Multiple Alleles

SBI3U Biology

Multiple = Many

Some genes have more than just 2 alleles

They may have 2 or more dominants or recessives

At the same time, these alleles could be codominant or incomplete dominant.

This is complex, but it is one big way genetic diversity happens.

Multiple Genotypes

When writing genotypes, use **superscripts**

There may be more than one superscript

Treat the allele letter and the superscript as **one symbol**

$C^R > C^w > C^r$

$*C^RC^r$ C^RC^R

C^wC^w C^rC^r

Example: Rabbit fur colour

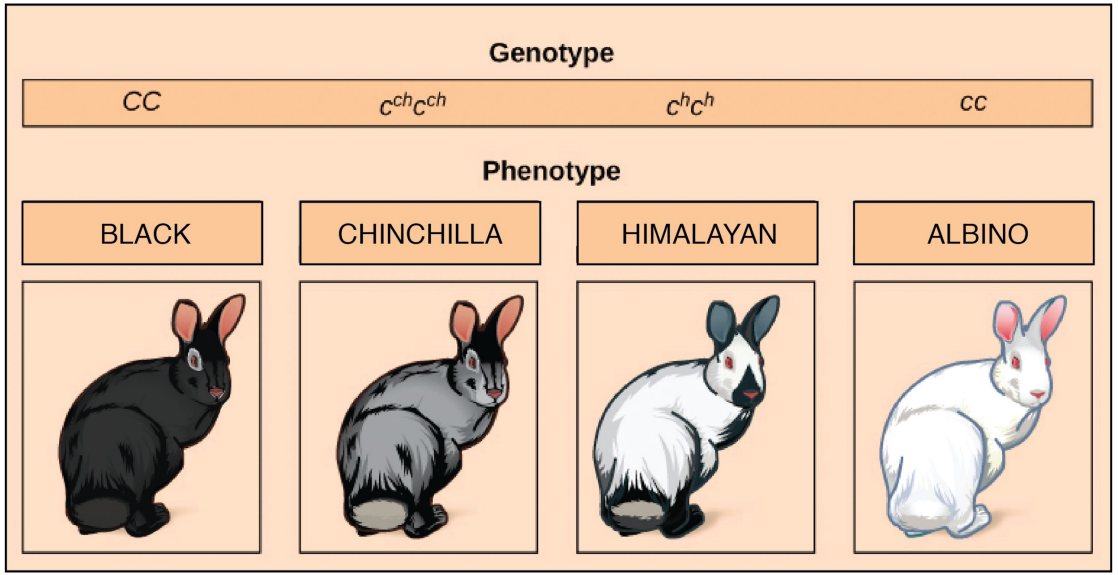
Multiple recessive alleles

C = dominant, black

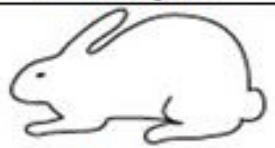
$\mathbf{c^{ch}}$ = recessive, chinchilla

$\mathbf{c^{h}}$ = recessive, himalayan

c = recessive, white albino



Example: Rabbit fur colour

Phenotype	Allele	Possible Genotypes	Order of Dominance
 Full color (brown)	**C** (capital C)	**CC** **Cc^{ch}** **Cc^{h}** **Cc**	Dominant over all others
 Chinchilla	**c^{ch}** (lowercase c with ch superscript)	**$c^{ch}c^{ch}$** **$c^{ch}c^{h}$** **$c^{ch}c$**	Dominant over Himalayan and albino
 Himalayan	**c^{h}** (lowercase c with h superscript)	**$c^{h}c^{h}$** **$c^{h}c$**	Dominant over albino
 Albino	**c** (lowercase c)	**cc**	Recessive to all others

