

## Unit 4: Genetics

### Living Environment Core Content

Core Content	Text Book Resources	Labs/Activities
<p><b>CHAPTER 11: Introduction to Genetics</b></p> <p><b>Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.</b></p> <p>Organisms from all kingdoms possess a set of instructions (genes) that determines their characteristics. These instructions are passed from parents to offspring during reproduction. Students are familiar with simple mechanisms related to the inheritance of some physical traits in offspring. They are now able to begin to understand the molecular basis of heredity and how this set of instructions can be changed through recombination, mutation, and genetic engineering. The inherited instructions that are passed from parent to offspring exist in the form of a code.</p>	<p><b>CHAPTER 11: Introduction to Genetics</b></p> <p><i>Workbook B</i> pg. 155 Introduction to Genetics Pre-Chapter Summary</p>	<p><b>PowerPoint/Notes Unit 4:</b> Videoclips and linked activities/worksheets/labs</p> <p>Genetics Tutorial online link from Genetics and Biotechnology page at <a href="http://www.sciencesupport.net">http://www.sciencesupport.net</a></p> <p>Modern Genetics for All Students <a href="http://www.so.wustl.edu/biology.html">http://www.so.wustl.edu/biology.html</a></p>

This code is contained in DNA molecules. The DNA molecules must be accurately replicated before being passed on. Once the coded information is passed on, it is used by a cell to make proteins. The proteins that are made become cell parts and carry out most functions of the cell. Throughout recorded history, humans have used selective breeding and other biotechnological methods to produce products or organisms with desirable traits. Our current understanding of DNA extends this to the manipulation of genes leading to the development of new combinations of traits and new varieties of organisms.

Explain how the structure and replication of genetic material result in offspring that resemble their parents.

#### Major Understandings

2.1b Every organism requires a set of coded instructions for specifying its traits. For offspring to resemble their parents, there must be a reliable way to transfer information from one generation to the next. Heredity is the passage of these instructions from one generation to another.

2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an

**11.1 The Work of Gregor Mendel** The 262-265

**Workbook B:** Section 11.1 Pages 156-158 The Work of Gregor Mendel

**11.2 Applying Mendel's Principles** Pages 266-270

\*You can use the one-factor punnett squares but do not need to do two-factor punnett squares. This is intermediate

**Cartoon Activity:** Monk Discovers Gene, World Yawns!

**Lab Activity:** Mendel Minds his Meiosis ....alias Sexual Reproduction of the Floral Kind!

individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

2.1a Genes are inherited, but their expression can be modified by interactions with the environment.

3.1c Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

3.1h The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions.

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2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the

level but helps students understand inheritance of traits from parents.

**Workbook B:** Section 11.2 Pages 159-161 Applying Mendel's Principles

**11.3 Other Patterns of Inheritance**  
Pages 271-279

**Inquiry** into Scientific thinking page 274

**Workbook B:** Section 11.3 Pages 162-164 Other Patterns of Inheritance

**11.4 Meiosis** Pages 275-279

\*Students don't need to know every stage of meiosis but just the end result and the concept of cell division in terms of sexual reproduction.

**Workbook B:** Section 11.4 Pages 165-166 Meiosis

sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

4.1c The processes of meiosis and fertilization are key to sexual reproduction in a wide variety of organisms. The process of meiosis results in the production of eggs and sperm which each contain half of the genetic information. During fertilization, gametes unite to form a zygote, which contains the complete genetic information for the offspring.

4.1d The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.

## **CHAPTER 12 DNA**

2.1g Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.

## **CHAPTER 12 DNA**

**Workbook B:** Chapter 12 Summary  
Pre-View Page 170

### **12.1 Identifying the Substance of**

5.2b Viruses, bacteria, fungi, and other parasites may infect plants and animals and interfere with normal life functions.

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2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

2.1f In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "bases") and replicated by means of a template.

## **Genes**

**12.1** Bacterial Transformation Page 288

**12.1** Bacterial Viruses Page 289

**12.1** The Role of DNA Page 290-291

**Workbook B:** Chapter 12.1 Identifying the Substance of Genes Page 171-174

## **12.2 The Structure of DNA**

**12.2** The Components of DNA Page 292

**12.2** The Double Helix Page 294

**Workbook B:** Chapter 12.2 The Structure of DNA Page 175-178

1.2i Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).

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5.1f Biochemical processes, both breakdown and synthesis, are made possible by a large set of biological catalysts called enzymes. Enzymes can affect the rates of chemical change. The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature.

