SACRAMENTO CITY UNIFIED SCHOOL DISTRICT
BOARD OF EDUCATION

Agenda Item# 9.1g

Meeting Date : July 18, 2013

Subject: Approve High School Course of Study: Honors Geology 1P and 2P

- ☐ Information Item Only
- ☒ Approval on Consent Agenda
- ☐ Conference (for discussion only)
- ☐ Conference/First Reading (Action Anticipated: _____)
- ☐ Conference/Action
- ☐ Action
- ☐ Public Hearing

Department: Academic Office/Curriculum and Instruction

Recommendation: Approve the Course of Study for "Honors Geology 1P and 2P"

Background/Rationale: "Honors Geology 1P and 2P" is a dual credit college-level laboratory course with Sacramento City Community College's Course Geology 302, Physical Geology. Students successfully completing this course may obtain 4 units that are UC/CSU transferable. Honors Geology provides an understanding of the dynamic nature of earth processes and includes the study of plate tectonics, rocks, minerals, volcanoes, earthquakes, crustal deformation and mountain building, geologic time, geologic hazards, energy and mineral resources, earth's water and the geomorphology of rivers, glaciers, deserts and coastlines. Students completing this course will attain an understanding of the interconnectedness of all science, and the significant controls that Earth systems exert on human activities.

The purpose for the Honors Geology course is to include a rigorous class that meets the "D" laboratory science requirement with a "Green" emphasis for students applying to college. The US Bureau of Labor Statistics projects a 23 percent increase in geoscience jobs between 2008 and 2018. Students completing the course will gain exposure to the field of study as well as other areas of science as they pursue scientific understanding of the basic constraints of Earth's natural systems and environments.

Financial Considerations : Instructional materials will be covered by school site.

Documents Attached: Course of Study for ""Honors Geology 1P and 2P"

Estimated Time of Presentation : N/A	
Submitted by:	Olivine Roberts, Chief Academic Officer Iris Taylor, Assistant Superintendent of Curriculum & Instruction
Approved by :	Jonathan P. Raymond, Superintendent

COURSE OF STUDY

FOR

HONORS GEOLOGY 1P & 2P

Segment High School

SECTION I – GENERAL INFO RMATION PAGE

SECTION II – COURSE UNITS (ESSENTIAL CONCEPTS)

SECTION I – GENERAL INFORMATION

COURSE DESCRIPTION

Honors Geology is a dual credit college-level laboratory course with Sacramento City Community College Course Geology 302, Physical Geology. Students successfully completing this course may obtain 4 units that are UC/CSU transferable. Honors Geology provides an understanding of the dynamic nature of earth processes and includes the study of plate tectonics, rocks, minerals, volcanoes, earthquakes, crustal deformation and mountain building, geologic time, geologic hazards, energy and mineral resources, earth's water and the geomorphology of rivers, glaciers, deserts and coastlines. Students completing this course will attain an understanding of the interconnectedness of all science, and the significant controls that Earth systems exert on human activities. Students will attend at least one field trip.

COURSE PREREQUISITES

- Algebra: Students will need an understanding of algebra in order to calculate discharge, rate, density, gradient, isostasy, sinuosity, and other relationships. In addition, students will be required to use Excel spreadsheets, graph data, and do statistical analysis of the data.
- Biology: Students will need an understanding of evolution, photosynthesis and respiration
- Chemistry: Students will need an understanding of atomic structure, ionic and covalent bonding, pH, radioactive decay rates, states of matter, and energy flow.

COURSE LENGTH

One Year (Comprehensive Written Final Exam)

GRADE LEVEL

11TH – 12TH Grade

TEXTBOOKS

- Exploring Geology, Reynolds, Johnson, Kelly, Morin, Carter, McGraw-Hill, 2nd edition, 2010
- Laboratory Manual in Physical Geology, AGI, NAGT, 9th edition, 2011

