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DEPARTMENT OF MEDICAL BIOLOGY

Lecture Mendel's Laws Genetic Interections

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QUESTIONS

- -Mendel's Laws:
- *Law of Dominans
- *Law of Segregation
- *Law of Independent Assortment
- -Genetic Interactions: allelic and non allelic
- - Multiple Alleles

Gregor Mendel was:

- a young priest
- a science and math teacher

Mendel formed the foundation of genetics, the scientific study of heredity.

Gregor Mendel
is a Father of Genetics

What he did…..

- He used pea plants because **they have many traits that exist in only two forms.** (tall/short, green seed/yellow seed) and they were self pollinating
- He decided to cross plants with opposite forms of a trait, for example, tall plants and short plants.

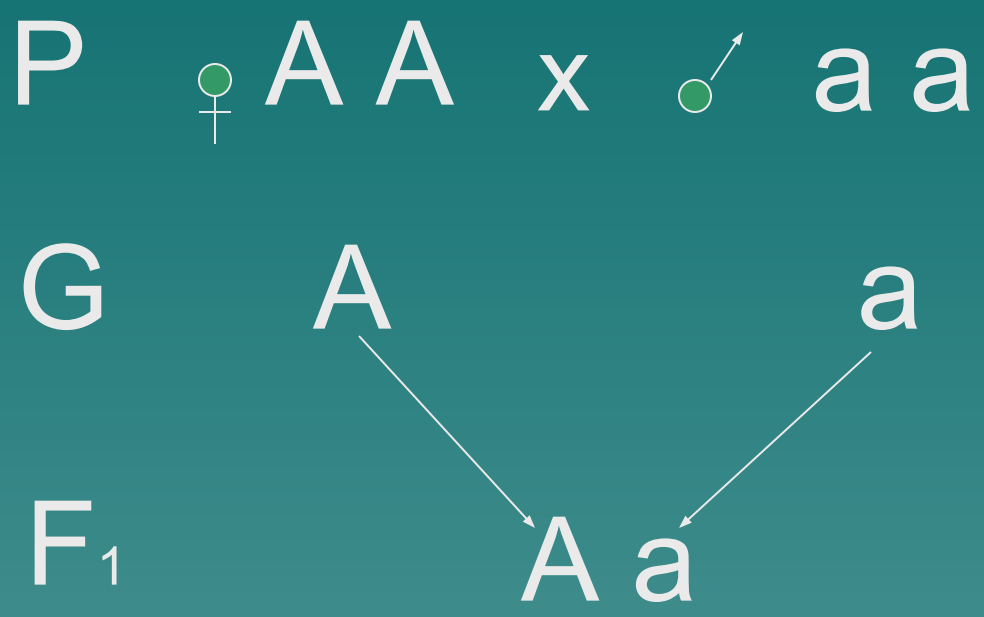
- He started with purebred (always produces offspring with the same form of a trait as the parent)

- By using purebreds he knew that the offspring's traits would always be identical to that of the parents.

First Experiment (P generation)

- Crossed purebred tall plants with purebred short plants. He called it the parental generation or P generation.
- He called the offspring from this cross the first filial generation (F1) filial meaning "son of".
- In the F1 generation all the plants were tall. The shortness trait had disappeared.

Monohybrid Cross



Law of Dominance

In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation. All the offspring will be heterozygous and express only the dominant trait.

Next experiment

- He allowed the F1 plants to self pollinate
- In the F2 generation there was a mix of tall and short plants.
- This occurred even though the parents were all tall.
- He found that ¾ of the plants were tall and ¼ of the plants were short.

F_1 ♀ A a x ♂ A a

G

♀ \ ♂	A	a
A	A A	A a
a	A a	a a

F_2 A A A a A a a a

3 : 1(phenotype)

P ♀ A A x ♂ a a

G A a

F_1 ♀ A a x ♂ A a

G

♀ \ ♂	A	a
A	A A	A a
a	A a	a a

F_2 A A A a A a a a

1 2 1

Law of Segregation

- During the formation of gametes, the two alleles resposible for a trait separate from each other.

Dihybrid Cross

P ♀ AA BB x ♂ aa bb

G AB ab

F_1 Aa Bb

100%

F_1 ♀ Aa Bb x ♂ Aa Bb

G

♀ \ ♂	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

F_2 9 3 3 1

Dihybrid Cross

Law of Independent Assortment

- Alleles for different traits are passed to offspring independently of one another

He concluded that:

- individual factors must control the inheritance of traits in peas.
- They exist in pairs and the female parent contributes one factor while the male parent contributes the other.

Today we call those factors that control traits genes.

