Advanced Placement Biology Vocabulary

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

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.

Subobjective 2.1: I can explain how biological systems use free energy based on empirical data that all organisms require constant energy input to maintain organization, to grow and to reproduce.

1. What is the relationship between energy and matter?
    1) Energy
       The ability to make a change
    2) Kinetic energy
       Energy of motion
    3) Heat
       Measure of the movement of energy from one place to another
    4) Potential energy
       Stored energy due to location or position
    5) Chemical energy
       Potential energy associated with the covalent bonds that hold atoms and molecules together
    6) Matter
       Anything with mass and volume
    7) Element
       A substance that cannot be broken down chemically into another substance
    8) Compound
       A substance made of two or more different elements
    9) Emergent property
       Properties of a system that arise due to complexity and cannot be attributed to the properties of the parts of the system (one of the unifying themes in biology)

2. How does the structure of atoms determine an element's properties?
    10) Atom
        The smallest unit of an element. Composed of a dense nucleus orbited by electrons
    11) Neutron
        A subatomic particle that is a component of the nucleus. It has no charge and a change in the number of them changes the isotope of the atom
    12) Proton
        A subatomic particle that is a component of the nucleus. It has a +1 charge and the number of them determines the type of atom
    13) Electron
        A subatomic particle that has a -1 charge. They are involved in bonding.

3. How does chemical bonding between atoms determine the formation and function of molecules?

14) Valence electrons
Electrons in the outermost energy level (they are involved in bonding and therefore determine the chemistry of an atom)

15) *Covalent bond*
Sharing one or more pairs of electrons

16) Molecule
2 or more atoms covalently bonded together

17) *Electronegativity*
How good an atom or molecule is at attracting electrons

18) Nonpolar covalent bond
A covalent bond where the electron pair is shared equally

19) Polar covalent bond
A covalent bond where the electron pair is shared unequally

20) *Ionic compound*
A combination of 2 different kinds of ions in a fixed ratio

21) *Ion*
A charged atom or compound

22) *Hydrogen bond*
An intermolecular force that holds two molecules together. It results from unequal electron sharing between a hydrogen atom and another atom it is covalently bonded to

23) Van der Waals forces
Weak interactions between atoms due to the constant movement of electrons causing brief moments of positive and negative charges around the atom

3b. What causes pH change and how does pH affect the function of molecules?

24) Mole
All you need to know is it's a really big number. 6.02×10^{23}

25) *Acid*
A molecule that gives up hydrogen ions in a solution

26) *Base*
A molecule that gives up hydroxide ions in a solution or a molecule that takes hydrogen ions out of solution

27) *Molarity*
It is a unit of concentration. It tells you how many moles of something is in one liter of water

28) *pH*
The concentration of hydrogen ions in a solution

29) *Buffer*
A molecule that resists pH changes because it can take up excess H^+ or OH^-

4. What are chemical reactions and what are their characteristics?

30) Chemical reaction
Making and breaking bonds resulting in a rearrangement of atoms and molecules

31) *Law of conservation of matter*
Matter cannot be created nor destroyed UNDER NORMAL CONDITIONS

5. How does life on Earth obey the laws of thermodynamics?

32) Thermodynamics
The study of energy transfers

33) First law of thermodynamics
Energy cannot be created nor destroyed. It only changes "forms"

34) *Second law of thermodynamics*
Disorder (entropy) increases in a closed system

6. How does life transform an increase in entropy from the Sun into a decrease in entropy on Earth?
7. How does free-energy change of a reaction tell us whether or not the reaction occurs spontaneously?

35) *Free energy*
The portion of a system's energy that can perform work when temperature and pressure are uniform

36) *Enthalpy*
Total energy of a system

37) *Chemical equilibrium*
When forward and backward reactions occur at the same rate

38) *Exergonic reaction*
A reaction where the free energy is lost (ΔG is negative)

39) *Endergonic reaction*
A reaction were the free energy is gained (ΔG is positive)

8. How does ATP power cellular work?

40) Energy coupling
Use of an exergonic pathway to drive an endergonic pathway utilizing ATP as an intermediate

41) *Hydrolysis*
A chemical reaction that consumes one water molecule and breaks up one molecule into two molecules releasing energy

42) *ATP*
Adenosine triphosphate. It is the energy currency of all life on the planet

43) *Phosphorylated intermediate*
A molecule that is phosphorylated, which couples an exergonic and endergonic reaction

Subobjective 2.2: I can defend a scientific claim that free energy is required for living systems to maintain organization, to grow, or to reproduce, but that multiple strategies for obtaining and using energy exist in different living systems.

9. What is the relationship between metabolism and homeostasis?

44) *Metabolism*
All of the chemical reactions that sustain an organism

45) Catabolism
Breaking down complex molecules into smaller ones releasing energy

46) Anabolism
Building up complex molecules from smaller ones consuming energy

47) Metabolic rate
The amount of energy an organism uses per unit of time

48) *Homeostasis*
Maintenance of internal conditions within a narrow range

10. How do form, function, and behavior influence thermoregulation?

49) *Endothermic*
An organism that maintains a relatively constant internal body temperature mostly by generating heat from metabolism

50) *Ectothermic*
An organism that mainly heats its internal environment with external sources

Subobjective 2.3: I can predict how changes in free energy availability affect organisms, populations, and/or ecosystems.

11. How do free energy changes affect individuals and populations?
12. How does free energy flow in an ecosystem?

51) *Producer*
Organisms that make their own carbon compounds (organic compounds) by photosynthesis or chemosynthesis

52) *Chemosynthesis*
Making carbon compounds using energy from the bonds holding inorganic molecules together (examples are hydrogen gas (H_2) and hydrogen sulfide (H_2S)

53) *Autotroph*
An organism that makes its own organic molecules by photosynthesis or chemosynthesis (all are producers)

54) *Heterotroph*
An organism that gets its organic molecules from other organisms (all are consumers)

55) *Trophic level*
Feeding level (where on a food chain you get your organic molecules)

Essential knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.

Subobjective 2.4: I can use representations to pose scientific questions about what mechanisms and structural features allow organisms to capture, store and use free energy.

13. How do photoautotrophs capture free energy?

56) Photoautotroph
An organism that makes its own food (organic compounds) using free energy from the Sun

57) Light
Electromagnetic radiation that we can see

58) Electromagnetic spectrum
The range of light radiation

59) Photon
The quantum unit or particle of electromagnetic radiation

60) *Protein*
A sequence of amino acids that fold up taking on a shape that determines their function

61) *Pigment*
A protein that absorbs certain wavelengths of light

62) Spectrophotometer
A device that directs photons of light of various wavelengths through a solution and measures the amount of radiation that is transmitted

63) *Chlorophyll *a**
The main pigment used by most photosynthesizing organisms to trap free energy from the Sun

14. How do chemoautotrophs capture free energy?

64) Chemoautotroph
An organism that uses the free energy in the bonds holding inorganic molecules together to make its food (synthesizing organic compounds)

15. What are the macromolecules heterotrophs and autotrophs utilize to derive the free energy necessary to drive endergonic reactions?

65) *Polymer*
A molecule made of similar or identical molecules (monomers) covalently bonded together

66) *Dehydration reaction*
A type of condensation reaction that binds monomers together resulting in the release of one water molecule

67) *Carbohydrate*
One or more saccharide (sugar) molecules covalently bonded together. They have many functions including being a source for free energy storage.

68) Disaccharide
A carbohydrate composed of 2 monosaccharides

69) Polysaccharide
A carbohydrate composed of many monosaccharides

70) *Lipid*
A macromolecule that is not a polymer. They have many functions, including insulation, protection, and storage of free energy

16. How does NAD^+ behave like an electron shuttle?

71) *Enzyme*
A protein catalyst. It speeds up reactions and doesn't get used up in the reaction.

72) *Active site*
The substrate binding region of the enzyme

73) *Oxidative – reduction reaction (redox)*
A reaction where one species gains electrons therefore becoming reduced by taking electrons from another species, which is oxidized

74) Reducing agent
A substance that donates electrons (it becomes oxidized)

75) Oxidizing agent
A substance that receives electrons (it becomes reduced)

76) *Cellular respiration*
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + Energy (ATP + heat)

77) *NAD^+*
The electron shuttle used in cellular respiration

Subobjective 2.5: I can construct explanations of the mechanisms and structural features of cells that allow organisms to capture, store or use free energy.

17. How do heterotrophs capture free energy?

78) *Substrate-level phosphorylation*
ATP synthesis mediated by enzymes that transfer a phosphate group from a molecule (substrate) to ADP

79) *Glycolysis*
The near universal metabolic pathway that oxidizes glucose into 2 3-carbon molecules. The negative free energy change is used to make 2 ATP molecules and 2 NADH molecules
80) *Alcohol fermentation*
NAD^+ is regenerated by reducing pyruvate to ethanol
81) *Lactic acid fermentation*
NAD^+ is regenerated by reducing pyruvate to lactate
82) *Anaerobic*
Not with oxygen
83) *Aerobic*
With oxygen

18. What happens to the products of glycolysis?

84) *Mitochondria*
Organelles (small cellular structures) that produce the majority of the ATP used by the cell
85) *Endosymbiont theory*
Some cellular structures such as mitochondria and chloroplasts evolved from symbiotic relationships between proto-eukaryotic and prokaryotic cells
86) *Prokaryote*
A single-celled organism composed of two domains (Archaea and Bacteria). They typically have a cell wall, no membrane bound organelles and a single "circular" chromosome
87) *Eukaryote*
An organism composed of one or more cells with membrane bound organelles, a true nucleus, and multiple linear chromosomes
88) *Oxidative phosphorylation*
ATP synthesis driven by the redox reactions of the electron transport chain. Inorganic phosphate is added to ADP by ATP synthase.
89) ATP synthase
The enzyme complex that utilizes a proton gradient to drive the endergonic synthesis of ATP from ADP and inorganic phosphate

19. What happens to acetyl CoA?

20. Where do the high energy electrons of the electron transport chain come from and why is oxygen essential for electron flow?

