North Carolina Essential Standards Correlation Chart

Structure and Functions of Living Organisms		
Essential Standard	**Clarifying Objectives**	**COACH Lesson(s)**
Bio.1.1 Understand the relationship between the structures and functions of cells and their organelles.	Bio.1.1.1 Summarize the structure and function of organelles in eukaryotic cells (including: the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and ways that these organelles interact with each other to perform the function of the cell.	1, 2, 8; Inv. 1
	Bio.1.1.2 Compare prokaryotic and eukaryotic cells in terms of their general structures (plasma membrane and genetic material) and degree of complexity.	1, 8; Inv. 1
	Bio.1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms.	6
Bio.1.2 Analyze the cell as a living system.	Bio.1.2.1 Explain how homeostasis is maintained in the cell and within an organism in various environments (including: temperature and pH).	2
	Bio.1.2.2 Analyze how cells grow and reproduce in terms of interphase, mitosis and cytokinesis.	5
	Bio.1.2.3 Explain how specific cell adaptations help cells survive in particular environments (focus on unicellular organisms).	8, Inv. 2
Ecosystems		
Essential Standard	**Clarifying Objectives**	**COACH Lesson(s)**
Bio.2.1 Analyze the interdependence of living organisms within their environments.	Bio.2.1.1 Analyze the flow of energy and cycling of matter (water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.	14, 15, 18
	Bio.2.1.2 Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations.	9–13, Inv. 2

Ecosystems *(cont.)*			
Essential Standard		**Clarifying Objectives**	**COACH Lesson(s)**
Bio.2.1 *(cont.)*	Bio.2.1.3	Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.	16, 17
	Bio.2.1.4	Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease).	17
Bio.2.2 Understand the impact of human activities on the environment (one generation affects the next).	Bio.2.2.1	Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.	18
	Bio.2.2.2	Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.	18, 19
Evolution & Genetics			
Essential Standard		**Clarifying Objectives**	**COACH Lesson(s)**
Bio.3.1 Explain how traits are determined by the structure and function of DNA.	Bio.3.1.1	Explain the double-stranded, complementary nature of DNA as related to its function in the cell.	20, 21
	Bio.3.1.2	Explain how DNA and RNA code for proteins and determine traits.	21
	Bio.3.1.3	Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype.	24
Bio.3.2 Understand how the environment, and/or the interaction of alleles, influences the expression of genetic traits.	Bio.3.2.1	Explain the role of meiosis in sexual reproduction and genetic variation.	23
	Bio.3.2.2	Predict offspring ratios based on a variety of inheritance patterns (including: dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).	22, 25
	Bio.3.2.3	Explain how the environment can influence the expression of genetic traits.	25

Evolution & Genetics *(cont.)*		
Essential Standard	**Clarifying Objectives**	**COACH Lesson(s)**
Bio.3.3 Understand the application of DNA technology.	Bio.3.3.1 Interpret how DNA is used for comparison and identification of organisms.	26
	Bio.3.3.2 Summarize how transgenic organisms are engineered to benefit society.	26
	Bio.3.3.3 Evaluate some of the ethical issues surrounding the use of DNA technology (including: cloning, genetically modified organisms, stem cell research, and Human Genome Project).	26
Bio.3.4 Explain the theory of evolution by natural selection as a mechanism for how species change over time.	Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.	27, 29
	Bio.3.4.2 Explain how natural selection influences the changes in species over time.	28
	Bio.3.4.3 Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.	28
Bio 3.5 Analyze how classification systems are developed based upon speciation.	Bio.3.5.1 Explain the historical development and changing nature of classification systems.	30
	Bio.3.5.2 Analyze the classification of organisms according to their evolutionary relationships (including: dichotomous keys and phylogenetic trees).	30
Molecular Biology		
Essential Standard	**Clarifying Objectives**	**COACH Lesson(s)**
Bio.4.1 Understand how biological molecules are essential to the survival of living organisms.	Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.	3
	Bio.4.1.2 Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.	20, 21
	Bio.4.1.3 Explain how enzymes act as catalysts for biological reactions.	4
Bio 4.2 Analyze the relationships between biochemical processes and energy use in the cell.	Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems.	7
	Bio.4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).	2, 14

Answer Keys

Chapter 1

Lesson 1

Discussion Question

Possible answer: All three types of cells have cytoplasm, a plasma membrane, and ribosomes. These three features, along with genetic material, are the minimum needed to sustain life and reproduce.

Lesson Review

1. D
2. D
3. C
4. Possible response: The folded inner membrane of the mitochondrion increases the surface area available for the release of energy during cellular respiration.

