# High School Science Flipchart
# Life Science

**▲ S.HS.3.1.2**
The student understands cell functions involve specific chemical reactions.

**Official Test Specifications**
- Multiple Choice
- Photosynthesis equation provided
- Can connect to chemistry indicators
- Low and Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Food molecules taken into cells provide the chemicals needed to synthesize other molecules.
- Enzymes catalyze both breakdown and synthesis in the cell.
- Identify the reactants and products of photosynthesis.

**Item Specification**
a. Describe the mechanism by which cell membranes regulate concentrations of compounds inside the cell, and distinguish between active and passive transport.
b. Explain that enzymes catalyze reactions in organisms by providing reaction sites that accept only the reacting molecules.
c. Identify water and carbon dioxide as the reactants and carbohydrates and oxygen as the products of the series of reactions known as photosynthesis. Know that the same substances are involved in the series of reactions known as respiration, with reactants and products reversed.
d. Describe the transfer and transformation of energy in photosynthesis and respiration reactions (i.e., light energy to chemical energy through photosynthesis, then to chemical energy stored in ATP, then primarily to heat and mechanical energy through respiration).
e. Identify the monomers from which organic polymers are synthesized (i.e., polysaccharides from monosaccharides, proteins from amino acids, and nucleic acids from nucleotides).

**State Assessment Practice Item**
Cells store energy in the phosphate bonds of adenosine triphosphate (ATP). Which **best** describes the type of energy stored in the bonds of an ATP molecule?

A) nuclear energy
B) X chemical energy
C) electrical energy
D) mechanical energy

QuestionId: 33165, Standard 3 "Life Science", Benchmark 1 "1", Indicator "2", Sub Indicator "2"

**▲ S.HS.3.2.1**

The student understands living organisms contain DNA or RNA as their genetic material, which provides the instructions that specify the characteristics of organisms.

**Official Test Specifications**

- Multiple Choice
- All Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**

- Nucleotides, with associated nitrogen bases (adenine, thymine, guanine, cytosine and uracil) make up DNA and RNA molecules.
- Sequences of nucleotides that either determine or contribute to a genetic trait are called genes.
- The sequence of the nucleotide bases within genes is not dictated by any known chemical or physical law.
- DNA is replicated by using a template process that usually results in identical copies.
- DNA and associated proteins supercoil during cellular replication to become structured as chromosomes.

**Item Specification**

a. Explain how DNA, nucleotides, genes, and chromosomes are related.
b. Identify the part of the cell where chromosomes are located.
c. Explain that coded genetic information in the form of nucleotide sequences determines the sequence of amino acids in protein synthesis.
d. Explain how the information for protein synthesis is copied to RNA, and explain the roles of mRNA and tRNA in protein synthesis (i.e., m(messenger) RNA carries information needed for protein construction from the nucleus to the ribosomes; t(transfer)RNA places specific amino acids in a peptide chain at the ribosome).
e. Understand that chromosomes are formed when DNA and associated proteins supercoil.
f. Recognize that the DNA in every cell of an organism is the same and that cells differentiate by expressing different parts of the DNA.
g. Identify the nitrogen base pairings in DNA (A to T and C to G).

**State Assessment Practice Item**

What are the individual strands of supercoiled DNA that are present during cell division?

A) genes
B) proteins
C) nucleotides
D) X chromosomes

QuestionId: 33182, Standard 3 "Life Science", Benchmark 2 "2", Indicator "1", Sub Indicator "1"

**▲ S.HS.3.2.3**

The student understands hereditary information is contained in genes, located in the chromosomes of each cell.

**Official Test Specifications**

- Multiple Choice
- F1 Punnett square illustrating incomplete dominance
- F2 diagram
- Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**

- An inherited trait of an individual can be determined by one gene or by many genes (a polygenic trait), and a single gene can influence more than one trait.
- The expression of traits is determined by a complex interaction of genes and the environment.
- Alleles, which are different forms of a gene, may be dominant, recessive, or co-dominant.

