HIGH SCHOOL CORE CLASSES

INTEGRATED/COORDINATED SCIENCE 3 AB
Annual Course—Grades 10-12
Prerequisites: Integrated/Coordinated Science 2AB. Concurrent enrollment in Algebra 2AB or equivalent is recommended.

36-01-31 INT/COORD 3A
36-01-32 INT/COORD 3B

Type of Credential
Life Science, or Science: Biological Science, **and** Physical Science, or Science: Chemistry, or Science: Physics, or Science: Geoscience. For further information please call Certificated Credentials and Contract Services Unit at 213-241-6520.

Course Description
Integrated/Coordinated Science 3AB builds upon the physics, chemistry, biology, and earth science concepts introduced in Integrated/Coordinated Science 1AB and 2AB. . The students use knowledge and skills obtained in year one and two as a foundation to broaden their abilities while experiencing both new and more advanced material. The relationships between the science disciplines will be explored and illustrated. This course will be quantitative and project-based as is Integrated/Coordinated Science 2AB. This laboratory course allocates at least 40 percent of the class time to student-centered laboratory activities and field study. In addition, 20 percent of the students' time should be in small-group activities working on team projects and research. The Integrated/Coordinated Science curriculum is used at a variety of sites with different school calendars, student population, and teaching resources. The curriculum follows a spiral approach, connected by common concepts that are matched to the State Standards. Because each year of Integrated/Coordinated Science builds upon the previous year's instruction, State Standards expected of all students should be addressed within the three years of Integrated/Coordinated Science. **Integrated/Coordinated Science 3AB meets one year of the University of California *'d'* entrance requirement for laboratory science.**

COURSE SYLLABUS

INSTRUCTIONAL UNITS	***SUGGESTED WEEKS**	
Cell Biology, Evolution	8	9
Conservation of Matter, Stochiometry, Gases and Their Properties, Acids and Bases, Reaction Rates		
Chemical Equilibrium	8	10
Energy in the Earth System, Structure and Composition of the Atmosphere	8	10
Motions and Forces, Conservation of Energy and Momentum	8	9
Total	***32 year-round**	***38 traditional**

* Suggested weeks are to be used as an estimate only. Integration of units and standards is highly recommended. Pacing will depend on how State Content Standards and the Literacy and Mathematics Initiatives are embedded.

Biology Standards Covered
Cell 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:
1.b. *Students know* that enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.
1.f. *Students know* that unstable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.
1.g. *Students know* the role of the mitochondria in making stored chemical bond energy available to cells by completing the breakdown of glucose to carbon dioxide.
1.i. **Students know* how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production.
Genetics
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. As a basis for understanding this concept:
4.c. *Students know* how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.
4.d. *Students know* specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.
4.e. *Students know* proteins can differ from one another in the number and sequence of amino acids.
4.f. **Students know why proteins having different amino acid sequences typicallly have different shapes and chemical properties.*
5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:
5.c. *Students know* how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.
5.d. **Students know* how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules.
5.e. **Students know* how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products.
Evolution
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:
7.a. *Students know* why natural selection acts on the phenotype rather than the genotype of an organism.
7.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.
7.c. *Students know* that new mutations are constantly being generated in a gene pool.
7.d. *Students know* that variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.
7.e. **Students know* the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.
7.f. **Students know* how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in population, given the frequency of phenotypes.
8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:
8.c. *Students know* the effects of genetic drift on the diversity of organisms in a population.
8.d. *Students know* how reproductive or geographic isolation affects speciation.

8.f. **Students* know how to use comparative embryology, DNA or protein sequence comparison, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships.
8.g. **Students know* how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another. *

Chemistry Standards Covered
Conservation of Matter and Stoichiometry
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. As a basis for understanding this concept:
3.b. *Students know* that the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.
3.c. *Students know* that one mole equals 6.02×10^{23} particles (atoms or molecules).
3.d. *Students know* how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.
3.e. *Students know* how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.
3.f. **Students know* how to calculate percent yield in a chemical reaction.
3.g. **Students know* how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.
Gases and Their Properties
4. The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:
4.a. *Students know* the random motion of molecules and their collisions with a surface create the observable pressure on that surface.
4.b. *Students know* the random motion of molecules explains the diffusion of gases.
4.c. *Students know* how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.
4.d. *Students know* the values and meanings of standard temperature and pressure (STP).
4.e. *Students know* how to convert between the Celsius and Kelvin temperature scales.
4.f. *Students* know there is no temperature lower than 0 Kelvin.
Acids and Bases
5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:
5.e. **Students know* the Arrhenius, Bronsted-Lowry, and Lewis acid-base definitions.
5.f. **Students know* how to calculate pH from the hydrogen-ion concentration.
5.g. **Students know* that buffers stabilize pH in acid-base reactions.
6. Solutions are homogenous mixtures of two or more substances. As a basis for understanding this concept:
6.d. *Students know* how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.
6.e. **Students know* the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.
Reaction Rates
8. Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. As a basis for understanding this concept:

8.a. *Students know* the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.
8.b. *Students know* how reaction rates depend on such factors as concentration, temperature, and pressure.
8.c. *Students know* the role a catalyst plays in increasing the reaction rate.
8.d. *Students know the definition and role of activation energy in a chemical reaction.**
Chemical Equilibrium
9. Chemical equilibrium is a dynamic process at the molecular level. As a basis for understanding this concept:
9.a. *Students know* how to use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.
9.b. *Students know* equilibrium is established when forward and reverse reaction rates are equal.
9.c. **Students know* how to write and calculate an equilibrium constant expression for a reaction.

