive radiation, macroevolution, microevolution, coevolution and human evolution.

Today, the population geneticists apply the principle of genetics to determine evolutionary relationships among species. Evolution is defined by the geneticist point of view as a change in gene pool. Gene pool pertains to genetic composition of individuals in a population. (Department of Education, Project EASE Biology Module 15)

What's In

You have learned from the previous lesson how fossils records, comparative anatomy and genetic information provide evidence for evolution. Evidence of evolution are classified as direct and indirect. Direct evidence means something that can be directly observed or seen like the fossils. Indirect evidence is some things that doesn't involve actual observation of evolution, but an inference made by careful analysis that evolution has taken place. Genetics, comparative anatomy, embryology, and biogeography are examples of indirect evidence.

Notes to the Teacher

This module will provide you with information and activities that will help you understand the occurrence of evolution in our planet. It also provides enrichment activities and assessments for the learners. The facilitator will assist and guide the learner as he go through the module.

Activity 1: Let us recall It! Complete Me

Direction: Supply the missing letters to identify a term related to evidence of evolution.

1. D _ R _ C _ - An evidence is something that can be directly observed or seen.
2. F _ SS _ L_ - These are the remains or impression left by an animal or by plants preserved in the earth's crust.
3. I_DI_EC_ - An evidence is something that does not involve actual observation of evolution but for which we can infer that evolution has taken place.
4. HOM_LO_OU_ - Structures suggesting similar ancestors of different species irrespective of their appearance or functions.
5. AN_L_GO_S - Structures which have similar appearance but originates from different ancestors.
6. VE_TIGI_L - Anatomical features or parts that are usually reduced or with little to no function in some organisms.
7. D_RW_N - He believed that the group of animals in each island is adapted to a different way of life.
8. NOT_CH_R_ - The supporting dorsal rod of vertebrates.
9. PR_MA_ES - Species who have hands capable of grasping objects.
10. E_BR_O - It is an early stage of development in an organism.

Key to answers on page 25

What's New

Activity 2: Bottlecap *EVOchallenge*

Part 1 Natural Selection

What you need:

50 pieces of bottlecap with same size (plastic cap or *tansan*) properly labelled with color (pink, green, yellow, blue, and white) which represent the original population
(10 pieces each color)
2 Bowls
Fabric or handkerchief (big)
Timer

Caution: Be careful in doing the bottlecap *EVOchallenge* activity.

What you must do:

1. Get a piece of fabric or handkerchief and spread it out on your table. Put the bottlecap (carefully so they do not go everywhere) on your fabric. Distribute them throughout the fabric.
2. Set the timer for 10 seconds. You will act as a predator (bottlecap collectors). You will pick up one-by-one as many bottlecap as possible within 10 seconds using only one hand. Put the bottlecaps you have picked up in a bowl.
3. Carefully slide your remaining bottlecap off the fabric or handkerchief. These are your survivors! Each survivor will have one offspring. So, count each bottlecap twice and record the data in column D on Table 1. After "reproducing", double the number of the bottlecaps. (Example: 15 bottlecaps x 2 = 30 bottlecaps). Spread all the bottlecap on your piece of fabric again.
4. Repeat step number 2.
5. Slide the remaining bottlecap off the fabric and repeat step Number 3. This is your final population after Natural selection. Fill out column E on Table 1. Calculate the percentage of survivors using your final population.

Table 1
Bottlecap Natural Selection Challenge

A	B	C	D	E	F
Color of bottlecap from original population	Number of each color from the original population	Percentage of each color from original population	Number of each color after natural selection round 1 (bottlecap left on the fabric)	Number of each color after natural selection round 2 (bottlecap left on the fabric)	Percentage of each color after natural selection (Use column E only) (No. of bottlecaps left on the fabric/total no. of bottlecap spread on the fabric after round 2) X100
Pink					
Green					
Yellow					
Blue					
White					
	Total number of bottlecap in original population = ☐	Your percentages should add up to 100%	Total number of bottlecap after natural selection = ☐	Total number of bottlecap after natural selection = ☐	Your percentages should add up to 100%

Learning Activity Questions

1.1. Based on the activity, what is natural selection?

1.2. Does the population after round 1 accurately represent the original population? Explain by citing your data.

1.3. What colors in the original population are not represented after the first and second round of natural selection simulation?

1.4. Based on the activity, how does natural selection lead to evolution?

Key to answers on page 25

Part 2 Genetic Drift Population

What you need:

- Same materials in Part 1

What you should do:

1. Pour the 50 pieces of bottlecap in a bowl which represents the original population.
2. Record the necessary information for the original population in the first two columns (A & B) of Table 1. Calculate the percentage of each color (number of color / total number of bottlecap) in column C.
3. Close your eyes and randomly pick out 15 bottlecaps from the bowl.
4. **DO NOT LOOK** at them until after you have picked the 15 bottlecaps. This represents the genetic drift population. Record all the necessary information for the genetic drift population in columns D & E in Table 1. Fill out Table 2.

Table 2

Bottlecap Genetic Drift Challenge

A	B	C	D	E
Color of bottlecap from original population	Number of each color from the original population	Percentage of each color from original population	Number of bottlecaps from each color drawn randomly	Percentage of each color from the drawn population (No. of colored bottlecaps drawn / total no. of bottlecap drawn) x 100
Pink	10	Example 10/50 x 100 = 20%		
Green				
Yellow				
Blue				
White				
	Total number of bottlecap in original population =	Your percentages should add up to 100%	Total number of bottlecap in the drawn population =	Your percentages should add up to 100%

Learning Activity Questions

2.1. Based on the activity, what is genetic drift?

2.2. Does the new population caused by random sampling accurately represent the original population? Explain by citing your data.

2.3. What colors in the original population are not represented in the new population?

2.4. When you compare the percentages of each color in the original and new population, are they the same? Explain your answer.

2.5 Based on the activity, how does genetic drift lead to evolution?

Key to answers on page 25

Part 3 Genetic Flow Population

What you need:

- Same materials in Part 1

What you should do:

1. Prepare 2 bowl. Put 30 pieces on the first bowl and the remaining 20 on the second bowl. Fill out columns A, B & C in Table 3. It should be the same information as in Table 2. You will now demonstrate gene flow.
2. Put your hand in the first bowl and grab 20 bottlecaps. Refrain from picking specific colors. Then put the 20 grabbed bottlecaps in the second bowl. (Record on a sheet of paper what colors they are so you can get them back later). Fill out Table 3.

