Biology 1 Semester Review

Chapter 1—The Science of Biology

1–1 What is Science?

Key Concepts

- One goal of science is to provide natural explanations for events in the natural world. Science also aims to use those explanations to understand patterns in nature and to make useful predictions about natural events.
- Scientific methodology involves observing and asking questions, making inferences and forming hypotheses, conducting controlled experiments, collecting and analyzing data, and drawing conclusions.

Vocabulary

science
observation
data
hypothesis
controlled experiment
independent variable
dependent variable

1–2 Science in Context

Key Concept

- Curiosity, skepticism, open-mindedness, and creativity help scientists generate new ideas.
- Publishing peer-reviewed articles in scientific journals allows researchers to share ideas and to test and evaluate each other's work.
- In science, the word theory applies to a well-tested explanation that unifies a broad range of observations and hypotheses and that enables scientists to make accurate predictions about new situations.
- Using science involves understanding its content in society and its limitations.

Vocabulary

theory
bias

1–3 Studying Life

Key Concepts

- Living things are made up of units called cells, are based on a universal genetic code, obtain and use materials and energy, grow and develop, reproduce, respond to their environment, maintain a stable internal environment, and change with time.
- Biology includes many overlapping fields that use different tools to study life from the level of molecules to the entire planet.
- Most scientists use the metric system when collecting data and performing experiments.

Vocabulary

biology
DNA
sexual reproduction
asexual reproduction
stimulus
homeostasis

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1. What is the goal of science?
2. How does an observation about an object differ from an inference about that object?
3. What is homeostasis? Give an example of how it is maintained.
4. Compare sexual reproduction and asexual reproduction.
5. Why is it advantageous for scientists to test only one variable at a time during an experiment?
6. Distinguish between a variable and a control.
7. What is the main difference between qualitative and quantitative observations?
8. What is a scientific hypothesis? In what two ways can a hypothesis be tested?
9. Is a scientific hypothesis accepted if there is no way to demonstrate that the hypothesis is wrong? Explain your answer.
10. What must happen for a hypothesis to become a theory?
11. What is differentiation?
12. How does a scientific theory compare with a scientific hypothesis?
13. Describe five characteristics of living things.
14. What are the units and prefixes used in the metric system?
15. Convert from one unit to another in the metric system.

Chapter 2 –The Chemistry of Life

2–2 Properties of Water

Key Concepts

- Water is a polar molecule. Therefore, it is able to form multiple hydrogen bonds, which account for many of its special properties.
- Acidic solutions contain higher concentrations of H^+ ions than pure water and have pH values below 7.
- Basic, or alkaline, solutions contain lower concentrations of H^+ ions than pure water and have pH values above 7.

Vocabulary

cohesion
adhesion
mixture
solution
solute
solvent
pH scale
acid
base

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2–3 Carbon Compounds

Key Concepts

- Carbon can bond with many elements, including hydrogen, oxygen, phosphorus, sulfur, and nitrogen, to form the molecules of life.
- Living things use carbohydrates as their main source of energy. Plants, some animals, and other organisms also use carbohydrates for structural purposes.
- Lipids can be used to store energy. Some lipids are important parts of biological membranes and waterproof coverings.
- Nucleic acids store and transmit heredity, or genetic information.
- Some proteins control the rate of reactions and regulate cell processes. Some proteins build tissues such as bone and muscle. Others transport materials or help fight disease.

Vocabulary

monomer
polymer
carbohydrate
monosaccharide
polysaccharide
lipid
nucleic acid
nucleotide
ribonucleic acid (RNA)
deoxyribonucleic acid (DNA)
protein
amino acid

2–4 Chemical Reactions and Enzymes

Key Concept

- Chemical reactions always involve the breaking of bonds in reactants and the formation of new bonds in products.
- Chemical reactions that release energy often occur spontaneously. Chemical reactions that absorb energy will not occur without a source of energy.
- Enzymes speed up chemical reactions that take place in cells.

