VARIATIONS & PRINCIPLES OF INHERITANCE

BY:-

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GENETICS: SCIENTIFIC STUDY OF MECHANISM OF TRANSMISSION OF CHARACTERS FROM PARENTS TO OFFSPRINGS & HEREDITARY VARIATION IN LIVING ORGANISMS BY DESCENT.

HEREDITY: TRANSMISSION OFCHARACTERS FROM ONE GENERATION TO NEXT GENERATION.

VARIATIONS: DIFFERENCES AMONG MEMBERS OF A SPECIES & OFFSPRINGS OF SAME PARENT.

TYPES OF VARIATION

1) SOMATIC OR SOMATOGENIC VARIATIONS

2) GERMINAL OR BLASTOGENIC VARIATIONS

- **SOMATIC VARIATIONS:** AFFECTS THE SOMATIC CELLS OF AN ORGANISM.
- ACQUIRED BY AN INDIVIDUAL DURING LIFE TIME &DIE WITH DEATH OF AN INDIVIDUAL
- NEITHER INHERITED FROM PARENTS NOR TRANSMITTED TO NEXT GENERATION.
- ALSO CALLED ACQUIRED VARIATIONS.

CAUSES OF SOMATIC VARIATION

- PRODUCED BY THREE FACTORS.
  - [A] ENVIRONMENT
  - [B] USE & DISUSE OF ORGANS
  - [C] CONSCIOUS EFFORTS

- **ENVIRONMENT:** INCLUDES ALL FACTORS THAT AFFECT ORGANISMS SUCH AS LIGHT, HABITAT, TEMPERATURE, FOOD ,WIND etc.

- **EFFECT OF LIGHT:** NEWLY HATCHED FLAT FISH HAS PIGMENTATION & EYE ON BOTH SIDES.

- LEFT SIDE LOSES PIGMENTATION & LEFT EYE MOVES TO RIGHT SIDE.

- SIMILARLY STRONG SUNLIGHT TANS HUMAN SKIN.

- **NUTRITION:** EXAMPLE:HONEYBEE

- LARVA FED ON BEE BREAD GROWS INTO WORKER & LARVA FED ON ROYAL JELLY GROWS INTO QUEEN.

- SIMILARLY DEFICIENCY OF IRON CAUSES CHLOROSIS IN PLANTS.

- **HABITAT:** EGGS OF FUNDULUS FISH IN SEA WATER HAVING MAGNESIUM CHLORIDE HATCHED INTO PECULIAR FISH HAVING A SINGLE MEDIAN EYE.

- IN NORMAL SEA WATER,TWO LATERAL EYES PRODUCED.

- **USE & DISUSE OF ORGANS:**

- CONTINUOUS USE OF AN ORGAN MAKES IT BETTER DEVELOPED WHEREAS CONSTANT DISUSE MAKES IT REDUCED.

- PERSONS USING LEFT HAND SINCE CHILDHOOD FOR WRITING CAN WRITE NICELY.

- MAN DOING DAILY EXERCISE DEVELOPS STRONGER & MORE MUSCULAR BODY THAN THE ONE WHO DOES NOT TAKE EXERCISE DAILY.

- **CONSCIOUS EFFORTS:** SOMATIC VARIATIONS ALSO CAUSED DUE TO CONSCIOUS EFFORTS OF MAN

- E.g: BORED PINNAE & NOSE IN INDIAN WOMEN

- SMALL FEET OF CHINESE WOMEN.

- SLENDER WAISTS IN EUROPEAN WOMEN

GERMINAL VARIATIONS

- AFFECTS GERM CELLS OF AN ORGANISM & ARE INHERITABLE.

- **CAUSES:** DUE TO RECOMBINATIONS

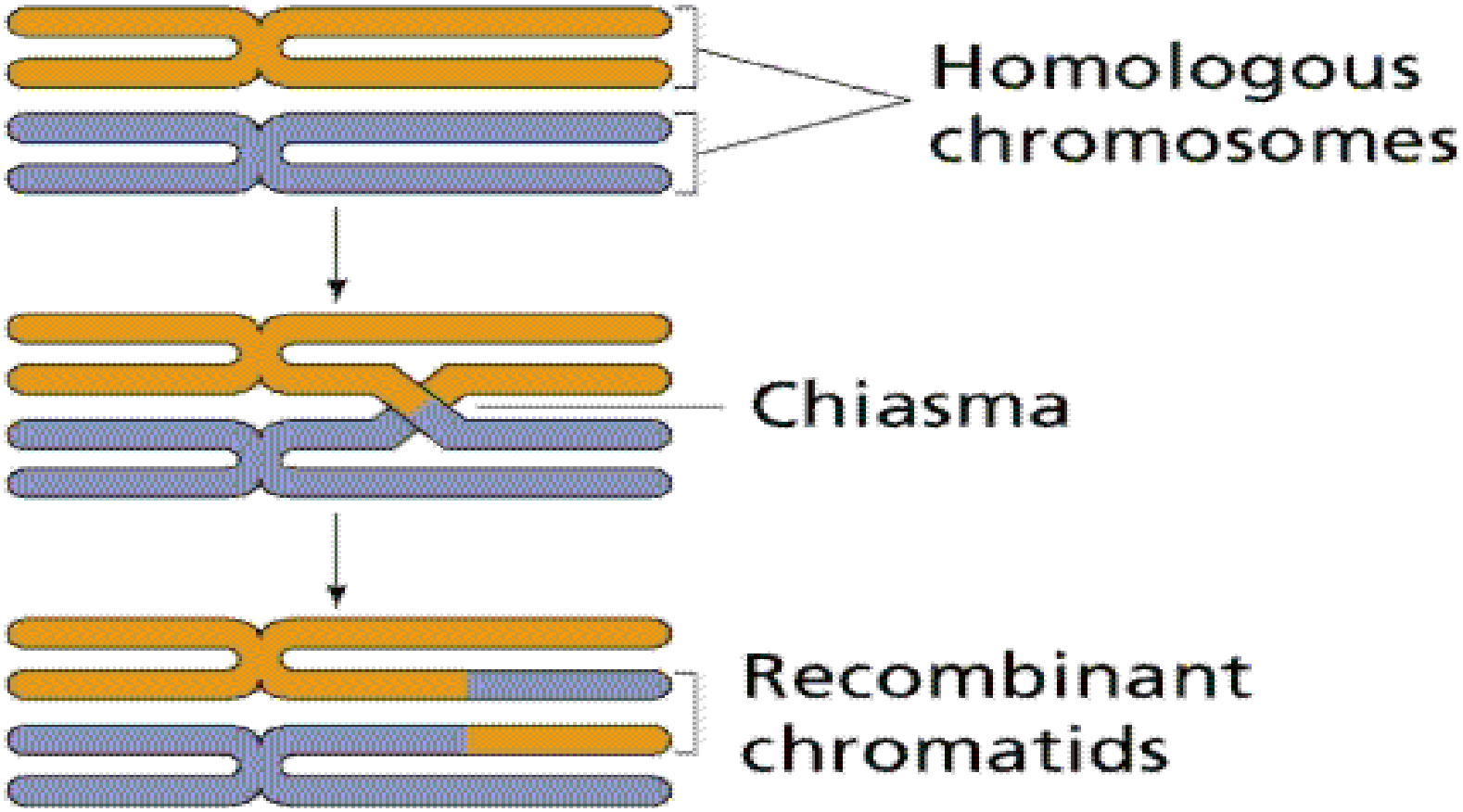
- MODIFICATION OF STRUCTURE OF CHROMOSOMES.