**Item Specification**

a. Understand that traits inherited by offspring from parents are coded in DNA.
b. Explain dominant and recessive traits in terms of expression of dominant and recessive alleles.
c. Understand that sexual reproduction involves genetic recombination, resulting in variation, while asexual reproduction does not.
d. Understand that an organism's genetic makeup (genotype) determines probabilities of how particular alleles will be expressed.
e. Understand that an organism's phenotype is the actual trait of that organism resulting from the expression of the genotype and the interaction with the environment.
f. Understand that offspring of parents may not necessarily express traits in the exact proportion predicted by the parents' genetic material (i.e., phenotypic ratios can vary from predicted genotypic ratios).
g. Understand that mutations are permanent changes in genetic code, which may benefit, but are more likely to harm, an organism. Recognize that the location of a mutation in the genetic code and the timing of the occurrence of the mutation determine its significance in affecting a trait.
h. Construct a Punnett square given dominant-recessive information of parents.
i. Use a Punnett square to predict traits of offspring.
j. Given the traits of offspring, make generalizations about the traits of their parents.
k. DO NOT assess pedigrees.

**State Assessment Practice Item**

During an investigation, tall pea plants were crossed with short pea plants. All of the offspring from this cross were tall. Which term **best** describes the tall trait for the pea plants?

A) linked
B) X dominant
C) recessive
D) codominant

QuestionId: 33191, Standard 3 "Life Science", Benchmark 2 "2", Indicator "3", Sub Indicator "3"

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| | | 3. Life | | | | |

**▲ S.HS.3.3.1**

The student understands biological evolution, descent with modification, is a scientific explanation for the history of the diversification of organisms from common ancestors.

**Official Test Specifications**

- Multiple Choice
- Diagram
- Knowledge Questions

**Instructional Examples and/or Additional Specificity**

*Not available at this time.*

**Item Specification**

a. The presence of the same materials and processes of heredity (DNA, replication, transcription, translation, etc.) is used as evidence for the common ancestry of modern organisms.
b. Patterns of diversification and extinction of organisms are documented in the fossil record. Evidence indicates that simple, bacteria-like life may have existed billions of years ago.
c. The distribution of fossil and modern organisms is related to geological and ecological changes (i.e. plate tectonics, migration). There are observable similarities and differences among fossils and living organisms.
d. The frequency of heritable traits may change over a period of generations within a population of organisms, usually when resource availability and environmental conditions change as a consequence of extinctions, geologic events, and/or changes in climate.
e. Evidence for biological evolution includes homologous skeletal and organ structures (e.g., similar bone structures in bat wings and primate hands), the fossil record, and comparing DNA.
f. Understands that rock layers of the same time period may contain similar fossils, regardless of the location of the rock layers (e.g. the more recent fossils are found above older fossils in undisturbed layers of rock)
g. Species with short life cycles can be used to directly observe evolution (e.g., bacteria developing resistance to multiple antibiotics).
h. Uses a cladogram to interpret a proposed phylogeny.

**State Assessment Practice Item**

***This indicator is new or has been altered to warrant writing new assessment questions. A released sample item will be added to this flipchart when available.*

**▲ S.HS.3.3.3**
The student understands biological evolution is used to explain the earth's present day biodiversity: the number, variety and variability of organisms.

**Official Test Specifications**
- Multiple Choice
- Diagram
- Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Separate populations within a species may become sufficiently different enough that new species develop. This process is called speciation.
- Changes in inherited traits accumulate in populations.
- Historically only a small percentage of species have survived to modern times.

**Item Specification**
a. Understands processes involved in speciation, such as geographic and temporal reproductive isolation (e.g., Darwin's finches, 13- and 17-year cicada cycles).
b. Understands that speciation can result from genetic variation, from genetic drift, and from genetic mutation. (Note: items should not address natural selection; natural selection is covered in S.HS.3.3.4.)
c. Understands that most mutations are harmful to an organism, however, some mutations have been beneficial
d. Recognizes that most of the species that have ever existed on Earth are now extinct.

