Tennessee Biology I
End of Course Assessment
Student Review Guide

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Preface

The ***Tennessee Biology I End of Course Assessment Student Review Guide*** is written to help students review the skills needed to pass the Biology I end-of-course test in Tennessee. This comprehensive guide is based on the Tennessee Framework of State Performance Indicators as published by the Tennessee Department of Education.

How To Use This Book

Students:

The Tennessee Biology I end-of-course (EOC) assessment will count 25% of your final grade for the Biology I course. The Tennessee Biology I EOC assessment contains a total of 60 multiple-choice questions. This book is a review for the Tennessee Biology I EOC assessment.

① Read the instructional material in this review book, do the practice exercises, and take the section review tests at the end of each section.

② After reviewing the material, take the two practice tests (provided as separate booklets). These practice tests are written to look similar to the actual Biology I end-of-course test, so they will give you practice in taking the test.

③ After taking Practice Test 1 and/or Practice Test 2, use the practice test evaluation charts, which are found directly after each practice test, to identify areas for further review and practice.

Teachers:

This review guide is also intended to save you, the teacher, time in the classroom. It can be used for classroom instruction or for individual student review. Since this student guide offers review for ALL of the Tennessee State Performance Indicators for the Biology I course, you, the teacher, have one consolidated resource of materials to help your students prepare for the end-of-course assessment.

① When teaching or tutoring individual students, use the strategy outlined above for students.

② For classroom study, use this guide to supplement lesson plans and to give additional review for skills required by the Biology I EOC. Purchase a class set of guides for use in the classroom or assign guides to students for out-of-classroom work.

③ Assign the practice tests (provided in separate booklets) as comprehensive review tests. Score the tests according to the scoring directions given on pages PT1-3 and PT2-3 of the testing booklets to approximate the scoring potential for the actual EOC assessment.

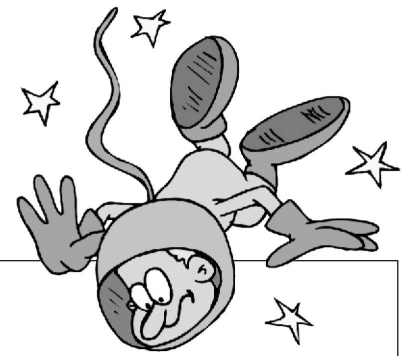
④ Use the practice test evaluation charts found after each practice test to identify areas needing further review.

⑤ To establish benchmarks, you may want to use one of the practice tests (provided in separate booklets) as a pre-test. Score the practice test according to the practice test scoring directions given on pages PT1-3 and PT2-3 of the testing booklets. Then after the students have completed all the exercises in this review guide, use the second practice test to gauge progress. You should see marked improvement between the initial and final benchmarks.

⑥ Please **DO NOT** photocopy materials from this guide or the practice test booklets. These materials are intended to be used as student workbooks, and individual pages should not be duplicated by any means without permission from the copyright holder. To purchase additional or specialized copies of sections in this book, please contact the publisher at 1-800-745-4706.

Laboratory Equipment and Procedures

Section 1.4
Mass and Weight Measurements



Pre-View 1.4

- **Gram** – the metric unit for mass
- **Mass** – the measure of how much matter is in an object
- **Newton** – the metric unit for force (and weight)
- **Spring scale** – equipment used to find force or weight
- **Triple beam balance** – a type of balance scale commonly used in high school laboratories
- **Weight** – the measurement of *force* exerted by gravity on an object

Measuring Mass

Mass is the measurement of how much matter is in an object, and it is measured in grams using a balance scale. The most common types of scale balances are the **triple beam balance** (figure 1-17) and the electronic balance (figure 1-18). Both types of balances measure mass in grams. The triple beam balance is commonly found in high school laboratories, but you may also have an electronic balance.

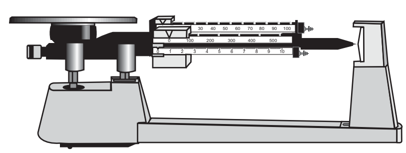


Fig. 1-17 Triple Beam Balance

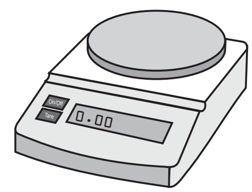


Fig. 1-18 Electronic Balance

Accuracy in Mass Measurements

To get an accurate mass using a triple beam balance, be sure the balance is calibrated correctly. As a quick check, the mass should be exactly zero when there is nothing in the pan.

Example: A laboratory technician tests the accuracy and precision of the two balances in her lab, a triple beam balance and an electronic balance. She uses a 5.0 gram mass to test each balance. In the chart below, she records the measurements of four trials for each balance.

	Trial 1	Trial 2	Trial 3	Trial 4
Triple beam balance:	4.9 g	4.8 g	5.1 g	5.0 g
Electronic balance:	4.4 g	4.3 g	4.4 g	4.4 g

Which balance is more accurate? Which is more precise? Which balance should be used for measuring small masses?

The actual mass is 5.0 grams, so the triple beam balance is more accurate than the electronic balance. The electronic balance is more precise because it consistently gives the same measurement, but its measurement is not as close to being correct. The technician should use the triple beam balance if she wants to accurately measure small masses. Remember, precision is only important once you know a measurement is accurate. Consistency (as indicated by precision) doesn't matter if the measurement is consistently wrong!

Scientific Investigations

Section 2.5
Determining Validity of Experiments

Pre-View 2.5

- **Conclusion** – the analysis of data in a scientific investigation that either supports or refutes the hypothesis
- **Scientifically valid** – a description of a scientific experiment, data, or conclusion that is relevant or meaningful
- **Technology** – new procedures or devices that use scientific advances or discoveries for practical purposes

In order for an experiment to be **scientifically valid**, it must give meaningful results. To get meaningful results, the experiment must be carefully designed, controlled, and performed. A **conclusion** is then made based on analyzing the data, which should either support or refute the hypothesis. Many things can affect the validity of an experiment and can make any conclusions drawn less valid. Look at some examples below.

Examples of Factors that Make an Experiment Less Scientifically Valid

- Using equipment that isn't calibrated; it gives inaccurate readings
- Using only one member in a test group instead of using multiple members per group
- Failing to have a control group
- Not controlling factors in an experiment that can affect the results and conclusions
- Making assumptions without sufficient data or failing to recognize alternative explanations
- Being unable to repeat an experiment to obtain the same results

Scientists make new discoveries every day. When these new discoveries are used for practical purposes, the new procedures or devices are called **technology**. New technologies often target specific audiences. For example, a new pharmaceutical drug for arthritis targets people who suffer from arthritis. The group of people who suffer from arthritis is the specific audience that this drug is designed to help. When scientists are designing experimental procedures to test new technologies, they are always mindful of the target audience, and the experiment must be designed so that it measures meaningful data. New technologies should also be carefully tested before they are made available to their intended audience.

Example 1: Fleas are often prevented from biting dogs by using a topical medication that is applied between the shoulder blades of the dog once a month. A pharmaceutical company develops an injection to prevent flea bites that can be given by a veterinarian once every six months. The scientists believe that the injection will be just as effective as preventing flea bites as the topical medication and will result in fewer side effects. What step should the scientists take next?

The next step is to test. The injection needs to be tested against the topical medication, so the scientists should design an experiment to perform such a test. One group of dogs should be given the topical medication, and another group of dogs should be given the injection. The scientists should then observe the effectiveness of each treatment and any side effects. Remember that extensive testing is always best before a new medication or technical device is distributed to its intended audience. Once the new flea injection is tested, it can then be made available to veterinarians for use on their clients' dogs.

Scientific Evaluation and Engineering

Section 4.3
The Engineering Design Process

- **Engineer** – a person who designs or builds new processes, structures, machines, etc.
- **Engineering design process** – the steps, similar to the scientific method, used in designing and implementing a new technology

As you have seen, scientists use a series of steps called the scientific method to ask questions, develop a hypothesis, design and perform an experiment, and analyze the resulting data. Similar to scientists, **engineers** are people who design new or better ways of doing things, build structures, or create new machines. Engineers also use a series of steps called the **engineering design process** when designing and implementing a new technology, whether it is a process, a structure, or some other invention. The general steps to this process are shown below.

Steps of the Engineering Design Process

Identify the Problem
Engineers start with a problem.
Who needs what, and why do they need it?
Research existing solutions. What improvements are needed?

↓

Specify Requirements
Based on the problem, what are key requirements for a new process or product? What features must be included?

↓

Brainstorm
Generate new ideas. Discuss and consider many different possible solutions, designs, or approaches.

↓

Evaluate the Ideas
Which solutions, designs, or approaches are the most promising?
What are the pros and cons of each promising idea?

↓

Select the Best Solution
After carefully analyzing each idea, which is the best?
Choose the best solution, design, or approach.

