DIHYBRID CROSS

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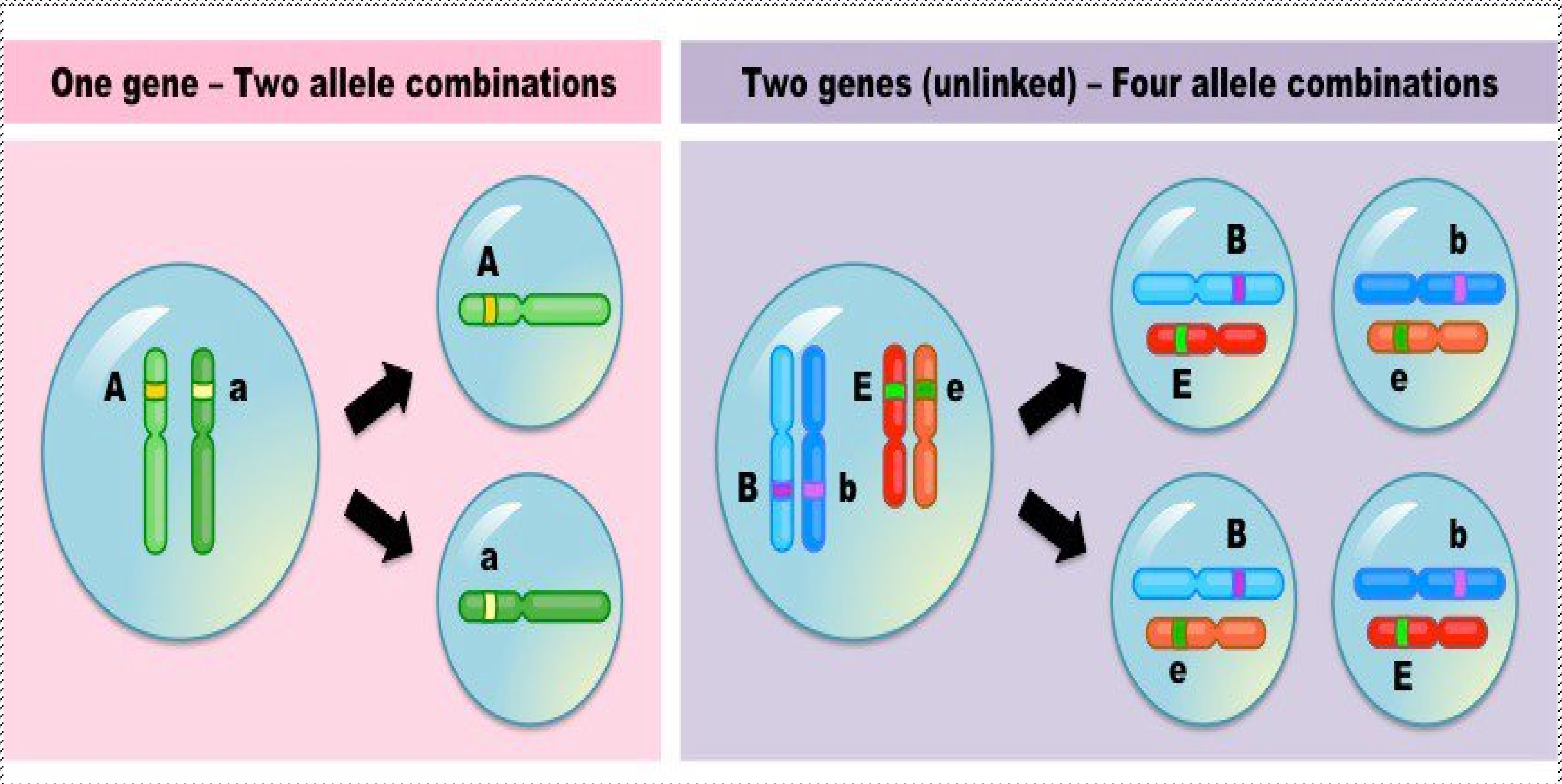
Unlinked gene and Dihybrid cross

- According to the law of independent assortment, pairs of alleles are inherited independently of one another if their gene loci are on separate chromosomes – these genes are said to be *unlinked*
- A dihybrid cross determines the genotypic and phenotypic combinations of offspring for two particular genes that are **unlinked**

CAUSE OF GENOTYPIC AND PHENOTYPIC VARIATIONS IN DIHYBRID CROSS OFFSPRING

- This is due to the random orientation of homologous pairs during metaphase I of meiosis.
- The independent segregation of unlinked genes results in a greater number of potential gamete combinations, as well as a greater variety of possible phenotypes
- Because there are two genes, each with two alleles, there can be up to *four* different gamete combinations

