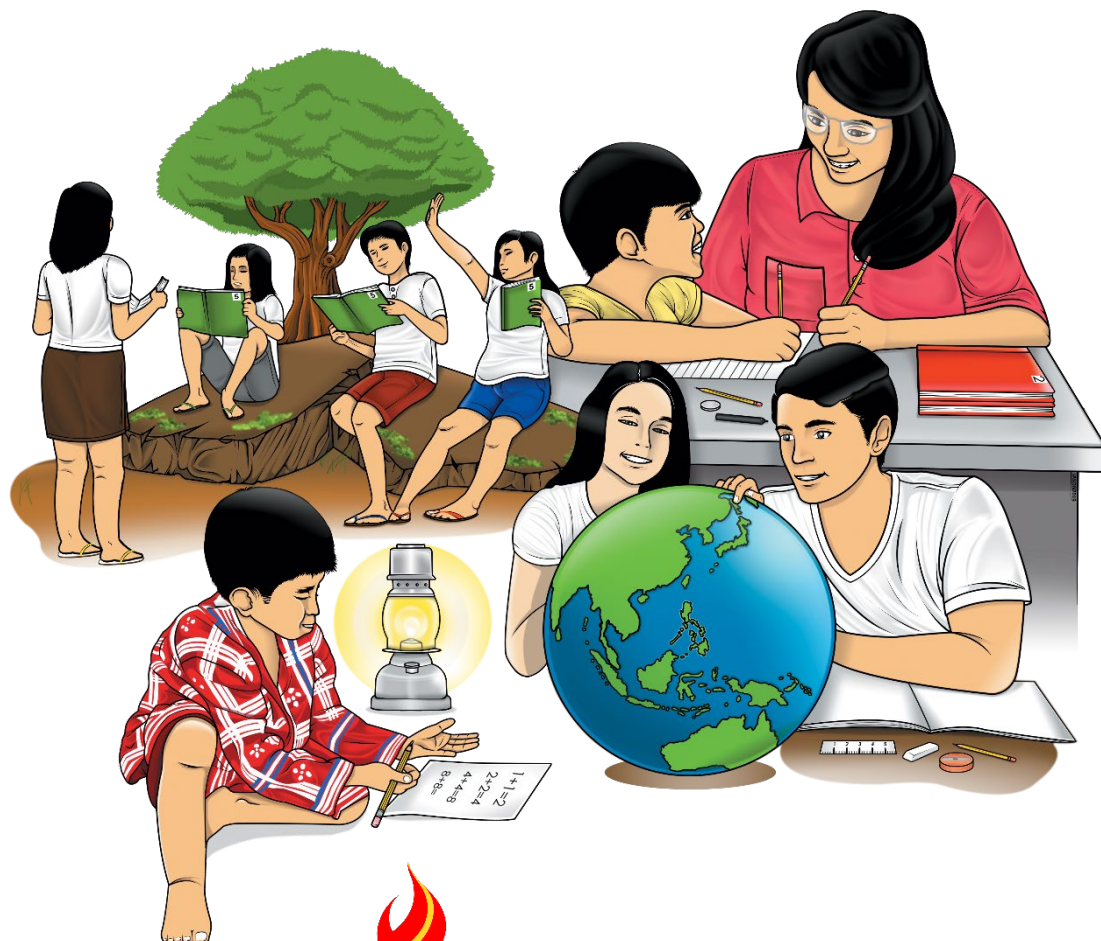


Earth and Life Science

Quarter 2 – Module 4:

Genetic Engineering



Earth and Life Science
Alternative Delivery Mode
Quarter 2 – Module 4: Genetic Engineering
First Edition, 2021

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Earth and Life Science

Quarter 2 – Module 2:

Perpetuation of Life

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

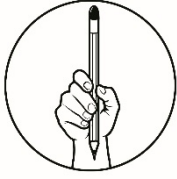
This module was designed and written with you in mind. It is here to help you master the nature of Earth and Life Science. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The module has one lesson:

