

Brief Contents

CHAPTER 1 The Study of Life 2

Unit 1 The Basis of Life 30-125

CHAPTER 2 Chemical Basis of Life 32

CHAPTER 3 Cell Structure and Function . . . 56

CHAPTER 4 Photosynthesis and Cellular Respiration 80

CHAPTER 5 Cell Division 102

Unit 2 Genetics 126-225

CHAPTER 6 Fundamentals of Genetics 128

CHAPTER 7 DNA, Genes, and Chromosomes . 156

CHAPTER 8 Protein Synthesis 180

CHAPTER 9 The Biotechnology Revolution . 204

Unit 3 Change and Diversity 226-321

CHAPTER 10 The Theory of Evolution 228

CHAPTER 11 The History of Life 254

CHAPTER 12 Human History 278

CHAPTER 13 Classification 298

Unit 4 Monerans, Protists, and Fungi 322-393

CHAPTER 14 Viruses and Monerans 324

CHAPTER 15 Protists 350

CHAPTER 16 Fungi 372

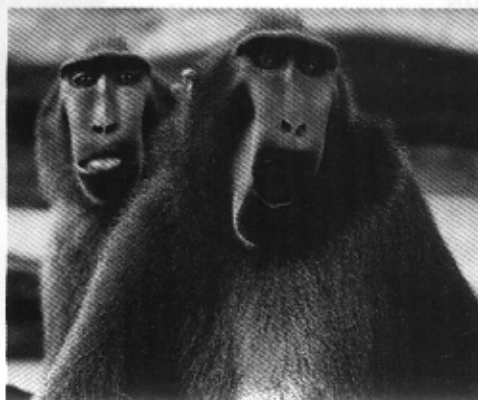
Unit 5 Plants 394-495

CHAPTER 17 Introduction to Plants 396

CHAPTER 18 Energy, Transport, and Growth in Plants 420

CHAPTER 19 Response and Reproduction in Plants 444

CHAPTER 20 Origin and Diversity of Plants . . 468



Unit 6 Invertebrate Animals 496-587

CHAPTER 21 Sponges and Cnidarians 498

CHAPTER 22 Worms and Mollusks 522

CHAPTER 23 Arthropods 544

CHAPTER 24 Echinoderms and Invertebrate Chordates 570

Unit 7 Vertebrate Animals 588-687

CHAPTER 25 Fishes and Amphibians 590

CHAPTER 26 Reptiles and Birds 618

CHAPTER 27 Mammals 646

CHAPTER 28 Animal Behavior 666

Unit 8 Human Biology 688-849

CHAPTER 29 Skin, Skeletal, and Muscular Systems 690

CHAPTER 30 Digestive and Excretory Systems . 718

CHAPTER 31 Respiratory and Circulatory Systems 742

CHAPTER 32 Immune System 768

CHAPTER 33 Endocrine and Reproductive Systems 792

CHAPTER 34 Nervous Systems 820

Unit 9 Organisms and the Environment 850-941

CHAPTER 35 The Biosphere 852

CHAPTER 36 Populations and Communities . 874

CHAPTER 37 Ecosystem Dynamics 896

CHAPTER 38 People and the Environment . . 916

Contents

CHAPTER 1 THE STUDY OF LIFE 2

The Big Idea: Living things share many characteristics, including organization and adaptation.

- 1.1 Similarities Among Living Things 4
- 1.2 Adaptation and Interdependence 12

The Big Idea: Scientists use careful observation and controlled experiments to study the natural world.

- 1.3 Doing the Science of Biology 19

Unit 1 The Basis of Life 30–125

CHAPTER 2 CHEMICAL BASIS OF LIFE 32

The Big Idea: Living things are made of chemicals with characteristic structures and functions.

- 2.1 Chemicals in Organisms 34
- 2.2 Basics of Chemistry 37

The Big Idea: Life processes depend on breaking and forming chemical bonds in chemical reactions.

- 2.3 Chemicals at Work 42
- 2.4 Chemistry in Life Processes 46

The Big Idea: Life processes depend on the properties of water and the characteristics of solutions.

- 2.5 Water and Solutions 49

CHAPTER 3 CELL STRUCTURE AND FUNCTION 56

The Big Idea: Cell structures of living organisms perform life functions.

- 3.1 A Look at Cells 58
- 3.2 Basic Cell Structures 62
- 3.3 Cell Organelles 66

The Big Idea: Cells of major groups of organisms can be distinguished by their structural differences.

- 3.4 Cell Diversity 69

The Big Idea: Cells exchange materials with their environment by chemical and physical processes.