COURSE RATIONALE

The purpose for the Honors Geology course is to include a rigorous class that meets the "D" laboratory science requirement with a "Green" emphasis for students applying to college. Presently, the majority of schools across the nation do not include a substantial earth science or geology component. Due to this lack of exposure in high school, there is a significantly lower level of geology literacy in our citizens and there are too few college students pursuing careers in any of the geosciences. The US Bureau of Labor Statistics projects a 23 percent increase in geoscience jobs between 2008 and 2018. According to the "Status of the Geoscience Workforce 2011," published by the American Geoscience Institute, due to the age demographics of the geoscience discipline, a meager 12 percent replacement rate for attrition will boost the increase in geoscience jobs from 23 to 35 percent. The need to fill these jobs will not go away; "as in any free market system, when human resource capital lacks for a given profession or discipline, substitution of talent from other disciplines and or importation of human capital from other countries will be used to meet the economic and societal goals" (Status of the Geoscience Workforce 2011).

Students completing this course will enter college with a more sound basis for choosing fields of study, whether in science or other disciplines. They will be more informed citizens, no matter what they choose to study because they will have a scientific understanding of the basic constraints of Earth's natural systems and environments.

STUDENT ASSESSMENT

Students will be assessed based on various methods; homework, exams, laboratory activities, lab quizzes, teacher observations, article analysis, and field trip. In order to earn 4 UC/CSU transferable units students must complete the class with an A or B. There is also a mandatory field trip that students will attend. At the end of the year, there will be a cumulative exam, allowing students to make many connections among the topics studied all year.

SECTION II – COURSE UNIT DESCRIPTION

Unit 1 – What is Geology?

Objectives

1. Break Earth Science into its constituent parts (geology, meteorology, oceanography, and astronomy) and distinguish the overlapping areas and distinctiveness
2. Demonstrate the Scientific Method
3. Deconstruct the nebular hypothesis for the origin of the solar system into its component pieces
4. For the planet earth, distinguish the following: hydrosphere,

b. Ocean-continent convergent boundaries
c. Continent-ocean convergent boundaries
d. Divergent boundary
e. Transform fault boundary

4. Defend the theory of magnetic reversals and its role in seafloor spreading
5. Evaluate the changes in the plates from Pangaea to the present and predict changes for the future
6. Connect convection currents to plate tectonics
7. Calculate the rate of plate movement
8. Relate the formation of Hawaii to the plate tectonic theory
9. Explain how magnetic dip can be used to determine the location of continents in the past

Reading: Chapter 3

Laboratory Activities:

- Laboratory 2: Plate Tectonics and the Origin of Magma
- Plate Tectonics Puzzle
- Plate Tectonics Model Lab
- Seafloor Spreading Worksheet
- Drifting Continents and Magnetic Fields Lab

Science Content Standards for California Public Schools

- Earth Science 3(a, b, e, f)
- Biology 6(a, b, c), 8(c, d, e)
-

a. Silicates: Quartz , potassium feldspar, plagioclase feldspar, olivine, biotite and muscovite mica, kaolinite, talc, hornblende, augite,
b. Metal ores: hematite, magnetite, galena, azurite
c. Carbonates: calcite
d. Elements: sulfur, graphite
e. other non-silicates: halite, fluorite, gypsum

Reading: Chapter 4

Podcasts:

- Silicates: http://www.youtube.com/watch?v=8q-Hzq0WXXw
- Mineral Properties Part 1: http://www.youtube.com/watch?v=FK9KlOAvFrA
- Mineral Properties Part 2: http://www.youtube.com/watch?v=y4HdZTyXm-4

Laboratory Activities:

- Laboratory 3: Mineral Properties, Uses, and Identification
- Crystal Tree Formation Lab
- Hardness Lab
- Silicates Lab

Science Content Standards for California Public Schools

- Earth Science 3(c)
- Chemistry 1(b, d, e), 2(a, b, c)

Unit 4 - Igneous Rocks, Magma and Volcanic Eruptions

Objectives

1. Break the rock cycle into its constituent parts
2.

7. Evaluate the formation of the following intrusive feature
    a. Dikes and sills
    b. Batholiths, laccoliths, stocks, volcanic neck
    c. Hydrothermal veins
8. Distinguish between shield volcanoes, composite volcanoes, fissure flows and lava domes and evaluate the following
    a. Kind of lava
    b. Tectonic location
    c. Shape and size
    d. Eruptive style
    e. Examples
9. Differentiate the differences between the following volcanic features
    a. Lava flows, pyroclastic flows, lahars
    b. Crater, caldera
    c. Lava tubes
    d. Tephra: ash, cinders, bombs, blocks
10. Evaluate the effects of volcanoes on human and environmental interaction