Table 3

Bottlecap Gene Flow Challenge

A	B	C	D	E
Color of bottlecap from original population 1st bowl 2nd bowl	Number of each color from the original population 1st bowl 2nd bowl	Percentage of each color from original population = (# per color/total number of bottlecaps per bowl) x 100 1st bowl 2nd bowl	Number of each color in 2nd bowl after transfer of the 20 grabbed bottlecaps from 1st bowl	Percentage of each color in the 2nd bowl after transfer (No. of each colored bottlecaps/40) X 100
Pink				
Green				
Yellow				
Blue				
White				
	Total number of bottlecap in original population =	Your percentages should add up to 100%	Total number of bottlecap after gene flow population =	Your percentages should add up to 100%

Learning Activity Questions

3.1. Compare the percentage of each color in the 2nd bowl before and after the transfer of the grabbed bottlecaps from the 1st bowl.
3.2. Based on the activity, what is gene flow?
3.3. Do the new gene flow population (2nd bowl after transferring the grabbed bottlecaps from 1st bowl) still represent the original population? Explain by citing your data.
3.4. What colors in the original population are not represented in the gene flow population?
3.5. What are the similarities and difference of Genetic drift and Gene flow?
3.6. Based on the activity, how does gene flow lead to evolution?

Did you enjoy the activity? Why or why not?

Key to answers on page 26

What is It

As you continue reading this module, you will learn more about the mechanisms and specific conditions for evolution to occur. The occurrence could be explained through theories of evolution, genetic basis for evolution and the evolutionary patterns.

Theories of Evolution

Jean Baptiste de Lamarck, a French naturalist was the first evolutionist who believed that organisms change over time. He proposed that organism evolve in response to their environment. The word "evolve" means to change gradually. He was able to develop three theories which includes Theory of Need, Theory of Use and Disuse and Theory of Acquired Characteristics.

Theory of Need states that organisms change in response to the changes in their environment. They were able to develop characteristics necessary for them to adapt in their modified environment that leads to size increase of body parts or function changes. Another is **Theory of Use and Disuse** which shows that organs that are not used will disappear while those that are constantly used will be developed. Lamarck believed that short-necked giraffes strained their necks to reach food from trees causing their necks to become longer. The acquired long necks of these giraffes were passed on to their offspring. This also explains the **Theory of Acquired Characteristics (Traits)**.

The Theory of Evolution of Charles Darwin, in his book *On the Origins of Species by Means of Natural Selection,* published in 1859, is based on natural selection which is different from the theories of Lamarck. According to Darwin,

originally, giraffes had varying neck lengths. Natural selection favored the survival of long-necked giraffes because it allows them to reach for food on tall trees while short-necked giraffes were eliminated because of their inability to reach higher vegetation when there is scarcity of low vegetation such as grasses. This eliminated them from the population of giraffes.

Darwin suggested the Theory of Natural Selection, after his voyage to the Galapagos Island aboard the HMS Beagle. He was fascinated by the diversity of organisms he found along his journey. He observed that finches have different beak structures for various food types. The abundance of certain type of finch in an island was somehow associated with the type of available food in their habitat.

(Source: Herma D. Acosta, et al. *Science Grade 10 Learner's Material*. Pasig City, Philippines: Rex Bookstore, Inc. and Department of Education, 2015, pp. 316-318.

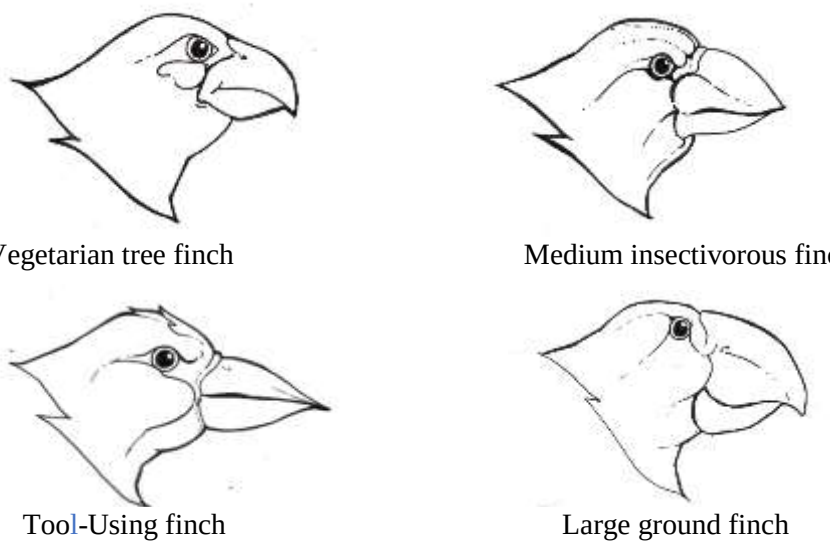


Figure 1: Different Beak Structures for Different Food Types
(Illustrator: Robinson A. Bayson)

Genetics Basis of Evolution

A. Population genetics deals with the hereditary factors affecting a population. An example of this specific condition is the **gene flow**. It could occur whether an individual migrate from one population to another or even without migration. When one migrates and interbreeds with the individuals of another population, there would be recombination of genes for different traits between the populations. It will result to an increase of variations in the population. For example, during the colonization period in the Philippines, the gene pool of the population has altered because the Spanish, American and Japanese soldiers had children with Filipino women.

B. Allele frequencies represent the fraction or percentage of the population carrying the allele. Non-random mating means that sexual selection is not merely by chance. The individual's choice of mate is influenced by some physical and

behavioral characteristics. One of the examples are white rabbits preferentially mate with rabbits of their own color. Also, some tall women prefer tall men rather than short men.

An example of non-random mating which is commonly observed in plants and in some kinds of animals is inbreeding. Inbreeding in plants is also known as self-fertilization. Animals that practice inbreeding are dogs, rats, cats, rabbits, pigs, and many other animals. It can result to a population whose members are alike in appearance, and behavior.

How does non-random mating lead to evolution? The gene pool in non-random mating rapidly shifts, so it contains only the desired alleles which can cause the population to evolve over time.

