PLANNED INSTRUCTION

A PLANNED COURSE FOR:

_____Advanced Placement Environmental Science_____

Curriculum writing committee:

Bernadine Salak

Grade Level: 11/12

Date of Board Approval: _____2021_____

Course Weighting: AP Environmental Science
(Science Department Scoring Guidelines)

Major Assessments **(Unit Exams 2-3 per marking period; 1-2 Laboratory Reports per marking period)**	**45%**
Skills Application **(Laboratory Reflections 2-3 per marking period; Unit Quizzes 2-3 per marking period)**	**30%**
Skills Practice **(Reflection Questions/Unit Questions 2-4 sets per unit; Case Studies 1-2 per unit)**	**20%**
Participation (1-3 per week, various assignments; AP Progress Checks (as they apply per unit with the College Board))	**5%**
Total	**100%**

Curriculum Map

Overview:

The AP Environmental Science course is an introductory college-level environmental science course. The course reflects learning that analyzes environmental concepts and processes to achieve understanding to propose and justify solutions to environmental problems. The course teaches students how to apply science to the solutions of important social problems. It also provides opportunities to practice applying scientific methods to practical, real-life problems. The AP Environmental Science course provides students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. The course helps students identify and analyze natural and human-induced environmental problems. It enables them to learn how to assess the risks associated with these problems and evaluate alternative solutions for resolving and preventing them. To accomplish this goal, the AP Environmental Science Course and Exam Description defines concepts, skills, and understandings required by representative colleges and universities for granting college credit and placement. Environmental science is interdisciplinary, embracing topics from geology, biology, environmental studies, environmental science, chemistry, and geography. The AP Environmental Science course is designed to be the equivalent of a one-semester, introductory college course in environmental science.

Time/Credit for the Course: 1 Full year; 1 science credit
Advanced Placement Environmental Science: Curricular Requirements

CR 1- The students and teacher have access to college-level resources including a recently published (within the last 10 years) college-level textbook and reference materials in print or electronic format.
CR 2- The course includes the required environmental legislation and policies.
CR 3- The course is structured to incorporate the big ideas and required content outlined in each of the units described in the AP Course and Exam Description.
CR 4- The course provides opportunities for students to develop the skills related to Science Practice 1: Concept Application, as outlined in the AP Course and Exam Description (CED).
CR 5- The course provides opportunities for students to develop the skills related to Science Practice 2: Visual Representations, as outlined in the AP Course and Exam Description (CED).
CR 6- The course provides opportunities for students to develop the skills related to Science Practice 3: Text Analysis, as outlined in the AP Course and Exam Description (CED).
CR 7- The course provides opportunities for students to develop the skills related to Science Practice 4: Scientific Experiments, as outlined in the AP Course Exam Description (CED).
CR 8- The course provides opportunities for students to develop the skills related to Science Practice #5: Data Analysis, as outlined in the AP Course Exam Description (CED).
CR 9- The course provides opportunities for students to develop the skills related to Science Practice 6: Mathematical Routines, as outlined in the AP Course and Exam Description (CED).
CR 10- The course provides opportunities for students to develop the skills related to Science Practice #7: Environmental Solutions, as outlined in the AP Course and Exam Description (CED).
CR 11- Students spend a minimum of 25% of instructional time engaged in a wide range of hands-on, inquiry-based laboratory investigations and/or field work to support learning required content and developing science practices throughout the course.
CR 12- The course provides opportunities for students to record evidence of their scientific investigations. Evidence can be recorded in lab reports, mini-posters, or another appropriate formal manner for inclusion in lab reports/notebooks (print or digital format).

Goals:
Marking Period 1:
Unit 1—The Living World: Ecosystems
Unit 2—The Living World: Biodiversity
Unit 3—Populations

Goals:
Unit 1: The Living World-Ecosystems
Understanding of:

- Introduction to Ecosystems
- Terrestrial Biomes
- Aquatic Biomes
- The Carbon Cycle
- The Nitrogen Cycle
- The Phosphorus Cycle
- The Hydrologic (Water) Cycle
- Primary Productivity
- Trophic Levels
- Energy Flow and the 10% Rule
- Food Chains and Food Webs

Unit 2: The Living World-Biodiversity
Understanding of:

- Introduction to Biodiversity
- Ecosystem Services
- Island Biogeography
- Ecological Tolerance
- Natural Disruptions to Ecosystems
- Adaptations
- Ecological Succession

Unit 3: Populations
Understanding of:

- Generalist and Specialist Species
- K-Selected; r-Selected Species
- Survivorship Curves
- Carrying Capacity
- Population Growth and Resource Availability
- Age Structure Diagrams
- Total Fertility Rate
- Human Population Dynamics
- Demographic Transition