INHERITANCE OF A SINGLE GENE VERSUS TWO UNLINKED GENES

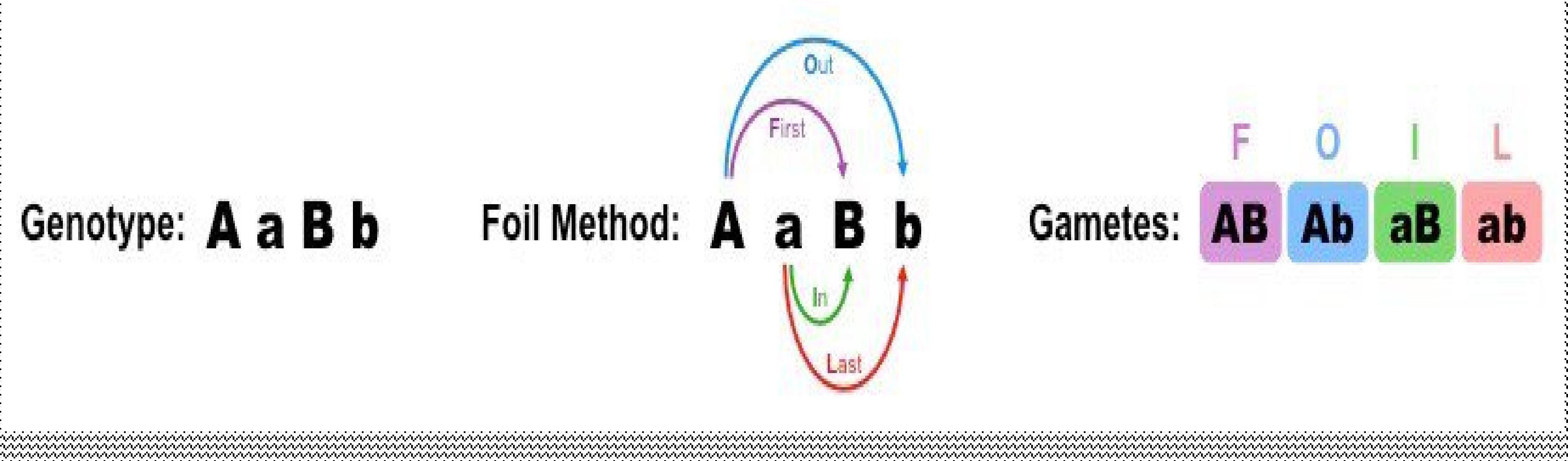


Two types of gamete form in monohybrid cross

Four types of gamete form in Dihybrid cross

DIHYBRID CROSS AND FOIL METHOD

- Because there are two genes, each with two alleles, there can be up to *four* different gamete combinations
  The easiest way to work out potential gamete combinations in a dihybrid cross is to use the FOIL method:
- **FOIL = F**irst / **O**utside / **I**nside / **L**ast



HOW TO COMPLETE A DIHYBRID CROSS

The inheritance of dihybrid traits can be calculated according to the following steps:

Step 1: Designate characters to represent the alleles
Capital letter for dominant allele, lower case letter for recessive allele

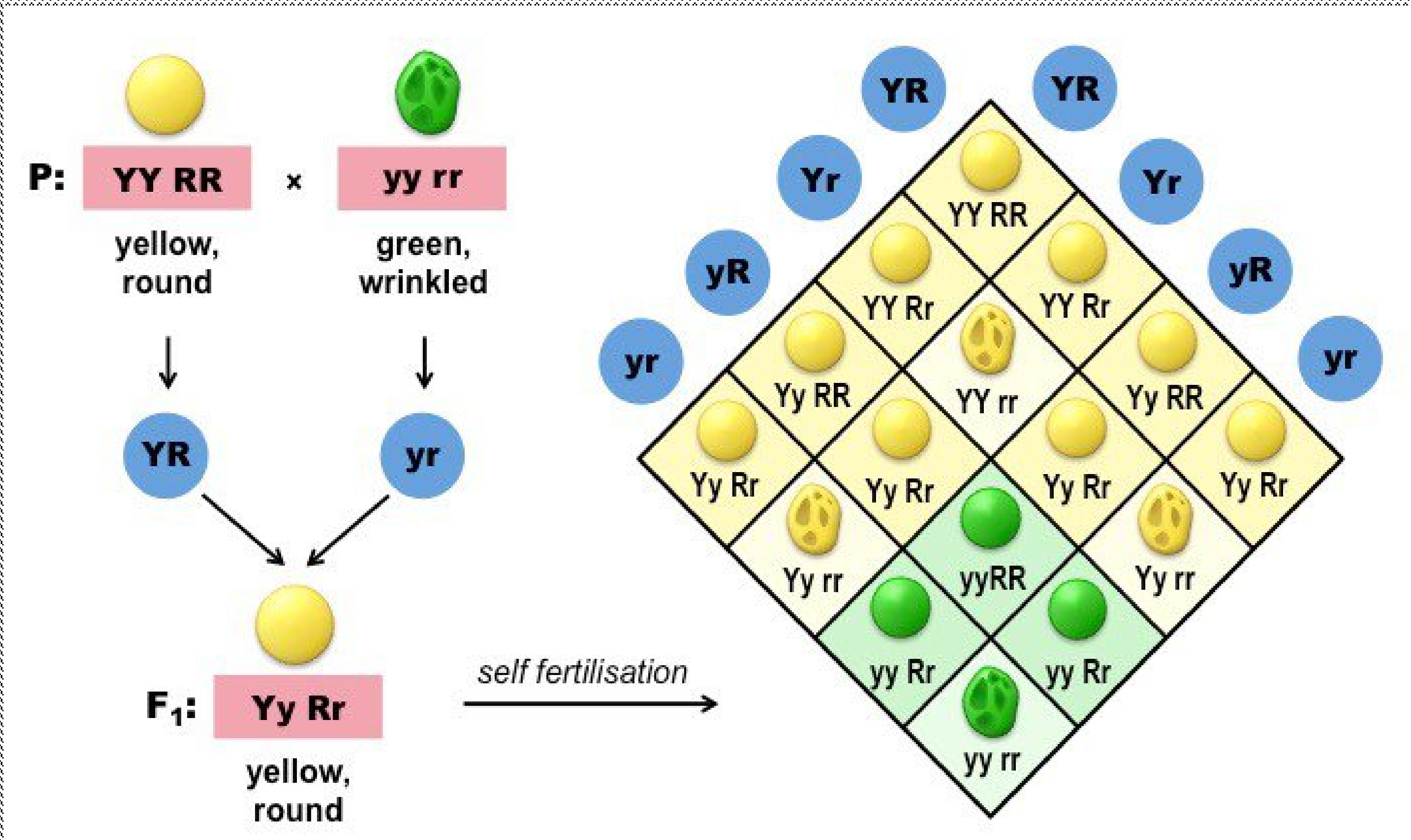
Step 2: Write down the genotype and phenotype of the parents (P generation)
Always pair alleles from the same gene and always write capitals first (e.g. AaBb, **not** ABab)