Lesson 2

Focus on Inquiry

Students should observe that the potato cube in tap water swells and the cube in sugar water shrinks. For the cube in tap water, students should infer that the concentration of starch (solute) is higher inside the potato cells than outside. Water moves into the cells by osmosis to equalize the concentration. For the cube in sugar water, students should infer that the concentration of sugar is lower inside the potato cells than outside. Water moves out of the cells by osmosis to equalize the concentration. Students should predict that if the potato cubes are swapped, the shriveled cube will expand and the swollen cube will contract. Again, water will move by osmosis to equalize the concentration. If time allows, have students test their predictions.

Lesson Review

1. A
2. B
3. B

Lesson 3

Discussion Question

Possible responses: Students should give examples such as potatoes, bread, cereal, and fruit for carbohydrates. They may distinguish starchy foods from sugary ones such as maple syrup and most fruits. All these foods come from plants. Foods with large amounts of lipids include bacon and some other meats, butter, ice cream, olives, and foods cooked in oil. Fats generally come from animals. Oils, such as olive and peanut oil, come from plants. Foods with large amounts of protein include meat, fish, cheese, eggs, nuts, and soybeans. Many protein-rich foods come from animals, but some come from plants. Students may notice that plant proteins tend to come from seeds, such as beans and nuts, rather than from other vegetables. Accept any reasonable answers.

Lesson Review

1. C
2. B
3. B

Lesson 4

Focus on Inquiry

Possible answers: For phenylketonuria (PKU): Untreated PKU can cause seizures, mental retardation, and other neurological problems. Students may give different specific symptoms. PKU results from a deficiency of phenylalanine hydroxylase (PAH). This enzyme's job is to convert the amino acid phenylalanine into another amino acid, tyrosine. PKU is treated with a special diet, which is low in protein. This diet also includes supplements of the amino acid tyrosine.

For Pompe disease: The symptoms include an enlarged heart and liver, muscle weakness, and breathing problems. Pompe disease is caused by a deficiency of the enzyme alpha-glucosidase (also called acid maltase). This enzyme helps break down glycogen, which is stored in the muscles of the body. Without this enzyme, excess glycogen causes muscle weakness. A child born with the disease suffers from weakness, enlarged liver, and breathing problems. Children with the infantile-onset form usually die from heart failure within the first year of life if the disease is not treated.

In older children and adults, Pompe disease is often less severe, but it can affect the muscles that control breathing. The disease can be treated with drugs that replace the missing enzyme.

Lesson Review

1. D
2. C
3. C

Lesson 5

Discussion Question

One set of chromosomes: G_1, cytokinesis; two sets of chromosomes: S, G_2, prophase, metaphase, anaphase, telophase

Lesson Review

1. B
2. C
3. A

Lesson 6

Discussion Question

Embryonic stem cells and adult stem cells are similar in that both have the capacity to differentiate into one or more types of specialized cells. The cells differ in that embryonic stem cells are found only in embryos and are capable

of dividing and differentiating to produce nearly any type of cell found in an organism. By contrast, adult stem cells are present only in mature organisms and typically produce only cells that the organism needs for growth and repair.

Lesson Review

1. C
2. A
3. B

Lesson 7

Discussion Question

The can swells and the dough rises because these organisms release a gas as a by-product of fermentation. The gas is carbon dioxide, the same gas produced by aerobic respiration. This discussion question can be used as a springboard to additional discussion of the process of alcohol fermentation.

Lesson Review

1. C
2. A
3. B
4. Aerobic respiration is the breakdown of sugars to release energy with the use of oxygen. Aerobic respiration begins in the cytoplasm and is completed in the mitochondria. By contrast, anaerobic respiration releases energy in the absence of oxygen. It occurs completely within the cytoplasm. Students may also indicate that aerobic respiration is more efficient than anaerobic respiration.

