California Science Teachers Association
In collaboration with the California Department of Education

INTEGRATED SCIENCE: Level 2

A Logic and Sequence for Meaningful Instruction

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Forward

In October, 2003, the California State Board of Education established sets of standards for each of four levels of high school integrated science. These standards are identical to the Grade 9-12 content standards in biology, chemistry, earth science, physics, and investigation and experimentation. By "successfully meeting the challenge [of these standards] . . . high school graduates can attain the highest level of science literacy . . ." (2003 Science Framework, Pg.154).

The 2003 Science Framework for California Public Schools states, "that no sequence or emphasis is prescribed" for structuring the high school science program (p.154) but leaves each high school and district the flexibility to design their own course structure. This document, developed collaboratively by the California Science Teachers Association and the California Department of Education, recognizes the autonomy of schools and districts and offers an instructional organization of standards that supports student learning in a four year integrated science program. The instructional models for the four levels of integrated science, as contained in this document, are provided as *examples* of how high school instruction in integrated science might be organized. There are alternative ways in which an integrated science curriculum might be organized and, therefore, this document does not represent a mandate for instruction.

The four models provide for the integration of each of the disciplines of science, as well as the process of science, contained in the investigation and experimentation standards. They include narrative information that describes the overarching concepts for each level. Each level, excluding level IV, is developed into two semesters. Each semester is then developed into possible units. Specific standards are listed for each unit, and narrative is provided to facilitate the reader's understanding of why specific standards are clustered together. The narrative also gives teachers a design for scaffolding the standards to enhance student understanding of the science concepts contained in the standards. Additionally, flowcharts are presented for one or two concepts in each level to graphically illustrate both the instructional sequence and the "integrated relationships" between the standards clustered in a particular unit of instruction. These visual tools provide teachers with a quick overview of the connections and probable sequences in their curriculum. Teachers are encouraged to review each level and make appropriate modifications to best match their students' needs and their school context. The reader will also find the investigation and experimentation topics placed at the beginning of each course, as these standards should be embedded and covered throughout the entire course.

It is important to note that the standards sets for the four levels of integrated science are aligned to the blueprints for the California Standards Tests (CSTs). Schools are advised not to rearrange standards from one level to another for this reason. Each high school standard appears once in the four levels of integrated science. However, some standards may be introduced and not tested or may need to be reintroduced to facilitate complete understanding at a particular level.

In January, 2004, the State Board of Education approved a set of blueprints that will be used to design a high school assessment mandated by the No Child Left Behind (NCLB) act. This exam will be administered in 10th grade and will be assess the high school biology and middle school

life science standards. Schools/districts that are implementing integrated science in both 9th and 10th grade should recognize that 57 percent of the standards defined on the blueprint are covered in years one and two of the integrated science blueprints. Districts are encouraged to offer a comprehensive 7th grade standards-based science course so that students entering high school will have mastery of the life science standards which form the foundation for the high school biology standards.

This document is designed primary for science teachers who are responsible for implementing the science standards. The document is also useful for designers of science materials and professional development, who will be able to familiarize themselves with what is expected from our California students in the integrated/coordinated sequence. Parents, guardians, and students will find this document useful to see the overall coverage of the Science Content Standards for California Public Schools grade 9-12.

Table of Contents
Integrated/Coordinated Science 2

INTEGRATED SCIENCE- LEVEL 2
PROPOSED INSTRUCTIONAL SEQUENCE

COURSE CONCEPT—The overarching concept for Integrated Science 2 is that the Earth is a unique system that supports life within an ever-changing and complex universe. Building upon the standards covered in Integrated Science 1, this theme includes standards taken from physics, chemistry, biology, and Earth science. Included among the standards from physics are those pertaining to energy and Newton's Laws. In chemistry, the standards pertain to solutions, chemical reactions, and organic chemistry. The biology standards include considerations of molecules, cells, protein synthesis, cell reproduction, and Mendelian genetics. Earth science standards pertain to planetary motion, solar radiation, energy transformations at the Earth's surface, and geological and climatic changes. The Integrated Science 2 concepts will be further enhanced by having students perform careful scientific investigations.