### **Chapter 13 RNA and Protein Synthesis**

2.1f In all organisms, the coded instructions for specifying the characteristics of the organism are

### **12.3 DNA Replication**

**12.3** Copying the Code Page 296-297

**12.3** Replication in Living Cells Page 298-299

**Workbook B:** Chapter 12.DNA Replication Page 179-181

### **Chapter 13 RNA and Protein Synthesis**

**Workbook B:** Chapter 13 RNA and Protein Synthesis Chapter Summary

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2.1g Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.

2.1i The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acids in a specific sequence. This sequence influences the shape of the protein. The shape of the protein, in turn, determines its function.

5.1c In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes.

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**13.1** RNA Pages 308-310

**Workbook B:** Chapter 13 RNA Pages 187-190

**13.2** Ribosomes and Protein Synthesis Pages 311-315

**Workbook B:** Chapter 13 RNA Pages 187-190

2.1h Genes are segments of DNA molecules. Any alteration of the DNA sequence is a mutation. Usually, an altered gene will be passed on to every cell that develops from it.

2.2d Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it.

3.1b New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.

3.1c Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

3.1d Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

3.1g Some characteristics give individuals an advantage over others in surviving and reproducing, and the

### 13.3 Mutations Pages 316-320

**Workbook B:** Chapter 13 Mutations  
Pages 195-197

advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

2.1a Genes are inherited, but their expression can be modified by interactions with the environment.

2.1k The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. This is because different parts of these instructions are used in different types of cells, and are influenced by the cell's environment and past history.

4.1a Reproduction and development are necessary for the continuation of any species.

5.1f Biochemical processes, both breakdown and synthesis, are made possible by a large set of biological catalysts called enzymes. Enzymes can affect the rates of chemical change. The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature.

5.1g Enzymes and other molecules, such

**13.4** Gene Regulation and Expression  
320-325

**Workbook B:** Chapter 13 Gene  
Regulation and Expression Page 198

as hormones, receptor molecules, and antibodies, have specific shapes that influence both how they function and how they interact with other molecules.

5.2j Biological research generates knowledge used to design ways of diagnosing, preventing, treating, controlling, or curing diseases of plants and animals.

### **Chapter 14 Human Heredity**

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14.1 Human Chromosomes Pages 334-338

**Workbook B:** Chapter 14 Human Chromosomes Pages 206-209

2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

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3.1g Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

2.1f In all organisms, the coded instructions for specifying the characteristics of the

14.2 Human Genetic Disorders Pages 339-341

**Workbook B:** Chapter 14 Human Genetic Disorders 210-212

14.3 Studying the Human Genome Pages 342-346

organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular bases) and replicated by means of a template.

2.2c Different enzymes can be used to cut, copy, and move segments of DNA. Characteristics produced by the segments of DNA may be expressed when these segments are inserted into new organisms, such as bacteria.

2.2e Knowledge of genetics is making possible new fields of health care; for example, finding genes which may have mutations that can cause disease will aid in the development of preventive measures to fight disease. Substances, such as hormones and enzymes, from genetically engineered organisms may reduce the cost and side effects of replacing missing body chemicals.

7.1a The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources and deplete those resources that cannot be renewed.

**Workbook B:** Chapter 14 Studying the Human Genome 213-214

7.1b Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental.

**Chapter 15 Genetic Engineering**

2.2a For thousands of years new varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.

2.2b In recent years new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to produce new characteristics.

3.1b New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.

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**Workbook B:** Chapter 15 Chapter Summary Page 218

15.1 Selective Breeding Pages 354-356

**Workbook B:** Chapter 15 Selective Breeding Pages 219-220

3.1d Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

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15.2 Recombinant DNA Pages 357-361

**Workbook B:** Chapter 15 Recombinant DNA Pages 221-224

new organisms, such as bacteria.

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4.1b Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.

6.2b Biodiversity also ensures the availability of a rich variety of genetic material that may lead to future agricultural or medical discoveries with significant value to humankind. As diversity is lost, potential sources of these materials may be lost with it.

2.1k The many body cells in an individual can be very different from one another, even though they are all descended from a single cell and thus have essentially identical genetic instructions. This is because different parts of these instructions are used in different types of cells, and are influenced by the cell's environment and past history.

15.3 Applications of Genetic Engineering Pages 362-366

**Workbook B:** Chapter 15 Applications of Genetic Engineering Pages 221-224

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7.3a Societies must decide on proposals which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs,

15.4 Ethics and Impacts of Biotechnology Pages 367-370

**Workbook B:** Chapter 15 Ethics and Impacts of Biotechnology Pages 230-232

benefits, and trade-offs.

7.3b The decisions of one generation both provide and limit the range of possibilities open to the next generation.

5.2h Disease may also be caused by inheritance, toxic substances, poor nutrition, organ malfunction, and some personal behavior. Some effects show up right away; others may not show up for many years.