GENETICS & INHERITANCE

GENETICS = STUDY OF HEREDITY.

CHROMOSOMES. DNA. GENES. ALLELES

GENES PRODUCE *CHARACTERISTICS*.

INTRODUCTION

- The cells in the body of each parent are **di**ploid (2n).
- **Each specific characteristic** of that person is thus made up from **two** possible plans.
- Only **one** plan for **that** characteristic comes through in the **ha**ploid sperm (or ovum) when that person has sex.
- This one (n) plan joins with the one (n) plan from the other parent's gamete for **that** characteristic.
- **Our job** is to predict probabilities of combinations of that characteristic in the children.

<u>MONOhybrid CROSSES</u>

- A ***CROSS*** refers to when two organisms have sex to reproduce.
- A ***HYBRID*** is the child from parents who have different genes.
- ***MONO*** tells us that we are only looking at **<u>ONE</u>** characteristic.
- **Gregor Mendel** is called ***The Father of Genetics***, because of all we know, resulting from his research.

MENDEL'S RESEARCH

- He identified the **ONE characteristic** to study, namely how TALL the pea plant is.
- He worked out that the **TALL** gene for peas is **dominant** over the **SHORT** gene, which is **recessive**.
- The dominant gene (TALL) decides the **letter**, and is written as a **capital** (T).
- The recessive gene (SHORT) uses the same letter, but in its **small** form (t).
- Each characteristic always has **two** genes - one from each parent. Possible combinations: **TT or Tt or tt**

PREDICTIONS using PUNNET SQUARES (Page 37)

HeteroZygous Tall crosses with **HomoZygous short.**

Parent PhenoType: Tall X Short

Parent GenoType: **Tt** X **tt**

Gametes: **T** *or* **t** X **t** *or* **t**

Sex:

	T	**t**
t	**Tt**	**tt**
t	**Tt**	**tt**

Chances: 2 X **Tt** out of 4 (50%) Tall HeteroZygous.

2 X **tt** out of 4 (50%) Short HomoZygous.

MENDEL'S LAWS

This slide merely <u>explains</u> the Text Book descriptions.

1. **<u>Law of Segregation</u>**: Each characteristic is controlled by two genes – one from Mommy, and one from Daddy.
2. **<u>Law of Independent Assortment</u>**: In meiosis, as the gamete's plan is randomly formed, each gene works by itself.

*See **details** of his experiments for the pea plant on p. 33.*

TT X tt → Tt only.

Tt X Tt → TT, Tt, Tt, tt.

TYPES OF DOMINANCE

- **Complete Dominance** = where one gene is dominant, the other is recessive. (The **T**allness of pea plants is an example; **B**rown eyes over green eyes; etc.)
- **Incomplete Dominance** = where **both** genes are **equally** dominant, and do not mind **sharing** the characteristic. (**B**lack rabbit **BB** crosses **W**hite rabbit **WW** to produce Grey rabbits **BW**.)
- **Co-Dominance** = **both** genes are **equally** dominant, but **insist** on being shown as they are, and will **not** share. (**R**ed cow **RR** crosses with **W**hite bull **WW** to make **RW**: parts of it **R**ed, parts of it **W**hite.)

BLOOD TYPES

- This is Co-Dominance of **Multiple Alleles**, because there are **three** possible genes. These include combinations of A (I^A), B (I^B), and O (i).
- A and B are co-dominant, O is recessive.

Blood Group A = $\mathbf{I^A\ I^A}$ *or* $\mathbf{I^A\ i}$

Blood Group B = $\mathbf{I^B\ I^B}$ *or* $\mathbf{I^B\ i}$

Blood Group AB = $\mathbf{I^A\ I^B}$

Blood Group O = $\mathbf{i\ i}$

father \ mother	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

alleles	blood type
A+A	A
A+O	A
A+B	AB
B+B	B
B+O	B
O+O	O

A man is homozygous for Blood Group A. His wife is heterozygous for Blood Group B. Find the genotype and phenotype probabilities for the F_1 generation.