Example: Pigeon Feather Colour

Multiple recessive alleles

B = dominant, blue-grey

b = recessive, brown

b^r = recessive, Ash-Red

Example: Human Blood Types

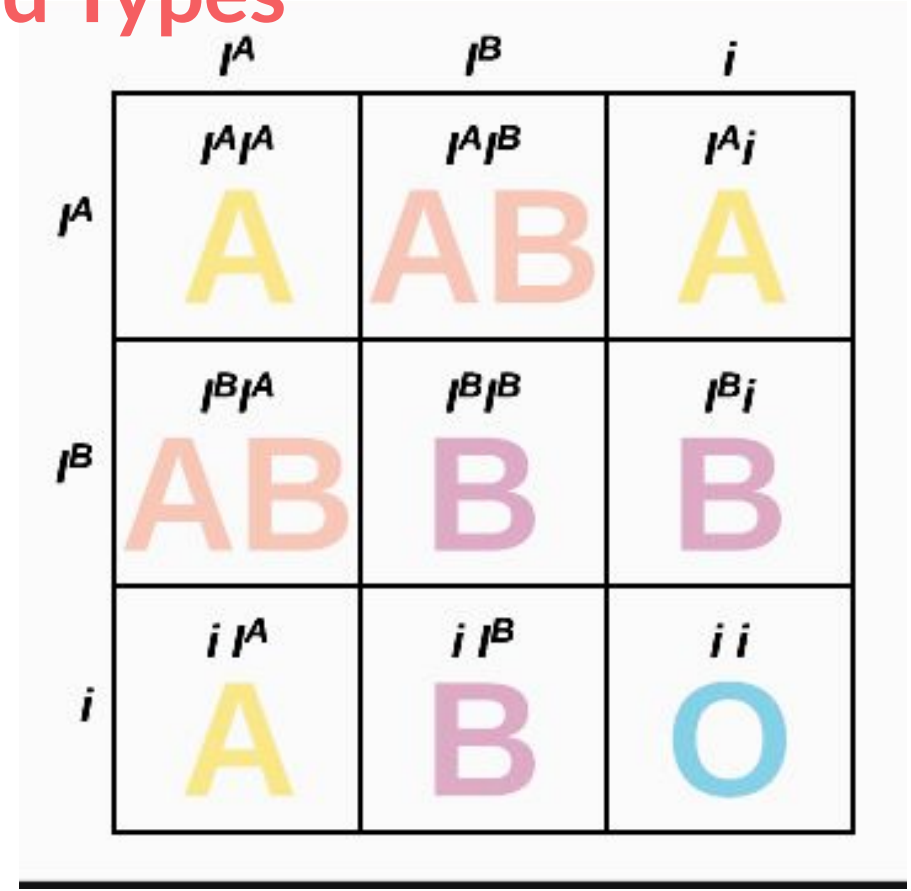
Multiple dominant alleles

I stands for **immunoglobin**, a blood cell protein

I^A = dominant, Protein A

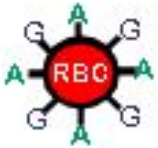
I^B = dominant, Protein B

i = recessive, no protein 0



Example: Human Blood Types

Co-dominance: ABO Blood Type

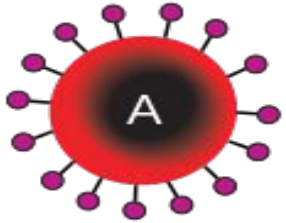
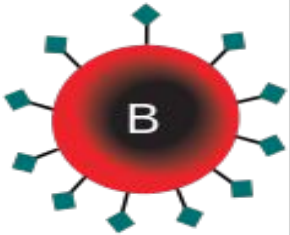
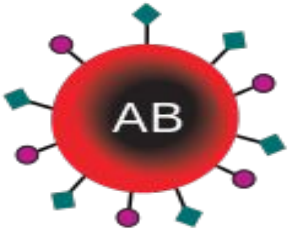
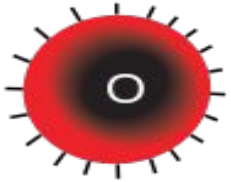
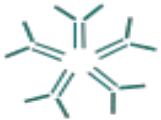
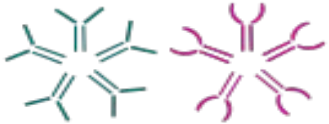
genotype	RBC	phenotype
I^AI^A		A
I^Ai		A
I^BI^B		B
I^Bi		B
I^AI^B		AB
ii		O

I^B: codes for enzyme that attaches galactose(G) to RBC

I^A: codes for enzyme that attaches acetyl galactosamine(A) to RBC

i: codes for inactive enzyme

Example: Human Blood Types

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	A antigen	B antigen	 A and B antigens	None

Example: Human Hair Colour

Multiple alleles in multiple genes! Very complex!

Try these:

1. A man with type A blood, but with a type O mother, has a child with a Type AB woman. What are their genotypes, and what can they expect to see in their children?

2. A male black rabbit, heterozygous for albino, mates with a female black rabbit heterozygous for chinchilla. What are their genotypes and what might we see in their litter of bunnies?

3. A male pigeon, homozygous for ash red, mates with a female, heterozygous for brown. What are their genotypes and what might we see among their squab?

Solution 1:

1. A man with type A blood, but with a type O mother, has a child with a Type AB woman. What are their genotypes, and what can they expect to see in their children?

Genotypes:

Father I^Ai Mother I^AI^B

Genotypic ratio 1:1:1:1

Phenotypic ratio 1:2:1

One AB, two A, one B

	I^A	i
I^A	I^AI^A	I^Ai
I^B	I^AI^B	I^Bi

Solution 2:

2. A male black rabbit, heterozygous for albino, mates with a female black rabbit heterozygous for chinchilla. What are their genotypes and what might we see in their litter of bunnies?

Genotypes:

Male Cc Female Cc^{ch}

Genotypic ratio 1:1:1:1

Phenotypic ratio 3:1

Three black, one chinchilla

	C	c^{ch}
C	C C	C c^{ch}
c	C c	c^{ch} c

Solution 3:

3. A male pigeon, homozygous for ash red, mates with a female, heterozygous for brown. What are their genotypes and what might we see among their squab?

Genotypes:

Male b^rb^r Female bb^r

Genotypic ratio 1:1

Phenotypic ratio 1:1

1 brown for every 1 ash red

	b^r	b^r
b	b b^r	b b^r
b^r	b^rb^r	b^r b^r