- Lesson 1 – Genetic Engineering

After going through this module, you are expected to:

1. define genetic engineering;
2. describe the techniques in genetic engineering as based from the situation given; and
3. appreciate the role of genetic engineering to human life



What I Know

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

1. Organisms that have transferred DNA from a different species are called
 - A. genetically modified organisms
 - B. transgenic organisms
 - C. both a and b
 - D. none of a and b
2. It is a process in which animals with desired characteristics are mated to produce offspring with the desired traits.
 - A. cloning
 - B. hybridization
 - C. inbreeding
 - D. selective breeding
3. It is a process of creating an organism that has an exact genetic copy of another.
 - A. artificial selection
 - B. cloning
 - C. gene splicing
 - D. selective breeding
4. A technique in artificial selection that involves propagation of organisms with desired traits.
 - A. cloning
 - B. hybridization
 - C. inbreeding
 - D. selective breeding
5. It is a process where a DNA is cut out from one organism and put into another organism.
 - A. cloning
 - B. gel electrophoresis
 - C. gene splicing
 - D. selective breeding
6. A technology used in genetic engineering where DNA molecules from two different species are combined.
 - A. DNA Recombinant technology
 - B. Recombinant DNA technology
 - C. both a and b
 - D. none of a and b
7. This refers to the DNA molecule that can replicate independently.
 - A. bacteriophage
 - B. enzymes
 - C. plasmid
 - D. vector
8. It is a tool that helps in carrying and integrating the desired gene.
 - A. bacteriophage
 - B. enzymes
 - C. plasmid
 - D. vector

9. It is produced when two different nucleotides had been fused as one.
 - A. DNA
 - B. recombinant DNA
 - C. restricted DNA
 - D. vector DNA
 10. All are tools in recombinant DNA technology **except**
 - A. enzymes
 - B. host organisms
 - C. restriction enzymes
 - D. vectors
 11. All are ancient practices of genetic engineering **except**
 - A. hybridization
 - B. inbreeding
 - C. recombinant technology
 - D. selective breeding
 12. Two individuals with unlike characteristics are crossed to produce the best in both organisms.
 - A. cloning
 - B. hybridization
 - C. inbreeding
 - D. selective breeding
 13. It is a process where genes are inserted into the genome of a different organism.
 - A. cloning
 - B. gel electrophoresis
 - C. gene splicing
 - D. selective breeding
 14. Most commonly used host organism in recombinant DNA technology
 - A. bacteriophage
 - B. cells
 - C. plasmids
 - D. vectors
- For numbers 15-16, refer to the following choices below.
- A. Statement I is correct
 - B. Statement II is correct.
 - C. Statement I and II are both correct.
 - D. Statement I and II are both incorrect.
15. I - Since ancient times the practice of genetic engineering had begun.
 II - Artificial selection is done to indirectly manipulate genes focusing on the physical traits among organisms.
 16. I – Vectors help in recombinant DNA technology by carrying and integrating the desired gene usually plasmids and bacteriophage.
 II- Host organisms are used to propagate the recombinant DNA.