I. Semester 1—The formation and motion of planets.

A. **Unit Concept #1—**The interaction of matter and energy result in a dynamic solar system that can be explained by the universal laws of physics. Forces affect planetary systems, and universal laws of energy and motion explain the movement of planets and all other objects. Universal laws can be observed by studying simple systems, and Newton's laws of motion help to explain simple and universal systems. Inherent in any useful study of motion is the concept of force, and Newton's laws provide a solid foundation upon which to analyze forces. There is an important relationship between the universal law of gravitation and the effect of gravity on an object at the surface of the Earth. Celestial and earth systems are affected by the same forces as explained by Newton's Laws.

1. Earth Science 1- Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time.
   a. Earth Science 1a- Students know how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system.
   b. Earth Science 1g*- Students know the evidence for the existence of planets orbiting other stars.
2. Physics 2a - Students know how to calculate kinetic energy by using the formula $E = (1/2)mv^2$
3. Physics 2b- Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) = mgh (h is the change in the elevation)l.
4. Physics 2c- Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.
5. Physics 2d- Students known how to calculate momentum as the product mv.

6. Physics 1- Newton's laws predict the motion of most objects.
    a. Physics 1a- Students know how to solve problems that involve constant speed and average speed.
    b. Physics 1b- Students know that when forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest (Newton's first law).
    c. Physics 1c- Students know how to apply the law F = ma to solve one-dimensional motion problems that involve constant forces (Newton's second law).
    d. Physics 1d- Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
    e. Physics 1e- Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of the Earth.
    f. Physics 1g - Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
    g. Physics 1h*- Students know Newton's laws are not exact but provide good approximations unless an object is moving close to the speed of light or is small enough that quantum effects are important.
    h. Physics 1i*- Students know how to solve problems in circular motion by using the formula for centripetal acceleration in the following form: $a=v^2/r$.
    i. Physics 1f- Students know the evidence for the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons and in mass extinction of life on Earth.

B. Unit Concept #2—The interaction of matter and energy results in a dynamic earth system. Energy affects Earth as a system; the uneven heating of Earth causes air movements, and oceans and the water cycle influence weather. Heat energy is transferred by radiation, conduction, and convection, and radiation from the sun is responsible for winds and ocean currents, which in turn influence weather and climate. Geologic and climatic changes are part of an evolving earth system.

1. Earth 4- Energy enters the earth system primarily as solar radiation and eventually escapes as heat.
    a. Earth 4b- Students know the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
2. Earth 5- Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.

a. Earth 5a- Students know how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
b. Earth 5b- Students know the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
c. Earth 5c- Students know the origin and effects of temperature inversions.
d. Earth 5e- Students know rain forests and deserts on Earth are distributed in bands at specific latitudes.
e. Earth 5f*- Students know the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.
f. Earth 5g*- Students know features of the ENSO (El Nino southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.

3. Earth 6- Climate is the long-term average of a region's weather and depends on many factors.
   a. Earth 6a- Students know weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.
   b. Earth 6b- Students know the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.
   c. Earth 6c- Students know how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.
   d. Earth 1c- Students know the evidence from geological studies of Earth and other planets suggest that the early Earth was very different from Earth today.

II. SEMESTER 2—The dynamic Earth supports life.

A. **Unit Concept #1—**The chemical structure of inorganic and organic matter forms the basis of life on Earth, and the laws of chemistry apply to both non-living and living systems. The cell can be viewed as a package of chemicals that interact according to basic laws of chemistry. The cell is composed of a major solvent (water) into which are dissolved a variety of solutes. The chemicals contained within a cell are subject to kinetic molecular theory and the law of the conservation of matter. Methods of chemistry, including those of chromatography and distillation, inform our understanding of the biochemical systems within the cell.

1. Biology 1- The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells.
2. Chemistry 6- Solutions are homogenous mixtures of two or more substances.
    a. Chemistry 6a- Students know the definitions of solute and solvent.
    b. Chemistry 6f*- Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.
    c. Chemistry 6b- Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.
    d. Chemistry 6c- Students know temperature, pressure, and surface area affect the dissolving process.
3. Chemistry 3- The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.
    a. Chemistry 3a- Students know how to describe chemical reactions by writing balanced equations.