**State Assessment Practice Item**

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**▲ S.HS.3.3.4**

The student understands organisms vary widely within and between populations. Variation allows for natural selection to occur.

**Official Test Specifications**

- MC
- High Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**

- Heritable variation exists in every species.
- New heritable traits result from new combinations of genes and from mutations or changes in the reproductive cells.
- Variation of organisms within and among species increases the likelihood that some members will survive under changing environmental conditions.

**Item Specification**

a. Describe the process of natural selection as the process whereby those individuals of a species best adapted to survive are the ones most likely to survive and reproduce, thereby passing their beneficial traits on to their offspring.
b. Understand that natural selection is typically a slow process in terms of the number of generations needed to cause adaptations.
c. Understand that extinction of a species can occur when the process of natural selection is too slow to produce an adaptation needed to counteract a threatening environmental change.
d. Recognize that many species that have lived on Earth are now extinct.
e. Recognize that extinction is a natural event not always related to human activity.
f. Compare the Lamarckian concept of acquired traits with the current theory of natural selection.
g. Understand that mutations are more likely to harm than to help an organism and rarely lead to a useful adaptation in a population.
h. Understand that each of the many thousands of species represents a unique adaptation to a particular environmental niche.
i. Compare artificial and natural selection.

**State Assessment Practice Item**

Which trait is **most likely** a result of artificial selection?

A) the thick fur on a polar bear
B) the green color of a tree snake
C) the hollow bones of most birds
D) X the short legs on some dog breeds

QuestionId: 33210, Standard 3 "Life Science", Benchmark 3 "3", Indicator "4", Sub Indicator "4"

**▲ S.HS.3.4.1**
The student understands atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.

**Official Test Specifications**
- MC
- Illustration/diagram of carbon cycle
- Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- The essential chemical elements for life circulate in the biosphere in characteristic paths known as biogeochemical cycles (i.e., cycles for water, nitrogen, carbon, oxygen).
- Identify a biochemical cycle illustrated in a diagram.
- Explain how burning fossil fuels affects the composition of the atmosphere.
- Describe the process that absorbs carbon from the atmosphere and cycles it into living systems.

**Item Specification**
a. Identify the chemical forms carbon takes in the carbon cycle, know where each form exists, and describe the processes (i.e., respiration, photosynthesis, combustion) that cause carbon to change form (i.e., carbon, carbohydrates, carbon dioxide).
b. Describe the forms of oxygen compounds and the processes in the oxygen cycle and understand how the oxygen cycle and carbon cycles are interwoven.
c. Identify the forms and location of nitrogen compounds (atmospheric nitrogen [$N_2$], ammonia [$NH_3$], nitrate, and nitrite) in the nitrogen cycle and explain the role of bacteria in the process.
d. Diagram the water cycle including the processes of evaporation, condensation, precipitation, runoff, transpiration, respiration, and photosynthesis.
e. Explain the mechanism whereby solar energy drives the water cycle.
f. Recognize that matter is cycled in biogeochemical cycles, whereas energy is not cycled.

**State Assessment Practice Item**
Which process in the water cycle **directly** increases in rate as the intensity of infrared solar radiation increases in an area?

A) runoff
B) X evaporation
C) precipitation
D) condensation

QuestionId: 33232, Standard 3 "Life Science", Benchmark 4 "4", Indicator "1", Sub Indicator "1"

**▲ S.HS.3.4.3**
The student understands the distribution and abundance of organisms and populations in ecosystems are limited by the carrying capacity.