- DUE TO CHANGE IN CHEMICAL NATURE OF GENES

- BY POLYPLOIDY.

- BY RADIATIONS.

CROSSING OVER



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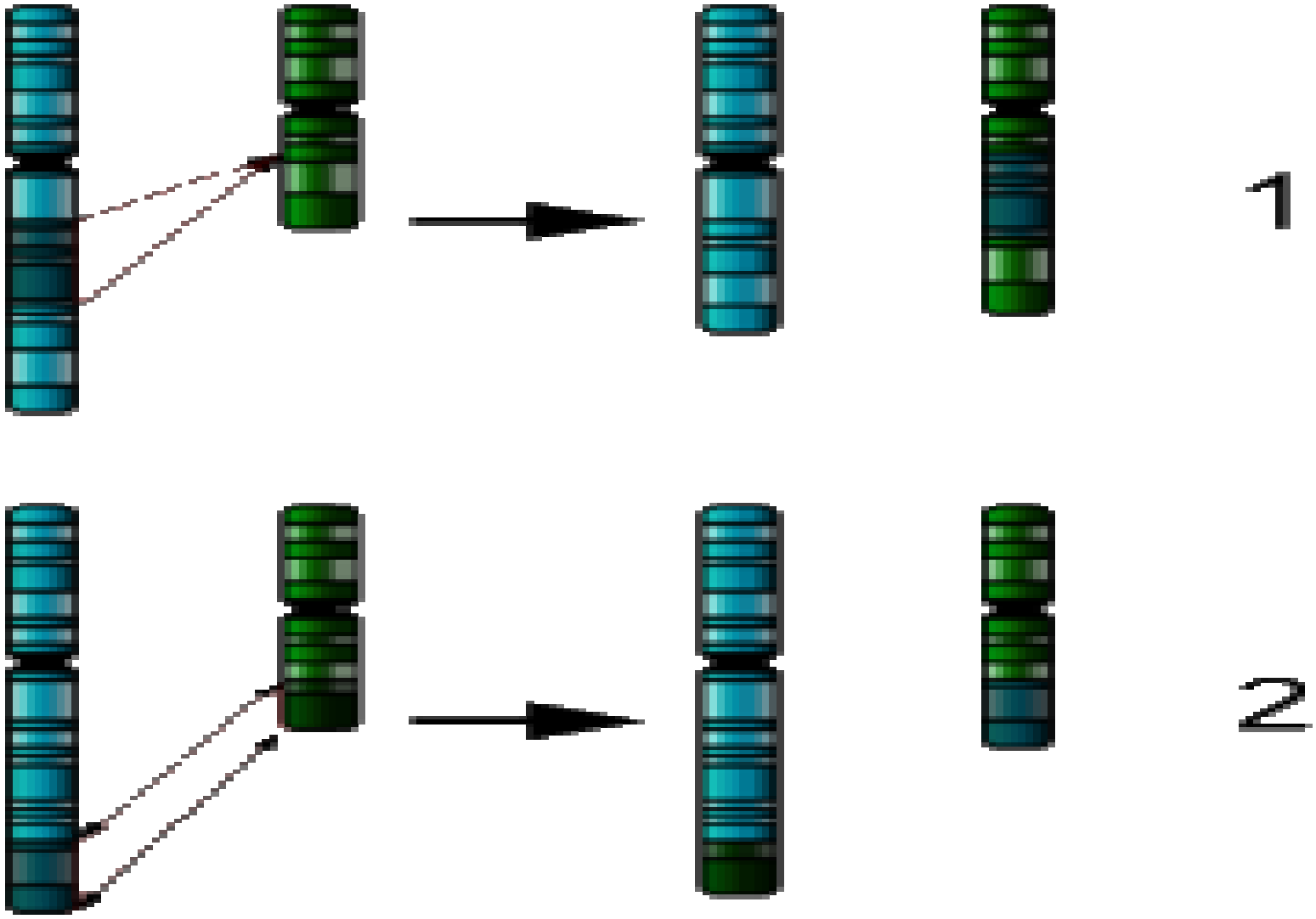


TYPES OF GERMINAL VARIATIONS

- **CONTINUOUS VARIATIONS**
- **DISCONTINUOUS VARIATION**

- **CONTINUOUS VARIATIONS:**
- SMALL INDISTINCT VARIATIONS FROM NORMAL.

- ALSO CALLED FLUCTUATING VARIATIONS OR FLUCTUATIONS.

- HEIGHT IN MAN, MILK YIELD IN COW.

- **TYPES OF CONTINUOUS VARIATIONS:**
- **SUBSTANTIVE CONTINUOUS VARIATIONS:**

- AFFECTS SIZE,WEIGHT,SHAPE & COLOUR OF ORGANISM.

- AFFECTS MORPHOLOGY OF ORGANISM.

- HEIGHT ,SKIN COLOUR, SHAPE OF EYES, NOSE etc.

- **MERISTIC CONTINUOUS VARIATIONS:**
- BRING CHANGE IN NO. OF CERTAIN PARTS OF AN ORGANISM.
- PRESENCE OF 4 OR 6 ARMS IN STARFISH,PRESENCE OF SIX PETALS IN PENTAMEROUS FLOWER.