90) *Kreb's cycle (also called the citric acid cycle)*
The complete oxidation of acetyl CoA into CO_2 forming 1 ATP, 3 NADPH, and 1 $FADH_2$ per acetyl CoA molecule
91) *Electron transport chain*
A series of protein complexes that use the free energy in the electrons of NADH and $FADH_2$ to create a proton (hydrogen ion) gradient across a membrane

21. How is the free energy of the proton gradient generated by the electron transport chain used to make ATP?

92) Chemiosmosis
Energy stored in the form of a hydrogen ion H+ gradient across a membrane is utilized to generate ATP
93) Proton-motive force
The capacity of the H^+ gradient to do work (generate ATP) established by the electron transport chain

22. How is the rate of glycolysis synchronized to the rate of the Kreb's cycle?

94) *Noncompetitive inhibition*
When a molecule binds allosterically (away from the active site) of an enzyme causing a shape change in the active site that prevents the substrate from binding and therefore inhibits the functioning of the enzyme

95) *Feedback inhibition*
A metabolic pathway that is switched off by the inhibitory binding of its end product to an enzyme that acts early in the pathway

23. What is an example of an alternative to oxygen as a final electron acceptor?

96) *Anaerobic respiration*
The complete breakdown of organic molecules for energy using a final electron acceptor other than oxygen

24. What are the structures involved in photosynthesis?

97) *Chloroplasts*
Organelles within plant cells and some protists where photosynthesis occurs

98) *Protist*
A polyphyletic grouping of eukaryotic organisms that is typically unicellular, but may be multicellular, without tissues. There are plantlike, animal-like, and fungus-like groups

99) *Stomata (singular is stomate)*
Openings in a leaf that allow for gas exchange

100) Stroma
The fluid interior of the inner membrane of the chloroplast (analogous to the cytosol)

101) Thylakoids
Stacked sacs within the stroma that contain photosystems II and I within their membranes

102) *Absorption spectrum*
The percentage absorption of various wavelengths of light by something

25. Where does the oxygen produced by photosynthesis come from?

103) *Photosynthesis*
$6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

104) *Isotope*
An alternative form of an element with a different mass number because it has more or less neutrons. They typically have identical chemical behavior

26. Where do the electrons that flow through photosystems II and I come from and where do these electrons get their free energy?

105) *Carotenoids*
Orangish pigments found in plant cells that protect chlorophyll *a* from harmful radiation and increase the range of light absorption

106) *Photosystem II*
A series of light dependent reactions that produce a proton gradient in the thylakoid lumen (space of thylakoid)

107) *$NADP^+$*
The electron shuttle for the Calvin cycle in photosynthesis

108) *Photosystem I*
A series of light dependent reactions that reduce $NADP^+$ to NADPH

27. What is the role of $NADP^+$ and what is the purpose of electron flow?
28. What do the light reactions generate and how?
29. How does the Calvin cycle use the chemical energy of ATP and NADPH to reduce CO_2 to sugar

109) *Calvin cycle*

A series of reactions that fix CO_2 and produce G3P (glyceraldehyde-3-phosphate), which is used to make glucose and other carbon compounds in photosynthesizing organisms.

30. How did life on Earth change after the evolution of photosynthesis?

Subobjective 2.41: I can evaluate data to show the relationship between photosynthesis and respiration in the flow of free energy through a system.

31. What is the evidence that supports the relationship between photosynthesis and respiration?

Essential knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

Subobjective 2.6: I can use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion.

32. How is surface to volume ratio calculated and how does an increase in cell size affect it?
33. How does surface to volume ratio affect how an organism exchanges matter and energy with the environment?

110) *Diffusion*

The spontaneous movement from an area of relatively high concentration to an area of relatively low concentration

Subobjective 2.7: I can explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination.

34. Why are mouse cells the same size as elephant cells?

111) Microvilli

Tiny projections of the cell membranes that contain cytoplasm found in certain cell types. They are used to increase absorption rate by increasing surface area

112) Root hairs

Tiny projections of the roots of plants that greatly increase surface area and therefore absorption

Subobjective 2.8: I can justify the selection of data regarding the types of molecules that an animal, plant or bacterium will take up as necessary building blocks and excrete as waste products.

35. What are the building blocks of life?

113) Macromolecule

A large molecule; typically, but not always, composed of monomers covalently bonded together by dehydration reactions

Subobjective 2.9: I can represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent use of these molecules to build new molecules that facilitate dynamic homeostasis, growth and reproduction.

36. How do nutrients cycle?

114) Detritus

Dead organic matter (bits of organisms and feces)

115) *Decomposer*

An organism that consumes detritus (they are essential for returning the nutrients locked up in producers and consumers to the environment)

37. How does carbon cycle?

38. How does nitrogen cycle?

116) *Nucleic acids*

Polymers of nucleotides. They are the hereditary material for all living things (DNA). RNA is the hereditary material for some viruses and is essential for translating the information in DNA into protein

117) *Mutualism*

A symbiotic relationship between 2 different species where both species benefit from the relationship

39. How does phosphorous cycle?

40. How do the four emergent properties of water contribute to Earth's suitability for life

118) *Xylem*

Vascular tissue found in vascular plants specialized for the transport of water

119) *Watershed*

A drainage basin

120) Cohesion

Sticking together

121) Adhesion

Sticking to other things

122) Temperature

The average kinetic energy of a volume of matter

123) calorie (c)

The amount of heat required to raise the temperature of 1 gram of water $1^{o}C$

124) kilocalorie (C)

1000 calories (c)

125) Joule (J)

A measure of energy like calorie

126) *Heat capacity*

The amount of heat necessary to change the temperature of a substance

127) Specific heat capacity or specific heat

The heat capacity per unit of mass

128) *Solvent*

A liquid that other substances dissolve in

129) *Solute*

A substance that dissolves in a solvent

130) *Solution*

A liquid with evenly distributed solute dissolved in a solvent

131) *Hydrophilic*

A substance that is attracted to water because it is polar

132) *Hydrophobic*

A substance that repels water because it is mostly nonpolar

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.

Subobjective 2.10. I can use representations and models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure.

41. What was the importance of membranes for the evolution of life and for the evolution of complex life?

133) *Ribozyme*

An RNA molecule that is a catalyst

42. Why is the plasma membrane referred to as a fluid mosaic?

134) *Phospholipid*

The type of lipid membranes are composed of. They typically have 2 fatty acid tails (one saturated and one unsaturated) that are hydrophobic, and a hydrophilic head group containing a phosphate molecule.

135) *Fatty acid*

A molecule with a carboxyl group followed by a hydrocarbon chain of varying length and saturation

136) *Saturated fatty acid*

Has all carbon atoms in the hydrocarbon chain with 4 bonds

137) *Unsaturated fatty acid*

Has one or more carbon atoms in the hydrocarbon chain with a double bond

138) *Glycoprotein*

A protein with a short carbohydrate (oligosaccharide) attached. They have numerous roles and are essential for cell to cell recognition and communication

139) *Glycolipid*

A lipid with a carbohydrate attached. They are mostly used for cell recognition and cell to cell attachment.

140) Peripheral protein

A protein that attaches (often reversibly) to the plasma membrane. They are involved in signal transduction (translation of a chemical signal from the outside of the cell into a cellular response). They are often the regulatory units of channel proteins and transmembrane protein receptors.

141) Integral protein

Proteins that are permanently attached to the plasma membrane. They have diverse functions including cell adhesion, enzymes, channel proteins, receptor proteins, and transmembrane proteins

142) *Cholesterol*

A type of lipid composed of 4 carbon rings. They form a starting molecule for steroid hormones and fat soluble vitamins such as vitamin D and they regulate the viscosity of cell membranes.

Subobjective 2.11. I can construct models that connect the movement of molecules across membranes with membrane structure and function.

43. What determines what goes into and what leaves a cell?

143) *Selective permeability*

A property of plasma membranes. Allowing some substances to pass through and preventing others from passing

44. What are cell walls composed of and what is their function?

144) *Cell wall*

An organelle found in all plant cells, most prokaryotic cells and photosynthesizing protists. It is found on the outside of the plasma membrane where it protects and helps regulate osmotic balance.

145) *Cellulose*

A polysaccharide composed of glucose monomers. It is the main component of plant and protist cell walls

Essential knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

2.12 I can use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes.

45. How do molecules that are impermeable to the plasma membrane cross the plasma membrane?

146) *Passive transport*

Movement of substances into and out of a cell without using energy

147) *Facilitated diffusion*

Passive transport of molecules that are polar or relatively large that require a channel protein or a carrier protein

148) *Channel proteins*

A type of transport protein that makes a pore in the plasma membrane allowing specific substances in or out

149) Aquaporins

Channel proteins specific for water molecules

150) *Carrier proteins*

A type of transport protein that changes shape in the presence of a specific substance in such a way that the substance is shuttled across the membrane

151) *Osmosis*

The diffusion of water across the plasma membrane

152) *Osmolarity*

A measure of concentration like molarity (M) expressed as osm/L. It is different because it considers dissociation of ions in solution. For example, one mole NaCl in a liter of water would be a 1M solution. However, its _____ would be 2osm/L because the sodium and chloride dissociate and both ions have an osmotic effect.

