*IB Biology*

Semester I Exam Guide

* **Introduction**
	+ List and describe the properties of life.
1. *Order* **-** organisms are highly ordered, and other characteristics of life emerge from this complex organization.
2. *Reproduction* **-** organisms reproduce; life comes only from life (biogenesis).
3. *Growth and Development* **-** heritable programs stored in DNA direct the species-specific pattern of growth and development.
4. *Energy Processing* **-** organisms take in and transform energy to do work, including the maintenance of their ordered state.
5. *Response to the Environment* **-** organisms respond to stimuli from their environment.
6. *Homeostasis/Regulation* **-** organisms regulate their internal environment to maintain a steady-state, even in the face of a fluctuating external environment.
7. *Evolutionary Adaptation* **-** life evolves in response to interactions between organisms and their environment.
	* List and explain the steps in the scientific process.
8. Ask a Question: The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where? And, in order for the scientific method to answer the question it must be about something that you can measure, preferably with a number.
9. Research: Rather than starting from scratch in putting together a plan for answering your question, use research to help you find the best way to do things and insure that you don't repeat mistakes from the past.
10. Hypothesis: A hypothesis is an educated guess about how things work:
"If \_\_\_\_\_*[I do this]* \_\_\_\_\_, then \_\_\_\_\_*[this will happen]*\_\_\_\_\_."
11. Experiment: Your experiment tests whether your hypothesis is true or false. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all other conditions the same. You should also repeat your experiments several times to make sure that the first results weren't just an accident.
12. Analysis of Results: Once your experiment is complete, you collect your measurements and analyze them to see if your hypothesis is true or false. Scientists often find that their hypothesis was false, and in such cases they will construct a new hypothesis starting the entire process of the scientific method over again. Even if they find that their hypothesis was true, they may want to test it again in a new way.
13. Form Conclusion: There are basically two possible outcomes. Either the experiment supported the hypothesis and can be regarded as true, or the experiment disproved the hypothesis as false. If the hypothesis is false, repeat the steps in the scientific method and make adjustments to your hypothesis.
* **Statistical Analysis**
* What is meant by the following terms?
* Mean – The mathematical average of a set of numbers.
* Standard Deviation – A measure of how varied the given data are.
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* Range/Variability – The length of the smallest interval which also contains all data points; calculated by subtracting the highest and lowest points.
* What are error bars used for?
* Represent variation and uncertainty in a sample statistic.
* What is quantitative data?
* Measurable data, dealing with numbers (ex. Height, Time, Temperature).
* What is qualitative data?
* Observable data, given in descriptions (ex. Taste, Smell, Texture).
* What is meant by uncertainty?
* The estimated amount or percentage by which an observed or calculated value may differ from the true value.
* What is statistics?
* The practice or science of collecting and analyzing numerical data in large quantities.
* What is a collation?
* The bringing together of different pieces of information in order to compare them.
* State whether the following are correlated or causal relationships.
* The more light the more photosynthesis in the plants.
* Causal: light directly effects photosynthesis.
* Higher SAT scores and higher achievement.
* Positive correlation: SAT scores do not necessarily cause higher achievement; one may be a symptom of the other, but this does not guarantee a causal relationship.
* The less oxygen to a cell the less cell respiration.
* Causal: oxygen directly effects cell respiration.
* More years in prison and less education.
* Negative correlation: longer time spent in prison does not cause lower education; one may be a symptom of the other, but this does not guarantee a causal relationship.
* **Biochemistry**
* Atoms are composed of:
* The subatomic particles protons, neutrons, and electrons.
* Protons, electrons, and neutrons have a charge of:
* Protons 🡪 positive charge
* Electrons 🡪 negative charge
* Neutrons 🡪 neutral charge
* An element is:
* A substance composed of atoms having an identical number of protons in each nucleus. Elements cannot be reduced to simpler substances by normal chemical means.
* Matter is composed of:
* Chemical elements, in the form of molecules and atoms.
* Polar molecules are:
* Molecules which have an electric dipole, meaning that their negative and positive charges are non-uniform (ex. H2O).
