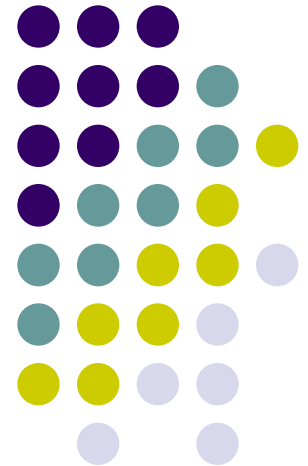
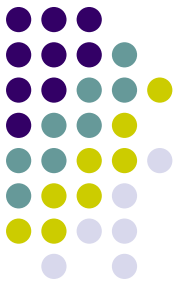




GENETIC PROBLEMS

March 2012





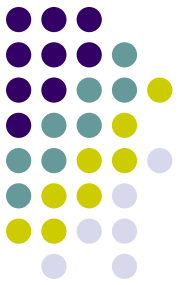
Exam Guideline

Solving monohybrid genetic problems (up to the F_2 /second generation) based on

- Complete dominance
- Incomplete dominance
- Co-dominance
- Inheritance of sex
- Inheritance of haemophilia and colour blindness as sex-linked characteristics

Interpretation of pedigree diagrams

Terminology



Monohybrid cross

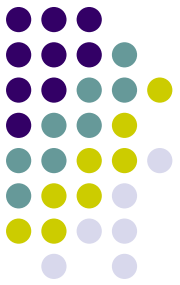
- Only one characteristic/hereditary trait is investigated at a time.

Mendel's Law of Segregation

- Each characteristic is regulated by two alleles/factors which separate during meiosis so that each gamete contains only one of the alleles/factors

Mendel's Principle of Dominance

- When two individuals with pure breeding contrasting characteristics are crossed, the F_1 -generation displays the dominant characteristic



Terminology

Complete dominance

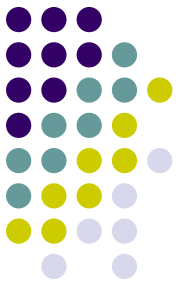
- A genetic interaction where one allele of a gene suppresses the expression of an alternative allele in the F_1 heterozygote (e.g. Bb) so that the phenotype is the same as that of the dominant allele.

Incomplete dominance

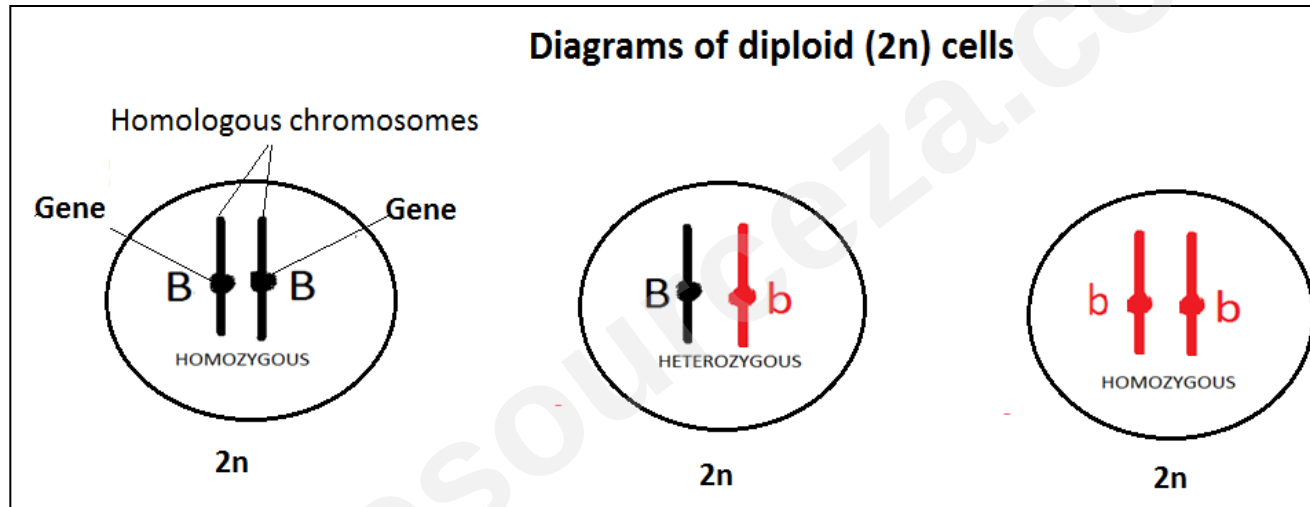
- A pattern of inheritance in which a cross between two phenotypically different parents produces an offspring different from both parents but containing partial features of both - intermediate.

Co-dominance

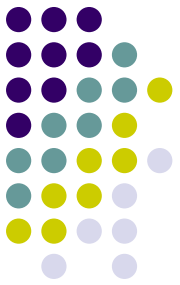
- Both alleles are equally dominant and therefore both are expressed in the phenotype