Marking Period 2:
Unit 4—Earth Systems and Resources
Unit 5—Land and Water Use
Unit 6—Energy Resources and Consumption

Goals:
Unit 4: Earth Systems and Resources
Understanding of:

- Plate Tectonics
- Soil Formation and Erosion
- Soil Composition and Properties
- Earth's Atmosphere
- Global Wind Patterns
- Watersheds
- Solar Radiation and Earth's Seasons
- Earth's Geography and Climate
- El Nino and La Nina

Unit 5: Land and Water Use
Understanding of:

- The Tragedy of the Commons
- Clearcutting
- The Green Revolution
- Impacts of Agricultural Practices
- Irrigation Methods
- Pest Control Methods
- Meat Production Methods
- Impacts of Overfishing
- Impacts of Mining
- Impacts of Urbanization
- Ecological Footprints
- Introduction to Sustainability
- Methods to Reduce Urban Runoff
- Integrated Pest Management
- Sustainable Agriculture
- Aquaculture
- Sustainable Forestry

Unit 6: Energy Resources and Consumption
Understanding of:

- Renewable and Nonrenewable Resources
- Global Energy Consumption
- Fuel Types and Uses
- Distribution of Natural Energy Resources
- Fossil Fuels
- Nuclear Power
- Energy from Biomass
- Solar Energy
- Hydroelectric Power
- Geothermal Energy
- Hydrogen Fuel Cell
- Wind Energy
- Energy Conservation

Marking Period 3:
Unit 7—Atmospheric Pollution
Unit 8—Aquatic and Terrestrial Pollution

Goals:
Unit 7: Atmospheric Pollution
Understanding of:

- Introduction to Air Pollution
- Photochemical Smog
- Thermal Inversion
- Atmospheric Carbon Dioxide and Particulates
- Indoor Air Pollutants
- Reduction of Air Pollutants
- Acid Rain
- Noise Pollution

Unit 8: Aquatic and Terrestrial Pollution
Understanding of:

- Sources of Pollution
- Human Impacts on Ecosystems
- Endocrine Disruptors
- Human Impacts on Wetlands and Mangroves
- Eutrophication
- Thermal Pollution
- Persistent Organic Pollutants (POPs)
- Bioaccumulation and Biomagnification

- Solid Waste Disposal
- Waste Reduction Methods
- Sewage Treatment
- Lethal Dose 50% (LD50)
- Dose Response Curve
- Pollution and Human Health
- Pathogens and Infectious Diseases

Marking Period 4:
Unit 9—Global Change
Unit 10—Research Projects and Sustainability

Goals:
Unit 9: Global Change
Understanding of:

- Stratospheric Ozone Depletion
- Reducing Ozone Depletion
- The Greenhouse Effect
- Increases in the Greenhouse Gases
- Global Climate Change
- Ocean Warming
- Ocean Acidification
- Invasive Species
- Endangered Species
- Human Impacts on Biodiversity

Unit 10: Research Projects and Sustainability
Understanding of:

- Sustainability
- Field Research and Observations

Big Ideas:

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.

Textbook and Supplemental Resources:

Environmental Science for AP, Second Edition
Textbook ISBN #: 1-4641-0868-4
Pearson: W.H. Freeman and Company
Third Edition: 2015

Strive for a 5: Preparing for the AP Environmental Science Examination
Textbook ISBN #1-4641-5616-6
Pearson: W.H. Freeman and Company
Third Edition: 2015

Environmental Science for AP, Second Edition
Textbook ISBN #: 1-4641-5618-2 (Teachers' edition)
Teacher's Resource Flash Drive: ISBN 1-4641-5619-0
Book Companion site: bcs.whfreeman.com/friedlandapes2e
ExamView Assessment Suite: ISBN 1-4641-5612-3
Textbook Publisher &Year of Publication:
Pearson: W.H. Freeman and Company
Third Edition: 2015

HHMI Biointeractive Labs and Videos: https://www.biointeractive.org/
The Biology Corner for Simulated Lab Activities: https://www.biologycorner.com/
ESRI Virtual Labs:
https://storymaps.arcgis.com/stories/92908ecee12d4f74bce30461dadb0e35

College Board AP Classroom: https://apclassroom.collegeboard.org

2019 AP Environmental Science Course Framework Alignment to Friedland & Relyea, *Environmental Science for the AP Course, 2nd Edition*.

