FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

INTERNATIONAL BACCALAUREATE PROGRAM

BIOLOGY SL, YEAR 1

Grade Level: 11

Credits: 5

BOARD OF EDUCATION ADOPTION DATE:

AUGUST 29, 2016

FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

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IB BIOLOGY SL, YEAR 1

COURSE PHILOSOPHY

The International Baccalaureate Organization aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect. Biology is the study of life. An interest in life is natural for humans; not only are we living organisms ourselves, but we depend on many species for our survival, are threatened by some and co-exist with many more. Biologists attempt to understand the living world at all levels using many different approaches and techniques. Many areas of research in biology are extremely challenging and many discoveries remain to be made. Biology is still a young science and great progress is expected in the 21st century. This progress is sorely needed at a time when the growing human population is placing ever greater pressure on food supplies and on the habitats of other species, and is threatening the very planet we occupy.

COURSE DESCRIPTION

Through studying biology, students should become aware of how scientists work and communicate with each other. While the scientific method may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that characterizes IB Biology SL. During this course, which must include at least 150 instruction hours, students will engage in at least 40 hours on practical activities and scientific investigation. These aims enable students, through the overarching theme of the nature of science, to appreciate scientific study and creativity within a global context through stimulating and challenging opportunities. In addition, students will acquire a body of knowledge, methods and techniques that characterize science and technology. They will be able to analyze, evaluate and synthesize scientific information, develop critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities and develop experimental and investigative skills including the use of current technologies and apply 21st century communication skills in the study of science. Students will, as global citizens, become aware of the ethical implications and limitations of using science and technology, and they will develop an understanding of the relationships amongst scientific disciplines and their influence on other areas of knowledge. The International Baccalaureate Organization provides the following description: *"Group 4 students at standard level (SL) and higher level (HL) undertake a common core syllabus, a common internal assessment (IA) scheme and have some overlapping elements in the option studied. They are presented with a syllabus that encourages the development of certain skills, attributes and attitudes, as described in the "Assessment objectives" section of the guide. While the skills and activities of group 4 science subjects are common to students at both SL and HL, students at HL are required to study some topics in greater depth, in the additional higher level (AHL) material and in the common options. The distinction between SL and HL is one of breadth and depth."*

COURSE SUMMARY

COURSE GOALS

CG1: Students will design insightful and ethical investigations to solve biological issues by using appropriate research protocols and experimental procedures.
CG2: Students will assess scientific problems and develop solutions by utilizing scientific inquiry to develop hypotheses, analyze data, and communicate their conclusions.

OURSE ENDURING UNDERSTANDINGS	COURSE ESSENTIAL QUESTIONS
CEU1: Scientific experimentation, data analysis, technology, and research are used to solve real-world problems.	CEQ1a: How do we investigate and solve problems to explain the natural world? CEQ1b: What constitutes useful scientific evidence? CEQ1c: How do scientists collaborate and communicate scientific information?
CEU2: Living systems share common characteristics and can be classified based on those characteristics.	CEQ2a: How do classification schemes remain the same or change with new ideas and technology? CEQ2b: There's a saying that the apple doesn't fall far from the tree. How does genetics both prove and disprove this? CEQ2c: If everything is truly interdependent, can anything be independent?
CEU3: Homeostatic mechanisms of biological systems are influenced by changes in the system's environment.	CEQ3a: How does environment impact stability? CEQ3b: Is a change in homeostatic balance good or bad?

UNIT GOALS & PACING		
UNIT TITLE	**UNIT GOALS**	**RECOMMENDED DURATION**
Unit 1: Molecular Biology	Students will synthesize and connect molecular structures with their functions in order to analyze their cellular roles.	10 weeks
Unit 2: Cell Biology	Students will analyze the evolutionary sequencing of cellular complexity and the roles organelles play in this complexity.	10 weeks
Unit 3: Genetics	Students will analyze the patterns inheritance from one generation to another.	10 weeks
Unit 4: Ecology	Students will analyze the interdependency of living organisms with each other and their environment.	4 weeks