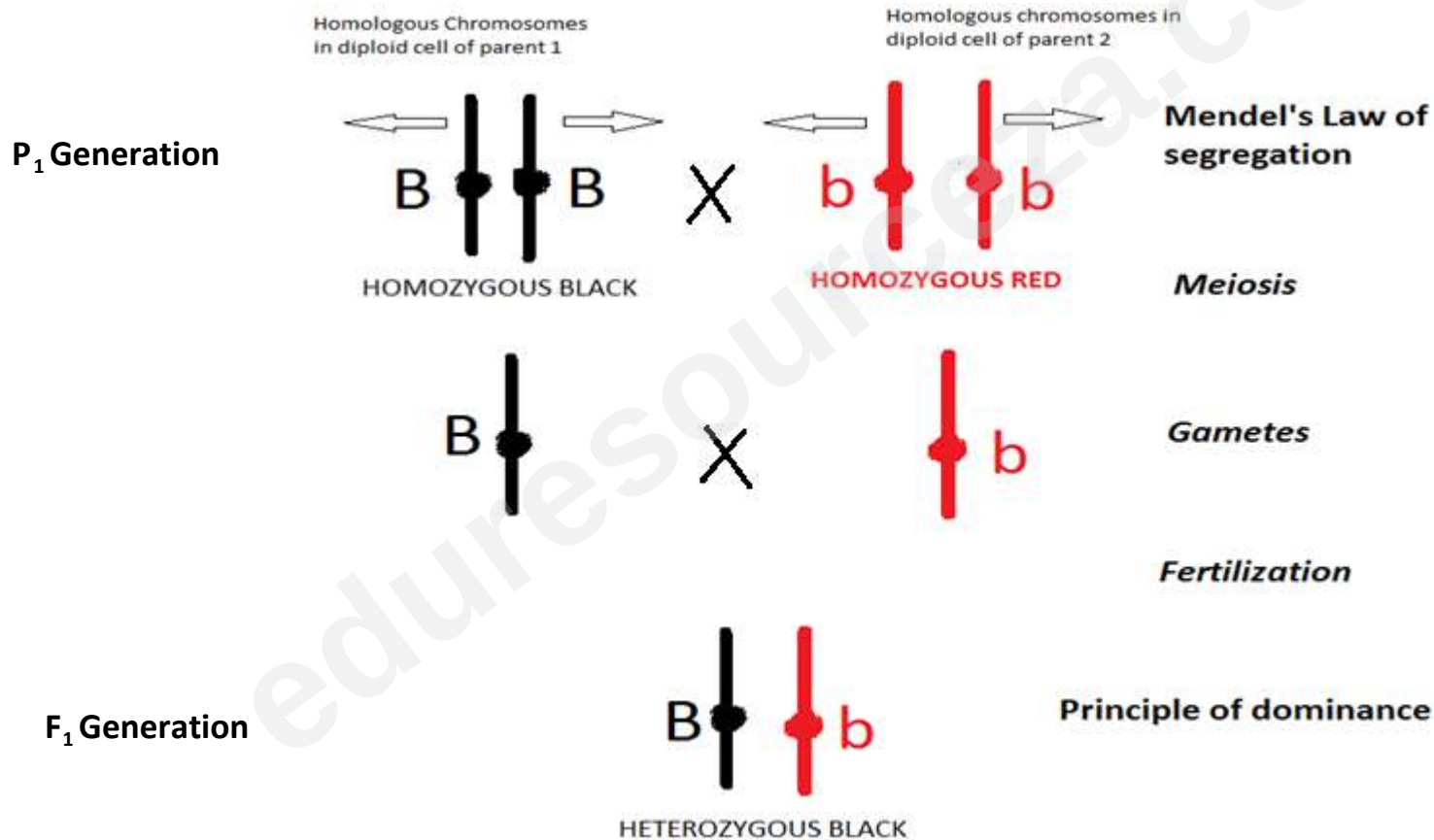
Terminology



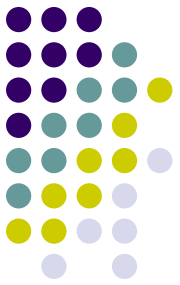
Allele: alleles are alternate forms of a gene localised on the same **locus** on homologous chromosomes. If alleles of the same characteristic are both the same, the organism will be **homozygous** for that characteristic. If the alleles for a characteristic are different the organism is described as **heterozygous** for that characteristic.



MONOHYBRID CROSS



Steps in Solving Monohybrid Genetic problems



- Determine the dominant characteristic.
- Determine the key i.e. symbol/letter to be used.
- Determine the phenotypes and genotypes of the parents.
- Determine the genes of each gamete after meiosis
- Determine the alleles of the zygote after fertilization
– F_1 - genotype
- Describe the phenotypes of the F_1 - generation



Template

Characteristic:.....
 Variation (Phenotype) of characteristic:.....
 Genetic variation (alleles)
 Type of dominance:.....

P₁ Phenotype _____ x _____
 Genotype _____ x _____

Meiosis

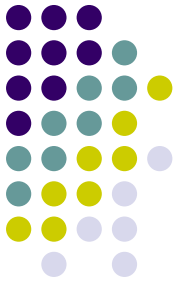
Gametes _____, _____, _____, _____ x _____, _____, _____, _____