Chapter 1 Review

1. A 4.1.1
2. C 1.2.1
3. B 1.2.2
4. A 1.1.1
5. B 1.1.3
6. Cellular respiration is the process by which organisms use oxygen to break down food to release energy. During cellular respiration, oxygen combines with sugar, releasing carbon dioxide and water. The reaction also releases energy in the form of ATP. Photosynthesis is the process by which plants and some other organisms make food in the form of glucose. During photosynthesis, carbon dioxide and water (the products of cellular respiration) are joined together using light energy from the sun. The process forms glucose and oxygen (the reactants of cellular respiration). In the process, the energy of sunlight is converted into chemical energy, which is stored in glucose. 4.2.1
7. C 4.1.3
8. C 4.1.1
9. A 1.2.1
10. C 1.1.1
11. Correct responses will probably include two of the following similarities and differences. Similarities: Both types of cell are capable of carrying out all the processes that keep the cell alive; both types of cells contain ribosomes; both types of cells contain both DNA and RNA; both types of cells have plasma membranes. Differences: Prokaryotic cells are usually smaller than eukaryotic cells; prokaryotic cells lack the nucleus and membrane-bound organelles present in eukaryotic cells; eukaryotic cells have chromosomes, and most of the DNA in a prokaryotic cell is found in a single tangle; prokaryotic cells tend to be less complex than eukaryotic cells. 1.1.2
12. D 4.1.3
13. D 4.2.1
14. During the growth 1, or G_1, stage of the cell cycle, the cell is taking in nutrients and growing. During the synthesis, or S, stage, the cell prepares for cell division by copying its chromosomes. During the growth 2, or G_2, stage, the cell continues to get ready for cell division by making more cytoplasm and copies of cell organelles. The cell then enters the M stage, during which the duplicate chromosomes formed in the S stage are separated into two complete sets of chromosomes and a new nuclear membrane forms around each set. Finally, during cytokinesis, the cell finishes dividing as the plasma membrane pinches in to divide the parent cell into two identical daughter cells. 1.2.2
15. D 1.1.3

Chapter 2

Lesson 8

Focus on Inquiry

Students can make their own slides for this project, work with commercially prepared slides of protists, or both. If they make their own slides, remind them of safety precautions.

Student sketches should show what the students actually saw. In most cases, sketches made with the low-power objective will reveal the rough shape of the

organism observed, and its plasma membrane and cytoplasm. The pseudopods of an amoeba will be visible. The cilia of a paramecium may be observed around the organism but will likely not be visible in detail. For a euglena, the general shape and possibly a nucleus will be detectable, but students will see few other details of the cell.

Under the high-power objective, students may be able to see the nucleus of an amoeba, and the cilia of the paramecium will be more visible, although not in great detail. The nucleus and cytoplasm of a euglena will be detectable, but its flagellum will not be clearly visible.

If a student's drawings do not reflect the details described above, discuss possible reasons why.

Depending on what is shown, the microscope may not have been focused properly, or the preparation of the slide may have been flawed. You may also wish to use students' observations to discuss how stains can be used to make some structures of organisms easier to observe.

Lesson Review

1. B
2. A
3. A
4. D

Lesson 9

Focus on Inquiry

Student models will vary depending upon which transport system they select and which materials they choose. Encourage students to be creative in their designs and to evaluate how well their models represent the systems they are designed to demonstrate. For example, if they model a closed circulatory system, their models should keep the fluid within structures that resemble vessels. By contrast, a model representing an open circulatory system should accurately show that fluid is not contained within vessels but able to move freely among the internal structures of the organism in response to movements of the organism.

If practical, have students construct their models, or select certain designs for construction.

Lesson Review

1. D
2. B
3. C
4. Possible answer: Both the vascular system of plants and the vertebrate circulatory system include a network of vessels that transport fluid and materials throughout the organism. In addition, both systems have vessels that are specialized for transporting certain types of materials in a specific direction within the organism. A key difference between the two systems is that the vertebrate circulatory system transports materials in blood, while the plant vascular system transports materials primarily in water.

Lesson 10

Discussion Question

Earthworms are land-dwelling animals that exchange gases with the air through their skin. They lack structures for gas exchange in water. During periods of heavy rain, the soil may become saturated with water. Earthworms must therefore come to the surface of the ground to be in contact with the air and avoid suffocation.

Lesson Review

1. C
2. C
3. A
4. D

Lesson 11

Focus on Inquiry

Students' completed diagrams should correctly show which organs are found in both humans and earthworms (mouth, pharynx, esophagus, intestine, rectum), which are found only in humans (stomach, liver, pancreas), and which are found only in earthworms (crop, gizzard). Students may note that the human intestine is divided into upper and lower. They may also note that both humans and earthworms carry out mechanical and chemical digestion.

You can extend this Focus on Inquiry feature by presenting a diagram of the digestive system of a cow (or other ruminant) or a chicken, and having students do a three-way comparison.

Lesson Review

1. B
2. D
3. D
4. A

Lesson 12

Discussion Question

Possible answer: The ability to reproduce by fragmentation may help an earthworm survive if the earthworm is broken into pieces, such as when a bird or other predator takes in only part of the earthworm. The remaining part can then regrow to form a complete new organism. Earthworms that are broken into pieces by a gardener may also be able to grow into new organisms that can later reproduce to ensure the survival of the species.