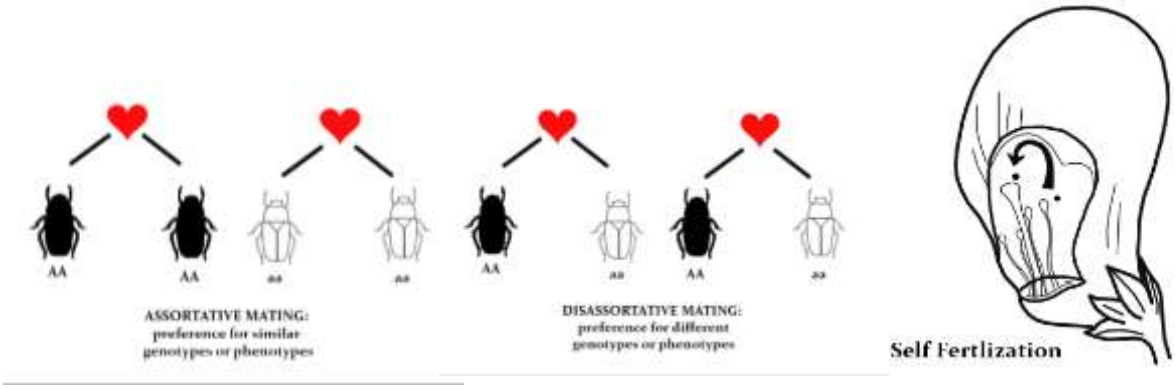


Figure 2: Non-random mating
(Illustrator: Emhil C. Medrano)

C. Synthetic theory *(neo-Darwinian synthesis)* primarily alludes to the combination of Darwin's evolution and the Mendelian principle of Genetics. It gives a better understanding of evolutionary changes through the study of genetic mechanisms and reevaluation of fossil records. It describes the evolution of life in terms of genetic changes occurring in the population that leads to the formation of new species.

D. Mutation is defined as any change in chromosomes or genes. It has two types - **gene mutations** which include changes in the genes composition or order and **chromosomal mutations** which involve changes in the structure or number of chromosomes.

How does mutation occur? It occurs because of the several mutagens like ultraviolet radiation and hazardous chemicals in the environment that can affect genes and chromosomes. As a result, the gene pool becomes different from the original population.

E. The Hardy-Weinberg equilibrium deals with the distribution of alleles within the population. It states that in stable population, allele frequencies remain constant from one generation to another if several conditions are met. **Hardy-Weinberg equilibrium** has a set of conditions that must be met for the population to have unchanging gene pool frequencies. There must be random mating, no mutation, no migration, no natural selection, and a large size.

F. Evolutionary Patterns

A. **Natural selection** wherein nature selects organisms that will or will not survive based on their existing traits. Organisms with favorable traits or those who are best suited in the environment have a better chance of survival. The survivors will pass on their favorable traits to their offspring. As the years pass by, the population will produce an organism with traits different from their ancestors.

B. **Genetic drift** is defined as a change in gene pool due to chance alone. Certain traits in the population could be reduce or eliminated through some unpredictable disasters or accidents such as earthquakes, floods, fires, and diseases. For example, a flood wiped out a population of organism, large land vertebrate animals. Though some of these animals can swim, prolonged heavy flooding could stress them out and cause death. Even when the animals have good traits adapted to their habitat, such natural calamities may affect their survival. Therefore, the survival or death in the population has nothing to do with the general structure or physiology of the organism.

It can also be observed when an insecticide kills specific insect pest. Some of the insect pest will not be affected by the insecticide and survive. The genes/traits that allowed the survival of these insect pest against the insecticide will be passed on to the next generation making them more able to survive. The success of insect pest is due to chance because they happen to have the trait to survive the specific insecticide used. Genetic drift also happens when a small population breaks off from a larger population and forms a new population. The resulting population inherits the traits of the founders, so the newly founded population becomes different from the population of origin.

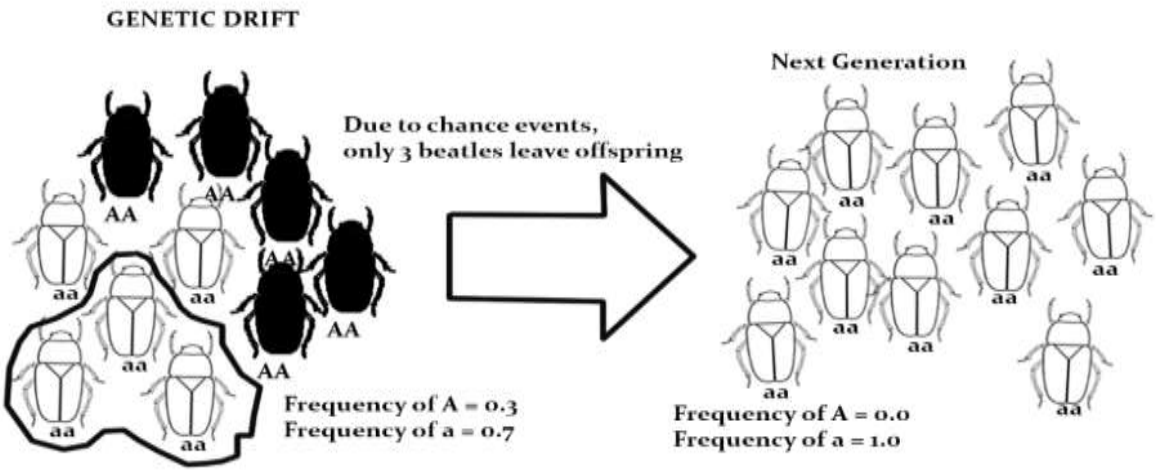
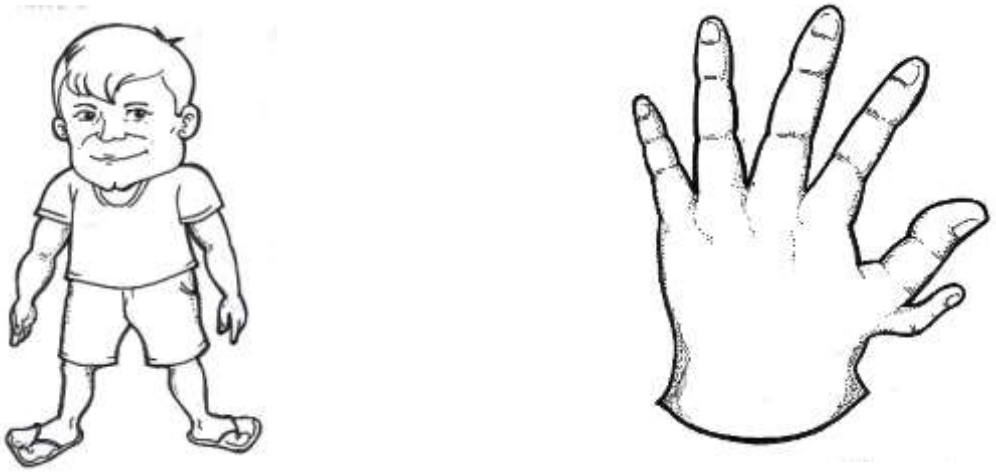


