LA IMMACULADA CONCEPCION SCHOOL
SENIOR HIGH SCHOOL
GRADE 11 – STEM: GENERAL BIOLOGY

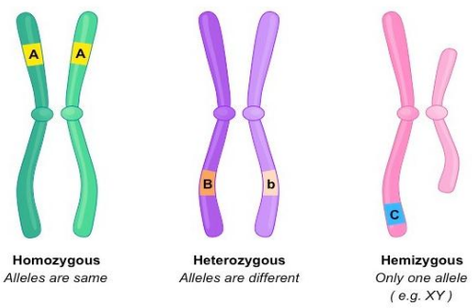
MARCH 30- APRIL 20-24, 2020
TOPIC: Sex Linkage

Overview

Sex linkage is different from genetic linkage; **Sex linkage** is the association of genes to the sex chromosome, which is either the X chromosomes in both male and female, or the Y chromosome in males. In other words, traits that are sex linked are passed on to the offspring by the 23rd chromosome of the sex chromosome rather than by any of the autosomes (1-22).

Sex linkage was discovered by **Thomas Hunt Morgan** in 1910 when he observed male flies with white eye color. In his experiment, he crossed a wild female with red eyes with males with white eyes. The offspring in the first filial generation exhibited a wild type phenotype for both sexes. Male and female flies from the first filial generation were "selfed", producing a varied phenotype of flies in the second filial generation. Morgan observed that all the female flies were wild type, half of the male flies were wild type, and another half of the males were with white eye. He concluded that the white eyes. He concluded that the white eye trait is recessive and is only expressed in males.

Morgan proposed the following in relation to this experiment. First, the allele for white eye is located in the X chromosome but not on the Y chromosome. Second, the male offspring gets the X chromosome from the female and not from the male parent. Accordingly, this study of Morgan provided the first ever experimental evidence for the claim that genes are located on chromosomes.



The realization that the sex chromosome carries traits that are passed on to the offspring gave way to the third term in describing genotype. Remember that the term homozygous refers to a chromosome carrying similar alleles for a gene while the term heterozygous carries dissimilar alleles for a gene. The third term Hemizygous is used to refer to genes located in heteromorphic chromosomes that will not follow the parental equivalence rule because the X and Y chromosomes are not homologous to each other. Traits or genes that are found in the X chromosome most often do not have a counterpart on the Y chromosome.

The Most Common Examples Of X-Linked Disorders In Humans

Disorder	**Gene**	**Phenotype**
Deuteranopia	GCP	Green color blindness
Protanopia	RCP	Red color blindness
Hemophilia A	F8C	Lacks clotting factor VIII

Hemophilia B	F9	Lacks clotting factor IX
Fragile X syndrome	FMR1	Deficiency of functional FMR1 protein
G6PD deficiency	G6PD	Anemia after specific exposure
Duchenne muscular dystrophy	DMD	Progressive muscle deterioration
Ocular albinism	OA1	Deficiency in eye pigments affecting visual acuity
Congenital stationary night blindness	CSNB1	Difficulty in vision at lower light intensity
X-linked deafness	DFN1, DFN2, DFN3	Deafness
Severe combined immunodeficiency	SCIDX1	Failure of the immune system

HighLights

- Linkage refers to the proximity of alleles of genes to each other which affects their inheritance pattern.
- Sex linkage refers to traits that are found in the X and Y chromosomes.
- Sex-linked traits are usually expressed in males since Y chromosome genes are not homologous to the genes in the X chromosomes.
- Y chromosome has less than 50 set of genes.
- Colour blindness and hemophilia are the most common sex-linked traits affecting more males than female

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ACTIVITY 1
Recombination Model

Objective

To simulate sex linkage learning through an art work using available materials at home.

Materials

Beads of 10 different colors. (beads can be replace by a DIY paper bead through Pinterest and YouTube)
Pliable wire (any ductile wire that can manipulate without the use of fliers (e.g. old notebook springs)\

Procedure

1. Using materials given make a model of homologous chromosomes that have no crossed-over genes.

2. Make a second model of homologous chromosome in the process of crossing over.

3. Make a third model of homologous chromosome after crossing over.

4. Stick your models in a used illustration board with proper captions.

5. Ask a member of a family to take a photo of you holding your work with date and time insert on it .

6. Wait for further announcements as to how you are going to submit your work

Guide Questions

1. What color or beads represents linked and unlinked genes? Why?

_____

_____

_____

_____

2. What color or beads represents genes involved in the crossover? What is the significance of exchanging segments of genes of one chromosome to its homologue?

