GRADE 9
K to 12 BEC

DepED
DEPARTMENT OF EDUCATION

SCIENCE

Quarter 1 – Module 3: Week 3-4

Heredity: Inheritance and Variation

SCHOOLS DIVISION OF ANTIQUE

Science – Grade 9

Quarter 1 – Module 3: Heredity: Inheritance and Variation
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Science

Quarter 1 – Module 3: Week 3-4
Heredity: Inheritance and Variation

DepED
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Aiming at the Target

This module was designed and written with you in mind. It is here to help you explain the different patterns of non-Mendelian inheritance (S9LT-Id-29). 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.

This module is divided into the following lessons:

- Lesson 1 – The Process of Fertilization
- Lesson 2 – Location of genes in the chromosomes
- Lesson 3 – Non-Mendelian inheritance

After going through this module, you are expected to

1. Explain how fertilization produces a diploid zygote;
2. Describe the location of genes in the chromosomes;
3. Identify how genes are responsible for specific traits;
4. Identify phenotypes as the expression of inherited character; and
5. Explain the different patterns of non-Mendelian inheritance

a. Incomplete dominance
b. Codominance
c. Multiple alleles
d. Polygenic traits
e. Sex-linked traits

Trying the Challenge

Direction. Read the statements carefully. Choose the letter of the best answer among the choices given. Write the letter on the answer sheets provided.

1. During fertilization, each gamete contributes a number of chromosomes to the resulting zygote. How many chromosomes does each gamete gives?

a. 23 pair of chromosomes b. 46 pair of chromosomes
c. 23 chromosomes d. 46 chromosomes

2. Genes are segments of DNA that carry inheritance of a particular trait. Genes are packed in the chromosomes found inside the ____ of the cell.

a. membrane b. cytoplasm c. ribosome d. nucleus

3. There are hundreds of information stored in the chromosomes. These are the hereditary material called _____.

a. protein b. DNA c. genes d. trait

4. Traits inherited are expressed in two forms. What are the traits inherited from parents that can be physically observed?

a. phenotype b. genotype c. alleles d. behavior

5. When a white flower is crossed with a red flower, it produces a pink flower. What pattern of inheritance is being described?

a. polygenic traits b. multiple alleles
c. codominance d. incomplete dominance

6. If RR represents red flower and WW for white flower, what will be the genotype of the resulting pink flower?

a. Rw b. RW c. RRWW d. rW

7. Human blood has blood group system called ABO system. The ABO blood system in humans is an example of what type of non-Mendelian inheritance?

a. incomplete dominance b. codominance
c. multiple alleles d. polygenic traits

8. When two alleles are physically observed in a heterozygote, it follows the codominance pattern of inheritance. Which of the following examples below can be considered codominance?

a. a pink flower b. roan fur in cow c. gray chicken d. skin color

9. Genes inherited are expressed in character. When two or more genes affect a character, it is considered ____.

a. codominance b. sex-linked c. polygenic trait d. multiple alleles

10. There are traits inherited that can affect either male or female which is called sex-linked. Males are often affected by sex-linked traits. Why?

a. males have XY chromosomes b. males have Y chromosome
c. males have one X chromosome d. males have XX chromosome

Lesson
1

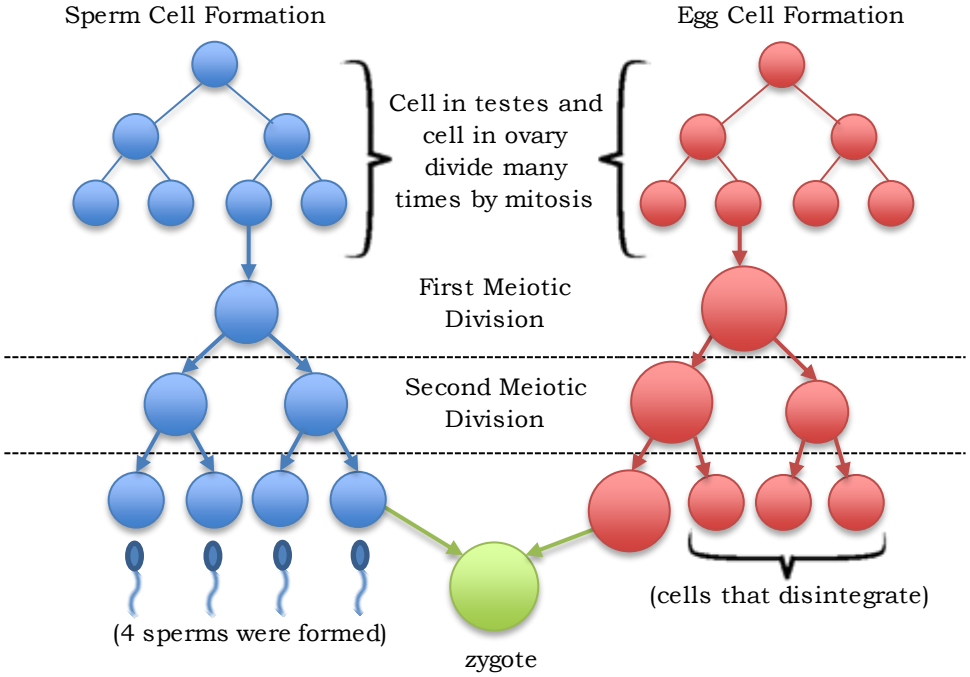
The Process of Fertilization

You have learned how cells divide through meiosis in your Grade 8 science. Meiosis is one of the processes in producing genetic variations in Mendelian patterns of inheritance. What is the role of meiosis in the process of fertilization? How are diploid zygote produced out of haploid gametes? Why is it called haploid? These are the questions to be answered in our next lesson.

Connecting to the Past

Activity1. Count Me In

Study the diagram below. Answer the following questions. Write your answer on the answer sheet provided.



Questions.

1. How many sperm cells are produced after meiosis? _____
2. How many egg cells are produced after meiosis? _____
3. In the formation of zygote, how many sperm cell and egg cell are needed?