Reading: Chapter 5 and Chapter 6

Podcasts:

- Bowens Reaction Series: http://www.youtube.com/watch?v=en6ihAM9fe8
- Melting Magma: http://www.youtube.com/watch?v=muu2DeXmJAU
- Magma Differentiation: http://www.youtube.com/watch?v=_NN2qJVoPBo

Laboratory Activities:

- Laboratory 4: Rock-Forming Processes and the Rock Cycle
- Laboratory 5: Igneous Rocks and Volcanic Hazards
- Bowen's Reaction Series Lab
- 3 Volcano Profile Google Earth assignment

Science Content Standards for California Public Schools

- Earth Science 3(c, e, f)
- Chemistry 7(a, c, d)
- Physics 3(c)

Unit 5 – Sediments and Sedimentary Rocks

Objectives

1. Assess the following processes of weathering
    a. Physical
        i. Exfoliation
        ii. Frost wedging
    b. Chemical
        i. Oxidation
        ii. Dissolution
        iii. Hydrolysis
2. Evaluate the chemical and physical weathering of granite
3. Distinguish between weathering, erosion, and deposition
4. Distinguish between clast sizes: clay, silt, sand, granule, pebble, cobble and boulder
5. Break the sedimentary environments into their constituent parts and assess the kind of sediment found in each
    a. Continental: lake, river, desert, glacier
    b. Coastal: delta, beach, tidal flat
    c. Marine: deep sea, continental shelf, tropical reef
6. Explain oil formation and synthesis, and the process to store it in sedimentary rocks
7. Organize sedimentary rocks by mineral composition and environmental formation
    a. Clastic rocks: sandstone, conglomerate, shale, arkose, breccia
    b. Chemical rocks: limestone, chert, rock salt, ironstone
    c. Biochemical: coal
8. Explain the formation of ripple marks
9. Assemble a timeline of steps in the formation of soil. Account for alternative steps
10. Defend sustainable agricultural practices for the preservation of California soils

Reading: Chapter 7

Podcasts:

- Sedimentary Facies: http://www.youtube.com/watch?v=sI-ac36PlmQ
- Sedimentary Rocks: http://www.youtube.com/watch?v=G0ru-kLpedo

Laboratory Activities:

- Laboratory 6: Sedimentary Rocks, Processes, and Environments
- Calcareous Precipitates Lab
- Sedimentary Environments Google Earth Lab

Science Content Standards for California Public Schools

- x Earth Science3c, 9a

Unit 6 – Metamorphic rocks

Objectives

1. Break the causes and effects of metamorphism into its component parts
2. Distinguish between regional (Barrovian), Contact, Hydrothermal,

4. Describe the effects of earthquakes: shaking, liquefaction, landslides, tsunamis, fires
5. Distinguish between magnitude and intensity, and tell which scales measure each
6. Understand how we determine seismic risk and the present state of tsunami warning and earthquake prediction.
7. Determine how well prepared your family is for an earthquake.
8. Understand how seismic waves give information about the interior of the Earth
9. Outline the history of the San Andreas Fault and compare it to other major faults

Reading: Chapter 12

Podcasts:

- Introduction to Earthquakes: http://www.youtube.com/watch?v=15QRpBq-aT8
- Seismic Waves: http://www.youtube.com/watch?v=mZ2e6cy4Cwo
- Magnitude and Intensity http://www.youtube.com/watch?v=ClXIWcLhETo
- Effects of Earthquakes http://www.youtube.com/watch?v=01N52gLIEB8

Laboratory Activities:

- Laboratory 16: Earthquake Hazards and Human Risks
- Virtual Earthquake Lab
- Seismograph Analysis and Epicenter Location Activity

Science Content Standards for California Public Schools

- Earth Science 3(d), 9(b, d)