B. **Unit Concept #2—**The unique properties of carbon and water contribute to the fundamental structure and functions of cells. There are many organic molecules essential to the structure and function of a cell. The four major groups of macromolecules that form the basis of life are carbohydrates, proteins, lipids, and nucleic acids. These macromolecules are the structural and functional building blocks of cell membranes and organelles**.**

1. Chemistry 10- The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.
    a. Chemistry 10b- Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.
    b. Chemistry 10d*- Students know the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.
    c. Chemistry 10a- Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.
    d. Chemistry 10c- Students know amino acids are the building blocks of proteins.
    e. Chemistry 10f*- Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.

f. Chemistry 10e*- Students know how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, aldehydes, and organic acids.
    i. Biology 1h- Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.
        (a) Biology 1a- Students know cells are enclosed within semi-permeable membranes that regulate their interaction with their surroundings.
        (b) Biology 1e- Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.
        (c) Biology 1j*- Students know how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both.

C. **Unit Concept #3—**The self-replicating property of DNA forms the bases for continuity and change in the reproduction of cells. Changes in DNA result in structural and functional alterations in cells, organisms and populations. DNA also serves as a template for the production of other molecules that are responsible for the structure and function of the cell. The processes of meiosis and fertilization determine the genotypes and diversity of offspring.

1. Biology 4- Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.
    a. Biology 4a- Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.
    b. Biology 4b- Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.
    c. Biology 4d- Students know the central dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm.
2. Biology 2- Mutation and sexual reproduction lead to genetic variation in a population.
    a. Biology 2a- Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.
    b. Biology 2b- Students know only certain cells in a multicellular organism undergo meiosis.

c. Biology 2c- Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.
d. Biology 2e-Students know why approximately half of an individual's DNA sequence comes from each parent.
e.

D. Unit Concept #4—The inherited genotype contributes to an organism's phenotype. Mendel's laws of segregation and independent assortment form the basis for understanding patterns of inheritance. Using Mendel's laws, we can predict the probable outcome of phenotypes based upon the genotypes of the parents.

1. Biology 3- A multi-cellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.
   a. Biology 3b- Students know the genetic basis for Mendel's laws of segregation and independent assortment.
   b. Biology 3f- Students know the role of chromosomes in determining an individual's sex.
   c. Biology 3a- Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).
   d. Biology 3c*- Students know how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes.
   e. Biology 2g- Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.
   f. Biology 3d*- Students know how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes.

ESSENTIAL QUESTIONS:

Year question: What are the universal laws that govern relationships of matter and energy and make possible the existence of life?

Semester One question: What are the forces that interact to form and sustain the dynamic universe?

Semester Two question: What exchanges of energy are necessary for life?

Integrated Science- Year 2
Sample Flowchart for Concept Instructional Sequence

Bridge Statements

IA

The Earth is a unique system that supports life within an ever-changing and complex

The interaction of matter and energy determine the characteristics of our Earth's system.

IB

The interaction of matter and energy results in a dynamic Earth

The interaction of matter and energy determine the characteristics of life.

IIA

The chemical structure of inorganic and organic matter forms the basis of life on Earth

The chemical structure of inorganic and organic determine the structures and functions of cells.

IIB

The unique properties of carbon and water contribute to the fundamental structures and functions of cells.

The structure and function of cells rely on the self-replicating properties of DNA.

IIC

The self-replication property of DNA forms the basis for continuity and change in the reproduction of cells.