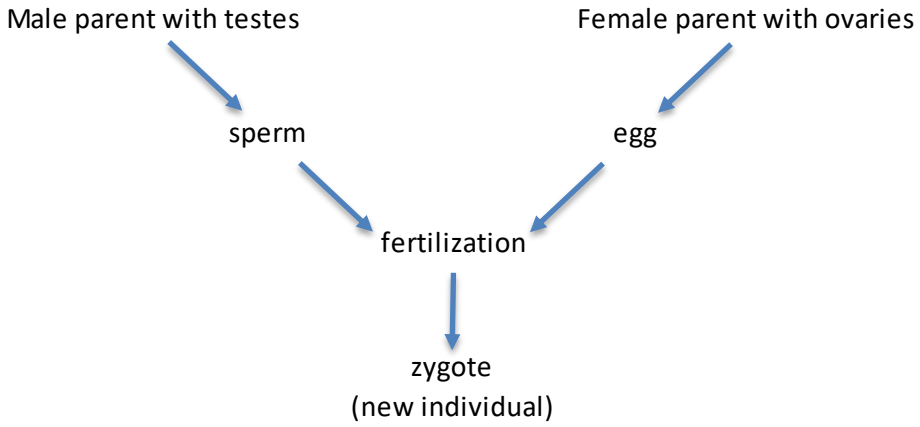
_____

Gearing Up to Start

One mature sperm cell and one mature egg cell is needed to form a zygote. What is fertilization? How does fertilization produce a diploid zygote? Why is it called diploid? Study the diagram below on how a diploid zygote is formed and answer the following questions.

Activity 2. You Made Me

Study the diagram and answer the questions after. Write your answers on the answer sheet provided.



Questions:

1. How did the sperm cell and the egg cell unite? _____
2. Discuss the process of fertilization. _____
3. Why is the result called diploid? _____

Hitting the Target

The process of meiosis occurs in the sex cells or gametes only. During this process, male produces a gamete called sperm cell and female produces a gamete called egg cell. During meiosis, the gametes reduces the chromosome number in half from diploid to haploid.

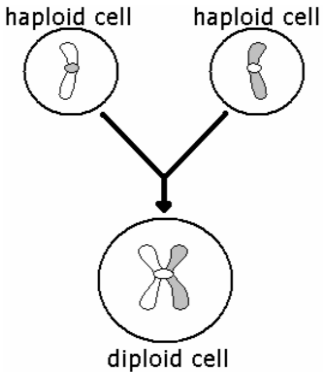
In your previous activity, the sperm cell and the egg cell are considered haploid cells. **Haploid** means the cell carries one set of chromosomes (23 chromosomes) represented by the symbol *n*. When the sperm cell and the egg cell unite, fertilization occurs.

Only one mature sperm cell and one mature egg cell will unite to undergo the process of fertilization.

Fertilization is the union of the nuclei of the two haploid cells, the sperm cell and the egg cell, producing a fertilized egg or **zygote**. Since both the sperm cell and the egg cell

are haploid, they carry a single set of chromosomes; thus, the zygote formed is a diploid cell. **Diploid** means the cell carries two sets of chromosomes (46 homologous chromosomes) and is represented by the symbol *2n*.

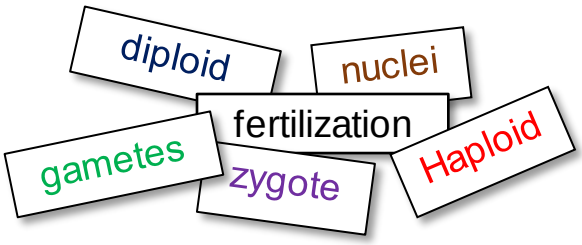
The figure below represents the process of fertilization. Observe that the haploid cell is a single strand before fertilization takes place. When these haploid cells unite, they form a double stranded structure which is a diploid.

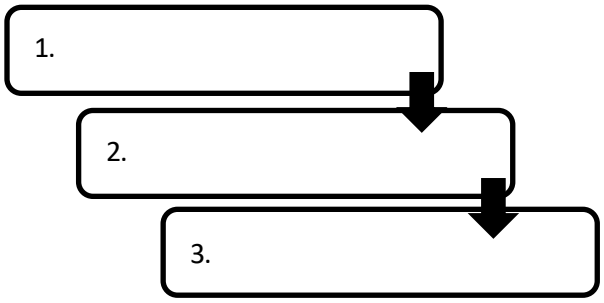


Source: *Summit Learning, retrieved on June 19, 2020*

Strengthening the Grasp

Direction: Based on what you have learned about how diploid zygote was formed from haploid gametes, complete the flow chart by providing a short description for each stage of the entire process. Use the key words below in constructing your sentences. Write your answers on the answer sheets provided.





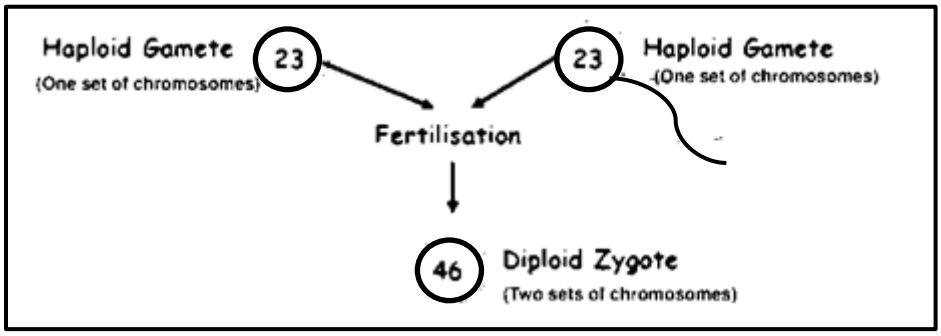
Wrapping Up to Go

Direction. Fill in the blanks with the missing words to complete the paragraph. Write your answers on the answer sheet provided.

The type of cells that undergo meiosis are called 1. _____. These are the 2. _____ and 3._____which are considered as 4. _____ cell and carries 5. _____ number of chromosomes symbolized as 6. _____. During the process of fertilization, these gametes unite in order to form 7. _____or fertilized egg. The fertilized egg is now considered as 8._____ cell and carry 9. _____ number of chromosomes symbolized as10. _____.

