Polygenic Inheritance

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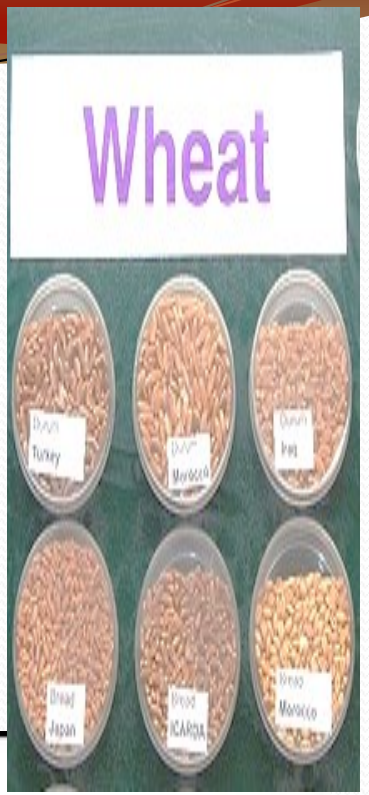
When two or more genes influence the expression of one trait

E.g.. Human Skin Colour,

Grain colour in wheat



polygenic inheritance can contribute to **continuous variation**

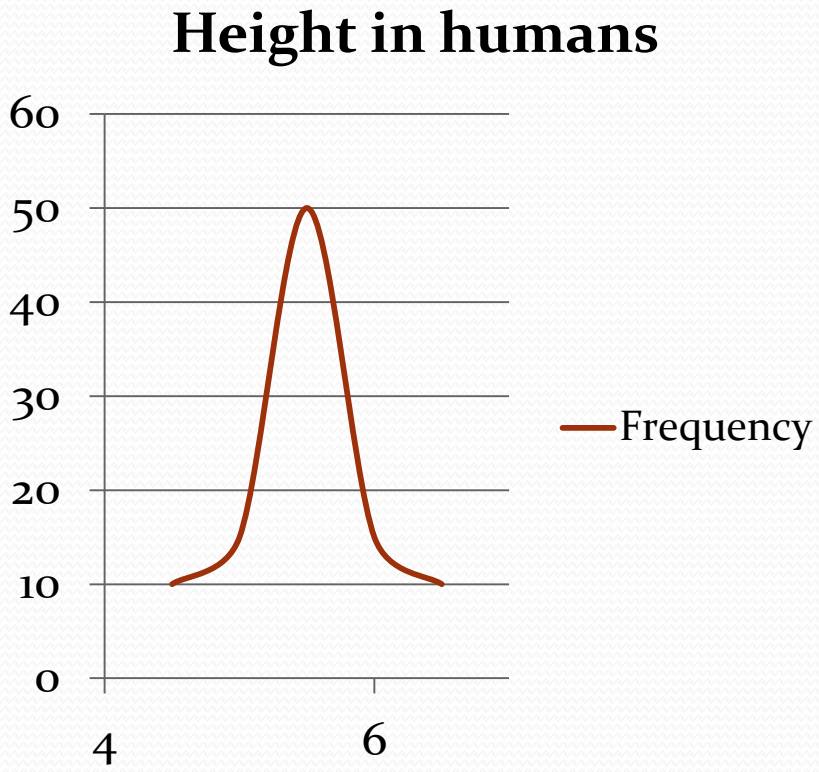
Continuous and discontinuous variation

- When an array of possible phenotypes can be produced, it is called continuous variation
  - Examples: skin color, height.