AP Environmental Science Course and Exam Description, Effective Fall 2019
List of Required Environmental Legislation:

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

Curriculum Plan

Unit 1—The Living World: Ecosystems **Summer work, plus 13-15 Days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.3.12.C; 4.6.12.A; 4.6.12.B; 4.6.12.C; 4.7.12.A; 4.8.12.A; 4.8.12.B

3.1.12.A; 3.3.12.A; 3.3.12.A5; 3.4.12.B1; 3.4.12.B2

Anchors: Biology Keystone Anchors
BIO.A.2.1; BIO.A.2.2; BIO.A.3.2; BIO.B.4.1; BIO.B.4.2

Eligible Content:
BIO.A.2.1.1; BIO.A.2.2.1; BIO.A.3.2.1; BIO.B.4.1.1; BIO.B.4.1.2; BIO.B.4.2.1BIO.B.4.2.3

(Unit 1 Corresponds with textbook Chapter 1 Modules 1-2; Ch 3 Modules 6-7; Ch 4 Modules 12-13; Chapter 6 Module 20)

Objectives: Big Idea 1—Energy Transfer; Big Idea 2—Interactions Between Earth Systems

Students shall be able to:

1. SKILL--Describe environmental concepts and processes. (DOK 2)
2. Investigate the impacts of invasive species on Pennsylvania ecology. (DOK 3)
3. Identify environmental issues in the greater Pike County community. (DOK 1)
4. Analyze how ecosystems are the result of biotic and abiotic interactions. (DOK 4)
5. Explain how the availability of resources influences species interactions. (DOK 3)
6. Describe the global distribution and principal environmental aspects of terrestrial biomes. (DOK 2)
7. Describe the global distribution and principal environmental aspects of aquatic biomes. (DOK 2)
8. Explain the steps and reservoir interactions in the carbon cycle. (DOK 3)
9. SKILL--Explain relationships between different characteristics of environmental concepts, processes, or models represented visually through theoretical and applied contexts. (DOK 3)
10. Explain the steps and reservoir interactions in the nitrogen cycle. (DOK 3)
11. Explain the steps and reservoir interactions in the phosphorus cycle. (DOK 3)
12. Explain the steps and reservoir interactions in the hydrologic cycle. (DOK 3)
13. Investigate how solar energy is acquired and transferred by living organisms. (DOK 3)
14. Analyze how energy flows and matter cycles through trophic levels. (DOK 4)
15. SKILL--Calculate an accurate numeric answer with appropriate units. (DOK 3)

16. Determine how the energy decreases as it flows through ecosystems. (DOK 2)
17. Describe food chains and food webs, and their constituent members by trophic level. (DOK 2)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Review and complete summer assignments relating to invasive species and environmental issues in Pike County.
2. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 1.
3. Day 1 Activity—Tragedy of the Commons Simulation
4. Ecosystem case studies, video examples, and online simulations. (Current events and other potential list)
    a. Ecological Footprint
    b. Prey Lab Simulation
    c. Altered Biomes
    d. Ecological Relationships
    e. Planet Earth clips (Shallow Seas)
    f. Other case studies, video examples, and online simulations that fit within the curricular topics.
5. Potential Lab Activities:
    a. Eco-columns—design and set up
    b. Experimental Design—Eutrophication Lab
    c. Owl Pellet Trophic Level with Math
    d. Thermodynamic Relay Races
    e. Other laboratory studies and activities that meet curricular standards with the College Board CED
6. Unit 1 reflection questions.
7. Unit 1 skills and math practice questions.
8. AP Classroom Progress Checks for Unit 1.
9. Practice FRQ questions for Unit 1.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes

        - Homework Worksheets / Reflection Questions / Writing Assignments
        - AP Free Response Questions
        - AP Multiple Choice Questions
        - Projects
        - Lab questions and reports

    - **Summative:**
        - Quizzes
        - Unit Exam
        - Formal Laboratory Reports

Unit 2—The Living World: Biodiversity **Time: 12-14 Days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.1.12.C; 4.1.12.D; 4.2.12.A; 4.3.12.B; 4.3.12.C; 4.6.12.A; 4.6.12.C

3.1.12.A1; 3.1.12.A2; 3.1.12.A8; 3.1.12.C1; 3.4.12.B1

Anchors: Biology Keystone Anchors
BIO.A.3.2; BIO.B.3.1; BIO.B.4.1; BIO.B.4.2

Eligible Content:
BIO.A.3.2.1; BIO.B.3.1.1; BIO.B.3.1.2; BIO.B.3.1.3; BIO.B.4.1.2; BIO.B.4.2.1; BIO.B.4.2.2; BIO.B.4.2.3; BIO.B.4.2.4; BIO.B.4.2.5

(Unit 2 Corresponds with textbook Chapter 1 Modules 1-2; Chapter 3 Module 8; Chapter 5 Modules 15-17; Chapter 6 Module 21; Chapter 10 Module 29; Chapter 14 Module 41; Chapter 18 Module 59 & 61; Chapter 19 Module 63; Chapter 20 Module 65)

