Plainfield East High School

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AP® Environmental Science Syllabus 2019/2020

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COURSE DESCRIPTION:

The AP Environmental Science course is designed to engage students with the scientific principles, concepts, and methodologies required to understand the interrelationships within the natural world. The course requires that students identify and analyze natural and human-made environmental problems, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving or preventing them. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography.

Emphasis is placed on critical thinking skills, writing skills, and analytical math skills. Students perform college level work and are expected to take the Advanced Placement exam on **May 11, 2020.** This course carries a weighted grade. This course may be taken for elective credit only. This course does not count toward Science credit for graduation. You may withdraw from this course in the first 15 days.

College Course Equivalent

The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science.

Prerequisites

Students should have completed two years of high school laboratory science—one year of life science and one year of physical science (e.g., a year of biology and a year of chemistry). Due to the quantitative analysis required in the course, students should also have taken at least one year of algebra. Also desirable (but not necessary) is a course in earth science.

Lab Requirement

Although there are no specific AP Environmental Science labs or field investigations required for the course, it is required that students have the opportunity to spend a minimum of 25% of instructional time engaged in hands-on, inquiry-based laboratory and/or fieldwork investigations.

SCIENCE PRACTICES:

The AP Environmental Science practices describe what a student should be able to do while exploring course concepts. The table that follows presents these practices, which students should develop during the AP Environmental Science course. These practices are categorized into skills, which form the basis of the tasks on the AP Exam.

Skill	Description	Exam Weighting	
		Multiple Choice	Free Response
1. Concept Explanation	Explain environmental concepts, processes, and models presented in written format	30%–38%	13%–20%
2. Visual Representation	Analyze visual representations of environmental concepts and processes	12%–19%	6%–10%
3. Text Analysis	Analyze sources of information about environmental issues	6%–8%	N/A
4. Scientific Experiments	Analyze research studies that test environmental principles	2%–4%	10%–14%
5. Data Analysis	Analyze and interpret quantitative data represented in tables, charts, and graphs	12%–19%	6%–10%
6. Mathematical Routines	Apply quantitative methods to address environmental concepts	6%–9%	20%
7. Environmental Solutions	Propose and justify solutions to environmental problems	17%–23%	26%–34%

BIG IDEAS:

The big ideas serve as the foundation of the course and allow students to create meaningful connections among concepts. They are often overarching concepts or themes that become threads that run throughout the course. Revisiting the big ideas and applying them in a variety of contexts allows students to develop deeper conceptual understanding. Below are the big ideas of the course and a brief description of each.

Big Idea 1: Energy Transfer

Energy conversions underlie all ecological processes. Energy cannot be created; it must come from somewhere. As energy flows through systems, at each step, more of it becomes unusable.

Big Idea 2: Interactions Between Earth Systems

The Earth is one interconnected system. Natural systems change over time and space. Biogeochemical systems vary in ability to recover from disturbances.

Big Idea 3: Interactions Between Different Species and the Environment

Humans alter natural systems and have had an impact on the environment for millions of years. Technology and population growth have enabled humans to increase both the rate and scale of their impact on the environment.

Big Idea 4: Sustainability

Human survival depends on developing practices that will achieve sustainable systems. A suitable combination of conservation and development is required. The management of resources is essential. Understanding the role of cultural, social, and economic factors is vital to the development of solutions.

COURSE OUTLINE

Semester	Unit	Exam Weighting Multiple Choice	Tentative Test Date
Semester 1	Unit 1: The Living World: Ecosystems	6%–8%	9/13/19
	Unit 2: The Living World: Biodiversity	6%–8%	10/4/19
	Unit 3: Populations	10%–15%	10/25/19
	Unit 4: Earth Systems and Resources	10%–15%	11/8/19
	Unit 5: Land and Water Use	10%–15%	12/13/19
Semester 2	Unit 6: Energy Resources and Consumption	10%–15%	1/29/20
	Unit 7: Atmospheric Pollution	7%–10%	2/14/20
	Unit 8: Aquatic and Terrestrial Pollution	7%–10%	3/20/20
	Unit 9: Global Change	15%–20%	4/24/20

REQUIRED ENVIRONMENTAL LEGISLATION:

The following list represents the required environmental policies and legislation for the course as they relate to solutions to environmental problems.

- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Montreal Protocol
- Kyoto Protocol (also, COP 21 “Paris Treaty”)
- Endangered Species Act (ESA)
- Safe Drinking Water Act (SWDA)
- Delaney Clause of Food, Drug, and Cosmetic Act
- Resource Conservation and Recovery Act (RCRA)

LABORATORY AND FIELD INVESTIGATIONS

- Tragedy of the Commons Lab
  - Students will simulate the concept of the "Tragedy of the Commons" and relate to the issue of overfishing.
- Trophic Level Simulation Lab
  - Students will calculate the amount of energy transferred between trophic levels and relate to the amount of energy lost.
- Midewin Tall Grass Prairie Field Trip (6 class periods)
  - Students will collect data about number and type of species in quadrants located in grassland and forest. Students will use the data to calculate biodiversity indicators including species richness, species evenness, and the Shannon-Wiener Index.
- Ecological Succession Lab
  - Students will use population data to calculate relative abundance of tree species over the course of 50 to 100 years.
- Morton Arboretum Field Trip (6 class periods)
  - Students will collect light intensity readings in different locations to determine the effect of invasive species on oak tree growth.
- Soil Composition Lab
  - Students will identify characteristics of different types of soil and relate to usage and formation of the soil.
- Water Quality Lab
  - Students will use analytical methods to determine the presence of common water pollutants in samples.
- Wastewater Treatment Plant Field Trip (3 class periods)
  - Students will observe primary and secondary treatment of wastewater.
- Plate Tectonics Lab
  - Students will simulate effects of plate boundaries.
- Electrical Usage and Efficiency Lab
  - Students will use a power meter to determine the energy demands of household items and calculate efficiencies for the items.
- Indoor Air Pollution Lab
  - Students will collect air quality data and calculate average PM concentration.
- Ocean Acidification Lab
  - Students will determine the acidity of salt water and the effect of increased carbon dioxide on the acidity of salt water.
- LD_{50} Toxicity Lab
  - Students will toxicity data to determine the relative safety of common products and evaluate the reliability of the tests.
- Prairieview Landfill Field Trip (3 class periods)
  - Students will observe a working landfill where their garbage goes and learn the methods used to prevent air and water pollution from the landfill.

Please note that this list is tentative and not exhaustive.

CLASSROOM POLICIES:

Course Grades

Course grades will not be based upon a total accumulation of points. Instead, student grades will be determined based on the following weighted categories:

- Assessments 75% (tests, quizzes, projects, labs)
- Practice 5% (homework, entrance and exit slips)
- Final Exam 20%

Homework

Students should come to class prepared every day. Lectures and laboratory activities will complement the required reading and homework assignments. There is a tremendous amount of reading for this class. Students should expect a ***minimum*** of one hour of homework every day.

Assessments

Tests will be given in a format and style similar to the AP exam. Therefore, the test will include a multiple-choice portion and a free-response portion.

Expectations

- Respect yourself, others, and the classroom.
- Come to class prepared every day and ready to work at a collegiate level.
- Complete assignments on time.
- Make up absent work on time. It is expected that students are using resources available to complete work during absences, unless circumstances prevent this.

Absence Policy

Students who have a pre-excused absence (field trips/vacations) are allowed to make up work missed during the absence. When assignments are provided by the teacher before the student leaves, the student is required to turn in the assignments upon return to each class. For an excused illness absence, the student is **entirely responsible** for requesting the make-up work from the teacher(s). Tests/quizzes will be scheduled at an agreed upon time. Students will be given one school day for each day of excused absence to make up assignments and tests. Additional considerations will be given for students with extended illnesses. In the matter of disciplinary absences, it is the student's responsibility to make up missed work or tests. Work is due on the date of return to school or class.

Academic Honesty

Unless otherwise stated by the teacher, all assignments are to be turned in and completed independently. The consequences for multiple occurrences of cheating are cumulative across subjects/disciplines.

Tests, Projects, Essays & Final Exams

If a student is caught cheating on a major assignment and/or test, he or she may receive the following:

1st Offense: 1 hour referral (referral submitted by teacher to the appropriate dean), but an opportunity to retest, and/or complete the assignment with 20% off their retake grade.