BIOLOGY SL, YEAR 1
UNIT 1: Molecular Biology **SUGGESTED DURATION: 10 WEEKS**

UNIT OVERVIEW	
UNIT LEARNING GOALS	
Students will synthesize and connect molecular structures with their functions in order to analyze their cellular roles.	
UNIT LEARNING SCALE	
4	In addition to score 3 performances, the student can: • evaluate the validity and application of data generated; • propose solutions to topic problems; and • identify and explain improvements to topic investigations.
3	The student can: • provide an example of a compound that is produced by living organisms but can also be artificially synthesized; • draw molecular diagrams of a carbohydrate, lipid, protein, and nucleic acid; • identify biochemicals (e.g., sugars, lipids or amino acids) from molecular diagrams; • compare the thermal properties of water with those of methane; • compare the structure and function of cellulose and starch in plants with glycogen in humans; • explain health risks that arise due to trans fats and saturated fatty acids using scientific evidence; • evaluate health claims made about lipids including the evidence and method to obtain the evidence; • draw molecular diagrams to show the formation of a peptide bond; • draw simple diagrams of the structure of single nucleotides of DNA and RNA; • deduce the sequence of amino acids using a table of mRNA codons; • design an experiment to investigate the effect of limiting factors on photosynthesis; and • analyze diagrams of the pathways of aerobic respiration and compare to anaerobic respiration.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of level 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with help, the student does not exhibit understanding of performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU1: Living organisms control their composition by a complex web of chemical reactions.	EQ1: Why does molecular biology explain living processes in terms of the chemical substances and reactions involved?
EU2: Water is the medium of life.	EQ2a: Why is water the medium of life? EQ2b: Claims about the “memory of water” are categorized as pseudoscientific. What criteria can be used to distinguish scientific claims from pseudoscientific claims?
EU3: Compounds of carbon, hydrogen, and oxygen are used to supply and store energy.	EQ3: Does everyone use and store energy the same?

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU4: Proteins have a very wide range of functions in living organisms.	EQ4a: There are thousands of proteins in the cells of organisms. What is the purpose for so many and would it be beneficial for the cell to streamline its number? EQ4b: Why do individuals have unique proteomes? EQ4c: Why should scientists who study proteomics share their results with others internationally in their field?
EU5: Enzymes control the metabolism of the cell.	EQ5: Why would environmental factors have an effect on metabolism?
EU6: The structure of DNA allows efficient storage of genetic information.	EQ6a: Why is the structure of DNA important for understanding life's processes and characteristics? EQ6b: The story of the elucidation of the structure of DNA illustrates that cooperation and collaboration among scientists exists alongside competition between research groups. To what extent is research anti-scientific? What is the relationship between shared and personal knowledge in the natural sciences?
EU7: Genetic information in DNA can be accurately copied and can be translated to make the proteins needed by the cell.	EQ7a: Why does DNA replication and gene expression allow for life's processes to occur? EQ7b: Should DNA replication and gene expression be separate processes?
EU8: Cell respiration supplies energy for the functions of life.	EQ8a: Why are there different methods of energy release? EQ8b: Why would the chemiosmotic theory lead to a paradigm shift in the field of bioenergetics?
EU9: Photosynthesis uses the energy in sunlight to produce the chemical energy needed for life.	EQ9: Why is photosynthesis needed for all life on Earth?

COMMON ASSESSMENT	
ALIGNMENT	DESCRIPTION
LG 1 EU5, EQ5 EU9, EQ9 HS-LS1-1,3,5 6,7 HS-LS3-1 RST.11-12.3, 4 WHST.11-12.1 DOK 4	Choose two of the following for independent investigation: 1. Design and implement an enzyme investigation pertaining to environmental factors such as temperature or pH. 2. Draw and build bio-molecular compounds (e.g., sugar, lipids, and amino acids). Relate each compound to the energy reserve and usage needed within the human body. 3. Utilizing technology, determine the production of oxygen and carbon dioxide from multiple organisms. Demonstrate the cyclic reaction of photosynthesis and cellular respiration. Determine the positive and negative ramifications causing global climate change and connect to real world applications.

TARGETED STANDARDS		
DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO INTRODUCE
covalent bonds hydrogen bonds inorganic molecules ionic bonds organic molecules water properties	Draw molecular diagrams of important biomolecules (DOK 1) Identify important biomolecules from molecular diagrams (DOK 1) Compare the structures and functions of the major classes of biomolecules - carbohydrates, lipids, proteins and nucleic acids (DOK 3) Compare the properties of water, and why it is such an important solvent in biological activities (DOK3)	HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
lock and key model induced fit model denaturation	Design an experiment to show a factor affecting enzyme activity (DOK 4)	HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
central dogma DNA protein synthesis RNA	Use a table of the genetic code to deduce which codon(s) corresponds to which amino acid and the corresponding DNA strand (DOK3)	HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
glycosylase ligase Okazaki fragments semi-conservative replication template	Analyze experimental results to obtain support for the theory of semi-conservative replication of DNA (DOK 4)	HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring.
cellular respiration electron transport chain glycolysis Krebs cycle	Analyze results from experiments involving measurement of respiration rates of germinating seeds or invertebrates using a respirometer (DOK 4)	HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
chromatography limiting factor photosynthesis	Design experiment to investigate limiting factors on photosynthesis, including separation of photosynthetic pigments by chromatography (DOK 4)	HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
	Follow precisely a complex multistep procedure when carrying out experiments (DOK 1)	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Attend to precise meaning of terms as they are used in particular scientific or technical contexts (DOK 2)	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	Write arguments that logically sequences claims, reasons, and evidence (DOK 4)	WHST.11-12.1 Write arguments focused on discipline-specific content.