Fertilisation

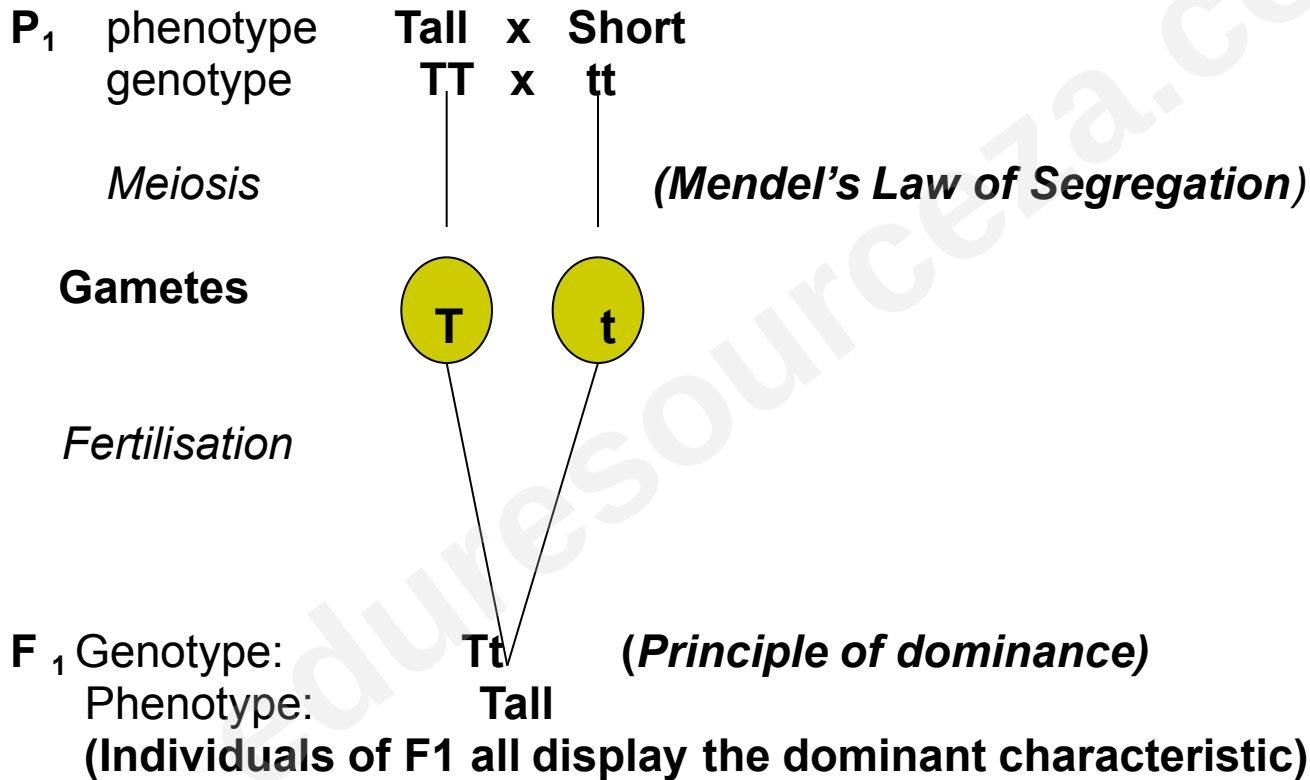
Punnet diagram

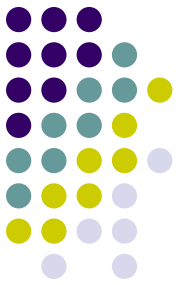
F₁ Genotype _____ Ratio: _____

Phenotype _____ Ratio: _____

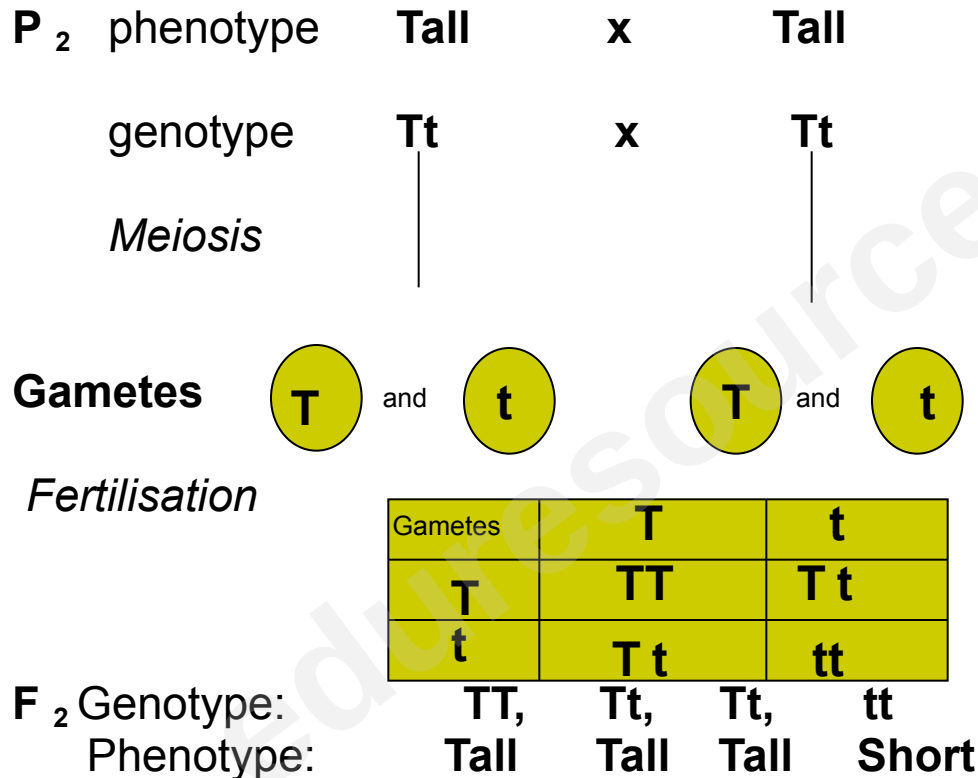


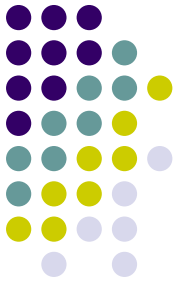
Complete dominance



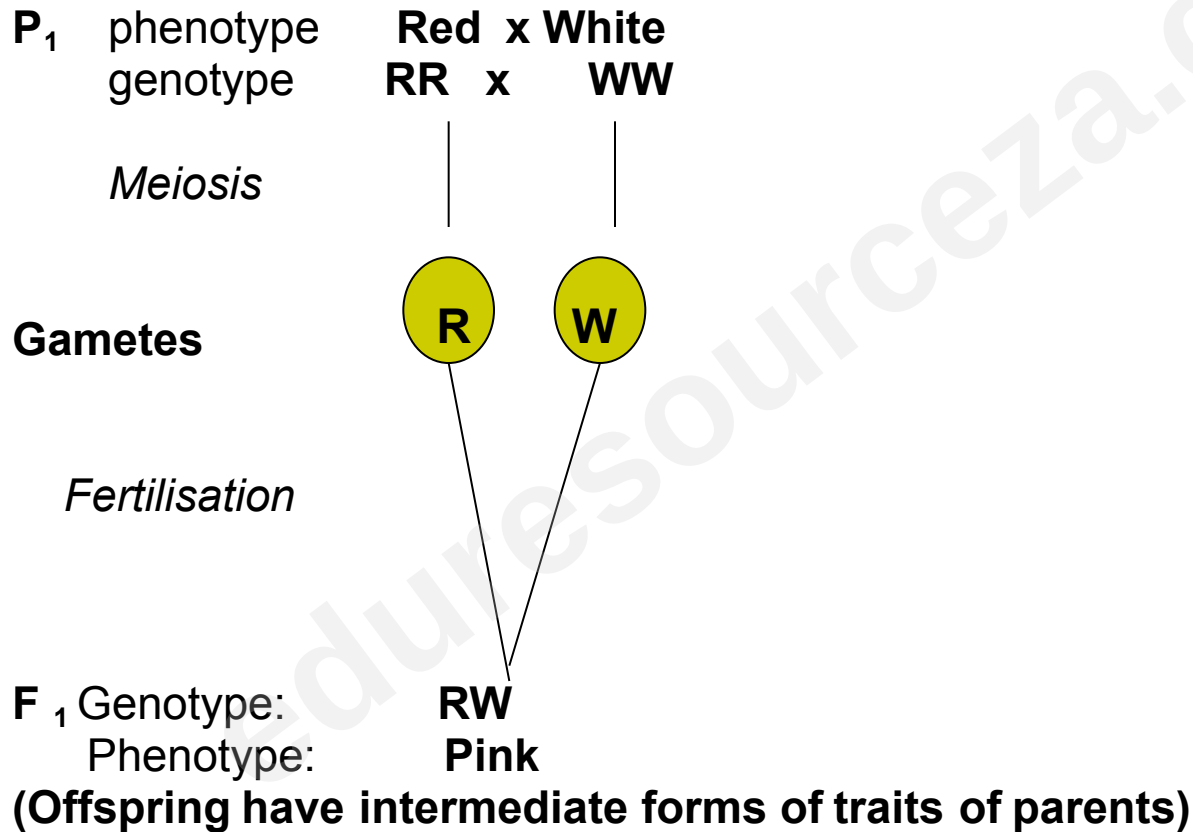


