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writing of this core fervently hope that this goal is realized in the years ahead.

Laboratory Requirements: Critical to understanding science concepts is the use of scientific inquiry to develop explanations of natural phenomena. Therefore, as a prerequisite for admission to the Regents examina tion in the Living Environment, students must have successfully completed 1200 minutes of laboratory experience with satisfactory written reports for each laboratory investigation.

It is expected that laboratory experiences will provide the opportunity for students to develop the scientific inquiry techniques in Standard 1, the use of informa - tion systems as outlined in Standard 2, the interconnectedness of content and skills and the problem-solving approaches in Standards 6 and 7, and the skills identified on the laboratory skills checklist found in Appendix A.

STANDARD 1

Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Science relies on logic and creativity. Science is both a body of knowledge and a way of knowingÑan intellectual and social process that applies human intelligence to explaining how the world works. Scientific explanations are developed using both observations (evidence) and what people already know about the world (scientific knowl - edge). All scientific explanations are tentative and subject to change. Good science involves questioning, observing and inferring, experimenting, finding evidence, collecting and organizing data, drawing valid conclusions, and undergoing peer review. Understanding the scientific view of the natural world is an essential part of personal, societal, and ethical decision making. Scientific literacy involves internalizing the scientific critical attitude so that it can be applied in everyday life, particularly in relation to health, commercial, and technological claims. Also see Laboratory Checklist in Appendix A.

Key Idea 1:

The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.

PERFORMANCE• INDICATOR 1.1•

Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to r epresent oneÕs thinking.

Major Understandings

1.1a Scientific explanations are built by combining evidence that can be observed with what people already know about the world.

1.1b Learning about the historical development of scientific concepts or about individu - als who have contributed to scientific knowledge provides a better understanding of scientific inquiry and the relationship between science and society.

1.1c Science provides knowledge, but values are also essential to making effective and ethical decisions about the application of scientific knowledge.

PERFORMANCE• INDICATOR 1.2•

Hone ideas through reasoning, library research, and discussion with others, including experts.

Major Understandings

1.2a Inquiry involves asking questions and locating, interpreting, and processing information from a variety of sources.

1.2b Inquiry involves making judgments about the reliability of the source and relevance of information.

PERFORMANCE INDICATOR 3.4 • Based on the results of the test and through public discussion, revise the explanation and contemplate additional research.

Major Understandings

3.4a Hypotheses are valuable, even if they turn out not to be true, because they may lead to further investigation.

3.4b Claims should be questioned if the data are based on samples that are very small, biased, or inadequately controlled or if the conclusions are based on the faulty, incomplete, or misleading use of numbers.

3.4c Claims should be questioned if fact and opinion are intermingled, if adequate evidence is not cited, or if the conclusions do not follow logically from the evidence given.

PERFORMANCE INDICATOR 3.5 • Develop a written report for public scrutiny that describes the proposed explanation, including a literature review, the research carried out, its result, and suggestions for further research.

Major Understandings

3.5a One assumption of science is that other individuals could arrive at the same explanation if they had access to similar evidence. Scientists make the results of their investigations public; they should describe the investigations in ways that enable others to repeat the investigations.

3.5b Scientists use peer review to evaluate the results of scientific investigations and the explanations proposed by other scientists. They analyze the experimental procedures, examine the evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations for the same observations.

PERFORMANCE• INDICATOR 1.2•

Describe and explain the structures and functions of the human body at dif ferent organizational levels (e.g., systems, tissues, cells, organelles).

Major Understandings

1.2a Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.

1.2b Humans are complex organisms. They require multiple systems for digestion, respiration, r eproduction, circulation, excretion, movement, coordination, and immunity. The systems interact to perform the life functions.

1.2c The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.

1.2d If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.

1.2e The organs and systems of the body help to provide all the cells with their basic needs. The cells of the body are of diferent kinds and are grouped in ways that enhance how they function together.

1.2f Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.

1.2g Each cell is covered by a membrane that performs a number of important functions for the cell. These include: separation from its outside environment, controlling which molecules enter and leave the cell, and recognition of chemical signals. The processes of diffusion and active transport are important in the movement of materials in and out of cells.

1.2h Many organic and inorganic substances dissolved in cells allow necessary chemical reactions to take place in order to maintain life. Large organic food molecules such as proteins and starches must initially be broken down (digested to amino acids and simple sugars respectively), in order to enter cells. Once nutrients enter a cell, the cell will use them as building blocks in the synthesis of compounds necessary for life.

1.2i Inside the cell a variety of specialized structures, formed from many dif ferent molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).