Figure 3: Genetic Drift
(Illustrator: Emhil C. Medrano)

There are some families or groups of people who isolated themselves from the surrounding populations. One example is the Amish group of Pennsylvania who carries a very rare condition known as Ellis-van Creveld Syndrome. They have an unusual dwarfism and has polydactyly or extra fingers. Today, this rare syndrome is common among the Amish group. (Department of Education, Project EASE Biology Module 15, *no publishing year indicated*)



dwarfism *polydactyly*

Figure 4: Unusual dwarfism and *polydactylism*, or extra fingers
(Illustrator: Robinson A. Bayson)

C. Speciation is a process within evolution that results in the formation of new, and distinct species that are reproductively isolated from other population when there is no gene flow. There are four types of speciation include allopatric, peripatric, parapatric and sympatric.

Term	Meaning
Allopatric (allo = other, patric = place) • geographically isolated populations	It occurs due to geographical isolation and both species evolve separately. The different development of each species was based on the demands of their unique habitat or the genetic characteristics of the group that are passed on to offspring.
Peripatric (peri = near, patric = place) • a small population isolated at the edge of a larger population	The process of speciation occurs at a small level, where geographical barriers separate the species at the periphery isolating the small population. Evolution occurs separately.

Parapatric (para = beside, patric = place) • a continuously distributed population	Species in this process of speciation spread out over a large geographic area but individuals only mate with those in their own geographic region. Also, different habitats influence the development of different species and separated by differences in the same environment, instead of being separated by a physical barrier.
Sympatric (sym = same, patric = place) • within the range of the ancestral population	Ecological differences or random genetic changes occur in a small population which reproduces and evolve within the population that of parent population. The two species evolve together without any geographical isolation.

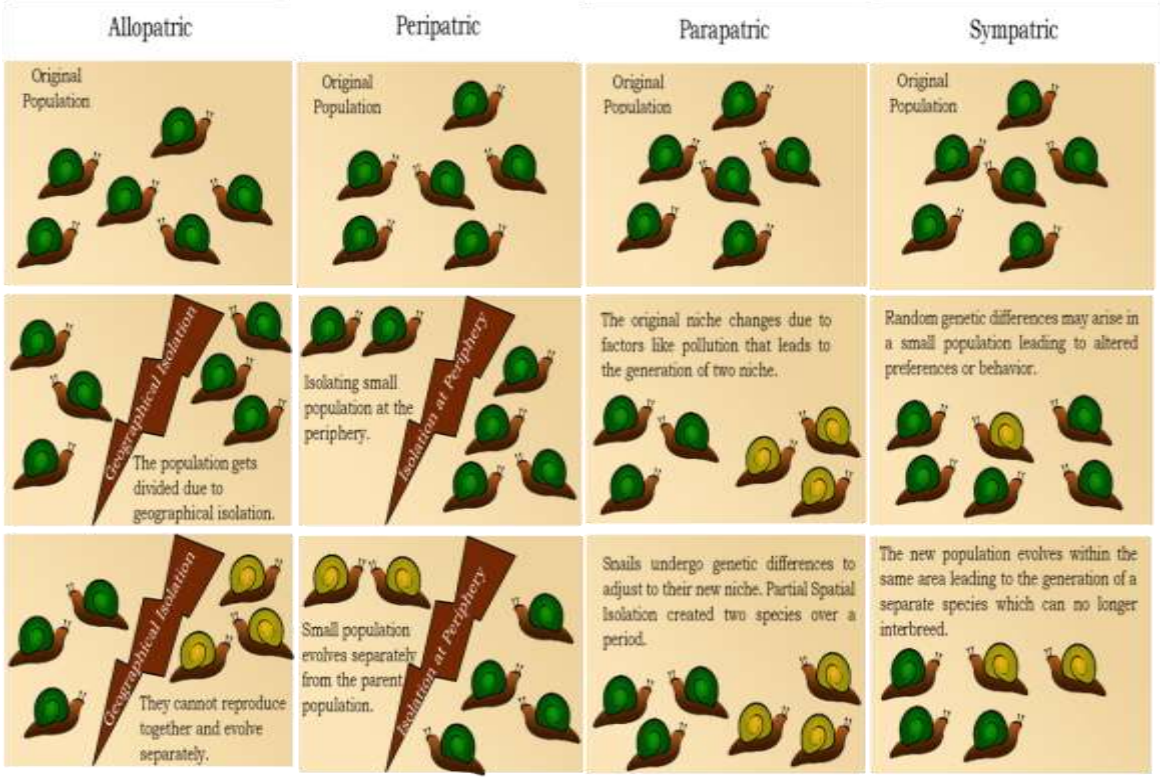


Figure 5: Speciation
(Illustrator: Emhil C. Medrano)

D. Punctuated equilibrium was proposed by Niles Eldredge and Stephen Jay Gould in 1972 and suggested that populations demonstrate rapid change when there is a need to survive sudden or abrupt environmental changes.

E. Microevolution is a changed in gene frequency that occurs within a population in short periods. Mutation, selection (natural and artificial), gene flow, and genetic drift are the different processes of this change.

F. Coevolution is the process wherein a species adapts or evolve in tandem with another species as they interact with each other. Example is the prey-predator relationship of a bat and a moth. When the moth evolves due to environmental pressures, the bat will also evolve because it has a dependent relationship with the moth as the moth's predator.