Relating to Real Life

Direction. Analyze the diagram below and write your answers to the following questions on the answer sheet provided.



Source: *https//:www.slideplayer.multicellularorganism-ppt, retrieved on July 14, 2020*

1. Why is haploid cell needed in fertilization and not a diploid cell?
2. In your opinion, is fertilization important? Why?

Direction. Read and understand the statements. Choose the letter of the best answer among the choices given. Write the letter on the answer sheet provided.

1. Fertilization is the union of gametes. What happens after fertilization?
   a. Haploid gametes are produced
   b. Diploid gametes are produced
   c. Haploid condition of the cell is restored
   d. Diploid condition of the cell is restored

2. The union of sperm cell and egg cell forms a zygote. Why is the resulting zygote referred to as diploid?
   a. It contains 23 chromosomes in single pair
   b. It contains 46 chromosomes in 23 pairs
   c. It contains 46 chromosomes in single pair
   d. It contains 92 chromosomes in double pairs

3. Gametes are considered haploid cells. Which correctly describes a haploid cell?
   a. *n* b. *2n* c. *N* d. *2N*
4. During fertilization, two haploid cells with ___ chromosomes unite to produce one diploid cell with ___ chromosomes.
   a. 46,23 b. 23,23 c. 23,46 d. 46,46
5. Fertilization describes how a haploid number gives rise to a diploid number. Which of the following describes haploid to diploid number?
   a. *N-2n* b. *n-2n* c. *2n-n* d. *2N-N*
6. A zygote is formed when egg cell and sperm cell unite. What particular part of the cell unites during fertilization?
   a. nucleus b. cytoplasm c. cell membrane d. cell itself

7. During fertilization, each gamete contributes a number of chromosomes to the resulting zygote. How many chromosomes does each gamete gives?
   a. 23 pair of chromosomes
   b. 46 pair of chromosomes
   c. 23 chromosomes
   d. 46 chromosomes

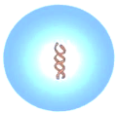
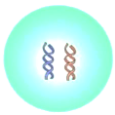
8. Fertilization involves haploid cell and diploid cell. What is the difference between a haploid cell and a diploid cell in structure?
   a. haploid cell is single stranded; diploid cell is single stranded
   b. haploid cell is double stranded; diploid cell is single stranded
   c. diploid cell is double stranded; haploid cell is double stranded
   d. diploid cell is double stranded; haploid cell is single stranded

9. Gametes undergo fertilization. Which of the following describes fertilization?
   a. haploid gametes to diploid zygote
   b. haploid gametes to haploid zygote
   c. diploid gametes to haploid zygote
   d. diploid gametes to diploid zygote

10. What is transmitted by gametes to the zygote being formed?
   a. the traits of sperm cell
   b. the traits of egg cell
   c. half the traits of both cell
   d. all the traits of both cell

Enriching the Skill

A. Match the illustration below with the correct label. Write your answer on the answer sheet provided.

1. 
2. 
3. 

a. ZYGOTE 2n=46

b. SPERM CELL n=23

c. EGG CELL n=23

Source: *https://www.ck12,org, Chromosomes (Read) Biology, retrieved on July 14, 2020*

B. LINE DIAGRAM. Make a line diagram about the process of fertilization on the provided answer sheet.

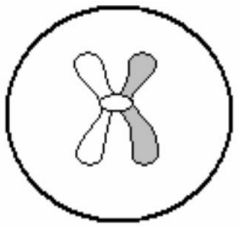
Lesson
2

Location of Genes in the Chromosomes

Fertilization gives rise to a diploid zygote from the haploid cells. The diploid zygote now contains 46 chromosomes, 23 each from the parent cell. But where are chromosomes located? What is being carried by these chromosomes? Why is the information carried by chromosomes important to all living organisms? Let us find out in lesson 2 of this module.

Connecting to the Past

You are familiar with the structure of the chromosome since Grade 8. And you know that chromosomes are present inside the diploid cell. Study the diagram below then answer the following questions on the answer sheet provided.



Source:
https://www.summitlearning.org, retrieved on June 19, 2020

Questions:

1. Where are the chromosomes located? _____

2. What is the structure of the chromosome? _____

3. Describe the centromere? _____

4. What do you call the upper part of the chromosomes? _____

5. The lower part of the chromosomes? _____

6. What do you think are embedded inside the chromosomes? _____

Gearing Up to Start

Genes are contained in the chromosomes. A chromosome may contain thousands of genes. But how are genes packed and arranged in the chromosomes? What molecule contains the genes? Perform the next activities below. Write the answers for questions on the provided answer sheet.

Activity 1. Genes in the Chromosomes

You will need nylon string or straw lace (if possible use two colors), a rubber band, a wire or hard straw (or any flexible material available), a pair of scissors. Below is a picture sample of how you are going to do the activity.

Procedure:

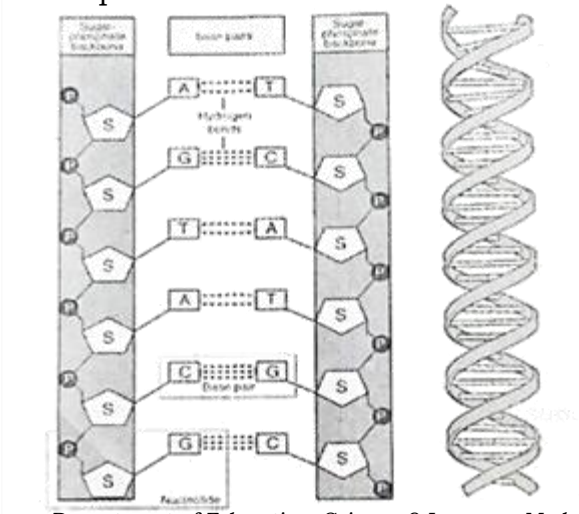
1. Bend or cut the wire or the straw and form it like a letter "X".
2. Tie the letter "X" at the center with a rubber band. Make sure to tie it tightly and it does not untangle.
3. Coil the nylon or straw lace around the wire or straw as tight as you can. If you have two colors, alternate the two colors. This is now your chromosome model.
4. Uncoil the nylon or straw lace from the wire by pulling slowly. Observe.
5. Repeat procedure number 3 and 4 for better understanding.

