

普通生物學實驗

General biology laboratory

- 課程名稱: 實驗一、二課程講解
Lecture for experiments 1 and 2
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學習目標: 如何使用光學顯學顯微鏡 及利用光學顯學顯微鏡觀察動物及植物細胞間，及玻片標本如何製作保存。

資料來源: Student Lab Manual for Biology Labs
On-Line

Summary: To observe the discrepancy between difference species in cellular levels, light microscope will be used as a tool. ◦

學習目標: 經由影片欣賞，認識新科技如何篩選胎兒是否罹犯遺傳性疾病 並如何安全植入健康的胚胎以確保胎兒的健康。

資料來源: Discovery Channel Video (生育科學系列)

Summary: a series of biotechnological process to select embryos free of inheritance diseases.

Lab 1. Cell structure and function

Hierarchy in biosphere:

chemicals → cells → tissue → organs
→ systems → organism → population
→ community → ecosystem → biosphere

Cell theory:

1. All living things are composed of cells and cell products.
2. New cells are formed only by the division of pre-existing cells.
 - A single cell is the structural and functional unit of life.

Ex: single cell organism – amoeba.

Multicellular organism – man.

Major function of cells

- Metabolism, absorption, secretion, movement growth, and division.
- Living organisms exhibit two fundamental characteristics
 - Self-maintenance
 - Self-replication

Eukaryotes

- Organisms whose cells contain a membrane-bounded structure called the nucleus, which serves to localize the hereditary material, DNA.

Prokaryotes

(meaning “before the nucleus”)

- No nucleus
- Generally much smaller than eukaryotic cells.
- Prokaryotes are single-celled organisms, e.g. Bacteria and cyanobacteria.

Mitosis

- Cell duplication process
 - in which each original cell produces two identical daughter cells,
 - each with the same number and types of chromosomes as were present in the original cells.
- Why mitosis is so important?
 - Repair, Growth
 - Mitosis is a cell duplicating process. If something is wrong during the process, abnormal cells will be produced.

Mitosis phases — Interphase:

- The period between successive nuclear division
- The chromosomes are diffuse and the nuclear envelope is intact.
- The cell is most active in transcribing and translating genetic information.

Mitosis phases — Prophase:

- The first stage of nuclear division,
- Chromosomes condense from diffuse, threadlike material to discrete, compact bodies.

Mitosis phases — Metaphase:

- The centromeres of the highly supercoiled chromosomes are all lying on a plane perpendicular to a line connecting the division poles.

Mitosis phases — Anaphase:

- the first separation of sister chromatids (or, in the first meiotic division, of paired homologues) occurs.
- Anaphase lasts from the moment of first separation to the time at which the moving chromosomes converge at the poles of the spindle.

Mitosis phases — Telophase:

- The final phase of mitosis or meiosis
- Chromosomes became diffuse,
- Nuclear envelopes reform
- Nucleoli begin to reappear in the daughter nuclei.

Calculate the magnification when you use the microscope?

- Ex: 10X oculars -----→ 40 X image
4X objectives

10X oculars -----→ 100X image
10X objectives

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學習目標: 如何利用化學試劑，簡單測量大分子的主要成份的化學反應之變化，認識大分子組成及化學反應的進行經由觀察試劑顏色的變化。

資料來源: Student Lab Manual for Biology Labs
On-Line

Summary: 認識酵素轉化酶作用的環境及觀察大分子包括雙醣、多醣、蛋白質、脂質與試劑間化學反應的進行式及顏色的變化。

Lab 2 —

Life's Chemical Components

About 99% of any living organism is composed of only six elements:

C: carbon

N: nitrogen

P: phosphorus

Carbon is the element of the life.

H: hydrogen

O: oxygen

S: sulphur

Organic Compounds Are the Complex Compounds That Contain Carbon.