G. Convergent Evolution is the evolution of morphological similarities in organism that are not closely related because they have similarities in their habitats. An example of this is a marsupial mouse that looks like a placental mouse.

H. Adaptive Radiation is the process by which the species diversifies rapidly into different types of closely related species with, each type occupying a new environment. An example of this type of evolution is that of Darwin's finches in Galapagos Island.

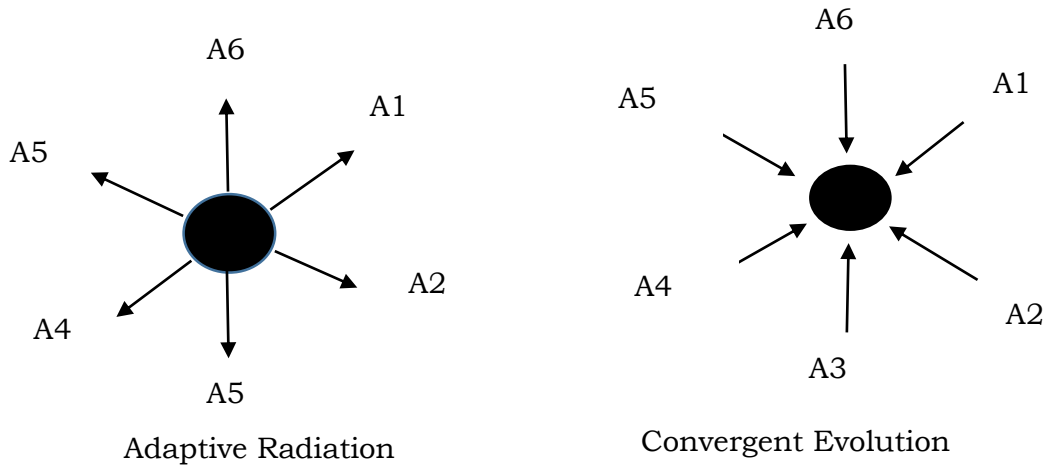
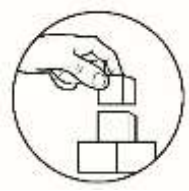


Figure 6: Diagram showing adaptive radiation and convergent evolution.

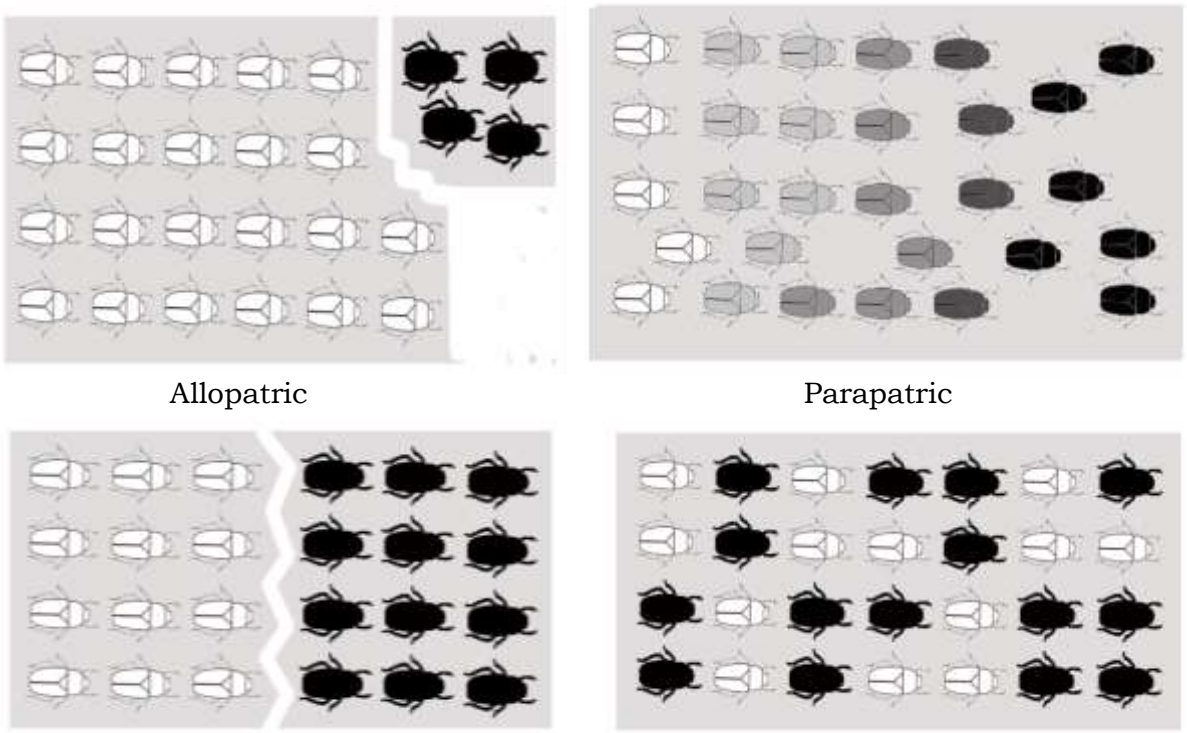


What's More

We were able to discuss the different mechanisms that explains the occurrence of evolution. This section provides you an enrichment activity that will help you to explore and understand more about the mechanisms and specific conditions for evolution to occur. Let us try to dig deeper in what you have learned from the previous discussion.

Enrichment Activity 1: Picture says a thousand Words

Direction: Study the following pictures and answer the learning activity questions.



Allopatric

Parapatric

Peripatric

Sympatric

(Illustrator: Emhil C. Medrano)

Enrichment Activity Questions

Direction: Read each item carefully. Write your answer on a clean sheet of paper.

1. What does the four pictures illustrate?
2. What happens when reproductive isolation has been established?

Key to answers on page 26

Learning Assessment 1: Match ME!

Direction**:** Match the evolutionary patterns in Column B with its description in Column A. Use a separate sheet of paper for your answers. Write only the letter of your choice.