- 3.5 Cells and Their Environment 72

CHAPTER 4 PHOTOSYNTHESIS AND CELLULAR RESPIRATION 80

The Big Idea: All organisms get energy by breaking down the chemical compounds in food and making ATP and other molecules.

- 4.1 Energy and ATP 82
- 4.2 Photosynthesis 85
- 4.3 Cellular Respiration 91

The Big Idea: Energy from sunlight passes through a series of living organisms.

- 4.4 Energy Flow in the Biosphere 97

CHAPTER 5 CELL DIVISION 102

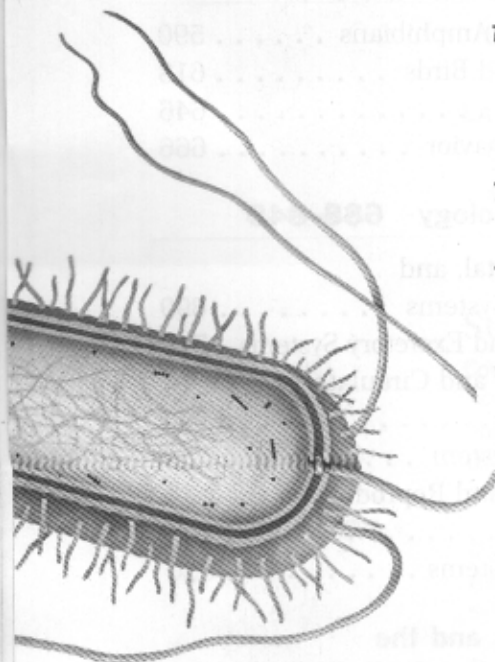
The Big Idea: Cell division is the basis of reproduction and development.

- 5.1 When Do Cells Divide? 104
- 5.2 How Do Cells Divide? 107

The Big Idea: Chromosome number is reduced in meiosis.

- 5.3 What Is Meiosis? 114
- 5.4 New Chromosome Combinations 118

UNIT 1 REVIEW 124–125



Unit 2 Genetics 126–225

CHAPTER 6 FUNDAMENTALS OF GENETICS 128

The Big Idea: Traits are inherited in a consistent pattern.

- 6.1 Patterns of Inheritance 130
- 6.2 Principles of Inheritance 134

The Big Idea: There are patterns of inheritance that make some traits predictable.

- 6.3 Genetics and Predictions 138
- 6.4 Predictions and People 142
- 6.5 Difficult Predictions 147

CHAPTER 7 DNA, GENES, AND CHROMOSOMES 156

The Big Idea: The structure of DNA, the molecule of heredity, enables the molecule to copy itself.

- 7.1 Molecule of Heredity 158
- 7.2 DNA Structure and Replication 160

The Big Idea: Genes, sections of DNA that code for a specific trait, are linked together on chromosomes.

- 7.3 Linked Genes 165
- 7.4 Sex Linkage 170
- 7.5 The Human Gene Map 173

CHAPTER 8 PROTEIN SYNTHESIS 180

The Big Idea: Genes are sequences of DNA bases that can be translated into proteins or parts of proteins when they are activated.

- 8.1 From Genotype to Phenotype 182
- 8.2 Protein and Phenotype 188

The Big Idea: Changes in DNA can cause changes in phenotype.

- 8.3 Changes in Chromosomes 192
- 8.4 Genes and Cancer 196

CHAPTER 9 THE BIOTECHNOLOGY REVOLUTION 204

The Big Idea: Genotypes can be changed through selective breeding and genetic engineering.

- 9.1 Breeding 206
- 9.2 Genetic Engineering 209

The Big Idea: Technology enables us to find out about genotype and use this knowledge to affect phenotype.

- 9.3 Applications of Genetic Engineering 213
- 9.4 Safety and Ethics in Biotechnology 219

UNIT 2 REVIEW 224–225





Unit 3 Change and Diversity 226-321

CHAPTER 10 THE THEORY OF EVOLUTION 228

The Big Idea: Populations change over time through natural selection.

10.1 Variation and Adaptation 230

10.2 Darwin and His Theory 233

The Big Idea: Scientific analysis of fossils and modern organisms supports the theory of evolution.

10.3 Tracking Changes 238

The Big Idea: New species can originate through natural selection and other changes in a population's gene pool.