↓

Build a Model or Prototype
Build an operating version of the solution in order to test it.
The model or prototype answers the question, "Will it really work?"

↓

Test, Refine, Redesign
Use the model or prototype to test the solution. What changes need to be made? Refine or redesign based on the testing.

Practice 1

Match each of the following terms with its best definition.

________ 1. cellulose

________ 2. starch

________ 3. dehydration synthesis

________ 4. polysaccharide

________ 5. monosaccharide

________ 6. carbohydrate

A. a macromolecule made up of carbon, hydrogen, and oxygen

B. a polysaccharide made by plants to give structural support to cell walls

C. a complex carbohydrate such as starch

D. a simple sugar like glucose

E. another name for a condensation reaction in which monomers are combined to form a polymer

F. a polysaccharide made by plants to store energy

Identifying Carbohydrates

Most people have a general idea of whether a food contains sugar or starch based on its flavor and/or consistency. For instance, let's consider two foods that most people love, candy and french fries. Candy gives a sugar "rush" that many crave, and starchy french fries are often a first choice as a comfort food.

What about being able to detect the presence of sugars or starches in the laboratory where tasting is ALWAYS prohibited? Substances called **indicators** can be used to test for the presence of a variety of compounds or macromolecules, including sugars and starches. In the case of carbohydrates, Benedict's reagent detects sugars and Lugol's iodine solution detects starches each by changing color in the presence of a specific type of carbohydrate.

Benedict's Reagent — A Carbohydrate Test for Simple Sugars (Monosaccharides and Disaccharides)
Benedict's reagent is a clear blue solution that contains copper ions. When Benedict's reagent is added to a sample containing simple sugars, such as glucose or fructose, and then heated in a hot water bath, the copper sulfate in the solution forms a copper oxide precipitate. The color change ranges from green to yellow to orange to a brick-red depending on the concentration of glucose or fructose present in the sample. See figure 6-3. Complex carbohydrates, such as starches, DO NOT react positively with Benedict's reagent.

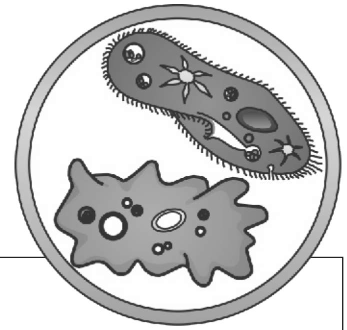
Range of Colors of Benedict's Reagent Testing Positive for Simple Sugars

Fig. 6-3

Lugol's (Iodine) Solution — A Carbohydrate Test for Starch (Polysaccharides)
Lugol's solution is a yellowish-brown indicator solution that contains iodine and water. When a sample containing starch contacts Lugol's solution, Lugol's solution changes to a bluish-black color. The color change is a result of the iodine in the solution staining the highly coiled structure of the polysaccharide. Disaccharides (such as table sugar) and monosaccharides (glucose or fructose) will not react with iodine in this manner, so no color change will be detected.

Cell Structure and Function

Section 7.3
Prokaryotic and Eukaryotic Cells



Pre-View 7.3

- **Bacteria** – living organisms made up of only one prokaryotic cell; singular is *bacterium*
- **Cell membrane** – a barrier that separates a cell from its surroundings
- **Cilia** – short, hairlike projections that some cells use for movement
- **DNA** – molecules in a cell that contain genetic information
- **Eukaryote** – any organism made up of eukaryotic cells; any organism other than bacteria
- **Eukaryotic cells** – cells that have a true nucleus and make up all other organisms other than bacteria
- **Flagella** – long, hairlike filament that some single-celled organisms use to propel themselves forward
- **Multicellular** – having many cells that work together to form an organism
- **Organelles** – structures within a cell that carry out specific functions
- **Prokaryote** – an organism made of a single cell that lacks a membrane-bound nucleus; a bacterium
- **Prokaryotic cells** – simple cells that do not have a nucleus; this type of cell is found in bacteria
- **Ribosome** – an organelle found in both prokaryotic and eukaryotic cells
- **Unicellular** – having only one single cell to form an organism; for example, bacteria are unicellular

Now let's look at different types of cells. As you've already seen, a cell is the smallest unit of life. It is the basic unit of structure of all living organisms. It is a collection of living and nonliving materials that is separated from its surroundings by a barrier called the **cell membrane**. Some organisms are made up of one single cell, so they are described as **unicellular**, which means "one cell." Other organisms are made up of many cells that work together and are called **multicellular**, which means "many cells."

Biologists classify cells into two main groups — prokaryotic cells and eukaryotic cells. **Bacteria** are living organisms that are each made up of a single cell. Bacteria are the only cells classified as **prokaryotic cells**. A single cell of bacteria, a bacterium, is sometimes called a **prokaryote**. All other cells are **eukaryotic cells**, so the cells that make up your body, or the cells in a rose bush, or even the cells in a ladybug are eukaryotic cells. In general terms, an organism that is made up of eukaryotic cells can be called a **eukaryote**.

Prokaryotic cells are much simpler than eukaryotic cells. Both types of cells are surrounded by a cell membrane and contain structures inside the cell that carry out specific functions. These structures are known as **organelles**. The organelles found in prokaryotic cells are not enclosed in a membrane. One type of organelle, the **ribosome**, is found in both prokaryotic and eukaryotic cells. Ribosomes consist of two protein subunits and are not considered membrane-bound.

DNA contains the genetic material for an organism. Both types of cells have DNA, but the DNA is found in different places. In prokaryotic cells, the DNA is located in the cytoplasm in an area called the nucleoid region. Prokaryotic DNA is not separated from the cytoplasm by a membrane. In eukaryotic cells, the DNA is enclosed in a porous membrane called the nuclear membrane. This membrane creates the organelle known as the nucleus. The absence of a nuclear membrane is one of the main differences in prokaryotic cells, so prokaryotic cells do not have a true nucleus that separates the DNA from the rest of the cell.

Cellular Transport

Section 8.3
Passive Transport: Osmosis

Pre-View 8.3

- **Hypertonic** – having a higher solute concentration in the solution outside the cell than inside the cell, causing the cell to shrink
- **Hypotonic** – having a lower solute concentration in the solution outside the cell than inside the cell, causing the cell to swell
- **Isotonic** – having equal solute concentrations inside and outside the cell
- **Osmosis** – the movement of water across a semi-permeable membrane
- **Osmotic pressure** – the pressure at which osmosis (the flow of water across a membrane) stops
- **Solute** – dissolved particles in a solution
- **Turgor pressure** – the pressure created by osmosis as water enters into a plant cell

Osmosis is also a type of passive transport since it does not use the cell's energy. Like diffusion, it moves molecules from a higher concentration to a lower concentration. So, you may be wondering what makes osmosis different from diffusion. There are two important things to remember about osmosis.

1. It is always the movement of *water* molecules.
2. It moves water molecules across a semi-permeable membrane through which the **solute** (dissolved particles) cannot cross. (Remember that *semi-permeable* membranes allow only some things to cross but not others.)

Osmosis occurs when the concentration of a solute (particles other than water) is greater on one side of a membrane than on the other side of the membrane, BUT the solute particles CANNOT diffuse through the membrane. If the solute particles could move through the membrane, they would do so by diffusion. If the solute particles cannot diffuse, water will move through the membrane in order to equalize the concentrations on each side of the membrane. The end result is that water molecules move through the membrane from an area of *higher water concentration* to an area of *lower water concentration* (figure 8-6).

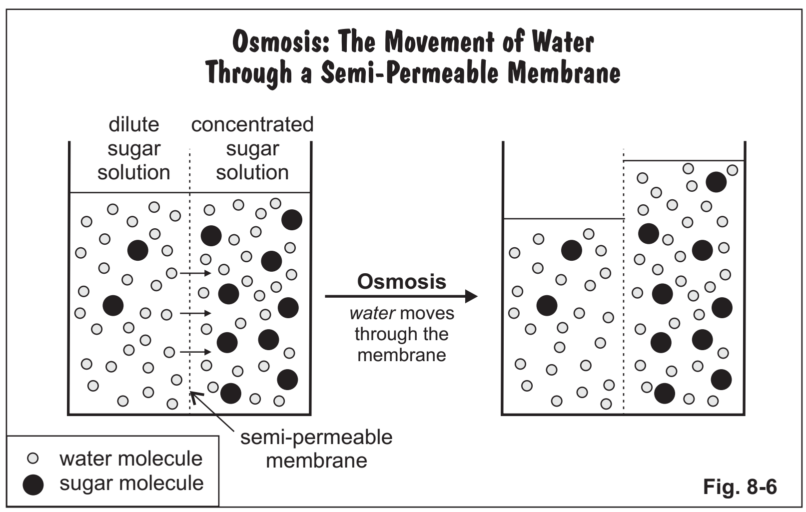


Fig. 8-6

As water passes to the other side of the membrane, pressure builds up as more and more water pushes against the membrane. For example, let's say water enters a cell by osmosis. As more and more water enters the cell, pressure will build up inside the cell as the water pushes against the inside of the cell membrane. Water will continue to pass through the membrane until the concentrations are equal across the membrane or until enough pressure is built up. At a certain pressure, called **osmotic pressure**, water stops flowing across the membrane and osmosis stops even if the concentrations are not equal on both sides of the membrane.