**Official Test Specifications**
- Multiple Choice
- Picture/diagram of a fish tank
- Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- The carrying capacity is determined by the availability of matter and energy, and the ability of the ecosystem to recycle materials.
- Living organisms produce more offspring than environmental resources can support, resulting in a competition for resources.
- Given a diagram of fluctuating essential resources, recognize it as an illustration of carrying capacity.

**Item Specification**
a. Distinguish between resources that establish carrying capacity (i.e., matter and energy) and other environmental factors that affect population size (e.g., predators, introduction of exotic species, disease).
b. Predict the effect on the carrying capacity of changing the supply of one of the resources.
c. Interpret graphs of species population vs. time in terms of carrying capacity.

**State Assessment Practice Item**
A desert ecosystem gets two years of above average rainfall. As a result, there is more vegetation than normal. Which effect on the desert ecosystem is **most likely**?

A) Carnivore populations will decrease as plants change the landscape.
B) Some animal species will go extinct as the plants take up more space.
C) X Herbivore populations will increase in number with more plants available.
D) Animal populations will remain constant as plant populations increase independently.

QuestionId: 33249, Standard 3 "Life Science", Benchmark 4 "4", Indicator "3", Sub Indicator "3"

**▲ S.HS.3.5.2**
The student understands the sun is the primary source of energy for life through the process of photosynthesis.

**Official Test Specifications**
- Multiple Choice
- Formula for photosynthesis
- Food web illustration
- Low Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Plants and other photosynthetic organisms use energy to make organic compounds (primarily glucose) from carbon dioxide and water ($CO_2$ and $H_2O$) through a series of biochemical reactions.
- The energy in these compounds is used to assemble larger molecules with biological activity, including proteins, DNA, carbohydrates, and fats.
- These molecules serve as sources of energy for the plants themselves and for many other organisms through food webs.
- Chemosynthetic organisms, unlike photosynthetic organisms, do not depend on solar energy as the energy source for life functions.

**Item Specification**
a. Understand that electromagnetic energy from the sun is the original source of energy for most types of organisms on Earth and for the energy stored in combustible fuels.
b. Explain that the basic difference between most plants and most animals is that plants use light energy to produce their own food for energy and animals extract chemical energy stored in food materials originally synthesized by plants.
c. Describe the roles of producers, consumers, and decomposers in a food web.
d. Understand that fungi and bacteria are true decomposer organisms that break down organic matter into the smallest compounds. DO NOT use earthworms, beetles, ants, etc. as examples of decomposers (either as correct or incorrect examples).
e. Trace the path of energy through a food web.
f. Given several organisms, construct a food web.
g. Explain why only about 10% of the energy at a given trophic level of a food web is available to the next trophic level.
h. Describe how a change in the population of one type of organism in a food web affects populations of other types of organisms in the food web.
i. Understand that most energy leaving a food web eventually becomes heat energy lost to the environment.

**State Assessment Practice Item**

What is the primary form in which energy is first taken in by plants and the primary form in which energy is first taken in by animals?

A) Plants take in chemical energy, and animals take in heat energy.
B) X Plants take in light energy, and animals take in chemical energy.
C) Plants take in heat energy, and animals take in mechanical energy.
D) Plants take in electromagnetic energy, and animals take in mechanical energy.

QuestionId: 33260, Standard 3 "Life Science", Benchmark 5 "5", Indicator "2", Sub Indicator "2"

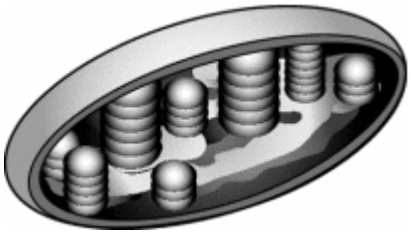
**▲ S.HS.3.5.3**
The student understands food molecules contain biochemical energy, which is then available for cellular respiration.

