Concept of Polygenic Inheritance with Suitable Examples

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Monogenic v/s Polygenic Inheritance

Monogenic Inheritance	Polygenic Inheritance
Discontinuous variation	Continuous variation
Single allelic gene	Many non-allelic genes
Qualitative inheritance	Quantitative inheritance
F1 individual resembles dominant parent	F1 individual are intermediate between the parents
Phenotype not influenced by environment	Phenotype influenced by environment
No intermediates	Numerous intermediates
Eg: All seven characters studied by Mendel	Eg: Skin color in human, Wheat kernel color, etc.

Polygenic inheritance

- When one phenotypic character is controlled by more than one gene, it is called **polygenic inheritance**
- **Kolerenter** is known as father of polygenic inheritance
- It is also called **Quantitative inheritance**
- The quantity of inheritance depends on dominant alleles
- Dominant alleles have **cumulative effect** each expressing part of trait

- Gene involved in quantitative inheritance is known as **polygenes**
- Polygenic inheritance don't follow the **mendelian ratio**
- Eg; **skin color of man, wheat kernel colour**

Difference between Qualitative and Quantitative characters:

S. No.	Qualitative inheritance	Quantitative inheritance
1	Qualitative traits are governed by major genes, whose effects are definite.	These traits are governed by minor genes. Their effect is additive.
2	These traits are not usually affected by environmental factors.	These traits are well affected by environmental factors.
3	Clear-cut difference between the phenotypes (two extremes)	No clear-cut difference between the phenotypes. The phenotype shows a spectrum between the two extremes.
4	Inheritance of These traits results in distinct phenotypic changes (Discontinuous variation).	Inheritance of These traits results in continuous variation. Quantitative characters may not be put up in to clear cut classes. Instead, they show a spectrum of the two extremes.
5	Single gene effect (monogenic inheritance): Effect of two alleles of a single is well detected.	Effect of several genes (polygenic inheritance): Effect of individual genes is too slight to be detected.
6	Concerned with mating of individuals and their progeny	Concerned with population of organisms consisting of all possible kinds of mating
7	Analyzed by making counts and ratios	Statistical analysis gives estimates of population parameters such as mean, standard deviation, variance, etc.

Examples of Polygenic Inheritance

Human polygenic traits

- Height
- Weight
- Eye Color
- Intelligence
- Skin Color
- Many forms of behavior

