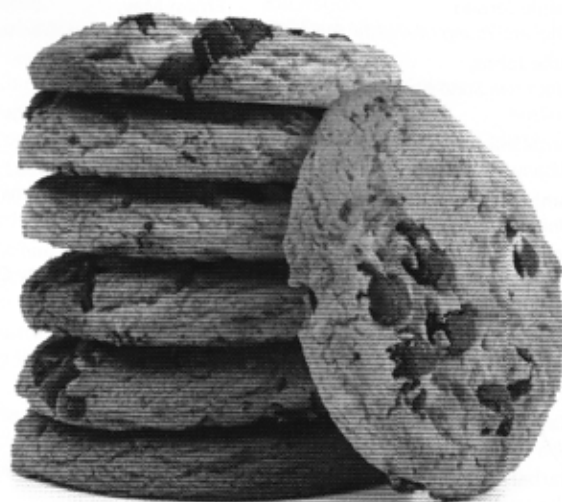


1

An Introduction to the Science of Life

1.1	All living organisms share certain properties	2
1.2	Life can be studied at many levels	4
1.3	Scientists use well-established methods to investigate the natural world	6
1.4	Scientists try to control for variables	8
1.5	Scientific thinking can be distinguished from other ways of viewing the world	10
1.6	Scientists communicate data using tables and graphs	12
1.7	Several major themes run throughout the study of biology	14



2

The Chemistry of Life

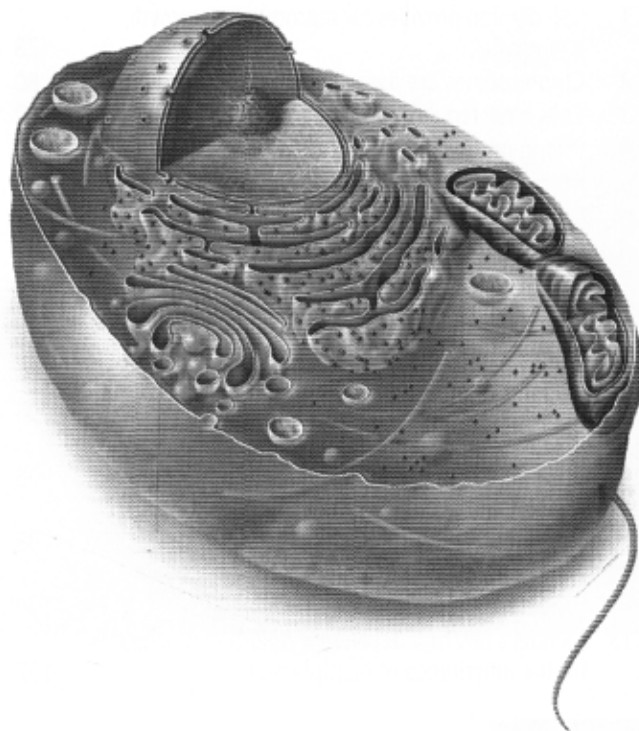
2.1	All life is made of molecules, which are made of atoms	16
2.2	All matter consists of chemical elements	18
2.3	Atoms are composed of subatomic particles	20
2.4	Atoms are held together by chemical bonds	22
2.5	The structure of water gives it unique properties	24
2.6	pH is a measure of the acidity of a solution	26
2.7	All life on Earth is based on carbon	28
2.8	Most biological macromolecules are polymers	30
2.9	Carbohydrates are composed of monosaccharides	32
2.10	Lipids are a diverse group of hydrophobic molecules	34
2.11	Your diet contains several different kinds of fats	36
2.12	Proteins perform many of life's functions	38
2.13	Enzymes speed chemical reactions	40