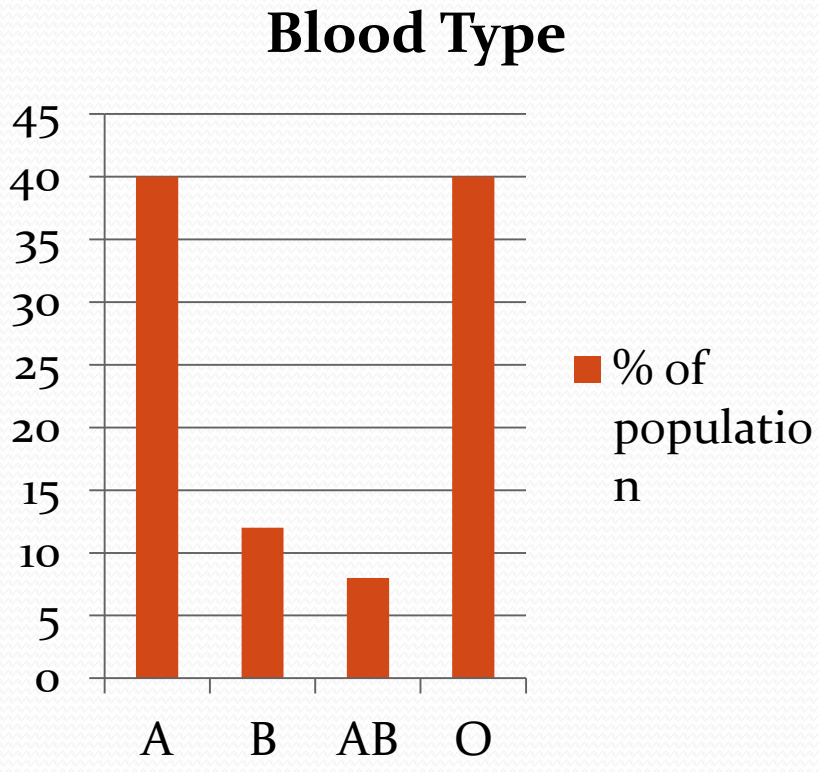
- When only a small number of phenotypes can be produced, it is called discontinuous variation
  - Examples: earlobe attachment, blood group

