

Gregor Mendel (1822-1884)

“father of Genetics”

- developed the basic principles of heredity
 - dominance
 - segregation
 - independent assortment
- without knowledge of genes or chromosomes.
- by mathematical analysis of large numbers of pea plant offspring

Genetics

- The study of how hereditary information is passed from parents to offspring.
- Gene - a unit of hereditary material found in chromosomes. Contains the information to make a specific protein.
- Alleles - the different forms of a gene. Found in same place on pairs of homologous chromosomes.

Dominant and Recessive

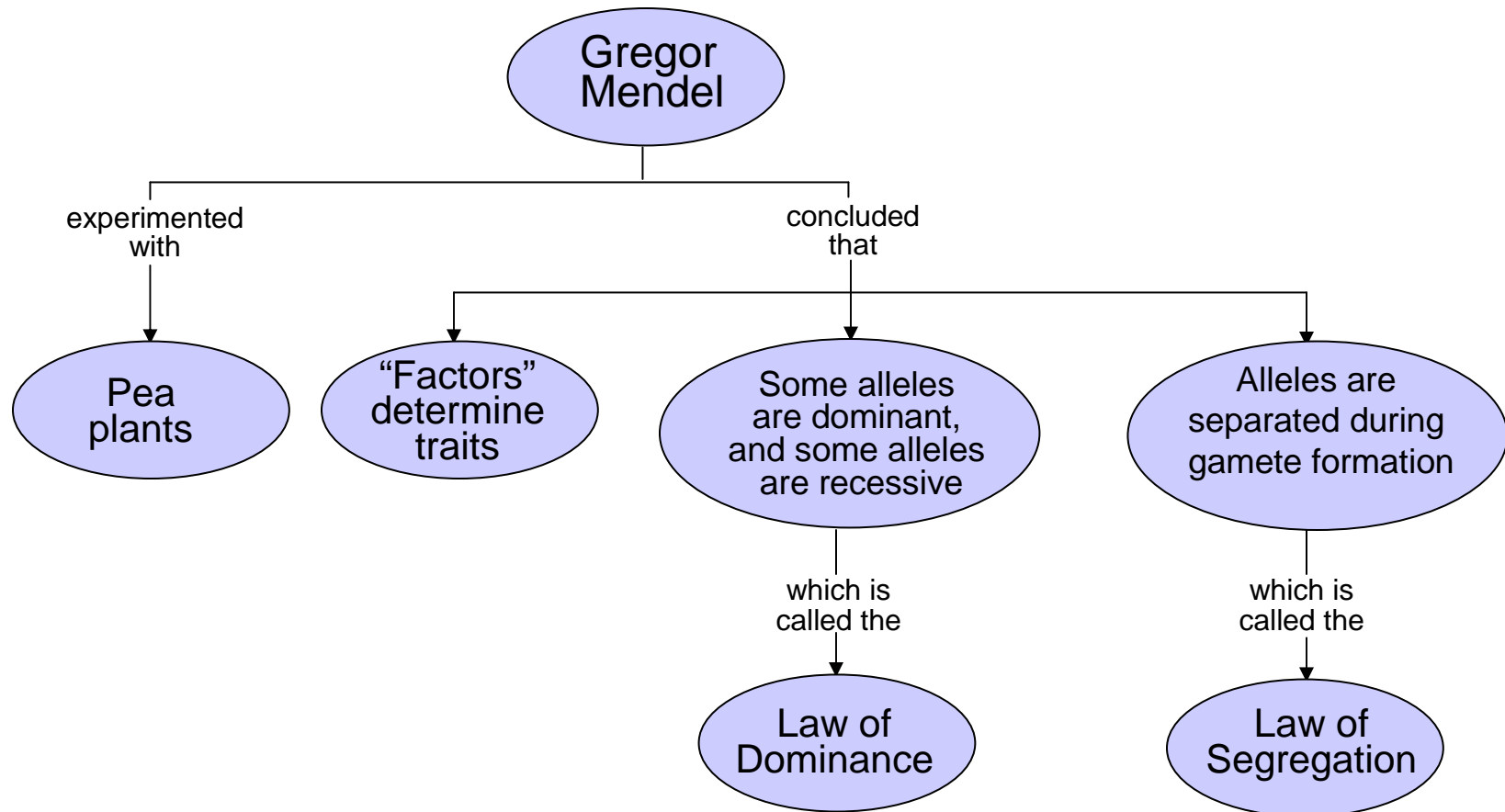
- dominant allele - the gene in an allelic pair that is expressed
 - for the dominant gene characteristic to be observed, you only need one dominant gene
- recessive allele - the gene which is present but not expressed
 - for the recessive gene characteristic to be observed, you must have two recessive genes






