_____

_____

_____

_____

3. In humans, identify genes that are linked which affect inheritance patterns. (This may take a little research).

_____

_____

_____

_____

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ACTIVITY 2
Chapter test

A. Multiple Choice : Choose the letter of the correct answer.

1. Which refers to the physical or chemical traits expressed in an individual?

    a. genotype

    b. phenotype

    c. allele

    d. homozygous

2. This is one way of creating variations in hybrid organisms

    a. cross

    b. pedigree

    c. inheritance

    d. link

3. Which of the following shows a systemic listing of individuals from one generation to another?

    a. cross

    b. pedigree

    c. inheritance

    d. link

4. It is the association of genes to the sex chromosome

    a. genetic linkage

    b. sex linkage

    c. homozygous

    d. heterozygous

5. In this stage, homologous chromosomes undergo a crossing over

    a. meiosis I

    b. meiosis II

    c. mitosis

    d. prophase

QUESTIONS AND PROBLEMS

1. Research on the Human Genome Project. Write a brief essay explaining its significance.

2. What are X-linked genetic disorders? Cite an example and discuss its symptoms.

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ACTIVITY 3

Critical-Thinking Questions

Answer the following

1. Is sex determined in humans?

2. Discuss the inheritance of hemophilia.

3. Briefly explain how sex linkage happens

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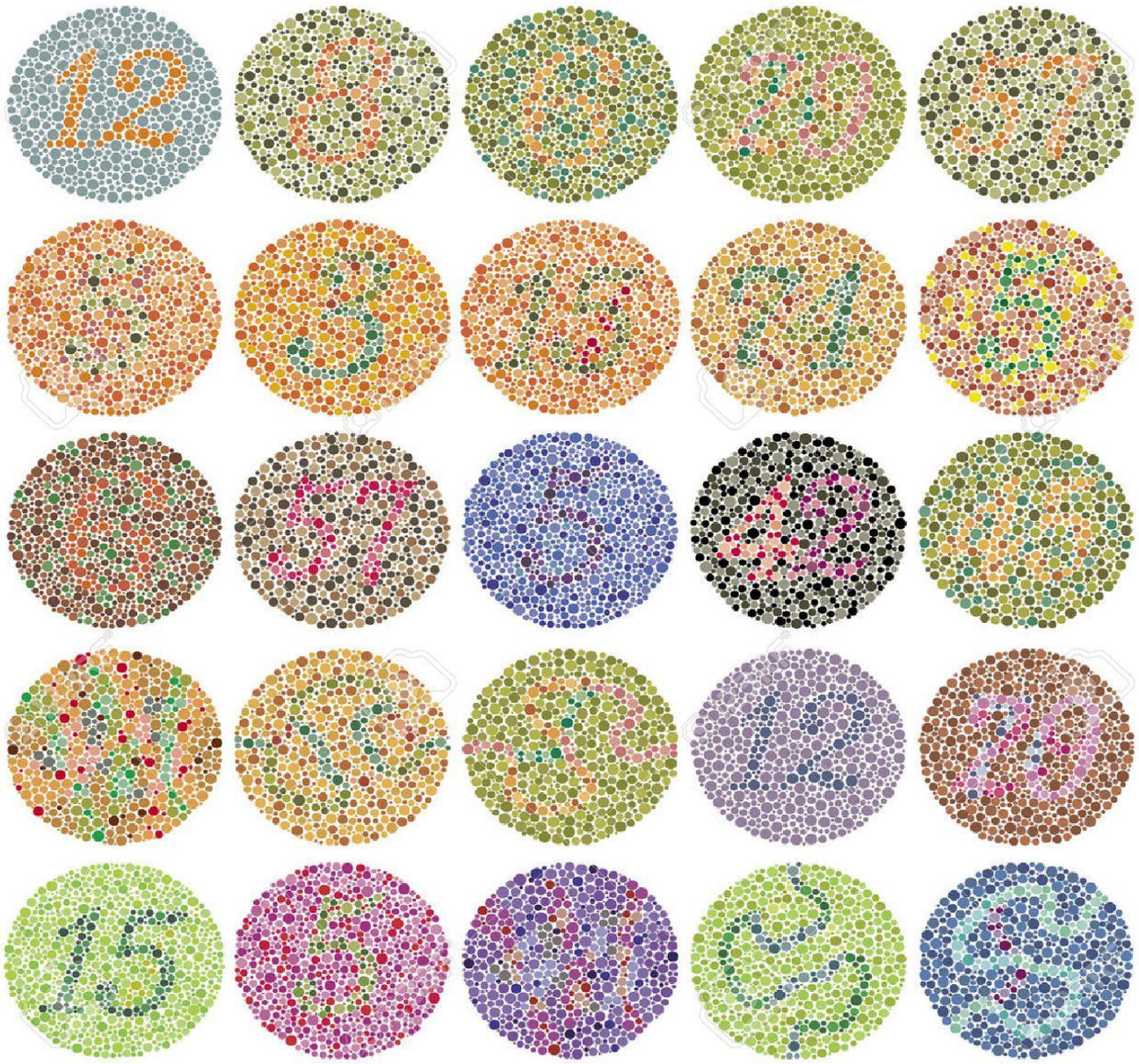
ACTIVITY 4
The Ishihara Test

Self –Check

Dr Shinobu Ishihara introduced in 1917—almost 100 years ago—the most well-known color blindness test. Each of his tests consists of a set of colored dotted plates, each of them showing either a number or a path. Try it yourself or members of your family and be surprised with the result…



Person with normal vision will often see a number at the middle of the PIP (Pseudo-Isochomic Plates) whereas those with social blindness will not recognize any number or will see a different number. This sex linked disorder can only be hand on by a female parent to a male offspring.