Parent Phenotypes: Homoz. A X Heteroz. B

Parent Genotypes: $I^A I^A$ X $I^B i$

Gametes: I^A *or* I^A X I^B *or* i

Sex:

	I^A	I^A
I^B	$I^A I^B$	$I^A I^B$
i	$I^A i$	$I^A i$

Results:

2 out of 4 = 50% $I^A I^B$ (AB).

2 out of 4 = 50% $I^A i$ (A).

DiHYBRID CROSSES (Pages 38-39)

- This is when we are looking at **TWO** different characteristics at the same time. This means that each parent has four possible gametes for these combinations.

E.g. Tall (T) dominant over short (t) rose plant.

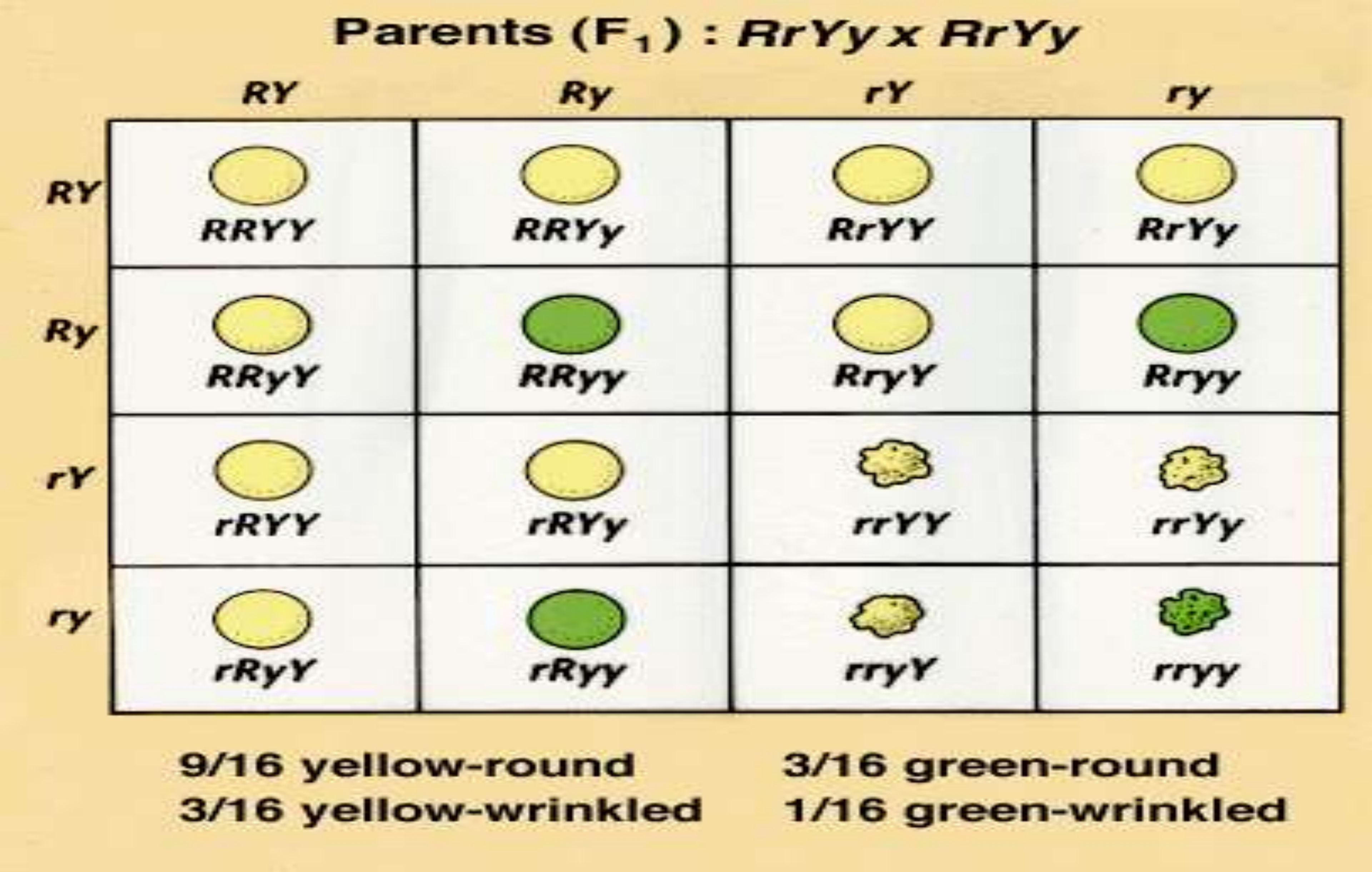
Red (R) flower dominant over yellow (r) flower.