Genotype and Phenotype

- Genotype - the genetic makeup (gene combination)
- Phenotype - the physical appearance as a result of its genetic makeup

Homozygous and Heterozygous

- Homozygous (pure) - two genes of an allelic pair that are the same
 - example: TT - tall or tt - short
- heterozygous (hybrid) - two genes of an allelic pair that are different
 - Tt - tall



	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position	Plant Height
P	Round  X 	Yellow  X 	Gray  X 	Smooth  X 	Green  X 	Axial  X 	Tall  X 
F₁	Round 	Yellow 	Gray 	Smooth 	Green 	Axial 	Tall 

Parents	First Generation	Second Generation
Long stems × short stems	All long	787 long: 277 short
Red flowers × white flowers	All red	705 red: 224 white
Green pods × yellow pods	All green	428 green: 152 yellow
Round seeds × wrinkled seeds	All round	5474 round: 1850 wrinkled
Yellow seeds × green seeds	All yellow	6022 yellow: 2001 green

- 1. In the first generation of each experiment, how do the characteristics of the offspring compare to the parents' characteristics?
- 2. How do the characteristics of the second generation compare to the characteristics of the first generation?

Law of Dominance

- One gene, the dominant gene, prevents the appearance of the trait controlled by the other gene, the recessive gene



	<i>T</i>	<i>t</i>
<i>T</i>	<p><i>TT</i> 25%</p>	<p><i>Tt</i> 25%</p>
<i>t</i>	<p><i>Tt</i> 25%</p>	<p><i>tt</i> 25%</p>

Law of Segregation

- When gametes are formed during meiosis there is a random segregation (separation and movement) of homologous chromosomes
- As a result of fertilization, alleles recombine.

Law of Independent Assortment

- If the genes for two different traits are located on different chromosome pairs (non-homologous chromosomes), they segregate randomly during meiosis.
- Therefore, they may be inherited independently of each other producing much of the genetic variation observed in living organisms.

Incomplete Dominance





- Heterozygous phenotype is intermediate between either homozygous parent.
 - WW = pure white
 - RR = pure red
 - RW = pink

RR



WW



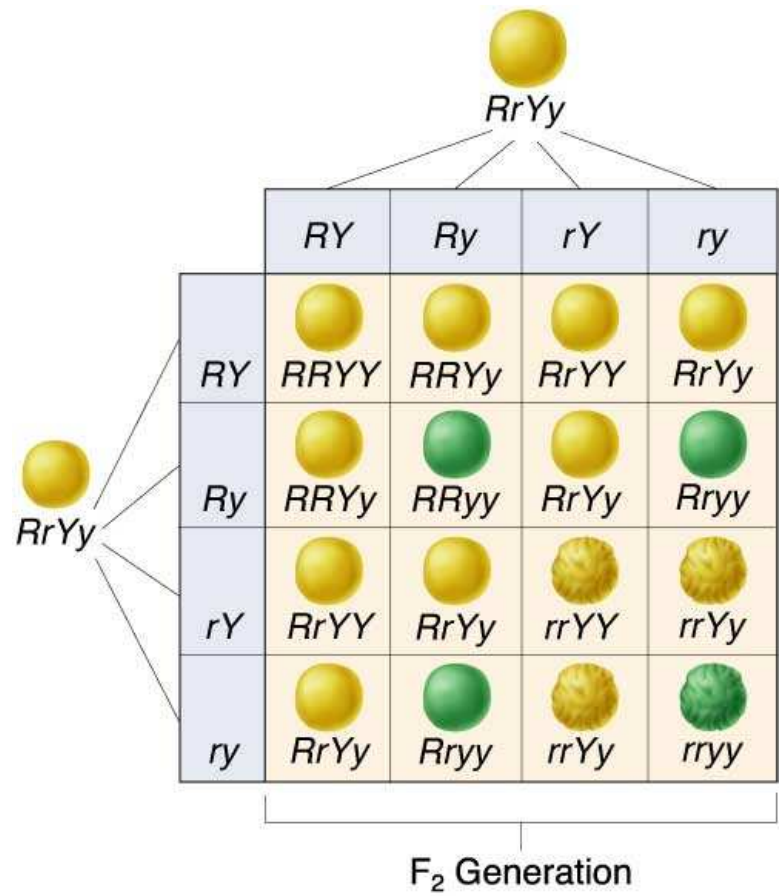
	<i>R</i>	<i>R</i>
<i>W</i>	<i>RW</i> 	<i>RW</i> 
<i>W</i>	<i>RW</i> 	<i>RW</i> 