10.4 Origin of Species 241

10.5 Population Genetics 246

CHAPTER 11 THE HISTORY OF LIFE 254

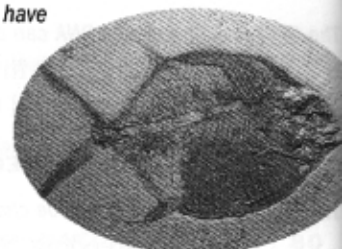
The Big Idea: Evidence indicates that organic molecules and cells may have formed spontaneously on ancient Earth.

11.1 Earth's Early History 256

The Big Idea: Our planet and the organisms that inhabit it have changed greatly over time.

11.2 The First Organisms 263

11.3 History of Living Things 268



CHAPTER 12 HUMAN HISTORY 278

The Big Idea: Primates are mammals with binocular vision and dexterous hands and arms.

12.1 Primates 280

The Big Idea: There have been many different hominid species over time, each species with its own unique characteristics.

12.2 Hominids 286

12.3 *Homo sapiens* 290



CHAPTER 13 CLASSIFICATION 298

The Big Idea: Scientists classify organisms into a hierarchy of groups based on evolutionary relationships.

13.1 Classification 300

13.2 Basis for Classification 305

The Big Idea: Classification has numerous applications, including identifying species.

13.3 Identifying Organisms 313

UNIT 3 REVIEW 320-321

Unit 4 Monerans, Protists, and Fungi 322-393

CHAPTER 14 VIRUSES AND MONERANS 324

The Big Idea: Viruses are particles that depend on living things to replicate.

- 14.1 Characteristics of Viruses 326
- 14.2 Origin and Diversity of Viruses 330
- 14.3 Viruses in the Biosphere 334

The Big Idea: Monerans are microscopic organisms that lack a membrane-bound nucleus and membrane-bound organelles.

- 14.4 Characteristics of Monerans 336
- 14.5 Origin and Diversity of Monerans 340
- 14.6 Monerans in the Biosphere 344

CHAPTER 15 PROTISTS 350

The Big Idea: Protists are a diverse group of eukaryotes that include unicellular and multicellular organisms.

- 15.1 Characteristics of Protists 352

The Big Idea: Protists can be classified into three groups—protozoans, algae, and molds.

- 15.2 Animal-like Protists—Protozoans 355
- 15.3 Plantlike Protists—Algae 358
- 15.4 Funguslike Protists—Molds 362

The Big Idea: Protists have a major ecological impact as food sources, decomposers, and infectious agents.

- 15.5 Protists in the Biosphere 365

CHAPTER 16 FUNGI 372

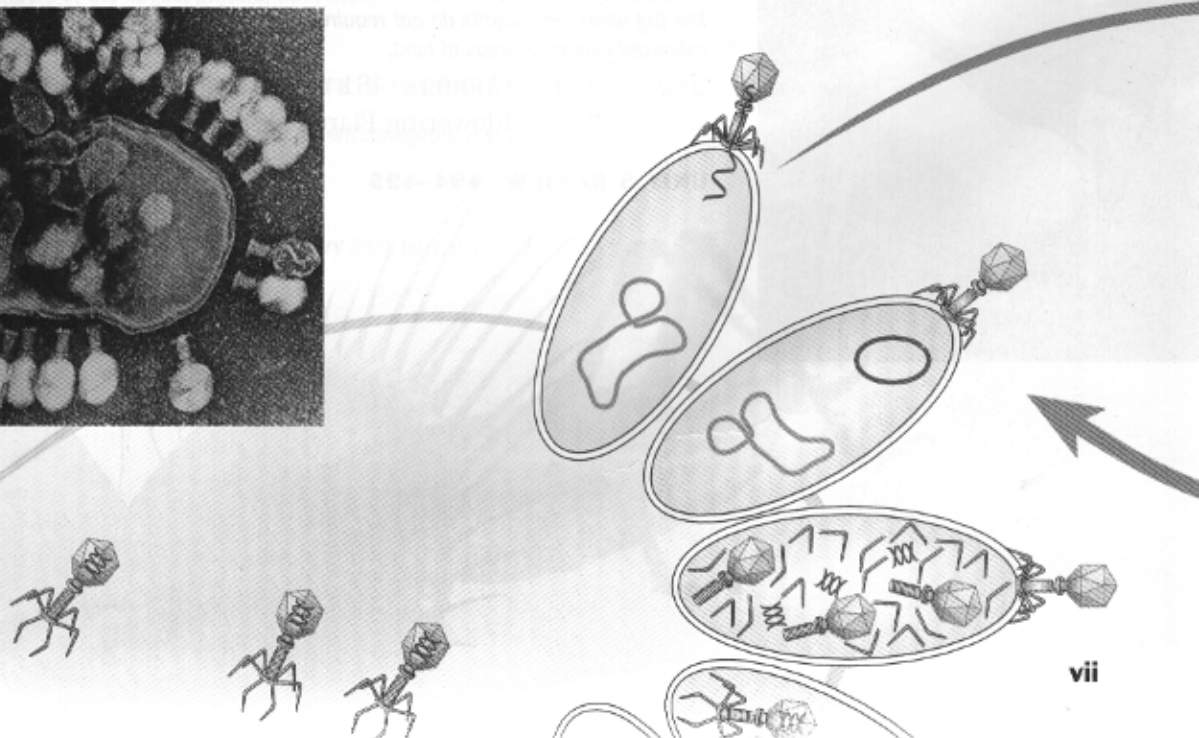
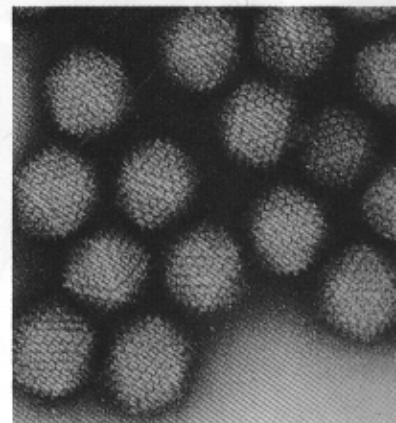
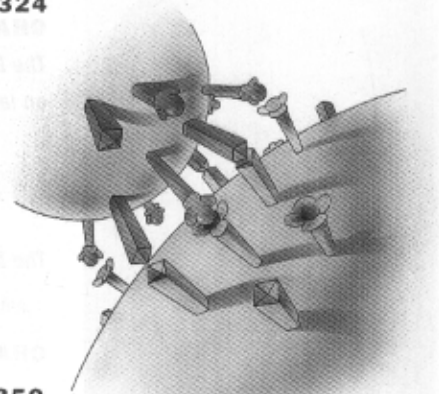
The Big Idea: Fungi are stationary organisms that live as heterotrophs.