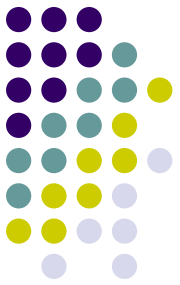
Complete dominance



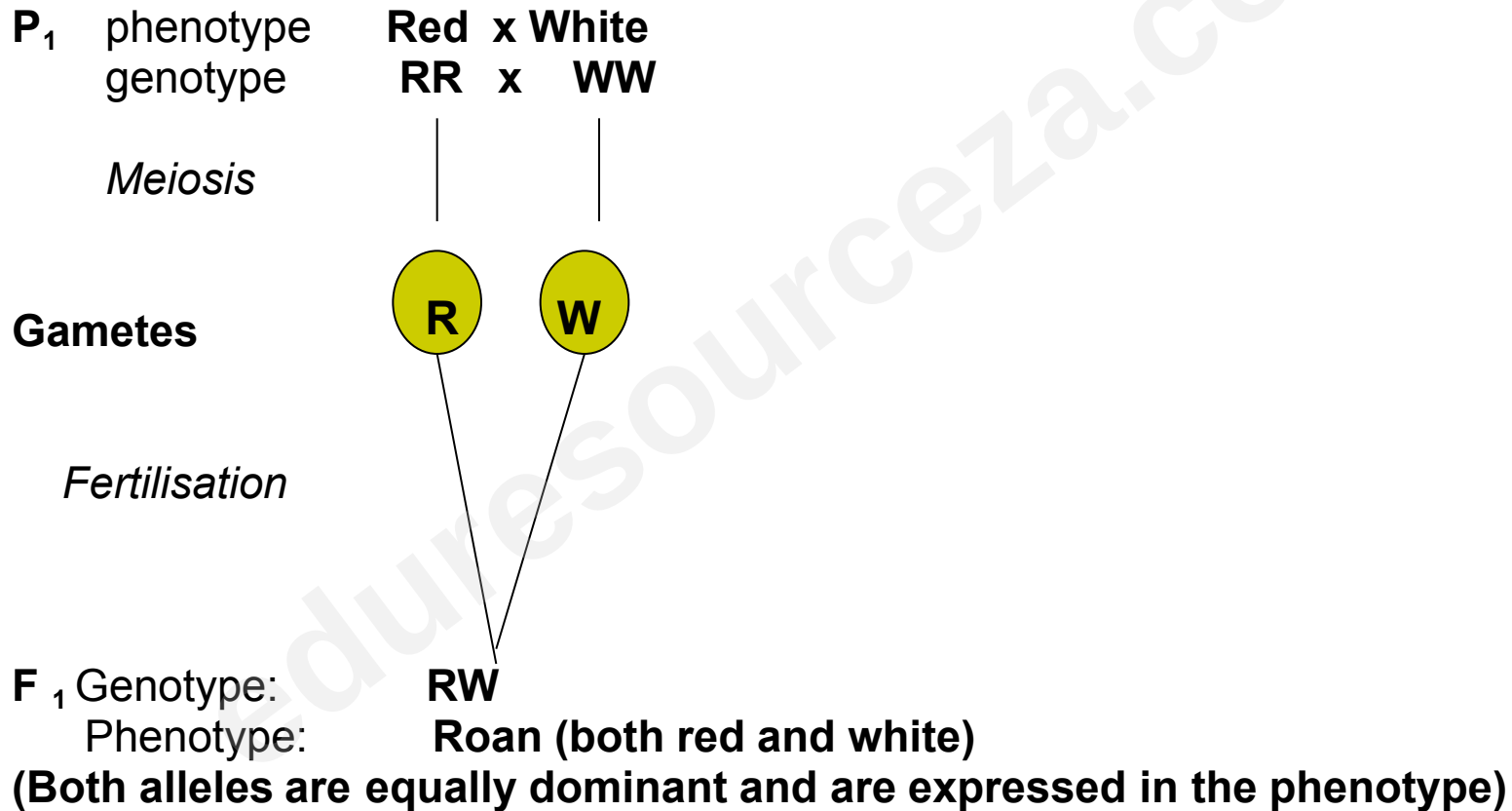


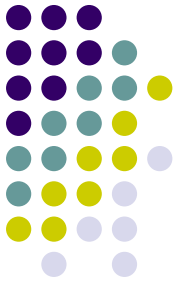
Incomplete dominance





Co-dominance





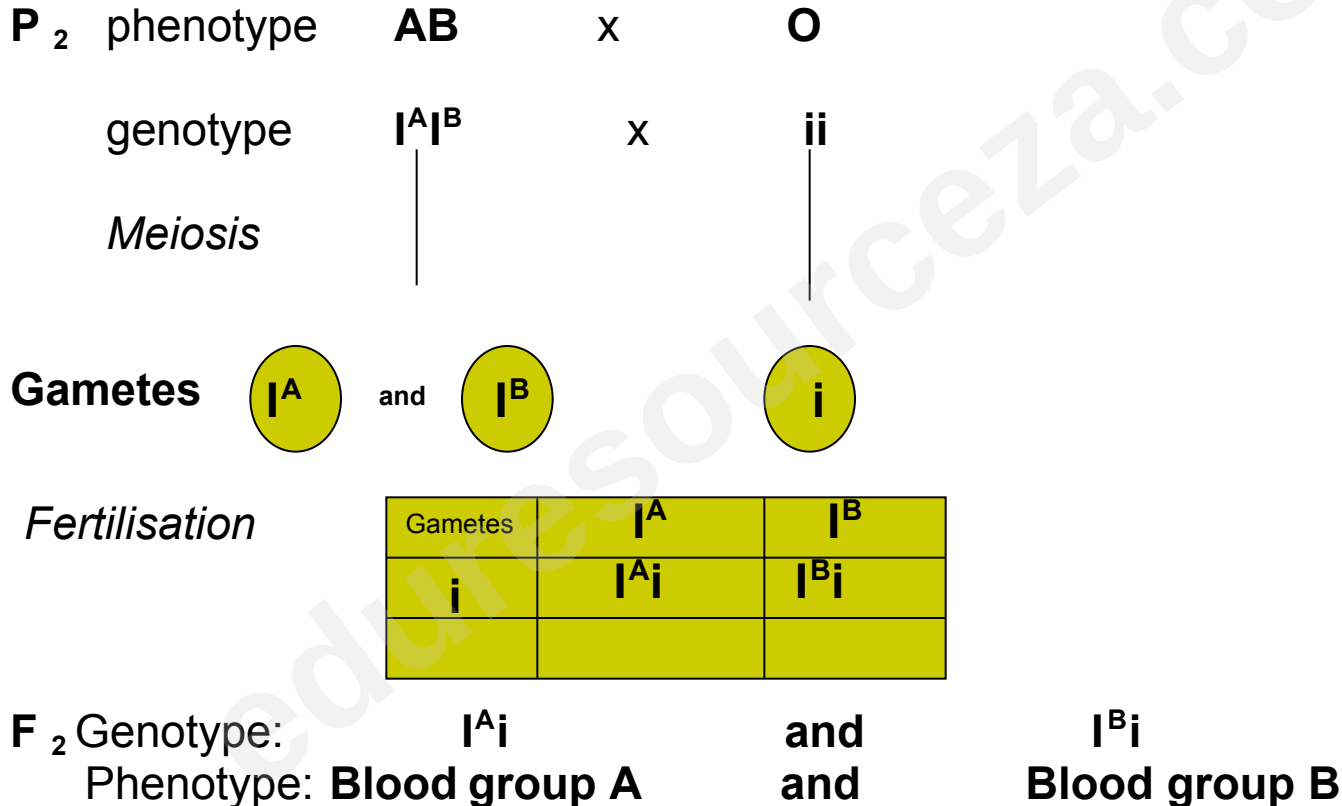
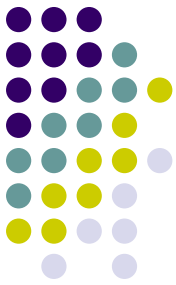
Blood groups