Questions:

1. What are being represented by the following:
   a. bended wire _____
   b. rubber band _____
   c. coiled nylon or straw lace _____
2. Describe the appearance of the straw lace as you pull it from the wire.
3. Based on your activity, how are genes arranged in the chromosomes?

Activity 2: DNA: The Genetic Material

Genes are segments of DNA. **DNA** or deoxyribonucleic acid is a long chain of nucleotides arranged in a spiral-like twisted ladder (double helix). Study the structure below and answer the questions on the provided answer sheets.



Source: Department of Education, Science 9 Learners Module

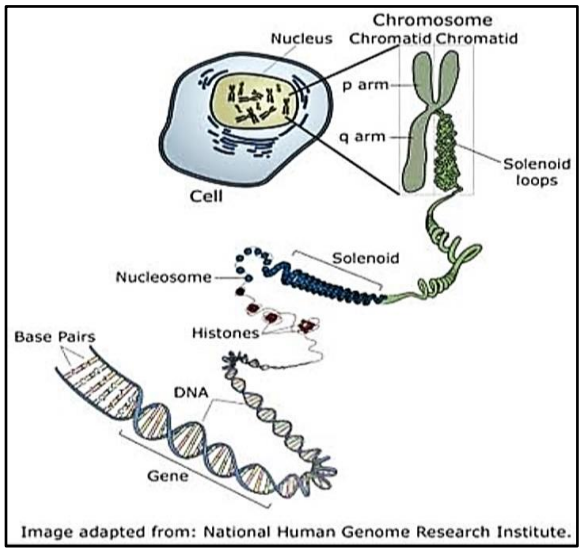
Questions:

1. What are the composition of DNA? _____
2. What is the pairing arrangement of base pairs? _____
3. What serves as the sides of the ladder-like DNA? _____
4. Why do you think the DNA is arranged in a twisted manner? _____

Hitting the Target

Chromosomes are thread-like structures found in the nucleus of the cell. Chromosomes are composed of two sister chromatids. It is composed of arms, the short arm (upper) and the long arm (lower). The arms are connected at the center by a structure called **centromere**. Each chromosome contains hundreds to thousands of material called genes.

Genes are contained in the locus (plural loci) of chromosomes. **Locus** is a spot on a chromosome at which a gene for a particular trait is located in all member of species. Genes carry messages which are expressed through certain complex process. Every gene is a piece of DNA (deoxyribonucleic acid) or genetic material. Chromosomes from a homologous pair have genes that control the same trait. Genes are responsible for the different expressions or characteristics of an individual. The shape of eyes, skin color, the height among others are results from the expression of these genes that makes every individual unique. Genes are expressed in two forms: phenotype and genotype. **Phenotype** is the physical expression of traits or the observable traits of an organism. **Genotype** is the set of genes carried by an individual or an individual's combination of alleles. Genotype are usually presented in combination of letters.



Source: *University of Leicester: DNA, Genes and Chromosomes, retrieved on June 22, 2020, https://www.le.ac.uk*

If a chromosome is unwound, it will reveal a long chain of DNA that holds thousands of genes. One segment of DNA can determine the inheritance of a particular trait. **DNA** is a macromolecule that forms the double helix structure and considered as the genetic

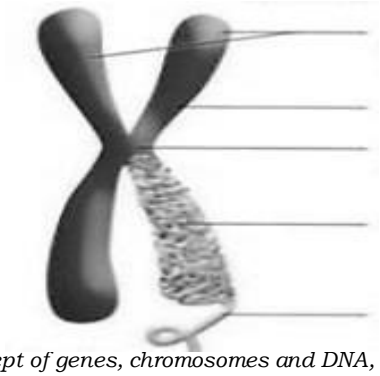
material in all living cells. In 1953, James Watson and Francis Crick presented DNA model. The DNA is of a long strand of nucleotides that contains a pentose sugar called deoxyribose, a phosphate group and nitrogenous bases.

Strengthening the Grasp

Activity 1. Let us Find!

A. Location of genes in the chromosomes.

Genes are found winding in the chromosomes. Label the chromosomes where genes are wound. An answer sheet is provided for you.



Source: Slideshare Basic concept of genes, chromosomes and DNA, retrieved on June 22, 2020

B. Answer the questions below. Choose the answer from the words inside the parenthesis. Write your answers on the answer sheet provided.

1. What structure joins the upper arm and the lower arm of chromosomes?
   The arms of the chromosomes are joined by (telomere, centromere).
2. Where are genes located?
   Genes are contained in the (nucleus, chromosome) of the cell.
3. What are genes?
   Genes are segments of (trait, DNA) winded around the chromosome.
4. What are genes responsible of?
   Genes are responsible for the transmission of (traits, DNA).
5. How are traits being carried by the genes?
   Genes for a specific trait are carried by (group, pairs).

Wrapping Up to Go

Direction: Complete the paragraph by filling-in the blanks with the correct words. Write your answers on the provided answer sheet.

Chromosomes are 1. _____ structures that contain information or messages. Two sister chromatids are joined by a structure called 2. _____. Genetic information is carried by 3. _____ which are found in the 4. _____ of the cell. Each gene has a small section of 5. _____ that controls the characteristics like shape of the eyes. DNA stands for 6. _____. It is a long chain made up of about 7. _____ of genes. Genes

are expressed through physical expression called 8. _____ and genotype or the set of 9. _____ carried by the organism. DNA is arranged in 10. _____ structure. It is composed of sugar, phosphates, and nitrogenous bases. Adenine pairs with thymine and cytosine pairs with guanine.

Relating to Real Life

Genes are responsible for our traits inherited from parents. The table below list some common traits that we inherit from parents.

Direction. Put a check (✓) mark on the appropriate column from whom you think you inherited such trait. An answer sheet is provided.