They are classified into four categories:

1. carbohydrates
2. lipids
3. proteins
4. nucleic acids

Carbohydrates:

1. They serve as fuel molecules and structural components.
2. $[\text{C}_n\text{H}_{2n}\text{O}]_n$
3. Ex: sugars and starches.
4. May be classified as monosaccharides, disaccharides, or polysaccharides.

Monosaccharides: (energy source)

- Glucose (dextrose) ($[\text{CH}_2\text{O}]_6$ or $\text{C}_6\text{H}_{12}\text{O}_6$) is the most common and is the subunit of which most polysaccharides are made.
- Fructose, galactose, ribose and deoxyribose are also important monosaccharides.

Disaccharides:

- They are often used for short-term energy storage or for transport.
- Sucrose, lactose and maltose are common disaccharides.

Polysaccharides:

1. Long term storage of energy

Starch (in plant), Glycogen (in animal).

2. Structural materials

- Cellulose makes up the cell walls of plants
- Chitin makes up the exoskeletons of insects, crabs and spiders.

3. Nonstructural molecules

- Many of them also incorporate carbohydrates as essential components.

Ex: Nucleic acids, mucus, some hormones.

Lipids:

Greasy or oily and relatively insoluble in water.

The lipids could be classified into

1. Oils, fats, and waxes (C, H, fewer O)
2. Phospholipids (C, H, O, P, N)
3. Steroids.

1. *Oils, fats, and waxes*

- Glycerol + 3 fatty acids → Oils & fats (Energy source)
- Alcohols + 3 fatty acid → waxes (long-chained)

2. *Phospholipids*

- Ex: Cell membrane contains several types of phospholipids.

- *Steroids*

- Cholesterol → steroids
- Ex: Sex hormones
- Insect molting hormones

Protein

1. Proteins are composed of C, H, O, N, and usually S (sulfur).
2. 20 different amino acids (a.a.) are basic subunits of proteins.
 - 2 a.a. → dipeptide + more a.a. → polypeptides
→ proteins
 - Ex: glycine is the simplest a.a.
3. Growth, repair and maintenance.
4. Enzymes are large protein molecules which catalyze the chemical reaction.
 - Ex: Absence of hexosaminidase will cause Tay-sachs disease.

Tests for lipids:

Sudan stains lipids bright red.

(Sudan stains can be dissolved at oily layer)

Tests for proteins:

10% NaOH + 0.5% CuSO₄ + Protein
→ Purple or violet color

Benedict's test for glucose and fructose



Blue

Orange red precipitate

Benedict's color	Amount of sugar
Blue	No
Greenish blue	Trace
Green	+
Yellow	++
Orange-red	+++

Sucrose → *glucose* + *fructose*

(invertase)

Invertase activity

- Temp. best at 37 °C, then room temperature.
- pH best at pH = 4.4

Iodine test for starch:

Iodine + starch \rightarrow blue-black color.

Coiled structure + $I_2 \rightarrow$ Black blue

Sudan stain (black red) + lipids

(Sudan stain only dissolved in lipid)

Benedict $Cu^{+2} \rightarrow Cu^{+1}$ (redox-oxidative reaction)

Protein: copper sulfate (Cu^{+2}) + peptide \rightarrow complex
(violet purple) ($COOH-NH_3$ (4-6 CN bond))

Solution	Benedict's Test Results
Sucrose	Blue
Glucose	Orange-red precipitate
Fructose	Orange-red precipitate

Temp.	Observation(color; precipitate)
0 °C	No color
R.T.	Some orange-red precipitate
37 °C	Lots of orange-red precipitate
100 °C	No color

Which pH level gives the most enzyme activity?

pH 1.0	Some
pH 4.4	Large amount of orange-red
pH 8.0	some
pH 12.0	little

Benedict's test for simple sugar

Benedict's reagent (Cu^{+2}) + Reduced Sugar (R-COH)

Heat



Benedict's reagent (Cu^{+}) + Oxidized Sugar (R-COOH)