Column A	Column B
1. It is a process within evolution that leads to the formation of new, distinct species that are reproductively isolated from one another when there is no gene flow.	a. Coevolution b. Convergent Evolution c. Genetic Drift d. Natural Selection
2. The evolution of organism, usually in morphology, that are not closely related because they have similarities in their habitats.	e. Punctuated Equilibrium f. Speciation
3. Nature selects which trait will or will not survive.	
4. It is defined as a change in gene pool due to chance alone.	
5. It is the process wherein a species adapts to ecological pressures from the other species.	

Key to answers on page 26

Enrichment Activity 2: Could I copy and paste?

Direction: Read carefully each item. Write your answer on a clean sheet of paper.

1. If a woman got pregnant and change the color of her hair from black to blond, do you think her child can inherit the blond color of her hair? Explain your answer.

2. If you a woman keeps on using whitening soap and becomes fair. Can her child inherit or acquire the fairness of her skin caused by the whitening soap? Explain your answer.

3. What traits of your parents did you inherit?

Key to answers on page 26

Learning Assessment 2: EvoWordAdventure

Direction: Complete the crossword by filling in a word that fits each clue. Use a separate sheet for your answer.

ACROSS

2 It is the transfer of genetic material from one population to another

3 It occurs when the probability that two individuals in a population will mate is not the same for all possible pairs of individuals

8 Change that occurs in the structure of chromosomes and genes

9 Change in the frequency of an allele within a population over time

DOWN

1 Nature selects organisms that will or will not survive based on their existing traits

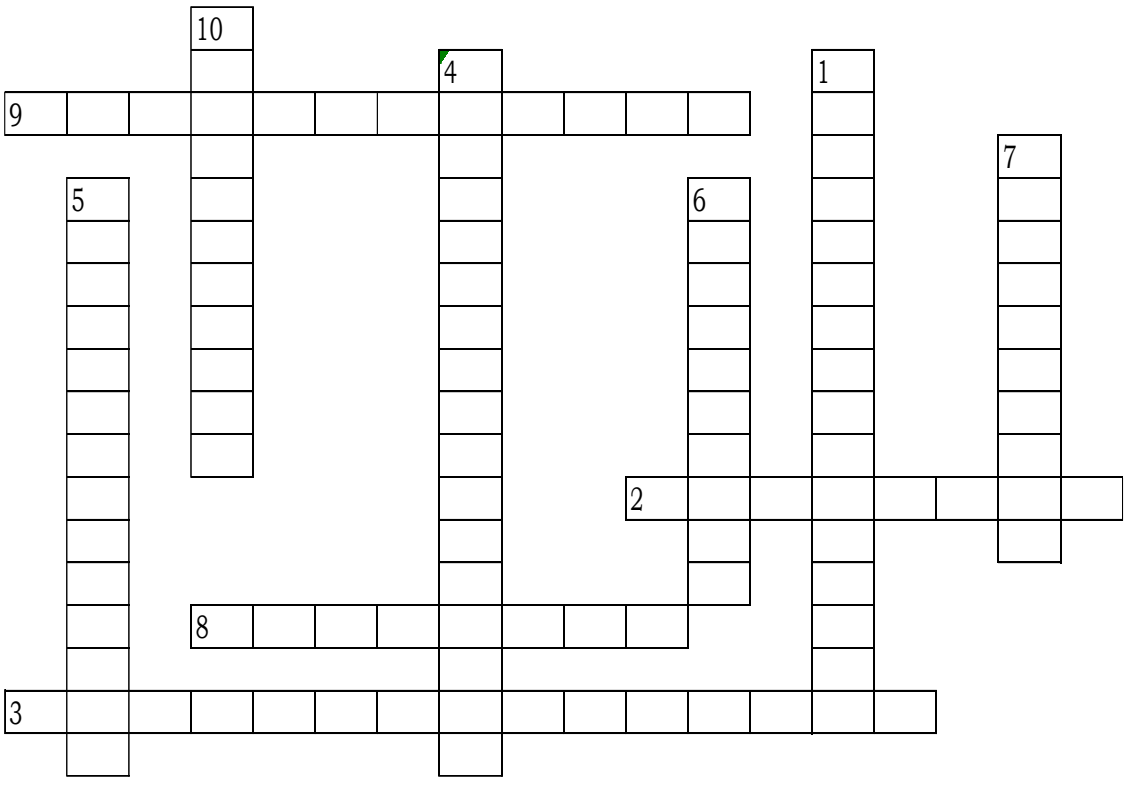
4 The process by which the species diversifies rapidly into different types of closely related species with, each type occupying a new environment.

5 Changes in gene frequency that occur within a population in short periods of time.

6 the evolution of morphological similarities in organism that are not closely related because they have similarities in their habitats

7 Evolution that leads to the formation of new species

10 The process wherein a species adapts or evolve in tandem with another species as they interact with each other



Key to answers on page 26

Enrichment Activity 3: I Will Survive!

Materials Needed

food stuff (beans, gummy bears, candies and or any food stuff available at home with different range of sizes)
large basin
chopsticks, matchsticks, popsicle sticks (any available materials that represents bird's beak)

Caution: Be careful in handling and or using the materials while doing the activity.

Procedure:

1. Put all the different food stuff (beans, gummy bears, candies and or any food stuff available at home with different range of sizes) in the large basin.
2. Use the different types of materials that represent bird's beak to pick up food stuffs in the large basin.
3. Record how many types of food stuffs you have eaten in every beak you use every 30 seconds.

Enrichment Activity Questions

1. Which representation of the bird's beak is best to use to get more food? Why?
2. What did you realize while doing the activity?

Key to answers on page 27

Learning Assessment 3: Compare Us!

Direction: Based from what you have learned about the theory of evolution, compare the theory of Lamarck and Darwin about the occurrence of Evolution. Fill in the table below. Use a separate paper to write your answers.

Lamarck's Theory	Darwin's Theory

What I Have Learned

Great job! You are almost done with this module. Let us summarize what you have learned from the lesson and activities by identifying what is asked in each statement. Choose your answer from the words given in the box. Use a separate sheet for your answer.