153) *Water potential*

The potential for water to move (water moves from a high to a low potential)

154) *Solute potential*

The potential for water to move in a solution

155) *Pressure potential*

A measure of force applied over an area

156) *Isotonic*

A solution with the same concentration of solutes as the cell's fluid

157) *Hypertonic*

A solution with a higher concentration of solute than the cell's fluid

158) *Hypotonic*

A solution with a lower concentration of solute than the cell's fluid

46. What is active transport and why is it necessary?

159) *Active transport*
Transport of products that requires energy (ATP)

160) Voltage
A difference in charge (it measures electrical potential energy)

161) Membrane potential
The voltage across the plasma membrane

162) *Electrochemical gradient*
The combined forces of concentration gradients of solutes and the voltage gradient across the plasma membrane

163) *Cotransport*
The movement of a substance against its concentration gradient via a transport protein that utilizes another substance going down its concentration gradient

47. How are large things transported across the plasma membrane?

164) *Exocytosis*
The active transport of cellular products out of the cell by fusing a vesicle with the plasma membrane

165) *Phagocytosis*
A type of endocytosis. Cell "eating" a large vesicle forms around large particles, viruses, and bacteria

166) *Ligand*
A substance that binds to a receptor site of another substance

167) *Receptor-mediated endocytosis*
Endocytosis of specific substances that bind to receptors

Essential knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

2.13 I can explain how internal membranes and organelles contribute to cell functions.

48. How does the nuclear membrane of eukaryotic cells contribute to the function of the nucleus?

168) *Gene*
A sequence of nucleotides of a DNA molecule that is a code for making a protein

169) *mRNA*
Ribonucleic acid that is a copy of a gene

170) *Transcription*
Converting the code of a gene into an mRNA molecule

171) *Translation*
Converting the code of an mRNA molecule into a protein

49. How does the endomembrane system regulate protein and other cell product traffic?

172) *Endomembrane system*
It synthesizes molecules and transports them, and detoxifies poisons. The nuclear envelope, endoplasmic reticulum, Golgi apparatus, lysosomes, various vesicles and vacuoles, and the plasma membrane

173) *Vesicle*
A small membrane bound sac

174) *Ribosomes*
Organelles composed of rRNA and proteins. They synthesize proteins

175) *Smooth endoplasmic reticulum*
Synthesizes various molecules necessary for the cell such as phospholipids and carbohydrates

176) *Rough endoplasmic reticulum*
Ribosomes deposit proteins into its lumen and membrane where they are modified and transported
177) *Golgi Apparatus*
A series of unconnected flattened sacs resulting from the fusion of numerous vesicles from the endoplasmic reticulum

50. How do membranes contribute to the function of lysosomes, mitochondria, and chloroplasts?
178) *Lysosome*
An organelle with powerful hydrolytic enzymes used to recycle worn out cell parts, digest pathogens, and food particles

2.14 I can use representations and models to describe differences in prokaryotic and eukaryotic cells.

51. What are the similarities and differences between prokaryotes and eukaryotes?
179) *Chromosome*
A DNA molecule wrapped up around histone proteins. It can refer to a single DNA molecule or 2 identical DNA molecules still attached after DNA replication
180) *Plasmid*
A small circular bit of DNA with just a few genes

Enduring understanding 2.C: Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain homeostasis.

Essential knowledge 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.

Subobjective 2.15: I can justify a claim made about the effect(s) on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered.

Subobjective 2.16: I can connect how organisms use negative feedback to maintain their internal environments.

52. How does the *trp* operon regulate tryptophan synthesis by negative feedback in bacteria?
181) Operator
A sequence of nucleotides of bacterial DNA usually within the promoter region upstream of a series of related genes that acts like a switch by allowing or prohibiting RNA polymerase to bind to DNA
182) *RNA polymerase*
An enzyme that uses a DNA template to synthesize an RNA molecule
183) *Operon*
The entire sequence of nucleotides of DNA that includes a promoter, operator, and a series of genes (in prokaryotes only)
184) *Repressor*
A regulatory protein that turns an operator off by binding to it and preventing transcription
185) Regulatory gene
A gene that codes for a protein or RNA that regulates the expression of one or more other genes
186) *Corepressor*
A molecule, often a metabolite, that activates a repressor protein, which causes it to bind to the operator and turn off transcription

187) *Mutation*
A change in the nucleotide sequence of DNA

53. How is hunger regulated by negative feedback in mammals?

188) *Hypothalamus*
a brain organ that regulates the endocrine system
189) *Hormone*
A chemical signal produced by endocrine organs that cause cellular change and therefore regulate physiological function
190) *Polypeptide*
This term typically refers to a protein composed of a single chain of amino acids folded up into a functional shape
191) Ghrelin
A peptide hormone produced by the stomach that causes hunger
192) Leptin
A peptide hormone produced by adipose tissue that suppresses hunger
193) *Adipose tissue*
A tissue specialized for fat storage
194) Fat
A type of lipid called a triglyceride used for long term energy storage, insulation, and organ protection

Subobjective 2.17: I can evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms.

54. How is blood glucose homeostasis regulated?

195) *Pancreas*
An endocrine organ that regulates blood glucose level by secreting insulin and glucagon
196) *Insulin*
A hormone secreted by the pancreas that causes cells to take up glucose
197) *Glucagon*
A hormone secreted by the pancreas that causes the liver to breakdown glycogen which releases glucose into the blood stream
198) *Glycogen*
A polysaccharide composed of glucose monomers used by animal cells to store glucose
199) Type I diabetes
Inability to regulate blood glucose level because of destruction of the beta cells of the pancreas
200) Type II diabetes
Inability to regulate blood glucose level because cells become resistant to the signal to take up glucose from the hormone insulin
201) *Autoimmune disease*
A type of disease caused by the immune system attacking body cells rather than pathogens

55. How does the *lac* operon regulate lactose metabolism by negative feedback in bacteria?

202) Repressible operon
An operon that is usually on and is turned off when a specific small molecule (metabolite) is present
203) Inducible operon
An operon that is usually off and is turned on when a specific metabolite is present

204) *Lactose*

A disaccharide that is the main sugar in mammal's milk

56. How is the lac operon under positive and negative gene regulation

205) *cAMP*

cyclic adenosine monophosphate. It is a secondary messenger in many types of signal transduction pathways and is involved in regulation of the *lac* operon in prokaryotes, and synchronizing glycolysis with the Kreb's cycle.

Subobjective 2.18: I can make predictions about how organisms use negative feedback mechanisms to maintain their internal environments.

57. How would a bacterium respond to changes in the components of the *lac* and *trp* operons?
58. How would an organism maintain blood glucose homeostasis if one of the components were changed?
59. How would an organism maintain energy homeostasis if one of the components were changed?
60. Why do people pee a lot when they drink beer?

206) *Pituitary gland*

It is called the master control gland because its hormones regulate many other endocrine glands

207) *Signal transduction*

The biochemical process where a signaling molecule triggers a cascade of events that leads to a cellular response

208) *ADH*

Antidiuretic hormone. A hormone produced by the posterior pituitary gland that causes aquaporins to increase in the nephrons of kidneys and therefore the amount of water in urine to decrease and the amount of water returned to the blood to increase.

209) *Nephron*

The functional unit of the kidney. It filters blood conserving water and electrolytes and excreting wastes

Subobjective 2.19: I can make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models.

61. Why does all the fruit on a plant ripen at the same time?

210) *Positive feedback*

A mechanism where a stimulus causes a response and the response increases the stimulus until the stimulus is gone

211) Ethylene

A gas that is also a plant hormone involved in stem elongation, apoptosis, and fruit ripening

212) *Apoptosis*

Programmed cell death. A cell self-destructs in response to a chemical signal

Subobjective 2.20: I can justify that positive feedback mechanisms amplify responses in organisms.

62. How do organisms stop bleeding?

213) Platelet

A bit of a cell that is a component of blood plasma and is involved in clotting

214) *Collagen*

A fibrous structural protein with many functions. It interacts with platelets initiating blood clotting

215) Thrombin

An enzyme produced by the coagulation cascade set in motion by clotting factors released by platelets that are activated by collagen

216) Fibrin

A protein derived from fibrinogen catalyzed by the enzyme thrombin. It forms long fibers that reinforce and seal the platelet plug

63. How does child birth illustrate positive feedback?

217) Oxytocin

A hormone produced by the posterior pituitary gland. It is important for social bonding in mammals and causes uterine contractions during child birth.

Essential knowledge 2.C.2: Organisms respond to changes in their external environments.

Subobjective 2.21: I can justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment.

64. How do plants move?

218) *Phototropism*

The movement towards or away from light

219) Auxin

A plant hormone that stimulates stem elongation in low concentration only

220) *Phototaxis*

An organism moving towards or away from light

Subobjective 2.42: I can pose a scientific question concerning the behavioral or physiological response of an organism to a change in its environment.

65. How is the flagellum involved in chemotaxis and phototaxis?

221) *Chemotaxis*

The movement of an organism in response to a chemical signal

222) *Flagellum*

A whip-like structure used for movement. This structure evolved independently in the 3 domains of life

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.

Subobjective 2.22 I can refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities and ecosystems.

66. How and why do biofilms form?

223) Biofilm

A group of microorganisms that stick together on a surface because they have secreted slime (a polysaccharide mixture)

224) Quorum sensing

A type of communication that allows a group of organisms to know when a critical number in the population has been reached, so a common behavior can be executed in concert

67. What are the categories of symbiosis?

225) *Symbiosis*

A close relationship between two different species

226) *Fitness*

is measured by the number of genes an organism gets into the next generation

227) *Commensalism*

A symbiotic relationship where the fitness of species A is increased when with species B, and that association has no effect on the fitness of species B

228) *Parasitism*

A symbiotic relationship where the fitness of species A is increased when with species B, and the fitness of species B is decreased by that association

68. What is species diversity and how does it affect the stability of ecosystems?

229) *Species diversity*

The number of different species and the proportion of each in a community

230) *Species richness*

The number of different species in a community

231) *Relative abundance*

The proportion each species contributes to the total number of individuals in a community

Subobjective 2.23 I can design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities and ecosystems) are affected by complex biotic and abiotic interactions.