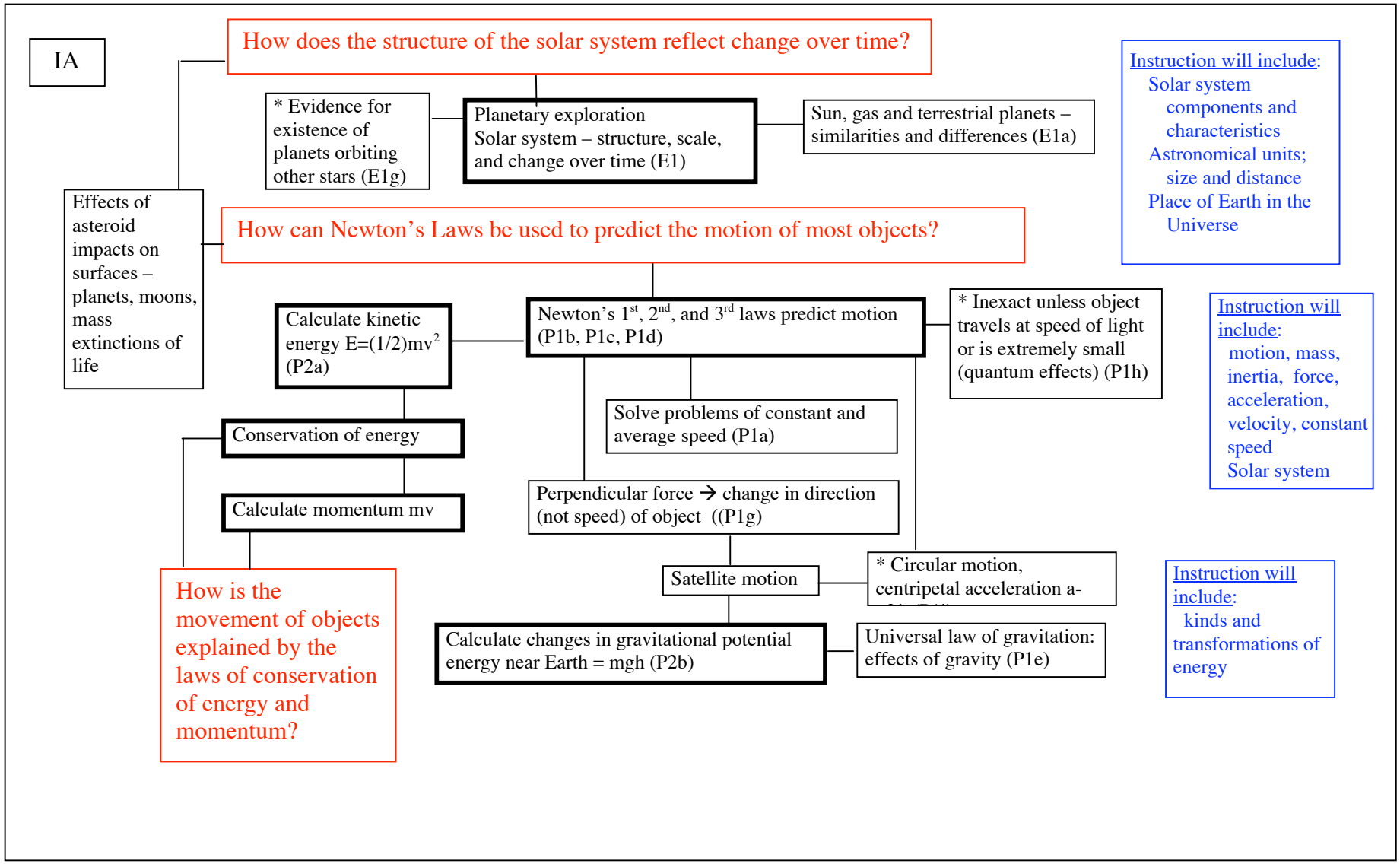
Continuity and change in the reproduction of cells rely on inherited genotype.

IIC

The inherited genotype determines an organism's phenotype.