Mutation	Theory of Need	Allele frequencies
Gene Flow	Charles Darwin	Theory of Use and Disuse
Inbreeding	Adaptive Radiation	Jean Baptiste de Lamarck
Coevolution	Population Genetics	Hardy-Weinberg equilibrium
Microevolution	Convergent Evolution	Theory of Acquired Characteristics

1. It could occur whether an individual migrate from one population to another or by migration.
2. It deals with the description of the gene pool of specific traits in a population.
3. It deals with the frequency of alleles in a population that has no gene modifications or remains stable.
4. It states that organs that are not used will disappear while those that are frequently used will be more developed.
5. He believed that natural selection favored the survival of giraffe with longer necks to feed themselves on taller trees that were available.
6. It states that organisms change in response to their environment through the fossil records as a guide.
7. Theory stating that acquired characteristics are inherited by their offspring and propagated to the next generation.
8. He was able to develop three theories which includes Theory of Need, Theory of Use and Disuse and Theory of Acquired Characteristics.
9. The process by which the species evolves into several different species, each occupying a new environment.
10. The evolution of organisms that are not closely related to have similarities in form and function driven by similarities in their habitats.
11. The process wherein a species adapts to ecological pressures from the other species.
12. The changes that occur within species that is usually seen as changes in their genetic makeup or genotype.
13. It represents the number of the population carrying the allele.
14. It is an example of non-random mating which is commonly observed in plants and in some kinds of animals.
15. Any change in the structure of chromosomes and gene composition.

Key to answers on page 27

What I Can Do

Understanding the occurrence of evolution helps us solve biological problems that impact our lives. In addition, having knowledge on the occurrence of evolution can improve the quality of human life.

SHOW ME WHAT YOU'VE GOT! In this activity, research on an animal that has evolved through time such as birds, insects and others. Draw the evolution of the organism that you have researched on showing how this organism has evolved.

Assessment

Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. The following are Genetic basis of evolution **EXCEPT**.
   A. Synthetic theory
   B. Natural Selection
   C. Allele Frequencies
   D. Population Genetics

2. What is Inbreeding?
   A. The mating of closely related individuals
   B. Mating between species
   C. Mating with population
   D. Breeding of dogs

3. Which of the following **best** describes that occurrence of gene flow?
   A. It occurs even without migration.
   B. It occurs if an individual migrates from one population to another with no gene exchange.
   C. It occurs with or without migration.
   D. It occurs when migration allowed sharing of traits and exchange of genes to happen that may alter gene frequency.

4. The theory believes that nature selects the trait that will or will not survive and that organisms with favorable traits or those who are best suited in the environment have a better chance of survival.
   A. Mutation
   B. Gene Drift
   C. Natural Selection
   D. Non-random mating

5. Those who survive will pass on their favorable traits to their offspring. After many years, the population will produce organisms with traits that are different from their ancestors. These conditions show _____.
   A. Mutation
   B. Gene Drift
   C. Natural Selection
   D. Non-random mating

6. Which is **not** an event that reduces or eliminates a certain trait in the population consistent of genetic drift?
   A. Earthquakes and Diseases
   B. Floods and fires
   C. Pandemic
   D. Suicide

7. It is an evolution process in organism that are not closely related, because they must adapt to similar challenges in their habitats.
   A. Coevolution
   B. Microevolution
   C. Adaptive Radiation
   D. Convergent Evolution

8. Why does adaptive radiation occur?
   A. Species adapts to ecological pressures from the other species.
   B. Species evolves into several different species, each occupying a new environment.
   C. Species change when there is a need to survive sudden or abrupt environmental changes.
   D. Species adapts to survive and evolve in a relative short time.

9. He proposed that organism evolve in response to their environment.
   A. Charles Darwin
   B. Gregor Mendel
   C. Jean Baptiste de Lamarck
   D. Alfred Russel Wallace

10. Who is the proponent of the Theory of Natural Selection?
   A. Charles Darwin
   B. Gregor Mendel
   C. Jean Baptiste de Lamarck
   D. Alfred Russel Wallace

11. Jean Baptiste de Lamarck believed that giraffes before have short necks, but because of their need to survive and in order to reach tall trees for food, they kept stretching their necks until these became longer and able to reach taller trees.
   A. Theory of Needs
   B. Theory of Use and Disuse
   C. Theory of Evolution
   D. Theory of Acquired Characteristics

12. The theory of Lamarck which explained that if an organism acquired a body structure with long limbs, leg, or neck during its lifetime, it could be passed on to its offspring. What theory is this?
   A. Theory of Need
   B. Theory of Evolution
   C. Theory of Use and Disuse
   D. Theory of Acquired Characteristics

13. Genetic drift is a change in the allele frequency of population due to _____.
   A. random chance
   B. natural selection
   C. artificial selection
   D. non-random mating

14. This mechanism of evolution occurs when populations migrate.
   A. Gene flow
   B. Speciation
   C. Genetic drift
   D. Natural Selection

15. Darwin's primary contribution to biological theory was the idea that:
   A. genes are the units of inheritance.
   B. new alleles arise through mutation.
   C. evolution is the change in gene frequencies over time.
   D. an important mechanism of biological evolution is natural selection.

Key to answers on page 27

Congratulations for accomplishing this module! You may now look at the correct answers to all the activities and assessments. The Key to Answers are found on pages 25-27.

Additional Activities

Did you enjoy our activities in this module? After learning the different mechanisms in the occurrence of evolution, let us do an activity which will shows the importance of occurrence of evolution as a mechanism for the survival of a species.

You can choose one (1) on the following forms to present the importance of occurrence of evolution.

a. Essay (150 words)
b. Poster and Slogan
c. Poem Writing

Rubrics:

Essay Writing		Poster and Slogan		Poem Writing	
Ideas/Organization	5	Relevance to the theme	5	Cohesiveness	5
Sentence Fluency	5	Visual Impact	5	Rhythm	5
Presentation	5	Graphics Originality	5	Creativity	5
Total	**15**	**Total**	**15**	**Total**	**15**

Answer Key

What I Know

1. A
2. B
3. C
4. B
5. B
6. B
7. C
8. A
9. A
10. B
11. A
12. C
13. B
14. C
15. D

What's In

1. Direct
2. Fossil
3. Indirect
4. Homologous
5. Analogous
6. Vestigial
7. Darwin
8. Notochord
9. Primates
10. Embryo

What's New

Bottlecap Natural Selection Challenge

Column B - 10 pieces each color

Column C - 20 % each color

Column D to F- depends on the result of the activity

What's New

Bottlecap Natural Selection Challenge

Learning Activity

1.1 Natural selection means nature selects which trait will or will not survive.

1.2 Answer may vary. It depends on the result of the activity.

1.3. Answer may vary. It depends on the result of the activity.

1.4 Based from the activity, Natural selection changes the number of individuals with specific characters in succeeding populations (colors of bottlecaps). Eventually, this may alter gene pool of the populations which will lead to evolution.