2nd Offense: 4 hour referral (referral submitted by teacher to the appropriate dean), but an opportunity to retest, and/or complete the assignment with 50% off their retake grade.

3rd Offense: ASDA (referral submitted by teacher to the appropriate dean) and a 0% on their grade.

Cheating on homework will result in a 0% on the assignment without opportunity to make up the assignment.

Required Materials

- Course Textbook: Miller Jr., G. Tyler. ***Living in the Environment. 16th Ed***.
- Paper
- Binder
- Lab Notebook (you may be required by your college to submit to earn college credit)
- Calculator
- Agenda Book
- Pencil/Eraser
- Pen

Lab Safety

This is a primary concern in this class. You need to read the Flinn Safety Contract carefully and have your parents sign and return it. There will be a Lab Safety Test on the information in this contract.

AP EXAM OVERVIEW

The AP Environmental Science Exam assesses student understanding of the science practices and learning objectives outlined in the course framework. The exam is 2 hours and 40 minutes long and includes 80 multiple-choice questions and 3 free-response questions. A four-function, scientific, or graphing calculator is allowed on both sections of the exam. The details of the exam, including exam weighting and timing, can be found below:

Section	Question Type	# of Questions	Weight	Timing
I	Multiple-choice questions	80	60%	90 mins
II	Free-response questions • Question 1: Design an investigation (10 points) • Question 2: Analyze an environmental problem and propose a solution (10 points) • Question 3: Analyze an environmental problem and propose a solution doing calculations (10 points)	3	40%	70 mins

Section I: Multiple-Choice

The multiple-choice section includes both individual and set-based questions. All set-based questions include stimulus material:

- Three to four sets include quantitative data, such as data tables, charts, or graphs. These questions primarily assess Practice 5, but can also assess Practices 1, 4, 6, or 7.
- Three to four sets include qualitative data or information, such as models, representations, or maps. These questions primarily assess Practice 2, but can also assess Practices 1, 4, or 7.
- Two sets include text-based sources. These questions primarily assess Practice 3, but can also assess Practices 1, 6, or 7.

Section II: Free-Response

The second section of the AP Environmental Science Exam includes three free-response questions.

Free-Response Question 1

Design an investigation presents students with an authentic environmental scenario accompanied by either a model/visual representation or quantitative data, and may assess student ability to:

- Describe and/or explain environmental concepts, processes, and models presented in written format (Practice 1).
- Analyze visual representations or data (Practice 2 and/or 5).
- Analyze research studies that test environmental principles (Practice 4).
- Describe environmental problems and/or potential responses (Practice 7).

Free-Response Question 2

Analyze an environmental problem and propose a solution presents students with an authentic environmental scenario accompanied by either a model/visual representation or quantitative data, and may assess student ability to:

- Describe and/or explain environmental concepts, processes, and models presented in written format (Practice 1).
- Analyze visual representations or data (Practice 2 and/or 5).
- Propose and justify solutions to environmental problems (Practice 7).

Free-Response Question 3

Analyze an environmental problem and propose a solution doing calculations presents students with an authentic environmental scenario and may assess student ability to:

- Describe or environmental concepts, processes, and models presented in written format (Practice 1).
- Apply quantitative methods to address environmental concepts (Practice 6).
- Propose and justify solutions to environmental problems (Practice 7).

Please refer to the Science Practices on the first page of this syllabus.

Task Verbs Used in FRQs

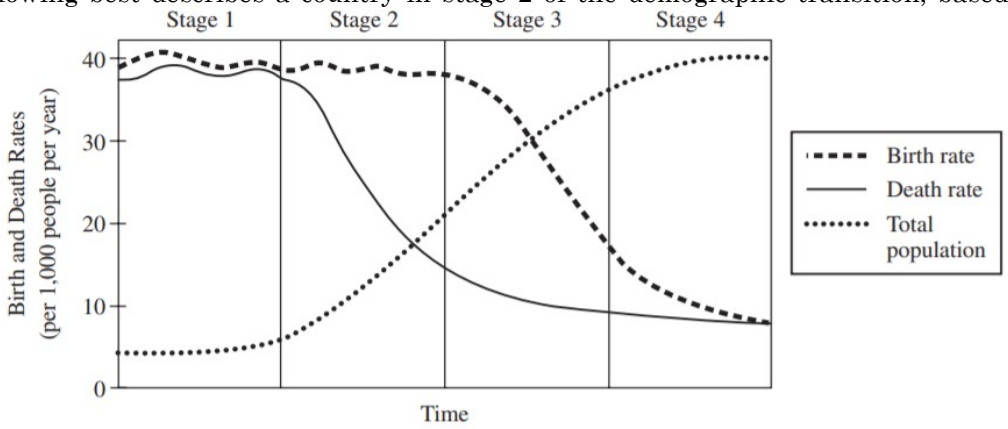
The following task verbs are commonly used in the free-response questions:

