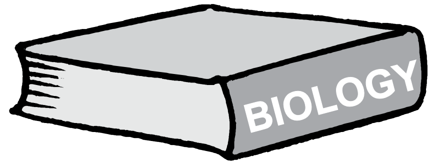
Science Basics
Appendix 1.1
Common Biology Root Words and Affixes



From your English classes, you probably remember root words and affixes. The main part of any word is called a *root word*. An *affix* is a part of a word that is added either to the beginning of a root word or to its end. A *prefix* is an affix added to the beginning of a word and a *suffix* is an affix added to the end of a word. The root word and the affix(es) make up a complete word.

The vocabulary words of biology often contain specific roots, prefixes, and suffixes. Knowing what these roots and affixes mean ahead of time can help you to remember and retain the meaning of important biology terms. The word *biology* itself is made up of a common root word and suffix. *Bio-* can be a root word or a prefix that means *life*, and *-logy* is a suffix that means *the study of*, so *biology* means *the study of life*.

Review common biology root words and affixes. Memorize the ones you don't already know.

Common Biology Root Words and Affixes

root or affix	meaning	example	root or affix	meaning	example
a-	not, without	abiotic	hydra-/hydro-	water	hydrolysis
aero-	air	aerobic	hyper-	over, excessive	hypertonic
anti-	against	antibiotic	hypo-	under, below	hypotonic
auto-	self	autotroph	iso-	same	isotonic
bi-	two	binomial	-lysis	split	glycolysis
bio-/biot-	life	biology, biotic	macro-	large	macromolecule
-bios	life, living	symbiosis	meio-	less	meiosis
chloro-	green	chlorophyll	micro-	small	microscope
co-/com-/con-	together, with	codominance	mono-	one	monomer
cyto-	cell	cytoplasm	muta-	change	mutation
di-/diplo-	two	dihybrid	-ology	the study of	geology
endo-	within, inner	endocytosis	-phil	loving	hydrophilic
ex-/exo-	out, outside	exoskeleton	-phob	fearing	hydrophobic
geo-	the earth	geology	photo-	light	photosynthesis
gluco-/glyco-	sweet, sugar	glucose	-phyll	leaf	chlorophyll
-graphy	the science of	geography	poly	many	polypeptide
haplo-	single	haploid	sym-	with, together	symbiosis
hetero-	other, different	heterotroph	-troph	food, nourishment	autotroph
homeo-/homo-	same, alike	homologues	uni-	one	unicellular

Practice

Using the chart above, make an educated guess at the meaning of the following biology terms.

________________________ 1. chlorophyll

________________________ 2. hydrophilic

________________________ 3. hydrophobic

________________________ 4. symbiotic

________________________ 5. abiotic

________________________ 6. geology

________________________ 7. hydrolysis

________________________ 8. glycolysis

Scientific Investigations

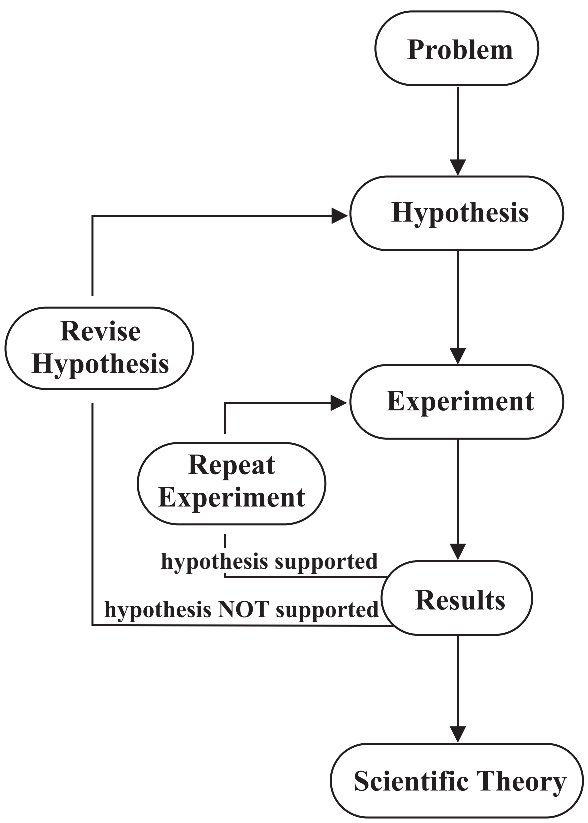
Appendix 2.1
The Scientific Method

Appendix 2.1 Important Terms

- **Experiment** – a step-by-step procedure used to test a hypothesis
- **Hypothesis** – a possible explanation or answer to a scientific problem that can be tested
- **Scientific method** – a logical set of steps used by scientists to solve a problem or to answer a scientific question
- **Theory** – an idea that is accepted as true because it is supported by repeated evidence and unifies a broad range of subjects

The **scientific method** is a series of steps in logical order that scientists use to help them solve a problem or to answer a scientific question. The general steps of the scientific process are shown below.

Steps of the Scientific Method



Start with an observation or a question.
State the problem. What do you need to find out?
Research the problem. What is already known about it?