Unit 8 – Rock Deformation and Mountain Building

Objectives

1. Compare and contrast tectonic forces that result in the following faults:
    a. dip slip faults
    b. normal
    c. reverse and thrust
    d. strike slip faults
        i. right lateral
        ii. left lateral

2. Evaluate different kinds of folds and interpret surface outcrops of the following:
    a. anticlines and synclines
    b. plunging and non-plunging
    c. basins and domes

Reading: Chapter 11

Podcasts:

- Folds, Dip and Strike: http://www.youtube.com/watch?v=UzZFMWH-lSQ

Science Content Standards for California Public Schools

- x Investigation and Experimentation 1(a, b, c, d, h)

Unit 10 – Deep Time, Fossils & Evolution

Objectives

1. Organize the history of Earth, geologic time into the following eras: Precambrian, Paleozoic, Mesozoic, and Cenozoic, and describe the major events that occurred in each
2. Interpret rock layers based upon
    a. Principle of original horizontality
    b. Principle of superposition
    c. Principle of cross-cutting relationships
    d. Principle of faunal succession
3. Categorize the following
    a. Formation
    b. Unconformity: disconformity, nonconformity, angular unconformity
4. Evaluate the principle of radiometric dating

Reading: Chapter 9

Podcasts:

- x Absolute Time: http://www.youtube.com/watch?v=ei_C0PWDs9s

Laboratory Activities:

- x Laboratory 8: Dating of Rocks, Fossils, and Geologic Time
- x Cross Section/Relative Dating Analysis
- x Rock Correlation Practice

Science Content Standards for California Public Schools

- x Earth Science 1(f), 8(b)
- x Biology 6(a, c), 8(c, d, e)
- x Chemistry 11(f)

Unit 11 – Glaciers

Objectives

1. Describe the formation and movement of a glacier
2. Evaluate the different kinds of glaciers
3. Distinguish and describe the formation of the following erosional features: fiord, horn, arête, cirque, hanging valley, striations
4. Distinguish and evaluate the formation of the following depositional features: terminal, recessional, ground, medial and lateral moraines, outwash plain, erratics, till
5. Distinguish and describe the formation of the following ice features: crevasse, snow line, terminus, iceberg
6. Prioritize possible causes of the Pleistocene Ice Age
7. Evaluate the Snowball Earth theory

Reading: Chapter 14

Podcasts:

- Glacial Erosion: http://www.youtube.com/watch?v=AG3luuhc-5Y

Laboratory Activities:

- Laboratory 13: Glacial Processes, Landforms, and Indicators of Climate Change
- Glacier Google Earth Lab

Science Content Standards for California Public Schools

- Earth Science

g. Cone of depression

4. Assess the formation of a limestone cavern, hot springs and geysers
5. Describe the following parts of a stream system: channel, divide, flood plain, headwaters
6. Evaluate the changes in a stream valley over time, from young to mature and old.
7. Analyze drainage patterns and explain why each develops: dendritic, trellis, radial
8. Explain how a stream flows, transports sediment, erodes and deposits
9. Predict the following affects of a stream's ability to erode and deposit based on: gradient, velocity, base level, volume, bed load, friction, discharge
10. Calculate a stream's discharge
11. Explain the formation of the following stream features: water gap,

1. Evaluate how wind interacts with water to produce surface currents and how the Coriolis Effect produ

b. Geothermal
c. Solar
d. Wind
e. Biomass
f. Ethanol

Reading: Chapter 18

Laboratory Activities:

- x Reclamation Lab
- x Interactive Energy Lab

Science Content Standards for California Public Schools

- x Chemistry 11(a, b, c, d, e, f)
- x Investigation and Experimentation 1(m)

Unit 15 – Global Climate Change

Objectives

1. Relate ocean currents to their influence on climate
    a. Describe the main flow of surface currents in the Northern and Southern Hemispheres and it influences sea temperatures
    b. Explain how ocean currents influence temperature and precipitation on adjacent lands
2. Summarize what causes short term climate variations
    a. Explain what a monsoon is and how it affects rainfall
    b. Relate the tilt of Earth's axis to seasons
3. Explain what causes the location of Rain Forests
    a. Summarize where rain forests occur and what conditions produce enough precipitation to form a rain forest
    b. Explain threats to rain forests and why rain forests are ecologically and genetically important
4. Explain desert formation
    a. Analyze what deserts and other arid lands are and where they form
    b. Describe desertification
    c. Evaluate common features of deserts and how the features form
        i. Alluvial fans
        ii. Washes

iii. Playas
iv. Dunes
v.