They call the different forms of gene alleles

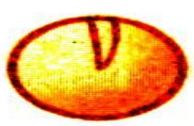
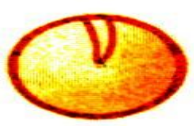
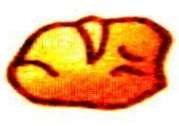
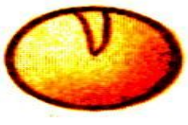
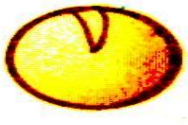
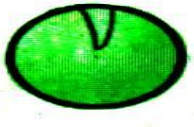
Genetic Interections

The phenomen to alter the phenotypic expression of a gene by the influence of other genes is called Interaction of Genes.

Allelic interaction – is interaction between two alleles of the same gene to change the phenotype:

- complete dominance,
- incomplete dominance,
- codominance,
- multiple alleles.

Full Dominance – one of the alleles is dominant and the other recessive

Гаметы ♂ / Гаметы ♀	AB	Ab	aB	ab
AB	 AABB	 AABb	 AaBB	 AaBb
Ab	 AABb	 AAbb	 AaBb	 Aabb
aB	 AaBB	 AaBb	 aaBb	 aaBb
ab	 AaBb	 Aabb	 aaBb	 aabb

Incomplete Dominance- the dominant gene fails to show complete dominancy and the hybrids appear intermediate between the two parents. This was observed by Correns in the "Four o'clock plant Mirabilis jalapa".

Co – dominance: both the alleles are equally dominant and hence express

Characters of Multiple Alleles

Multiple Alleles – more than two alleles of a gene occupying the same locus in a given pair of homologous chromosomes.

1. They always occupy the same locus in the chromosome and influence the same character.
2. Only two members of such alleles are present at a time in a diploid.
3. The wild type allele is nearly always dominant while the other mutant alleles in the series may show dominance or there may be an intermediate phenotypic effect.

Inheritance of blood groups in man.

Blood group A Blood group B

P ♀ I^AI^0 × ♂ I^BI^O

G (I^A) (I^O) (I^B) (I^O)

F_1 I^AI^B(AB), I^AI^O(A), I^BI^O(B), I^OI^O(O)

Human blood groups

Blood groups	Blood groups (phenotype)	Genotype	Antigen in RBC	Antibodies in plasma
I	0	I^0I^0	absent	α и ß
II	A	I^AI^A,I^AI^0	A	ß
III	B	I^BI^B,I^BI^0	B	α
IV	AB	I^AI^B	AB	absent

Non-allelec interaction – is interaction between alleles of different genes present on different chromosomes:

-Complementary Genes,

-Epistasis,

-Polygenic Inheritance.

Complementary Genes – one must be present for the other to have an operative effect.

A_B_ – Red
aaB_ – White
aabb – White
A_bb – White

P ♀AAbb × ♂aaBB
G Ab aB
F1 AaBb- 100% Red

P ♀AaBb × ♂AaBb
G AB, Ab, aB, ab AB, Ab, aB, ab
F 2 ***9 : 7***
Red : White

Epistasis

- Epistasis is an interactoin between two non-allelic genes in which one gene supresses the expression of another affecting the same character. The expressed gene is called epistatic, while the supressed gene is said to be hypostatic.

Dominant Epistasis (13:3) in Poultry

A_bb – Colored
aabb – White
♂AaBb
aaB_ - White
A_B_ -White
a

P ♀AaBb ×

G AB,Ab AB, Ab

aB,ab aB,ab

F2 13 : 3

Ratio white : colored

P ♀AABB × ♂aabb

G AB ab

F 1 AaBb – 100% White

Polygenic Inheritance – each gene has a certain amount of effect and the more number of dominant genes, the more pronounced is the effect.

In such inheritance the complete expression of a trait is controlled by two or more genes.

A dominant allele of each gene contributes only a unit fraction of the traits and the total phenotypic expression is the sum total or additive or cumulative effect of the dominant alleles of genes or polygenes.

Height in Man.

- $A_1A_1A_2A_2A_3A_3$ – 180 см
- $a_1a_1a_2a_2a_3a_3$ – 150 см
- $A_1a_1A_2a_2A_3a_3$
- $A_1A_1A_2a_2a_3a_3$
- $a_1a_1a_2A_2A_3A_3$

165 см

Pleiotropism.

A single gene influences more then one phenotypic trait. The phenomenon of multiple phenotypic expressions of a single gene is called pleiotropism.

In man a pleiotropic gene has a multiple effect causing a hereditary disease called phenylketonuria.

a

1. excessive quantaty of phenylalanine in urine, blood and cerebrospinal fluid
2. short stature
3. mentally deficiency
4. pigmented patches on skin
5. excessive sweating
6. non – pigmented hair and eyes