Objectives: Big Idea 2—Interactions Between Earth Systems

Students shall be able to:

1. SKILL--Describe environmental concepts and processes. (DOK 2)
2. Apply the concept the ecosystems have structure and diversity that change over time. (DOK 4)
3. Explain levels of biodiversity and their importance to ecosystems. (DOK 3)
4. Describe ecosystem services. (DOK 2)
5. Describe the results of human disruptions to ecosystem services. (DOK 2).
6. Explain island biogeography. (DOK 3)
7. Describe the role of island biogeography in evolution. (DOK 2)
8. SKILL--Identify the claim of an author. (DOK 1)
9. Describe ecological tolerance. (DOK 2)
10. SKILL—Describe patterns or trends in data. (DOK 3)
11. Explain how natural disruptions, both short-and long-term, impact an ecosystem. (DOK 3)
12. SKILL—Describe relationships among variables in data representation. (DOK 3)
13. Describe how organisms adapt to their environment. (DOK 2)
14. Analyze ecological succession. (DOK 4)
15. Describe the effect of ecological succession on ecosystems. (DOK 2)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 2.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. HHMI Biodiversity Elephant Study
    b. Virtual Island Biogeography Lab
    c. Butterfly Migration
    d. Trophic Cascade examples
    e. Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Eco-columns—data collection and monitoring
    b. Biodiversity measurements
    c. Shannon Weiner Index field study
    d. Leaf pack diversity
    e. NPP plant growth lab
    f. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 2 reflection questions.
5. Unit 2 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 2.
7. Practice FRQ questions for Unit 2.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion
- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions
    - Projects
    - Lab questions and reports
- **Summative:**
    - Quizzes
    - Unit Exam
    - Formal Laboratory Reports

Unit 3: Populations **Time: 13-16 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.6.12.A; 4.7.12.A; 4.8.12.A

3.1.12.C; 3.4.12.B1

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4; BIO.B.4.2.5

(Unit 3 corresponds with textbook Chapter 5 Module 17; Chapter 6 Modules 18-19; Chapter 7 Modules 22-23; Chapter 11 Module 31.)

Objectives: Big Idea 2—Interactions Between Earth Systems; Big Idea 3—Interactions Between Different Species and the Environment

Students shall be able to:

1. SKILL—Explain environmental concepts and processes. (DOK 2)
2. Analyze how populations change over time in reaction to a variety of factors. (DOK 4)
3. Identify differences between generalist and specialist species. (DOK 1)
4. Compare the differences between K-and r-selected species. (DOK 3)
5. Explain survivorship curves. (DOK 3)
6. SKILL—Explain what the data implies or illustrates about environmental issues. (DOK 3)
7. Describe carrying capacity. (DOK 2)
8. Describe the impacts of carrying capacity on ecosystems. (DOK 2)
9. SKILL—Apply appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis). (DOK 4)
10. Explain how resource availability affects population growth. (DOK 3)
11. Analyze how human populations change in reaction to a variety of factors, including social and cultural factors. (DOK 4)
12. Explain age structure diagrams. (DOK 2)
13. Investigate factors that affect total fertility rate in human populations. (DOK 3)
14. SKILL—Describe environmental problems. (DOK 2)
15. Explain how human populations experience growth and decline. (DOK 3)
16. Define the demographic transition. (DOK 1)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 3.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. China's one child policy
    b. HHMI: Niche Partitioning and Species Coexistence
    c. The World in Balance
    d. Gapminder Investigations
    e. Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Eco-columns—data collection and monitoring
    b. Survivorship Lab
    c. Cemetery Statistics Lab
    d. Population Pyramids
    e. Human Population Virtual Lab
    f. Population Math
    g. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 3 reflection questions.
5. Unit 3 Population dynamics graphing questions.
6. Unit 3 skills and math practice questions.
7. AP Classroom Progress Checks for Unit 3.
8. Practice FRQ questions for Unit 3.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions
    - Projects
    - Lab questions and reports

- **Summative:**
  - Quizzes
  - Unit Exam
  - Formal Laboratory Reports

Unit 4: Earth Systems and Resources **Time: 11-13 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.1.12.A; 4.1.12.B; 4.1.12.C; 4.1.12.D; 4.6.12.A; 4.6.12.B; 4.6.12.C; 4.8.12.D

3.3.12.A1; 3.3.12.A5; 3.3.12.A6

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.3; BIO.4.2.4

(Unit 4 corresponds with textbook Chapter 3 Module 8; Chapter 4 Modules 8-11; Chapter 8 Modules 24-25; Chapter 11 Module 33.)