TtRr parent could produce: TR Tr tR tr

The other parent also has ***four*** *possibilities.*

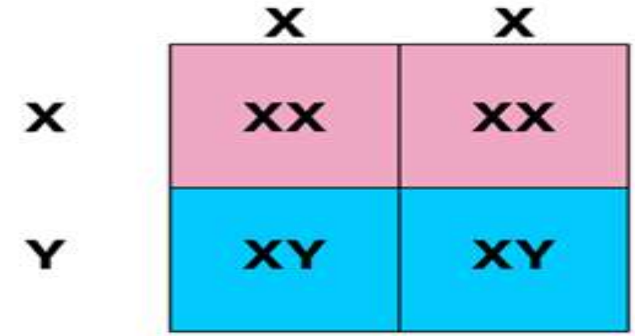
(***See the Punnet Square on Page 39 to explain this***.)

(***See, also, the whole of page 38***.)



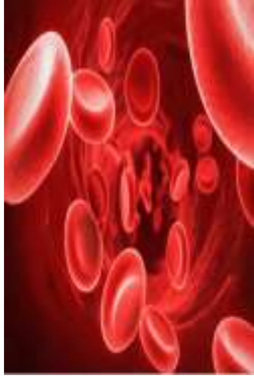
DiHYBRID CROSS (Page 38)

<u>CHANCES of GENDER</u>



- Each human has 23 pairs of chromosomes.
- 22 pairs are called AutoSomes.
- 1 pair is the GonoSome. It is called the *Sex Chromosome*, because it determines your **Gender**. Females are XX. Males are XY.
- Female eggs can only have one X.
- 50% of male sperms have X, 50% have Y.
- There is **always** a 50% chance of **either** of them fertilizing the egg.
- So **<u>every</u>** conception has a 50% chance of being either boy or girl.

GENDER-LINKED DISEASES: ColourBlindness & Haemophilia



- These diseases are **recessive**, attached to the X chromosome. (E.g. colour-blindness.)
- If a boy is born with this gene, he only has another Y - he has no other X which can be dominant. And so he will be born ColourBlind.
- If a girl is born with this gene, she has another X (which will probably be dominant). And so she herself will not be ColourBlind, but will be a **carrier** of ColourBlindness.

Sex-linked

H = normal & h = hemophilia

Cross: XX^h x X^hY

	X	X^h
X^h	X^hX	X^hX^h
Y	XY	X^hY

Genotypic ratio: 1:1:1:1

(X^hX =25% X^hX^h=25% XY=25% X^hY=25%)

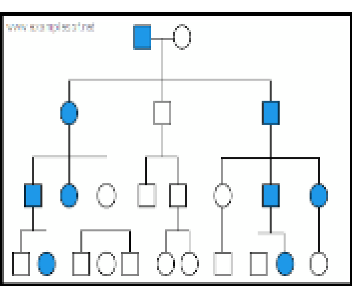
Phenotypic ratio: 1:1:1:1

Female carrier =25% Female hemophilia =25%

Male normal =25% Male hemophilia =25%

INTERPRETING PEDIGREE DIAGRAMS

- These look at how often that characteristic has occurred in the ancestors of a family.
- You will be asked to read it, and identify the genes for that characteristic in specific individuals of that family.
- In pencil (on the diagram), write down all the genes that are obvious.
- Then look at the children to see what the parents must have.



For further guidance, see page 43.

An Example

Generation IV: **Female 4** wants to marry **Male 5**. Recessive gene (n) for albinism is shown in dark. They are worried about their possible children. Give them advice.

N = normal gene.

n = albino gene.