Lesson Review

1. B
2. D
3. A hard outer shell helps prevent an egg laid by a land animal from drying out.

A shell also helps protect the embryo from other harmful environmental conditions and from predators.

Lesson 13

Discussion Question

Through habituation, an animal learns to filter the sensory information that surrounds it. By learning to ignore less important or harmless stimuli, the animal can focus on important features of its environment, including potential threats.

Lesson Review

1. D
2. B
3. C
4. D

Chapter 2 Review

1. A 2.1.2
2. C 2.1.2
3. D 2.1.2
4. A closed circulatory system is made up of a network of interconnected tubes that carry the fluid used for the transport of materials throughout the organism. The fluid within these tubes, usually blood, does not leave the tubes. Instead, materials are exchanged between the fluid and cells by diffusion. All vertebrates and some invertebrates, such as earthworms and squids, have a closed circulatory system. An open circulatory system lacks vessels for the transport of materials. Instead, a fluid fills the organism's body cavity and is in direct contact with the organism's cells and tissues. Arthropods and most mollusks have open circulatory systems. 2.1.2
5. C 1.2.3
6. B 2.1.2
7. The euglena moving toward light and the bird flying north are examples of instinctive (unlearned) behaviors. (Students may identify one as a taxis and the other as migration.) Organisms are born with the ability to carry out these behaviors. The deer ignoring humans and the dog salivating are examples of learned behavior. (Students may specify that one is habituation and the other is the result of classical conditioning.) Organisms are not born with these behaviors. Instead, they develop these behaviors through experience. 2.1.2
8. C 2.1.2
9. D 1.2.3
10. C 2.1.2
11. The cell on the left is a prokaryotic cell. The indicator for this is that it lacks a nucleus or other membrane-bound organelles. The cell on the right is a eukaryotic cell, which is shown by its clear nucleus and other membrane-bound structures. Characteristics shared by both cells are cytoplasm, a plasma membrane, DNA, and a flagellum that can be used for movement. 1.1.1, 1.2.1
12. C 2.1.2
13. A 2.1.2
14. D 1.1.2

Chapter 3

Lesson 14

Focus on Inquiry

Student energy pyramids should match the following description: Grasses are in the first trophic level, mice are in the second trophic level, snakes are in the third trophic level, and hawks are in the fourth trophic level. To determine the amount of energy passed from one trophic level to the next, students should multiply by 10%. 125,000 Kcal of energy is available at the first trophic level, 12,500 Kcal is available at the second, 1,250 Kcal is available at the third, and 125 Kcal is available at the fourth.

Students should indicate that to include the bacteria, they would need to add a level at the top of the pyramid that shows bacteria. The amount of energy available at the level of the bacteria would be 12.5 Kcal (10 percent of the 125 Kcal available at the fourth trophic level occupied by the hawks). However, point out that some organisms at each trophic level would die before being consumed. The remains of these organisms would become sources of energy for decomposers. Decomposers would also feed on the wastes of living organisms at each trophic level.

Lesson Review

1. D
2. C
3. Many answers are possible. All correct answers should begin with producers (grasses, plants) and end with decomposers (fungi or bacteria). Accept all correct responses. Some possible answers include:

plants → fungi

grasses/plants → grasshoppers → bacteria

grasses → grasshoppers → small birds → bacteria

plants → grasshoppers → small birds → foxes → bacteria

grasses/plants → rabbits → hawks → bacteria

Lesson 15

Discussion Question

Possible answers: An increase in respiration would release more carbon dioxide into the atmosphere and remove more oxygen from it. A decrease in photosynthesis would decrease both the amount of carbon dioxide removed from the atmosphere and the amount of oxygen released into it. Burning more fossil fuels would release more stored carbon into the atmosphere and remove more oxygen from the atmosphere. All three of these changes would have the same effect: there would be more carbon dioxide and less oxygen in the atmosphere.

Lesson Review

1. D
2. C
3. A
4. Possible answers: Humans are a part of the carbon-oxygen cycle because they carry out cellular respiration. In addition, carbon and oxygen are components of macromolecules, such as proteins, carbohydrates, and lipids, that are used to make various tissues in the body. Humans also contribute to this cycle by burning fossil fuels. Humans are part of the nitrogen cycle because they store nitrogen in their bodies, particularly in the form of proteins. Humans are part of the water cycle because much of the human body is composed of water. Humans need water in order to live. Water is released from the body as a by-product of respiration as well as through perspiration and urination.