Objectives: Big Idea 1—Energy Transfer; Big Idea 2—Interactions Between Earth Systems

Students shall be able to:

1. SKILL—Explain how environmental concepts and processes represented visually relate to broader environmental issues. (DOK 2)
2. Describe how Earth's systems interact, resulting in a state of balance over time. (DOK 2)
3. Describe the geological changes and events that occur at convergent, divergent, and transform plate boundaries. (DOK 2)
4. SKILL—Identify a research method, design, and/or measure used. (DOK 1)
5. Describe the characteristics and formation of soil. (DOK 2)
6. Describe similarities and differences between properties of different soil types. (DOK 2)
7. Describe the structure and composition of the Earth's atmosphere. (DOK 2)
8. Explain how environmental factors can result in atmospheric circulation. (DOK 3)
9. Describe the characteristics of a watershed. (DOK 2)
10. Analyze how most of the Earth's atmospheric processes are driven by input of energy from the sun. (DOK 4)
11. Explain how the sun's energy affects the Earth's surface. (DOK 3)
12. Describe how the Earth's geography affects weather and climate. (DOK 2)
13. Describe the environmental changes and effects that result from El Niño or La Niña events (El Niño–Southern Oscillation). (DOK 2)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 4.

2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. Plate Tectonics Demonstration (virtual)
    b. Role of Earthworms
    c. Watershed Articles
    d. El Nino Current Events and Maps
    e. Ocean Current Simulation
    f. Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Physical and Chemical Properties of Soil
    b. Soil Productivity
    c. Erosion Lab
    d. Stream Table/Watershed Modeling
    e. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 4 reflection questions.
5. Unit 4 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 4.
7. Practice FRQ questions for Unit 4.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions
    - Projects
    - Lab questions and reports

- **Summative:**
    - Quizzes
    - Unit Exam
    - Formal Laboratory Reports

Unit 5: Land and Water Use **Time: 18-20 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.2.12.A; 4.4.12.A; 4.4.12.B; 4.4.12.C; 4.4.12.D; 4.5.12.A; 4.5.12.B; 4.5.12.C; 4.6.12.A; 4.8.12.A

3.3.2.A2; 3.4.12.B1

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4

(Unit 5 corresponds with textbook Chapter 1 Module 2; Chapter 3 Module 7; Chapter 7 Module 23; Chapter 8 Module 25; Chapter 9, Module 26 & 28; Chapter 10 Modules 29-30; Chapter 11 Modules 32-33; Chapter 13 Module 37; Chapter 18 Module 60; Chapter 20 Module 65-66.)

Objectives: Big Idea 3—Interactions Between Different Species and the Environment; Big Idea 4—Sustainability

Students shall be able to:

1. Analyze how when humans use natural resources, they alter natural systems. (DOK 4)
2. Explain the concept of the tragedy of the commons. (DOK 3)
3. Assess the effect of clearcutting on forests. (DOK 3)
4. Describe changes in agricultural practices. (DOK 2)
5. Compare agricultural practices that cause environmental damage. (DOK 3)
6. Describe different methods of irrigation. (DOK 2)
7. Compare the benefits and drawbacks of different methods of irrigation. (DOK 3)
8. Compare the benefits and drawbacks of different methods of pest control. (DOK 3)
9. Identify different methods of meat production. (DOK 1)
10. Compare the benefits and drawbacks of different methods of meat production. (DOK 3)
11. SKILL—Describe the potential responses or approaches to environmental problems. (DOK 2)
12. Explain causes of and problems related to overfishing. (DOK 3)
13. Describe natural resource extraction through mining. (DOK 2)
14. Summarize ecological and economic impacts of natural resource extraction through mining. (DOK 2)
15. Describe the effects of urbanization on the environment. (DOK 2)
16. Explain the variables measured in an ecological footprint. (DOK 3)

17. Analyze how Humans can mitigate their impact on land and water resources through sustainable use. (DOK 4)
18. Explain the concept of sustainability. (DOK 3)
19. Describe methods for mitigating problems related to urban runoff. (DOK 2)
20. Describe integrated pest management. (DOK 2)
21. Compare the benefits and drawbacks of integrated pest management (IPM). (DOK 3)
22. Describe sustainable agricultural and food production practices. (DOK 2)
23. Compare the benefits and drawbacks of aquaculture. (DOK 3)
24. Describe methods for mitigating human impact on forests. (DOK 2)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 5.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. Forest Ecosystem Management and Fire
    b. Plant-based Protein
    c. Deforestation Simulation
    d. Food / Agriculture documentaries (TED Talks, Dirt, The Biggest Little Farm, Empty Oceans)
    e. Human Footprint
    f. Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Soil Salinization Lab
    b. Mining Lab
    c. Experimental Design Lab—Climate change and Urban Design
    d. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 5 reflection questions.
5. Unit 5 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 5.
7. Practice FRQ questions for Unit 5.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion

        - Math Practice
        - Quizzes
        - Homework Worksheets / Reflection Questions / Writing Assignments
        - AP Free Response Questions
        - AP Multiple Choice Questions
        - Projects
        - Lab questions and reports

    - **Summative:**
        - Quizzes
        - Unit Exam
        - Formal Laboratory Reports

Unit 6: Energy Resources and Consumption **Time: 16-18 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.2.12.A; 4.2.12.B; 4.2.12.C; 4.6.12.C; 4.8.12.A; 4.8.12.B

3.3.12.A2; 3.4.12.B1; 3.4.12.E3

Anchors: Biology Keystone Anchors
None

Eligible Content:
None

(Unit 6 corresponds with textbook Chapter 9 Module 27; Chapter 12 Modules 34-36; Chapter 13 Modules 37-40.)

Objectives: Big Idea 1—Energy Transfer

Students shall be able to:

1. Analyze how humans use energy from a variety of sources, resulting in positive and negative consequences. (DOK 4)
2. Identify differences between nonrenewable and renewable energy sources. (DOK 1)
3. Describe trends in energy consumption. (DOK 2)
4. Compare types of fuels and their uses (DOK 3)
5. Investigate where natural energy resources occur. (DOK 3)
6. Compare the use and methods of fossil fuels in power generation. (DOK 3)
7. Investigate the effects of fossil fuels on the environment. (DOK 3)
8. Describe the use of nuclear energy in power generation. (DOK 2)
9. Investigate the effects of the use of nuclear energy on the environment. (DOK 3)
10. Describe the effects of the use of biomass in power generation on the environment. (DOK 2)
11. Describe the use of solar energy in power generation. (DOK 2)
12. Investigate the effects of the use of solar energy in power generation on the environment. (DOK 3)
13. Describe the use of hydroelectricity in power generation. (DOK 2)
14. Investigate the effects of the use of hydroelectricity in power generation on the environment. (DOK 3)
15. Describe the use of geothermal energy in power generation. (DOK 2)
16. Analyze the effects of the use of geothermal energy in power generation on the environment. (DOK 4)
17. Describe the use of hydrogen fuel cells in power generation. (DOK 2)

18. Analyze the effects of the use of hydrogen fuel cells in power generation on the environment. (DOK 4)
19. Describe the use of wind energy in power generation. (DOK 2)
20. Explain the effects of the use of wind energy in power generation on the environment. (DOK 3)
21. Analyze methods for conserving energy. (DOK 4)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 6.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. Electric Vehicles
    b. Where does Pennsylvania's energy come from?
    c. Nuclear Energy Myths
    d. Bird Deaths and Wind Power
    e. Virtual Energy Activity
    f. NOVA-Power Surge
    g. NOVA-Saved by the Sun
    h. Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Kill-A-Watt Lab
    b. Carbon Footprint
    c. Design Challenge—Renewable Energy
    d. Biofuels
    e. Energy Math Interpretation
    f. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 6 reflection questions.
5. Unit 6 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 6.
7. Practice FRQ questions for Unit 6.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice

- Quizzes
- Homework Worksheets / Reflection Questions / Writing Assignments
- AP Free Response Questions
- AP Multiple Choice Questions
- Projects
- Lab questions and reports

- **Summative:**
  - Quizzes
  - Unit Exam
  - Formal Laboratory Reports

Unit 7: Atmospheric Pollution **Time: 11-13 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.3.12.A; 4.3.12.B; 4.3.12.C; 4.7.12.B; 4.8.12.A; 4.8.12.B; 4.9.12.A

3.3.12.A; 3.4.12.B1; 3.4.12.E3

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4

(Unit 7 corresponds with textbook Chapter 12 Module 35; Chapter 14 Module 14; Chapter 15 Modules 46-50.)

Objectives:

Students shall be able to:

1. Explain how human activities have physical, chemical, and biological consequences for the atmosphere. (DOK 3)
2. Compare the sources and effects of air pollutants. (DOK 3)
3. Explain the causes and effects of photochemical smog and methods to reduce it. (DOK 3)
4. Describe thermal inversion and its relationship with pollution. (DOK 2)
5. Describe natural sources of CO2 and particulates. (DOK 2)
6. Investigate indoor air pollutants. (DOK 3)
7. Describe the effects of indoor air pollutants. (DOK 2)
8. Explain how air pollutants can be reduced at the source. (DOK 3)
9. Describe acid deposition. (DOK 2)
10. Investigate the effects of acid deposition on the environment. (DOK 3)
11. Describe human activities that result in noise pollution and its effects. (DOK 2)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 7.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. Current Air Pollution Levels

b. Air Pollution and China
c. VOCs in your life
d. Air Quality Index
e. TED-ED-Smog
f. Pollution Murder Mysteries
g. Other case studies, video examples, and online simulations that fit within the curricular topics.