69. What data would you collect from a bacterium that can survive 100°C temperatures? (100°C is the boiling point of water)

232) *Denature*

Proteins or nucleic acids losing their functional shape due to some stress like temperature, acidity, or salinity

233) Thermophile

A bacterium that can survive in temperatures that would kill other organisms. They live in hot springs near volcanic vents

70. What data would you need to collect to explain how albatrosses survive? (they spend nearly all of there time out at sea where the water is too salty for a human to survive)

234) *Counter current exchange*

A mechanism by which some property of a fluid, such as heat or a chemical substance, is transferred from one fluid across a semi-permeable membrane to another fluid flowing in the opposite direction

71. Does feeding by sea urchins limit seaweed distribution?

Subobjective 2.24 I can analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities or ecosystems).

72. Why has the range of the washed fritillary expanded northward and how do you know?

235) Correlation

A relationship between 2 variables, it can be positive (directly proportional), or negative (inversely proportional)

236) Causation

when one variable affects change in another variable

73. How do changes in predator populations affect prey populations and vice versa?

237) *Density dependent factor*
Something that affects population growth and its effect is dependent on the density of the population (nesting sites)

238) *Density independent factor*
Something that affects population growth and its effect is independent of the density of the population (weather)

239) *Logistic growth*
Population increases exponentially until reaching carrying capacity where population sizes stabilize

240) *Carrying capacity*
The size of a population that can be maintained without degrading the environment

241) Dispersion
The spatial arrangement of individuals of a population within their environment

242) Dispersal
The capacity for an organism to move away from where it was born

74. How did wolves change the course of rivers in Yellowstone?

243) *Keystone species*
A species that has a profound effect on the diversity and species composition in an ecosystem

Essential knowledge 2.D.2: Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.

Subobjective 2.25 I can construct explanations based on scientific evidence that homeostatic mechanisms reflect continuity due to common ancestry and/or divergence due to adaptation in different environments.

75. How do bilaterian animals eliminate wastes?

244) Bilateral symmetry
A body plan that can be divided into 2 mirror images by a single cut down a central axis

245) Radial symmetry
A body plan that can be divided into 2 mirror images by any cut down a central axis

246) *Ectoderm*
The germ layer that gives rise to the nervous system, epidermis of skin, jaws and teeth, pituitary and adrenal medulla, and germ cells

247) *Mesoderm*
The germ layer that forms the skeletal, muscular, circulatory, lymphatic, excretory and reproductive systems (except the germ cells), the dermis of the skin, and the adrenal cortex

248) *Endoderm*
The germ layer that forms the cells lining the digestive tract and digestive organs, cells lining the respiratory, excretory, and reproductive tracts, and it forms the thymus, thyroid, and parathyroid glands

249) Gastrulation
An early phase of embryonic development where the 3 germ layers form cells of the blastocyst

250) Coelom
A fluid filled or air filled body cavity between the digestive tract and body wall

251) Coelomate
Animals with a true coelom; formed by the mesoderm only

252) Pseudocoelomate
Animals with a cavity formed by the endoderm and mesoderm

253) Acoelomate
Animals with no cavity between the digestive tract and body wall
254) *Phylum*
A taxonomic ranking below kingdom and above class.
255) *Phylogeny*
The evolutionary history of a group of organisms
256) *Clade*
The latest common ancestor and all of its extant relatives
257) *Cladogram*
A simplified phylogeny that shows the relative relationship among extant groups of organisms
258) *Homologous*
A characteristic shared between 2 groups of organisms with a common evolutionary origin but not necessarily having the same function
259) *Derived character*
A characteristic that is unique to a group of organisms

76. How do organisms maintain osmotic homeostasis?

260) Osmoregulation
Controlling solute concentration and balancing water gain and loss
261) *Osmoregulator*
An organism that maintains an internal osmolarity that is different from its environment
262) *Osmoconformer*
An organism that is isosmotic with its environment
263) *Plasmolysis*
A cell losing water to its environment because it is in a hypertonic solution
264) Contractile vacuoles
An organelle that pumps water out of the cell
265) *Acclimation*
Changes in gene expression due to environmental stresses
266) *Adaptation*
Changes is genes that make an organism more likely to survive in a given environment

Subobjective 2.26 I can analyze data to identify phylogenetic patterns or relationships, showing that homeostatic mechanisms reflect both continuity due to common ancestry and change due to evolution in different environments.

77. How are enzymes regulated?

267) *Hemoglobin*
A protein composed of 4 polypeptides each with an iron containing heme group that loosely binds oxygen
268) Cooperativity
An allosteric type of regulation where the binding of the substrate to an active site of a multisubunit enzyme triggers a shape change in the other subunits, which increases the activity of the other sites.

78. How is oxygen delivered to cells?

269) *Myoglobin*
A protein that stores oxygen in muscle tissue

79. How does the graph below illustrate common ancestry and adaptation to different environments?

Subobjective 2.27 I can connect differences in the environment with the evolution of homeostatic mechanisms.

80. How are the circulatory systems of fish, amphibians, and mammals organized?

270) *Paraphyletic*

A group that includes the common ancestor of both groups, but doesn't include all of the descendants of the group. For example, fish are a _____ group.

271) *Monophyletic*

Describes a group of organisms that is a clade (the common ancestor and all of its descendants)

272) Atria

Chambers of the heart where blood enters

273) Ventricles

Chambers of the heart where blood is pumped out of the heart

274) Single circulation

Blood passes through the heart one time each time it circulates forming a single circuit

275) Double circulation

Blood passes through the heart twice each time it circulates forming 2 circuits

276) *Vestigial structure*

It is a homologous structure that has a reduced function or no function

81. What causes blood pressure?

277) Artery

Muscular blood vessels that carry blood away from the heart

278) Systolic pressure

Blood pressure during the contraction phase of the cardiac cycle

279) Diastolic pressure

Blood pressure during the relaxation phase of the cardiac cycle

82. How does the respiratory system of whales demonstrate adaptation of homeostatic mechanisms?

280) Fossil

Any ancient trace of an organism

281) *Transitional fossil*

A fossil that has characteristics of 2 different species or larger taxonomic grouping

Essential knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.

Subobjective 2.28 I can use representations of models to analyze quantitatively and qualitatively the effects of disruptions to dynamic homeostasis in biological systems.

83. How does salinity affect water homeostasis in plants?

282) Mycorrhiza

A symbiotic relationship between the roots of most vascular plants and fungi

84. How do humans contribute to salinization and what are the consequences?

283) *Transpiration*

water loss from roots through the plant out through stomata

284) *Evapotranspiration*

Water transferring from the land to the atmosphere due to evaporation and transpiration

Essential knowledge 2.D.4: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.

Subobjective 2.29 I can create representations and models to describe immune responses.

Subobjective 2.30 I can create representations of models to describe nonspecific immune defenses in plants and animals.

85. How do plants defend themselves against pathogens?

285) *Cytoplasm*

Everything within a cell except for the nucleus

286) Plasmodesma (plural is plasmodesmata)

Microscopic channels between plant cells connecting cytoplasm of adjacent cells and allowing for cell communication

287) *Innate immune response*

A nonspecific immune response, meaning the immune response is dependent on traits common to a class of pathogen (bacteria, virus, fungus, etc.)

288) PAMP

Pathogen associated molecular pattern. These are molecular patterns found in pathogens that are not found in the organism. They can be proteins, lipoproteins, glycoproteins, DNA, and RNA

289) PRR

Pattern recognition receptor. These are molecules that bind to PAMPs and trigger an immune response

290) DAMP

Damage associated molecular pattern. Any molecule that tells the organism that cells have been killed. They are often ATP and DNA, but they can be any molecule that typically is not found outside of the cell.

86. How do invertebrates defend themselves against pathogens?

291) *Functional group*

A group of atoms involved in chemical reactions. They give the molecules they belong to their characteristics

292) *Methyl group*

A carbon atom attached to 3 hydrogen atoms and some other molecule called an R group

293) Carbonyl group

A carbon atom double bonded to an oxygen atom, single bonded to two R-groups

294) Acetyl group

A two carbon functional group composed of a carbonyl group and a methyl group

295) Amino group

A nitrogen atom bonded to 1, 2, or 3 R-groups. Molecules containing amino groups are called amines

296) Keratin

A fibrous structural protein that gives skin, hair, and nails their toughness

297) *Chitin*

A polymer of glucose molecules that have an amino group attached. It forms the cell wall of fungi, which makes it analogous to cellulose. It forms the exoskeleton of arthropods making it analogous to keratin

298) Arthropoda

A phylum of invertebrates characterized by jointed limbs, and an exoskeleton composed of chitin that is often mineralized by calcium carbonate. It includes organisms like insects, spiders, and crustaceans

87. How do vertebrates defend themselves against pathogens?

Subobjective 2.43 I can connect the concept of cell communication to the functioning of the immune system.

88. How is the vertebrate immune system structured?

299) *Lymphatic system*

A network of _____ vessels (analogous to capillaries, venules, and veins) that is part of the circulatory system and the immune system

300) Lymph node

A kidney shaped organ of the lymphatic system that filters foreign particles, cancer cells, and pathogens from lymphatic fluid. It does this by housing large quantities of immune cells.

89. How does the innate immune system protect against pathogens?

301) Histamine

A signaling molecule produced by specialized immune cells (mast cells) that causes inflammation

302) *Macrophage*

A large generalized cell eater. They produce cytokines that activate other immune system cells

303) *Cytokine*

A type of molecule (there are many kinds of cytokines). Some are used by immune system cells to “talk” to each other.

304) Dendritic cell

A type of macrophage that consumes pathogens and presents antigens from the pathogen to activate helper T cells

305) *Antigen*

Anything that stimulates the immune system (usually a protein or a part of a protein from a pathogen)

306) *Complement*

A collection of a few dozen proteins that circulate in an inactive form. A cascade of activations occurs because of activation by the presence of a pathogen.

