# BIOL-BLE: YOUR BIOL1020 BIBLE (PART FOUR)

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BASED ON SEMESTER 1, 2016 CONTENT

NOTES FROM MODULES IN AND ALL FIGURES FROM PRINCIPLES OF BIOLOGY TEXTBOOK

Welcome to your guide to make it through BIOL1020! There is a lot of content, but hopefully the biol-ble will help you to manage and understand it all.

Included in Part Four are all modules covered in Weeks 11-13 of Semester 1, 2016 in preparation for Mini Test 4. Content from Week 13 was not included in Mini Test 4 but was examinable in the final. These are modules 39, 40, 43 and 61-68. Parts One, Two and Three are also available for purchase on StudentVIP.

Due to the interactive nature of the Principles of Biology textbook, some figures may be referred to that are not found here, and that is likely as they are interactives exclusively available by purchase of the online textbook.

Please note that this should in no way serve as a replacement for a completing required readings, but are an extensive additional resource and great for exam revision.

Many abbreviations as well as acronyms have been used as shorthand within modules and for this reason a comprehensive table containing all of them and their relevant meanings in alphabetical order has been provided at the end of the biol-ble.

Good luck in your studies!

# Module 39 Non-Mendelian Inheritance

- Genes whose inheritance is complex follow **non-Mendelian inheritance**
- e.g. carnations *Dianthus caryophyllus*:
  - Diff. colours
  - Cross true-breeding red w/ true-breeding white prod. pink $F_1$ gen. (Fig 1)
  - $F_2$ gen. is pink crossed w/ pink and prod. red, pink and white in 1:2:1 ratio
  - Inheritance pattern called **incomplete dominance**
  - Neither red not white completely dom. in heterozyg. individual
- In incomplete dom., each allele of heterozyg. has partial effect on phenotype
- **Codominance**:
  - Alleles combine to influence phenotype
  - e.g. human blood types:
    - Red blood cells can carry molecules on surface called **antigens**
    - 2 types of antigens, A and B, are encoded by *ABO* gene
    - 3 common alleles in pop.:
      - $I^A$ adds A antigen
      - $I^B$ adds B antigen
      - i gives no antigen
    - Immune sys. w/ one or other will not prod. antibodies against antigen of own blood
    - If opp. antigen introduced, is treated as foreign
    - Table 1
    - Heterozyg. w/ one $I^A$ and one $I^B$ have both A and B antigens and are codom.
    - Fig 2
- **Overdominance**:
  - Heterozyg. can express phenotype more extreme than either parent
  - e.g. tomato plants (Fig 3):
    - In nature, size and # fruits constrained by balance of immediate potential fitness gains by allocating rss. to reprod. (prod. fruit) versus long-term fitness gaines by allocating rss. to survivorship (prod. of leaves and storage of rss.)
    - Those w/ normal or wt alleles have genes that balance
    - Mut. in one gene that shifted balance
    - Heterozyg. w/ one fn.al copy of gene shifted toward growing fruit and had higher yield than wt (homozyg. non-mut.)
    - Homozyg. mutant shifted toward leaves prod.