BIOLOGY SL, YEAR 1
UNIT 2: Cell Biology **SUGGESTED DURATION: 10 WEEKS**

UNIT OVERVIEW	
UNIT LEARNING GOALS	
Students will analyze the evolutionary sequencing of cellular complexity and the roles organelles play in this complexity.	
UNIT LEARNING SCALE	
4	In addition to score 3 performances, the student can: • evaluate the validity and application of data generated; • propose solutions to topic problems; and • identify and explain improvements to topic investigations.
3	The student can: • question the cell theory using atypical examples; • investigate the functions of life using unicellular organisms; • investigate the ethics of stem cell use; • draw cells and calculate actual sizes based on an investigation with a light microscope; • draw ultrastructure of prokaryotic cells based on electron micrographs; • interpret electron micrographs to identify organelles and deduce the function of specialized cells; • analyze the fluid mosaic model of the cell membrane; • estimate osmolality in tissues by bathing samples in hypotonic and hypertonic solutions; • provide evidence from Pasteur's experiments that spontaneous generation of cells and organisms do not occur on Earth; • identify the phases of mitosis in cells viewed with a microscope or a micrograph; and • determine the mitotic index from a micrograph.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of level 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with help, the student does not exhibit understanding of performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU1: The evolution of multicellular organisms allows for cell specialization and cell replacement.	EQ1a: Why would there be advantages and/or disadvantages to multicellularity? EQ1b: How would life evolve from nonliving sources?
EU2: Eukaryotes have a much more complex cell structure than prokaryotes.	EQ2a: Why did eukaryotes evolve from prokaryotes and what are the advantages? EQ2b: Why would technological developments lead to greater understanding of cell structure and function?
EU3: The structure of biological membranes makes them fluid and dynamic.	EQ3a: Could there be advantages and/or disadvantages of cell membranes being fluid and dynamic? EQ3b: The explanation of the structure of the plasma membrane has changed over the years as new evidence and ways of analysis have become known. Why should we learn about theories that are now discredited?
EU4: Membranes control the composition of cells by active and passive transport.	EQ4: Why would there be better mechanisms to move materials across the plasma membrane? Why is efficiency in this movement so important?

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU5: There is an unbroken chain of life from the first cells on Earth to all cells in organisms alive today.	EQ5: How can different approaches to explain the functions of life be demonstrated by a single cell?
EU6: Cell division is essential and controlled by checkpoints.	EQ6a: If cancer is just uncontrolled cell division, why can't we prevent it? EQ6b: A number of scientific discoveries are incidental or serendipitous. To what extent might some of these scientific discoveries (such as cell division process) be the result of intuition rather than luck?
EU7: Stem cell research is still in developmental stages, but research demonstrates that it has therapeutic use in the treatment of diseases and traumas.	EQ7a: How do stems cells compare to eukaryotic cells? EQ7b: How has the debate on stem cell research slowed down the use of stem cells in treating disease and trauma?

COMMON ASSESSMENT	
ALIGNMENT	DESCRIPTION
LG1 EU1, EQ1a, b EU2, EQ2a, b EU3, EQ3a HS-LS1-2,3,4 RST.11-12.3, 4 WHST.11-12.1 DOK 3	Complete both independent investigations: 1. Use microcopy to investigate the cellular structure and tissue structure of animals. Drawings and micrographs should demonstrate cellular structure and ultra-structure and cellular mechanisms. 2. Design an experiment to estimate the osmolality in tissues by bathing multiple samples in hypotonic and hypertonic solutions.