Develop a testable statement that describes what you think will happen. This testable statement is called a **hypothesis**.

Develop a plan, called an **experiment**, to test the hypothesis:
- Determine dependent, independent, and control variables.
- Determine a control group and experimental groups.

Perform the experiment. Record and organize data.

Analyze the data. Does the data support the hypothesis?
- If so, repeat the experiment to verify the results.
- If not, revise the hypothesis and do a new experiment.

Verified results can then be reported or published.

An experiment repeated and verified many times may lead to a **theory**, an idea that is accepted as true because much evidence supports it.

Study these steps and the explanations. As you can see, each general step can be broken down into smaller steps.

Scientific Evaluation and Engineering

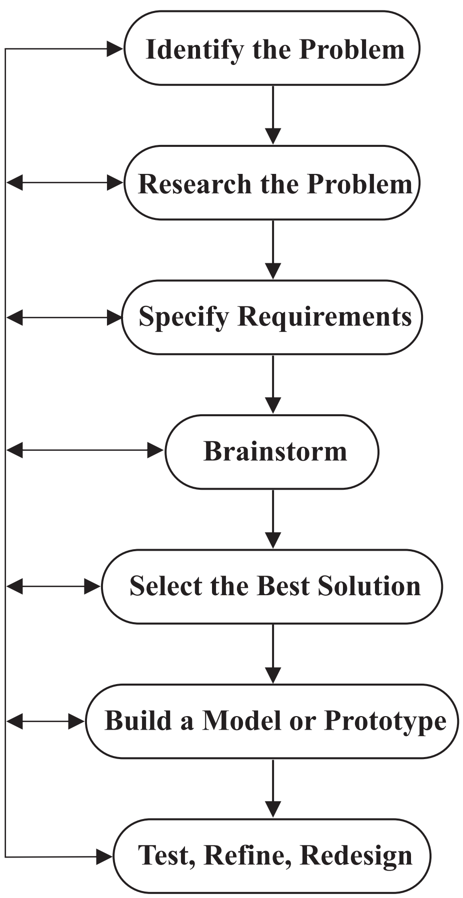
Appendix 3.3
The Engineering Design Process

Appendix 3.3 Important Terms

- **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



Engineers start with a problem.
Who needs what, and why do they need it?

Research existing solutions and technologies.
What improvements are needed?
What technologies already exist that may be applied to this problem?

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

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

Which solutions, designs, or approaches are the most promising?
What are the pros and cons of each promising idea?
After carefully analyzing each idea, which is the best?
Choose the most promising solution, design, or approach.

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

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

Performance Objective Correlation Chart (Teacher's Edition)

The chart below correlates each performance objective for the Biology I course as given in the 2018 Mississippi College- and Career-readiness Standards for Science. The Text Section column gives the section numbers in the text where each performance objective is reviewed. The Pre-Test column gives the question number(s) in the pre-test that correlates to each performance objective. (Enrichment Performance Objectives, marked with an asterisk*****, are addressed in the text as noted, but they have no corresponding pre-test questions since they are not tested on the MAAP-EOC exam.

MS CCRS Biology Disciplinary Core Idea, Standard, and Performance Objective	Text Section(s)	Pre-Test
BIO.1 Cells as a System **BIO.1A Students will demonstrate an understanding of the characteristics of life and biological organization.**		
BIO.1A.1 Develop criteria to differentiate between living and non-living things.	Subsections 1.1, 2.1, 2.6	1
BIO.1A.2 Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow.	Subsection 2.1	12
BIO.1A.3 Using specific examples, explain how cells can be organized into complex tissues, organs, and organ systems in multicellular organisms.	Subsection 2.5	13
BIO.1A.4 Use evidence from current scientific literature to support whether a virus is living or non-living.	Subsection 2.6	4
BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.		
BIO.1B.1 Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.	Subsections 1.2, 1.3, 1.4, 1.5, 1.7, 1.8, 6.2, 6.3	5, 6
BIO.1B.2 Design and conduct an experiment to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.	Subsection 1.6	7
BIO.1C Students will relate the diversity of organelles to a variety of specialized cellular functions.		
BIO.1C.1 Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria, chloroplast, centrosomes, and vacuoles) interact to carry out the functions necessary for organism survival.	Subsections 2.3, 2.4	8, 9
BIO.1C.2 Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells.	Subsections 2.2, 2.4, 12.2	2, 10
BIO.1C.3 Contrast the structure of viruses with that of cells, and explain why viruses must use living cells to reproduce.	Subsection 2.6	58
BIO.1D Students will describe the structure of the cell membrane and analyze how the structure is related to its primary function of regulating transport in and out of cells to maintain homeostasis.		
BIO.1D.1 Plan and conduct investigations to prove that the cell membrane is a semi-permeable, allowing it to maintain homeostasis with its environment through active and passive transport processes.	Subsection 2.3, Section 3	11
BIO.1D.2 Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hypertonic, hypotonic, and isotonic conditions, sodium/potassium pump).	Subsections 3.3, 3.4	14, 16