* Ionic bonds form when:
* Two atoms with unfilled valence shells fully exchange electrons by either giving or taking, thus completing their outer ring and making them stable. Each particle now has a charge, making them ions.
* Covalent bonds form when:
* Two atoms with unfilled valence shells “share” electrons between them, giving them some stability. These electrons aren’t always shared evenly, leading to polarity or uneven charges throughout the molecule.
* Water is a polar molecule because:
* The hydrogen atoms retain a positive charge while the oxygen atom is negatively charged.
* Organic molecules are:
* Molecules that generally consist of carbon atoms in a ring or chain where other atoms (eg. Oxygen, hydrogen, nitrogen) are attached.
* Organic molecules can be classified into four main groups. What are they?
* Carbohydrates, lipids, proteins, and nucleic acids.
* Polysaccharides are:
* Complex carbohydrates.
* A straight or branched chain of hundreds or thousands of sugar monomers.
* Examples include starch, cellulose, glycogen (all polymers of glucose).
* Amino acids are found in:
* Proteins.
* Consist of elements carbon, hydrogen, oxygen, nitrogen, and sulfur.
* Include an amino group and a carboxyl group.
* Examples of lipids are:
* Oils (on fur and feathers for waterproofing), fats (for thermal insulation), waxes, steroids, cholesterol.
* Animals store glucose in the form of:
* Glycogen.
* Formed in the liver.
* Two types of nucleic acids are:
* Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).
* Hydrogen bonding is:
* A low-energy force between a hydrogen atom and another element such as oxygen.
* Plays a major role in determining the properties of water.
* Cohesion occurs because:
* Like molecules are attracted to each other and stick together.
* Especially recognizable in water and its extensive hydrogen bonds.
* Cohesion is the science behind the surface tension of water.
* State the effects that occur for each of the following statements.
* Organisms resist temperature changes, although they give off heat due to chemical reactions.
* High specific heat of water.
* A water strider can walk across the surface of a small pond.
* Surface tension of water, due to cohesion.
* Lakes don’t freeze solid in winter, despite low temperatures.
* Low density of ice.
* The pH of water remains exactly neutral.
* Preserves freshwater and saltwater life.
* Water can mix with other substances easily.
* Universal solvent; polarity of water molecule attracts ionic or polar compounds put into water. Many biochemical reactions can’t take place outside of aqueous solutions.
* Why does ice float in liquid water?
* As temperature decreases, volume increases and density decreases; water molecules become more loosely packed.
* Summarize dehydration reactions.
* When molecules of water are removed to assemble polymers; also called condensation.
* Summarize hydrolysis reactions.
* When molecules of water are added to polymers; breaks them down.
* What are monosaccharides, disaccharides, and polysaccharides? Give examples.
* Monosaccharides – simplest carbohydrates, characterized by sweet taste and usually found in ring-form (ex. Glucose, fructose, galactose).
* Disaccharides – two sugar units bonded together, formed in condensation reactions (ex. Maltose, sucrose, lactose).
* Polysaccharides – complex carbohydrates (ex. Starch, glycogen, cellulose, chitin).
* What is a lipid? Give examples.
* An organic compound made up of a fatty acid and glycerol and soluble in nonpolar solvents.
* Contains carbon, hydrogen, and oxygen.
* Steroids, cholesterol, waxes, oils, fats.
* What is the difference between a saturated and unsaturated fat?
* Saturated fatty acids have no double bonds, are abundant in fats (solid), are more reduced, have more energy and higher melting point.
* Unsaturated fatty acids have one or more double bonds, are abundant in oils (liquid), are less reduced, have less energy and lower melting point.
* Are lipids soluble in water?
* No; they are insoluble in water but soluble in organic solvents (ex. Alcohols, acetone, chloroform).
* What is a triglyceride?
* A combination of fatty acids and glycerol, through dehydration (condensation). Made of one molecule of glycerol and three fatty acid molecules.
* Two amino acids bonded together form a peptide bond.