1.2j Receptor molecules play an important role in the interactions between cells. Two primary agents of cellular communication are hormones and chemicals produced by nerve cells. If nerve or hormone signals are blocked, cellular communication is disrupted and the organismÕs stability is affected.

PERFORMANCE INDICATOR 1.3

Explain how a one-celled organism is able to function despite lacking the levels of organization present in more complex organisms.

Major Understandings

1.3a The structures present in some single-celled organisms act in a manner similar to the tissues and systems found in multicellular organisms, thus enabling them to perform all of the life processes needed to maintain homeostasis.

Key Idea 2:

Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.

Organisms from all kingdoms possess a set of instructions (genes) that determines their characteristics. These instructions are passed from parents to offspring during reproduction. Students are familiar with simple mechanisms related to the inheritance of some physical traits in offspring. They are now able to begin to understand the molecular basis of heredity and how this set of instructions can be changed through recombination, mutation, and genetic engineering.

The inherited instructions that are passed from parent to offspring exist in the form of a code. This code is contained in DNA molecules. The DNA molecules must be accurately replicated before being passed on. Once the coded information is passed on, it is used by a cell to make proteins. The proteins that are made become cell parts and carry out most functions of the cell.

Throughout recorded history, humans have used selective breeding and other biotechnological methods to produce products or organisms with desirable traits. Our current understanding of DNA extends this to the manipulation of genes leading to the development of new combinations of traits and new varieties of organisms.

PERFORMANCE INDICATOR 2.1

Explain how the structure and replication of genetic material result in offspring that resemble their parents.

Major Understandings

2.1a Genes are inherited, but their expression can be modified by interactions with the environment.

2.1b Every organism requires a set of coded instructions for specifying its traits. For offspring to resemble their parents, there must be a reliable way to transfer information from one generation to the next. Heredity is the passage of these instructions from one generation to another.

2.1c Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.

2.1d In asexually reproducing organisms, all the genes come from a single parent. Asexually produced offspring are normally genetically identical to the parent.

2.1e In sexually reproducing organisms, the new individual receives half of the genetic information from its mother (via the egg) and half from its father (via the sperm). Sexually produced offspring often resemble, but are not identical to, either of their parents.

Key Idea 3:

Individual organisms and species change over time.

Evolution is the change of species over time. This theory is the central unifying theme of biology. This change over time is well documented by extensive evidence from a wide variety of sources. Students need to know that in sexually reproducing organisms, only changes in the genes of sex cells can become the basis for evolutionary change and that these evolutionary changes may occur in structure, function, and behavior over time. Students need to be able to distinguish between evolutionary change and the changes that occur during the lifetime of an individual organism.

According to many scientists, biological evolution occurs through natural selection. Natural selection is the result of overproduction of offspring, variations among offspring, the struggle for survival, the adaptive value of certain variations, and the subsequent survival and increased reproduction of those best adapted to a particular environment. Selection for individuals with a certain trait can result in changing the proportions of that trait in a population.

The diversity of life on Earth today is the result of natural selection occurring over a vast amount of geologic time for most organisms, but over a short amount of time for organisms with short reproductive cycles such as pathogens in an antibiotic environment and insects in a pesticide environment.

PERFORMANCE INDICATOR 3.1•

Explain the mechanisms and patterns of evolution.

Major Understandings

3.1a The basic theory of biological evolution states that the EarthÕs present-day species developed from earlier, distinctly different species.

3.1b New inheritable characteristics can result from new combinations of existing genes or from mutations of genes in reproductive cells.

3.1c Mutation and the sorting and recombining of genes during meiosis and fertilization result in a great variety of possible gene combinations.

3.1d Mutations occur as random chance events. Gene mutations can also be caused by such agents as radiation and chemicals. When they occur in sex cells, the mutations can be passed on to offspring; if they occur in other cells, they can be passed on to other body cells only.

3.1e Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life-forms, as well as for the molecular and structural similarities observed among the diverse species of living organisms.

3.1f Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

3.1g Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.

3.1h The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions.

PERFORMANCE•
INDICATOR 3.1•

continued

3.1i Behaviors have evolved through natural selection. The broad patterns of behavior

PERFORMANCE•
INDICATOR 4.1•

continued

4.1f The structures and functions of the human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta, and nutrition through milk for the newborn.

4.1g The structures and functions of the human male reproductive system, as in other mammals, are designed to produce gametes in testes and make possible the delivery of these gametes for fertilization.