SECTION III – ALIGNMENT WITH CAL IFORNIA STATE SCIENCE CONTENT STANDARDS

Only the California State Content Standards for Earth Science, Biology, Chemistry, Physics, and Investigation and Experimentation that are used in the Dual Credit Honors Geology course are listed.

EARTH SCIENCE

Earth's Place in the Universe

1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:
   a. 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. Students know the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.
   c. Students know the evidence from geological studies of Earth and other planets suggest that the early Earth was very different from Earth today. d. Students know the evidence indicating that the planets are much closer to Earth than the stars are. e. Students know the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.
   f. Students know the evidence for the dating and effects that asteroid impacts have had in shaping the surfaces of planets and their moons and in mass extinctions of life on Earth.

2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept:
   a. Students know the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.
   b. Students know galaxies are made of billions of stars and comprise most of the visible mass of the universe.

Dynamic Earth Processes

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:

   a. Students know features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.

   b. Students know the principal structures that form at the three different kinds of plate boundaries.

   c. Students know how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.

   d. Students know why and how earthquakes occur and the scales used to measure their intensity and magnitude.

   e. Students know there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes.

   f.* Students know the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction.

Energy in the Earth System

5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:

   a. Students know how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.

   b. Students know the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.

   d. Students know properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.

   g.* Students know features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle.

6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:

   a. Students know weather (in the short run) and climate (in the long run) involve the transfer of energy in and out of the atmosphere.

   b. Students know the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.

   c. Students know how Earth's climates have changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.

   d.* Students know how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet as a whole and for specific regions.

Biogeochemical Cycles

7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept:

   d.* Students know the relative residence times and flow characteristics of carbon in and out of its different reservoirs.

Structure and Composition of the Atmosphere

8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:
   a. Students know the thermal structure and chemical composition of the atmosphere.
   b. Students know how the composition of Earth's atmosphere has evolved over geologic time and know the effects of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.
   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.

California Geology

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:
   a. Students know the resources of major economic importance in California and their relation to California's geology.
   b. Students know the principal natural hazards in different California regions and the geologic basis of those hazards.
   c. Students know the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.
   d.* Students know how to analyze published geologic hazard maps of California and know how to use the maps' information to identify evidence of geologic events of the past and predict geologic changes in the future.

Heat and Thermodynamics

3. Energy cannot be created or destroye

CHEMISTRY

Atomic and Molecular Structure

1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:
   b. Students know how to use the periodic table to identify metals, semimetals, nonmetals, and halogens.
   d. Students know how to use the periodic table to determine the number of electrons available for bonding.
   e. Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.

Chemical Bonds

2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:
   a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
   b. Students know chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, $HCCH_2$, N_2, Cl_2, and many large biological molecules are covalent.
   c. Students know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.
   d. Students know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
   h.* Students know how to identify solids and liquids held together by van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/ melting point temperatures.

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:

a. Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.

b. Students know the random motion of molecules explains the diffusion of gases.

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.

Solutions

6. Solutions are homogeneous mixtures of two or more substances. As a basis for understanding this concept:

a. Students know the definitions of solute and solvent.

d. Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.

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.

Chemical Thermodynamics

7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:

a. Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).

c. Students know energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.

d. Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.

Nuclear Processes

11. Nuclear processes are those in which atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:

a. Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.

b. Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by $E=mc^2$) is small but significant in nuclear reactions.

c. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.

d. Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.

e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.

f.* Students know how to calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.

Ecology

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.
   b. Students know how to analyze change in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
   c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.

8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:
   c. Students know the effects of genetic drift on the diversity of organisms in a population.
   d. Students know reproductive or geographic isolation affects speciation.
   e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.