Lesson

1

Genetic Engineering

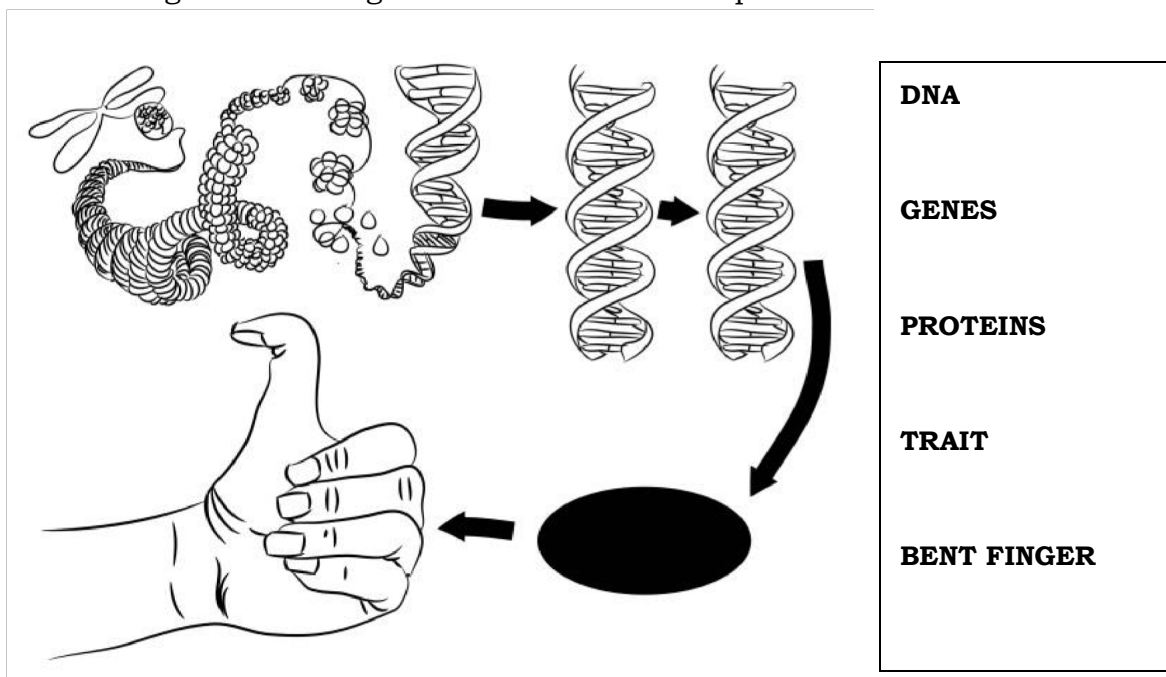
Genetic engineering is the direct manipulation of an organism's genes using biotechnology. It covers different kinds of technologies used to alter the genomes that includes the insertion of genes from other individual either the same or from different species that aims to produce or improve products.



What's In

Activity 1: DNA, Genes, Proteins and Individual Trait

Use the diagram and the grid below to answer the questions.



1. What are the roles of the DNA, genes and proteins in a given trait?
2. How would you relate the individual trait or characteristics to proteins, genes and DNA?
3. Would the manifestation of a trait be affected once the DNA nor the genes are altered? Why? Explain your answer.

RUBRICS	Above Expectation	Meets Expectation	Below expectation
ANALYSIS	Response provided an in-depth analysis of the question given. Show an understanding of the lesson. Examples were given to explain the concept.	Response provided an in-depth analysis of the question given. Show little understanding of the lesson. Examples were given to explain the concept.	Response do not provide an in-depth analysis of the question given. Show an understanding of the lesson. Examples were not given to explain the concept.
CLARITY	The thoughts were clearly expressed and the organization of the words were exemplified.	The thoughts were slightly expressed and the organization of the words were exemplified.	The thoughts were unexpressed and there is no organization of the words in the sentence.
WRITING SKILL	Clear writing complete sentence, no errors in grammar and spelling.	Clear writing with errors in grammar and spelling.	Unclear writing complete sentence, all errors in grammar and spelling.



What's New

Activity 2: Students are asked to answer the questions.

1. What do you think are the objectives of scientists in genetic engineering?
2. How are scientists able to realize their objectives in genetic engineering?
3. Can you cite the techniques in genetic engineering scientists utilize in creating outcomes?