- 16.1 Characteristics of Fungi 374
- 16.2 Origin and Diversity of Fungi 378

The Big Idea: Fungi act as decomposers and symbiotic partners of humans and many other organisms.

- 16.3 Fungi in the Biosphere 384

UNIT 4 REVIEW 392-393



Unit 5 Plants 394-495

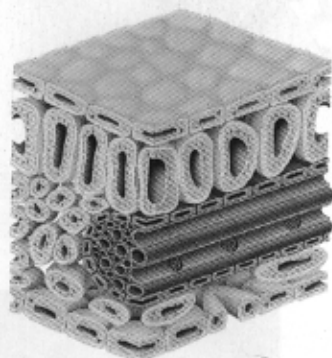
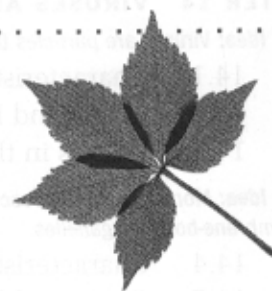
CHAPTER 17 INTRODUCTION TO PLANTS 396

The Big Idea: Most plants have structures that enable them to survive on land and produce food.

- 17.1 The Structure of Plants 398
- 17.2 Plants in the Biosphere 405
- 17.3 Characteristics of Plants 409

The Big Idea: Key features can be used to classify plants.

- 17.4 Overview of Plant Diversity 413



CHAPTER 18 ENERGY, TRANSPORT, AND GROWTH IN PLANTS 420

The Big Idea: Plants perform life processes using specialized structures.

- 18.1 Photosynthesis in Plants 422
- 18.2 Transport in Plants 428

The Big Idea: The parts of most plants grow from specialized tissues.

- 18.3 Plant Growth 435

CHAPTER 19 RESPONSE AND REPRODUCTION IN PLANTS 444

The Big Idea: Plants respond to and affect the environment.

- 19.1 Plants Respond to the Environment 446
- 19.2 Plants Change the Environment 452

The Big Idea: Plants reproduce both asexually and sexually.

- 19.3 Asexual Reproduction in Plants 455
- 19.4 Sexual Reproduction in Plants 458
- 19.5 Focus on Flowers 463

CHAPTER 20 ORIGIN AND DIVERSITY OF PLANTS 468

The Big Idea: Plants are multicellular organisms with adaptations for life on land.