- **INHERITANCE:** DARWIN MADE CONTINUOUS VARIATION AS THE BASIS OF HIS THEORY OF ORGANIC EVOLUTION

DISCONTINUOUS VARIATIONS

- LARGE ,CONSPICUOUS DIFFERENCES OF OFFSPRINGS FROM PARENTS
- KNOWN AS **MUTATION OR SPORTS OR SALTATIONS**.
- NOT COMMON IN NATURE AND APPEARS SUDDENLY.
- ARE STABLE AND INHERITABLE

- **TYPES:**
- **SUBSTANTIVE DISCONTINUOUS VARIATIONS :**
- AFFECT SIZE,WEIGHT,SHAPE ,COLOUR etc.

- HORNLESS VARIETY OF CATTLE ,SHORT LEGGED ANCON SHEEP,HAIRLESS VARIETY OF DOGS etc.

- MANY CLIMBING VARIETIES OF ROSE ARE MUTANTS OF DWARF OR BUSH VARIETIES.

MERISTIC DISCONTINUOUS VARIATIONS

- INVOLVES CHANGE IN A NUMBER OF CERTAIN PARTS OF ORGANISMS.
- PRESENCE OF ADDITIONAL DIGITS IN HUMAN BEINGS CALLED **POLYDACTYLY**

- **INHERITANCE:** PLAYS AN IMPORTANT ROLE IN EVOLUTION.
- DEVRIES MADE MUTATION AS BASIS OF HIS THEORY OF ORGANIC EVOLUTION i.e. MUTATION THEORY.

TERMS

- **GENE:** A UNIT OF INHERITANCE. EACH GENE CONTROLS A CHARACTER
- **GENE LOCUS**: SPECIAL POSITION OCCUPIED BY A GENE ON CHROMOSOME.
- **ALLELE OR ALLELOMORPHS**: TWO ALTERNATIVE FORMS OF A GENE WHICH EXPRESS CONTRASTING TRAITS OF SAME CHARACTER e.g: T&t ARE ALLELES OF PLANT HEIGHT IN PEA PLANT.
- **DOMINANT ALLELE**: AN ALLELE WHICH CAN EXPRESS IN PRESENCE OF CONTRASTING ALLELE e.g: “T” FOR TALL

- **RECESSIVE ALLELE**: AN ALLELE WHICH FAILS TO EXPRESS IN PRESENCE OF CONTRASTING DOMINANT ALLELE e.g: “t” FOR DWARF

- **HOMOZYGOUS** :AN INDIVIDUAL CONTAINING IDENTICAL GENES OR FACTORS OF A CHARACTER ON ITS HOMOLOGOUS CHROMOSOMES e.g; TT,tt

- **HETEROZYGOUS:** AN INDIVIDUAL HAVING TWO DIFFERENT OR CONTRASTING GENES OF A CHARACER ON ITS HOMOLOGOUS CHROMOSOME[e,g:Tt]

- **P GENERATION** : IT IS THE PARENTAL GENERATION

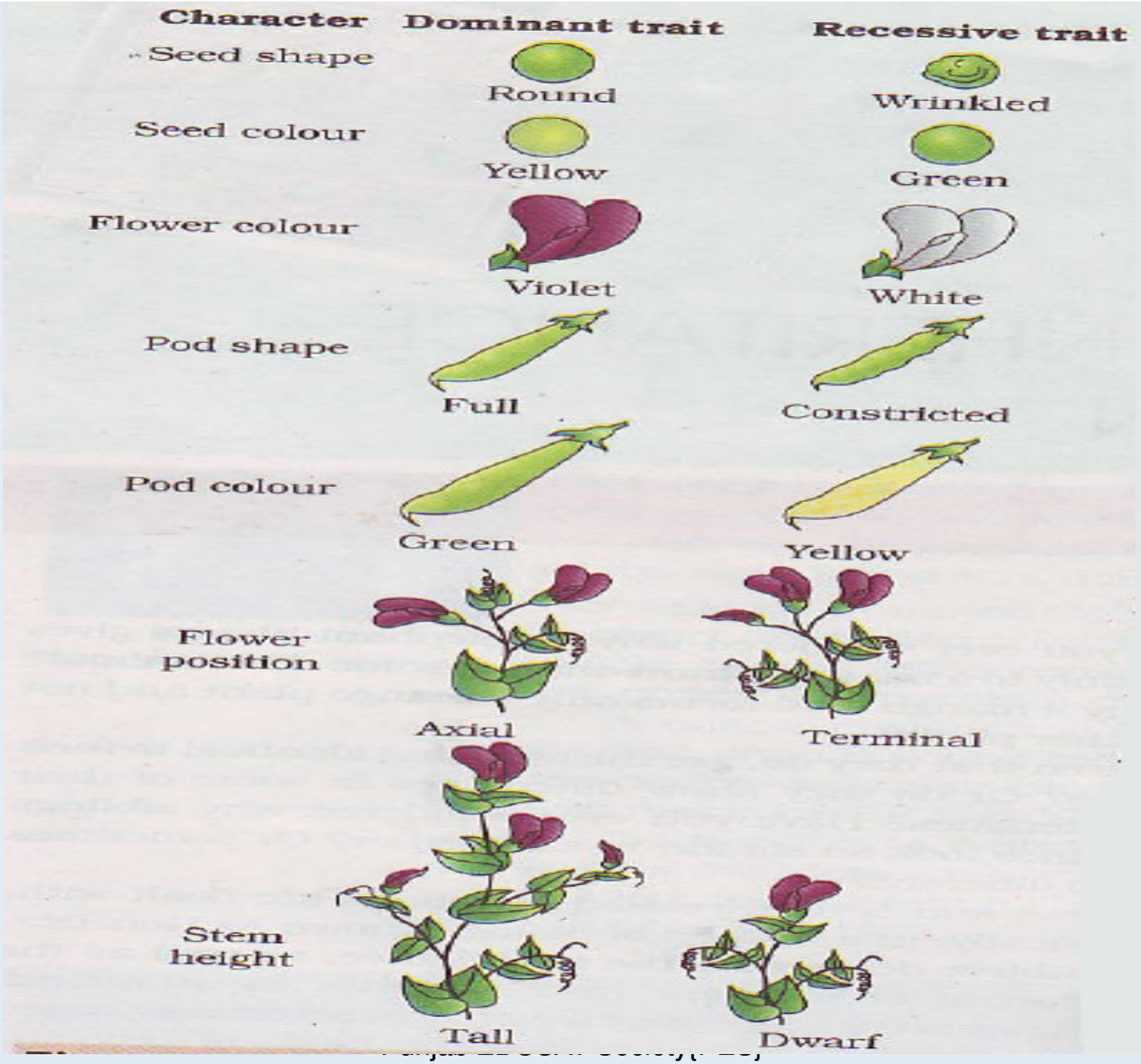
- **F1 GENERATION** : THE FIRST FILIAL GENERATION OBTAINED BY CROSSING TWO MEMBERS OF PARENTAL GENERATION.
- **F2 GENERATION** : SECOND FILIAL GENERATION OBTAINED BY CROSSING TWO MEMBERS OF F1 GENERATION.
- **GENOTYPE** : GENETIC CONSTITUTION OR MAKEUP OF AN INDIVIDUAL.
- **PHENOTYPE** : EXTERNALLY OBSERVABLE STRUCTURAL OR FUNCTIONAL TRAIT OF AN INDIVIDUAL.
- **PURE-LINE :** ORGANISMS THAT ALWAYS PRODUCE OFFSPRINGS WITH SAME TRAITS AS THEIR PARENTS.