3

The Cell: The Fundamental Unit of Life

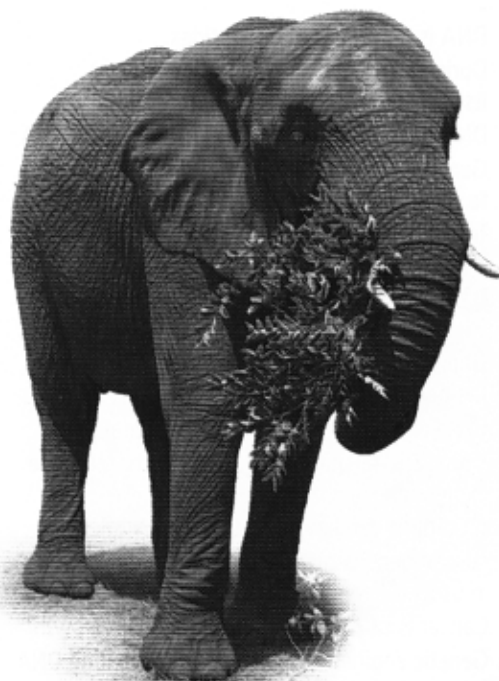
3.1	Cells are the fundamental units of life	42
3.2	Plant and animal cells have common and unique structures	44
3.3	Membranes are made from two layers of lipids	46
3.4	Membranes regulate the passage of materials	48
3.5	The nucleus houses DNA packaged as chromosomes	50
3.6	Several organelles participate in the production of proteins	52
3.7	Chloroplasts and mitochondria provide energy to the cell	54
3.8	Various cellular organelles provide storage, movement, and shape	56



4

Energy and Life

4.1	Energy can be converted from one form to another	58
4.2	Energy flows through an ecosystem	60
4.3	Within chloroplasts, the energy of sunlight is used to produce sugars	62
4.4	Photosynthesis occurs in two linked stages	64
4.5	In the light reactions, the energy of sunlight is captured as chemical energy	66
4.6	In the Calvin cycle, high-energy molecules are used to make sugar	68
4.7	In cellular respiration, oxygen is used to harvest energy stored in sugar	70
4.8	Cellular respiration is divided into three stages	72
4.9	In fermentation, energy is harvested from sugar without oxygen	74
4.10	Cellular respiration is a central hub of many of life's metabolic processes	76



5

Chromosomes and Inheritance

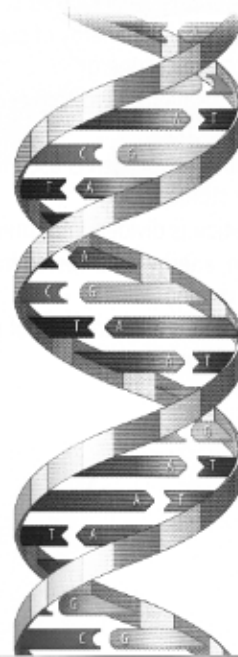
5.1	Cell division provides for reproduction, growth, and repair	78	5.14	Pedigrees can be used to trace traits in human families	104
5.2	Chromosomes are associations of DNA and protein	80	5.15	The inheritance of many traits is more complex than Mendel's laws	106
5.3	Cells have regular cycles of growth and division	82	5.16	Linked genes may not obey the law of independent assortment	108
5.4	During mitosis, the nucleus is divided	84	5.17	Sex-linked genes display unusual inheritance patterns	110
5.5	During cytokinesis, the cell is split in two	86	5.18	Nuclear transfer can be used to produce clones	112
5.6	Gametes have half as many chromosomes as body cells	88			
5.7	Meiosis produces gametes	90			
5.8	Mitosis and meiosis have important similarities and differences	92			
5.9	Several processes produce genetic variation among sexually reproducing organisms	94			
5.10	Mistakes during meiosis can produce gametes with abnormal numbers of chromosomes	96			
5.11	Mendel deduced the basic principles of genetics by breeding pea plants	98			
5.12	A Punnett square can be used to predict the results of a genetic cross	100			
5.13	Mendel's law of independent assortment accounts for the inheritance of multiple traits	102			