Blood group (Phenotype)	Alleles (Genotype)
A	$I^A I^A$ or $I^A i$
B	$I^B I^B$ or $I^B i$
AB	$I^A I^B$
O	ii

Blood Groups

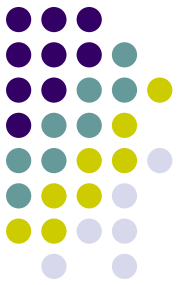
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A man with blood group AB marries a woman with blood group O. Predict the nature of their possible offspring



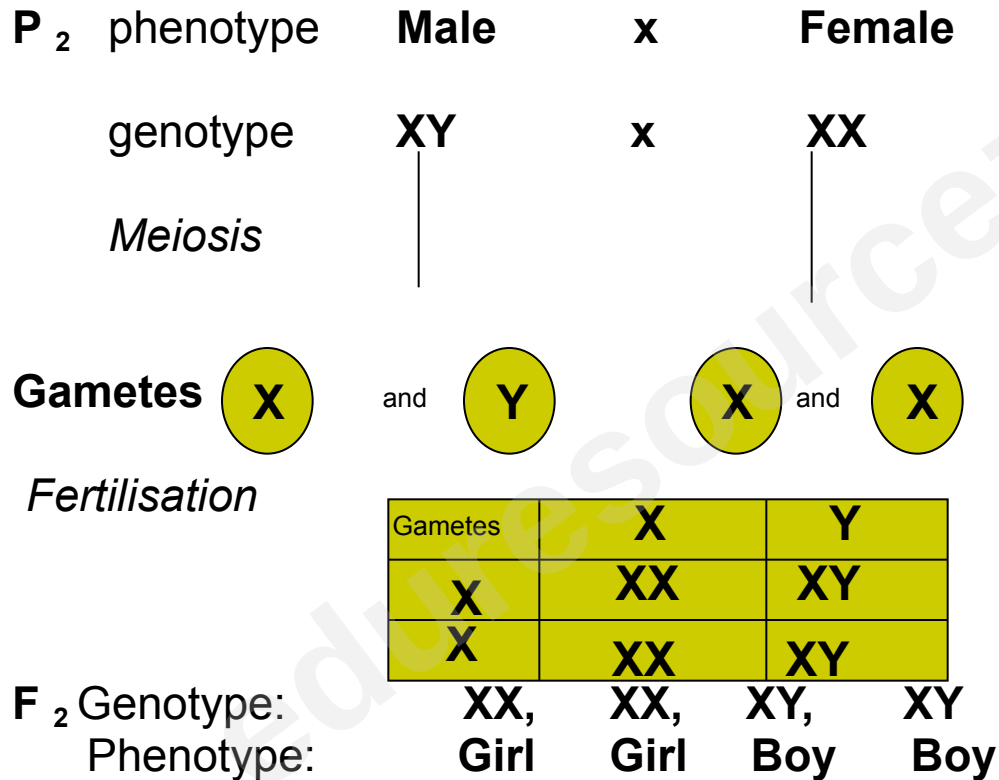
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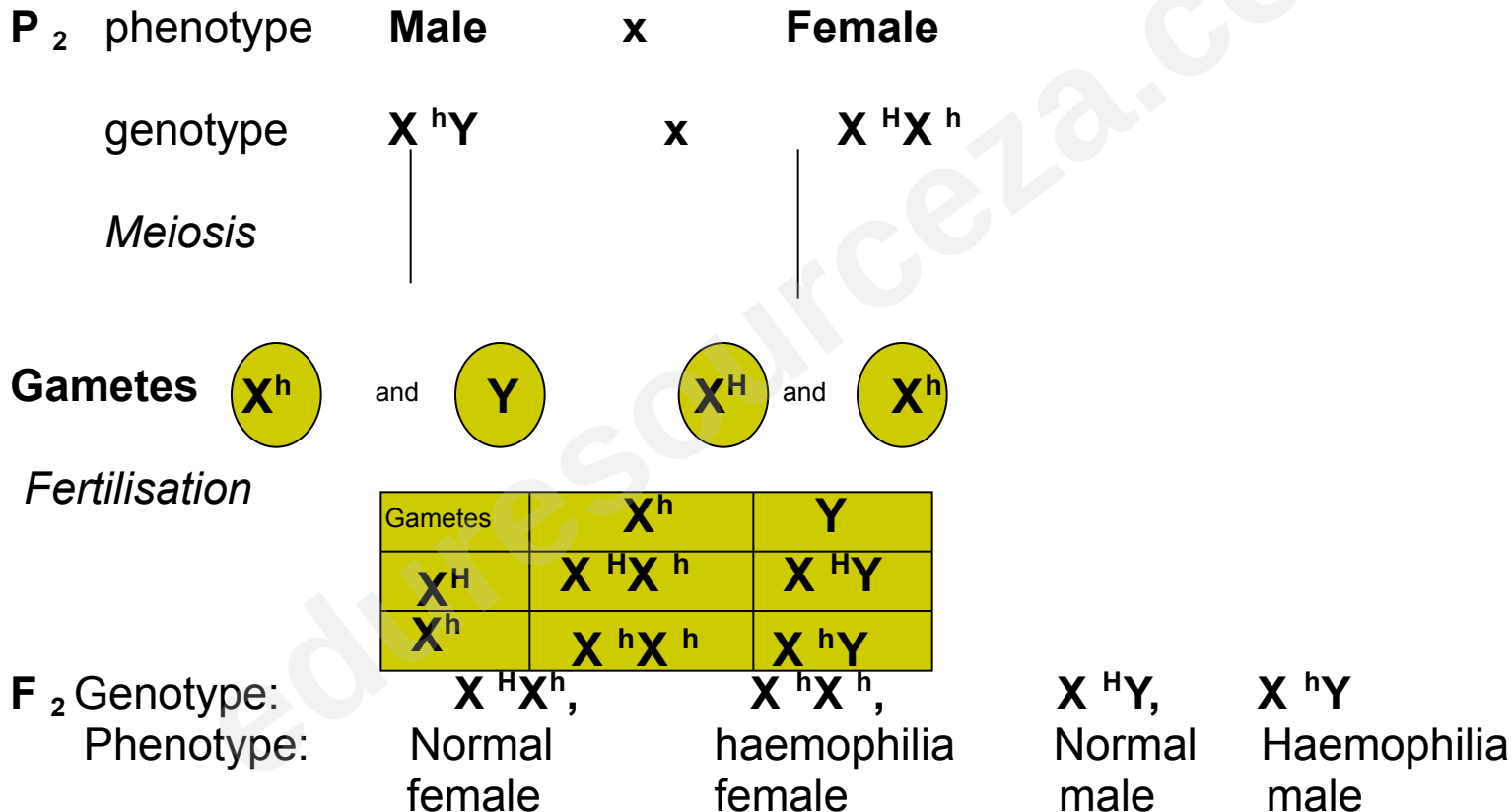
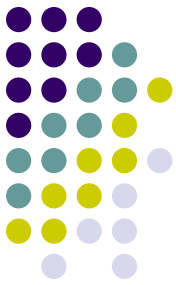