MENDELISM

- MENDEL SELECTED PEA PLANTS AS A MATERIAL FOR HIS EXPERIMENTATIONS DUE TO FOLLOWING REASONS :
- MANY VARIETIES OF PEA PLANT WERE AVAILABLE WITH ALTERNATIVE FORMS FOR TRAITS.
- PEA PLANTS ARE SELF- POLLINATING SO PURE LINES CAN BE EASILY OBTAINED.
- PEA PLANTS ARE EASILY GROWN.
- DOES NOT REQUIRE AFTER CARE
- SHORT LIFE SPAN.
- FLOWERS BISEXUAL.

SEVEN PAIRS OF CONTRASTING CHARACTERS OF PISUM SATIVUM

Character	Dominant Trait	Recessive Trait
1.Height	Tall	Dwarf
2.Position of flower	Axial	Terminal
3. Colour of pod	Green	Yellow
4. Shape of pod	Smooth	Constricted
5. Colour of seed	Yellow	Green
6. Shape of seed	Round	Wrinkled
7. Colour of seed coat	Grey	White

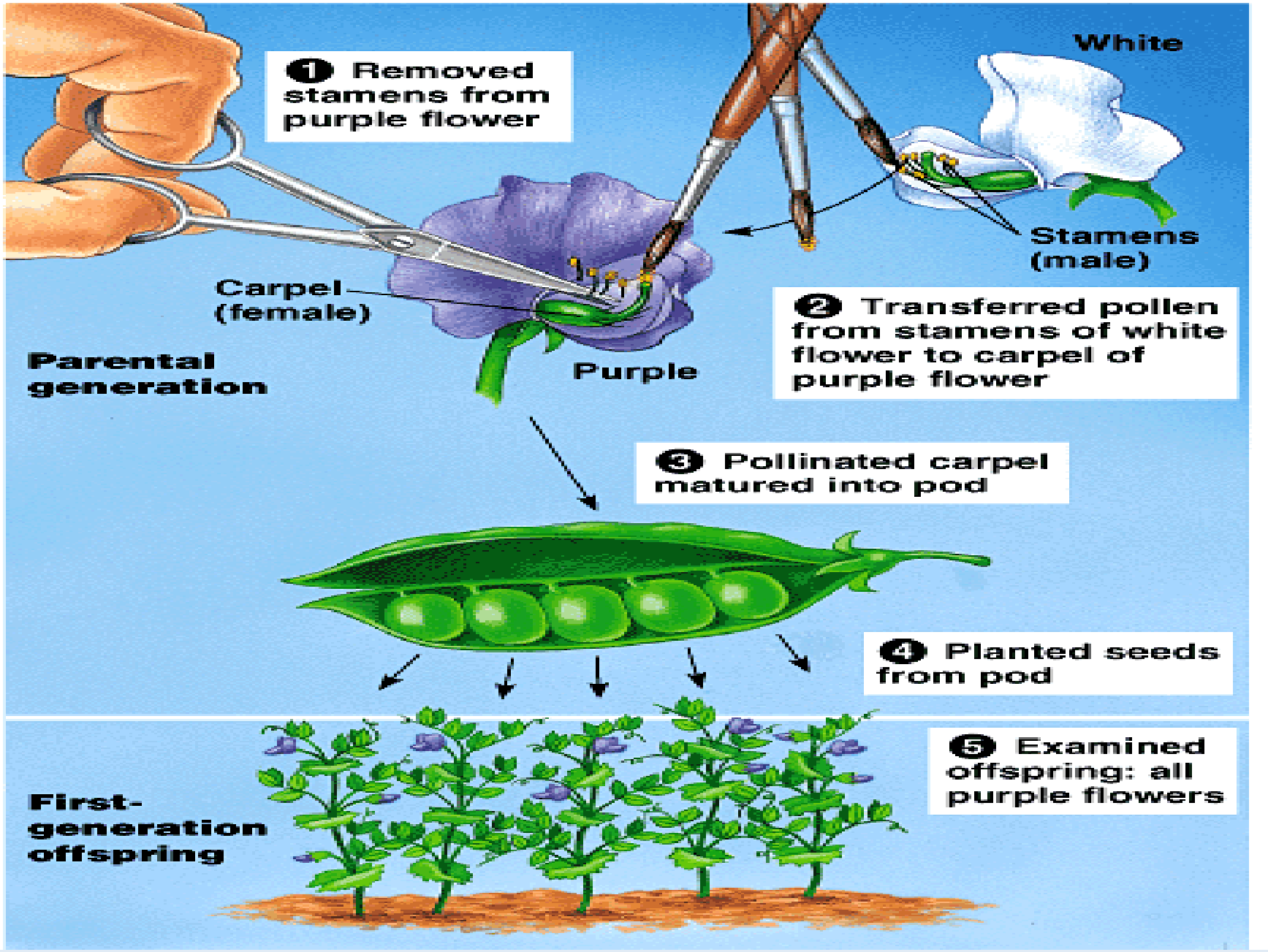

Character
Dominant trait
Recessive trait
Seed shape
Round
Wrinkled
Seed colour
Yellow
Green
Flower colour
Violet
White
Pod shape
Full
Constricted
Pod colour
Green
Yellow
Flower position
Axial
Terminal
Stem height
Tall
Dwarf