Light Independent Reactions/The Calvin Cycle

The second part of photosynthesis is the **Calvin cycle**, or the light independent reactions. The light independent stage takes place in the stroma, which is the watery fluid that surrounds the thylakoids. Since the stroma does not contain photosynthetic pigments, light is not needed for this stage of photosynthesis. Instead, the Calvin cycle uses the energy stored in the products of the light dependent reactions — ATP, hydrogen ions, and NADPH (an electron carrier coenzyme) — to drive this series of reactions. Along with carbon dioxide from the atmosphere, the ATP, NADPH, and hydrogen ions are used to form high energy sugars such as glucose. If more glucose is made than the plant can use for growth and development, then it is stored as complex carbohydrates, such as cellulose and starch.

Summary of the Calvin Cycle (Light Independent Stage of Photosynthesis)

- This stage does not require light.
- Carbon dioxide and hydrogen ions combine to form simple sugars.
- Simple sugars can be stored as complex carbohydrates, such as cellulose and starch.

$$\underset{\text{carbon dioxide}}{CO_2} + \underset{\text{hydrogen ions}}{H^+} \xrightarrow[\text{and ATP}]{\text{NADPH, enzymes,}} \underset{\text{glucose}}{C_6H_{12}O_6}$$

Plants use the glucose made in photosynthesis to get energy. They also convert the glucose to larger, more complex carbohydrates, such as starch and cellulose, that are needed for development and growth. If another organism eats a plant, the organism breaks the chemical bonds holding the carbohydrate molecules together (through the process of cellular respiration). The stored energy is then released for the organism's own use.

A summary of photosynthesis is given in figure 9-6.

Summary of Photosynthesis

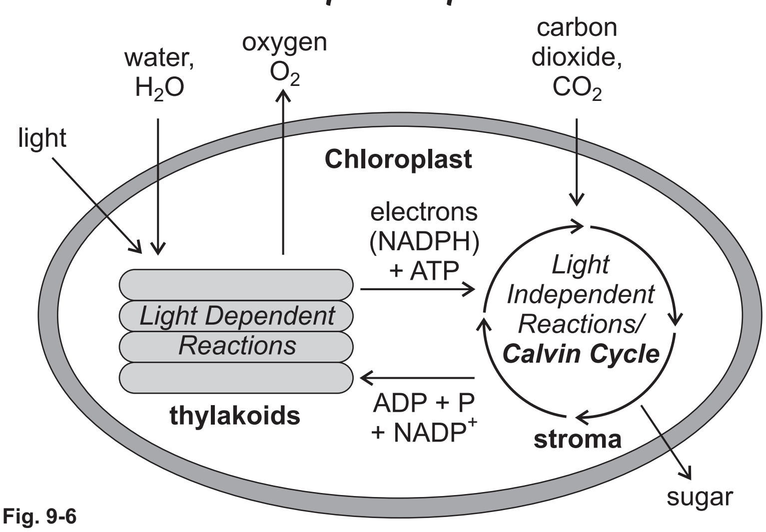
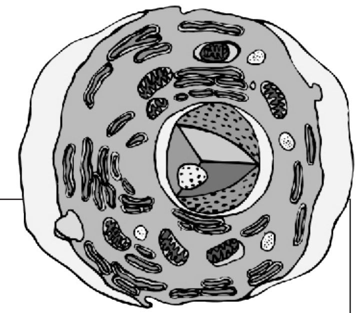


Fig. 9-6

Cellular Reproduction

Section 10.1
Cell Size and Cellular Division



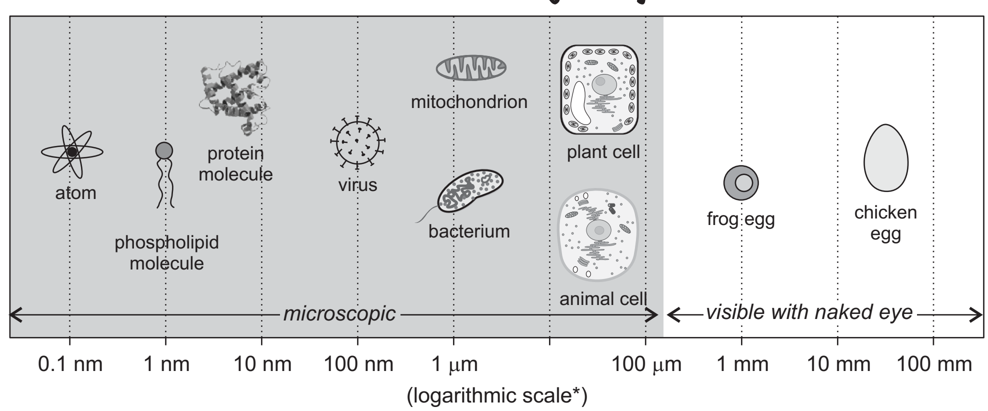
Pre-View 10.1

- **Cellular division** – the process by which cells multiply in number by growing and then dividing
- **Surface area to volume ratio** – a ratio calculated by dividing the surface area of a cell by the cell's volume; the larger the cell, the smaller the surface area to volume ratio

Relative Size of Biological Objects

Before Robert Hooke and Anton van Leeuwenhoek, no one had ever seen a living cell, cell wall, or any other cellular structures. Why not? Because cells are just too small to be seen by the naked eye. Visualizing cells takes specialized lenses like those found in the light microscopes that you use in your biology classroom. To view even smaller structures, including viruses and extremely small cellular organelles, electron microscopes are required. Take a look at figure 10-1 to see why it is impossible to see cells without a microscope. Cell sizes typically range from 1 μm to 100 μm. Prokaryotic (bacterial) cells can range from 1 to 5 μm in diameter, whereas eukaryotic cells are usually 10 to 100 μm in diameter (depending on the specific cell type).

Relative Sizes of Biological Objects



* On a logarithmic scale, each graduate mark is ten times greater than the one before it.

Fig. 10-1

Example 1: Using figure 10-1 above, approximately how many times larger is a bacteria cell than a virus? How many times larger is a plant cell than a virus?

Notice that the scale used in figure 10-1 is logarithmic. Each dashed line represents a value ten times greater than the line to its left. An object located 1 line to the right is 10 times larger. An object two lines to the right is 100 times larger.

The average virus is around 100 nm in diameter. A small bacteria cell is around 1 μm in diameter. Using the logarithmic scale, you can easily see that a bacterium cell is at least ten times larger than a virus.

Since each line represents a 10-fold increase in size, you can see that a plant cell is somewhere between 100 and 1000 times larger than a virus cell because they are more than two lines apart but less than three lines apart.

Genetic Mutations

Suppose that you had a sentence made of 3 letter words (like codons):

THE RAT HID AND THE CAT SAT AND GOT FAT.

If we substituted a different letter for the letter R, words are still formed, but the sentence doesn't make sense:

substitution

THE PAT HID AND THE CAT SAT AND GOT FAT.

If we add a letter or delete a letter somewhere, it's even worse because all of the "words" after the insertion or deletion change:

insertion

THE RAT HIX DAN DTH ECA TSA TAN DGO TFA T

deletion

THE RAH IDA NDT HEC ATS ATA NDG OTF AT

Remember, amino acids make up polypeptide chains, polypeptide chains make up proteins, and proteins are a vital component of living materials and carry out vital cellular processes. Remember also that genes in the DNA are made up of nucleotide sequences that are "read" in groups of threes similar to the three-word sentences shown above. The sequence of the letters in the mRNA determines the amino acid that is added to the polypeptide chain. If one or more amino acids added to that polypeptide chain are wrong, the organism will not be able to build proteins with the correct structure. Look at figure 11-10 to review the different types of gene mutations and how they affect protein production. Notice that the amino acids that make up the protein can change when different gene mutations occur. Gene mutations are sometimes called **point mutations** because the mutation occurs at only one point in the DNA. Insertions or deletions of a single nucleotide are also called **frameshift mutations** because they shift how the codons are read and can result in different amino acids being added to the protein. (Note: Since some nucleotide sequences "code" for the same amino acid, not all gene mutations result in a different amino acid.) Both point mutations and frameshift mutations may also create a stop codon, which will stop protein synthesis. The resulting protein will be shorter than it is supposed to be.