Inheritance of sex

A couple want to know what their chances are of having a baby girl/boy



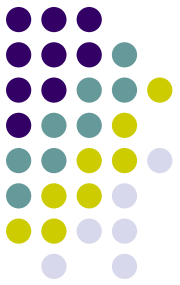
Sex – linked disease. Haemophilia is caused by a recessive allele on the X-chromosome. Males have only one X-chromosome – they mainly suffer from this disorder. Cross a mother who is normal but a carrier with a haemophiliac father.



Pedigree diagrams

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Shows the pattern of inheritance of characteristics over a few generations

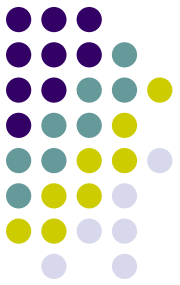


Follow the following steps when interpreting pedigree diagrams

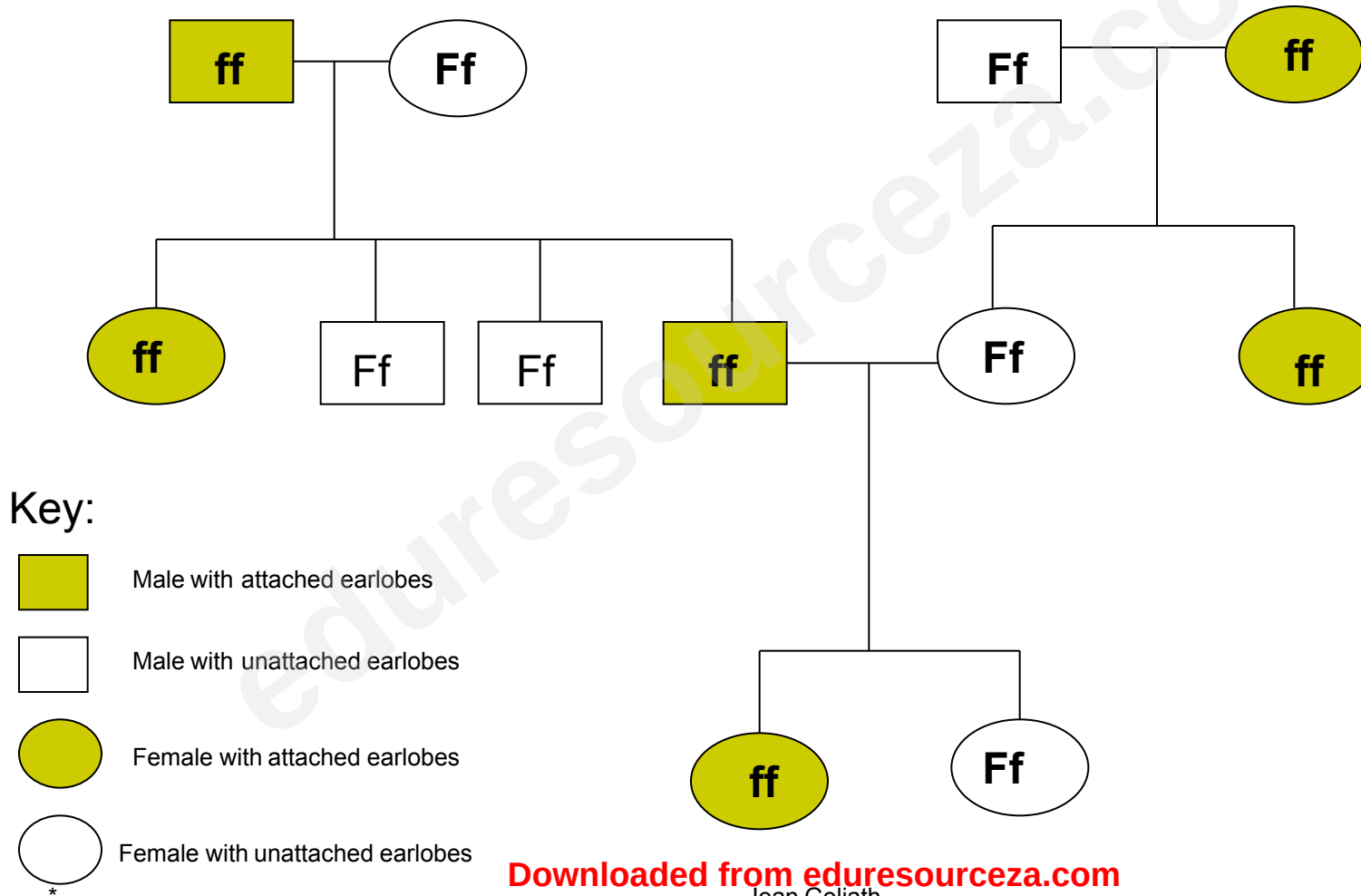
- Study any **key and opening statement/s** and look for **dominant characteristics** and phenotypes
- Write in the **phenotypes** of all the individuals as given in the problem.
- Fill in the **genotype of all the individuals with the recessive condition**- it has to have 2 lower case letters e.g. ff
- For every individual in the diagram that has the recessive condition, it means that each gene was obtained from each of the parents. Work backwards and fill in one recessive gene for each parent.
- If the parents showed the dominant characteristic fill in the second letter which has to be a capital letter.
- Any other individual showing the dominant characteristic will most likely be homozygous dominant – two capital letters

Example 1 – earlobes

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Please note: Unattached earlobes are dominant (F) and Attached earlobes are recessive (f)– complete missing genotypes