Graphical representation

Continuous variation

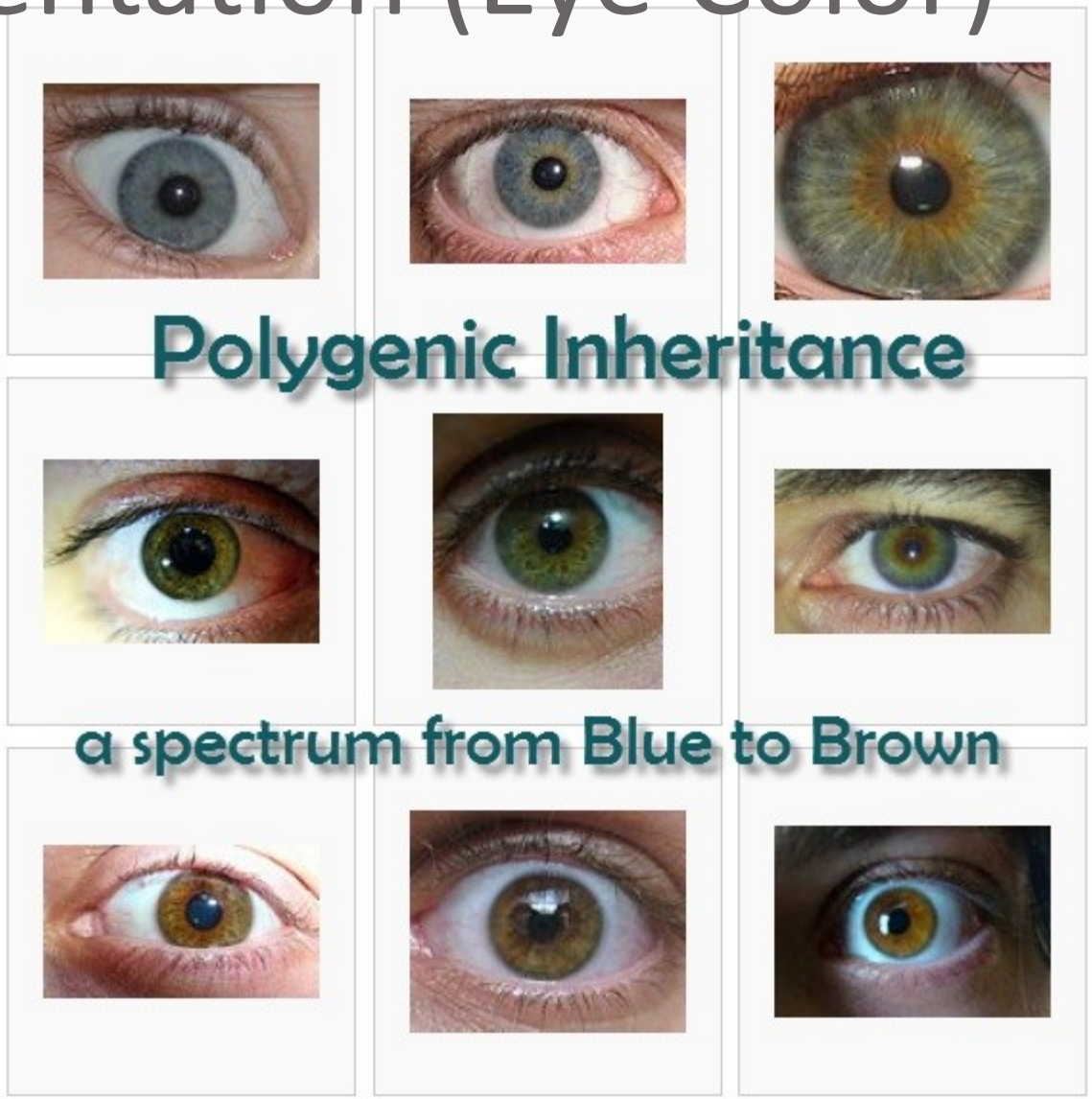


Discontinuous variation



Iris pigmentation (Eye Color)

- Look closely at your iris.
- What color are your friends eyes?
- Is this a trait controlled by multiple alleles?
- Does it show continuous variation?



Polygenic inheritance of colour in wheat

Kernel color in wheat is determined by two genes. A range of colours occur, from white to dark red, depending on the combinations of alleles.

Dark plants are homozygous AABB.

Light plants are homozygous aabb.

Crossing individuals with the phenotype extremes yield offspring that are a 'blend' of the two parents.

When these homozygous phenotypes are crossed …

AABB x aabb

Dark x white

the F1 offspring are all double heterozygous AaBb.

What happens when the two double heterozygous genotypes are crossed?

- Parent Phenotypes: all brown
- Genotypes: AaBb x AbBb

- Punnet square:

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

Blending doesn't occur.

Offspring can be darker or lighter than the parents.

polygenic inheritance can contribute to **continuous variation**

Skin color

How do multiple genes control skin colour?

Do we see “blended inheritance”

Do children always have a skin colour which is a blend of the skin colours of their parents?

Human skin color

- **Melanin pigment causes the brown colour in the skin.**
- **At least three genes control human skin colour.**
- **The more alleles promoting melanin pigment the darker the skin.**

Human skin colour

At least three genes control skin color, let's call these genes A, B, and C.

Each gene has a dominant allele which promotes melanin.

Each recessive allele doesn't result in melanin production.

- Someone who is AABBCC would have very dark skin color because all six alleles promote melanin production.
- Someone who is aabbcc would have very light skin color.

Human skin colour

If a person who had the AABBCC genotype and a person with the aabbcc genotype had children ..

Genotypes AABBCC X aabbcc

Gametes ABC abc

- their children would all be the AaBbCc genotype
- and have a ‘mid-brown skin’ phenotype.

Parents with mid-brown skin have children

Parent Genotypes AaBbCc X AaBbCc

Gametes ABC, ABc, AbC, Abc, aBC, aBc, abC, abc are possible

Punnet square (colouring shows grading of the phenotypes)

	ABC	ABc	AbC	Abc	aBC	aBc	abC	abc
ABC	AABBCC	AABBCc	AABbCC	AABbCc	AaBBCC	AaBBCc	AaBbCC	AaBbCc
ABc	AABBCc	AABBcc	AABbCc	AABbcc	AaBBCc	AaBBcc	AaBbCc	AaBbcc
AbC	AABbCC	AABbCc	AAbbCC	AAbbCc	AaBbCC	AaBbCc	AabbCC	AabbCc
Abc	AABbCc	AABbcc	AAbbCc	AAbbcc	AaBbCc	AaBbcc	AabbCc	Aabbcc
aBC	AaBBCC	AaBBCc	AaBbCC	AaBbCc	aaBBCC	aaBBCc	aaBbCC	aaBbCc
aBc	AaBBCc	AaBBcc	AaBbCc	AaBbcc	aaBBCc	aaBBcc	aaBbCc	aaBbcc
abC	AaBbCC	AaBbCc	AabbCC	AabbCc	aaBbCC	aaBbCc	aabbCC	aabbCc
abc	AaBbCc	AaBbcc	AabbCc	Aabbcc	aaBbCc	aaBbcc	aabbCc	aabbcc

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IB-style question (HL)

- How can the existence of multiple **genes** controlling skin colour result in the appearance of many different shades of skin colour in humans?
- 1

  .....
- 2

  .....
- 3

  .....
- 4
- .....

IB-style Questions

If a polygenic trait is controlled by two genes each with two alleles.
How many different genotypes are possible for this trait?

- A. 2
- B. 4
- C. 9
- D. 16

In the polygenic trait above, controlled by two genes, how many different genotypes are possible with;

a. No dominant alleles
b. One dominant allele
c. Two dominant alleles
d. Three dominant alleles
e. Four dominant alleles