* Which four elements make up approximately 96% of living matter?
* Oxygen, nitrogen, carbon, hydrogen.
* **Cells**
* State the cell theory.
* Cells are the smallest unit of life, and nothing smaller can survive independently.
* All living things consist of cells, although the smallest organisms may consist of one cell only.
* All cells come from pre-existing cells, by division, and therefore new cells cannot be constructed from non-living chemical substances.
* How did the following influence the belief in the cell theory?
* Robert Hooke – first to describe the cell; published *Micrographia* in 1665, was the first important work devoted to microscopal observation.
* Matthias Jakob Schleiden – suggested that every structural element of plants is composed of cells or their products in 1838.
* Theodor Schwann – stated that “the [basic] parts of all tissues are formed of cells’ and that ‘there is one universal principle of development for the [basic] parts of organisms… and this principle is in the formation of cells.”
* Note: Schwann and Schleiden’s conclusions are considered to represent the official formulation of ‘cell theory’.
* Pasteur – disproved the idea that life forms arose spontaneously from non-living matter with microorganisms. Discovered the significance of bacteria and disease.
* Light microscope – allowed scientists to observe the microscopic structures of cells.
* Electron microscope – allowed even closer inspection of cells and study of organelles and their structures.
* Walther Flemming – introduced the term “mitosis” in 1882, and gave super descriptions of its various processes. Coined term “chromatin”.
* State advantages of maximizing the surface area: volume ratio in a cell.
* The larger the ratio, the larger the surface area and the smaller the volume.
* More surface area provides more opportunity to absorption of nutrients, transpiration, and osmosis through the cell membrane.
* Less volume means less demand for maintenance and upkeep.
* Two things a large cell might do to increase its surface area: volume ratio are:
* Flatten to increase surface area.
* Divide.
* State the six functions of life.
1. Nutrition – using sustenance for energy, growth, and repair.
2. Transport – water, oxygen, and waste products moved throughout cell.
3. Respiration – oxygen brought to organism, chemically release nutrients from food.
4. Excretion – removal of cellular waste products (ex. Water, carbon dioxide, nitrogen).
5. Reproduction – organism produces new members; necessary for survival of species.
6. Growth – increases size and productivity of cell.
* State the difference between eukaryote and prokaryote.
* Prokaryotes lack membrane-bound nuclei, have only ribosomes as organelles, and their DNA floats freely through their cytoplasm. They are considered more ancient and less complex. Reproduce through binary fission. Include Archaea and Eubacteria.
* Eukaryotes have a nucleus and organelles such as mitochondria and chloroplasts. Reproduce through mitosis and meiosis. Include animal and plant cells.
* What is an organelle?
* A membrane-bound structure within a cell that specializes in a particular function.
* Identify the following structures and function in an animal and plant cell.
* Cell membrane (plasma membrane) – semi-permeable outer covering which acts as a protective barrier.
* Cell wall – found in plant and fungi cells; provides rigidity and structure.
* Nucleus – contains genetic material in multiple linear DNA molecules.
* Chromosomes – structure that bears genetic material.
* Ribosomes – protein factories; embedded in RE reticulum.
* Golgi apparatus – composed of membrane-bound stacks; packages molecules such as proteins into vesicles.
* Smooth and rough endoplasmic reticulum – structure of interconnected flattened sacs or tubules attached to the nuclear membrane. RER involved in protein synthesis and secretion. SER transports, synthesizes lipids, and metabolizes carbohydrates.
* Vacuole – serves as storage; plant cells have one large central vacuole.
* Cytoplasm – jelly-like substance between cell and nuclear membrane; contains organelles.
* Lysosomes – contain digestive enzymes, digest macromolecules.
* Chloroplasts – a plastid which contains chlorophyll; photosynthesis takes place here.
* Mitochondria – respiration and energy production occur.
* Flagella are:
* Slender thread-like structures used for locomotion.
* Cilia are:
* Hair-like vibrating structures on cell surfaces; can have sensory or locomotive purpose.