TARGETED STANDARDS		
DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO INTRODUCE
cell theory cell types cellular organization microscopy	Use a light microscope to investigate the structure of cells and tissues (DOK 3) Calculate the magnification of drawings and the actual size of structures of prokaryotes and eukaryotes shown in drawings or micrographs (DOK 3)	HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
cell membrane properties cellular transport concentration gradient tonicity	Perform an investigation or construct models of cell membranes that explain the movement of molecules across membranes with membrane structure and function (DOK 3)	HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
cell cycle cytokinesis interphase mitosis	Identify the phases of mitosis in cells, and determine the mitotic index (DOK 2)	HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO FURTHER DEVELOP
organelles micrograph cell junctions	Interpret electron micrographs to identify organelles and deduce the function of specialized cells (DOK 2)	HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
	Follow precisely a complex multistep procedure when carrying out experiments (DOK 1)	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Attend to precise meaning of terms as they are used in particular scientific or technical contexts (DOK 2)	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	Write arguments that logically sequences claims, reasons, and evidence (DOK 4)	WHST.11-12.1 Write arguments focused on discipline-specific content.

BIOLOGY SL, YEAR 1
UNIT 3: Genetics **SUGGESTED DURATION: 10 WEEKS**

UNIT OVERVIEW	
UNIT LEARNING GOALS	
Students will analyze the patterns inheritance from one generation to another.	
UNIT LEARNING SCALE	
4	In addition to score 3 performances, the student can: • evaluate the validity and application of data generated; • propose solutions to topic problems; and • identify and explain improvements to topic investigations.
3	The student can: • compare the number of genes in humans with other species; • use a database to determine differences in the base sequence of a gene in two species; • compare genome sizes and chromosome numbers between different species; • use karyograms to deduce gender and diagnose chromosomal mutations; • use a database to identify the locus of a human gene and its polypeptide product; • draw diagrams to show the stages of meiosis resulting in the formation of four haploid cells; • construct Punnett squares to predict outcomes of genetic crosses; • compare predicted and actual outcomes of genetic crosses using real data; • analyze pedigree charts to deduce the pattern of inheritance of genetic diseases; • use DNA profiling in paternity and forensic investigations; and • assess potential risks and benefits of cloning and genetic modification.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of level 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with help, the student does not exhibit understanding of performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU1: Every living organism inherits a blueprint for life from its parents.	EQ1a: If we are a blueprint of our parents, then why are we so different? EQ1b: The nature versus nurture debate concerning the relative importance of an individual's innate qualities versus those acquired through experiences is still under discussion. Is it important for science to attempt to answer this question?"
EU2: Chromosomes carry genes in a linear sequence that is shared by members of a species.	EQ2: Could sequencing of plant and/or animal genomes tell researchers information on a worldwide scale?
EU3: Alleles segregate during meiosis allowing new combinations to be formed by the fusion of gametes.	EQ3: How can mutations during meiotic processes be helpful, harmful or harmless?
EU4: The inheritance of genes follows patterns.	EQ4a: How can a mutation of genes still be a pattern of inheritance? EQ4b: What factors might encourage the acceptance of new ideas about genes by the scientific community? What factors may cause the rejection of new ideas?

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU5: Biologists have developed techniques for artificial manipulation of DNA, cells and organisms.	EQ5a: Why should humans manipulate DNA, cells, and organisms? EQ5b: If our understanding of DNA is still evolving, how reliable is our use of it as evidence in legal cases? Would you want your life dependent on it? EQ5c: To what extent do the labels and categories used in the pursuit of knowledge affect the knowledge we obtain?"

COMMON ASSESSMENT	
ALIGNMENT	DESCRIPTION
LG1 EU1, EQ1a, EU2, EQ2 EU5, EQ5a HS-LS1-3 HS-LS3-1, 3 RST.11-12.3, 4 WHST.11-12.1 DOK 4	Choose two of the following for independent investigation: 1. Design an experiment to access one factor affecting the rooting of stem cuttings. Hormones, abiotic factors or various root media can be used to determine whether natural clones will grow. 2. Research current global sequencing accomplishments of the human genome. Describe new scientific career options related to the research of the human genome globally. 3. Assess the potential risks and benefits associated with genetically modified crops.