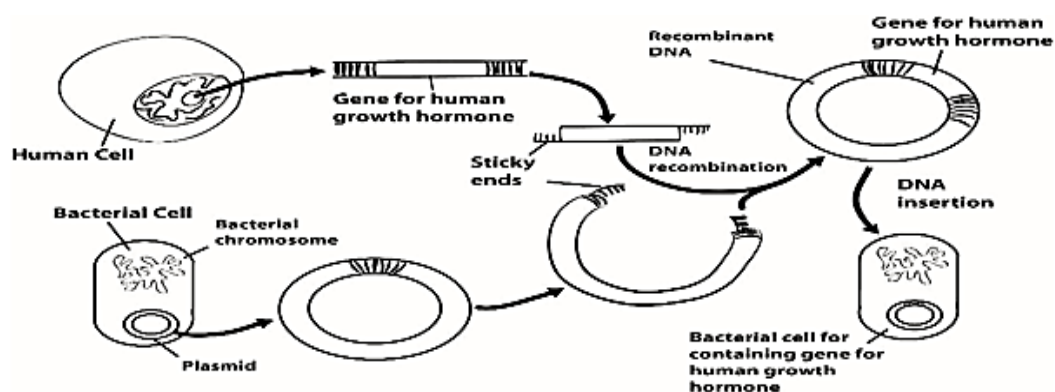


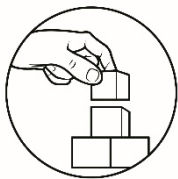
What Is It

Since ancient times the practice of genetic engineering had begun. Artificial selection is done to indirectly manipulate genes focusing on the physical traits among organisms. Breeders choose which organism to mate and produce offspring with desirable traits. They maintain this procedure without control of what genes can be passed. Selective breeding is a process when animals with desired characteristics are mated to produce offspring with those desired traits such as Angus cows are bred to increase more meat. Hybridizations are when two individuals with unlike characteristics are crossed to produce the best in both organisms like the disease resistant potato called the Burbank potato. Inbreeding is a technique of breeding organisms that are genetically similar to maintain desired traits found in the pure dog breeds. As defined, genetic engineering is the process of changing the DNA in living organisms to create something new. It involves artificial manipulation, modification, and recombination of DNA or other nucleic acid molecules to modify an organism or population of organisms.

Recombinant DNA Technology

Recombinant DNA is made by mixing DNA from two different sources. Restriction enzymes were discovered in 1968 by Swiss microbiologist Werner Arber. This was used to splice, connect (or ligate), and remove or add nucleotides to sequences of the DNA. This process is used in recombinant DNA technology to remove and insert genetic sequences from and into other sequences of other organisms. Inserting the desired gene into the genome of the host involves the selection of the desired gene for administration into the host followed by a selection of the perfect vector (either plasmid or bacteriophage) with which the gene has to be integrated and a recombinant DNA is formed. The recombinant DNA has to be introduced into the host, maintained and carried forward to the offspring. Biotechnology and pharmaceutical companies practice these techniques in working with medical and research purpose.





What's More

Activity 3: Match me!

Using the terms in the box, match the genetic techniques with their descriptions. Write your answer in separate sheet of paper.

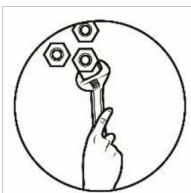
GEL ELECTROPHORESIS;	GENE SPLICING
CLONING;	INBREEDING
HYBRIDIZATION;	SELECTIVE BREEDING

- _____ 1. A science of changing the DNA in a living organism to create something new
- _____ 2. Breeders choose which organism to mate to produce offspring with desired traits.
- _____ 3. Animals with desired characteristics are mated to produce offspring with those desired traits.
- _____ 4. Two individuals with unlike characteristics are crossed to produce the best in both organisms.
- _____ 5. Breeding of organisms that are genetically similar to maintain desired traits.
- _____ 6. Creating an organism that is an exact genetic copy of another
- _____ 7. DNA is cut out of one organism and put into another organism
- _____ 8. A technique used to compare DNA from two or more organisms.