- 20.1 Natural History of Plants 470
- 20.2 Mosses 475

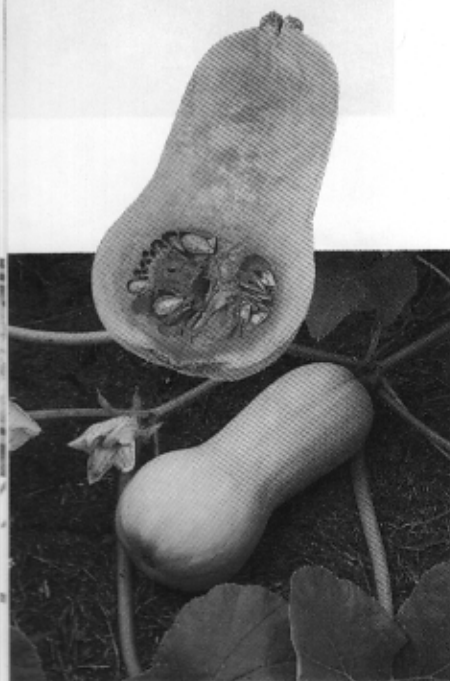
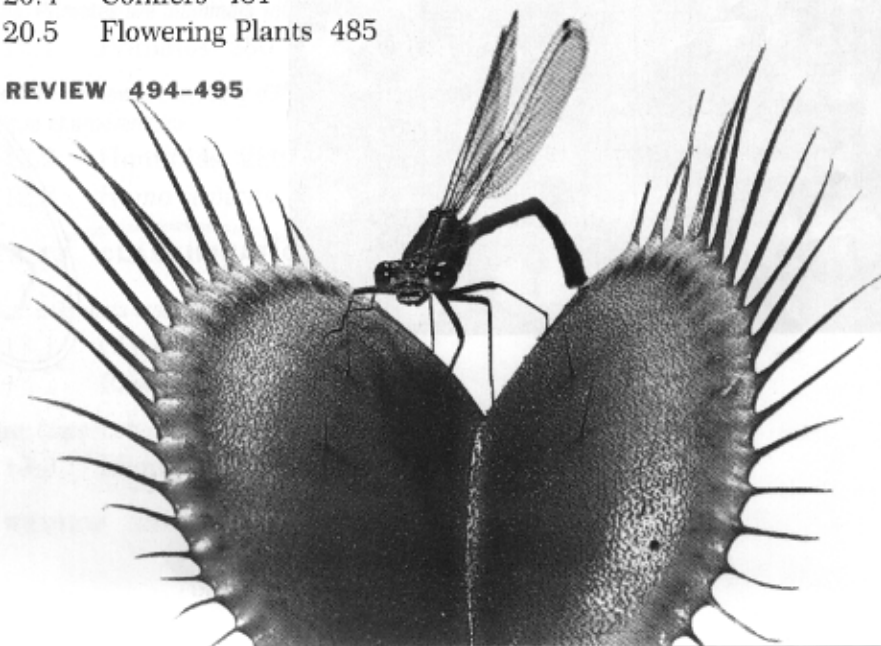
The Big Idea: Ferns have vascular systems and reproduce by means of spores.

- 20.3 Ferns 478

The Big Idea: Seed plants do not require water for fertilization and have therefore colonized extensive areas of land.

- 20.4 Conifers 481
- 20.5 Flowering Plants 485

UNIT 5 REVIEW 494-495



Unit 6 Invertebrate Animals 496–587

CHAPTER 21 SPONGES AND CNIDARIANS 498

The Big Idea: Animals have evolved a number of adaptations enabling them to perform essential functions of life.

21.1 Introduction to Animals 500

The Big Idea: Sponges are sessile animals without specialized tissues and organs.

21.2 Characteristics of Sponges 504

21.3 Origin and Diversity of Sponges 507

The Big Idea: Cnidarians are radially symmetrical animals with specialized tissues and stinging tentacles.

21.4 Characteristics of Cnidarians 509

21.5 Origin and Diversity of Cnidarians 513

The Big Idea: Sponges and cnidarians provide food and protection for a large number of organisms.

21.6 Sponges and Cnidarians in the Biosphere 516

CHAPTER 22 WORMS AND MOLLUSKS 522

The Big Idea: Flatworms and roundworms have bilateral symmetry and specialized tissues.

22.1 Flatworms and Roundworms 524

The Big Idea: Mollusks share a common body plan that includes a muscular foot, a visceral mass, and a mantle.

22.2 Mollusks 530

The Big Idea: Annelids are wormlike animals with a segmented body.

22.3 Segmented Worms 536

CHAPTER 23 ARTHROPODS 544

The Big Idea: Arthropods are segmented invertebrates with jointed appendages and an exoskeleton.