- **Calculate**: Perform mathematical steps to arrive at a final answer, including algebraic expressions, properly substituted numbers, and correct labeling of units. Showing work is required.
- **Describe**: Provide the relevant characteristics of a specified topic.
- **Explain**: Provide information about how or why a relationship, process, pattern, position, situation, or outcome occurs, using evidence and/or reasoning to support or qualify a claim. Explain "how" typically requires analyzing the relationship, process, pattern, position, situation, or outcome; whereas, explain "why" typically requires analysis of motivations or reasons for the relationship, process, pattern, position, situation, or outcome. Also phrased as "give one reason."
- **Identify**: Indicate or provide information about a specified topic, without elaboration or explanation.
- **Justify**: Provide evidence to support, qualify, or defend a claim and/or provide reasoning to explain how that evidence supports or qualifies the claim.
- **Make a claim**: Make an assertion that is based on evidence or knowledge.
- **Propose a solution**: Provide a proposed solution to a problem based on evidence or knowledge.

SAMPLE EXAM QUESTIONS

Section I: Multiple-Choice

1. Which of the following best describes a country in stage 2 of the demographic transition, based on the model shown below?

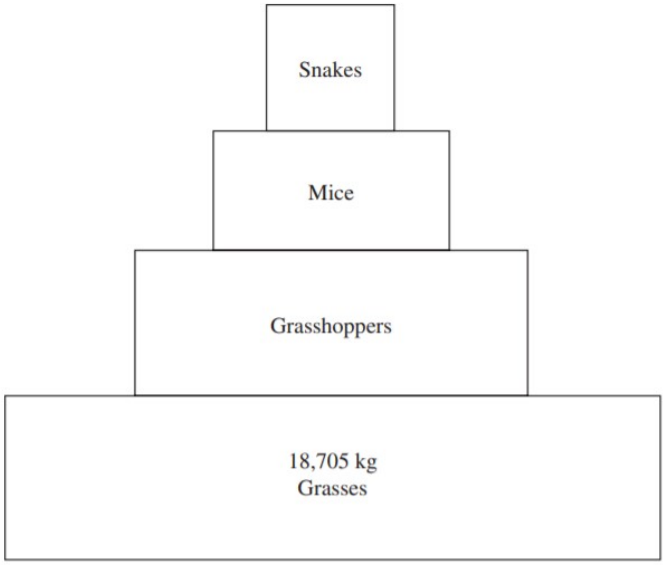


(A) Birth and death rates are both high, and the population is experiencing a slow rate of increase.
(B) Birth and death rates are both low, and the population is stable.
(C) Birth rates are high and death rates are declining, and the population is increasing rapidly.
(D) Birth rates are low and death rates are high, and the population is declining rapidly

2. Which of the following is a nonanthropogenic source of carbon dioxide emissions into the atmosphere?
(A) Cellular respiration
(B) Photosynthesis
(C) A coal-fired power plant
(D) A hydrogen-powered car

3. Scientists are interested in determining the impact of the construction of a hydroelectric dam on a population of salmon that live downstream of a populated area. They measure the health of the salmon population in its current state, several years after the dam was constructed. Which of the following would be the best to use as a control in this study?
(A) The health of the salmon population in the river before humans lived in the area
(B) The health of the salmon population at the apex of the dam's construction
(C) The health of the salmon population just after the dam's construction was completed
(D) The health of the salmon population prior to any dam construction

Questions 4 and 5 refer to the diagram below of a biomass pyramid in a grassland ecosystem.