What I Have Learned

- 1. Genetic engineering is the process of changing the DNA in living organisms to create something new.
- 2. Artificial selection is practiced to indirectly manipulate genes focusing on the physical traits among organisms. This include selective breeding, hybridization and inbreeding.
- 3. Genetic engineering is referred to various techniques used for the modification or manipulation of organisms through the processes of heredity and reproduction.
- 4. This includes cloning, gene splicing, gel electrophoresis and DNA recombinant technology.
- 5. Recombinant DNA technology use to remove and insert genetic sequences from and into other sequences of another organism.
- 6. The tools used in Recombinant DNA technology are restriction enzymes, vectors and host organisms.



What I Can Do

Activity 4: Genetic Engineering Techniques

Directions. Distinguish the techniques in genetic engineering as based from the situations and examples given. Write the letter of the correct answer on a separate sheet of paper.

A. Artificial selection	B. Selective breeding	C. Hybridization	D. Inbreeding
E. Cloning	F. Gene splicing	G. Gel electrophoresis: analyzing DNA	

- ___ 1. This is when animals with desired characteristics are mated to produce offspring with those desired traits. Dachshunds were once bred to hunt badgers and other burrowing animals.
- ___ 2. Creating an organism that is an exact genetic copy of another. They will have the same exact DNA as the parent.
- ___ 3. DNA is cut out of one organism and put into another organism. A trait will be transferred from one organism to another.
- ___ 4. Luther Burbank created a disease resistant potato called the Burbank potato. He crossed a disease resistant plant with one that had a large food producing capacity.
- ___ 5. A technique used to compare DNA from two or more organisms.
- ___ 6. Breeding of organisms that are genetically similar to maintain desired traits. It keeps each breed unique from others.

Activity 5: Genetic Engineering Techniques

Directions. Voice out your perceptions on the following statements about the current technology in genetic engineering. Discuss whether you agree or not. Your answer must have an in-depth analysis of the statement with clear expression and no grammatical errors. Write your answers in your journal notebook. Choose two from the three techniques.

1. Monkeys have been Cloned, Paving the Way for Human Cloning
2. Bacteria as Living Microrobots to Fight Cancer
3. Two genetic regions (*variants in both ABO blood group locus and cluster of genes in chromosome 3*) Linked with Severe COVID-19

RUBRICS	Above Expectation	Meets Expectation	Below expectation
ANALYSIS	Response provided an in-depth analysis of the question given. Show an understanding of the lesson. Examples were given to explain the concept.	Response provided an in-depth analysis of the question given. Show little understanding of the lesson. Examples were given to explain the concept.	Response do not provide an in-depth analysis of the question given. Show an understanding of the lesson. Examples were not given to explain the concept.
CLARITY	The thoughts were clearly expressed and the organization of the words were exemplified.	The thoughts were slightly expressed and the organization of the words were exemplified.	The thoughts were unexpressed and there is no organization of the words in the sentence.
WRITING SKILL	Clear writing complete sentence, no errors in grammar and spelling.	Clear writing with errors in grammar and spelling.	Unclear writing complete sentence, all errors in grammar and spelling.