Performance Objective Correlation Chart, continued

MS CCRS Biology Disciplinary Core Idea, Standard, and Performance Objective	Text Section(s)	Pre-Test
BIO.1E Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.		
BIO.1E.1 Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.	Subsections 2.5, 5.1, 5.5, 7.2	17
BIO.1E.2 Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer).	Subsections 5.1, 5.2, 6.2	18, 19
BIO.1E.3 Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.	Subsections 5.3, 5.6	56, 59
BIO.1E.4 *Enrichment: Use an engineering design process to investigate the role of stem cells in regeneration and asexual reproduction, then develop applications of stem cell research to solve human medical conditions.	Subsection 7.2	
BIO.2 Energy Transfer **BIO.2 Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.**		
BIO.2.1 Use models to demonstrate that ATP and ADP are cycled within a cell as a means to transfer energy.	Subsection 4.1	20
BIO.2.2 Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.	Subsections 4.2, 4.5, 16.3	22
BIO.2.3 Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.	Subsections 4.3, 4.5, 16.3	24, 53
BIO.2.4 Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.	Subsection 4.3	15
BIO.2.5 *Enrichment: Investigate variables (e.g., nutrient availability, temperature) that affect anaerobic respiration and current real-world applications of fermentation.	Subsections 4.3, 4.4	
BIO.2.6 *Enrichment: Use an engineering design process to manipulate factors involved in fermentation to optimize energy production.	Subsections 4.3, 4.4	
BIO.3 Reproduction and Heredity **BIO.3A Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.**		
BIO.3A.1 Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell.	Subsections 5.4, 5.5, 5.6, 8.1	3, 25
BIO.3A.2 Compare and contrast mitosis and meiosis in terms of reproduction.	Subsections 5.3, 5.4, 5.6	26
BIO.3A.3 Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes).	Subsection 7.1	27

Performance Objective Correlation Chart, continued

MS CCRS Biology Disciplinary Core Idea, Standard, and Performance Objective	Text Section(s)	Pre-Test
BIO.3B Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.		
BIO.3B.1 Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs.	Subsections 8.1, 8.2, 8.3, 8.5	23, 55
BIO.3B.2 Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze monohybrid crosses.	Subsections 8.2, 8.3, 8.4, 8.5	60
BIO.3B.3 Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage).	Subsections 9.1, 9.2, 9.3	28, 30
BIO.3B.4 Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.	Subsection 8.5, Section 9	31, 32
BIO.3C Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.		
BIO.3C.1 Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring.	Subsection 6.1	35
BIO.3C.2 Evaluate the mechanisms of transcription and translation in protein synthesis.	Subsection 6.3	38, 41
BIO.3C.3 Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait.	Subsection 7.1	33
BIO.3C.4 Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).	Subsection 7.2	36
BIO.3C.5 *Enrichment: Investigate current biotechnological applications in the study of the genome (e.g., transcriptome, proteome, individualized sequencing, and individualized gene therapy).	Subsection 7.3	
BIO.4 Adaptations and Evolution **BIO.4 Students will analyze and interpret evidence to explain the unity and diversity of life.**		
BIO.4.1 Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs.	Subsections 10.1, 10.3, 10.4	34, 39
BIO.4.2 Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution.	Subsection 12.1, Section 13	37, 43
BIO.4.3 Construct cladograms/phylogenetic trees to illustrate relatedness between species.	Subsections 12.1, 12.2,12.3, 12.4	46
BIO.4.4 Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations.	Subsection 5.6, Section 11	40, 42

Performance Objective Correlation Chart, continued

MS CCRS Biology Disciplinary Core Idea, Standard, and Performance Objective	Text Section(s)	Pre-Test
BIO.4.5 Use Darwin's Theory to explain how genetic variation, competition, overproduction, and unequal reproductive success acts as driving forces of natural selection and evolution.	Subsection 10.2, Section 11	44
BIO.4.6 Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation).	Subsections 11.6, 11.7, 11.8	48
BIO.4.7 *Enrichment: Construct explanations for how various disease agents (bacteria, viruses, chemicals) can influence natural selection.	Subsections 11.3,11.4, 11.5	
BIO.5 Interdependence of Organisms and Their Environments **BIO.5 Students will Investigate and evaluate the interdependence of living organisms and their environment.**		
BIO.5.1 Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere.	Subsection 14.1	45
BIO.5.2 Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem.	Section 16	50, 52
BIO.5.3 Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases on the carbon dioxide cycle and global climate.	Subsections 16.1, 16.2, 17.3	54
BIO.5.4 Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids.	Section 15	21, 29
BIO.5.5 Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments.	Subsection 14.2	47, 51
BIO.5.6 Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.	Subsections 14.3, 15.4	57
BIO.5.7 Investigate and evaluate factors involved in primary and secondary ecological succession using local, real world examples.	Subsection 17.1	49
BIO.5.8 *Enrichment: Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification, or natural phenomena).	Subsections 17.2, 17.3, 17.4	
BIO.5.9 *Enrichment: Use an engineering design process to investigate and model current technological uses of biomimicry to address solutions to real-world problems.	Subsection 17.5	