Types and Examples of Gene Mutations

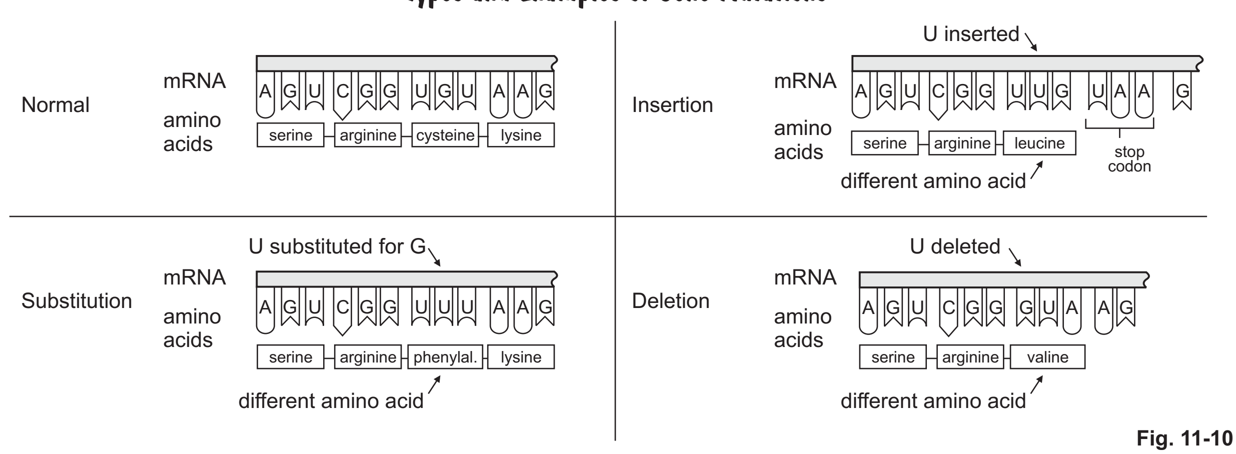


Fig. 11-10

Applied Genetics

Section 13.5
Pedigrees

Pre-View 13.5

- **Pedigree** – a diagram used by geneticists to chart a trait from one generation to another

Have you ever seen your family tree? You know — a family tree is a diagram that shows different generations and various members of your family. Geneticists use a diagram called a **pedigree** that is similar to a family tree to show genetic inheritance. Pedigrees can help geneticists determine if a trait is inherited, they can show how a trait is passed from one generation to the next, and they can help determine whether an allele for a trait is dominant or recessive.

Pedigrees always use certain symbols that you should know. Study the sample pedigree given below in figure 13-6.

Sample Pedigree of a Family with Color Blindness

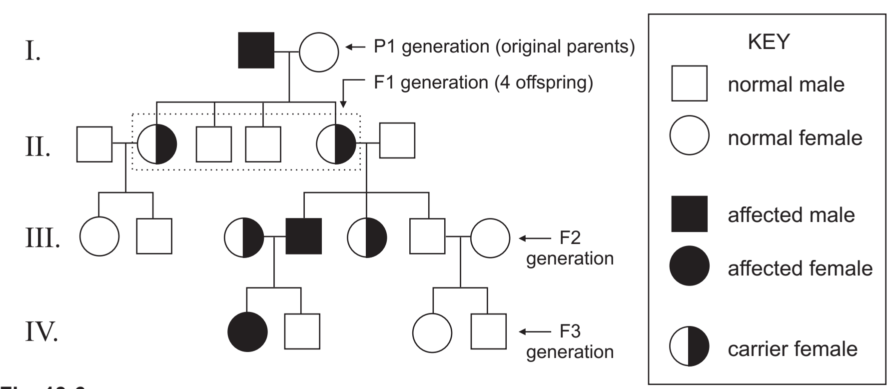


Fig. 13-6

Each horizontal row represents one generation, and the youngest generation is at the bottom. The rows are usually labeled with Roman numerals. Row I corresponds to the first generation (P1), row II corresponds to the children of the first generation and their spouses (F1), row III represents their grandchildren (F2), and so on. The horizontal line between a square and a circle represents parents. The vertical line between the parents that link to the next generation shows the offspring of the parents.

In the first generation (P1) of the sample above, the father is affected by color blindness, and the mother is normal. The parents have four children, 2 sons and 2 daughters (enclosed by the dotted line). Both sons are normal, but both daughters are carriers.

Example 1: In the pedigree given in figure 13-6, determine the genotypes of the parents in the first generation. The sons are normal, but the daughters are carriers. If the first generation parents had additional children, could the genotypes of sons and daughters be different?

We know that color blindness is an X-linked gene. Since the man in the P1 generation is affected, we know that his genotype is X^bY. The woman in the first generation is normal, so her genotype is X^BX^B. Use a Punnett square to see the possible genotypes of offspring.

	X^b	Y
X^B	X^BX^b	X^BY
X^B	X^BX^b	X^BY

From the Punnett square we can see that these parents will always have daughters that are carriers and sons that are normal.

Redi is often given credit as the first scientist to develop a controlled experiment. He may not have actually been the first person to use controls or to understand the need for a control group. However, his simple experiment successfully used a control group and two experimental groups to support his hypothesis. His experiment may have looked something like the illustrations in figure 14-1.

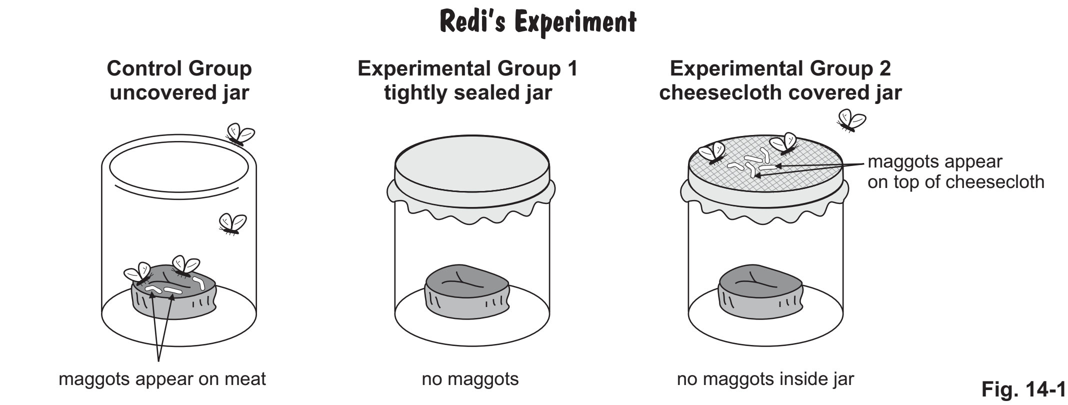


Fig. 14-1

John Needham (1713 – 1781) vs. Lazzaro Spallanzani (1729 – 1799)

As we observed from Redi's 1668 experiment, large organisms, such as maggots and flies, were not spontaneously generated. But questions still remained about the spontaneous generation of microorganisms. In the 1700s, some still believed that organisms unseen by the naked eye, microorganisms, were spontaneously generated.

John Needham was one of the scientists made famous by his *incorrect* assumption. In 1745 Needham attempted to prove spontaneous generation does occur with microscopic organisms. With the knowledge that heat killed living organisms, Needham boiled a nutrient-rich chicken broth, transferred the heated broth to a flask, covered it, and then allowed it to cool. Afterwards he maintained the broth at a constant temperature for some time. A thick, cloudy solution containing microorganisms resulted from his experiment. Needham believed this to be "proof" that the microorganisms were created by the broth.

Another scientist **Lazzaro Spallanzani** suspected that the microorganisms in Needham's experiment were coming from the air during the transfer to the flask, so he repeated Needham's experiment with a slight modification. Spallanzani placed the chicken broth in a flask, covered it, and removed air from the flask by creating a partial vacuum. He then boiled the broth and allowed the flask to cool with the covering and then waited. No growth occurred in Spallanzani's experiment, so he concluded that his experiment disproved spontaneous generation of microorganisms.

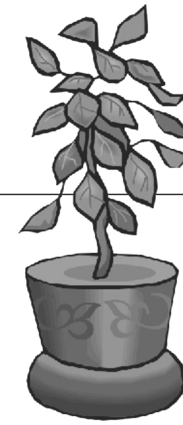
Not everyone was convinced of Spallanzani's conclusion. Many felt that air was the "vital force" for the microorganisms to appear and suggested that all his experiment proved was that spontaneous generation could not occur without air.

Louis Pasteur (1822 – 1895)

Another hundred years passed by before the French chemist **Louis Pasteur** finally settled the debate on spontaneous generation. He designed an experiment that disproved spontaneous generation once and for all! In 1859 Pasteur performed a variation of both Needham's and Spallanzani's experiments. He modified the flask by heating the neck and reshaping it to form an S. The newly designed *swan-necked* flask prevented dust and microbial contaminants from entering the broth while still allowing the exchange of air. Over a prolonged incubation, the flasks remained free of microbes. Microbes developed in the broth only if the swan-neck was broken to expose the broth to air or if the flask was tilted to allow broth to settle in the lowest point of the flask neck.