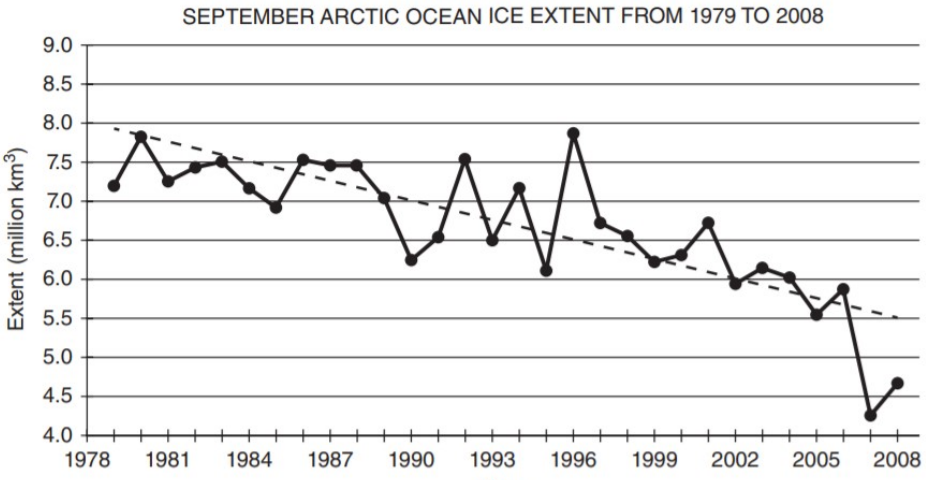


4. Based on the diagram, which group of organisms would be considered herbivores?
   (A) Snakes
   (B) Mice
   (C) Grasshoppers
   (D) Grasses

5. Based on the laws of thermodynamics, which of the following is the applied mathematical routine used to estimate the biomass of the mice in the pyramid?
   (A) 18,705 kg × 10
   (B) 18,705 kg/10 × 100
   (C) 18,705 kg × 0.10 × 0.10
   (D) 18,705 kg/0.10

6. Which of the following describes a component of a modern sanitary landfill?
   (A) A series of screens and grates to prevent large objects from entering the landfill
   (B) A bottom liner of plastic or clay to prevent groundwater contamination
   (C) Aerated tanks in which bacteria break down organic matter
   (D) Chemical or ultraviolet light systems that kill pathogens

Questions 7 and 8 refer to the graph below.



7. Based on the data in the graph, by approximately what percent did the sea ice decrease from 1980 to 2005?
   (A) 10%
   (B) 30%
   (C) 50%
   (D) 70%

8. Which of the following is the most likely consequence of the trend for the change in sea ice shown in the graph, creating a positive feedback loop in the Arctic?
   (A) Increasing albedo and increasing absorption of heat by the ocean
   (B) Increasing albedo and decreasing absorption of heat by the ocean
   (C) Decreasing albedo and increasing absorption of heat by the ocean
   (D) Decreasing albedo and decreasing absorption of heat by the ocean

9. Which of the following is a disadvantage associated with the genetic modification of crops?
   (A) Genetically modified crops have a decreased resistance to drought.
   (B) Genetically modified crops have a shorter shelf life and are more difficult to transport long distances.
   (C) Genetically modifications can decrease the genetic diversity of crop species.
   (D) Genetic modifications decrease nutritional content in foods.

10. The table below shows volcano and earthquake data for four countries that are approximately equal in size.

Country	Number of active volcanoes	Number of earthquakes ≥ magnitude 5 since 1990
Country A	0	0
Country B	4	0
Country C	0	18
Country D	16	41

Based on the data in the table, which of the countries is most likely located at a subduction zone between an oceanic tectonic plate and a continental tectonic plate?

(A) Country A
(B) Country B
(C) Country C
(D) Country D

Questions 11–13 refer to the information below.

The Chernobyl nuclear disaster led to the release of massive radiation, specifically iodine-131 and cesium-137, which has been connected to a variety of environmental problems in the 30 years following the disaster.

11. A meltdown in which of the following structures at a nuclear power plant, such as Chernobyl, would most likely lead to the accidental release of radiation?