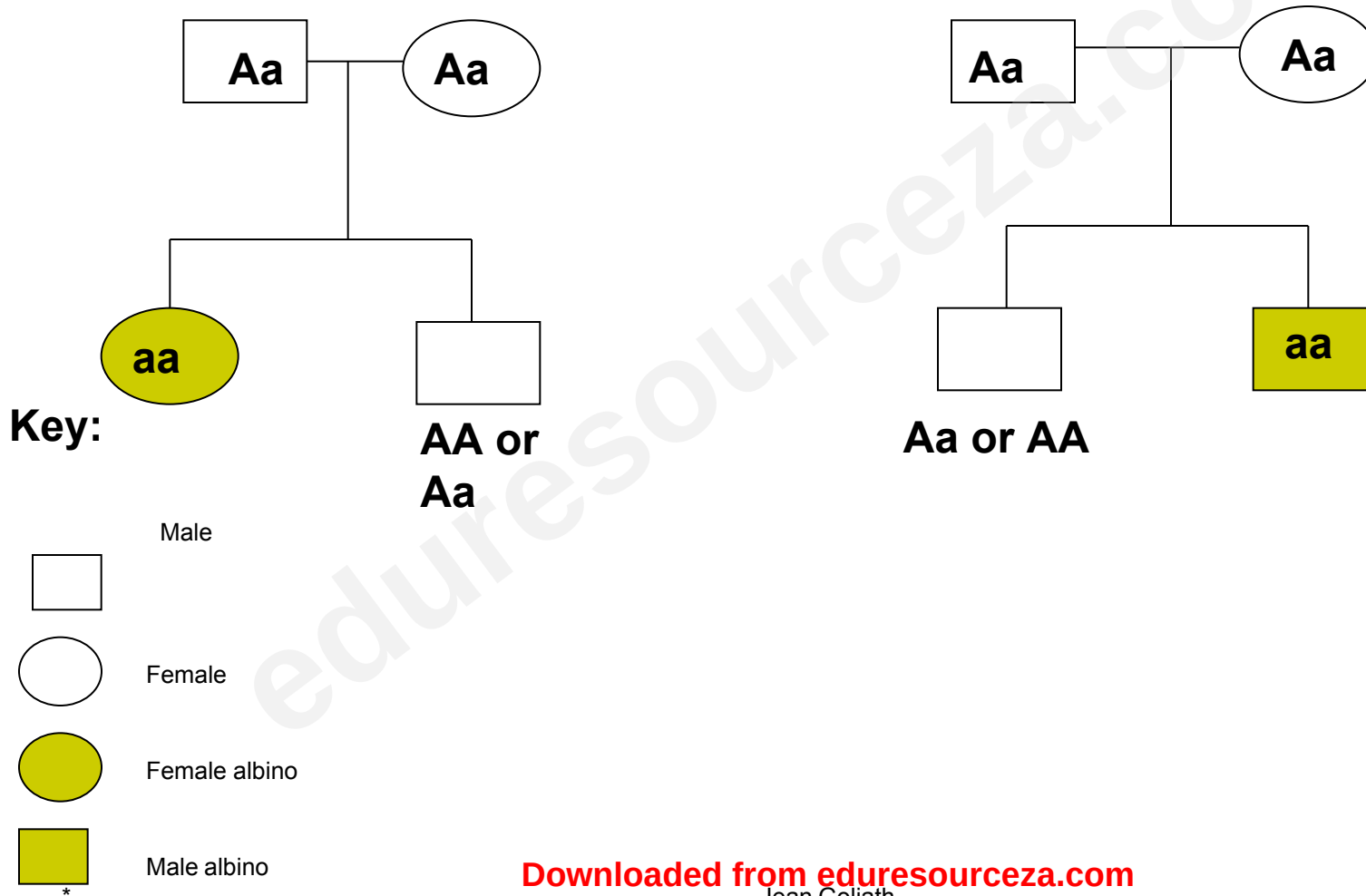
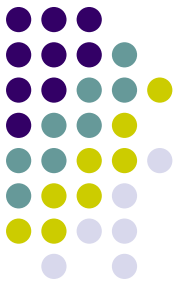
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Example 2 – Albinism

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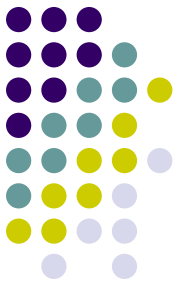
Please note : Albinism (a) is caused by a recessive allele

Use symbols A and a to complete the following pedigree diagram



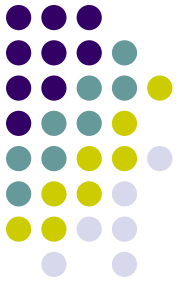
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- Complete the following activity in pairs

In humans, the ability to roll the tongue is because of a dominant gene. Use the letters **(R)** to represent rolling and **(r)** for non –rolling and show diagrammatically, by means of a genetic cross, how a man who is a roller, who marries a woman who is also a roller, may have a girl who cannot roll her tongue.



Activity 1 Answer

P₁ phenotype **Roller** x **Roller**

genotype **Rr** x **Rr**

Meiosis

Gametes **R** and **r** **R** and **r**

Fertilisation

Gametes	R	r
R	RR	Rr
r	Rr	rr

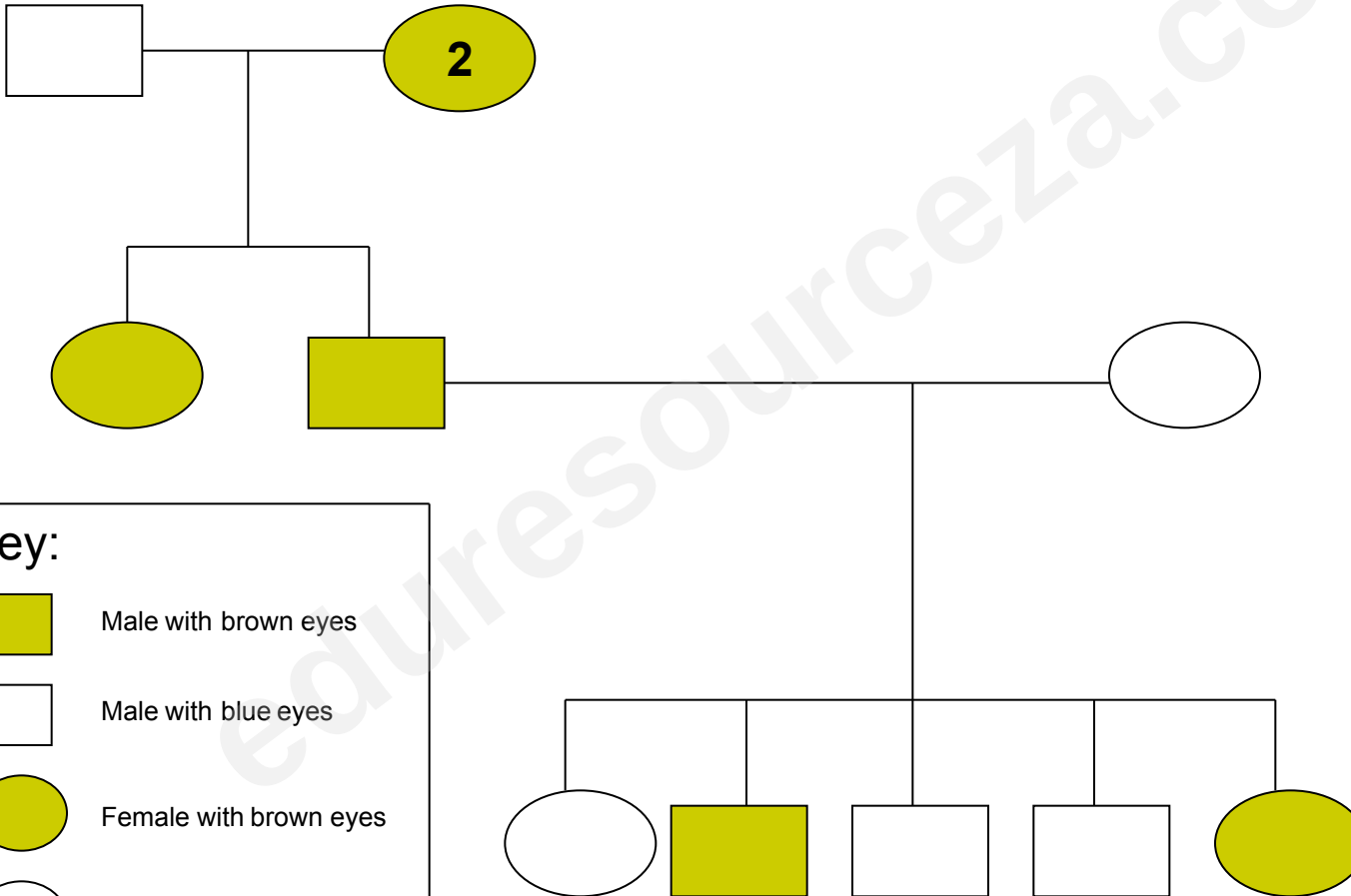
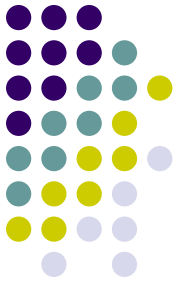
F₁ Genotype: **RR,** **Rr,** **Rr,** **rr**