Vocabulary

chemical reaction
reactant
product
activation energy
catalyst
enzyme
substrate

1. Name four groups of organic compounds found in living things.
2. Explain the properties of cohesion and adhesion. Give an example of each property.
3. What is the relationship among solutions, solutes, and solvents?
4. Compare acidic and basic solutions in terms of their H^+ ion and OH^- ion concentrations. How do their pH values differ?
5. Explain the relationship between monomers and polymers, using polysaccharides as an example.
6. Identify three major roles of proteins.
7. What is a chemical reaction? Describe the role of energy in chemical reactions
8. What are enzymes, and how are they important to living things?

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Chapter 7 – Cell Structure and Function

7–1 Life Is Cellular

Key Concepts

- The cell theory states that (1) all living things are composed of cells, (2) cells are the basic units of structure and function in living things, and (3) new cells are produced from existing cells.
- Most microscopes use lenses to magnify the image of an object by focusing light or electrons.
- Prokaryotic cells have genetic material that is not contained in a nucleus. Eukaryotic cells contain a nucleus in which their genetic material is separated from the rest of the cell.

Vocabulary

cell
cell theory
cell membrane
nucleus
eukaryote
prokaryote

7–2 Eukaryotic Cell Structure

Key Concepts

- The nucleus contains nearly all the cell's DNA and the coded instructions for making proteins and other important molecules.
- Vacuoles store materials like water, salts, proteins, and carbohydrates. Lysosomes break down large molecules into smaller ones that can be used by the cell. They are also involved in breaking down organelles that have outlived their usefulness. The cytoskeleton helps the cell maintain its shape and it also involved in movement.
- Proteins are assembled on ribosomes.
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- Proteins made on the rough ER include those that will be released from the cell as well as many membrane proteins and proteins destined for specialized locations within the cell. The Golgi apparatus then modifies, sorts, and packages proteins and other materials for storage in the cell or release outside the cell.
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- All cells have a cell membrane. The cell membrane regulates what enters and leaves the cell and also provides protection and support. Some cells also have cell walls. Cell walls provide additional support and protection.

Vocabulary

organelle
cytoplasm
chromatin
chromosome
nucleolus
ribosome
endoplasmic reticulum
Golgi apparatus
lysosome
vacuole
mitochondrion
chloroplast
cytoskeleton
centriole
cell wall
lipid bilayer
selectively permeable

7–3 Cell Transport

Key Concept

- Passive transport (including diffusion and osmosis) is the movement of materials across the cell membrane without cellular energy.

Vocabulary

diffusion
equilibrium
osmosis

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- The movement of materials against a concentration difference is known as active transport. Active transport requires energy.
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- Osmosis is the diffusion of water through a selectively permeable membrane.

facilitated diffusion
active transport
endocytosis
exocytosis

7–4 Homeostasis and Cells

Key Concepts

Vocabulary

- To maintain homeostasis, unicellular organisms grow, respond to the environment, transform energy, and reproduce.
- The cells of multicellular organisms become specialized for particular tasks and communicate with one another to maintain homeostasis
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- The levels of organization in a multicellular organism are individual cells, tissues, organs, and organ systems.

cell
specialization
homeostasis
tissue
organ
organ system

1. What three statements make up the cell theory?
2. How are prokaryotic and eukaryotic cells alike? How do they differ?
3. Draw a cell nucleus. Label and give the function of the following structures: chromatin, nucleolus, and nuclear envelope.
4. List and describe the function of the cell organelles.
5. What process takes place in the rough endoplasmic reticulum?
6. Which organelles are only found in plant cells? In animal cells?
7. Briefly describe the structure of a cell membrane. How does the cell contents of a cell?
8. What is meant by the concentration of a solution? Give a specific example of concentration involving volume and mass.
9. Describe the process of diffusion. Name and describe the condition that exists when the diffusion of a particular substance is complete.
10. What is the relationship between osmosis and diffusion? By definition, what is the only substance that carries out osmosis?
11. List and describe the two types of electron microscopes.
12. Use an example to describe the relationship among cells, tissues, organs, and organ systems.