STAGES IN MENDEL'S EXPERIMENTS

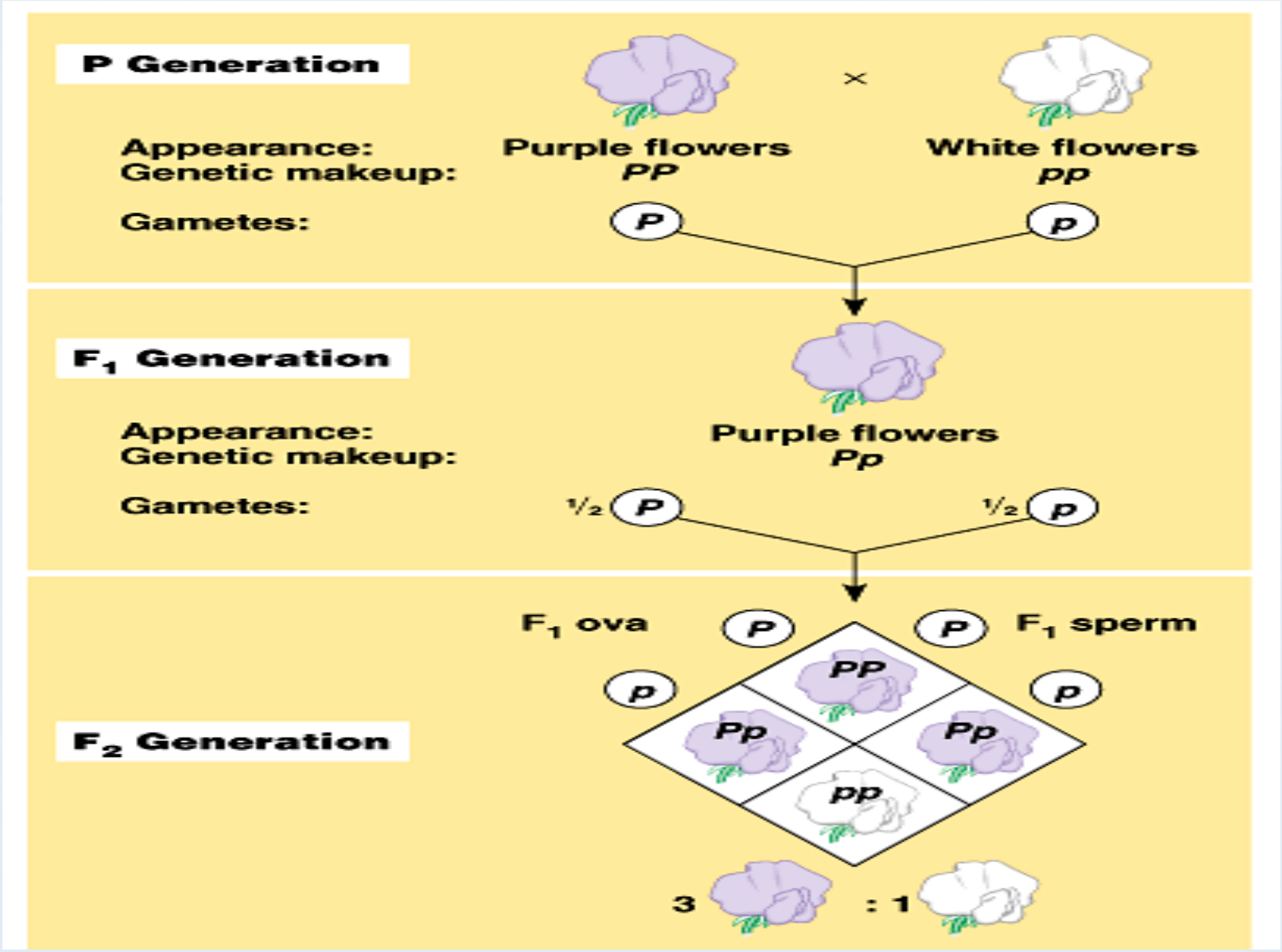
- TRUE BREEDS : MENDEL FIRST TRIED TO FIND OUT WHETHER OR NOT THE SEVEN CHARACTERS NOTED BY HIM PASSED ON FROM PARENTS TO OFFSPRINGS. RAISED SEEDS BY SELF-POLLINATION FROM EACH OF SEVEN TYPES OF PLANTS & SOWED THEM. PLANTS RAISED THUS SHOWED THAT SEVEN CHARACTERS PASSED FROM PARENTS TO OFFSPRINGS.MENDEL NAMED EACH OF THESE AS **PURE CHARACTER**.

- **HYBRIDISATION OF PURE PLANTS:** CROSSING OR MATING OF TWO VARIETIES IS CALLED HYBRIDISATION .MENDEL CROSS-POLLINATED PLANTS WITH ALTERNATE FORMS OF TRAITS . SEEDS FROM THESE PLANTS PRODUCED HYBRID PLANTS CONSTITUTING F1 GENERATION.