TARGETED STANDARDS		
DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO INTRODUCE
karyogram karyotype non-disjunction	Diagram the stages of meiosis to show the production of four haploid gametes (DOK 2) Create a karyogram to illustrate chromosomal abnormalities (DOK 4)	HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or, (3) mutations caused by environmental factors.
codominance incomplete dominance inheritance pattern monohybrid cross sex linked traits simple dominance	Construct Punnett squares to predict outcomes of monohybrid genetic crosses (DOK 3) Compare predicted and actual outcomes of genetic crosses using real data (DOK 2) Analyze pedigree charts to deduce the pattern of inheritance of genetic diseases (DOK 4)	HS-LS3-3 Apply concepts of statistics and probability to explain variation and distribution of expressed traits in a population.
DNA fingerprinting genetic engineering genome	Analyze examples of DNA profiling (DOK 4) Analyze data on risks by environmental factors to organismal DNA (DOK 4)	HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO FURTHER DEVELOP
autosome chromosome gene homologous chromosome sex chromosome	Compare the number of genes in humans with other species, including comparing base sequence differences (DOK 2) Identify the locus of a human gene and its polypeptide product by incorporating use of an online database (DOK 3)	HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring.
	Follow precisely a complex multistep procedure when carrying out experiments (DOK 1)	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Attend to precise meaning of terms as they are used in particular scientific or technical contexts (DOK 2)	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	Write arguments that logically sequences claims, reasons, and evidence (DOK 4)	WHST.11-12.1 Write arguments focused on discipline-specific content.

BIOLOGY SL, YEAR 1
UNIT #4: Ecology **SUGGESTED DURATION: 4 WEEKS**

UNIT OVERVIEW	
UNIT LEARNING GOALS	
Students will analyze the interdependency of living organisms with each other and their environment.	
UNIT LEARNING SCALE	
4	In addition to score 3 performances, the student can: • evaluate the validity and application of data generated; • propose solutions to topic problems; and • identify and explain improvements to topic investigations.
3	The student can: • classify organisms based on trophic level; • create a sealed mesocosm to try to establish sustainability; • represent energy flow using pyramids of energy; • analyze data from air monitoring stations to explain carbon fluctuations; • construct a diagram of the carbon cycle; • correlate global temperatures and carbon dioxide concentrations on Earth; and • evaluate claims that human activities are not causing climate change.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of level 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with help, the student does not exhibit understanding of performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
EU1: The continued survival of living organisms including humans depends on sustainable communities.	EQ1: Why should the sustainability of natural resources be a factor when discussing human activities?
EU2: Ecosystems require a continuous supply of energy to fuel life processes and to replace energy lost as heat.	EQ2: Why are the energetics of food chains a factor of food production for the alleviation of world hunger? What are the ethical concerns that may emerge?
EU3: Continued availability of carbon in ecosystems depends on carbon cycling.	EQ3: Why is it important to obtain reliable data on the concentration of carbon dioxide and methane in the atmosphere? What factors make data reliable or unreliable?
EU4: Concentration of gases in the atmosphere affect climates experienced at the Earth's surface.	EQ4a: Why is international cooperation of climate related issues essential? EQ4b: The precautionary principle is meant to guide decision making in conditions where a lack of certainty exists. Is certainty ever possible in the natural sciences?

COMMON ASSESSMENT	
ALIGNMENT	DESCRIPTION
LG1 EU1, EQ1 EU2, EQ2 HS-LS2-2,4,6 HS-LS4-6 RST.11-12.3, 4 WHST.11-12.1 DOK 4	Choose two of the following for independent investigation: 1. Design and construct a sealed microcosm in order to establish sustainability using the principles studied within the ecology unit and abiotic and biotic materials. 2. Demonstrate the ability to conduct a chi-squared test with data obtained by quadrant sampling. 3. Create an analysis of databases from air monitoring stations to analyze the needs within a community. 4. Compare carbon dioxide concentrations on Earth with global temperature changes. Use this analysis to explain the effects on individual ecosystems (e.g., freshwater lakes, coral reefs).

TARGETED STANDARDS		
DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO INTRODUCE
autotroph heterotroph trophic levels	Classify species as autotrophs, consumers, detritivores, or saprotrophs using their mode of nutrition (DOK 2)	HS-LS2-6 Evaluate the claims, evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
carrying capacity exponential growth limiting factors	Test for association between two species using the chi-square test with data obtained by quadrat sampling. Recognize and interpret the statistical significance (DOK 4)	HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
competition deforestation energy pyramid overexploitation symbiosis	Represent energy flow of ecosystems using pyramids of energy (DOK 2) Construct a diagram of the carbon cycle, interpreting and estimating carbon fluxes (DOK 3) Evaluate claims that human activities are not causing climate change (DOK 3)	HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. HS-LS4-6 Design, evaluate, and refine a solution or simulation for reducing the impacts of human activities on the environment and biodiversity.
DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	STANDARDS TO FURTHER DEVELOP
	Follow precisely a complex multistep procedure when carrying out experiments (DOK 1)	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Attend to precise meaning of terms as they are used in particular scientific or technical contexts (DOK 2)	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
	Write arguments that logically sequences claims, reasons, and evidence (DOK 4)	WHST.11-12.1 Write arguments focused on discipline-specific content.