90. How does the cell mediated adaptive immune system protect against pathogens?

307) *Stem cell*

A cell that is not completely differentiated and produces one or more different kinds of cells indefinitely

308) *Differentiation*

The specialization of cells. Generalized cells becoming more and more specialized.

309) *Somatic cell*

A body cell (all cells except reproductive cells)

310) *Helper T cell*

A leukocyte made in bone marrow that matures in the thymus. They are essential for the cell-mediated and the humoral response.

311) *Thymus*

An organ of the lymphatic system where T cells mature

312) *Cytotoxic T cell*

A leukocyte made in bone marrow that matures in the thymus. They produce perforin and granzymes that kill cells infected by pathogens

91. How does the humoral adaptive immune system protect against pathogens?

313) *B cell*

A lymphocyte that is produced and matures in the bone marrow. They differentiate into plasma cells.

314) *Plasma cell*

A *B* cell that has specialized to make one type of antibody

315) *Antibody*

A protein produced by plasma cells (differentiated B cells). They are often called immunoglobulin proteins (Ig). They recognize and bind to different antigens and neutralize them.

92. How do the innate and adaptive immune systems enhance each other?
93. How do vaccines work?

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.

2.31 I can connect concepts in and across domains to show that timing and coordination of specific events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms.

94. What causes wisdom teeth to develop?

316) *General transcription factors*

Proteins necessary for all transcription resulting in a low rate of transcription

317) *Specific transcription factors*

Proteins necessary for a high rate of transcription at particular times and places for specific genes

318) *Enhancer*

A region of DNA that transcription factors bind to. This binding can either activate or repress gene expression

95. How did homeobox genes evolve?

319) *Homeotic gene*

A gene for a transcription factor that regulates many other genes for transcription factors necessary for the development of a complex anatomical structure

320) *Morphogenesis*

The organization of and spatial distribution of cells during embryonic development causing the development of the shape of the organism

321) Homeobox gene (Hox gene)

A gene for a transcription factor that regulates many other genes for transcription factors necessary for morphogenesis (embryonic patterns of anatomical development)

322) Homeodomain

The part of the protein that binds to an enhancer region of a gene

323) *Duplication*

A mutation where one or more nucleotides are copied. It can involve whole genes and even chromosomes.

324) *Deletion*

A mutation where one or more nucleotides are lost. It can involve whole genes and even chromosomes!

325) *Insertion*

A mutation where one or more nucleotides are inserted. It can involve whole genes and even chromosomes!

96. What good is fruit fly research?

326) Ubiquitin

A tagging protein that changes the function of a protein and may mark it for destruction by a proteasome

327) Proteasome

A protein complex that destroys proteins tagged by ubiquitin

97. How does a chicken wing develop?

328) *Embryonic induction*

One tissue inducing (causing differentiation in) another tissue

329) Zone of polarizing activity (ZPA)

An area that produces signals that define the anterior/posterior axis of limb development

98. What would happen if I put a homeotic gene that causes an eye to develop from a mouse into a fruit fly and turned it on in the fly's leg?

330) *Divergent evolution*

The accumulation of differences in structures inherited from a common ancestor

331) *Convergent evolution*

The independent evolution of similar structures

99. How is pattern formation in plants different from pattern formation in animals?

332) Lineage based mechanisms of pattern formation

Cell's fate determined early in development and this fate is passed on within the cell's lineage

333) Position based mechanisms of pattern formation

The cell's final position in a developing organ determines what kind of cell it will become

2.32 I can use a graph or diagram to analyze situations or solve problems (quantitatively or qualitatively) that involve timing and coordination of events necessary for normal development in an organism.

100. What is the role of light in morphogenesis in plants?

334) Photomorphogenesis

The effect of light on plant morphology

335) *Kinase*

A protein that phosphorylates another

336) Photoreceptor

A protein that absorbs a particular wavelength of light and initiates a cellular response

2.33 I can justify scientific claims with scientific evidence to show that timing and coordination of several events are necessary for normal development in an organism and that these events are regulated by multiple mechanisms.

101. How does a plant switch from vegetative (indeterminate) growth to flowering (determinate growth)

337) Meristem

Plant tissue containing undifferentiated stem cells that produce various plant organs

338) Apical meristem

The tip of a root or shoot that causes an increase in length (growth)

339) Carpel

The female reproductive organ of a plant (consists of an ovary, stigma, and style)

340) Stamen

The pollen producing part of a plant (the part of the stamen that produces pollen is the anther)

341) Sepal

Usually green, supports and protects the petals of the flower

342) ABC hypothesis

Flower development is controlled by 3 classes of homeotic genes. Each class of homeotic gene is expressed in 2 layers and the combination of expression results in what organ develops.

2.34 I can describe the role of programmed cell death in development and differentiation, the reuse of molecules, and the maintenance of dynamic homeostasis.

102. How do fingers develop?

343) Mesenchyme

Multipotent stem cells that can become cells comprising bone, cartilage, muscle, and fat

Essential knowledge 2.E.2: Timing and coordination of physiological events are regulated by multiple mechanisms.

2.35 I can design a plan for collecting data to support the scientific claim that the timing and coordination of physiological events involve regulation.

103. How is the timing of flowering controlled?

344) Photoperiodism

A physiological response to a photoperiod

2.36 I can justify scientific claims with evidence to show how timing and coordination of physiological events involve regulation.

104. Why do West Coast teams hate playing East Coast teams (especially in the playoffs) at 1pm?

345) *Circadian rhythm*

A biological process that shows an approximately 24-hour cycle. They have been observed in plants, animals, fungi, and cyanobacteria.

346) *Pineal gland*

An endocrine gland located in the center of the brain next to the 2 halves of the thalamus. It produces the hormone melatonin which regulates the wake/sleep circadian cycle

347) Melatonin

A hormone produced by the pineal gland that controls the wake/sleep circadian cycle

348) Retina

The layer of cells at the back of the eye that has photosensitive cells

105. Why is jet lag more frequent and severe when traveling from west to east than east to west?

2.37 I can connect concepts that describe mechanisms that regulate the timing and coordination of physiological events.

106. How are multicellular fungi organized?

349) Hyphae (singular hypha)

Tiny filaments composed of cells arranged end to end (they may or may not have a cell wall between cells)

350) *Mycelium*

A bunch of hyphae

351) *Cytoplasmic streaming*

The directed flow of cytosol and organelles around cells

352) *Cytoskeleton*

The proteins that give a cell its shape and ability to resist compression and tension. They organize organelles, allow movement, and are essential for cell division (cytokinesis)

353) Actin

One of the main components of the cytoskeleton composed of many proteins linked together forming a thin fiber. They give the cell compression resistance; they are involved in organelle movement and are one of the main proteins involved in muscle contraction.

354) *Motor protein*

A type of protein involved in movement

355) Myosin

A family of motor proteins. Their diversity reflects their involvement in different types of movement. One type is one of the key proteins in muscle contraction

107. How do fungi "know" when to reproduce asexually and when to reproduce sexually?

356) *Mitosis*

Technically nuclear division. It is often used to indicate the replication of a cell (one cell becoming two identical daughter cells)

357) *Haploid*

A cell with one set of chromosomes

358) *Diploid*

A cell with two sets of homologous chromosomes

359) *Zygote*

The diploid cell that results from the union of the nuclei of sperm and egg

360) *Meiosis*

Cell division that results in 4 unique haploid cells from 1 diploid cell

361) *Karyotype*

The number and appearance of chromosomes in a cell

362) Spore

A unit of asexual reproduction in plants, fungi, algae, and protozoans

363) *Gamete*

Units of sexual reproduction

364) Sporangium

A single or multicellular enclosure where spores are formed. They may produce spores by mitosis. In fungi and plants they are sites where meiosis occurs. In plants, _____ are where gametophytes are produced.

Essential knowledge 2.E.3: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.

2.38 I can analyze data to support the claim that responses to information and communication of information affect natural selection.

108. How do birds know where to migrate to?

365) Electromagnetic receptor

Receptors that respond to electromagnetic radiation

109. How do plants talk to animals and other plants?

2.39 I can justify scientific claims, using evidence, to describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms.

110. How do fruit flies decide who to have sex with and when?

366) *Stimulus response chain*

The response to a stimulus is a stimulus for the next behavior

2.40 I can connect concepts in and across domain(s) to predict how environmental factors affect responses to information and change behavior.

111. How does evolution by natural selection explain resource partitioning?

367) *Community*

A group of populations of different species living close enough to interact

368) *Niche*

The ecological role of an organism. How it meets its needs for shelter, space, water, and food. How it is arranged within a habitat and the abiotic conditions it can tolerate

369) *Habitat*

Where an organism lives

370) Intraspecific competition

Competition for a limited resource within a species

371) Interspecific competition

Competition for a limited resource between species

372) *Competitive exclusion principal*

One species will eventually lead to the local extinction (extirpation) of another if occupying the same niche

373) *Resource partitioning*

A reduction in interspecific competition caused by natural selection favoring specialization for some aspect of a resource

374) *Allele*

An alternative form of a gene that occupies the same location on homologous chromosomes

375) *Homozygous*

An individual with 2 identical alleles at a given location on homologous chromosomes

376) *Heterozygous*

An individual with 2 different alleles at a given location on homologous chromosomes

377) *Heterozygous advantage*

A heterozygous individual has a greater fitness than either homozygous alternative

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

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.

3.1 I can construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and, in some cases, RNA are the primary sources of heritable information.

112. What are the structures used to pass genetic information from generation to generation?

Subobjective 3.2 I can justify the selection of data from historical investigations that support the claim that DNA is the source of heritable information.