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Chapter 10– Cell Growth and Division

10–1 Cell Growth, Division, and Reproduction

Key Concepts

- The larger a cell becomes, the more demands the cell places on its DNA. In addition, a larger cell is less efficient in moving nutrients and wastes across the cell membrane.
- Asexual reproduction is the production of genetically identical offspring from a single parent.
- Offspring produced by sexual reproduction inherit some of their genetic information from each parent.

Vocabulary

cell division
asexual reproductior
sexual reproduction

10–2 The Process of Cell Division

Key Concepts

- Chromosomes make it possible to separate DNA precisely during cell division.
- During the cell cycle, a cell grows, prepares for division, and divides to form two daughter cells.
- During prophase, the genetic material inside the nucleus condenses. During metaphase, the chromosomes line up across the center of the cell. During anaphase, the chromosomes separate and move along the spindle fibers to opposite ends of the cell. During telophase, the chromosomes, which were distinct and condensed, begin to spread out into a tangle of chromatin.
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- Cytokinesis completes the process of cell division—it splits one cell into two.

Vocabulary

mitosis
chromosome
chromatin
cytokinesis
chromatid
centromere
interphase
cell cycle
prophase
centriole
metaphase
anaphase
telophase

10–3 Regulating the Cell Cycle

Key Concepts

- The cell cycle is controlled by regulatory proteins both inside and outside the cell.
- Cancer cells do not respond to the signals that regulate the growth of most cells. As a result, the cells divide uncontrollably.

Vocabulary

cyclin

cancer

growth factor

tumor

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10–4 Cell Differentiation

Key Concepts

- During the development of an organism, cells differentiate into many types of cells.
- The unspecialized cells from which differentiated cells develop are known as stem cells.
- Stem cells make it possible to develop a new field of regenerative medicine, in which undifferentiated cells are used to repair damaged cells and tissue.

Vocabulary

embryo
differentiation
transition
stem cell

1. Summarize what happens during the process of cell division.
2. Explain how a cell's DNA can limit the cell's size.
3. Describe what is meant by each of the following terms: cell volume, cell surface area, ratio of surface area to volume.
4. How is a cell's potential growth affected by its ratio of surface area to volume?
5. Describe how a cell's chromosomes change as a cell prepares to divide.
6. What is the relationship between interphase and cell division?
7. Summarize what happens during interphase.
8. Explain how the following terms are related to one another: DNA, centromere, chromosome, chromatid.
9. List the following events in the correct sequence, and describe what happens during each event: anaphase, metaphase, prophase, and telophase.
10. How does the number of chromosomes in the two new cells compare with the number in the original cell at the end of cell division?
11. Summarize what happens during the cell cycle.
12. When some cells are removed from the center of a tissue culture, will new cells replace the cells that were removed? Explain.
13. Describe the role of cyclins in the cell cycle.
14. Why is it important that cell growth in a multicellular organism be regulated so carefully?
15. How do cancer cells differ from noncancerous cells? How are they similar?

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Chapter 11—Introduction to Genetics

11–1 The Work of Gregor Mendel

Key Concept

- An individual's characteristics are determined by factors that are passed from one parental generation to the next.
- The principle of dominance states that some alleles are dominant and others are recessive.
- During gamete formation, the alleles for each gene segregate from each other so that each gamete carries only one allele for each gene.

Vocabulary

genetics
fertilization
trait
hybrid
gene
allele
segregation
gamete

11–2 Applying Mendel's Principles

Key Concepts

- Punnett squares use mathematical probability to help predict the genotype and phenotype combinations in genetic crosses.
- The principle of independent assortment states that genes for different traits can segregate independently during gamete formation.
- Mendel's principles of heredity, observed through patterns of inheritance, form the basis of modern genetics.

