# IDX 10 [Biology][S]
# Study Guide Issue #4
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**Contents: 10.1 10.2 10.3 11.1 11.2 (9.2 and 9.3 in issue #3)**

## 10.1 Cell Growth, Division, and Reproduction

- The limits of cell size increase
  - DNA overload: the larger the cell gets, the more demands it places on its DNA
- Exchanging materials
  - Larger cell: harder to move enough food or waste across cell membrane
  - surface area of cells: rate that materials enter or leave the cell
  - volume of cells: rate that nutrients are used and wastes are produced
  - SA:V ratio decreases when a cell grows

CELL DIVISION

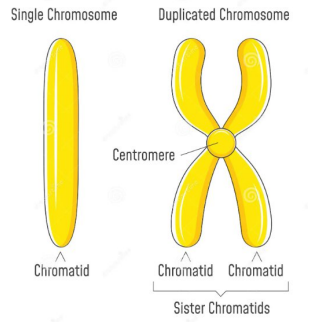
- The process which a cell divides into two new daughter cells
- Solve the issue of DNA overload and exchanging materials
- Asexual reproduction: the production of genetically identical offspring from single parent
  - Ex: Paramecium (mitosis), Bacterium (Binary fission), Hydra (budding).
- Sexual reproduction: offspring inherit some of their genetic information from each parent.
  - Preferred during environmental changes.
- A part of cell cycle, to keep genetic information consistent between generations.

## 10.2 Process of Cell Division

CHROMOSOMES AND CELL DIVISION

- Chromosomes contain generic materials in the cell
- Prokaryotic cell chromosome: in cytoplasm, single, circular DNA
- Eukaryotic cell chromosomes: in nucleus, linear DNA and protein (histone)

- Chromatin: spread through nucleus, in non dividing period, in non dividing period, invisible under light microscope.
- Chromosome: supercoiled chromatin (during cell division), visible under light microscope
- Condensation: to ensure equal division of DNA during cell division.




PROKARYOTIC CELL CYCLE

1. Cell growth
2. DNA replication
3. Cell division
    - Binary fission (asexual)

EUKARYOTIC CELL DIVISION

- Interphase (non-dividing period)
    - G1: cells grow (increase in size, synthesize new proteins and organelles)
    - G2: DNA replicates
    - G2: cells get ready to divide (similar to G1 but very short)
- M phase (cell division)
    - Mitosis: nucleus divides
    - cytokinesis: cytoplasm divides

MITOSIS

- In somatic cells (body cells)
- 4 stages: PMAT

PROPHASE (THE LONGEST)

- Chromatin coil to chromosomes
- Centrioles separate
- Nuclear envelope breaks

- Nucleolus disappears
- Spindle is formed

METAPHASE (THE SHORTEST)

- Chromosomes lime up at the center
- Microtubules attach to centromere on each chromosome

ANAPHASE

- Centromeres split (chromosome no. x2)
- Microtubules contract
- Sister chromatids separate

TELOPHASE

- Spindle disappears
- Chromosomes uncoil
- Nuclear envelope and nucleolus reform

CYTOKINESIS

- Occurs with telophase
- Animal cell: cell membrane is drawn inward until cytoplasm is pinched
- Plant cell: cell plated gradually develops halfway

KEY WORDS

◎ Chromatids：each strand of a duplicated chromosome

◎ Centromere: area where chromatids join

◎ Centrioles: tiny microtubules located in cytoplasm of animal cell that help organize spindles

◎ Spindles: fanlike microtubules that help separate chromatids

**10.3 Regulating the Cell Cycle**

CYCLINS

◎ Family of proteins that regulates timing of eukaryotic cell cycles

REGULATORY PROTEINS

- The cell cycle is controlled by regulatory proteins both inside and outside the cell
- 1. Internal regulators

◎ proteins that respond to events inside a cell

- allow the cell cycle to proceed only once certain process have happened in the cell
- External regulators
- proteins that respond to events outside the cell
- direct cells to speed up or slow down the cell cycle
- stimulate growth and division of cells
- Growth factors like embryonic development and wound healing
- Control on cell growth & division can be turned on and off

APOPTOSIS

- Means programmed cell death
- Shaping the structure of tissue and organs in plants' and animals' development