*An example: wheat berry color

Skin color in Human

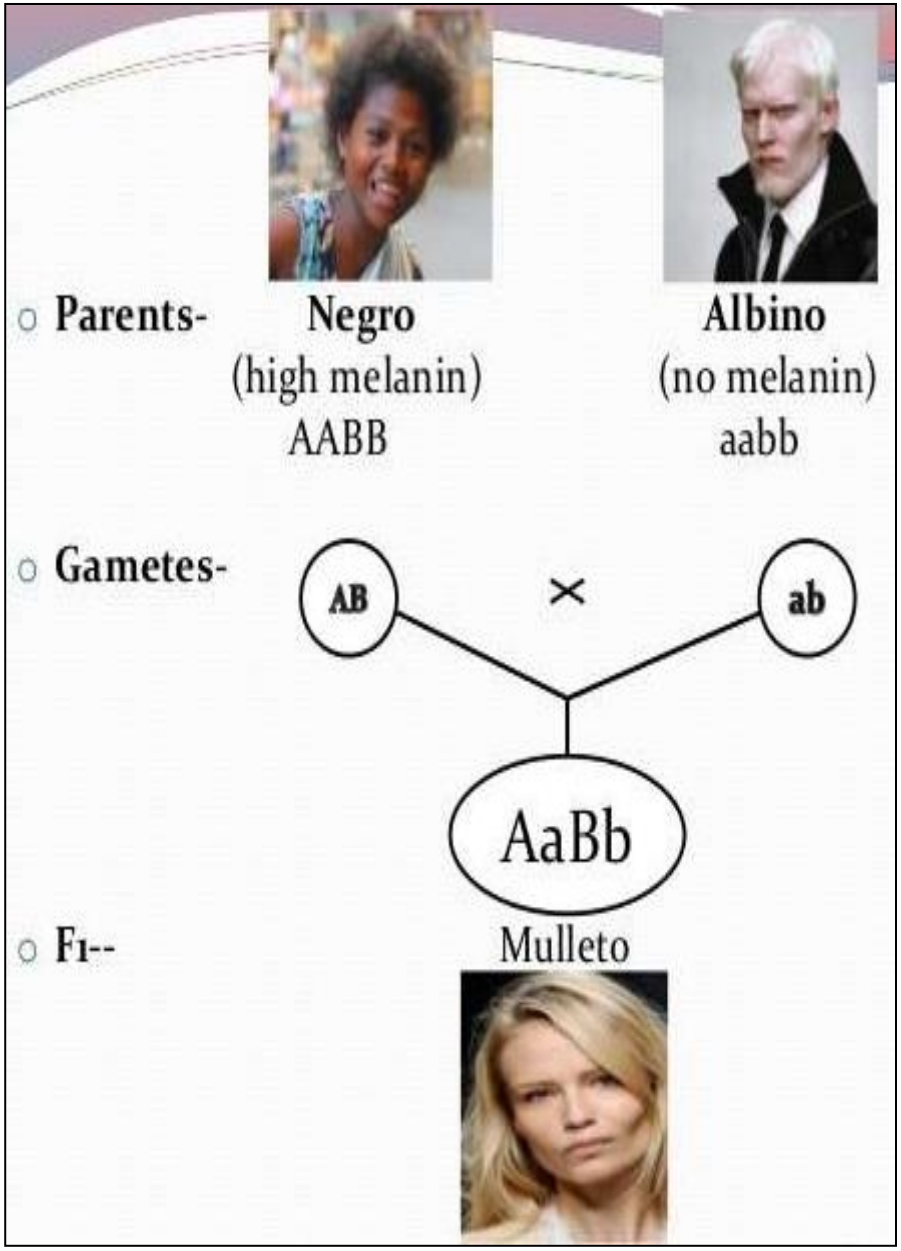
- Skin color is due primarily to the presence of a pigment called melanin
- skin color in humans is controlled by at least 3 different genes
- each gene has 2 alleles, (light/dark)
- *AABBCC* (dark) and *aabbcc* (light)
- Cross between 2 *AaBbCc* (intermediate) produces wide range of shades
- *It is believed that more than 20 genes affect skin colour in humans*

- It was first studied by **Devenport** (1913) in case of Negro-Europeian intermarriage.

- Skin colour is due to pigment melanin. **More pigment, darker is the colour.**

- There are many traits in humans, which show polygenic inheritance, e.g. skin and hair colour, height, eye colour, the risk for diseases and resistance, intelligence, blood pressure, bipolar disorder, autism, longevity, etc.
- Brief description of some of the traits:
- **Skin pigmentation:** inheritance of skin pigmentation is polygenic inheritance. Around 60 loci contribute to the inheritance of a single trait. If we take an example of a pair of alleles of three different and unlinked loci as A and a, B and b, C and c. The capital letters represent the incompletely dominant allele for dark skin colour.

- The more capital letters show skin colour towards the darker range and small letters towards the lighter colour of the skin. Parents having genotype AABBCC and aabbcc will produce offspring of intermediate colour in the F_1 generation, i.e. AaBbCc genotype. In the F_2 generation of two triple heterozygotes (AaBbCc x AaBbCc) mate, they will give rise to varying phenotypes ranging from very dark to very light in the ratio 1:6:15:20:15:6:1.



- The pigment melanin is responsible for dark coloration in the skin and there are at least three genes, which control for human skin colour. Using a hypothetical example where the production of melanin is controlled by *contributing alleles* (denoted here as A, B and C), resulting in dark skin colour, and therefore light skin colour is produced by *non contributing alleles* (denoted here as a, b and c), it is possible to see how the spectrum of different skin colours can result in the offspring.

	ABC	*ABc*	*AbC*	*aBC*	*Abc*	*aBc*	*abC*	*abc*
ABC	6	5	5	5	4	4	4	3
ABc	5	4	4	4	3	3	3	2
AbC	5	4	4	4	3	3	3	2
aBC	5	4	4	4	3	3	3	2
Abc	4	3	3	3	2	2	2	1
aBc	4	3	3	3	2	2	2	1
abC	4	3	3	3	2	2	2	1
abc	3	2	2	2	1	1	1	0