Lesson 16

Focus on Inquiry

Student graphs should show the cyclical relationship between predator and prey populations. Keys should indicate different colors or kinds of lines for the arctic seal and polar bear populations. Students may use the key to label one line as "Arctic Seals (× 10)," or put the scale information on the *y*-axis, or show a second scale at the right-hand side of the graph.

Answers will vary. Possible answers:

Population size range of arctic seal: about 500–700. Range of polar bear: about 20–30.

If nothing changed, the line for polar bears would most likely trend downward, while the line for arctic seals would trend upward. If the fish population decreased, both the seal and the bear populations would decrease. They would continue to cycle together at much lower population levels.

If a disease killed half of the bears and seals, both populations would fall at month 13. Both populations would then begin to grow. In the long term, they would stabilize, and the cycling would occur at the previous levels.

Lesson Review

1. D
2. A
3. C
4. B

Lesson 17

Discussion Question

Answers will vary. Possible answers: If a volcanic eruption destroyed part of a habitat, there would be less room for all the organisms in that habitat. A long-term drought could kill many plants, and less food would be available for animals. That would reduce the ecosystem's carrying capacity for most organisms. A change in climate might affect some populations but not others. For example, hotter summers might harm some plants. The carrying capacity for those plants, and for the animals that eat them, would decrease. The carrying capacity for other plants and animals might not be affected. The carrying capacity for plants that thrive in hot weather might increase because they would have less competition for nutrients and living space.

Lesson Review

1. C
2. D
3. A

Lesson 18

Focus on Inquiry

Responses will vary depending upon the species researched. Some invasive species students may include in their presentations are the fungus that causes Dutch elm disease, the shrub known as beach vitex, and insects such as fire ants and the ambrosia beetle. You can use this project as practice in either science writing or oral presentations.

Lesson Review

1. A
2. B
3. A
4. D

Lesson 19

Discussion Question

Responses will vary. Likely responses will include that students play a role in recycling some materials, such as glass, plastic, and aluminum cans, in the home. Students may indicate that they use mass transit, ride a bicycle, or walk when possible rather than ride in a car. They may suggest reusing plastic bags or taking a reusable cloth bag to the store when buying groceries. Accept all reasonable responses.

Lesson Review

1. D
2. A
3. C
4. Possible answer: The clippings can be added to soil to nourish it. Another way to nourish soil is to add other kinds of organic matter, such as manure. Students may also suggest planting cover crops that add nutrients to soil.

Chapter 3 Review

1. A 2.1.3
2. The graphs show that when two populations compete for the same limited resource, an increase in the size of one population will result in a decrease in the size of the other because there will not be enough resources available to support the growth of both populations. By contrast, if two populations living in the same ecosystem are not in competition with each other for a limited resource, population sizes will increase or decrease independently of each other. 2.1.4
3. C 2.2.1
4. A 2.1.1
5. A 2.1.3
6. Answers will vary. Sample responses might include using less paper by storing information in a computer rather than on paper, riding a bike or walking instead of relying on a car, and reusing containers rather than discarding them and buying new ones. 2.2.2
7. B 2.2.1
8. D 2.1.4
9. C 2.1.1
10. A 2.2.1
11. A 2.2.2
12. C 2.2.2
13. B 2.1.4
14. B 2.1.3
15. Within most ecosystems, energy flows from the sun to producers, which use the light energy to make food in the form of glucose. In this process, the light energy is converted to chemical energy, which is stored in the glucose. The chemical energy is passed to consumers that feed on producers, which in turn pass some of the chemical energy on to consumers or decomposers that feed at higher trophic levels. In this process, some of the energy is released to the environment as heat. 2.1.1

Chapter 4

Lesson 20

Discussion Question

Possible answer: A few letters can be arranged to form many different words. Even though each nucleotide contains one of only four possible bases, a chromosome contains thousands of genes, each of which consists of many nucleotides. With four possible bases, two nucleotides can be arranged in 4×4 or 16 possible ways. Three nucleotides can be arranged in $4 \times 4 \times 4$ or 64 ways. As the number of nucleotides increases, the number of possible combinations increases. Because each chromosome contains thousands of nucleotides, the number of possible arrangements is huge. Each arrangement is like a different word or sentence. Students may point out that all the words in English can be spelled with only 26 letters or that computers use only 1s and 0s to store huge amounts of information.