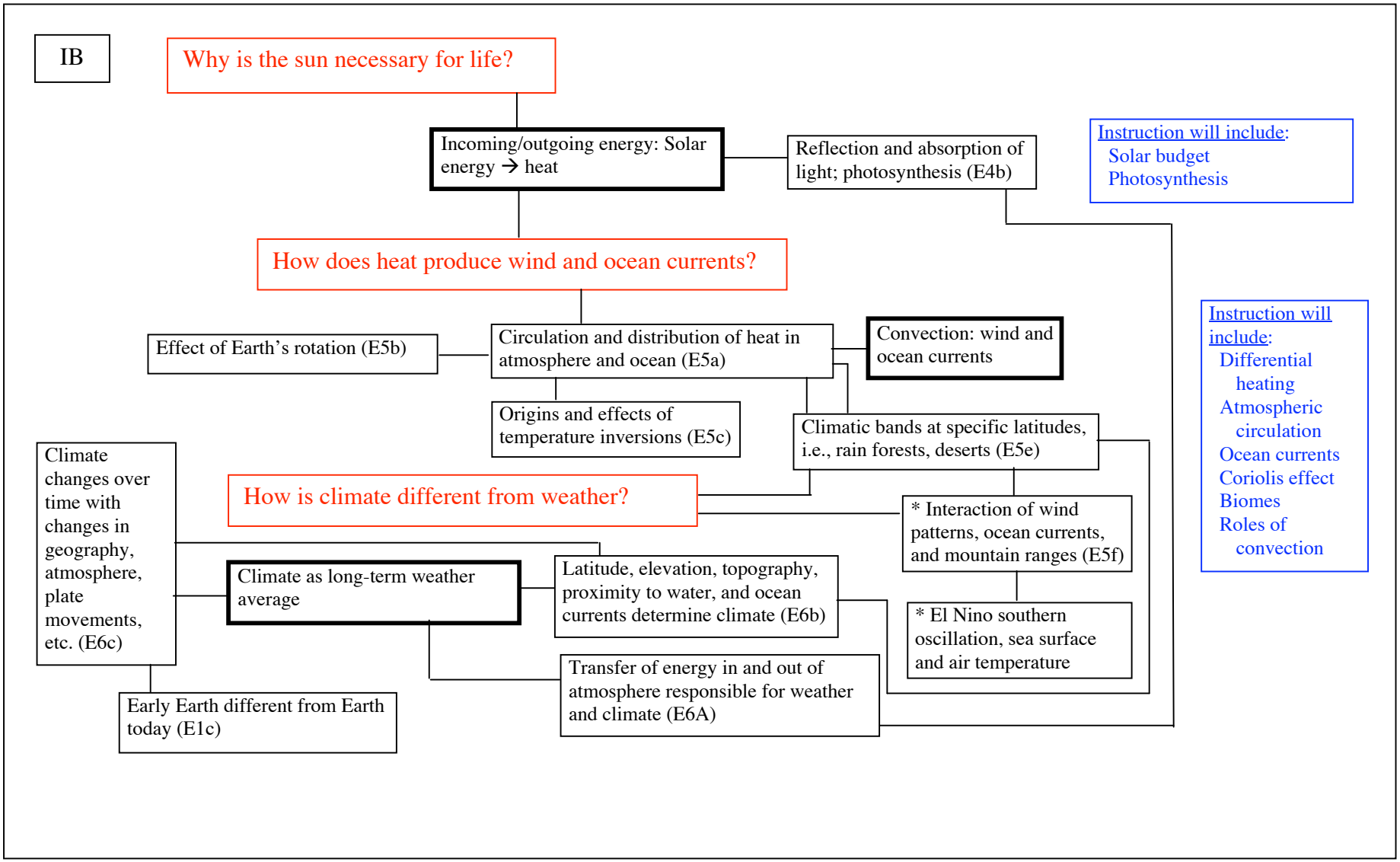
Integrated Science- Year 2
Sample Flowchart for Concept Instructional Sequence

The Earth is a unique system that supports life within an ever-changing and complex universe.



Integrated Science- Year 2
Sample Flowchart for Concept Instructional Sequence

The interaction of matter and energy results in a dynamic Earth system.



Integrated Science- Year 2
Sample Flowchart for Concept Instructional Sequence

The chemical structure of inorganic and organic matter forms the basis of life on Earth

IIB

How do simple subunits combine to form large molecules that make up all living things?