Assessment

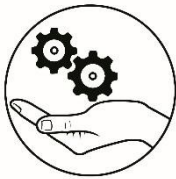
Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. It is the process of manipulating genes in order to have the desired trait.
 - A. artificial selection
 - B. cloning
 - C. genetic engineering
 - D. gene splicing
2. It is the process of breeding an organism that are genetically similar to maintain desired traits. It keeps each breed unique from others.
 - A. artificial selection
 - B. cloning
 - C. inbreeding
 - D. selective breeding
2. It is a technique where the DNA is cut out of one organism and put into another organism. A trait will be transferred from one organism to another.
 - A. artificial selection
 - B. cloning
 - C. gene splicing
 - D. gel electrophoresis
3. It is a technique of creating an organism that is an exact genetic copy of the other organism.
 - A. artificial selection
 - B. cloning
 - C. gene splicing
 - D. gel electrophoresis
4. An applied science of manipulating the genetic material of an organism through artificial selection and biomedical techniques
 - A. artificial selection
 - B. cloning
 - C. genetic engineering
 - D. selective breeding
5. It is referred to the joining of almost any nucleotide sequences to create a new gene product or to introduce a new gene sequence.
 - A. DNA Recombinant technology
 - B. Recombinant DNA technology
 - C. both a and b
 - D. none of a and b
6. It is produced chiefly by certain bacteria and has the property of cleaving DNA molecules at or near a specific sequence of bases.
 - A. bacteriophage enzymes
 - B. plasmid enzymes
 - C. restriction enzymes
 - D. vector enzymes
7. Most common vector used in genetic engineering techniques
 - A. bacteriophage and plasmid
 - B. enzymes and plasmid
 - C. plasmid and DNA
 - D. restriction enzymes and DNA
8. All of these are performed to produce recombinant DNA **except**
 - A. Removal of the genetic sequences of an organism.
 - B. Selection of the perfect vector with which the gene has to be integrated
 - C. Insertion of the genetic sequences into other sequences of another organism
 - D. Selection of the perfect enzymes with which the gene has to be integrated
9. All of these are tools in recombinant DNA technology **except**
 - A. enzymes
 - B. host organisms
 - C. restriction enzymes
 - D. vectors

10. These are ancient practices of genetic engineering **except**
- A. hybridization
 - B. inbreeding
 - C. recombinant technology
 - D. selective breeding
11. Two individuals with unlike characteristics are crossed to produce the best in both organisms.
- A. artificial selection
 - B. cloning
 - C. genetic engineering
 - D. hybridization
12. This is the most commonly used host organism in recombinant DNA technology.
- A. bacteria
 - B. cells
 - C. plasmid
 - D. vectors

For numbers 14-15, refer to the following choices below.

- A. Statement I is correct
 - B. Statement II is correct.
 - C. Statement I and II are both correct.
 - D. Statement I and II are both incorrect.
14. I - Since ancient times, the practice of genetic engineering had begun.
II - Artificial selection is done to directly manipulate genes focusing on the physical traits among organisms.
15. I - Enzymes help in recombinant DNA technology by carrying and integrating the desired gene.
II - Host organisms are used to propagate the recombinant DNA.



Additional Activities

Activity 6: PROS and CONS

- A. Directions. Conduct a short interview with one or two of your family members. Ask them about how they think of the positive and negative effects of genetic engineering. List all their responses. Below is the rubric that will guide you on what to do in the activity. Write your answer on a separate sheet of paper.

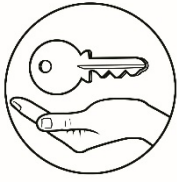
QUESTIONS	RESPONSES

- B. Make a list of pros and cons of genetic engineering by summarizing the interview done. Below is the rubric that will guide you on what to do in the activity. Write your answer on a separate sheet of paper.

PROS	CONS

Rubrics

0	The student has not reached a standard described by any descriptors given below.
1	The student demonstrates minimal communication and collaboration in providing information, literacy, thinking and reflection.
2	The student demonstrates communication and collaboration in providing information, literacy, thinking and reflection.
3	The student demonstrates satisfactory communication and collaboration in providing information, literacy, thinking and reflection.
4	The student demonstrates well developed communication and collaboration in providing information, literacy, thinking and reflection.



Answer Key

What I Know 1. C 2. D 3. B 4. D 5. C 6. B 7. C 8. D 9. B 10. C 11. C 12. B 13. C 14. A 15. C 16. C	What's More Activity 3 -genetic engineering -artificial selection -selective breeding -hybridization -inbreeding -cloning -gene splicing -gel electrophoresis What I Can Do -B -E -F -C -G -D	Assessment 1. A 2. C 3. C 4. B 5. C 6. B 7. C 8. A 9. D 10. C 11. C 12. D 13. A 14. A 15. B
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