Co-dominance

- Simultaneous expression of two dominant alleles
- coat color in roan cattle

Multiple Alleles

- More than two of an allele exist in a population
 - only two can be present in any given cell
- Blood Type
 - Type “A” and Type “B” are co-dominant
 - Type “O” is recessive to both “A” and “B”



Punnett Square Problem #1

“T” represents the dominant trait tall and “t” represents the trait Short. Cross a pure bred tall with a recessive and give the genotypic and phenotypic ratios of the offspring.

Punnett Square Problem #2

In pea plants, tall is dominant over short. Cross two hybrids and give the genotypic and phenotypic ratios of the offspring.

Punnett Square Problem #3

In pea plants, tall is dominant over short. If 50% of the offspring are short, what is the genotype phenotype of the parents?

Punnett Square Problem #4

In humans, right handedness is dominant over left handedness. If the parents were both right handed, what would their genotype have to be in order to produce a left handed child?

Punnett Square Problem #5

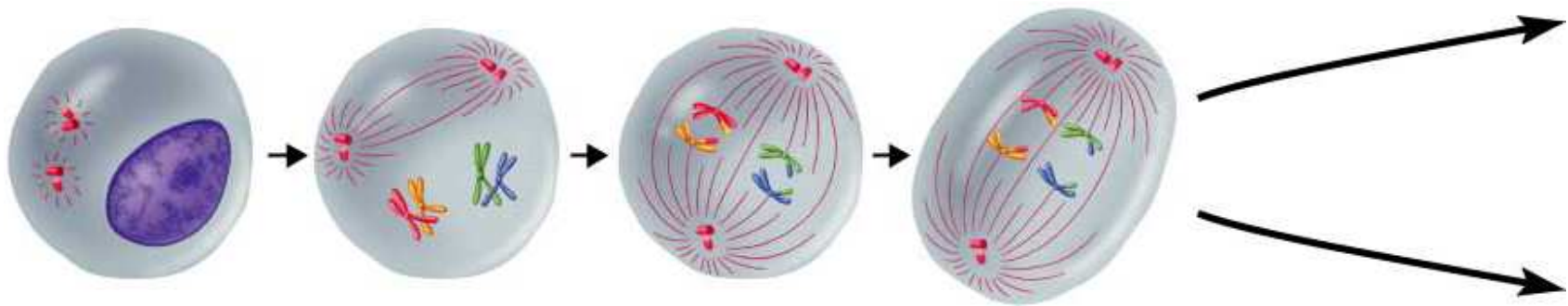
In a certain animal black fur “B” is dominant over white fur “b”. Determine the expected genotypic and phenotypic ratios resulting from crosses between:

- A homozygous black and homozygous white individual
- Two heterozygous black individuals
- A heterozygous black and a white individual.

Punnett Square Problem #6

In *Drosophila* the gene for long wing "L" is dominant to the gene for short wings "l". When a long-winged male was bred with a short-winged female they produced a total of 98 long-winged offspring and 101 short winged offspring. What were the parental genotypes?

Meiosis I



Interphase I

Cells undergo a round of DNA replication, forming duplicate Chromosomes.

Prophase I

Each chromosome pairs with its corresponding homologous chromosome to form a tetrad.