Lesson Review

1. B
2. C
3. D
4. The complementary strand will be TTCAAGCAGTAG.

   First, the DNA molecule separates at the nucleotide bases to form two strands. Next, new nucleotides pair up with the bases along each strand. Adenine pairs with thymine and guanine with cytosine. The new nucleotides join together to form complementary strands that are connected to the original strands. When this process is complete, two identical new DNA molecules have formed.

Lesson 21

Discussion Question

Possible answer: They are all single-stranded molecules composed of the same four nucleotides: uracil, adenine, guanine, and cytosine. The several types of RNA differ mainly in function and in what part of the cell they are found. For example, mRNA is made in the nucleus and travels into the cytoplasm, while tRNA is found only in the cytoplasm.

Lesson Review

1. B
2. B
3. C
4. A
5. serine, lysine, valine, glutamine

Lesson 22

Focus on Inquiry

	C^W	C^W
C^R	C^RC^W	C^RC^W
C^R	C^RC^W	C^RC^W

Based on the information given, the hybrid offspring could have either pink flowers or mixed red-and-white flowers. Students should identify that all the offspring will have the same hybrid phenotype, not pure white or pure red flowers.

Possible answers: Carrying out the experiment would show whether the alleles for this trait exhibit codominance or incomplete dominance, or what color flowers the C^RC^W genotype produces.

	C^R	C^W
C^R	C^RC^R	C^RC^W
C^W	C^RC^W	C^WC^W

Phenotypic ratio: 25% red flowers, 50% mixed (pink or red-and-white) flowers, 25% white flowers

Some of the offspring of a cross between a red and a hybrid plant would have red flowers, and some would have mixed (pink or red-and-white) flowers.

Lesson Review

1. B
2. C
3. A
4. 75% white fur, 25% black fur

Lesson 23

Discussion Question

Possible responses: Genetic variation can be a disadvantage if it gives an organism a trait that make it less able to survive in its environment, if it causes the organism to lose a useful trait, or if it results in a genetic disorder or disease.

Lesson Review

1. C
2. D
3. A
4. C, because the nuclei have half as many chromosomes as the nuclei in the other diagrams.

Lesson 24

Discussion Question

Possible answers: A color-blind person might not be able to tell when a piece of fruit was ripe and would not cause stomach pains. Color blindness might even make it hard for someone to find enough good food to eat. A color-blind driver might have trouble identifying a red light. Some snakes have bright colors indicating that they are venomous, and a color-blind person might come too close to one of those snakes by mistake. Students may also suggest that a color-blind person would be less likely to be distracted by certain brightly colored objects or would not be fooled by green jungle camouflage, which might help the person avoid an attack. Accept all reasonable answers.

Lesson Review

1. C
2. B
3. C
4. D
5. B

Lesson 25

Focus on Inquiry

Student pedigrees: The first row should have a half-shaded square and a half-shaded circle. Each should be labeled *Aa*. The second row should have a shaded square labeled *aa*, two unshaded squares labeled with question marks, and a half-shaded square labeled *Aa*. The third row should have two shaded circles. Each should be labeled *aa*.

Possible answer: Hypothesis: Albinism is recessive. This is based on the information that two parents without albinism had one child who had the trait. The pedigree supports this. It shows that carriers of the allele who did not express the trait had children who did express it. The unknown genotypes could be *AA* or *Aa*. *Aa* is more likely. A Punnett square shows that two parents with the genotype *Aa* have a 50% chance of producing children with the genotype *Aa* but only a 25% chance of producing children with the genotype *AA*.

Lesson Review

1. C
2. B
3. C

Lesson 26

Focus on Inquiry

Possible answers: People sometimes die of severe burns because transplanted skin may be rejected. Stem cells would be less likely to be rejected. This could also mean that patients would not need to take drugs to prevent transplant rejection. Skin transplants from stem cells could be less painful than skin grafts taken from the patient's own body because the skin would not have to first be removed. Students may also suggest that stem cells could be used to remove scars by growing new skin.

Factors that might slow or stop the acceptance of this technology include difficulties in developing it, ethical concerns among patients or regulators, the possibility that another burn treatment, such as a new drug, could be developed first, and the potential cost of the new technique. Accept all reasonable suggestions.

Lesson Review

1. C
2. B

3. Possible answers: The Human Genome Project made it possible to identify which genes carry certain genetic conditions and to determine whether an individual carries those genes. People can use this information in deciding whether to have children. Knowledge resulting from the Human Genome Project may be useful in the development of gene therapy. It may also be useful in developing drugs for treating inherited diseases.