Traits	Father	Mother
1. shape of the eyes		
2. type of hair (curly or straight)		
3. skin color		
4. height		
5. shape of nose		

Checking the Target

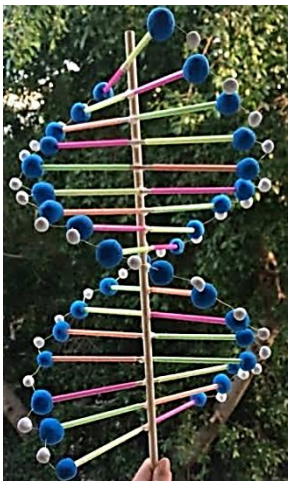
Direction. Read and understand the statements. Write the word TRUE if the statement is correct. If the statement is false change the underlined word/s to make the statements correct. Write your answers on the provided answer sheets.

1. A chromosome is composed of two sister chromatids joined together by a structure called arm.
2. A gene is a short section of DNA in the chromosomes.
3. Each gene carry a specific trait or information to be transmitted.
4. A person has two copies of genes, one from each parent.
5. Genotype is the physical expression of genes.
6. The set of genes carried by the organism is called a genotype.
7. Alleles are pair of genes that control a trait.
8. The inherited characteristic that is determined are called traits.
9. The structure of DNA is described as double helix.
10. Nitrogenous bases serve as the backbone of the DNA.

Enriching the Skill

Direction: Construct a DNA model using materials available in your area (like aluminum wire, used straw, yarn, modelling clay or used styro). You can base your work from the sample pictures provided. If it is possible, document your work and pass the picture of the finished model. If it is not possible, pass your model through learning partner. The criteria for scoring are provided below.

Source: www.coreknowledge.org.uk retrieved on July 15, 2020



Source: https://www.pinterest.ph retrieved on July 15, 2020

Criteria	5	4	3	2
Creativity	Model show excellent creativity	Model show good creativity	Model show creativity	Model lacks creativity
Concept/Ideas presented	Model clearly present the concept, self-explanatory with complete parts	Model clearly present the concept, self-explanatory and misses some parts	Model vaguely present the concept and misses most parts	Model miss the concept and parts

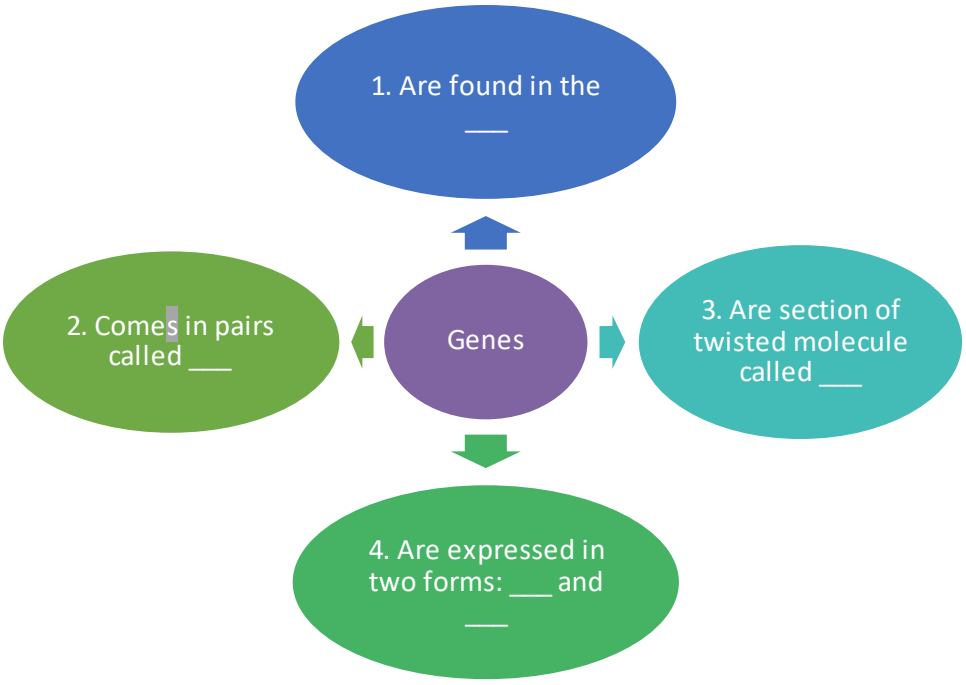
Lesson
3

Non-Mendelian Inheritance

In Grade 8, you have learned that Mendelian inheritance show patterns of dominant and recessive genes. Dominant genes are usually expressed than recessive genes. But do you think all traits inherited from parents follow the Mendelian inheritance? What about traits that express two or more phenotypes? How do these traits are transmitted from one generation to another generation? Let us find out in the next lesson.

Connecting to the Past

Activity. Interpret and complete the graphic organizer below. Write your answers on the provided answer sheets.



Gearing Up to Start

What happens if traits are neither dominant nor recessive? What will be the phenotype of the resulting generation? Are genes only controlled by a dominant or recessive allele? Recall how you filled up the Punnett square in Grade 8 as you perform the following activity.

Answers to all activities will be written on the answer sheet provided.

Activity 1

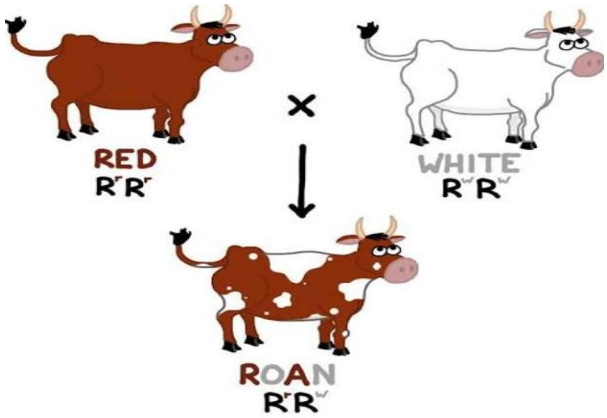
You will need water color or paint (color white and red/black), small container and plastic spoon. Materials may also be based on what is available in you place.

Pour a small amount of white colored paint in the small container. Slowly add the colored paint then mix. Observe what happens. Repeat if necessary.

Questions:

1. What is the resulting color?
2. Does the color produced differ from the original color? Why?
3. Do you think the color white and red/black disappear totally?

Activity 2. The cross below shows a red cow and a white cow. Study the given cross and answer the following questions.