* Describe a phospholipid.
* A lipid with a phosphate group attached.
* Distinguish between active transport and passive transport.
* Active transport requires energy and passive transport does not (follows concentration gradient).
* Describe the types of passive transport.
* Diffusion
* Movement of molecules from region of higher concentration to lower concentration.
* Facilitated Diffusion
* Movement of molecules from region of higher concentration to lower concentration by means of a carrier molecule. Movement is still along concentration gradient; energy is not required.
* Osmosis
* Net movement of a solvent (usually water) through a semi-permeable membrane.
* What happens when a cell is placed in the following solutions:
* Hypertonic – draws water from cell.
* Hypotonic – gives water to cell.
* Isotonic – solution and cell have same water concentration.
* Describe the types of active transport.
* Bulk Transport
* The uptake or extrusion from a cell of fluid or solid particles.
* Endocytosis
* the process in which cells absorb molecules by engulfing them with their plasma membrane.
* Exocytosis
* The process in which cells expel molecules.
* Pinocytosis
* the process in which cells bring in liquid suspended within vesicles which fuse with lysosomes to break down said particles.
* Phagocytosis
* the process in which cells engulf solid particles by the cell membrane.
* What is a concentration gradient?
* The gradual difference in the concentration of solutes in a solution between two regions.
* Describe the sodium-potassium pump.
* A active transport method in which a special transport protein moves potassium into and sodium out of the cell against their gradient.
* **Cell Division**
* Describe the phases of mitosis – include interphase and cytokinesis.
* Interphase – cell maintains metabolism and continues growing; synthesizes DNA and prepares for division.
* Prophase – chromosomes condense, nuclear membrane and nucleolus dissolve.
* Metaphase – chromosomes begin to arrange themselves on the metaphase plate, or the equator of the cell. Spindle fibers attach to chromatids.
* Anaphase – spindle fibers guide chromatids toward centrioles at opposite poles.
* Telophase – Chromatids are separated and cleavage furrow begins to form.
* Cytokinesis – Nuclear membrane and nucleolus have reformed, cytoplasm has been completely separated; two cells exist.
* Identify a sketch of the phases of mitosis.
* How many cells exist at the end of mitosis? How many chromosomes in those cells?
* Two cells, 23 chromosomes and 46 chromatids.
* What are the cells called at the end of mitosis?
* Diploid, somatic cells.
* What happens after mitosis?
* Two somatic cells exist; cells begin interphase.
* Describe the phases of meiosis.
* Prophase I through Telophase I and Cytonkinesis – same as Mitosis, except with two chromosomes.
* Prophase II through Telophase II and Cytokineses – the cells split again, left with 23 chromatids, four haploid cells, called gametes.
* Identify a sketch of the phases of meiosis.
* How do homologous chromosomes appear at each phase in meiosis I?
* Attached partially, due to chiasmata.
* How do the chromosomes appear at each phase in meiosis II?
* Singular, similar to mitosis.
* Synapsis is:
* When homologous chromosomes are held tightly together by proteins along their lengths.
* Crossover is:
* The exchange of DNA molecules by non-sister chromatids. Completed while homologs are in synapsis.
* How many cells exist at the end of meiosis? How many chromosomes in those cells?
* Four gamete cells exist; each are haploid, with 23 chromatids.
* What are the cells called at the end of meiosis?
* Gamete – sex cells. Or haploid – with half the chromosomes.
* Describe the cell cycle.
* Includes interphase as the vast majority of time and then mitosis when the cell actually divides.
* Cancer is:
* Abnormal growth of cells.
* Describe the types of cancer.
* Benign – the growth is localized and not fatal.
* Malignant – the cell division is uncontrolled; invades and damages nearby tissue.
* Stem cells are:
* Relatively unspecialized cells that can both reproduce indefinitely but also differentiate into specialized cells of one or more types.
* Types of stem cells are:
* Embryonic stem cells and adult stem cells.
* Stem cells are used for:
* Growing them into hearts and other organs after being harvested and cultured. Also used to repair damaged organs.