Step 3: Write down all potential gamete combinations for both parents
Use the FOIL method (or the claw) to identify all possible combinations

Step 4: Use a Punnett square to work out potential genotypes of offspring
Only include the different gamete combinations for each parent (e.g. AaBB has two combinations = AB and aB)

Step 5: Write out the phenotype ratios of potential offspring
Phenotypic ratios reflect mathematical probabilities only and may not necessarily reflect actual offspring ratios

EXAMPLE OF A TYPICAL DIHYBRID CROSS



MENDEL'S EXPLANATION OF THE RESULTS OF A DIHYBRID CROSS

- Given the principles revealed in a **monohybrid** cross, Mendel hypothesized that the result of two characters segregating simultaneously (a **dihybrid** cross) would be the **product** of their independent occurrence. Consider two characters, seed color and seed shape. As previously shown, **Y** dominates **y** to determine seed color, and **R** factor for "*round*" dominates the **r** factor for "*wrinkled*" to determine seed shape. He then proceeded to test his hypothesis experimentally.
- The **P** (**Parental**) cross is between true-breeding lines of **wrinkled yellow** peas (**rrYY**) and **round green** peas (**RRyy**). The F_1 offspring are therefore all **RrYy**, and are all **round and yellow**. In forming the F_2 plants, the alleles at the two loci **segregate independently**. That is, the chance of getting an **R** allele *and* a **Y** allele is **1/2 x 1/2**, of getting an **R** *and* a **y** **1/2 x 1/2**, and so on. Thus, all four possible diallelic combinations occur with an equal probability of **1/4.** The same is true for both parents. Given four possible gamete types in each parent, there are **4 x 4 = 16** possible F_2 combinations, and the probability of any particular dihybrid type is **1/4 x 1/4 = 1/16**. The phenotypes and phenotypic ratios of these **16** genotype can be determined by inspection of the diagram above, called a **Punnet Square** after the geneticist who first used it.

PHENOTYPIC RATIO IN DIHYBRID CROSS

phenotypic ratio expected for either character is **3:1**, either 3 "**Y**" : 1 "**y**", or 3 "**R**" : 1 "**r**". Then, the expected phenotypic ratios of the two traits together can be calculated algebraically as a **binomial distribution**:

(3Y + 1y) x **(3R + 1r)** = **9YR** + **3Yr** + **3Ry** + **1 ry**

That is, we expect a characteristic **9:3:3:1** phenotypic ratio of **round-yellow** : ***wrinkled*-yellow** : **round-*green*** : ***wrinkled-green*** pea seeds.

GENOTYPIC RATIO IN DIHYBRID CROSS

To predict the **genotypic ratios**, recall that for each gene the ratio is **1 : 2 : 1 :: AA : Aa : aa** . Then, algebraically

(1YY + 2Yy + 1yy) x **(1RR + 2Rr + 1rr) = 1 YYRR + 2 YYRr + 1 YYrr + 2YyRR + 4YyRr + 2 yyRR + 1yyRR + 2yyRr + 1yyrr**

That is, we expect a characteristic **1:2:1:2:4:2:1:2:1** ratio of the nine possible genotypes. These nine genotypes can be grouped into four phenotypes, for example **1 YYRR + 2 YYRr + 2 YyRR + 4 YyRr = 9Y-R-** round, yellow peas. The ratio of these phenotypes is of course **9:3:3:1**.

Thank u