Source: https://ibiologia.com, retrieved on June 30, 2020

Questions:

1. How is the appearance of the resulting cow different from its parents appearance?
2. What do you think causes the patches on the skin of the cow?
3. Do you think the cow has inherited the characteristics of its parents?

Activity 3. Below is a given cross of the same blood type between individuals. Study the Punnett Square and answer the questions that follow.

	A	**B**
A	**AA**	**AB**
B	**AB**	**BB**

Question:

1. How many offsprings have phenotype AA? AB? B?
2. What is the probability of an offspring to inherit the parents blood type?

Activity 4. Below is a picture of a group of people. Observe carefully the picture and answer the following questions.

Source: *You Tube: Polygenic inheritance, retrieved on June 30, 2020*

Questions:

1. Are the people in the picture of the same origin?
2. Do they have the same skin colors? Why?

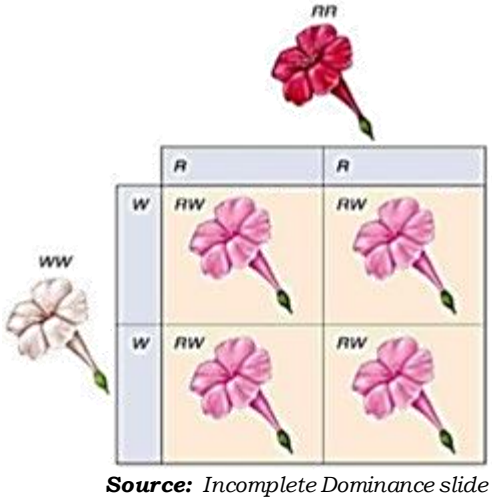
Activity 5. Illustrate the given cross below using a Punnett Square.

Females have XX sex chromosomes while males have XY sex chromosomes. Supposing a normal male marry a woman with a disorder in one of the X- chromosome, is there a possibility that they can have a child with a disorder?

Hitting the Target

INCOMPLETE DOMINANCE

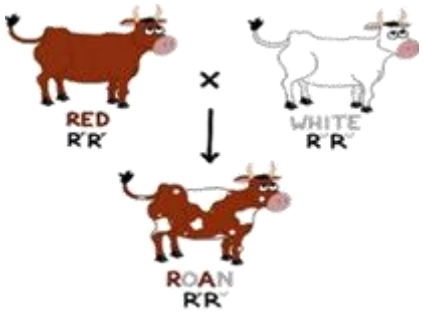
In activity 1, you have produced a pink/gray color because the white and red/black color blended together. When an allele for a particular trait is not completely dominant over the other allele and is inherited, it results to a third phenotype in which the expressed physical trait is a combination of both parents. This is **incomplete dominance**. An example is the cross between the white flower and the red flower producing a pink flower in the figure below. In incomplete dominance, only the phenotype is intermediate. The alleles for the white and red remains separate and distinct. Half the gametes of pink flower carry the allele for red and half carry the allele for white.



Source: *Incomplete Dominance slide share, retrieved on June 22, 2020*

CODOMINANCE

In **codominance**, the traits of the parents are equally expressed in the phenotype of the resulting heterozygote. This results when one allele is not dominant over the other allele. For example, when a red bull was crossed with a white cow, the resulting heterozygote shows both the traits of the parents. In this particular example of cows, the resulting offspring exhibits roan fur color. **Roan** means there are blotches or patches of red and white furs.



Codominance pattern in cattle
Source: https://ibiologia.com, retrieved on June 30, 2020

MULTIPLE ALLELES

There are cases wherein not only two types of alleles control a trait. There may be more than two types which can lead to more than two phenotypes expressed. This is **multiple alleles** where more than two alleles can code for a single gene. One example is the ABO blood system in humans. There are three possible alleles in the ABO blood system: I^A, I^B and ***i***. The alleles I^A and I^B are dominant over the allele ***i***, which is a recessive. When alleles I^A and I^B are inherited together, they are both expressed equally thus they are also codominant. The ABO blood type has two antigens: A and B. Allele ***i*** does not code for an antigen. There are four possible phenotypes of human blood system as presented below.

The Human ABO System

Blood Types	Genotypes
A	$I^A I^A$, $I^A i$
B	$I^B I^B$, $I^B i$
AB	$I^A I^B$
O	***ii***

POLYGENIC INHERITANCE

If multiple alleles are controlled by two or more traits, there is also a character controlled by more than one gene. When two or more genes affect a single character, this is called **polygenic inheritance**. For example, the human skin color. The color of the skin depends on the amount of melanin present. There are genes that have alleles which promote melanin production and there are alleles which do not. Black skin has more melanin production while fair skin has less. Environment also may influence the traits. For example, in coat color of rabbit, the pigmentation may be influenced from where the habitat of the rabbit.

The polygenic inheritance of skin color

Source: *You tube, Polygenic* inheritance (*IB Biology), retrieved on July 1, 2020*

SEX-LINKED TRAITS

The inheritance of some characters may not follow the law of independent assortment. There are traits that are inherited together and the expression depends on whether one is male or female.

A **sex-linked trait** is a trait brought by the sex chromosomes commonly the X-chromosomes. Since females have two X-chromosomes, they may either inherit the trait or carry the trait. Males have one X-chromosomes so if they inherit an affected X-chromosomes, they will show the disorder. Example of sex-linked is the color-blindness or the inability to identify true colors. For female, she must be homozygous (both X chromosome carry the disorder) for the color-blind genes to become color-blind. If it is only one x chromosome, she is only a carrier. Since males have one X chromosome, when they inherit the X chromosome that carry the genes, they are affected by the disorder. The table below shows phenotype and genotype for colorblindness.

GENOTYPE	PHENOTYPE
1. XX	Normal female
2. X^CX	Normal, carrier female
2. X^CX^C	Color-blind female
4. XY	Normal male
5. X^CY	Color-blind male

However common X-linked traits of males also carry Y-linked traits. An example is the *hypertrochosis pinnae auris*. This is a genetic disorder in humans that causes hairy ears. Since this is carried by Y chromosomes, if the father has the disorder, all his sons will inherit the trait. The figure below shows the example of Y-linked traits.

