TENDER HEART HIGH SCHOOL, SEC-33B, CHD

CLASS - 10 [BIOLOGY] 22.07.2024

CHAPTER - 3 TEACHER Nidhi Rane

CHAPTER-3 GENETICS- Some basic Fundamentals

SEX-LINKED INHERITANCE - is the appearance of a trait which is due to the presence of an allele exclusively either on 'X' or 'Y' chromosome.

X Linked inheritance - Certain diseases like colour-blindness and haemophilia are due to recessive genes which occur exclusively on X chromosome.

Colour blindness - in which affected Individual cannot differentiate between certain colours mostly red and green.

Haemophilia is a genetic diseases in which the sufferers are at risk of bleeding to death because the blood fails to clot in them.

These genetic diseases occur in an individual as-

(i) Homozygous recessive female - because being a recessive trait it will be observed only in homozygous condition Hence

$X^c X$ - Normal female

$X^c X^c$ - Colour blind female

X^c - Colourblindness gene on X chromosome (recessive)

X - Normal gene on X chromosome (dominant)

(ii) In males it is expressed if it is present on X as-

XY - Normal male

$X^c Y$ - Colour blind male.

To elaborate let us see the following cases -

CASE I

$X^c Y$ (Colour blind father)

Male gametes

♀ \ ♂	X^c	Y
X	XX^c	XY
X	XX^c	XY

XX - Normal Mother. (Female gametes)

XX^c - hetrozygous dominant i.e. Normal female

XY - Normal male

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CASE - 2

XY (Normal father)

(Carrier mother) X^cX

♀ \ ♂	X	Y
X^c	X^cX	X^cY
X	XX	XY

X^cX - Carrier daughter
X^cY - Colourblind son
XX - Normal daughter
XY - Normal son

Case 3

X^cY (Colourblind father)

(Carrier mother) X^cX

♀ \ ♂	X^c	Y
X^c	X^cX^c	X^cY
X	XX^c	XY

X^cX^c - Colourblind daughter
X^cY - Colourblind son
XX^c - Carrier daughter
XY - Normal son.

Mendel's Experiment on inheritance

Gregor John Mendel was an Australian monk who conducted his experiments on garden pea - Pisum sativum He chose pea for 3 reasons -

i) Many varities were available in alternative forms of a character Eg Purple & white colour flower

ii) Varieties were available in pure forms that bred True i.e. produced same type generation after generation

iii) Peas are normally self pollinated but could as well be cross pollinated artificially

Mendel took varities of pea plant showing 7 pairs of contrasting features as -

Flower colour - Purple and white
Seed colour - Yellow and green
Seed Shape - Round and wrinkled
Pod colour - Green and yellow
Pod shape - Inflated and constricted
Flower Position - Axillary and Terminal
Plant Height - Tall and dwarf.

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Mendel crossed pure breeding varities first by taking only one feature at a time - Monohybrid cross

Monohybrid cross- A cross between two pure breeding different varities of an organism taking the alternative traits of one single character

Eg a cross between pure tall TT and dwarf tt pea plants is shown below -

TT (Tall) × tt (dwarf) Parents

↓

F1 generation → Tt [Heterozygous Tall]

Male gametes

♀ \ ♂	T	T
t	Tt	Tt
t	Tt	Tt

Female gametes

F2 generation: TT (Pure Tall), Tt, Tt (Hybrid Tall), tt (Pure dwarf)

Male gametes

♀ \ ♂	T	t
T	TT	Tt
t	Tt	tt

Female gametes

Genotypic Ratio = 1:2:1 = TT: Tt: tt

Phenotypic Ratio = 3:1 = Tall: dwarf

The above monohybrid cross shows -

1) When the pure breeding tall TT and dwarf tt plants are cross bred then the first generation ie. F1 generation offsprings are all same ie. -

F1 generation - Phenotype - Tall

Genotype - Tt [Heterozygous tall]

2) When the F1 generation offsprings are self pollinated among themselves then in second generation ie. F2 generation offsprings are -

F2 generation - Phenotypic ratio = 3:1 = Tall : dwarf

Genotypic ratio = 1:2:1 = TT: Tt: tt

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Dihybrid cross. A cross between two parents taking into consideration alternative traits of two different characteristics / characters.
For Eg. Cross between Tall Round and yellow seeds with wrinkled and green seeds. is shown below -

RRYY x rryy
(Round & yellow seeds) [Wrinkled & green seeds]

F1 generation → RrYy
[Heterozygous Round & yellow seeds.]

← Male gametes →

F2 generation

♀ \ ♂	RY	Ry	rY	ry
RY	RYRY	RYRy	RYrY	RYry
Ry	RyRY	RyRy	RyrY	Ryry
rY	rYRY	rYRy	rYrY	rYry
ry	ryRY	ryRy	ryrY	ryry

(Female gametes)

Genotypic ratio = very complex
Phenotypic ratio = 9:3:3:1 =
= Round & yellow: Round & green: wrinkled & yellow : wrinkled & green.

From above dihybrid cross it is clear that -
1) When pure breeding Round & yellow seeded pea plant is crossed with wrinkled & green seeded pea plant then F1 generation offsprings have -
Phenotype - All Round & yellow seeds
Genotype - RrYy [heterozygous round & yellow seeds]

2) When the F1 generation offsprings are cross bred then the offsprings have - F2 generation -
Phenotypic ratio = 9 : 3 : 3 : 1.

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Mendel tried several combinations. Every time with any contrasting characters the outcome i.e. phenotypic and genotypic ratios remained same.

MENDEL'S LAWS OF INHERITANCE

(i) Law of dominance - "Out of a pair of contrasting characters present together, only one is able to express itself while the other remains supressed." The one that expresses is called dominant character & the one unexpressed is the recessive. The recessive character can express only when the pair contains / consists of both recessives.

(ii) Law of segregation - "The two members of a pair of factors separate during the formation of gametes" They donot blend but segregate or separate into different gametes Gametes combine together by random fusion at the time of zygote formation

iii) Law of Independent Assortment - When there are two pairs of characters, the distribution of the alleles of one character into the gametes is independent of the distribution of the alleles of the other character.

Application of Mendel's Laws

1) A Knowledge of basic Mendelian principles gives us an idea about the new combinations in the progeny of hybrids and enables us to pridict their frequency

2) With this information plant & animal breeders may produce better breeds.

3) New types of plants with new combinations of useful characters can be produced by hybridisation.

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Mutation is sudden change in one or more genes or in the number or in the structure of chromosomes It alters the hereditary material of an organism's cell and results in change in certain characters or traits. Eg

i Sickle cell anaemia - is a blood disease caused by gene mutation (resulting in change in DNA) resulting in the production of sickle shaped RBCs.

2) Radioactive radiations may cause mutation that is seen generation after generation Atomic explosion in Japan led to a number of deformities in the body of plants and animals which are still persisting.

NOTE FOR STUDENTS

Kindly go through the notes and chapter as being discussed in your text book.
It may take several readings to grasp the topics discussed in the chapter

HOME ASSIGNMENT

Do the following Review Questions given on Page 35 (of your text book) in your notebook

C. Short Answer Type
QNo. 4.

D Descriptive Type
QNo. 3

E Structured / Application / Skill type
QNo 1, 2 and 3