23.1 Arthropods 546

The Big Idea: In general, arthropods are classified by the number of body segments they have and the structure of their appendages.

23.2 Crustaceans 549

23.3 Spiders and Their Relatives 552

23.4 Insects and Their Relatives 556

The Big Idea: Arthropods, as members of the largest phylum, have many important roles in the biosphere.

23.5 Arthropods in the Biosphere 564

CHAPTER 24 ECHINODERMS AND INVERTEBRATE CHORDATES 570

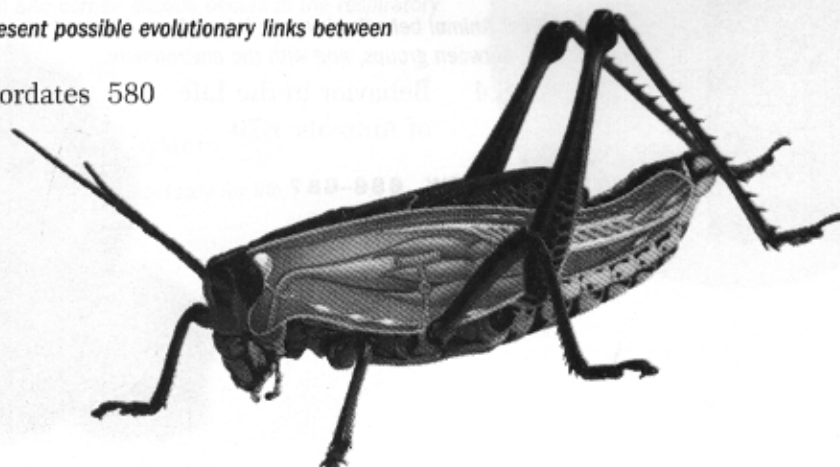
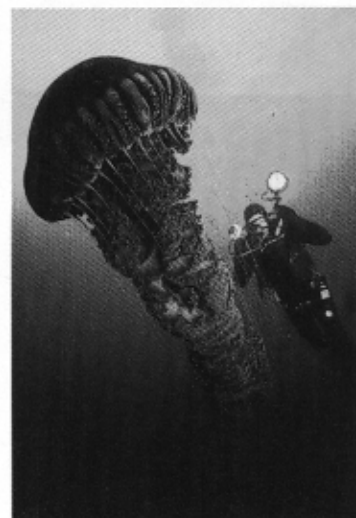
The Big Idea: Echinoderms are marine animals with spiny skin, an endoskeleton, and a water vascular system.

24.1 Echinoderms 572

The Big Idea: Invertebrate chordates represent possible evolutionary links between invertebrates and vertebrates.

24.2 Invertebrate Chordates 580

UNIT 6 REVIEW 586–587



Unit 7 Vertebrate Animals 588-687

CHAPTER 25 FISHES AND AMPHIBIANS 590

The Big Idea: Vertebrates are animals with backbones.

25.1 Vertebrates 592

The Big Idea: Fishes are a diverse group of vertebrates that are adapted for life in the water.

25.2 Characteristics of Fishes 594

25.3 Origin and Diversity of Fishes 599

25.4 Fishes in the Biosphere 603

The Big Idea: Although amphibians share some fish traits, they are adapted to life on land.

25.5 Characteristics of Amphibians 605

25.6 Origin and Diversity of Amphibians 609

25.7 Amphibians in the Biosphere 612

CHAPTER 26 REPTILES AND BIRDS 618

The Big Idea: Reptiles represent the first vertebrates with adaptations that enable them to live their entire lives out of water.

26.1 Characteristics of Reptiles 620

26.2 Origin and Diversity of Reptiles 625

26.3 Reptiles in the Biosphere 629

The Big Idea: With the development of feathers, birds were the first vertebrates able to maintain a constant body temperature.

26.4 Characteristics of Birds 632

26.5 Origin and Diversity of Birds 638

26.6 Birds in the Biosphere 640

CHAPTER 27 MAMMALS 646

The Big Idea: Although different species have unique adaptations, all mammals are endothermic vertebrates with hair and mammary glands.

27.1 Characteristics of Mammals 648

27.2 Origin and Diversity of Mammals 654

The Big Idea: Mammals live almost everywhere on Earth and play important roles in ecosystems.

27.3 Mammals in the Biosphere 660

CHAPTER 28 ANIMAL BEHAVIOR 666

The Big Idea: Animal behaviors are adaptations that maximize survival and reproductive fitness.