6

DNA: The Molecule of Life

6.1	DNA is a polymer of nucleotides	114	6.15	Plants and animals can be genetically modified	142
6.2	During DNA replication, a cell duplicates its chromosomes	116	6.16	PCR can be used to multiply samples of DNA	144
6.3	DNA directs the production of proteins via RNA	118	6.17	DNA profiles are based on STR analysis	146
6.4	Genetic information flows from DNA to RNA to protein	120	6.18	Whole genomes can be sequenced	148
6.5	Transcription creates a molecule of RNA from a molecule of DNA	122	6.19	Gene therapy aims to cure genetic diseases	150
6.6	Translation involves the coordination of three kinds of RNA	124			
6.7	Translation creates a molecule of protein via the genetic code	126			
6.8	Gene expression is regulated in several ways	128			
6.9	Signal transduction pathways can control gene expression	130			
6.10	Mutations can have a wide range of effects	132			
6.11	Loss of gene expression control can result in cancer	134			
6.12	Cancer is caused by out-of-control cell growth	136			
6.13	Genetic engineering involves manipulating DNA for practical purposes	138			
6.14	DNA may be manipulated many ways within the laboratory	140			



7

Darwinian Evolution

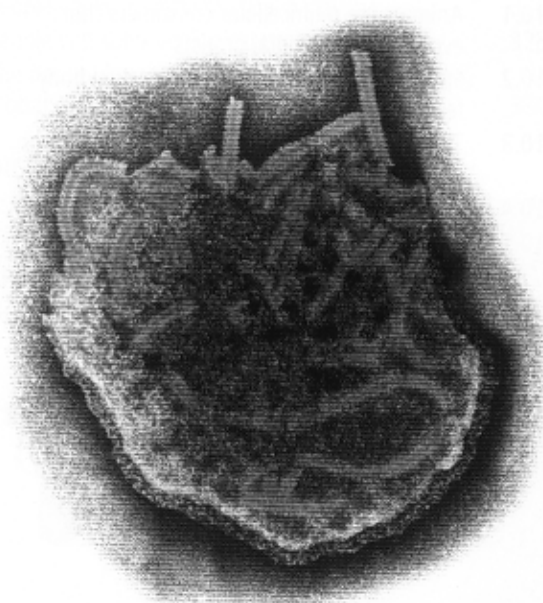
7.1	Darwin's influences and experiences led him to publish his theory of evolution	152
7.2	Unequal reproductive success leads to natural selection	154
7.3	Evolution affects our daily lives	156
7.4	The fossil record provides important evidence for evolution	158
7.5	Evidence for evolution is found in the natural world	160
7.6	Populations are the units of evolution	162
7.7	Evolution proceeds through several mechanisms	164
7.8	Macroevolution encompasses large-scale changes	166
7.9	The geological record ties together the history of Earth and its life	168
7.10	Species are maintained by reproductive barriers	170
7.11	Speciation can occur through various mechanisms	172
7.12	Taxonomy is the classification of life	174
7.13	Phylogenetic trees represent hypotheses about evolutionary history	176



8

Biodiversity 1: Microscopic Organisms

8.1	Biologists hypothesize that life originated in a series of stages	178
8.2	Prokaryotes have unique cellular structures	180
8.3	Archaea are found in extreme habitats	182
8.4	Bacteria are very numerous and common	184
8.5	Bacteria can transfer DNA	186
8.6	Eukaryotic cells evolved from prokaryotic cells	188
8.7	Protists are very diverse	190
8.8	The origin of multicellular life was a major milestone in evolution	192
8.9	Viruses are nonliving parasites	194
8.10	HIV cripples the human immune system	196
8.11	Prions and viroids are nonliving parasites even smaller than viruses	198



9

Biodiversity 2: Fungi and Plants

9.1	Fungi are a diverse group of eukaryotes	200
9.2	Fungi have specialized structures and means of reproduction	202
9.3	Plants have unique adaptations that allow them to survive on land	204
9.4	Plant bodies consist of roots, stems, and leaves	206
9.5	Plant bodies follow a structural hierarchy	208
9.6	Four major groups of plants have evolved	210
9.7	Bryophytes are seedless, nonvascular plants	212
9.8	Vascular tissue transports water and nutrients	214
9.9	Ferns are seedless vascular plants	216
9.10	The first plants to evolve seeds were gymnosperms	218
9.11	Angiosperms dominate the modern landscape	220
9.12	Flowers, fruit, and seeds aid angiosperm reproduction	222
9.13	Angiosperms grow in length and in thickness	224