(A) Cooling tower
(B) Turbine
(C) Generator
(D) Reactor core

12. Which of the following best describes the process of electricity generation at a nuclear power plant?

(A) Nuclear power is generated through fission, which releases a large amount of heat. The heat is used to generate steam, which turns a turbine that powers a generator.
(B) Nuclear power is generated when photons are converted to a direct current using a semiconducting material such as silicon. An inverter is used to convert the direct-current electricity into an alternating current.
(C) Nuclear power is generated from the thermal energy of Earth, which is a result of radioactive decay. The water underground is turned to steam, which turns a turbine to produce electricity.
(D) Nuclear power is generated from the combustion of mined uranium, which provides enough heat to power a generator. The generator turns a turbine to create electricity.

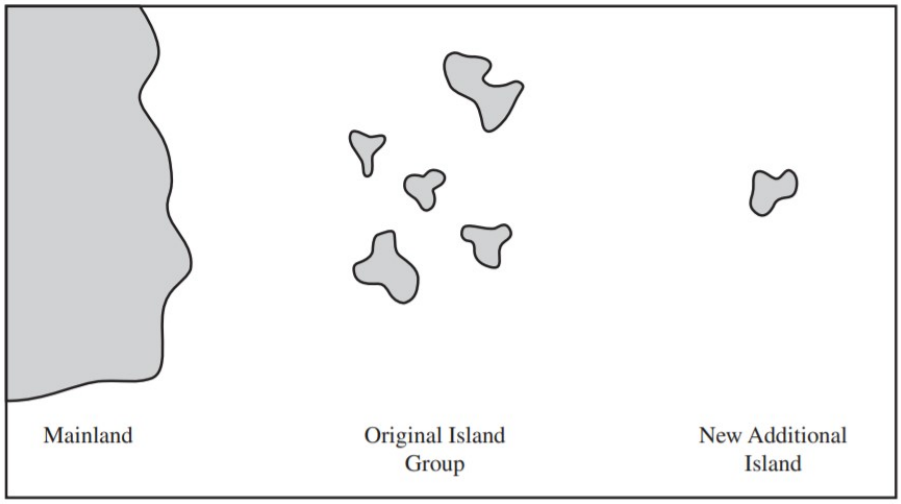
13. A soil sample near Chernobyl was found to contain 187 kBq/m2 of cesium-137. If the half-life of cesium-137 is approximately 30 years, how much cesium-137 will remain in the sample after 90 years?

(A) 93.50 kBq/m2
(B) 23.38 kBq/m2
(C) 6.23 kBq/m2
(D) 1.58 kBq/m2 14.

14. During an El Niño event, warm surface water moves from the western equatorial Pacific Ocean to the eastern equatorial region. Which of the following best describes how the warm water will affect upwelling off the coast of equatorial South America?

(A) The warm surface water will not change upwelling because this region is at the equator and always has warm water.
(B) The warm surface water will increase upwelling because of the difference in salinity between the warm surface water and the cold deep water.
(C) The warm surface water will decrease upwelling because the cooler temperatures on land in the region will prevent upwelling.
(D) The warm surface water will decrease upwelling because of the density difference between the warm surface water and the cold deep water.

Scientists are interested in determining the average number of species that have migrated from the mainland to a group of islands, as shown below. Partway through their study, they decided to include an additional island in their study group



15. Based on the theory of island biogeography, which of the following best explains how the scientists' calculation of average number of species would change with the inclusion of this new island in their study?

(A) The average would increase because more species would have migrated directly to the farther island.

(B) The average would decrease because fewer species would have migrated directly to the farther island.

