LAB – 2 - GENETICS

LAW OF INDEPENDENT ASSORTMENT (THE "SECOND LAW")

The Law of Independent Assortment, states **that separate genes for separate traits are passed independently of one another from parents to offspring with phenotype ratio 9:3:3:1.** Mendel concluded that different traits are inherited independently of each other, so that there is no relation, for example, between a cat's color and tail length. This is actually only true for genes that are not linked to each other. Then Mendel's second law says that the two genes will segregate independently, as:

$AA \rightarrow A + A$ and $BB \rightarrow B + B$

When breeding yellow round seeds pea plants with green wrinkled seeds the resulting progeny was

	Yellow Round		Green Wrinkled
P1	YYRR	X	yyrr
G1	YR	↓	yr
F1		YyRr	

100% yellow round (heterozygous)

When self pollination occurs

	Yellow Round			Yellow Round	
P2	YyRr		X	YyRr	
G2	YR	Yr	↓	YR	Yr
	yR	yr		yR	yr

F2

	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YyRr
Yr	YYRr	YYrr	YyRr	YyRR
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

Phenotype : 9 round yellow

3 wrinkled yellow

3 round green

1 wrinkled green

Types of dominance

1) Complete dominance

In complete dominance two alleles code for a characteristic but only the dominant one (A) is expressed (e.g. you could have alleles for both brown eyes(B) and blue eyes (b) but since brown eyes are dominant over blue eyes, you'll have brown eyes (Bb))

	brown		blue
P1	BB	X	bb
G1	B	↓	b
F1		Bb	

100% brown eyes

Self-pollination

	brown		brown
P2	Bb	X	Bb
G2	B b	↓	B b
F2		BB , Bb , Bb,bb	

Phenotype : 3 (brown) : 1 (blue) , Genotype : 1 : 2 : 1

2) Incomplete Dominance

If two alleles have an incomplete dominance relationship, the phenotype of the heterozygote will be intermediate between the phenotypes of the two homozygotes. A good example of incomplete dominance is the color of Japanese 4 o'clock flowers. A red Japanese 4 o'clock will have the genotype RR. A white Japanese 4o'clock will have the genotype WW. When these two flowers are crossbred, each will give one of their genes. The red flower will give a R (for red) gene. The white flower will give a W (for white) gene. The offspring will have the genotype RW. Since neither of these are recessive, (recessive genes have lower case letters) they both show up in the phenotype. The result is a mix of red and white (pink flowers) Had the white gene been recessive, and the offspring had the genotype Rw, then the flower would be red. Since both are dominant, they have incomplete control of the phenotype.

	Red		White
P1	RR	X	rr
G1	R	↓	r
F1		Rr	

100% Pink flower

Self – pollination

	pink		pink
P2	Rr	X	Rr
G2	R r	↓	R r
F2		RR, Rr,Rr,rr	

Phenotype : (red) 1 : (pink) 2 : (white) 1

Genotype : 1 : 2 : 1

3) Codominance

Codominance is similar to incomplete dominance in that there is no dominant allele. However, the phenotypic expression is quite different. If two alleles have a codominance relationships, in the heterozygote **both** alleles will be completely expressed. For example, in humand ABO blood types, two of the three alleles (the A allele, properly designated as I^A, and the B allele, properly designated as I^B) are codominant. This gene controls the deposition of antigenic markers on cells. A person with blood type A (homozygous for I^A or heterozygous for I^A and the recessive i (for O type)) has one kind of antigen marker, while a person with blood type B (homozygous for I^B or heterozygous for I^B and the recessive i (for O type)) has a slightly different kind of antigen marker. The heterozygote has blood type AB, and this person's cells have **both** A antigens and B antigens on their surfaces. There is no "in-between" antigen, as would be expected if the alleles showed incomplete dominance. Both of the alleles are completely expressed, and the person has both blood types at the same time.

P1 $I^A I^A$ X $I^B I^B$

G1 I^A ↓ I^B

F1 $I^A I^B$

4) Overdominance

That state in which the heterozygous has greater phenotype value than the homozygous as in the eyes color of fruit fly

	White eyes		wild eyes
P1	WW	X	ww
G1	W	↓	w
F1		Ww	

100% radiant (shining) white eyes

When self pollination

	Radiant White			Radiant White
P2	Ww		X	Ww
G2	W w		↓	W w
F2		WW, Ww, Ww, ww		

Phenotype : 1 white : 2 radiant white : 1 wild eyes

Genotype : 1 : 2 : 1

5) Lethal gene

Lethal genes are Alleles that cause an organism to die only when present in homozygous condition .

a- Dominant lethal genes

Alleles that cause an organism to die only when present in homozygous dominant condition .

For example the **Coat Color in mice**

YY ⟶ lethal

Yy ⟶ produces yellow coat

yy ⟶ gray (normal)

	Yellow			Yellow
P1	Yy		X	Yy
G1	Y y		↓	Y y
F1		YY, Yy, Yy, yy		

Phenotype : (yellow) 2 : 1 (gray)

Genotype : 2 : 1

b- Recessive lethal gens

Alleles that cause an organism to die only when present in homozygous recessive condition .

For example **Reptilian Chicken**

CC ⟶ normal

Cc ⟶ reptilian

cc ⟶ lethal

	reptilian		reptilian
P1	Cc	X	Cc
G1	C c	↓	C c
F1	CC , Cc, Cc, cc		

Phenotype : reptilian 2 : 1 normal

Genotype : 2 : 1