4.1h In humans, the embryonic development of essential organs occurs in early stages of pregnancy. The embryo may encounter risks from faults in its genes and from its motherÕs exposure to environmental factors such as inadequate diet, use of alcohol/drugs/tobacco, other toxins, or infections throughout her pregnancy.

Key Idea 5:

Organisms maintain a dynamic equilibrium that sustains life.

Life is dependent upon availability of an energy source and raw materials that are used in the basic enzyme-controlled biochemical processes of living organisms. These biochemical processes occur within a narrow range of conditions. Because organisms are continually exposed to changes in their external and internal environments, they must continually monitor and respond to these changes. Responses to change can range in complexity from simple activation of a cell chemical process to elaborate learned behavior. The result of these responses is called homeostasis, a Òdynamic equilibrium Òor Òsteady stateÓ which keeps the internal environment within certain limits.

PERFORMANCE• INDICATOR 5.3•

Relate processes at the system level to the cellular level in order to explain dynamic equilibrium in multicelled organisms.

Major Understandings

5.3a Dynamic equilibrium results from detection of and response to stimuli. Organisms detect and respond to change in a variety of ways both at the cellular level and at the organismal level.

5.3b Feedback mechanisms have evolved that maintain homeostasis. Examples include the changes in heart rate or respiratory rate in response to increased activity in muscle cells, the maintenance of blood sugar levels by insulin from the pancreas, and the changes in openings in the leaves of plants by guard cells to regulate water loss and gas exchange.

Key Idea 6:

Plants and animals depend on each other and their physical environment.

The fundamental concept of ecology is that living organisms interact with and are dependent on their environment and each other. These interactions result in a flow of energy and a cycling of materials that are essential for life.

Competition can occur between members of different species for an ecological niche. Competition can also occur within species. Competition may be for abiotic resources, such as space, water, air, and shelter, and for biotic resources such as food and mates. Students should be familiar with the concept of food chains and webs.

PERFORMANCE INDICATOR 6.1•

Explain factors that limit growth of individuals and populations.

Major Understandings

6.1a Energy flows through ecosystems in one direction, typically from the Sun, through photosynthetic organisms including green plants and algae, to herbivores to carnivores and decomposers.

6.1b The atoms and molecules on the Earth cycle among the living and nonliving components of the biosphere. For example, carbon dioxide and water molecules used in photosynthesis to form energy-rich organic compounds are returned to the environment when the energy in these compounds is eventually released by cells. Continual input of energy from sunlight keeps the process going. This concept may be illustrated with an energy pyramid.

6.1c The chemical elements, such as carbon, hydrogen, nitrogen, and oxygen, that make up the molecules of living things pass through food webs and are combined and recombined in dif ferent ways. At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment as heat.

6.1d The number of organisms any habitat can support (carrying capacity) is limited by the available energy, water, oxygen, and minerals, and by the ability of ecosystems to recycle the residue of dead organisms through the activities of bacteria and fungi.

6.1e In any particular environment, the growth and survival of organisms depend on the physical conditions including light intensity, temperature range, mineral availability, soil/rock type, and relative acidity (pH).

PERFORMANCE• INDICATOR 6.1•

continued

6.1f Living organisms have the capacity to produce populations of unlimited size, but environments and resources are finite. This has profound effects on the interactions among organisms.

6.1g Relationships between organisms may be negative, neutral, or positive. Some organisms may interact with one another in several ways. They may be in a producer/consumer, predator/prey, or parasite/host relationship; or one organism may cause disease in, scavenge, or decompose another.

PERFORMANCE• INDICATOR 6.2•

Explain the importance of preserving diversity of species and habitats.

Major Understandings

6.2a As a result of evolutionary processes, there is a diversity of organisms and roles in ecosystems. This diversity of species increases the chance that at least some will survive in the face of large environmental changes. Biodiversity increases the stability of the ecosystem.

6.2b Biodiversity also ensures the availability of a rich variety of genetic material that may lead to future agricultural or medical discoveries with significant value to humankind. As diversity is lost, potential sources of these materials may be lost with it.

PERFORMANCE• INDICATOR 6.3•

Explain how the living and nonliving environments change over time and respond to disturbances.

Major Understandings

6.3a The interrelationships and interdependencies of organisms affect the development of stable ecosystems.

6.3b Through ecological succession, all ecosystems progress through a sequence of

PERFORMANCE INDICATOR 7.3

• Explain how individual choices and societal actions can contribute to improving the environment.

Major Understandings

7.3a Societies must decide on proposals which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.

7.3b The decisions of one generation both provide and limit the range of possibilities open to the next generation.

APPENDIX A
LIVING ENVIRONMENTÑLABORATORY CHECKLIST