AP Biology
Essential Knowledge
Student Diagnostic

Background

The Essential Knowledge statements provided in the AP Biology Curriculum Framework are scientific claims describing phenomenon occurring in the physical world. These statements represent conclusions drawn from myriad scientific experimentations and observations. This is in contrast with conjecture, an opinion formed with insufficient supporting information. The Essential Knowledge statements are supported by multiple lines of evidence with examples found in widely published scientific research.

Scientific claims are fully understood when evaluated against supporting evidence found in scientific literature. Students of AP Biology will not only learn statements of Essential Knowledge but be able to evaluate and describe the supporting evidence.

Scientific claims can be incorporated into a broader concept, the scientific explanation. There is research to suggest that a scientific explanation will incorporate three features. These features include the claim, the supporting evidence, and the reasoning for how the evidence supports the claim (McNeill & Krajcik, 2008).

Assignment

- Read each Essential Knowledge (EK) statement as listed in the attachment "AP Biology Concepts at a Glance."

- Enter a code in the "comprehension level" column, next to each of the EK statements. Choose a code from the following list.
  Note: Use the code for your CURRENT knowledge that you will bring with you to the course
    - **UC** – I understand this claim and can support the concept with evidence.
    - **KC** – I know this claim but cannot support the concept with specific evidence.
    - **NC** – I have not encountered this claim before; this is a new concept to me.

- Choose one Essential knowledge that you labeled UC (if no Essential Knowledges are labeled UC, then skip this step and do 2 in the next step)
  a. State the Essential Knowledge.
  b. Describe a piece of evidence that supports this Essential Knowledge.
  c. Provide the reasoning behind your selection of this particular evidence.
- Choose one Essential knowledge that you labeled KC or NC (or choose 2 if you had no UC labels)
  A. State the Essential Knowledge.
  B. Research the topic using reliable academic sources. Describe a piece of evidence that supports this Essential Knowledge.
  C. Provide the reasoning behind your selection of this particular evidence.

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EXAMPLE:

Statement of Essential Knowledge
Essential knowledge 2·B·1: Cell membranes are selectively permeable due to their structure·
Evidence that supports this claim
Some molecules enter and leave the cell via "gated" channel proteins embedded in the cell membrane· These transport proteins open and close in response to changes in the cellular environment·
How does the evidence support the claim?
Gated channel proteins function as selective barriers, allowing cells to regulate the uptake of certain molecules while restricting the passage of others·

References

McNeill, K. L. and J. Krajcik (2008). Scientific explanations: Characterizing and evaluating the effects of teachers' instructional practices on student learning. *Journal of Research in Science Teaching* 45(1): 53-78.

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AP Biology Concepts at a Glance

Big Idea 1: The process of evolution drives the diversity and unity of life.

For each of the statements of **Essential Knowledge**, indicate your comprehension level by filling in the appropriate code from the choices below.

UC – I understand this claim and can support the concept with evidence.

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NC – I have not encountered this claim before; this is a new concept to me.

		Comprehension Level
Enduring understanding 1.A: Change in the genetic makeup of a population over time is evolution.	**Essential knowledge 1.A.1**: Natural selection is a major mechanism of evolution.	
	Essential knowledge 1.A.2: Natural selection acts on phenotypic variations in populations.	
	Essential knowledge 1.A.3: Evolutionary change is also driven by random processes.	
	Essential knowledge 1.A.4: Biological evolution is supported by scientific evidence from many disciplines, including mathematics.	
Enduring understanding 1.B: Organisms are linked by lines of descent from common ancestry.	**Essential knowledge 1.B.1**: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.	
	Essential knowledge 1.B.2: Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.	
Enduring understanding 1.C: Life continues to evolve within a changing environment.	**Essential knowledge 1.C.1**: Speciation and extinction have occurred throughout the Earth's history.	
	Essential knowledge 1.C.2: Speciation may occur when two populations become reproductively isolated from each other.	
	Essential knowledge 1.C.3: Populations of organisms continue to evolve.	
Enduring understanding 1.D: The origin of living systems is explained by natural processes.	**Essential knowledge 1.D.1**: There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.	
	Essential knowledge 1.D.2: Scientific evidence from many different disciplines supports models of the origin of life.	