There are far fewer Y-linked than X-linked genetic disorders

This is not surprising given that the Y chromosome is smaller and has many less genes than the X chromosome.

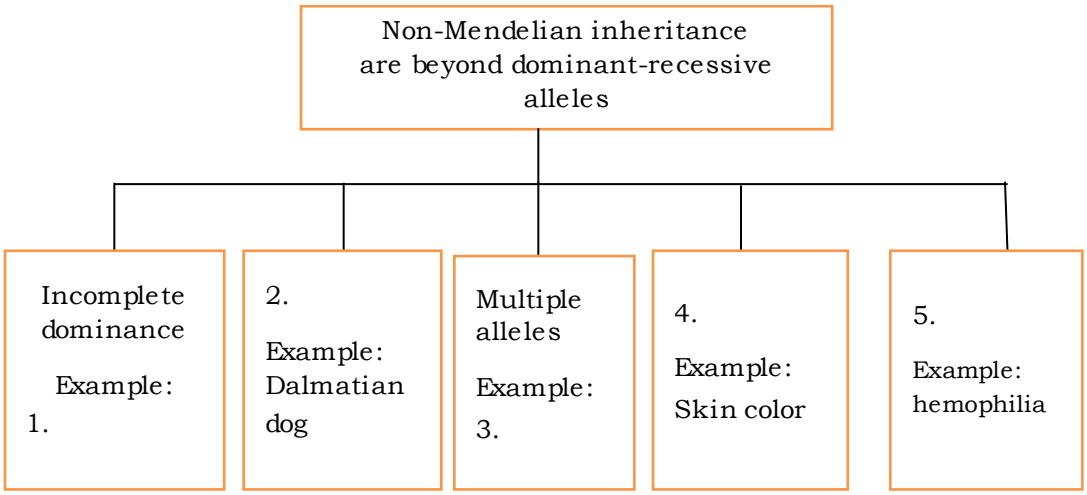
Y-linked inheritance shows a pattern of transmission of the mutant phenotype from father to son, and it is never observed in females.

An example of a Y linked phenotypic trait is hairy ears.

Source: https://slideplayer.com, Sex linkage and pedigree, retrieved on July 14, 2020

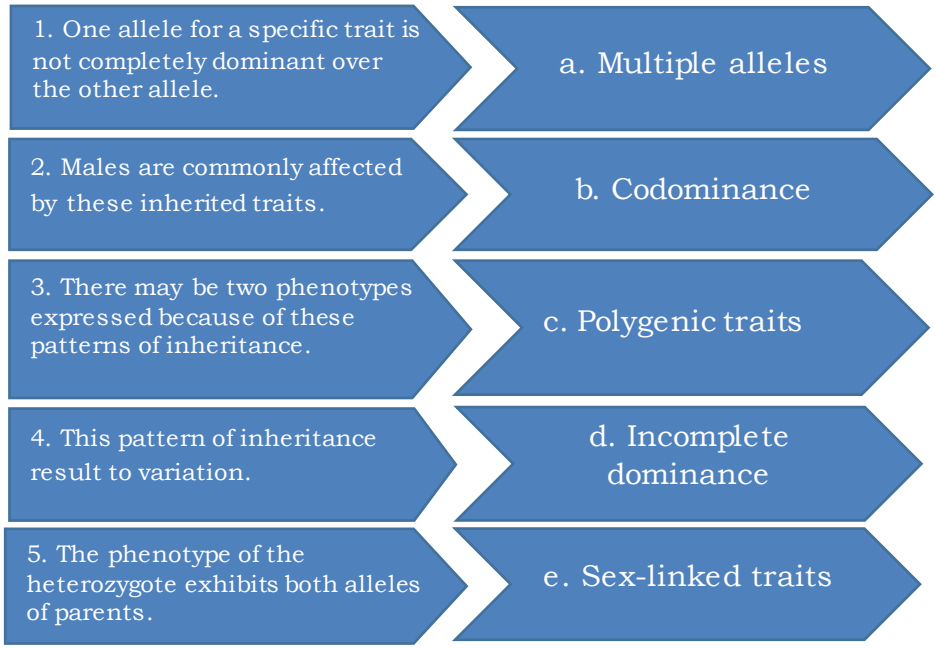
Strengthening the Grasp

Direction. Fill up what is missing in the statement to complete the concept map. Write your answers on the answer sheet provided.



Wrapping Up to Go

Direction. Read carefully the statements about non-Mendelian inheritance inside the block arrows. Then match it with the correct non-Mendelian patterns written on the opposite block arrows. Write your answers on the provided sheet.



Relating to Real Life

Suppose your brother owns a dog with a fur of pure white and he wants to have puppies with beautiful patches of color. What are you going to suggest to your brother and how are you going to explain your suggestion to him? Write your answers on the answer sheet provided.

Source: *rlbbio8.weebly.com, Genetics, Ms. Blount's Biology class 8, retrieved on July 15, 2020*

Checking the Target

Direction. Read and understand the statements. Choose the letter of the best answer among the choices given on the answer sheet provided.

1. There are at least five non-Mendelian patterns of inheritance. Which pattern shows intermediate phenotype of offspring from parents?

a. incomplete dominance b. codominance
c. multiple alleles d. polygenic traits

2. Phenotype is the observable inherited traits. What will be the phenotype of the offspring when two pink flowers are crossed?

a. red and white b. red, pink, white c. pink and red d. red only

3. In ABO blood system, blood type O has recessive allele. What is the probability of having type O child if the cross is between a heterozygous blood type A and heterozygous blood type B?

a. 75% b. 50% c. 25% d. 0%

4. Supposing a checkered (black/white) hen is crossed with a black rooster, what will be the offspring?

a. 100% black b. 75% black, 25% checkered
c. 75% checkered, 25% black d. 50% black, 50% checkered

5. Hemophilia is a blood disorder carried by the X chromosomes. What type of inheritance is hemophilia?

a. multiple alleles b. codominance
c. sex-linked traits d. polygenic traits

6. In sex-linked traits, who are often affected by the disorder and who are the carriers?

a. female, male b. male, male c. female, female d. male, female

7. When two or more genes affect a single character it is polygenic traits. Which of the following does not follow polygenic inheritance?

a. skin color b. height c. blood type d. skin color

8. Skin color is an example of polygenic inheritance. Which of the following describes polygenic inheritance?

a. The traits exhibit variation b. There are two distinct phenotypes
c. The traits are intermediate d. The traits are expressed on males only

For numbers 11-15, refer to the Punnett Square below showing the cross between a heterozygous blood type A and blood type B.