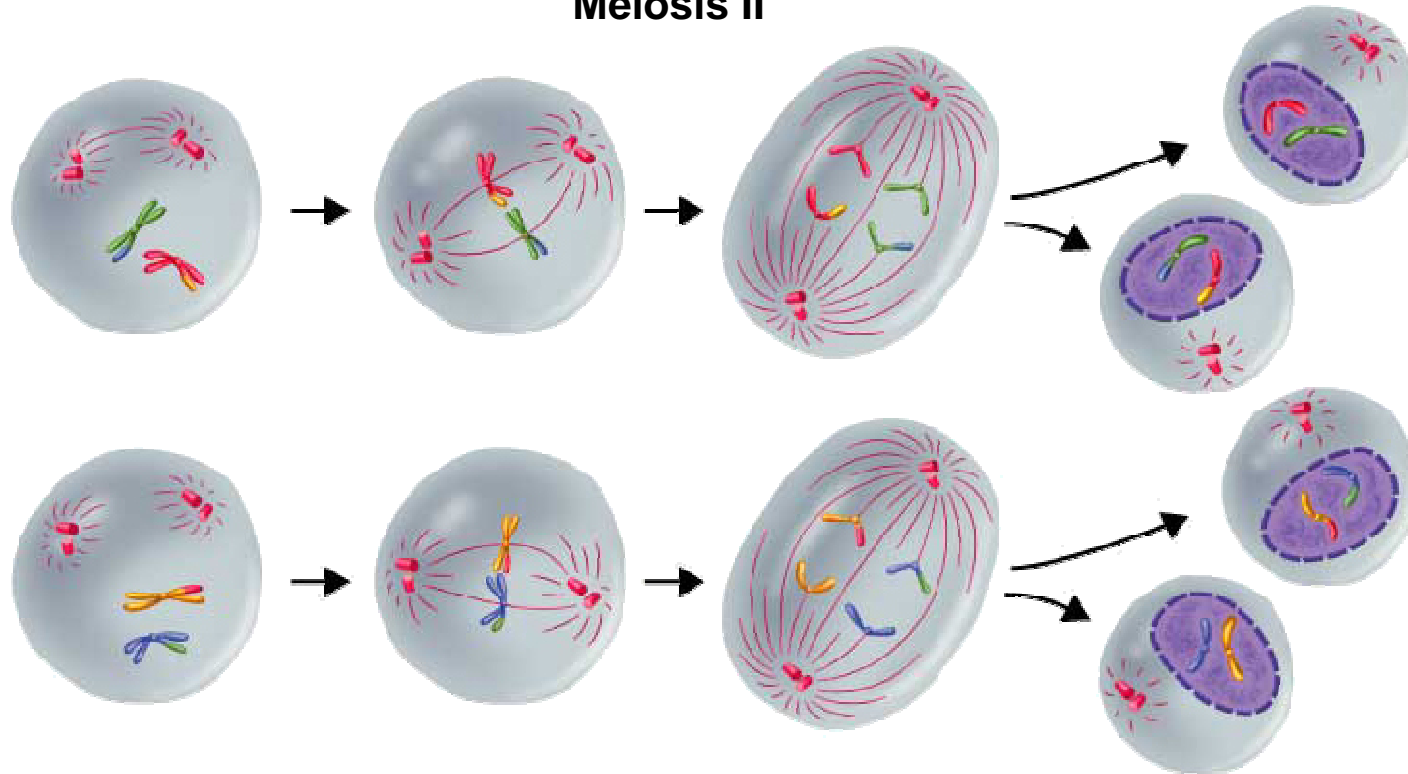
Metaphase I

Spindle fibers attach to the chromosomes.

Anaphase I

The fibers pull the homologous chromosomes toward the opposite ends of the cell.

Meiosis II



Prophase II

Meiosis I results in two haploid (N) daughter cells, each with half the number of chromosomes as the original.

Metaphase II

The chromosomes line up in a similar way to the metaphase stage of mitosis.

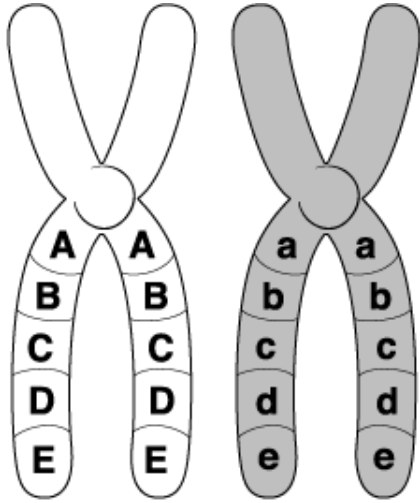
Anaphase II

The sister chromatids separate and move toward opposite ends of the cell.