Adaptations

Section 15.2
Adaptations in Plants



Pre-View 15.2

- **Cuticle** – the waxy coating on leaves
- **Guard cells** – cells on either side of a stoma that cause the stoma to open or close
- **Stomata** – openings usually on the underside of a leaf that allow carbon dioxide to enter and oxygen and water to escape
- **Transpiration** – the process of losing water through a plant's leaves

Structural adaptations in plants include differences in roots, stems, and leaves as well as those in fruits, seeds, and flowers. Consider some of the structural adaptations that may be seen in plants.

Roots

The roots of plants take in water and nutrients, and they hold the plant in place in the ground. To allow the roots to absorb as much water and nutrients as possible, the roots are covered with tiny root hairs that increase the surface area sometimes as much as 130% more than the surface area of the stems and leaves of a plant. Plant roots can have several adaptations depending on where they grow and especially how much water is available.

Desert plant adaptations: Because water is scarce, plants that live in the desert usually have very extensive root systems, which are either deep or wide. They have extra root hairs to quickly absorb the water after it rains.

Rain forest plant adaptations: If plants in the desert have deep roots, what kind of roots do plants in a rain forest most likely have? Trees and plants in a rain forest often have shallow root systems, and because the ground remains moist most of the time, the roots have developed adaptations to resist rotting.

Stems

Plant stems have several important functions. Most obviously, they support the leaves and flowers.

Vascular material adaptations: In most types of plants, stems contain vascular material, which are like small tubes that allow water and nutrients to pass through. The adaptation of some plants to have vascular material allow them to grow larger than those without vascular material. For example, mosses do not contain vascular material and can grow only close to the ground or surface. Grasses, on the other hand, do contain vascular material, and can therefore grow much taller.

Woody stem adaptations: Another adaptation in stems is the production of wood. Plants that produce wood in their stems can grow very tall and have additional support and protection. How tall do you think an oak tree could grow without a woody trunk? Woody stems are an advantage to the types of plants that have them.

Herbaceous stem adaptations: Stems that lack woody tissues are called herbaceous stems. Herbaceous stems are more flexible and can also be an advantage to plants. Aquatic plants, for instance, often lack woody tissue because the buoyancy of the water provides them the support they need for growth. (*Buoyancy* is the force of a liquid that allows objects to float.) A flexible, herbaceous stem also allows aquatic plants to bend in flowing water, but a rigid, woody stem may cause the plant to be uprooted.

Allopatric Speciation

As previously mentioned, geographic isolation can lead to the formation of a subspecies, or it may lead to speciation. Speciation occurs due to **reproductive isolation**, which is the inability of different populations to breed due to some kind of barrier.

Allopatric speciation is the most common form of speciation, and it occurs when populations of a species are geographically isolated from breeding with one another. (*Allo* means *different*; *patric* means *homeland*.) If the divided populations are unable to interbreed because of their separation, the new, smaller populations may develop specific adaptations through natural selection or genetic drift. In time, allopatric speciation may result from geographic isolation if each new population becomes so different that they are considered different species.

Example 2: The vastness of Arizona's Grand Canyon and the Colorado River are insurmountable geographic barriers for small rodents such as squirrels and mice. For example, two species of antelope squirrels live in the canyon. The Harris antelope squirrel lives on the south rim of the canyon, and the White-tailed antelope squirrel lives on the north rim of the canyon. What makes the antelope squirrels of the Grand Canyon an example of allopatric speciation?

These two distinct species of antelope squirrels are descended from a common ancestor, but even given the chance with human intervention, they can no longer interbreed. They are an example of allopatric speciation because at some point in the past, the Grand Canyon and the Colorado River created geographic isolation in the antelope squirrel population, and the end result was two different species.

Figure 16-8 summarizes how geographic isolation may affect a species. Natural selection and/or genetic drift can cause a divided population to develop into a subspecies or a new species.

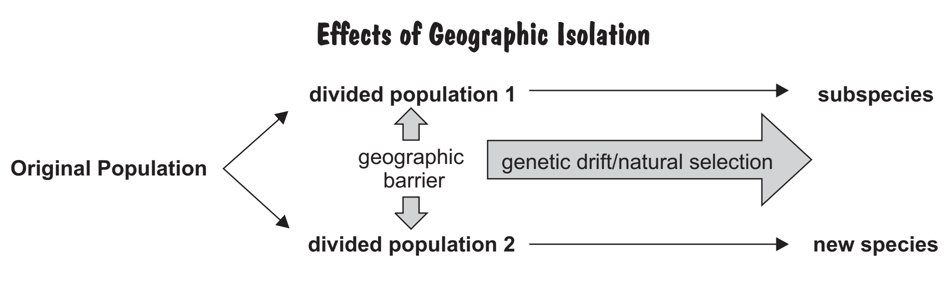


Fig. 16-8

Example 3: Clearcutting through a tropical rainforest created a small section of trees that were separated from the main forest by a barren area. As a result, a population of salamander living among the trees was isolated from other members of its species in the main forest. Over time, what could happen to this smaller population of isolated salamanders?

The geographic separation of the salamanders prevents gene flow from one population to the other. The isolated population may become different from the population in the main forest especially if the environmental conditions are different between the isolated forest and the main forest. Genetic drift could cause the isolated population to become a distinct subspecies. Natural selection in changing environments may even lead to speciation in the separated populations over a long period of time.

Section 17.1, continued
Taxonomy

Example 1: The chart on the right shows the classification of a dog and a gorilla. What is the LOWEST taxonomic level that they have in common?

	Dog	Gorilla	
Kingdom	Animalia	Animalia	same
Phylum	Chordata	Chordata	same
Class	Mammalia	Mammalia	same
Order	Carnivora	Primates	different
Family	Canidae	Hominidae	
Genus	*Canis*	*Gorilla*	
Species	*familiaris*	*gorilla*	

The smallest taxonomic level that the dog and the gorilla have in common is the class of Mammalia. The chart shows that they are in the same kingdom, phylum, and class, but they are in different orders.

Naming Organisms

Organisms are named using their genus name followed by their species name. The genus name is always capitalized, and the species name is always lowercase. Both the genus and the species are italicized. This naming system is called **binomial nomenclature**.

Example 2: The scientific name for a red maple tree is *Acer rubrum.* Which word represents the genus name? Which word represents the species name?

Remember that genus name is always given first and then the species. *Acer* is the genus name and includes all types of maple trees. The name *rubrum* represents the specific species of maple tree, which in this case is the red maple.

Acer rubrum

Genus → *Acer*; **species** → *rubrum*

Evolutionary Relationships

Evolutionary theory dictates that scientific classifications also show ancestral relationships. Organisms that share a lower taxon are considered more closely related that organisms that share a higher taxon. For example, plants and animals are in two different kingdoms. Any two animals are considered more closely related than any plant and animal. An earthworm and a domestic cat are considered more closely related than an earthworm and an oak tree. So to determine which organisms are the most closely related, look for the smallest shared taxon.

Example 3: Study the chart below. Which two trees are the mostly closely related?

	Oak Tree	Pine Tree	Palm Tree	Apple Tree
Kingdom	Plantae	Plantae	Plantae	Plantae
Phylum	Magnoliophyta	Coniferophyta	Magnoliophyta	Magnoliophyta
Class	Magnoliopsida	Pinopsida	Liliopsida	Magnoliopsida
Order	Fagales	Pinales	Arecales	Rosales
Family	Fagaceae	Pinaceae	Arecaceae	Rosaceae

Class is the lowest taxon that any of the trees has in common. Notice that the oak tree and the apple tree share the same taxa down to class Magnoliopsida. Of these four trees, the oak tree and the apple tree are therefore the most closely related.

Example 1: What is the potential impact of introducing a non-native species into an ecosystem?

Introducing a non-native species into an ecosystem can be disastrous. It often results in an overall decrease in biodiversity in the ecosystem. Consider the problem of the rabbits in Australia. Rabbits were not native to Australia when some settlers took about two dozen rabbits there in the mid-1800s to use as game. The rabbits had no natural predators and now had a very large area of land with a huge food supply. They began to multiply quickly. Soon the rabbits were eating all of the grass that was intended for sheep and cattle. Even though "gentlemen hunters" could shoot as many as 1200 a day for sport, the rabbit population kept increasing. In about ten years, 2 million rabbits could be shot or trapped yearly with little effect on the rabbit population size. The rabbits destroyed vegetation and wiped out entire species of native plants. The extinction of certain plants led to the extinction of one-eighth (1/8th) of Australia's mammal species. Meanwhile, the rabbits continued to multiply. Eventually, Australians built miles of fences in an attempt to keep the rabbits from spreading into other parts of Australia. The rabbits are still a significant problem for Australian landowners today.