Phenotype: **Roller** **Roller** **Roller** **Non-roller**

Activity 2

Complete the following activity in pairs

The diagram below shows the inheritance of eye colour in humans. Brown (B) eye colour is dominant over blue (b). Individual 2 is homozygous. Use the letters B and b and write down the phenotypes and genotypes of individuals.



Key:



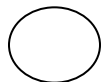
Male with brown eyes



Male with blue eyes



Female with brown eyes



Female with blue eyes

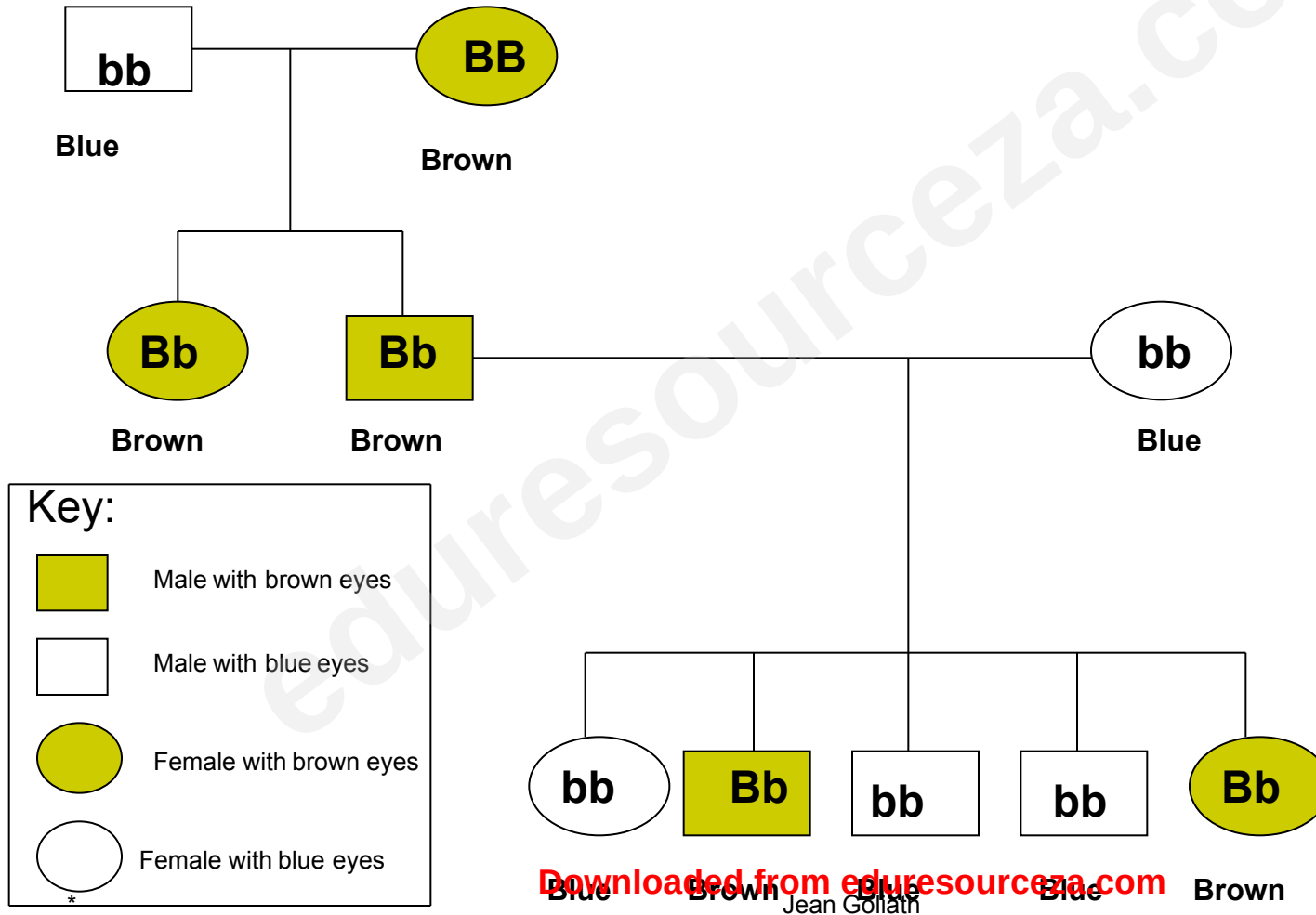
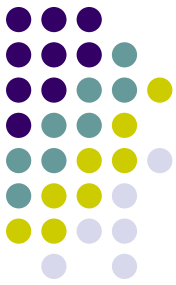
*

Activity 2

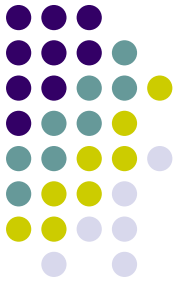
Complete the following activity in pairs

The diagram below shows the inheritance of eye colour in humans. Brown (B) eye colour is dominant over blue (b).

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THANK YOU