10

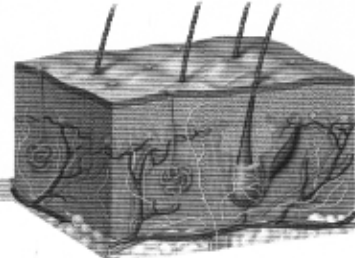
Biodiversity 3: Animals

10.1	Animals are multicellular consumers that evolved from colonial protists	226	10.6	Echinoderms are a sister phylum to the chordates	236
10.2	Sponges and cnidarians have unusual body features	228	10.7	Vertebrates belong to the chordate phylum	238
10.3	Three phyla of worms have unique structures and belong to separate evolutionary lineages	230	10.8	The first vertebrates to evolve were fishes	240
10.4	Mollusks are a very diverse phylum	232	10.9	Amphibians and reptiles were the first tetrapods to occupy land	242
10.5	The arthropods are extremely diverse and numerous	234	10.10	Mammals have hair and produce milk	244
			10.11	Humans evolved from ancestral primates several million years ago	246



11

Human Body Systems



11.1	Animal bodies are organized into a structural hierarchy	248	11.12	The immune system contains a huge number of defensive elements	270
11.2	The human body contains several major types of tissues	250	11.13	Immune system malfunctions cause a variety of disorders	272
11.3	An animal's internal environment remains relatively constant	252	11.14	The endocrine system regulates the body via hormones	274
11.4	The human digestive system consists of an alimentary canal and accessory organs	254	11.15	The urinary system regulates water and rids the body of wastes	276
11.5	Food is processed in a series of stages	256	11.16	Males and females produce, store, and deliver gametes	278
11.6	Proper nutrition provides energy and building materials	258	11.17	A human develops from a single cell	280
11.7	An unbalanced diet or malfunctioning digestive system can lead to health problems	260	11.18	Issues of reproductive health affect us all	282
11.8	The respiratory system exchanges gases between the environment and the body	262	11.19	The brain is the hub of the human nervous system	284
11.9	The circulatory system transports materials throughout the body	264	11.20	The nervous system receives input, processes it, and sends output	286
11.10	The heart is the hub of the human circulatory system	266	11.21	The senses use receptors to convey information about the outside world	288
11.11	Blood contains cells in liquid	268	11.22	The human skeleton contains 206 bones	290
			11.23	Skeletal muscles produce movement	292

12

Ecology

12.1	Ecology affects your life and the broader society	294	12.17	People cause many ecological problems	326
12.2	Ecology is the scientific study of organisms in their environments	296	12.18	People can solve ecological problems	328
12.3	Ecosystems include a variety of abiotic factors	298	12.19	The accumulation of greenhouse gases is causing global climate change	330
12.4	Populations vary in age structure, survivorship, density, and dispersion	300			
12.5	Growth models can predict changes in population size	302			
12.6	Human population growth has been exponential	304			
12.7	Interactions between species play important roles in communities	306			
12.8	Food webs describe multiple trophic structures	308			
12.9	Several factors affect species diversity	310			
12.10	Invasive species can disrupt ecosystems	312			
12.11	Biodiversity is measured on many levels	314			
12.12	There are a variety of terrestrial biomes	316			
12.13	Aquatic biomes cover most of Earth's surface	318			
12.14	Energy is lost as it moves through trophic levels	320			
12.15	Elements cycle through the biosphere	322			
12.16	All water on Earth is interconnected in a global cycle	324			

APPENDICES

A: Metric Conversion Table A-1

B: The Periodic Table B-1

GLOSSARY G-1

CREDITS C-1

INDEX I-1