While populations grow continuously with unlimited resources, the rate of population growth slows down until it levels off or stops once there is competition for resources. The population growth levels off when the environment has reached its **carrying capacity, *k***, which is the maximum number of organisms that can be supported in a given environment. Most natural populations have a pattern of growth that, when graphed, follows an S-shaped curve as shown in figure 15-3. This S-shaped pattern represents **logistic growth**.

Natural Population Growth (Logistic Growth)

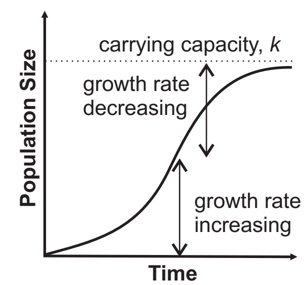
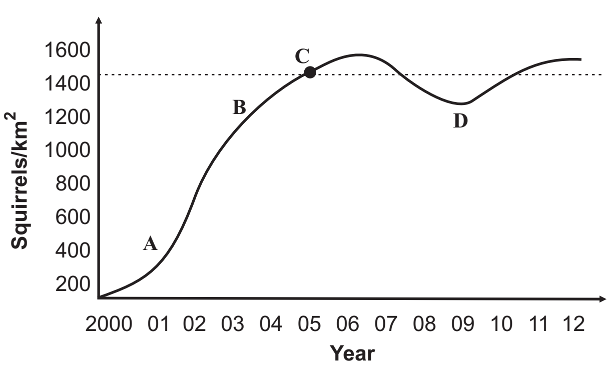


Fig. 19-4

The S-shaped pattern shown in figure 19-4 is theoretical. In reality, a population often fluctuates around carrying capacity, *k*. For example, as a population reaches carrying capacity or exceeds it, the population may experience crashes or die offs as a result of limited resource availability. The decline in the population makes additional resources available to the remaining individuals, and as a result, the population may rebound and approach its carrying capacity once again.

Example 2: The population graph below shows the population growth of gray squirrels introduced into a large, newly-developed residential area. What do each lettered area of the graph represent?



A: In this section of the graph between 2000 and 2002, the squirrel population increases rapidly because resources are abundant and competition is minimal.

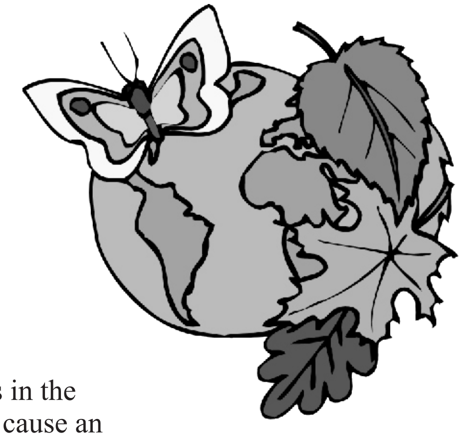
B: Between 2002 and 2006, the population continues to increase but at a slower rate most likely because of increasing competition for resources. The population begins to stabilize as it approaches its carrying capacity.

C: At Point C around the year 2005, the carrying capacity is reached.

D: Once the squirrel population reaches and exceeds its carrying capacity, the population experiences a crash followed by a rebound. This trend will likely continue as the population hovers around its carrying capacity.

Environmental Interdependence

Section 20.3
Interdependence and the Importance of Biodiversity



Interdependence

Food chains and food webs show herbivory and predation relationships. If the population of one species changes, it will affect the populations of other species in the food chain or food web. For example, a decrease in one population will usually cause an increase in the trophic level populations below it and a decrease in trophic level populations above it.

Example 1: Consider the food chain below that you saw in figure 20-2.

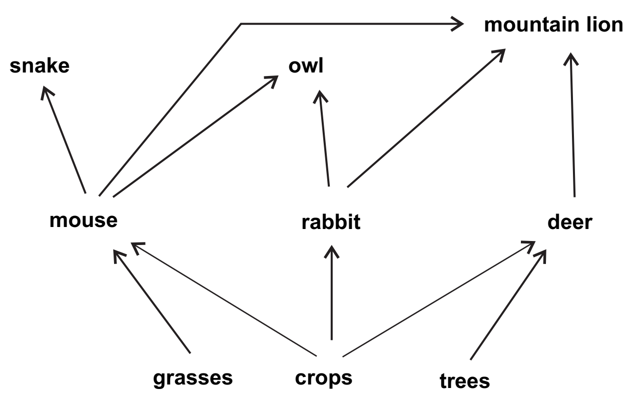
grass → **grasshopper** → **mouse** → **snake** → **hawk**

A harsh winter with below-average temperatures greatly decreases the number of grasshoppers that survive until spring. How will the decreased grasshopper population affect the grass? How will it affect the mouse population?

A decrease in the grasshopper population would increase the grass population because fewer grasshoppers would be feeding on the grass. However, with fewer grasshoppers to eat, the mice population would also decrease.

Interdependency can also be seen in food webs.

Example 2: Consider the food web below.



A bacterial infection spreads in the mouse population and causes a drastic decrease in the number of mice in the ecosystem. How would you explain a decrease in the number of rabbits in the ecosystem as well?

Notice that rabbits are in the same trophic level as the mice. Mice are prey for snakes, owls, and mountain lions. If fewer mice are available for prey, owls and mountain lions will have to get more of their food from hunting rabbits. As a result, a decrease in the mouse population may cause a decrease in the rabbit population.

Ecosystems and Their Development

Section 21.4
The Effects of Ecosystem and Habitat Disruption and Destruction

Pre-View 21.4

- **Desertification** – the process of dry but fertile land becoming less and less able to support plant and animal life usually through the use of unsustainable or irresponsible farming methods
- **Extinction** – the complete death of a species
- **Migration** – the movement of animals, such as birds, from one area to another, usually occurring during a change of seasons

Natural events can disrupt ecosystems. A volcanic eruption can completely cover an area of land with lava. A forest fire started by lightning or a tornado can destroy acres of trees and kill or displace the populations of species living there. These natural events can cause ecological succession to occur as an ecosystem recovers from the disruption.

Humans have also greatly impacted ecosystems, but many times, humans prevent succession and recovery from taking place. As the human population has increased, humans have competed with other organisms for space, food, and water. The increased competition has disrupted the flow of energy within ecosystems and has interrupted how nutrients are recycled. Human activities can even threaten the survival of populations.

Factors that Threaten Extinction

Extinction occurs when the last surviving organism in a particular species dies. Many species living today are considered endangered and could face extinction. What causes a species to be in danger of extinction while other species thrive? Several human and ecological factors contribute to the threat of extinction.

Human Factors that Threaten Extinction

- Habitat disturbance or destruction
- Hunting or poisoning
- Introducing non-native/exotic species
- Pollution

Ecological Factors that Threaten Extinction

- Low rate of reproduction/low birth rate
- Highly specialized diet
- Small or limited habitat area
- Inability to adapt to environmental changes

Example 1: The giant panda is a good example of an endangered species that faces extinction because of several human and ecological factors. In the wild, this panda species lives in isolated forests in southwestern China. Its main food source is bamboo. Mature panda parents average one cub every two years. What factors can you identify that contribute to the panda's threat of extinction?

By cutting down forest areas, humans have decreased the size of the giant panda's habitat so that it must survive in much smaller areas. Ecological factors that threaten the panda's ability to survive are its low rate of reproduction and its specialized diet of bamboo. Its habitat is limited to bamboo forests. As habitat size shrinks, so does the number of pandas that survive.

Some of the precipitation is taken in and used by plants and animals. Plants also give off water through a process called **transpiration**, which puts water back into the atmosphere. Some of the precipitation sinks into the ground and becomes groundwater beneath the earth's surface. Eventually, it may flow into lakes and oceans where some is evaporated into the atmosphere.

When conditions are right, the water vapor in the atmosphere will condense and form clouds. Whenever the clouds get too heavy to hold any more water vapor, precipitation occurs. Once again, water returns to the earth for organisms to use in a natural cycle.

Importance and Effects on Ecosystems

The water cycle is very important to ecosystems because water is arguably the most important chemical compound found in ecosystems. An **ecosystem** is made up of all the living organisms in an area plus the nonliving parts of the environment. The amount of water an ecosystem receives determines the plants and animals that can live in the area. As you will see in Section 17 on biomes, deserts that receive little precipitation have few plants and animals, but tropical rain forests that receive a lot of precipitation have many plants and animals. In general, the more precipitation in an ecosystem, the greater the biodiversity.

Construction

Human actions can impact the water cycle. For example, areas paved with asphalt or concrete affect the amount of water that can percolate through the soil and enter the ground water table. Ground cleared of trees can also cause rainwater from a heavy rain to run into lakes, rivers, and streams instead of penetrating into the ground.

Global warming

Global warming, as you reviewed in Section 15.5, may also affect the water cycle and impact ecosystems in several ways:

Higher atmospheric temperatures increase the rate of evaporation, and warm air can hold more water vapor. Since water vapor is a greenhouse gas, the increased evaporation may cause global temperatures to rise further.