Earth Science Standards Covered
Energy in the Earth System
4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:
4.c. *Students know* the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.
4.d. **Students know* the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.
8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:
8.a. *Students know* the thermal structure and chemical composition of the atmosphere.
8.b. *Students know* how the composition of Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.
8.c. *Students know* the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.

Physics Standards Covered
Motion and Forces
1. Newton's laws predict the motion of most objects. As a basis for understanding this concept:
1.g. *Students know* that circular motion requires the application of a constant force directed toward the center of the circle.
1.i. **Students know* how to solve two-dimensional trajectory problems.
1.j. **Students know* how to resolve two-dimensional vectors into their components and calculate the magnitude and direction of a vector from its components.
1.k. **Students know* how to solve two-dimensional problems involving balanced forces (statics).
1.m. **Students know* how to solve problems involving the forces between two electric charges at a distance (Coulomb's law) or the forces between two masses at a distance (universal gravitation).
Conservation of Energy and Momentum
2. The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept:
2.e. *Students know* that momentum is a separately conserved quantity different from energy.
2.f. *Students know* that an unbalanced force on an object produces a change in its momentum.

2.g. *Students know* how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.
2.h. *Students know* how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.

Representative Performance Outcomes and Skills
In accordance with their individual capacity, students will grow in the ability to:

- Demonstrate process skills of scientific thinking: observing, communicating, comparing, ordering, categorizing, relating, inferring, and applying.
- Demonstrate skills in the areas of speaking, listening, writing, reading, graphing, mapping skills, and mathematics.
- Handle safely the equipment and materials common to chemistry laboratory.
- Evaluate the contributions of science and technology and their relevance to improving our daily lives in preparation for the future.
- Establish the relevance of science and its applications to careers and real-life situations.
- Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests collect data, analyze relationships, and display data.*
- Identify and communicate sources of unavoidable experimental error.*
- Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.*
- Formulate explanations by using logic and evidence.*
- Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.*
- Distinguish between hypothesis and theory as scientific terms.*
- Recognize the usefulness and limitations of models and theories as scientific representations of reality.*
- Read and interpret topographic and geologic maps.*
- 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).*
- Recognize the issues of statistical variability and the need for controlled tests.*
- Recognize the cumulative nature of scientific evidence.*
- Analyze situations and solve problems that require combining and applying concepts from more than one area of science.*
- Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.*
- Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).*
- Investigate a societal issue by researching literature, analyzing data and communicating findings and discuss possible future outcomes.
- Demonstrate interconnections between the many disciplines of science.
- Demonstrate the interdisciplinary connections between science and other curricular fields.

Assessments

Instruction in our district is assessment-driven. The Framework states "that effective science programs include continual assessment of student's knowledge and understanding, with appropriate adjustments being made during the academic year (p.11)."[1] Assessments can be on demand or over a long period of time. The District Periodic Assessments and STAR State Testing play a significant role in Student Assessments. The chart below, adapted from *A Guide for Teaching and Learning*, NRC (2000), gives some examples of on demand and over time assessment.

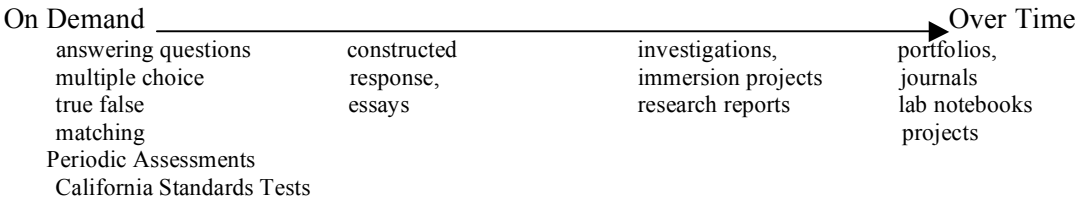

Chart 1 - Assessment Examples

Texts/Materials

- *Science Framework for California Public Schools*
- District Authorized Textbook and ancillary materials:
  - Wiley & Sons Inc. *The Sciences: An Integrated Approach*, 4th ed. Trefil, Hazel 2004
- *Science Safety Handbook for California Public Schools*
- Appropriate science laboratory materials