28.1 Animal Behavior 668

28.2 Innate Behavior 671

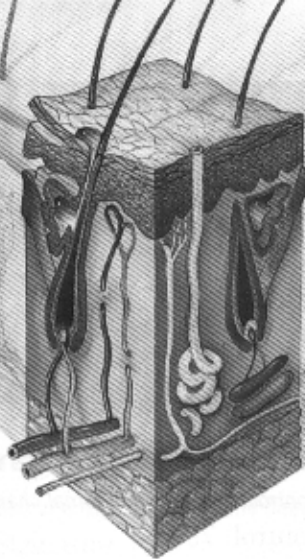
28.3 Learned Behavior 675

The Big Idea: Animal behavior involves interactions between individuals, between groups, and with the environment.

28.4 Behavior in the Life of Animals 679

UNIT 7 REVIEW 686-687





Unit 8 Human Biology 688-849

CHAPTER 29 SKIN, SKELETAL, AND MUSCULAR SYSTEMS 690

The Big Idea: The human body consists of twelve systems.

29.1 Body Systems 692

The Big Idea: The body's skeleton provides support and protection.

29.2 Support 696

29.3 Human Skeleton 698

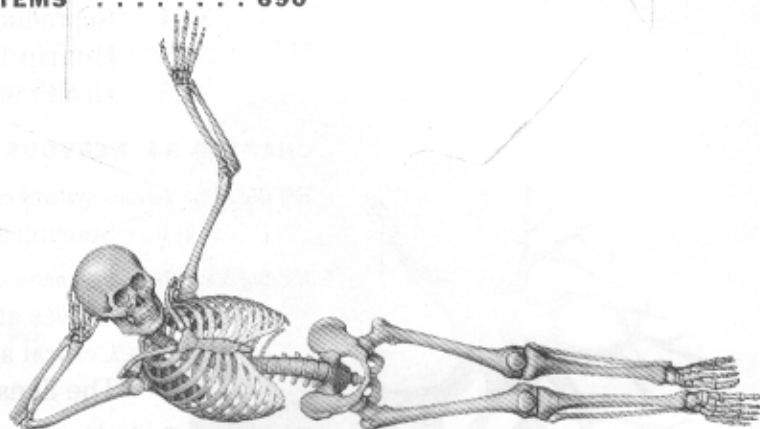
The Big Idea: Muscles contract to move the body.

29.4 Movement 703

29.5 Human Muscles 706

The Big Idea: The skin covers and protects the body's internal organs.

29.6 Covering 710



CHAPTER 30 DIGESTIVE AND EXCRETORY SYSTEMS 718

The Big Idea: The digestive system breaks down food into usable compounds.

30.1 Digestion 720

30.2 Human Digestive System 725

30.3 Health of the Digestive System 729

The Big Idea: The excretory system eliminates nitrogen-containing wastes and helps maintain homeostasis.

30.4 Excretion 733

30.5 Human Excretory System 735

CHAPTER 31 RESPIRATORY AND CIRCULATORY SYSTEMS . . .742

The Big Idea: The vital exchange of oxygen and carbon dioxide occurs in the respiratory systems of animals.

31.1 Respiratory Systems 744

31.2 Every Breath You Take 748

31.3 Health of the Respiratory System 751

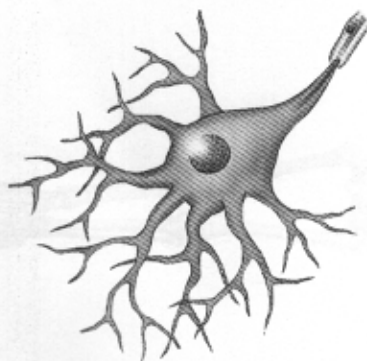
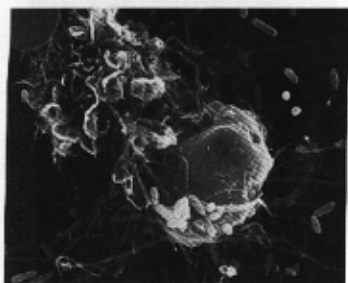
The Big Idea: Circulatory systems transport materials necessary for life.

31.4 Circulatory Systems 754

31.5 Blood 759

31.6 Health of the Circulatory System 762





CHAPTER 32 IMMUNE SYSTEM 768

The Big Idea: The immune system protects the body from harmful organisms and substances.

32.1 Protecting the Organism 770

The Big Idea: The immune system consists of specialized cells, organs, and organ systems that respond to the presence of a pathogen.