About 97% of all the water on the earth is found in the ocean. The remaining 3% of the earth's water is freshwater, but most of that freshwater, almost 70% of it, is frozen in glaciers or icecaps. Higher atmospheric temperatures due to global warming will cause more ice to melt from glaciers and icecaps. As this ice melts, ocean levels are predicted to rise. Melting ice can negatively affect the tundra biome and arctic ecosystems since many animals rely on ice coverage as a part of their survival. Rising ocean levels and higher ocean temperatures can negatively affect coral reef ecosystems by killing the coral.

Global warming may also speed up the water cycle. As more water evaporates, more water also falls as precipitation. Many scientists believe that this change in the water cycle may result in more severe weather events, such as violent storms. They also believe the precipitation will not be evenly distributed. Because the cycling of water between evaporation and precipitation is accelerated, wet ecosystems may get more precipitation, but dry ecosystems may get less. Droughts in already-dry ecosystems can lead to a decrease in ecosystem biodiversity. The more intense rainfall may increase freshwater runoff, which increases soil erosion, but it may also decrease the amount of available groundwater.

Tennessee Biology I
End of Course Assessment
Student Review Guide

Practice Test

1

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34 **A student tested an unknown cloudy white liquid for the presence of protein, lipids, starches, and sugars. The observations are given in the chart below.**

Unknown Solution Results

Testing Indicator	Observed Change in Color
Iodine	from cloudy white to yellow
Benedict's Solution	from cloudy white to yellow
Sudan Red	little change in cloudy white liquid; no red ring or layers
Biuret Solution	from cloudy white to purple

Based on the data, which molecules are present in the unknown liquid?

F sugars and proteins
G lipids and proteins
H starches and sugars
J starches and lipids

Ⓕ Ⓖ Ⓗ Ⓙ

35 **Diabetics commonly check their blood glucose levels by pricking their skin for a blood sample and then testing a droplet of blood using test strips and a glucose monitor. A biomedical device company claims to have developed a blood glucose monitor that uses skin cells instead of a blood sample to determine blood glucose levels. This device would eliminate the need for skin pricking. Which step will most help the company determine if the new glucose monitoring device is as effective in accurately determining blood glucose levels as blood testing?**

A conduct a pilot study to test the new device in a controlled experiment
B market the new device directly to diabetic patients
C recruit diabetic and non-diabetic volunteers to use the new device for a trial period
D encourage doctors to prescribe the new device to their diabetic patients

Ⓐ Ⓑ Ⓒ Ⓓ

GO ON

Biology I
Practice Test 1
Evaluation Chart

Circle the questions you answered incorrectly on the chart below, and review the corresponding sections in the book. Read the instructional material, do the practice exercises, and take the section review tests at the end of each section.

If you missed question #:	Go to section(s):	If you missed question #:	Go to section(s):	If you missed question #:	Go to section(s):
1	17.1	21	Section 6	41	7.3, 7.4, 14.4
2	1.1, 1.3	22	2.3	42	20.1, 20.2
3	12.1, 12.2	23	21.5, 22.4	43	3.1, 19.2, 19.3
4	Section 12, 13.4, 13.5	24	Section 6	44	10.4, 13.3
5	7.4	25	21.4, 22.3	45	11.5
6	21.3	26	Section 12, 13.4	46	20.1, 20.2
7	3.1	27	11.3	47	6.1, 6.6
8	12.1, 12.2	28	20.2, 20.3	48	8.3
9	8.1, 8.2, 8.3	29	1.4	49	9.1, 9.3
10	7.3	30	12.1, 12.2, 13.5	50	3.1, 3.2, 15.2, 21.1
11	20.2, 20.3	31	4.3	51	6.4
12	10.4, 11.4	32	9.2, 9.3, 9.4	52	21.4, 21.5
13	Section 16	33	3.1, 21.5, 22.4	53	8.2
14	20.1, 20.2	34	6.1, 6.2, 6.3, 6.6	54	10.1
15	9.1, 9.3	35	2.1, 2.3, 2.5	55	15.3, 21.1
16	11.1, 11.3	36	10.2, 11.2	56	Section 12, 13.4
17	10.4, 10.5	37	9.2, 9.3, 9.4	57	15.2, 19.1, 19.2
18	11.3	38	Section 19, 20.3	58	Section 9
19	18.1	39	21.5, 22.2	59	10.4, 10.6
20	6.4	40	15.1, 15.3	60	

Tennessee Biology I
End of Course Assessment
Student Review Guide

Practice Test

2

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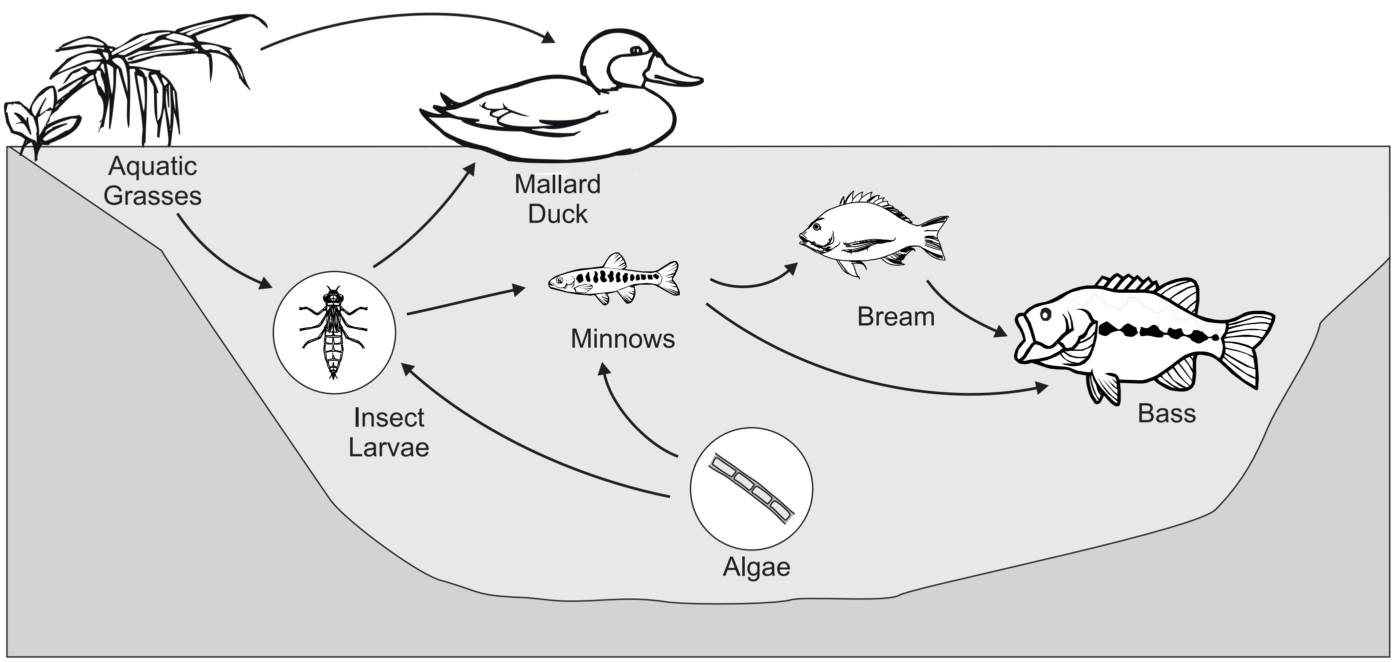
45 **Genotyping is a process that determines genetic variations in an individual. For a fee, a person can mail a sample of his or her DNA to a genotyping company and receive results that show ancestry, physical characteristics, and traits for inheritable diseases. Which is the <u>most</u> important ethical concern the genotyping company must consider?**

A keeping the cost of the test affordable
B maintaining the privacy of customers' DNA results
C processing DNA samples in a timely manner
D ensuring the samples are free from contamination

Ⓐ Ⓑ Ⓒ Ⓓ

46 **The diagram shows a pond food web.**



In this diagram, which organism receives energy directly from the minnow?

F Insect Larvae
G Algae
H Mallard Duck
J Bass

Ⓕ Ⓖ Ⓗ Ⓙ

GO ON

Biology I
Practice Test 2
Evaluation Chart

Circle the questions you answered incorrectly on the chart below, and review the corresponding sections in the book. Read the instructional material, do the practice exercises, and take the section review tests at the end of each section.