3. Potential Lab Activities:
    a. Indoor Air Pollution Survey
    b. Particulate Lab
    c. Noise Pollution Experimental Design Lab
    d. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 7 reflection questions.
5. Unit 7 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 7.
7. Practice FRQ questions for Unit 7.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions
    - Projects
    - Lab questions and reports

- **Summative:**
    - Quizzes
    - Unit Exam
    - Formal Laboratory Reports

Unit 8: Aquatic and Terrestrial Pollution **Time: 20-24 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.1.12.C; 4.2.12.D; 4.3.12.A; 4.3.12.B; 4.3.12.C; 4.6.12.C; 4.7.12.B; 4.8.12.A; 4.8.12.B; 4.8.12.C; 4.9.12.A

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4

(Unit 8 corresponds with textbook Chapter 4 Module 13; Chapter 8 Module 25; Chapter 14 Modules 41-44; Chapter 15 Modules 46-47; Chapter 16 Modules 51-55; Chapter 17 Module 56-57; Chapter 18 Module 60; Chapter 19 Module 64.)

Objectives:

Students shall be able to:

1. Analyze how human activities, including the use of resources, have physical, chemical, and biological consequences for ecosystems. (DOK 4)
2. Identify differences between point and nonpoint sources of pollution. (DOK 1)
3. Describe the impacts of human activities on aquatic ecosystems. (DOK 2)
4. Describe endocrine disruptors. (DOK 2)
5. Investigate the effects of endocrine disruptors on ecosystems. (DOK 3)
6. Describe the impacts of human activity on wetlands and mangroves. (DOK 2)
7. Explain the environmental effects of excessive use of fertilizers and detergents on aquatic ecosystems. (DOK 3)
8. Describe the effects of thermal pollution on aquatic ecosystems. (DOK 2)
9. Investigate the effect of persistent organic pollutants (POPs) on ecosystems. (DOK 3)
10. Describe bioaccumulation and biomagnification. (DOK 2)
11. Describe the effects of bioaccumulation and biomagnification. (DOK 2)
12. Describe solid waste disposal methods. (DOK 2)
13. Describe the effects of solid waste disposal methods. (DOK 2)
14. Describe changes to current practices that could reduce the amount of generated waste and their associated benefits and drawbacks. (DOK 2)
15. Examine best practices in sewage treatment. (DOK 3)
16. Analyze how pollutants can have both direct and indirect impacts on the health of organisms, including humans. (DOK 4)
17. Calculate and interpret lethal dose 50% (LD_{50}). (DOK 4)

18. Evaluate dose response curves. (DOK 4)
19. Identify sources of human health issues that are linked to pollution. (DOK 1)
20. Explain human pathogens and their cycling through the environment. (DOK 3)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 8.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)
    a. Flint Water Case Study
    b. Great Pacific Garbage Patch
    c. Oil Spills
    d. Tire Pollution
    e. Food Choice
    a. Pandemics Other case studies, video examples, and online simulations that fit within the curricular topics.
3. Potential Lab Activities:
    a. Biomagnification Lab
    b. LD_{50} and Dose Response Curve Lab
    c. Toxins Lab
    d. Experimental Design—Landfills
    e. Water Quality Testing
    f. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 8 reflection questions.
5. Unit 8 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 8.
7. Practice FRQ questions for Unit 8.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions

        - Projects
        - Lab questions and reports

    - **Summative:**
        - Quizzes
        - Unit Exam
        - Formal Laboratory Reports

Unit 9. Global Change **Time: 19-22 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.6.12.A; 4.6.1.C; 4.7.12.A; 4.7.12.B; 4.7.12.C; 4.8.12.A; 4.9.12.A

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4; BIO.B.4.2.5

(Unit 9 corresponds with textbook Chapter 1 module 2; Chapter 3 Module 7; Chapter 4 Module 11; Chapter 10 Module 30; Chapter 12 Module 35; Chapter 13 Module 38; Chapter 15 Module 46 & 49; Chapter 18 Module 59-61; Chapter 19 Module 62-64.)