32.2 Overview of the Immune System 774

32.3 Activities of the Immune System 777

The Big Idea: A healthy immune system requires a healthy lifestyle.

32.4 Health of the Immune System 783

CHAPTER 33 ENDOCRINE AND REPRODUCTIVE SYSTEMS 792

The Big Idea: The endocrine system controls long-lasting internal changes.

33.1 Endocrine Control 794

33.2 Human Endocrine System 796

33.3 Health of the Endocrine System 801

The Big Idea: Reproductive systems make possible the continuation of life.

33.4 Reproduction 803

33.5 Human Development 809

33.6 Health of the Reproductive System 815

CHAPTER 34 NERVOUS SYSTEMS 820

The Big Idea: Nervous systems control our detection of and response to the environment.

34.1 Sensing and Control 822

The Big Idea: The human nervous system consists of the brain, spinal cord, nerves, and sensory organs.

34.2 Nerves at Work 825

34.3 Central and Peripheral Nervous Systems 828

34.4 The Senses 834

The Big Idea: The health of the nervous system can be affected by injury, disease, and substance abuse.

34.5 Nervous System Health and Substance Abuse 838

UNIT 8 REVIEW 848-849

Unit 9 Organisms and the Environment 850-941

CHAPTER 35 THE BIOSPHERE 852

The Big Idea: Life depends on the relationships between living and nonliving parts of the environment.

35.1 Characteristics of the Biosphere 854

35.2 Climate 858

The Big Idea: Regions of the biosphere have distinguishing characteristics.

35.3 Land Biomes 861

35.4 Water Biomes 866

CHAPTER 36 POPULATIONS AND COMMUNITIES 874

The Big Idea: The size of a population is affected by living and nonliving factors.

36.1 Population Growth 876

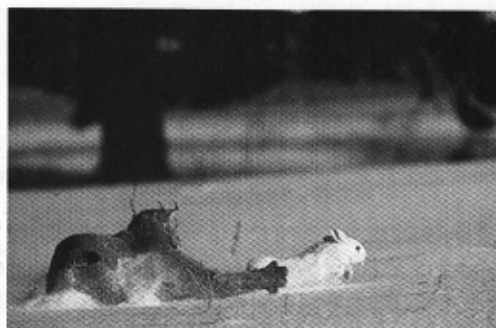
36.2 Limits on Population Growth 881

The Big Idea: How populations interact determines the structure and characteristics of a community.

36.3 Communities 885

The Big Idea: Biotic and abiotic changes in a community alter the community structure.

36.4 Ecological Succession 890



CHAPTER 37 ECOSYSTEM DYNAMICS 896

The Big Idea: In an ecosystem, the flow of energy moves in one direction.

37.1 Ecosystem Structure 898

37.2 Energy Levels 902

The Big Idea: Nutrients are recycled in ecosystems.

37.3 Chemical Cycles 905

CHAPTER 38 PEOPLE AND THE ENVIRONMENT 916

The Big Idea: Human use of essential natural resources can affect the web of life.

38.1 Earth's Resources 918

The Big Idea: Land, water, and air are invaluable natural resources.

38.2 Land in the Biosphere 920

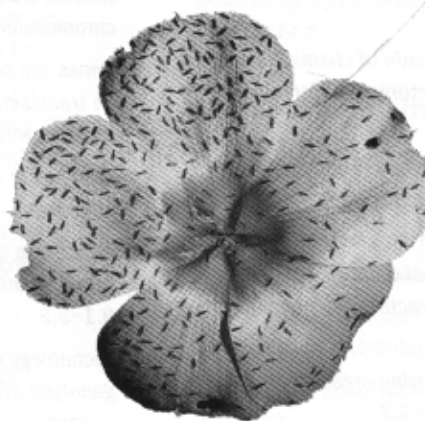
38.3 Water in the Biosphere 924

38.4 Air in the Biosphere 928

The Big Idea: Humans can affect the future of the biosphere in a positive way.

38.5 Environmental Success Stories 932

UNIT 9 REVIEW 940-941



References and Resources

LETTER FROM THE AUTHORS 942

APPENDIX A: METRIC CONVERSIONS 943

APPENDIX B: THE PERIODIC TABLE 944

APPENDIX C: LABORATORY SAFETY 946

APPENDIX D: LABORATORY SKILLS 947

APPENDIX E: PROBLEM-SOLVING SKILLS 949

APPENDIX F: CLASSIFICATION OF ORGANISMS 957

BIOLOGY ATLAS 962

GLOSSARY 976

INDEX 997

ACKNOWLEDGMENTS 1013