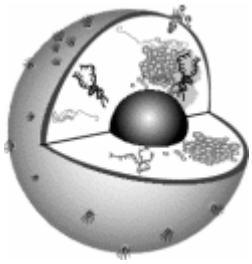
**Official Test Specifications**
- Multiple Choice
- Concept: ATP
- Glucose breaking down into carbon dioxide and water (show two way chemical reaction)
- Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Energy is released when the food molecules are broken down into simpler compounds.
- Energy is transferred to adenosine triphosphate (ATP) through cellular respiration.
- Most biochemical reactions, fueled by ATP, are catalyzed by enzymes.
- Understand that ATP powers all chemical reactions in a cell.

**Item Specification**
a. Understand that energy released during the series of reactions that take place during respiration is stored in the chemical bonds of ATP molecules.
b. Know that ATP is produced in mitochondria.
c. Understand that larger food molecules (i.e., complex carbohydrates, fats, and proteins) are broken down during digestion into basic subunits (i.e., simple sugars, fatty acids, or amino acids) that can be used directly for cellular respiration or quickly converted by the body into sources of energy.

**State Assessment Practice Item**
Which diagram **best** represents the organelle that produces ATP in the cell?

A) 

B) 

C) 

D) X 

QuestionId: 33272, Standard 3 "Life Science", Benchmark 5 "5", Indicator "3", Sub Indicator "3"

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| | | 3. Life | | | | |

**▲ S.HS. 3.6.1**
The student understands animals have behavioral responses to internal changes and to external stimuli.

**Official Test Specifications**
- Multiple Choice
- Mid Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes.
- These responses can be innate and/or learned.
- Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change.
- Recognize basic animal instincts, such as searching for food, reproduction, caring for young, as examples of innate behavior.

**Item Specification**
a. Identify a particular animal behavior as being primarily learned or primarily innate.
b. Recognize that behaviors are a result of the interaction of genetic and environmental influences.
c. Describe instinctive reactions to seasonal change (e.g., hibernation, migration, color change).
d. Given an external stimulus (e.g., temperature change, competition, predator, population pressure, disease) identify a behavioral response (e.g., migration, aggression, camouflage, food storage, mating display).

**State Assessment Practice Item**
Which is the **most** learned and the **least** innate in male sparrows?

A) singing patterns
B) coloration of feathers
C) X location of food sources
D) aggression during mating season

QuestionId: 33296, Standard 3 "Life Science", Benchmark 6 "6", Indicator "1", Sub Indicator "1"

**▲ S.HS.3.7.2**
The student understands that homeostasis is the dynamic regulation and balance of an organism's internal environment to maintain conditions suitable for survival.

**Official Test Specifications**
- Multiple Choice
- Diagram
- Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- The systems of an organism interact with one another to maintain homeostasis.

**Item Specification**
a. Recognize that organisms maintain homeostasis in different ways (e.g., humans sweating, dogs panting, reptiles resting in sunlight, humans adjusting to altitude by producing more red blood cells).
b. Describe and predict how transport of substances across membranes is related to maintaining homeostasis (e.g., red blood cells in pure water vs. salt solution).
c. Body temperature and heart rate are related to maintaining homeostasis.
d. Organisms may have specialized structures designed to monitor and maintain homeostasis (including buffers).

**State Assessment Practice Item**

***This indicator is new or has been altered to warrant writing new assessment questions. A released sample item will be added to this flipchart when available.*

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| ▲ **S.HS.3.7.3**<br>The student understands that living things change following a specific pattern of developmental stages called life cycles. |
| **Official Test Specifications**<br>• Multiple Choice<br>• Diagram<br>• Knowledge Questions |
| **Instructional Examples and/or Additional Specificity**<br><br>*Not available at this time.* |
| **Item Specification**<br>a. Compare and contrast the life cycles of different organisms (both plants and animals), including those that go through metamorphosis and periods of dormancy.<br>b. Recognize that all organisms go through life cycle stages.<br>c. Recognize that certain species alternate sexual and asexual stages in their typical life cycle. |
| **State Assessment Practice Item**<br><br>***This indicator is new or has been altered to warrant writing new assessment questions. A released sample item will be added to this flipchart when available.* |