CANCER: UNCONTROLLED CELL GROWTH

- Body cell loses ability to control cell death
- Don't respond to signals that regulate growth
- Tumors: abnormal mass of tissue by uncontrolled proliferation of cells
- Benign tumor: noncancerous, does not spread
- Malignant tumor: cancerous, spreads
- Metastasis: Spread of cancer cells
- Cancer cells absorb nutrients needed by other cells, block nerve connections, and prevent organs from functioning
- Causes: smoking, radiation, viral infections

**11.1 The Work of Gregor Mendel**

GENETICS (AND TERMS)

- The scientific study of heredity
- Traits
- a specific feature inherited from the parents
- Determined by genes
- A trait may have different forms
- Genes
- specific fragments of DNA on chromosomes
- basic unit of heredity, determines traits
- Alleles
- different forms of genes

- ◎ determine different forms of one trait
- Gametes: sex cells
- Self pollinated plants: pollen fertilizes the egg in the same plant
- Cross pollinated plant: pollen fertilizes another plant
- P: first generation
- F1: first generation offspring
- F2: second generation offspring
- True breeding plant: when self pollinated, offspring will always be same as parents
- Hybrid: the offspring of across between parents with different traits

GREGOR MENDEL

- Austrian monk
- Father of genetics
- Used peas to study genetics
- Used pea plant because it is easy to grow and has only two contrasting forms
- Mendel prevents peas from self pollinating by cutting away the make part and manually put the pollen in the female part.
- Mendel's experiment 1:
- ◎ crossed two breeding parents with contrasting form of one trait to produce F1
- ◎ results: traits of F1 does not equal to the blend in of P, only show the same trait of one of the parents
- Mendel's 1st conclusion: inheritance
- ◎ Traits are determined by factors (genes) which are passes from parental generation to the next
- Mendel's 2nd conclusion: principle of dominance
- ◎ some alleles are DOMINANT, some are recessive
- ◎ dominant alleles mask recessive alleles

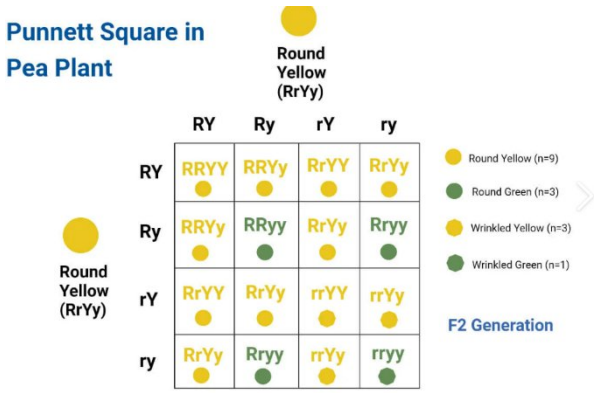
MENDEL 2ND EXPERIMENT

- Self pollinate F1 to create F2
- Results: traits by recessive alleles reappeared in F2 (3 dominant :1 recessive)
- Mendel's 3rd conclusion: principle of segregation
- ◎ Each F1 plant produces two types of gametes
- ◎ Two alleles of one gene will be separated during formation of gametes
- ◎ So each gamete carries only one allele for each gene

## 11.2 Application of Mendel's Principles

GENOTYPE

- Combination of alleles, which organisms carry for a trait
- Homozygous dominant: TT
- Homozygous recessive: tt
- Heterozygous: Tt




PHENOTYPE

- Observable characteristics/ traits

PROBABILITY

- The likelihood that a particular event will happen
- Predict the average outcome of a large number of events
- Probability= number of ways it can happen / humber of outcomes
- Just a prediction, not actual results
- In genetics, the larger the number of offsprings, the closer to the predicted values

PUNNETT SQUARES

- A diagram which uses math probability to help predict the genotype and phenotype of offspring in genetic crosses
- Genotype: TT: Tt:tt= 1:2:1
- Phenotype: Tall: short=3:1

CROSS

- Monohybrids: offspring produced by the true breeding parents differing in one trait
- Monohybrid cross: across between monohybrids
- Dihybrids: offerings produced by true breeding different parents differing in two characters (or genes)
- Dihybrid cross: a cross between two dihybrids (AaBb x AaBb (9:3:3:1))
  - ◎ independent assortment states genes for different traits can segregate independently during the formation of gametes; it helps account for many genetic variations observed in plants, animals, and other organisms.