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Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

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		Comprehension Level
Enduring understanding 2.A: Growth, reproduction and maintenance of the organization of living systems require free energy and matter.	**Essential knowledge 2.A.1:** All living systems require constant input of free energy.	
	Essential knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.	
	Essential knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.	
Enduring understanding 2.B: Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.	**Essential knowledge 2.B.1**: Cell membranes are selectively permeable due to their structure.	
	Essential knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.	
	Essential knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.	
Enduring understanding 2.C: Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.	**Essential knowledge 2.C.1**: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.	
	Essential knowledge 2.C.2: Organisms respond to changes in their external environments.	

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Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

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		Comprehension Level
Enduring understanding 2.D: Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.	**Essential knowledge 2.D.1**: All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.	
	Essential knowledge 2.D.2: Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.	
	Essential knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.	
	Essential knowledge 2.D.4: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.	
Enduring understanding 2.E: Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.	**Essential knowledge 2.E.1**: Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms.	
	Essential knowledge 2.E.2: Timing and coordination of physiological events are regulated by multiple mechanisms.	
	Essential knowledge 2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.	

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Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

For each of the statements of **Essential Knowledge**, indicate your comprehension level by filling in the appropriate code from the choices below.

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		Comprehension Level
Enduring understanding 3.A: Heritable information provides for continuity of life.	**Essential knowledge 3.A.1:** DNA, and in some cases RNA, is the primary source of heritable information.	
	Essential knowledge 3.A.2: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.	
	Essential knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.	
	Essential knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.	
Enduring understanding 3.B: Expression of genetic information involves cellular and molecular mechanisms.	**Essential knowledge 3.B.1**: Gene regulation results in differential gene expression, leading to cell specialization.	
	Essential knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.	
Enduring understanding 3.C: The processing of genetic information is imperfect and is a source of genetic variation.	**Essential knowledge 3.C.1**: Changes in genotype can result in changes in phenotype.	
	Essential knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.	
	Essential knowledge 3.C.3: Viral replication results in genetic variation and viral infection can introduce genetic variation into the hosts.	

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Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

For each of the statements of **Essential Knowledge**, indicate your comprehension level by filling in the appropriate code from the choices below.

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		Comprehension Level
Enduring understanding 3.D: Cells communicate by generating, transmitting and receiving chemical signals.	**Essential knowledge 3.D.1**: Cell communication processes share common features that reflect a shared evolutionary history.	
	Essential knowledge 3.D.2: Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.	
	Essential knowledge 3.D.3: Signal transduction pathways link signal reception with cellular response.	
	Essential knowledge 3.D.4: Changes in signal transduction pathways can alter cellular response.	
Enduring understanding 3.E: Transmission of information results in changes within and between biological systems.	**Essential knowledge 3.E.1**: Individuals can act on information and communicate it to others.	
	Essential knowledge 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.	

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Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

For each of the statements of **Essential Knowledge**, indicate your comprehension level by filling in the appropriate code from the choices below.

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KC – I know this claim but cannot support the concept with specific evidence.

NC – I have not encountered this claim before; this is a new concept to me.

		Comprehension Level
Enduring understanding 4.A: Interactions within biological systems lead to complex properties.	**Essential knowledge 4.A.1:** The subcomponents of biological molecules and their sequence determine the properties of that molecule.	
	Essential knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.	
	Essential knowledge 4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.	
	Essential knowledge 4.A.4: Organisms exhibit complex properties due to interactions between their constituent parts.	
	Essential knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.	
	Essential knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.	
Enduring understanding 4.B: Competition and cooperation are important aspects of biological systems.	**Essential knowledge 4.B.1**: Interactions between molecules affect their structure and function.	
	Essential knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.	
	Essential knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.	
	Essential knowledge 4.B.4: Distribution of local and global ecosystems changes over time.	
Enduring understanding 4.C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.	**Essential knowledge 4.C.1**: Variation in molecular units provides cells with a wider range of functions.	
	Essential knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.	
	Essential knowledge 4.C.3: The level of variation in a population affects population dynamics.	
	Essential knowledge 4.C.4: The diversity of species within an ecosystem may influence the stability of the ecosystem.	

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