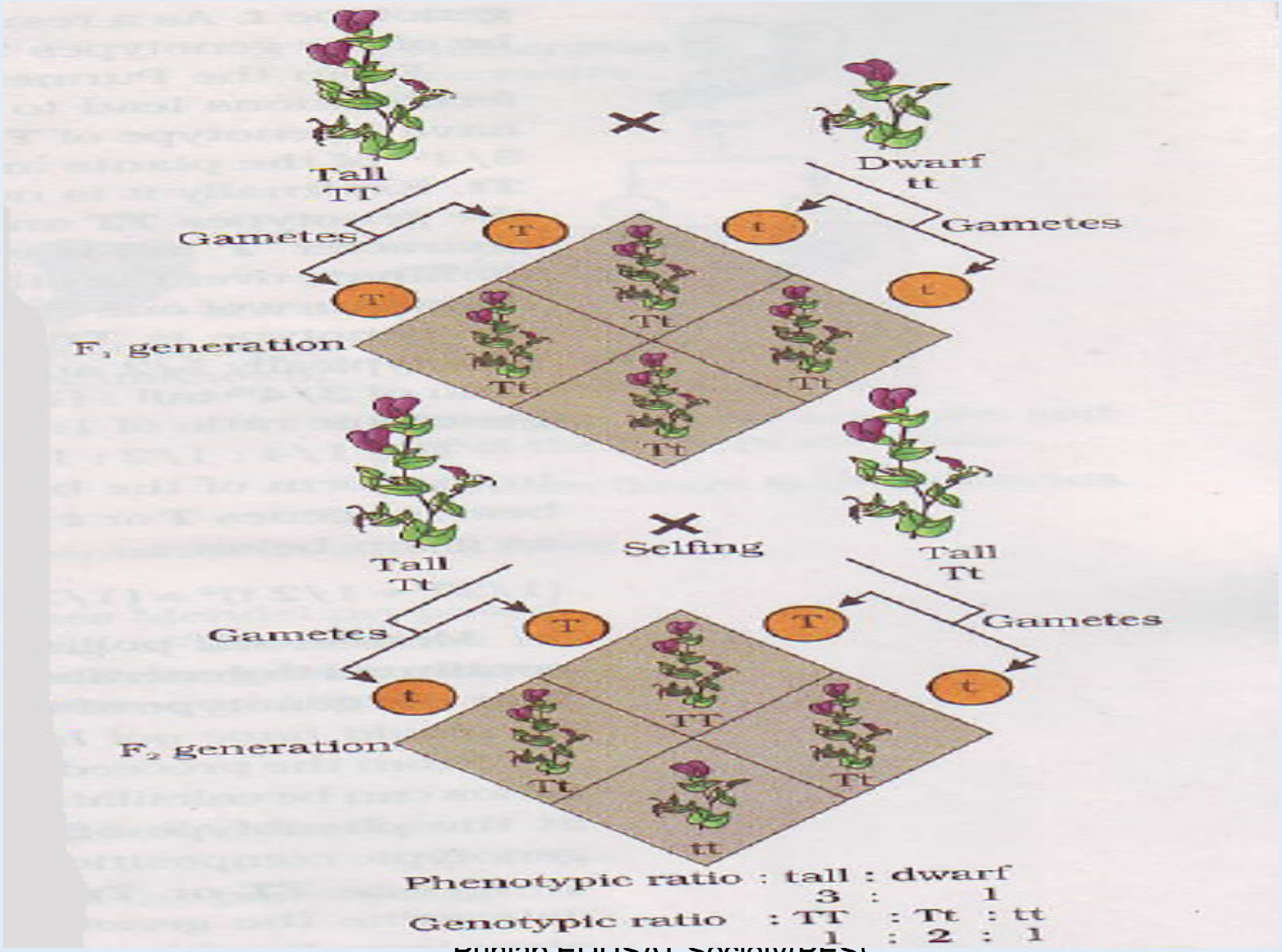
- **SELF –POLLINATION IN HYBRIDS:** SELF-POLLINATION WAS CARRIED IN EACH F1 OFFSPRING PLANT.SEEDS PRODUCED WERE SOWN WHICH PRODUCED F2 GENERATION.


1 Removed stamens from purple flower
White
Stamens (male)
Carpel (female)
Purple
Parental generation
2 Transferred pollen from stamens of white flower to carpel of purple flower
3 Pollinated carpel matured into pod
4 Planted seeds from pod
5 Examined offspring: all purple flowers
First-generation offspring

MONOHYBRID CROSS



MONOHYBRID CROSS



RESULTS OF MONOHYBRID CROSS

- GEMETES BRING ‘SOMETHING’ i.e FACTOR OR UNIT FROM PARENTS WHICH MAKES A CHARACTER APPEAR IN NEXT GENERATION.

- THERE ARE A PAIR OF UNIT FACTORS FOR EACH CHARACTER.

- SOME FACTORS DO NOT EXPRESS THEIR CHARACTERS IN INDIVIDUALS BUT DO NOT CHANGE& MAY EXPRESS IN LATER STAGES. e.g: FACTOR FOR DWARFNESS DID NOT APPEAR INF1 GENERATION BUT APPEARED IN F2 GENERATION.

- FACTORS OF EACH CHARACTER SEGREGATE DURING GAMETE FORMATION SO THAT EACH GAMETE RECEIVES ONLY ONE FACTOR FOR EACH CHARACTER.

- MENDEL FOUND THAT CONTRASTING CONDITION OF A TRAIT EXPRESSED IN F1 GENERATION APPEARS IN THREE FOURTHS OF F2 PLANTS.

- **CONCLUSIONS:**
- INHERITED CHARACTERS ARE DETERMINED BY SEPARATE UNITS.

- PAIR OF UNIT FACTORS FOR EACH CHARACTER, ONE INHERITED FROM EACH PARENT.