Chapter 4 Review

1. D 3.3.2
2. A 3.2.2
3. C 3.2.1
4. D 3.2.3
5. The first stage of meiosis, called meiosis I, is nearly identical to mitosis. Both processes begin with a single cell that has a diploid number of chromosomes and end with two daughter cells that also have a diploid number of chromosomes. Meiosis differs from mitosis in that the cells formed by meiosis I divide a second time without first duplicating their chromosomes. This second cell division reduces each daughter cell's chromosome number by half, producing four haploid daughter cells known as gametes.
   3.2.1
6. B 3.3.3
7. D 4.1.2
8. D 3.3.1
9. C 3.1.2
10. A 3.3.2
11. Possible responses: Skin cancer is linked to overexposure to UV rays. The disease has a genetic component in that people who inherit traits for fair skin color and light-colored eyes or hair tend to be at higher risk for the disease. Type 2 diabetes and heart disease seem to run in families and have a genetic component. Environmental factors that play a role in development of these diseases include poor eating habits and a sedentary lifestyle that lead to obesity.
    3.2.3
12. B 3.1.1
13. A 3.3.3
14. B 3.1.1
15. D 4.1.2
16. D 3.1.2
17. A 3.3.1
18. Phenotypic ratio: 50% *Dd* and 50% *dd*

    Genotypic ratio: 50% with dimples and 50% without dimples
    3.2.2

Chapter 5

Lesson 27

Discussion Question

Possible responses: The emergence of land plants added more oxygen to Earth's atmosphere, making oxygen more available to other organisms. Once land plants evolved, animals could also move onto land because the plants provided them with a food source.

Lesson Review

1. C
2. C
3. B
4. B

Lesson 28

Discussion Question

Possible answer: Thick fur helps animals retain body heat and keeps them warm. This is a useful trait for animals that live in cold areas, such as polar bears. However, the same trait might make animals in a warm ecosystem overheat. If the animals' environment grew warmer, thinner fur would be selected for. Over time, fewer and fewer animals would have thick fur. Encourage students to discuss a variety of traits and environments.

Lesson Review

1. C
2. B
3. B
4. A

Lesson 29

Discussion Question

Answers will vary. Possible answer: Two species might have analogous structures that look similar because they are used for similar purposes. For example, a bird's wing and a bat's wing both contain bones. However, the common ancestor of bats and birds did not have wings. Wings evolved separately in bats and birds. Comparisons of other body structures can help show these differences. For example, bats do not have feathers, but birds do. Scientists can also use the fossil record to check their conclusions. Birds and bats have different nonflying ancestors, which suggests that the wings of these organisms evolved separately.

Note: The wings of bats and birds can be considered homologous in the same way that a bird's wing is homologous to the human arm. However, the bat's and the bird's bones differ in shape, as do the bones in a bird's wing and the bones in a human arm. The structures show a very distant shared ancestor, not that the ancestor could fly.

Lesson Review

1. D
2. A

3. Possible response: Based upon the data available, scientists might infer that *Ichthyostega* is a transitional organism between fish and amphibians.

Lesson 30

Focus on Inquiry

Possible answer: The proposed classification of wolves and dogs as a single species suggests that these two animals are able to interbreed and produce fertile offspring.

It makes sense that fungi were removed from the plant kingdom because they have many characteristics that are not shared by plants. For example, some fungi are unicellular, while plants are all multicellular. Fungi do not have chloroplasts and cannot make their own food via photosynthesis, as plants do. Students many also note that the cell walls of fungi and the cell walls of plants are made of different materials.

Students may say that the reasons are the same because both reclassifications are based on grouping organisms according to how closely they are related. Or students may say that dogs are not being reclassified because of new information—wolf-dog hybrids are not new. Scientists are suggesting this change because they think the ability to interbreed is more important than differences in body shape and behavior. By contrast, the change in how fungi are classified is based mostly on new discoveries about fungi.

Lesson Review

1. D
2. B
3. C
4. The fact that all these animals have a similar bone is evidence that they are descended from a common ancestor that had a humerus in each forelimb.