Shape, internal organization of eukaryotic cells due to cytoskeleton, cell wall, or both

Biochemical basis of life: bonding characteristics of carbon determine size and shape of molecules and their chemical properties

Simple hydrocarbons to complex polymers and biological molecules (C10b)

Simple subunits form large molecules such as proteins, nucleic acids, and starch. (C10a)

* simplest linear hydrocarbons and isomers; single, double, triple bonds; nomenclature (C10d)

Macromolecules: polysaccharides, nucleic acids, proteins, lipids (B1h)

* bonding of amino acids, R-groups (C10f)

Building blocks of protein are amino acids. (C10c).

Role of endoplasmic reticulum and Golgi apparatus in secretion of proteins (B1e)

Cells enclosed within semipermeable membranes regulating interaction with surroundings (B1a)

* functional groups: alcohols, ketones, ethers, amines, aldehydes, and organic acids (C10e)

Instruction will include:
- Carbon bonding
- Simple hydrocarbons
- Functional groups
- Formation and structure of macromolecules
- Membranous cell structures, cytoskeleton, cell wall

Bridge Statements Integrated Science 2

Semester 1

Formation and motion of planets.

IA

The interaction of matter and energy result in a dynamic solar system that can be explained by the universal laws of physics.

The interaction of matter and energy determine the characteristics of our Earth's system.

IB

The interaction of matter and energy results in a dynamic Earth system.

The interaction of matter and energy make life possible.

Semester 2

The dynamic Earth supports life.

IIA

The chemical structure of inorganic and organic matter forms the basis of life on Earth.

The chemical structure of inorganic and organic matter determine the structures and functions of cells.

IIB

The unique properties of carbon and water contribute to the fundamental structures and functions of cells.

The structure and function of cells rely on the self-replicating properties of DNA.

IIC

The self-replication property of DNA forms the basis for continuity and change in the reproduction of cells.

Continuity and change in the reproduction of cells rely on inherited genotype.

The inherited genotype contributes to an organism's phenotype.

10th GRADE NCLB TEST
COMPARISON OF STANDARDS ADDRESSED IN BIOLOGY WITH INTEGRATED SCIENCE I AND II

	% of Test	Number of Items	Integrated I	Integrated II
CELL BIOLOGY	**17**	**10**		
CALIFORNIA CONTENT STANDARDS: Grade 7 **1. All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:** c. Students *know* the nucleus is the repository for genetic information in plant and animal cells. d. Students *know* that mitochondria liberate energy for the work that cells do and that chloroplasts capture sunlight energy for photosynthesis. e. Students *know* cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes. **CALIFORNIA CONTENT STANDARDS: Grade 8** **6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:** b. Students *know* that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur. c. Students *know* that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.	**X = a match between the Biology Standard and Biology/Life Science Standard in either the Integrated I or II Blueprint**			
CALIFORNIA CONTENT STANDARDS: Biology				
1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:				
a. Students *know* cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.				**X**
c. Students *know* how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.				**X**
f. Students *know* usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.				

	% of Test	Number of Items	Integrated I	Integrated II
GENETICS	**20**	**12**		
CALIFORNIA CONTENT STANDARDS: Grade 7 **2. A typical cell of any organism contains genetic instructions that specify itstraits. Those traits may be modified by environmental influences. As a basis for understanding this concept:** a. Students *know* the differences between the life cycles and reproduction methods of sexual and asexual organisms. c. Students *know* an inherited trait can be determined by one or more genes. d. Students *know* plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive. e. Students *know* DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell				
CALIFORNIA CONTENT STANDARDS: Biology				
2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:				
b. Students *know* only certain cells in a multicellular organism undergo meiosis.				**X**
d. Students *know* new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).				
e. Students *know* why approximately half of an individual's DNA sequence comes from each parent.				**X**
f. Students *know* the role of chromosomes in determining an individual's sex.				**X**
3. A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:				
a. Students *know* how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or Xlinked, dominant or recessive).				**X**
5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:				
a. Students *know* the general structures and functions of DNA, RNA, and protein.				