What's New

Bottlecap Genetic Drift Challenge

Column B - 10 pieces each color

Column C - 20 % each color

Column D and E- depends on the result of the activity

Bottlecap Genetic Drift Challenge

Learning Activity

2.1. Genetic drift is the drastic change of the number of individuals in a population because of chance. Their traits will be carried over to the establishment of a new population.

2.2. Answers may vary, it depends on the results. Citation of data vary.

What's New

Bottlecap Genetic Drift Challenge

Learning Activity

2.4. No, by random chance the original number could be reduced or eliminated.

2.5. Based from the activity, genetic drift may lead to evolution by means of changes of certain traits could be reduce or eliminated through some unpredictable chance events.

Bottlecap Gene Flow Challenge

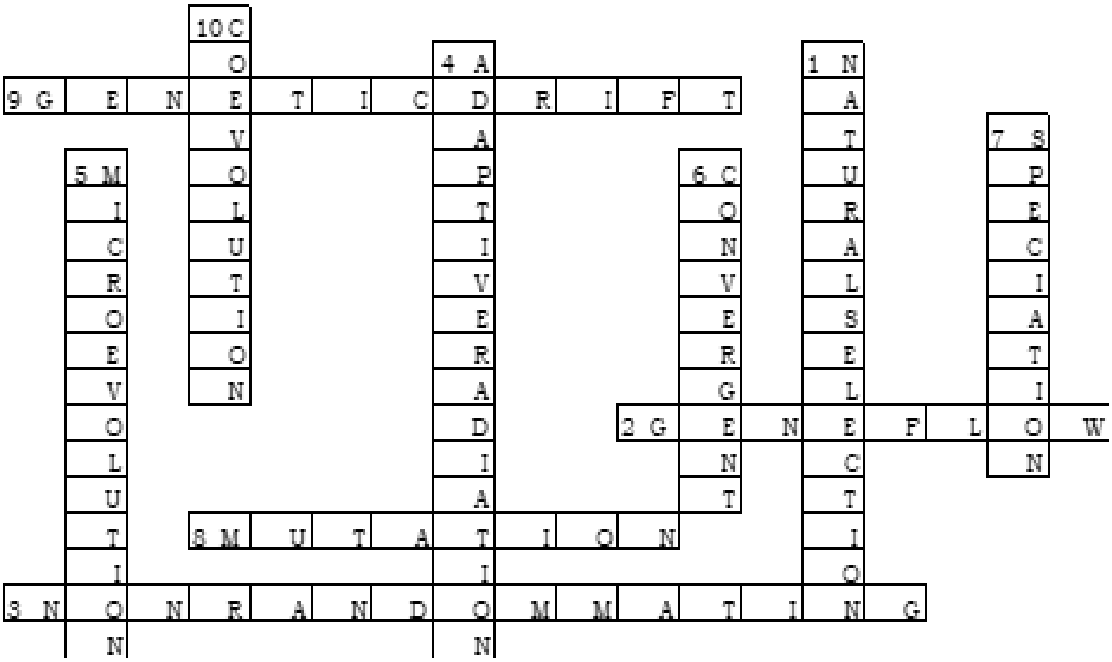
Column B - 10 pieces each color

Column C - 20 % each color

Column D and E- depends on the result of the activity

What's More

Learning Assessment 2: EvoWord Adventure



What's New

Bottlecap Gene Flow Challenge
Learning Activity

3.1. The percentage changed by increasing the number of each colored bottlecaps.
3.2. Gene flow is the transfer of individuals (grabbed bottlecaps) from one population to another population of the same species which may lead to changes in both populations.
3.3. No. Explanation may vary.

What's New

3.4. Answers may vary
3.5. Both may lead to evolution, but genetic drift happens in the same place where the original population is but may have changes due to chance survival of individuals in the population. Gene flow or migration involves the intermixing between 2 populations of similar species.
3.6. Gene flow leads to evolution because traits coming from a separate population is introduced to another population. This may alter the traits in the population where the individuals migrated to.

What's More

Enrichment Activity 1

1. It portrays the four types of speciation include allopatric, peripatric, parapatric and sympatric.
2. They prevent members of different species from producing offspring.

Learning Assessment 1: Match ME!
1. F
2. B
3. D
4. C
5. A

Enrichment Activity 2: Could I Copy and Paste?
1. No. Because acquired traits cannot be passed on.
2. No. Because acquired traits cannot be passed on.
3. Some of my inherited traits are height, hair texture, widow's peak, dimples, skin complexion, and others.

What's More

Enrichment Activity 3: I will Survive!

1. Popsicle sticks because it is wider that it can accommodate more food stuffs.
2. I realized that while doing the activity the organisms who were able to adapt to a changing environment will have a greater chance to survive. It also shows that the abundance of species is somehow related to type of food available to these species. The structure of bird beak is directly related to the food it eats.

What's More

Learning Assessment 3: Compare us!

Lamarck's Theory

- Genetic change occurs in response to need.
- The environment causes adaptations to develop
- Adjustments resulting from sustained use of the body handed on to the offspring.
- Theory of Use and Disuse
- Theory of Acquired Characteristics
- Theory of Need

Darwin's Theory

- Genetic change is random.
- The environment selects the best-adapted individuals from the population.
- Change in the body acquired during the life are not handed on to the offspring.
- Theory of Natural Selection

What I Have Learned

1. Gene Flow
2. Population Genetics
3. Hardy-Weinberg equilibrium
4. Theory of Use and Disuse
5. Charles Darwin
6. Theory of Need
7. Theory of Acquired Characteristics
8. Jean Baptiste de Lamarck
9. Adaptive Radiation
10. Convergent Evolution
11. Coevolution
12. Microevolution
13. Allele frequencies
14. Inbreeding
15. Mutation

Assessment

1. B	6. D	11. A
2. A	7. D	12. D
3. D	8. B	13. A
4. C	9. C	14. A
5. C	10. A	15. D

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Module

Department of Education, Project EASE Biology Module 15, pp. 14- 25.

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