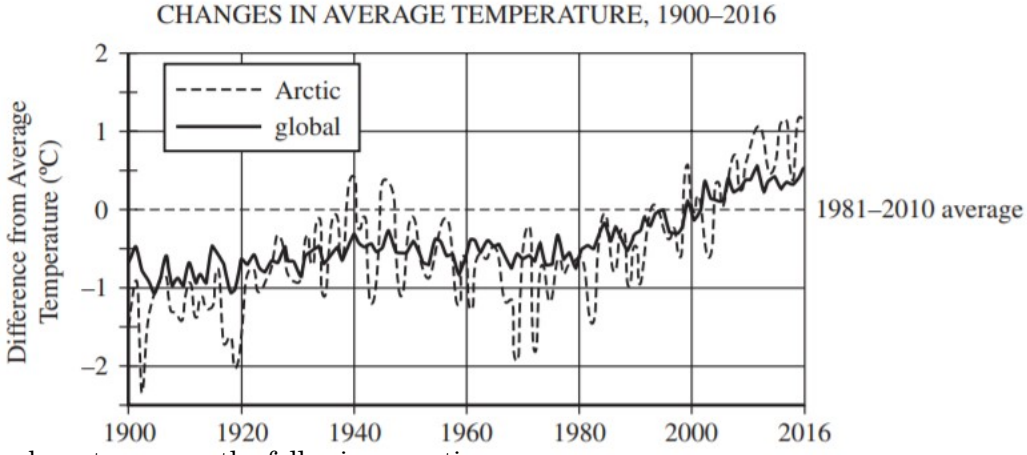
(C) The average would not change because it is likely that the additional island has about the same number of species that migrated as the original island group.

(D) The average would not change because the island is approximately the same size as those in the original group and therefore just as likely to recruit species from the mainland.

Section II: Free-Response

ANALYZE AN ENVIRONMENTAL PROBLEM AND PROPOSE A SOLUTION (FREE-RESPONSE QUESTION 2):

The graph below shows temperature anomalies from 1900 to 2016 globally and in the Arctic.



(a) Refer to the graph above to answer the following questions.

i. Based on the data in the graph, identify the change in the difference from average temperature in the Arctic between 1980 and 2016.

ii. Describe the difference in the change in temperatures in the Arctic with the change in global temperatures from 2000 to 2016.

(b) The cause of the temperature trend seen in the map is a result of increasing concentrations of greenhouse gases in the atmosphere.

i. Identify a greenhouse gas that has a global warming potential (GWP) that is greater than 1.

ii. Identify an anthropogenic source that contributes to greenhouse gas emissions.

iii. Explain how increasing amounts of greenhouse gases in the atmosphere are linked to a change in pH of the ocean.

(c) Greenhouse gases can pose threats to both human health and the environment.
i. Describe TWO impacts that global climate change can have on human health.

ii. Describe one effect global climate change can have on marine organisms.

(d) In order to reduce the effect of greenhouse gases on ecosystems, greenhouse gas emissions must be reduced.
i. Propose one realistic solution to reduce greenhouse gas emissions.

ii. Justify how the solution posed in (d)(i) would lead to a decrease in greenhouse gas emissions.

ANALYZE AN ENVIRONMENTAL PROBLEM AND PROPOSE A SOLUTION DOING CALCULATIONS (FREE-RESPONSE QUESTION 3):

An individual has decided to convert a grassy area on property to a large garden in order to grow food, primarily vegetables. The garden measures 50 meters in length by 7 meters in width.

(a) Describe one environmental advantage of producing food locally.

(b) Vegetable production in the garden was less than expected for the season.
i. Identify one soil property that affects crop production.

ii. The gardener applied a synthetic fertilizer to the garden for the next growing season. Describe one benefit of using synthetic fertilizer in the garden.

iii. A neighbor proposes using compost rather than a synthetic fertilizer on the garden, stating that composting is a more sustainable agricultural practice. Justify this claim.

(c) The gardener finds a synthetic fertilizer with 34% nitrogen and a recommended application rate of 1 kg of nitrogen per 70.0 square meters. Calculate the number of kilograms of synthetic nitrogen fertilizer that should be spread on the garden area. Show your work.

(d) The gardener also finds a local compost source with 2.5% nitrogen. Calculate the number of kilograms of compost that would need to be added to the garden to provide as much nitrogen as using the synthetic fertilizer. Show your work.

(e) The price of a kilogram of synthetic fertilizer is $3.11, while the price of a kilogram of compost is $0.04. Calculate the savings to provide 1 kg of nitrogen per 70 square meters using compost rather than nitrogen. Show your work.

RESOURCES

You will be required to use these resources to be successful in this course:

- AP Classroom*
- Google Classroom*
- Course Textbook and/or Supplemental Readings
- Ms. Young's Teacher Page

It is recommended that you also use these resources to be successful in this course:

- Bozeman Science*
- APES in a Box*
- AP Review book(s)
- Khan Academy Math Review*

*Links are available on Ms. Young's Teacher Page