	% of Test	Number of Items	Integrated I	Integrated II
PHYSIOLOGY	**17**	**10**		
CALIFORNIA CONTENT STANDARDS: Grade 7 **5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:** a. Students *know* plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism. c. Students *know* how bones and muscles work together to provide a structural framework for movement. **6. Physical principles underlie biological structures and functions. As a basis for understanding this concept:** j. Students *know* that contractions of the heart generate blood pressure and that heart valves prevent backflow of blood in the circulatory system.				
CALIFORNIA CONTENT STANDARDS: Biology				
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:				
a. Students *know* how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.				
b. Students *know* how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.				
10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:				
b. Students *know* the role of antibodies in the body's response to infection.				
c. Students *know* how vaccination protects an individual from infectious diseases.				
d. Students *know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.				

	% of Test	Number of Items	Integrated I	Integrated II
ECOLOGY	**18**	**11**		
CALIFORNIA CONTENT STANDARDS: Grade 6 **5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:** b. Students *know* matter is transferred over time from one organism to others in the food web and between organisms and the physical environment. c. Students *know* populations of organisms can be categorized by the functions they serve in an ecosystem. e. Students *know* the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.				
CALIFORNIA CONTENT STANDARDS: Biology				
6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:				
a. Students *know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.			**X**	
b. Students *know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.			**X**	
c. Students *know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.			**X**	
d. Students *know* how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.			**X**	
e. Students *know* a vital part of an ecosystem is the stability of its producers and decomposers.			**X**	
f. Students *know* at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid			**X**	

	% of Test	Number of Items	Integrated I	Integrated II
EVOLUTION	**18**	**11**		
Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept: a. Students *know* both genetic variation and environmental factors are causes of evolution and diversity of organisms. b. Students *know* the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution. c. Students *know* how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.				
CALIFORNIA CONTENT STANDARDS: Biology				
7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:				
a. Students *know* why natural selection acts on the phenotype rather than the genotype of an organism.				
b. Students *know* why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.				
c. Students *know* new mutations are constantly being generated in a gene pool.				
d. Students *know* variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.				
8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:				
a. Students *know* how natural selection determines the differential survival of groups of organisms.			**X**	
b. Students *know* a great diversity of species increases the chance that at least some organisms survive major changes in the environment.			**X**	
e. Students *know* how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.			**X**	

	% of Test	Number of Items	Integrated I	Integrated II
INVESTIGATION AND EXPERIMENTATION	**10**	**6**		
CALIFORNIA CONTENT STANDARDS: Grade 6 **7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:** c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables. e. Recognize whether evidence is consistent with a proposed explanation. **CALIFORNIA CONTENT STANDARDS: Grade 7** **7. Scientific progress is made by asking meaningful questions …** c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence. **CALIFORNIA CONTENT STANDARDS: Grade 8** **9. Scientific progress is made by asking meaningful questions …** b. Evaluate the accuracy and reproducibility of data. c. Distinguish between variable and controlled parameters in a test.				
CALIFORNIA CONTENT STANDARDS: Grades 9-12				
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. …				
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.			**X**	**X**
f. Distinguish between hypothesis and theory as scientific terms.			**X**	**X**
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).			**X**	**X**
j. Recognize the issues of statistical variability and the need for controlled tests.			**X**	**X**
TOTALS	**100**	**60**		

Comments:

- 61% coverage of Integrated I and II Biology/Life Sciences Standards with Biology Standards in 10th grade NCLB Blueprint. [There is a match of 19 of 31 Biology Standards.]*
- Because Biology Standards in 10th grade NCLB test make up 57% of the test, 78% of the total standards for the 10th Grade NCLB test are addressed in Integrated Science I and II and 6th, 7th and 8th grade Standards.
- Integrated Science I and II do not address any of the area of Physiology in the Biology portion of the 10th grade NCLB test.
- Some Biology standards not addressed in Integrated Science I and II can be incorporated into a review of 7th and 8th grade standards. For example, Biology Standard 1f that is not addressed in either Integrated I or II, can be taught as part of Biology Standard 6d which is addressed in Integrated I. There are numerous other places where Biology Standards that are not components of the Integrated Science I or II Blueprint can be taught in a Chemistry or Earth Science unit or as part of a review of 7th and 8th grade Standards.

*There are 31 Biology Standards in the NCLB 10th grade Blueprint, not 30 as stated by CDE.

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