113. How do we know DNA is the genetic material?

378) *Transformation*

A change in the characteristics of a bacterium due to the assimilation of DNA outside of the cell

114. How was the structure of DNA determined?

379) Purines

RNA and DNA nucleotides that have a double nitrogenous ring (guanine and adenine)

380) Pyrimidines

RNA and DNA nucleotides that have a single nitrogenous ring (cytosine, uracil, and thymine)

381) *Antiparallel*

The arrangement of nucleotides of double stranded DNA and RNA. Complementary bases are parallel but running in opposite directions. One is in a 3' to 5' orientation and the other is in a 5' to 3' orientation

Subobjective 3.3 I can describe representations and models that illustrate how genetic information is copied for transmission between generations.

115. How are DNA and RNA similar and different?

116. How is DNA replicated and how do we know?

117. How is prokaryotic and eukaryotic DNA replication similar and different

118. How do the details of DNA replication of the leading strand support the RNA world hypothesis?

382) *Replication fork*

At the origin of replication, a Y-shaped region of DNA where DNA synthesis proceeds from

383) *Helicase*

Unwinds DNA

384) *Topoisomerase*

Relieves pressure from unwinding caused by helicase. It snips and reattaches single strands of DNA

385) *DNA polymerase*

Reads DNA in the 3' to 5' direction and adds complementary DNA nucleotides in the 5' to 3' direction

386) *RNA primase*

Synthesizes the complementary RNA primer that signals the starting point for DNA polymerase

119. How is the lagging strand of DNA copied?

387) *Leading strand*

The 3' to 5' parent strand of DNA that is replicated continuously by DNA polymerase

388) *Lagging strand*

The 5' to 3' parent strand of DNA that is replicated in segments by DNA polymerase

389) *Ligase*

Catalyzes the covalent (phosphodiester) bond between the phosphate group of one nucleotide and the sugar of another

Subobjective 3.4 I can describe representations and models illustrating how genetic information is translated into polypeptides.

120. Why is calling DNA a blueprint a bad analogy?

121. How is transcription and translation similar and different in prokaryotes and eukaryotes?

390) *Codon*

3 nucleotide sequence of mRNA written in the 5' → 3' direction that codes for a specific amino acid

122. How is DNA transcribed into mRNA and how does it differ in prokaryotes and eukaryotes?

391) *Promotor*

A sequence of DNA nucleotides upstream of a gene that general transcription factors bind with RNA polymerase forming the initiation complex

392) *Intron*

Non-coding sequences within a gene that are spliced out

393) *Exon*

Coding sequences within a gene

123. How is pre-mRNA processed in eukaryotes?

394) 5' RNA cap

A GTP molecule attached to an mRNA transcript to protect it from oxidizing reactions

395) *Poly-A tail*

50-250 adenine nucleotides added to the 3' end of an RNA molecule to facilitate the transcript leaving the nucleus via a nuclear pore

396) 3' UTR

An untranslated region of mRNA that has binding sites for repressor proteins and RNA silencing complexes which are part of the RNAi system

124. How are mRNA transcripts regulated?

397) RNAi

An mRNA regulatory system important for development and gene regulation. It is also an important system of defense against viruses for many organisms.

398) Transposon

A DNA sequence that can change its position within a genome, sometimes creating or reversing mutations and altering the cell's genome size. This often results in duplication of the sequence. They make up about 44% of human DNA.

399) miRNA

Small single stranded RNAs that bond to complementary sequences of mRNA. They are made from primary transcripts that form double stranded hair pin structures

400) *Pleiotropy*

A gene that affects multiple traits (phenotypes)

401) SRY gene

A gene that determines maleness by regulating other genes during early embryonic development

125. How do proteins form?

402) Carboxyl group
A carbon atom with a carbonyl group and a hydroxyl group covalently bonded to an R-group

403) Peptide bond
A covalent bond that forms between two amino acids by dehydration synthesis between the hydroxyl group of the carboxyl group of one amino acid and the amino group of another amino acid

404) *Primary structure*
The sequence of amino acids of the polypeptide chain

405) *Secondary structure*
The level of structure that results from the hydrogen bonding within a single polypeptide chain (alpha helices and beta pleated sheets)

406) *Tertiary structure*
A folded-up polypeptide chain caused by bonds between R-groups

407) *Quaternary structure*
Multiple polypeptides bonded together

408) *Disulfide bridges*
Strong covalent bonds between sulfur atoms among amino acid groups within a polypeptide that contribute to the tertiary structure of proteins

126. How is mRNA translated into protein?

409) *Start codon*
AUG in mRNA, which codes for methionine

410) *Nucleolus*
Site within the nucleus where ribosomes are synthesized

411) *tRNA*
An RNA molecule that carries a specific amino acid at one end and has an anticodon at the other

127. How does the genetic code provide strong evidence for the theory of evolution by natural selection?

Subobjective 3.5 I can explain how heritable information can be manipulated using common technologies.

128. What do bacteria use plasmids for?

412) *Genetic engineering*
Direct mechanical manipulation of the genetic makeup of a cell

413) *Transduction*
Incorporating viral DNA into the bacterial genome (see the Hershey and Chase experiment in question #113)

414) *Conjugation*
Transfer of DNA from one bacterium to another by direct contact (analogous to sexual reproduction in eukaryotes)

129. How do bacteria protect themselves from viral attacks?

415) *Endonuclease*
Enzymes that cut DNA at specific sequences

416) *Restriction site*
A palindromic DNA sequence recognized by an endonuclease

417) Palindromic DNA sequence
A sequence of DNA where the complementary sequences are the same in opposite directions

418) *Methylation*
Adding a methyl group. When a methyl group is added to a DNA nucleotide, it typically prevents transcription. It can also prevent endonucleases from binding and therefore cutting DNA at that location.
419) *Sticky ends*
The result of a restriction site being cut leaving complementary single-stranded oligonucleotides at each end
420) *Blunt ends*
The result of a restriction site being cut leaving all complementary base pairs together

130. How do scientists use endonucleases and plasmids?

421) Cloning vector
Something used to genetically modify an organism (it may be a chromosome, plasmid, or virus)
422) *Recombinant DNA or recombinant plasmid*
DNA that has been genetically engineered to carry DNA from another organism
423) Genomic library
A complete set of cell colonies containing all of the fragments of an organism's genome
424) *Reverse transcriptase*
An enzyme that converts single-stranded viral RNA into double stranded DNA within the cytoplasm of the host
425) *cDNA (complementary DNA)*
Double stranded DNA made from an mRNA transcript, which means it contains exons and no introns

131. How do scientists make copies of DNA of interest?

426) *PCR (polymerase chain reaction)*
It is a 3-step process of amplifying small samples of DNA in a very short period of time

132. How are all of the fragments of DNA produced by PCR separated?

427) *Gel electrophoresis*
The separation of molecules such as proteins or DNA fragments based on size and physical properties

133. What are restriction length polymorphisms and what are they used for?

428) *Restriction fragment length polymorphism*
A change in the sequence of DNA within a restriction site preventing the endonuclease from cutting, which causes a different banding pattern

134. How do scientists clone mammals and what are some technical problems that need to be overcome?

429) *Totipotent*
A cell capable of producing all cell types of an adult organism
430) *Cytoplasmic determinants*
Special molecules (mRNAs and proteins) that cause cell differentiation during embryonic development
431) *Epigenetics*
Changes in the regulation of the genome that do not involve changes in DNA sequence (DNA methylation, histone modification, RNAi)
432) *Pluripotent*
Able to differentiate into many cell types
433) Induced pluripotent cells (iPSCs)
Adult cells that have been transformed by a retrovirus with 4 genes involved in early differentiation. They appear to behave like embryonic stems cells, but they differ in gene expression and cell division behavior.

135. What are some practical applications of DNA technology that improve our lives?

434) Gene therapy

Inserting a normal allele for a defective gene into the affected tissue of a patient

136. Should using genetically modified foods be promoted as a moral imperative like vaccinating children?

435) *Transgenic organism*

An organism that has been genetically engineered with a gene from a different species

3.6 I can predict how a change in a specific DNA or RNA sequence can result in changes in gene expression.

137. How do changes in genotype (mutations) affect phenotype?

436) *Genotype*

The type and combination of alleles you have for a protein

437) *Phenotype*

The characteristic an organism has (the observed expression of the genes an organism has)

438) *Substitution*

A mutation where one nucleotide is swapped for another

439) *Silent mutation*

A mutation that does not affect the amino acid sequence of the polypeptide

440) *Nonsense mutation*

A mutation that results in a stop codon resulting in a partially transcribed polypeptide

441) *Frameshift mutation*

An insertion or deletion of a nucleotide resulting in the entire sequence upstream shifting forward or backward one position

138. What causes mutations?

442) Retrovirus

An RNA virus that transcribes (reverse transcribes) its RNA genome into double stranded DNA. This double stranded DNA inserts itself into the host genome where new RNA viral particles are transcribed.

443) *Provirus*

The DNA copy of the retrovirus RNA in the genome of the host

444) Endogenous retrovirus

A retrovirus that has become “stuck” within the genome of a population and is no longer infective

139. How can mutations be used to test phylogenic hypotheses?

445) *Pseudogene*

A DNA sequence that is nearly identical to that of a functional gene, but contains one or more mutations, making it non-functional. Much of the intron material in the genomes of organisms is composed of these.

446) Gene (updated definition)

A region of DNA that can be expressed to produce a final functional product that is either a polypeptide or an RNA molecule

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 3. plus fertilization.

Subobjective 3.8 I can describe the events that occur in the cell cycle.

140. What is the cell cycle and what is it for?

447) *Interphase*

Growth, DNA synthesis, and preparation for mitosis

448) *Cytokinesis*
Cell division
449) Sister chromatids
Two identical duplicated chromosomes attached at the centromere
450) *Centromere*
The point where sister chromatids are most closely attached
451) *Histones*
Proteins that DNA wraps around to form chromosomes

141. How are chromosomes similar and different among organisms?

452) *Telomere*
Repetitive sequences at the end of each chromosome that prevents DNA from damaging oxidative reactions

142. What is mitosis?

Subobjective 3.7 I can make predictions about natural phenomena occurring during the cell cycle.