	I^B	i
I^A	$I^A I^B$	$I^A i$
i	$I^B i$	$i\ i$

9. What is the probability of having a heterozygote offspring?

a. 25% b. 50% c. 75% d. 100%

10. What is the chance of producing a blood type O child?

a. 25% b. 50% c. 75% d. 100%

Enriching the Skill

Answer the following problem using the Punnett Square. Write your Punnett Square on the provided answer sheet.

1. Suppose you marry a person with blood type O. Your blood type is AB. What are the possible blood types of your offspring?

	i	i
A		
B		

2. Supposing a mother is a carrier of the disorder color blindness and her husband has normal vision. What is the probability that they will have a colorblind child?

	X	Y
X		
X^c		

Finding the Score

Lesson 1. Fertilization

Trying the Challenge

1. c
2. d
3. c
4. a
5. d
6. b
7. c
8. b
9. c
10.c

Connecting the Past

1. 4/four
2. 4/four
3. one egg cell and one sperm cell

Gearing up to Start

Possible answer

1. Through the process of fertilization
2. Fertilization is the union of egg cell and sperm cell to form a zygote
3. It contains 46 chromosomes, 23 from each parent

Strengthening the Grasp

Possible answers

1. The two haploid gametes will meet.
2. The nuclei of the two gametes unite through fertilization.
3. A diploid zygote is formed.

Wrapping up to Go

1. gametes/sex cells
2. sperm cell
3. egg cell
4. haploid
5. 23
6. n
7. zygote
8. diploid
9. 46
10. 2n

Relating to Real Life

Possible answers

1. Haploid is needed so that the number of chromosomes in the offspring will not exceed
2. Fertilization is important to continue life

Checking the Target

1. d	6. a
2. b	7. c
3. a	8. d
4. c	9. a
5. b	10. c

Enriching the Skill

A

1. c
2. a
3. b

B.

Egg cell + Sperm cell——

— Fertilization → Zygote

Lesson 2. Location of Genes in the Chromosomes

Connecting the Past

Possible answers

1. nucleus of the cell
2. double stranded
3. Centromere joins the sister chromatids
4. p arm, q arm
5. hereditary characters

Gearing up to Start

A. Possible answers

1. a. chromosome
   b. centromere
   c. genes
2. The yarn seems to be twisted
3. Genes are twisted around the chromosomes

B. Possible answers

1. sugar, phosphate, base pair
2. C always pair with G, A always pair with T
3. Sugar and phosphate
4. So they can be packed in the chromosomes

Strengthening the Grasp

A.

1. sister chromatids
2. p arm
3. centromere
4. q arm
5. DNA molecules

B.

1. centromere
2. nucleus
3. DNA
4. traits
5. pairs

Wrapping up to Go

1. thread-like
2. centromere
3. chromosomes
4. nucleus
5. DNA
6. deoxyribonucleic acid
7. hundreds/thousands
8. phenotype
9. genes/alleles
10. double helix

Relating to Real Life

(answers of students may vary)

Checking the Target

1. False – centromere
2. True
3. True
4. True
5. False - phenotype
6. True
7. True
8. True
9. True
10. sugar/phosphate

Enriching the Skill

Please refer to the rubric presented in the activity page

Lesson 3. Non-Mendelian Inheritance

Connecting the Past

1. chromosomes
2. alleles
3. DNA
4. phenotype, genotype

Gearing up to start

Possible answers

Activity 1

1. pink/gray
2. Yes, the color appears different from the original color
3. No, the color just blended together

Activity 2

1. The offspring exhibits both colors of the parents
2. The patches may be caused by the combination of parents' colors
3. Yes because it can be seen on its appearance

Activity 3

1. one AA, two AB and one B
2. 50% probability

Activity 4

1. No, because they have different looks
2. No, they have different colors because they may come from different places

Activity 5

The Punnett Square shows there is 50% probability that they can have a child with a disorder.

Strengthening the Grasp

1. Red flower and white flower produces pink flower
2. Codominance
3. ABO blood type
4. Polygenic inheritance
5. Sex-linked traits

Wrapping up to go

1. d
2. e
3. a
4. c
5. b

Relating to Real Life

I will suggest to him to breed the dog with pure brown furred dog or other pure colored dog so the puppy will have a chance to have patches of colors and explain to him by showing the probable result of the crosses using Punnett Square.

Checking the Target

1. a
2. b
3. c
4. d
5. a
6. d
7. c
8. a
9. b
10. a

Enriching the Skill

1.

Blood types A and B

2.

25% probability

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Science 9 Teacher's Guide, Department of Education

ANSWER SHEET

LESSON 1: THE PROCESS OF FERTILIZATION

NAME: _____

GRADE LEVEL: _____ **SECTION:** _____

1.	3	5.	7.	9.
2.	4.	6.	8.	10.

1.
2.
3.

1.
2.
3.

1.
2.
3.

ANSWER SHEET

LESSON 2: LOCATION OF GENES IN THE CHROMOSOMES

NAME: _____

GRADE LEVEL: _____ **SECTION:** _____

1. 4.
2. 5.
3.

A. 1 a. b. c.

2.
3.

B1.
2.
3.
4.

A1. 4.
2. 5.
3.

B1. 4.
2. 5.
3.

ANSWER SHEET

Lesson 3: Non-Mendelian Inheritance

NAME: _____

GRADE LEVEL: _____ **SECTION:** _____

1. 3.

2. 4.

Activity 1

1.

2.

3.

Activity 2

1.

2.

3.

Activity 3

1.

2.

Activity 4

1.

2.

Activity 5

ANSWER SHEET

1. 3. 5.
2. 4.

1. 2. 3. 4. 5.

1. 3. 5. 7. 9.
2. 4. 6. 8. 10.

1.

2.

For inquiries or feedback, please write or call:

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