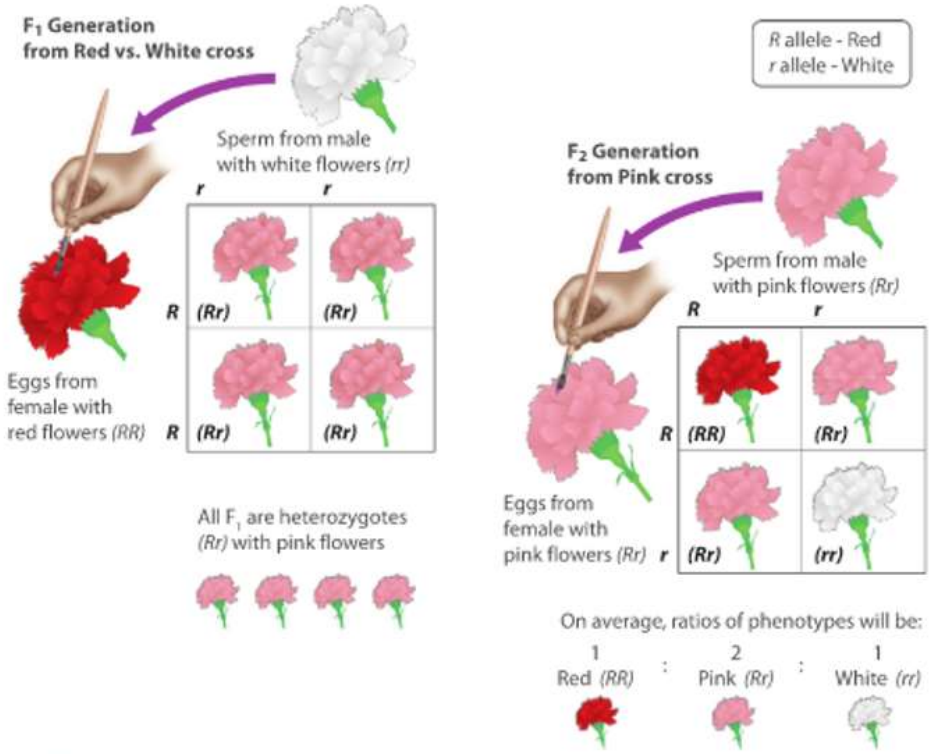


**FIGURE 1** Carnation flower colour demonstrating incomplete dominance in genetic inheritance. Crossing true-breeding red (*RR*) and white (*rr*) carnations produces pink carnations in the $F_1$ generation. Crossing pink (*Rr*) flowers yields red, pink and white flowers in an approximately 1:2:1 ratio.

| Blood type | Genotype | Antigen on red blood cell | Red blood cell phenotype |
|---|---|---|---|
| A | $I^AI^A$ or $I^Ai$ | | |
| B | $I^BI^B$ or $I^Bi$ | | |
| AB | $I^AI^B$ | | |
| O | $ii$ | | |

**TABLE 1** Blood types and related genotypes. The $I^A$ and $I^B$ alleles of human red blood cells code for specific antigens. The *i* allele does not code for any antigen.

- **Multiple allelic inheritance**:
  - e.g. pea plants flowering:
    - Gene called *LATE FLOWERING (LF*) has 4 alleles:
      - Lf for later
      - lf for earlier
      - $Lf^{d}$ latest
      - $lf^{a}$ earliest
    - Influence shows inheritance pattern called **dominance series**, where one allele is dom. over other 3, 2nd over 2 others, 3rd over 1 other and 4th recess. to all
    - Table 2
- **Pleitropy**:
  - Single gene influences >2 seemingly unrelated traits
  - e.g. dom. allele caused birds' feathers to curl out (frizzle) not lie flat (Fig 4):
    - Chickens w/ altered feathers unable to regulate body temp. as effectively as those w/ normal feathers
    - As a result, had higher metabolism rates, blood flow and digestive capacity as well as less eggs laid
  - Fig 5
  - e.g. fibrillin-1, connective tissue protein:
    - Marfan Syndrome caused by dom. mut. in fib.-1 gene
    - Affected usually tall and thin w/ long arms and legs
    - Have higher risk of heart disease and eye problems
- Multiple genes can affect phenotype in 2 ways:
  - **Epistasis**:
    - product of one gene masks or changes expected phenotype of 1+ other genes
  - **Polygenic inheritance**:
    - multiple genes influence expression of trait that is usually quantitatively variable e.g. human height

**FIGURE 3** Overdominance in tomatoes. The hybrid tomato plant in the middle has more and larger tomatoes than the wild-type plant on the left or the double mutant on the right.

| Genotype | Earliest flowering | Earlier flowering | Later flowering | Latest flowering |
|---|---|---|---|---|
| *Lf Lf* | | | X | |
| *lf lf* | | X | | |
| $Lf^{d}$ $Lf^{d}$ | | | | X |
| $lf^{a}$ $lf^{a}$ | X | | | |
| *lf* $lf^{a}$ | | X | | |
| *Lf* $lf^{a}$ | | | X | |
| $Lf^{d}$ *Lf* | | | | X |
| *Lf lf* | | | X | |
| $Lf^{d}$ *lf* | | | | X |
| $Lf^{d}$ $lf^{a}$ | | | | X |

**TABLE 2** Flowering times in pea plants (*Pisum sativum*) are influenced by a gene with multiple alleles. The 'X's in each cell indicate when a plant with a given genotype is most likely to flower. Plants with the $lf^{a}$ $lf^{a}$ genotype flower earliest, and any plant with at least one $Lf^{d}$ allele (homozygote or heterozygote) flowers latest.