LAWS FORMULATED FROM THE CONCLUSIONS

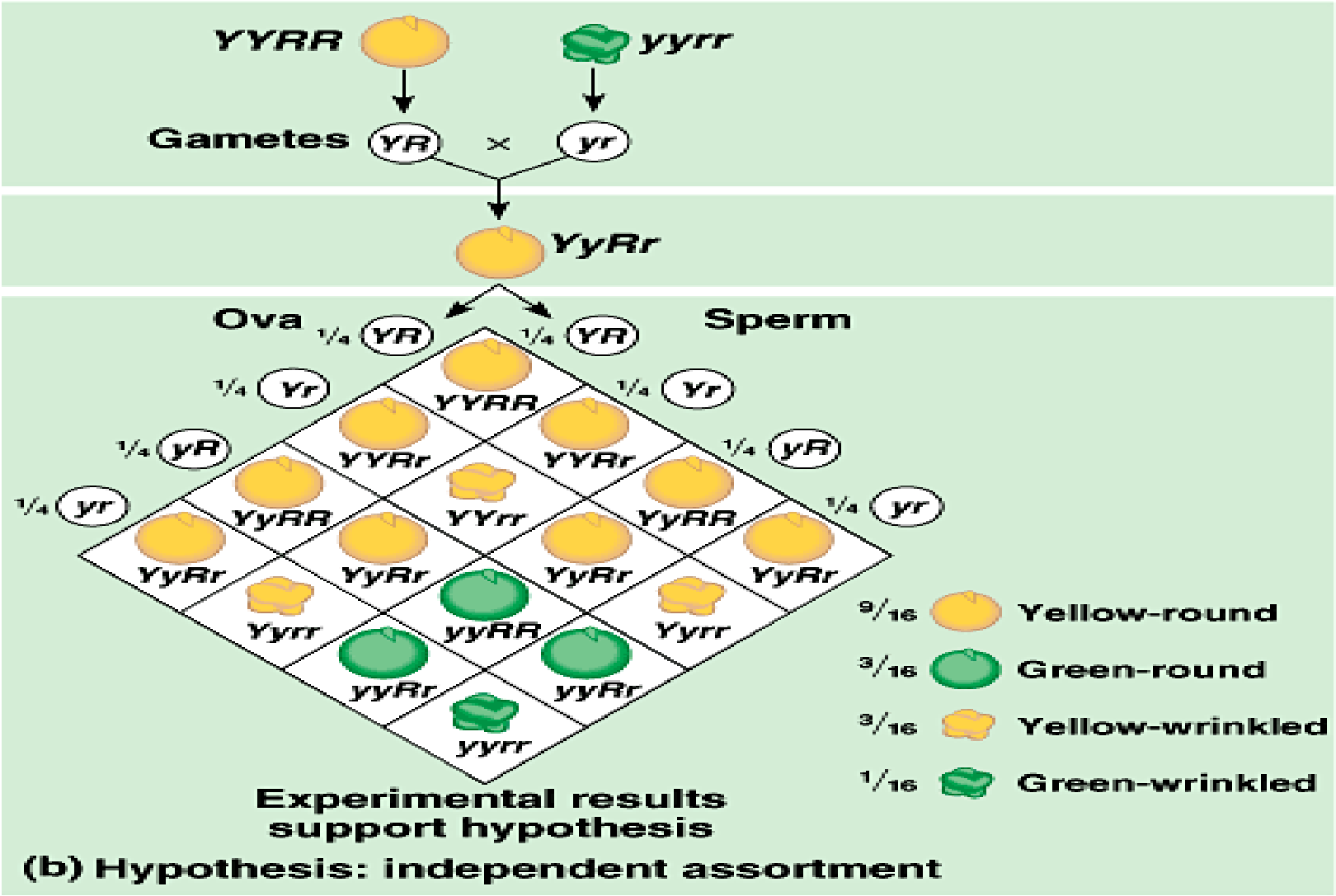
- **LAW OF UNIT OR PAIRED FACTORS:** THIS LAW STATES THAT THE VARIOUS HEREDITORY CHARACTERS ARE CONTROLLED BY FACTORS AND THERE IS A PAIR OF FACTORS FOR EACH CHARACTER.

- **LAW OF DOMINANCE :** THIS LAW STATES THAT ONE FACTOR IN A PAIR EXPRESSES ITSELF AND PREVENTS EXPRESSION OF THE OTHER,IN F1 GENERATION.

- **LAW OF SEGREGATION:** THE FACTORS OF EACH CHARACTER SEGREGATE DURING GAMETE FORMATION SO THAT EACH GAMETE RECEIVES ONLY ONE FACTOR AND IS ALWAYS PURE. THE TWO FACTOR OR A TRAIT OCCUR WITH EQUAL FREQUENCY IN MALE AND FEMALE GAMETES.

DIHYBRID CROSS

(Inheritance of two genes)



RESULTS OF DIHYBRID CROSS

- **FOUR TYPES OF PLANTS:** A DIHYBRID CROSS PRODUCES FOUR TYPES OF PLANTS IN F2 GENERATION IN THE RATIO OF 9:3:3:1, 9 WITH TWO DOMINANT TRAITS, 3 WITH ONE DOMINANT AND ONE RECESSIVE TRAIT, 3 WITH THE OTHER DOMINANT AND THE OTHER RECESSIVE TRAIT AND 1 WITH TWO RECESSIVE TRAITS.

9	:	3	:	3	:	1
ROUND		ROUND		WRINKLED		WRINKLED
YELLOW		GREEN		YELLOW		GREEN

- **NEW COMBINATIONS:** TWO NEW COMBINATION OF CHARACTERS i.e. ROUND GREEN AND WRINKLED YELLOW, HAD APPEARED IN A DIHYBRID CROSS.