143. How is the cell cycle regulated?

453) *G_1 check point*
Called the "restriction point" because cells usually complete the cell cycle if given the go signal (part of interphase)
454) *G_0*
Part of interphase when a cell is not in the cell cycle
455) Cyclin
A group of proteins that varies in concentration throughout the cell cycle. They help regulate the cell cycle by activating kinases in high concentrations
456) Cyclin-dependent kinase
A type of kinase that regulates the cell cycle. Their concentration remains constant throughout the cell cycle and only become active in the presence of cyclin proteins.

144. What causes cells to become cancerous and how does cancer cell behavior differ from non-cancerous cells?

457) *Growth factor*
A signaling protein that causes other cells to divide via a signal transduction mechanism
458) Platelet-derived growth factor (PDGF)
It causes connective tissue stem cells (fibroblasts) to enter the cell cycle
459) *Cancer*
Uncontrolled cell growth
460) Metastasis
Cancerous cells breaking off of tumors and taking root in other places in the body
461) *Density-dependent inhibition*
Crowding of cells cause them to leave the cell cycle
462) *Anchorage dependence*
Cells require contact with a substrate to enter the cell cycle
463) Benign tumor
Cancerous cells that do not have all of the properties of deadly cancerous cells
464) Malignant tumor
Cancerous cells that will cause death if not treated

Subobjective 3.9 I can explain, using visual representations or narratives, as to how DNA in chromosomes is transmitted to the next generation via mitosis, or meiosis followed by fertilization.

145. Why is it a safe bet to dismiss the claims people make about alien reproductive experimentation?

465) Fertilization

The fusion of the nuclei of male and female gametes

466) *Autosomes*

The chromosomes that are not sex chromosomes

467) *Homologous chromosomes*

Chromosomes with genes for the same traits in the same location

146. Why do males exist?

147. What is meiosis and how is it similar and different to mitosis?

468) *Meiosis I*

Nuclear division where crossing over occurs, homologous chromosomes are separated, the genetic material is halved, and the cells become haploid

469) *Meiosis II*

Nuclear division where the genetic material is halved and sister chromatids are separated

Subobjective 3.10 I can represent the connection between meiosis and increased genetic diversity necessary for evolution.

148. How does sexual reproduction maximize variation from generation to generation?

470) *Recombinant chromosome*

A chromosome that has alleles from mom and dad

471) Chiasmata

The point where two homologous non-sister chromatids exchange genetic material during meiosis I

Subobjective 3.11 I can evaluate evidence provided by data sets to support the claim that heritable information is passed from one generation to another generation through mitosis, or meiosis followed by 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.

Subobjective 3.12 I can construct a representation that connects the process of meiosis to the passage of traits from parent to offspring.

149. How do chromosomes explain inheritance patterns of traits?

472) *Chromosomal theory of inheritance*

Genes segregate and assort independently because they occupy specific locations on chromosomes

Subobjective 3.13 I can pose questions about ethical, social or medical issues surrounding human genetic disorders.

150. What are some common problems with meiosis?

473) *Nondisjunction*

Failure of homologous chromosomes to separate during meiosis I or failure of sister chromatids separating during meiosis II

474) *Aneuploidy*

One or more extra chromosomes or missing chromosomes

475) Monosomy
1 of one type of chromosome
476) Trisomy
3 of one type of chromosome
477) *Polyploidy*
One or more extra sets of chromosomes
478) *Inversion*
A segment of a chromosome is cut out reversed and stitched back in the same location
479) *Translocation*
A segment of a chromosome is moved to a nonhomologous chromosome
480) *Barr body*
A highly condensed inactive X chromosome. One of the X chromosomes gets inactivated randomly so that half of female cells have inactive X chromosomes inherited from their mother and half have inactive X chromosomes inherited from their father.

151. What are the moral implications of genetic testing?

481) Amniocentesis
Fetal cells are collected by sampling the amniotic fluid
482) Chorionic villi sampling
A little risky, but can be performed at about week 5. Fetal cells collected from _____.
483) In vitro fertilization
Fertilization occurs in a petri dish and the embryo is planted in the uterus

Subobjective 3.14 I can apply mathematical routines to determine Mendelian patterns of inheritance provided by data sets.

152. Why is Las Vegas so successful?

484) *Multiplication rule*
The probability of two independent events happening is equal to the product of the probabilities of each
485) *Addition rule*
The probability of two mutually exclusive events is equal to the individual probabilities added together

153. How did Gregor Mendel discover the laws of inheritance?

486) *P generation*
Parental generation
487) F_1 generation*
First filial generation (offspring of P generation)
488) *F_2 generation
Second filial generation. Offspring of a cross between individuals (brothers and sisters) of the F_1 generation.
489) *Law of segregation*
Alleles for the same trait segregate during gamete formation
490) *True-breeding*
An organism that always produces offspring with a particular phenotype
491) *Test-cross*
A cross between an organism of unknown genotype that has the dominant phenotype (AA or Aa) with an organism with the recessive phenotype and therefore known genotype (aa)
492) Monohybrid cross
A mating where a single trait is followed

493) Dihybrid cross
A mating where two traits are followed
494) *Law of independent assortment*
Allele pairs are sorted independently of each other during gamete formation

154. What are some non-Mendelian inheritance patterns?

495) Incomplete dominance
A phenotype of a heterozygous individual is intermediate between the phenotypes of homozygous individuals
496) Codominance
The phenotypes of 2 alleles are expressed equally in a heterozygous individual
497) Multiple alleles
More than 2 versions of the gene for a single trait exist
498) *Epistasis*
A gene at one locus affects the expression of a gene on another locus
499) *Polygenic traits*
Traits that are influenced by multiple genes
500) Sex-influenced trait
The phenotype a gene causes is dependent on whether it is in a male or a female body

155. Why doesn't natural selection remove disease causing alleles from the population?

Subobjective 3.16 I can explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics.

Subobjective 3.17 I can describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits.

156. What are sex-linked inheritance patterns?

501) *Sex-linked gene*
A gene located on one of the sex chromosomes

157. How does relative gene position on a chromosome affect inheritance patterns?

502) *Linked genes*
Genes that are frequently inherited together because they exist close together on the same chromosome
503) *Parental type*
Offspring with phenotypes that match one of their parents
504) *Recombinant type*
Offspring with a combination of phenotypes that is different from both parental phenotype combinations
505) *Linkage map*
An ordered list of the genetic loci along a particular chromosome based on recombination frequency (the farther apart genes for different traits are, the more frequently they will recombine)
506) *Map unit*
A non-precise, relative distance between two genes based on % recombination frequency

158. What are causes of inheritance patterns that cannot be explained by the chromosomal theory of inheritance and crossing over during meiosis 1?

507) *Genomic imprinting*
A phenotype caused by an allele differs depending on whether it was inherited from the male or female because it is silenced based on who it was inherited from

159. How are pedigree charts used to determine inheritance patterns?

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.

Subobjective 3.19 The student is able to describe the connection between the regulation of gene expression and observed differences between individuals in a population.

160. How is eukaryotic gene regulation similar and different from prokaryotic gene regulation?

508) *Genome*

Total complement of genes an organism has

509) *Chromatin*

The material eukaryotic chromosomes are made of (DNA, RNA, Histones and other proteins

510) *Activator*

A type of specific transcription factor that binds to an enhancer region stimulating transcription

161. How can gene regulation lead to insulin resistance and obesity?

Subobjective 3.18 The student is able to describe the connection between the regulation of gene expression and observed differences between kinds of organisms.

162. How does gene regulation explain macroevolution?

511) *Evolution*

A change in the frequency or type of alleles found in a population

512) *Natural selection*

Non-random survival of randomly varying instructions for building embryos

513) Microevolution

Small evolutionary change within a species

514) Macroevolution

Major evolutionary change resulting in new taxonomic groups

Subobjective 3.20 The student is able to explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function.

Subobjective 3.21 The student can use representations to describe how gene regulation influences cell products and function.

163. How does gene regulation explain cell specialization?

Essential knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.

Subobjective 3.22 The student is able to explain how signal pathways mediate gene expression, including how this process can affect protein production.

164. Do yeast cells communicate with pheromones?

515) Microfilament

Refers to actin filaments that are part of the cytoskeleton. They resist compression and allow for cell movement. See definition for actin.

516) Microtubule

Cytoskeletal structure composed of tubulin dimers that provides tracks that direct intercellular transport of vesicles and chromosomes during mitosis and meiosis. They also resist tension.

517) Pheromone

A chemical substance produced and released into the environment by an animal, especially a mammal or an insect, affecting the behavior or physiology of others of its species

Subobjective 3.23 The student can use representations to describe mechanisms of the regulation of gene expression.

165. How does a zygote produce 200+ different cell types using the exact same genetic information?

518) Pattern formation

The establishment of the major axes of an animal in early embryonic development

519) Maternal effect gene

A mutated maternal gene that results in a mutant phenotype in the offspring ***regardless*** of the offspring's genotype (they code for cytoplasmic determinants)

520) *Morphogen gradient hypothesis*

Concentration gradients of substances called morphogens (cytoplasmic determinants) establish the embryo's axis

521) *Determination*

Irreversible changes in cell lines that lead to differentiation

166. How does gene regulation explain cancer?

522) *Oncogene*

A cancer causing gene

523) *Proto-oncogene*

A gene that, when functioning normally, codes for proteins that stimulate normal cell growth and division

524) *Tumor-suppressor gene*

A gene, when functioning normally, produces proteins that inhibit cell division

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.

Subobjective 3.24 The student is able to predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection.

167. Why are most mutations neutral?

Subobjective 3.25 The student can create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced.