Chapter 5 Review

1. B 3.5.1
2. D 3.4.3
3. A 3.5.2
4. A 3.4.1
5. It is likely that the bacteria will evolve so that all members of future populations will be resistant to the antibiotic. This will occur because the bacteria that survived the antibiotic are very likely to pass the trait for antibiotic resistance to their offspring. These offspring, in turn, will pass the genes for resistance to their offspring. Because bacteria reproduce rapidly through asexual reproduction, barring a mutation, all bacteria descended from the original resistant population are likely to show the trait for antibiotic resistance.
   3.4.3
6. A 3.4.2
7. B 3.4.1
8. Today's classification system attempts to group organisms according to their evolutionary relationships or how closely related they are. Modern classification is based on information about an organism's structure, its development as an embryo, its chemical makeup and processes, and its DNA.
   3.5.1
9. B 3.5.2
10. B 3.4.2

Investigation 1

This investigation relates directly to Lesson 1, "Cell Structure," and Lesson 2, "Homeostasis and Cell Transport." This investigation may be integrated with Lesson 2 or presented as a stand-alone activity.

Question and Hypothesis

Questions and hypotheses will vary but should relate to the effect each solution will have on the cell. Hypotheses should reflect students' understanding of hypotonic, hypertonic, and isotonic solutions, as described in Lesson 2. However, it is not necessary for them to use those terms in stating their hypotheses.

Materials

Students should list all the materials they used in this investigation.

Procedure

Students should accurately describe the procedures they followed. In most cases, the procedure will closely resemble the steps given in the instructions.

Observations and Data

Check students' data to be sure that the magnification used to examine each cell is included in the data. Individual drawings will vary; however, the following trends should be apparent.

Onion cells in plain water: The cell wall, nucleus, and vacuole are likely visible under low and high power when the cell is in water. The cytoplasm completely fills the cell, exerting pressure on the cell wall. It is unlikely that the cell membrane can be clearly distinguished from the cell wall.

Onion cells in salt water: After the salt water is added, water begins moving out of the cell by osmosis. This causes the cell contents to shrink and the cell membrane to become clearly visible as it collapses inward. The cell wall, nucleus, and vacuole are likely to be easily visible.

Onion cells in sugar water: The cell wall, nucleus, and vacuole are likely visible under low and high

power when the cell is in sugar water. Internal cell structures will appear larger or more spread out than they do in an onion cell in salt water.

Conclusion

When placed in water, the onion cells become slightly larger, indicating that they are taking in water because water is a hypotonic solution. The onion cells in salt water are in a hypertonic solution. In this type of solution, water flows out of the cells, causing the cells to shrink and the cell membranes and cell walls to look wilted. Sugar water is an isotonic solution. Water moves neither into nor out of the cells, or does so in very small amounts, causing little change in the size or appearance of the cells. Conclusions should state whether students' observations supported their hypotheses.

Investigation 2

This investigation relates directly to Lesson 13, "Behavioral Adaptations," and less directly to information presented in Lesson 8, "Single-Celled Organisms."Cultures of planarians are readily available at most biological supply houses.

Hypotheses

Hypotheses will vary but should relate to how planarians respond to light and chemicals (acid) in their environment.

Materials

Students should list all the materials they use in this investigation: planarian culture, six petri dishes, hand lens, two sheets of black construction paper, lamp, scissors, vinegar, dropper, and a marker.

Procedure

Students should accurately describe the procedures they followed. In most cases, the procedure will closely resemble the steps given in the instructions.

Observations and Data

Observations may vary but will likely reflect the following trends:

Dishes A1, A2, B1, B2, C1, C2: The planarians generally drift in the dishes but may be most often observed near the edges of the dishes.

Dishes B1 and B2 half-covered with black paper: Students will likely observe that the planarians in each dish move toward the portion of the petri dish covered by the paper to avoid the light.

Dishes B1 and B2 exposed to the light of the lamp: The planarians will move away from the light, so they will likely move to the part of the petri dish covered by the black paper.

Dishes with drop of vinegar: Students will likely report that the planarians moved away from the vinegar. If the planarians were swimming around the edges of the petri dish, they swam away from the area where the vinegar was added.

Conclusions

Students should relate the movement of the planarians to taxes, specifically phototaxis and chemotaxis. Students are likely to conclude that planarians demonstrate negative phototaxis—that is, they move away from light. This may contradict the hypotheses of some students who predicted that because planarians have eyespots similar to those of a euglena, they would move toward light in the same way that a euglena does. Discuss with students the possible advantages of the type of phototaxis demonstrated by each organism in its environment.

Most students will likely hypothesize that planarians display negative chemotaxis because the environment in which they live is typically slightly basic. This hypothesis is likely to be supported by the data gathered during the investigation.

At the conclusion of the investigation, you may wish to point to this investigation as an example of a controlled experiment with multiple trials. Be sure students understand that the planarians in dishes A1 and A2 represented control groups because the organisms in these dishes were not exposed to any change in variables. Also point out that group B and group C represented different experimental groups because each was exposed to a change in a different variable.

NOTES