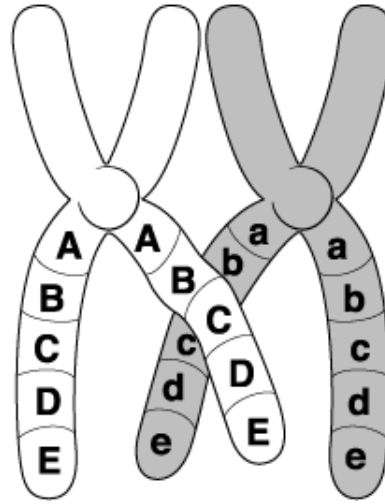
Telophase II

Meiosis II results in four haploid (N) daughter cells.

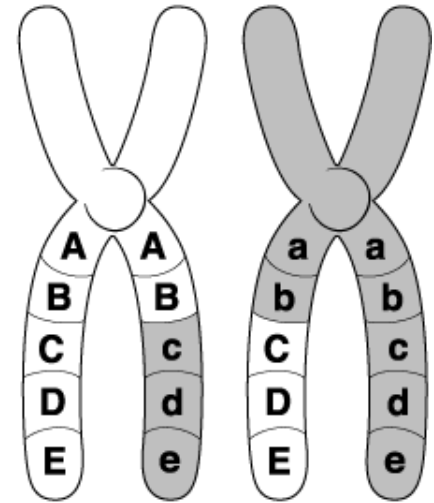
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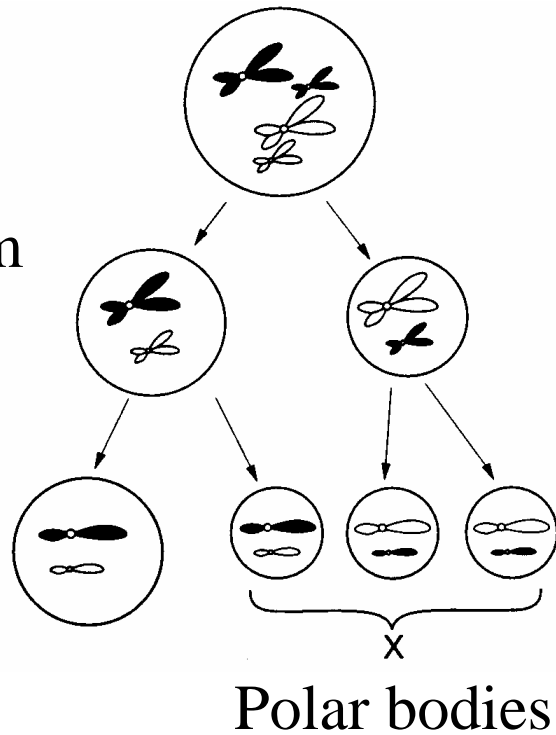
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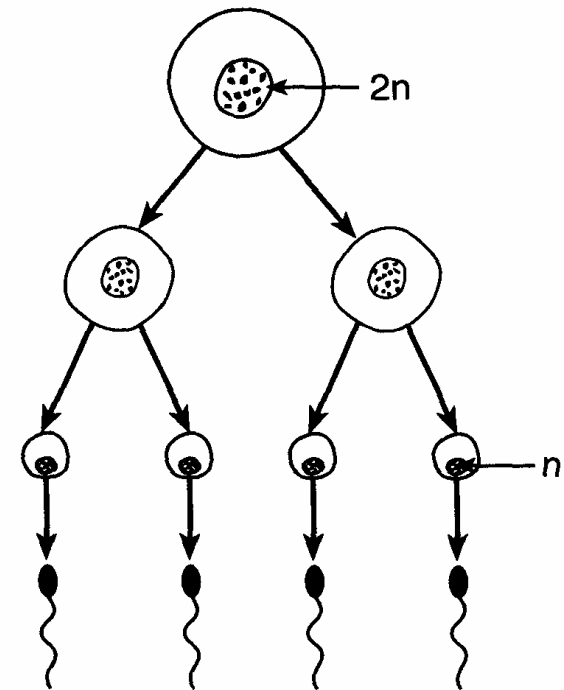
Gametogenesis

Unequal
division
of the
cytoplasm

Develops
into the
ovum



oogenesis



spermatogenesis

Sex Cells