168. How do mutations change phenotypes?

Subobjective 3.26 The student is able to explain the connection between genetic variation in organisms and phenotypic variation in populations.

169. Why are there phenotypic variations within populations?

170. How do organisms evolve resistance to pesticides?

Essential knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.

Subobjective 3.27 The student is able to compare and contrast processes by which genetic variation is produced and maintained in organisms from multiple domains.

Subobjective 3.28 The student is able to construct an explanation of the multiple processes that increase variation within a population.

Essential knowledge 3.C.3: Biological systems have multiple processes that increase genetic variation.

Subobjective 3.30 The student is able to use representations and appropriate models to describe how viral replication introduces genetic variation in the viral population.

171. How does a typical virus replicate?

525) *Capsid*

A protein coat that contains viral genetic material

526) *Phage*

Prokaryotic virus (typically lacking an envelope and usually uses DNA for genetic material)

172. Why does the HIV virus evolve so quickly?

527) *Horizontal gene transfer*

The movement of genetic material between unicellular and/or multicellular organisms other than via vertical transmission (the transmission of DNA from parent to offspring.). See transduction, transformation, and conjugation

Subobjective 3.29 The student is able to construct an explanation of how viruses introduce genetic variation in host organisms.

173. How is it possible for *E. coli* to be both mutualistic and parasitic?

528) *Lytic cycle*

Phage replicative cycle that leads to the death of the host cell

529) Lysogenic cycle

Phage replicative cycle without killing the host cell. Some phages are capable of being both _____ and _____

530) Prophage

A bacterial virus that has incorporated its DNA into the DNA of the host cell (analogous to a provirus)

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.

Subobjective 3.31 I can describe basic chemical processes for cell communication shared across evolutionary lines of descent.

174. How does the fight or flight response evidence for common ancestry in mammals?

531) *Adrenal gland*

An endocrine gland that produces several hormones including epinephrine and norepinephrine that regulate the fight or flight response, glucocorticoids such as cortisol that help regulate glucose level, and suppress the immune system (they increase when under stress), and mineralocorticoids such as aldosterone that regulate blood pressure and electrolyte balance.

532) *Epinephrine*

A hormone also called adrenaline that prepares the body for action by dilating blood vessels and pupils, and increasing blood sugar by causing glycogen catabolism

533) *G-protein*

A peripheral membrane protein involved in signal transduction. It is activated by a transmembrane protein. It activates another membrane protein that is necessary for producing a secondary messenger.

534) *Adenylyl cyclase*

A membrane protein activated by a G protein that converts ATP into cAMP, which is a secondary messenger

Subobjective 3.32 I can generate scientific questions involving cell communication as it relates to the process of evolution.

175. How can we use our understanding of evolution to gain insight into signal transduction pathways and enzyme function in prokaryotes?

535) Phosphatase

An enzyme that removes a phosphate group form a molecule

Subobjective 3.33 I can use representation(s) and appropriate models to describe features of a cell signaling pathway.

Essential knowledge 3.D.2: Cells communicate with each other through direct contact with other cells or from distance via chemical signaling.

Subobjective 3.34 I can construct explanations of cell communication through cell-to-cell contact or through chemical signaling.

176. How do neurons talk to each other?

536) *Dendrites*

Receive incoming signals from other neurons

537) Neuron cell body

Contains the nucleus and most organelles

538) *Axon*

Carries signals to other neurons or organs

539) *Synapses*
The space between 2 neurons
540) *Neurotransmitter*
A chemical messenger that carries a signal from one neuron to the next
541) *Voltage-gated ion channel*
A channel protein that opens or closes depending on the voltage
542) *Ligand-gated ion channel*
A channel protein that opens or closes in response to a neurotransmitter

Subobjective 3.35 I can create representation(s) that depict how cell-to-cell communication occurs by direct contact or from a distance through chemical signaling.

177. How is spermatogenesis controlled?

543) GnRH (gonadotropin-releasing hormone)
A hormone released by the hypothalamus causing the anterior pituitary to release LH and FSH
544) LH (luteinizing hormone)
A hormone released by the anterior pituitary. In women, it causes ovulation and development of the corpus luteum. In men, it causes Leydig cells of the testes to produce testosterone.
545) FSH (follicle stimulating hormone)
A hormone released by the anterior pituitary. In women it causes the ovarian follicle to grow. In men, it causes Sertoli cells of the testes to produce inhibin and work synergistically with testosterone to cause sperm maturation.
546) Inhibin
A hormone produced by Sertoli cells of the testes that inhibits secretion of LH and FSH from the anterior pituitary gland
547) *Testosterone*
A hormone that causes secondary sexual characteristics in men as well as sperm maturation

Essential *knowledge 3.D.3: Signal transduction pathways link signal reception with cellular response.*

Subobjective 3.36 I can describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response.

Essential *knowledge 3.D.4: Changes in signal transduction pathways can alter cellular response.*

Subobjective 3.37 I can justify claims based on scientific evidence that changes in signal transduction pathways can alter cellular response.

178. Why do opiates make good pain killers?

548) Endorphin
A diverse group of neurotransmitters composed of short amino acid chains (neuropeptides). They reduce pain and cause euphoric feelings.
549) Opiate
A molecule that mimics the effects of endorphins

179. How do we know female is the default sex?

550) Gonad
An organ that produces gametes (testes or ovaries)

Subobjective 3.38 I can describe a model that expresses key elements to show how change in signal transduction can alter cellular response.

180. Why do some people think sugar is a drug?

551) Dopamine

A neurotransmitter necessary for fine motor movement, decision making, and reward

552) *Limbic system*

A collection of brain organs involved in emotion, motivation, memory, and olfaction

Subobjective 3.39 I can construct an explanation of how certain drugs affect signal reception and, consequently, signal transduction pathways.

181. How does "the pill" prevent pregnancy?

553) *Estrogen*

A hormone that causes secondary sexual characteristics in women as well as thickening of the endometrium (uterus lining)

554) Ovarian follicle

A collection of cells that support, protect, and nourish egg cells and are involved in regulating the menstrual cycle by secreting hormones such as estrogen

555) Corpus luteum

a temporary gland that forms from leftover follicular tissue. It produces progesterone and estrogen to prevent more follicles from maturing and to get the uterus ready for implantation of embryo (pregnancy)

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.

Subobjective 3.40 I can analyze data that indicate how organisms exchange information in response to internal changes and external cues, and which can change behavior.

182. How does natural selection explain the apparent cost/benefit analysis seen in the foraging behavior of many animal species?

556) Optimal foraging

Foraging that maximizes calories while minimizing the costs of seeking out calories. Costs would be energy expenditure, exposure to elements, and exposure to predation

Subobjective 3.41 I can create a representation that describes how organisms exchange information in response to internal changes and external cues, and which can result in changes in behavior.

Subobjective 3.42 I can describe how organisms exchange information in response to internal changes or environmental cues.

183. Why does altruism exist?

557) *Inclusive fitness*

The total number of genes an individual gets into the next generation (fitness) plus the total number of shared genes an individual helps get into the next generation by helping kin

558) *Kin selection*

Natural selection that favors altruistic behavior towards kin

559) Glucocorticoid

Steroid hormones such as cortisol produced by the adrenal glands that suppress inflammation, suppress the immune system, and increase production of glucose from amino acids and fatty acids. They increase in response to stress.

Essential knowledge 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.

Subobjective 3.43 I can construct an explanation, based on scientific theories and models, about how nervous systems detect external and internal signals, transmit and integrate information, and produce responses.

Subobjective 3.44 I can describe how nervous systems detect external and internal signals.

Subobjective 3.45 I can describe how nervous systems transmit information.

184. How is the voltage gradient across cells maintained?

560) *Sodium-potassium pump*

A transmembrane enzyme that pumps sodium and potassium ions in opposite directions against their concentration gradients using ATP. It pumps 3 sodium ions out of the cell for every 2 potassium ions in, which creates a negative voltage on the inside of the cell.

561) Electricity

The presence and flow of electric charge

185. How is an action potential conducted along a neuron?

186. Why is listening to load music a bad idea?

562) *Cilia*

Tiny extensions of the cell membrane used for motility and sensory purposes

563) Mechanosensitive channel

A membrane channel that opens in response to mechanical stress

564) *Cerebral cortex*

The outer layer of gray matter of the cerebrum. It is found only in mammals. It is responsible for the integration of complex sensory and neural functions and the initiation and coordination of voluntary activity in the body.

187. What adaptations have allowed for increased action potential conduction speed?

565) *Myelin sheath*

Insulating fat cells wrapped around axons that increase action potential conduction rate

Subobjective 3.46 I can describe how the vertebrate brain integrates information to produce a response.

Subobjective 3.47 I can create a visual representation of complex nervous systems to describe/explain how these systems detect external and internal signals, transmit and integrate information, and produce responses.

Subobjective 3.48 I can create a visual representation to describe how nervous systems detect external and internal signals.

188. How does the brain handle complex and simple tasks?

566) Central nervous system

The brain and spinal cord. It is responsible for integrating and controlling all actions and physiological functions

567) *Afferent neuron*

A sensory neuron of the peripheral nervous system that brings sensory information to the central nervous system

568) *Efferent neuron*

A motor neuron of the peripheral nervous system

569) *Interneuron*

A neuron that transmits signals from one neuron to another

Subobjective 3.49 I can create a visual representation to describe how nervous systems transmit information.

Subobjective 3.50 I can create a visual representation to describe how the vertebrate brain integrates information to produce a response.

189. How does the brain make decisions?

570) Sensory cortex

The part of the cerebral cortex that processes information from sensory neurons

571) Motor cortex

The part of the cerebral cortex that plans, controls, and executes voluntary movements

572) Prefrontal cortex

The region involved in planning complex cognitive behavior, personality expression, decision making, and moderating social behavior