CONCLUSION DRAWN FROM DIHYBRID CROSS

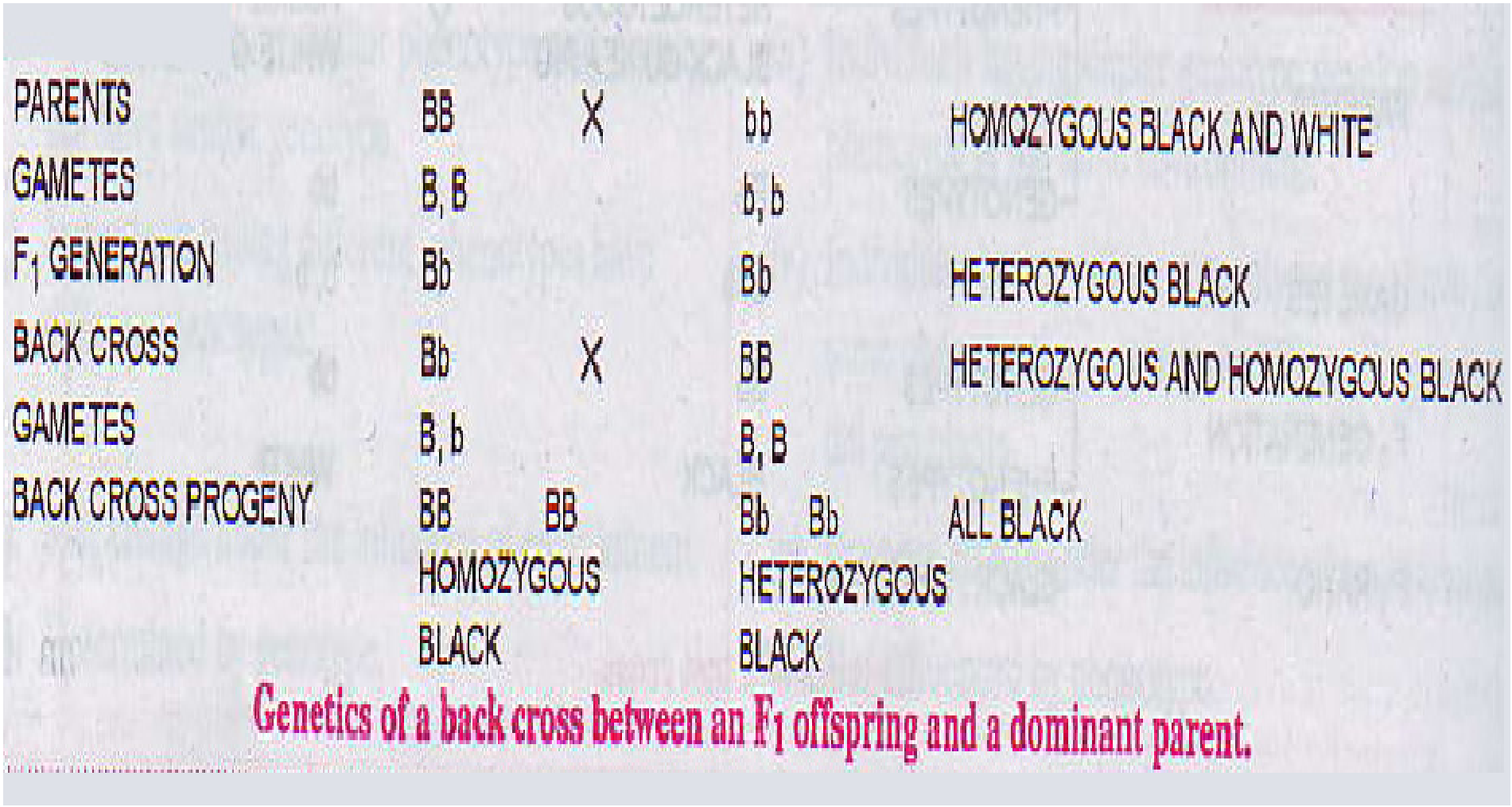
- INHERITANCE OF ONE CHARACTER i.e. COLOUR OF SEED WAS INDEPENDENT OF THE INHERITANCE OF ANOTHER CHARACTER i.e. SEED SHAPE. THIS LED HIM TO FORMULATE THE LAW OF INDEPENDENT ASSORTMENT.

LAW OF INDEPENDENT ASSORTMENT

FACTORS OR ALLELES OF DIFFERENT CHARACTERS LOCATED IN DIFFERENT PAIRS OF HOMOLOGOUS CHROMOSOMES ARE INDEPENDENT OF ONE ANOTHER IN THEIR SEGREGATION DURING GEMETE FORMATION AND THEIR COMING TOGETHER INTO THE OFFSPRING BY FERTILIZATION.

BACK CROSS

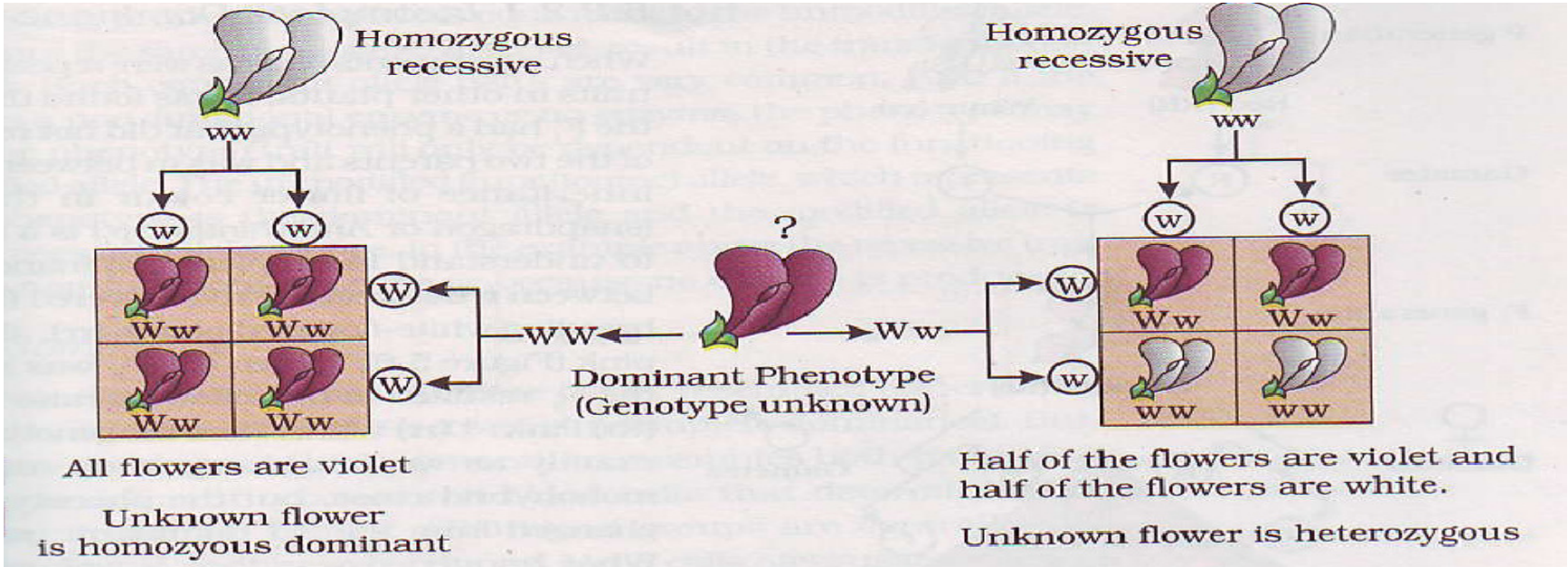
- GENETIC CROSS BETWEEN A **HYBRID ORGANISM** & **ONE OF ORIGINAL PARENTS.**
- RESULTS: DEPENDS ON PARENTAL TYPE.



TEST CROSS

- CROSS BETWEEN AN ORGANISM OF AN **UNKNOWN GENOTYPE** & A **HOMOZYGOUS RECESSIVE ORGANISM.**

- RESULTS: IF TEST CROSS YIELDS OFFSPRINGS OF WHICH 50% SHOW DOMINANT CHARACTER & 50% SHOW RECESSIVE CHARACTER ,INDIVIDUAL UNDER TEST IS HETEROZYGOUS.IF ALL OFFSPRINGS SHOW DOMINANT TRAIT INDIVIDUAL BEING TESTED IS HOMOZYGOUS DOMINANT

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