Vocabulary

probability
Punnett square
homozygous
heterozygous
phenotype
genotype
independent assortment

11–3 Other Patterns of Inheritance

Key Concepts

- Many genes exist in several different forms and are therefore said to have multiple alleles. Many traits are produced by the interaction of several genes.
- Environmental conditions can affect gene expression and influence genetically determined traits.

Vocabulary

incomplete dominance
codominance
multiple alleles
polygenic trait

11–4 Meiosis

Key Concept

- Meiosis is a process of reduction division in which the number of chromosomes per cell is cut in half through the separation of homologous chromosomes in a diploid cell.
- Mitosis results in the production of two genetically identical diploid cells, whereas meiosis produces four genetically different haploid cells.

Vocabulary

homologous
diploid
haploid
meiosis
tetrad
crossing-over

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1. List the four basic principles of genetics that Mendel discovered in his experiments. Briefly describe each of these principles.
2. What is probability? How does probability relate to genetics?
3. In pea plants, the allele for yellow seeds is dominant to the allele for green seeds. Predict the genotypic ratio of offspring produced by crossing two parents heterozygous for this trait. Draw a Punnett square to illustrate your prediction.
4. How do multiple alleles and polygenic traits differ?
5. Why can multiple alleles provide many different phenotypes for a trait?
6. Are an organism's characteristics determined only by its genes? Explain.
7. Suppose that for an organism, 2N = 8. How many chromosomes do the organism's gametes contain?
8. In rabbits, *B* is an allele for black coat and *b* is an allele for brown coat. Write the genotypes for a rabbit that is homozygous for black coat and another rabbit that is heterozygous for black coat.
9. Describe the process of meiosis.
10. Compare the phases of meiosis I with the phases of meiosis II in terms of the number and arrangement of the chromosomes.

Chapter 14 – Human Heredity

14–1 Human Chromosomes

Key Concepts

- All human egg cells carry a single X chromosome (23,X). However, half of all sperm cells carry an X chromosome (23,X) and half carry a Y chromosome (23,Y). This ensures that just about half of the zygotes will be 46,XX (female), and half will be 46,XY (male).
- A karyotype shows the complete diploid set of chromosomes grouped together in pairs, arranged in order of decreasing size.
- Many human traits follow a pattern of simple dominance. The alleles for other human genes display codominant inheritance. Because the X and Y chromosomes determine sex, the genes located on them show a pattern of inheritance called sex-linkage.
- Males have just one X chromosome. Thus, all X-linked alleles are expressed in males, even if they are recessive.
- The information gained from pedigree analysis makes it possible to determine the nature of genes and alleles associated with inherited human traits.

Vocabulary

karyotype
genome
sex chromosome
autosome
sex-linked gene
pedigree

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14–2 Human Genetic Disorders

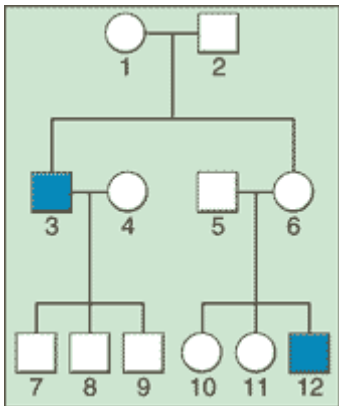
Key Concepts

- If nondisjunction occurs, abnormal numbers of chromosomes may find their way into gametes, and a disorder of chromosome numbers may result.
- In both cystic fibrosis and sickle cell disease, a small change in the DNA of a single gene affects the structure of a protein, causing a serious genetic disorder.

Vocabulary

nondisjunction

1. Describe how a karyotype is prepared and analyzed.
2. What is the difference between autosomes and sex chromosomes?
3. How can a family pedigree be helpful in determining the probability of having a child with a genetic disorder?
4. In the pedigree below, the shaded symbols indicate people who have hemophilia. Which mothers certainly are carriers? Why did the sons of person 3 not inherit the trait?



5. Why are sex-linked disorders more common in males than in females?

6. How does nondisjunction cause chromosome number disorders?