If you missed question #:	Go to section(s):	If you missed question #:	Go to section(s):	If you missed question #:	Go to section(s):
1	17.3	21	6.3	41	7.3
2	1.1, 1.3	22	2.1, 2.2	42	20.1, 20.2
3	Section 12	23	20.1, 22.4	43	3.1, 19.2, 19.3
4	Section 12, 13.4, 13.5	24	Section 6	44	10.4, 10.6, 16.1, 16.2, 16.3
5	7.4, 12.3	25	21.4, 21.5, 22.2	45	11.5
6	21.3	26	Section 12, 13.2	46	20.1, 20.2
7	3.2	27	11.1, 11.3	47	6.1, 6.6
8	12.1, 12.2, 13.1	28	19.3, 20.3, 21.4	48	Section 8
9	8.1, 8.2, 8.3	29	7.2	49	9.3
10	7.3	30	12.1, 12.2, 13.5	50	12.1, 13.3
11	20.1, 20.2	31	4.4	51	6.4
12	11.1, 11.2, 11.3, 11.4	32	9.2, 9.3, 9.4	52	20.2, 20.3
13	Section 16	33	4.2	53	8.2, 8.4
14	20.1, 20.2	34	6.1, 6.2, 6.3, 6.6	54	10.1, 10.2
15	9.1, 9.3	35	1.1, 1.4	55	15.3, 16.4, 16.5
16	6.5, 11.1, 11.3	36	10.2, 11.2	56	11.4
17	10.4, 10.5	37	9.2, 9.3, 9.4	57	19.1, 19.2, 19.3
18	11.3	38	21.4	58	9.2, 9.3, 9.4
19	18.1	39	21.4, 22.5	59	10.4
20	3.1, 6.4	40	15.1, 15.2, 21.1	60	15.1, 15.3, 15.4

Competency Correlation Chart (Teacher's Edition)

The chart below correlates each standard as given in the 2009 Tennesse Biology I Framework to the student guide. The Text Section column gives the section numbers in the text where each competency is reviewed. The Practice Test columns give the question number(s) in that test that correlates to each competency.

Reporting Category, Standard, and State Performance Indicator	Text Section(s)	Practice Test 1	Practice Test 2
Reporting Category 1 (Embedded Standard) Inquiry, Technology and Engineering, Mathematics			
3210.T/E.1 Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.	Section 1, Subsections 2.3, 2.5, 5.3, 7.2	29	29
3210.T/E.2 Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.	Subsection 4.3	31	
3210.T/E.3 Evaluate the overall benefit to cost ratio of a new technology.	Subsection 4.4		31
3210.T/E.4 Use design principles to determine how a new technology will improve the quality of life for an intended audience.	Subsections 2.3, 2.5, 4.3	35	
3210.Math.1 Interpret a graph that depicts a biological phenomenon.	Section 3, Subsections 4.1, 6.4, 13.2, 16.1, 19.3, 21.1	7	7
3210.Math.2 Predict the outcome of a cross between parents of known genotype.	Sections 12, 13	8	8
3210.Inq.1 Select a description or scenario that reevaluates and/or extends a scientific finding.	Subsections 7.1, 12.1, 12.2, 13.3, Section 14		50
3210.Inq.2 Analyze the components of a properly designed scientific investigation.	Section 2, Subsection 14.1	22	22
3210.Inq.3 Determine appropriate tools to gather precise and accurate data.	Section 1, Subsection 7.2	2	2
3210.Inq.4 Evaluate the accuracy and precision of data.	Section 1		35
3210.Inq.5 Defend a conclusion based on scientific evidence.	Subsections 2.4, 2.5, 4.1, 14.1, Section 3	50	
3210.Inq.6 Determine why a conclusion is free of bias.	Subsections 2.3, 2.5, 4.2		33
3210.Inq.7 Compare conclusions that offer different, but acceptable explanations for the same set of experimental data.	Subsections 2.5, 4.1, 14.1 Section 3	33	

Reporting Category, Standard, and State Performance Indicator	Text Section(s)	Practice Test 1	Practice Test 2
Reporting Category 2, Standard 1 **Cells**			
3210.1.1 Identify the cellular organelles associated with major cell processes.	Subsections 7.4, 7.5, 9.2, 9.3, 14.4	5	5
3210.1.2 Distinguish between prokaryotic and eukaryotic cells.	Subsections 7.3, 7.5, 14.4	10, 41	10, 41
3210.1.3 Distinguish among proteins, carbohydrates, lipids, and nucleic acids.	Sections 5, 6	21, 24	21, 24
3210.1.4 Identify positive tests for carbohydrates, lipids, and proteins.	Subsections 6.1, 6.2, 6.3, 6.6	34, 47	34, 47
3210.1.5 Identify how enzymes control chemical reactions in the body.	Section 5, Subsection 6.4	20, 51	20, 51
3210.1.6 Determine the relationship between cell growth and cell reproduction.	Subsections 10.1, 10.2, 10.3	54	54
3210.1.7 Predict the movement of water and other molecules across selectively permeable membranes.	Sections 5, 8	9, 48	9
3210.1.8 Compare and contract active and passive transport	Section 8	53	48, 53
Reporting Category 3, Standard 2 **Interdependence**			
3210.2.1 Predict how populations changes of organisms at different trophic levels affect an ecosystem.	Subsections 19.2, 20.2, 20.3	11	11
3210.2.2 Interpret the relationship between environmental factors and fluctuations in population size.	Subsections 20.2, 20.3, 21.4, 21.5	52	52
3210.2.3 Determine how the carrying capacity of an ecosystem is affected by interactions among organisms.	Subsections 19.3, 21.5	43	43
3210.2.4 Predict how various types of human activities affect the environment.	Subsections 19.3, 20.3, 21.4, 21.5	25	25
3210.2.5 Make inferences about how a specific environmental change can affect the amount of biodiversity.	Section 16, Subsections 19.1, 21.1, 21.2, 21.4, 21.5	57	57
3210.2.6 Predict how a specific environmental change may lead to extinction of a particular species.	Subsections 19.3, 21.4, 21.5	38	38
3210.2.7 Analyze factors responsible for the changes associated with biological succession.	Subsection 21.3	6	6

Reporting Category, Standard, and State Performance Indicator	Text Section(s)	Practice Test 1	Practice Test 2
Reporting Category 4, Standard 3 **Flow of Matter & Energy**			
3210.3.1 Interpret a diagram that illustrates energy flow in an ecosystem.	Section 20	14, 42, 46	14, 42, 46
3210.3.2 Distinguish between aerobic and anaerobic respiration.	Subsections 9.1, 9.3	15, 49	15, 49
3210.3.3 Compare and contrast photosynthesis and cellular respiration in terms of energy transformation.	Subsection 7.5, Section 9	32, 37, 58	32, 37, 58
3210.3.4 Predict how changes in a biogeochemical cycle can affect an ecosystem.	Subsections 21.4, 21.5, Section 22	23, 39	23, 39
Reporting Category 5, Standard 4 **Heredity**			
3210.4.1 Identify the structure and function of DNA.	Subsections 6.5, 6.6, 11.1, 11.2, 11.3	16	16
3210.4.2 Associate the process of DNA replication with its biological significance.	Subsections 10.2, 11.1, 11.2, 11.4, 13.2	36	36
3210.4.3 Recognize the interactions between DNA and RNA during protein synthesis.	Subsections 11.1, 11.3	18, 27	18, 27
3210.4.4 Determine the probability of a particular trait in an offspring based on the genotype of the parents and the particular mode of inheritance.	Sections 12, 13	3, 26, 56	3, 26, 56
3210.4.5 Apply pedigree data to interpret various modes of genetic inheritance.	Subsection 13.5	4, 30	4, 30
3210.4.6 Describe how meiosis is involved in the production of egg and sperm cells.	Subsections 10.4, 10.5	17	17
3210.4.7 Describe how meiosis and sexual reproduction contribute to genetic variation in a population.	Subsections 10.4, 10.6, 13.1	44, 59	44, 59
3210.4.8 Determine the relationship between mutations and human genetic disorders.	Subsections 11.4, 12.3, 13.4	12	12, 56
3210.4.9 Evaluate the scientific and ethical issues associated with gene technologies: genetic engineering, cloning, transgenic organism production, stem cell research, and DNA fingerprinting	Subsection 11.5	45	45

Reporting Category, Standard, and State Performance Indicator	Text Section(s)	Practice Test 1	Practice Test 2
Reporting Category 6, Standard 5 Biodiversity & Change			
3210.5.1 Compare and contrast the structural, functional, and behavioral adaptations of animals or plants found in different environments.	Section 15, Subsection 18.1	40, 60	60
3210.5.2 Recognize the relationship between form and function in living things.	Section 15, Subsections 16.1, 17.4, 18.1, 19.2, 21.1, 21.2	55	40, 55
3210.5.3 Recognize the relationships among environmental change, genetic variation, natural selection, and the emergence of a new species.	Section 16	13	13
3210.5.4 Describe the relationship between the amount of biodiversity and the ability of a population to adapt to a changing environment.	Section 16, Subsection 20.3	28	28
3210.5.5 Apply evidence from the fossil record, comparative anatomy, amino acid sequences, and DNA structure that support modern classification systems.	Subsection 17.4, Section 18	19	19
3210.5.6 Infer relatedness among different organisms using modern classification systems.	Section 17	1	1