**▲ S.HS.4.2.1**
The student understands geological time is used to understand the earth's past.

**Official Test Specifications**
- Multiple Choice
- Diagrams of geologic time scale, each showing different proportional size of 4 eras
- Low Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Radioactive dating and relative dating (i.e., stratigraphy, fossils) are used to estimate the time rocks were formed.
- Earth changes can be short term (during a human's lifetime), such as earthquakes and volcanic eruptions, or long term (over a geological time scale), such as mountain building and plate movements.
- The Earth's atmosphere has changed over time. For example, the dramatic changes in Earth's atmosphere (i.e., introduction of $O_2$), was caused by the emergence of life on Earth.
- Relate geologic evidence to a record of Earth's history.
- Explain the presence of sedimentary rock in Kansas.
- Given a choice of diagrams of geologic time scales, choose the one with the correct proportions.

**Item Specification**
a. Recognize that the current accepted age of Earth is about 4.5 billion years.
b. Understand that geologic time periods are based on major geologic and paleontologic events (e.g., mass extinctions, glaciation, climatic changes).
c. Explain and apply the principle of superposition in establishing relative ages of rock strata.
d. Understand that radioactive dating has made it possible to assign reference dates to specific rock layers in strata.

**State Assessment Practice Item**
Scientific evidence indicates that the concentration of oxygen in Earth's atmosphere increased dramatically approximately 2 billion years ago. Which event **most** closely coincides with this change in Earth's atmosphere?

A) mammals appeared on land
B) volcanic outgassing increased
C) decay of organic matter increased
D) X photosynthetic organisms appeared

QuestionId: 33332, Standard 4 "Earth and Space Science", Benchmark 2 "2", Indicator "1", Sub Indicator "1"

**▲ S.HS.6.3.1**
The student understands natural resources from the lithosphere and ecosystems are required to sustain human populations.

**Official Test Specifications**
- Multiple Choice
- Low Level Knowledge Questions

**Instructional Examples and/or Additional Specificity**
- Understand that the processes of ecosystems required to sustain human populations include maintenance of the atmosphere, generation of soils, control of the hydrologic cycle, and recycling of nutrients. Humans are altering many of these processes, and the changes may be detrimental, beneficial, or both to ecosystem function.
- Natural systems can reuse waste, but this capacity is limited. Recycling and environmentally sound decisions improve the quality of human life.

**Item Specification**
a. Explain how human activities (e.g., power production, livestock operations, controlled burning) can change the relative abundance of atmospheric gases (e.g., $CO_2$, $H_2O$, $CH_4$, $H_2S$, $SO_2$, $O_3$), relate these changes to consequences, and explain the mechanisms that cause the consequences.
b. Explain how human activities (e.g., use of pesticides and herbicides, fertilizers, livestock operations, landfills, irrigation practices, urbanization, removing forest cover) affect the abundance and quality of fresh water.
c. Explain how human activities affect the availability and quality of soil and soil nutrients (e.g., stream and river management, farming practices, ranching practices, and mining practices).
d. Explain how changing vegetation cover can affect localized climate conditions.
e. Explain the concept of sustainable yield as it relates to forest products, fisheries, soil nutrients, etc.
f. Distinguish among resources that are renewable, renewable through very slow processes (e.g., soils), and nonrenewable.

**State Assessment Practice Item**
Large scale clear-cutting of forests near a heavily populated area would **most likely** result in a local increase in which atmospheric gas?

A) Oxygen
B) sulfur dioxide
C) nitrogen
D) X carbon dioxide

QuestionId: 33425, Standard 6 "Science in Personal and Environmental Perspectives", Benchmark 3 "3", Indicator "1", Sub Indicator "1"

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| | | | | | 6. Perspectives | |