Objectives:

Students shall be able to:

1. Analyze how local and regional human activities can have impacts at the global level. (DOK 4)
2. Explain the importance of stratospheric ozone to life on Earth. (DOK 3)
3. Describe chemicals used to substitute for chlorofluorocarbons (CFCs). (DOK 2)
4. Identify the greenhouse gases. (DOK 1)
5. Examine the sources and potency of the greenhouse gases. (DOK 3)
6. Investigate the threats to human health and the environment posed by an increase in greenhouse gases. (DOK 3)
7. Explain how changes in climate, both short- and long term, impact ecosystems. (DOK 3)
8. Explain the causes and effects of ocean warming. (DOK 3)
9. Explain the causes and effects of ocean acidification. (DOK 3)
10. Analyze how the health of a species is closely tied to its ecosystem, and minor environmental changes can have a large impact. (DOK 4)
11. Explain the environmental problems associated with invasive species and strategies to control them. (DOK 3)
12. Explain how species become endangered and strategies to combat the problem. (DOK 3)
13. Explain how human activities affect biodiversity and strategies to combat the problem. (DOK 3)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Direct instruction using presentations, lecture, guided notes, video examples and diagrams for Unit 9.
2. Ecosystem case studies, video examples, and online simulations. (Current events and potential list)

a. NOVA-Power Surge
b. NOVA-Wild Ways
c. Cane Toads
d. Polar Lab
e. Virtual Ocean Acidification Simulation
f. HHMI Interactive Activities
g. Endangered Species Current Events
h. Other case studies, video examples, and online simulations that fit within the curricular topics.

3. Potential Lab Activities:
    a. Ozone Depletion Mapping
    b. Global Temperature Change Investigation
    c. NSTA Data Analysis—Global Change
    d. Ocean Acidification Lab
    e. Experimental Design—Cities and Climate Change
    f. Other laboratory studies and activities that meet curricular standards with the College Board CED
4. Unit 9 reflection questions.
5. Unit 9 skills and math practice questions.
6. AP Classroom Progress Checks for Unit 9.
7. Practice FRQ questions for Unit 9.

Assessments:

- **Diagnostic:**
    - Teacher Observation
    - Informal questioning
    - Pre-lab questions
    - Discussion

- **Formative:**
    - Teacher Observation
    - Discussion
    - Math Practice
    - Quizzes
    - Homework Worksheets / Reflection Questions / Writing Assignments
    - AP Free Response Questions
    - AP Multiple Choice Questions
    - Projects
    - Lab questions and reports

- **Summative:**
    - Quizzes
    - Unit Exam
    - Formal Laboratory Reports

Unit 10: Research and Sustainability **Time: 20-25 days**

Standards:
PA-Academic Standards: Environmental and Ecology
PA-Academic Standards: Science and Technology and Engineering Education
PACCS Reading and Writing for Science and Technology

4.8.12.A; 4.8.12.B; 4.8.12.C; 4.8.12.D

3.4.12.B

Anchors: Biology Keystone Anchors
BIO.B.4.2

Eligible Content:
BIO.B.4.2.4; BIO.B.4.2.5

Objectives:

Students shall be able to:

1. Summarize and compare the environmental topics covered in the course. (DOK 2)
2. Apply concepts learned in the course to prepare for the AP exam. (DOK 4)
3. Analyze major approaches to environmental policy. (DOK 4)
4. Connect the concepts of sustainability and sustainable development. (DOK 4)
5. Apply course knowledge to environmental sustainability and field research opportunities on campus. (DOK 3)

Core Activities and Corresponding Instructional Methods (include, but are not limited to):

1. Review for AP Environmental Science Exam.
    a. Practice exams
        i. Multiple choice
        ii. Free Response
    b. Diagnostic reviews
    c. Math practice
    d. Other review resources
2. Campus field research and laboratory opportunities
3. Other case studies, video examples, and online simulations that fit within the curricular topics.
4. Other laboratory studies and activities that meet curricular standards with the College Board CED
5. Sustainability projects

Assessments:

- **Diagnostic:**

        - Teacher Observation
        - Informal questioning
        - Discussion

    - **Formative:**
        - Teacher Observation
        - Discussion
        - Projects
        - Lab questions and reports

    - **Summative:**
        - Research Projects
        - Campus Field Research Laboratory Reports

Checklist to Complete and Submit:

(Scan and email)

_____ **Copy of the curriculum using the template entitled "Planned Instruction," available on the district website.**

_____ **The primary textbook form(s).**

_____ **The appropriate payment form, in compliance with the maximum curriculum writing hours noted on the first page of this document.**

Each principal and/or department chair has a schedule of First and Second Readers/Reviewers. Each Reader/Reviewer must sign & date below.

First Reader/Reviewer Printed Name_____
First Reader/Reviewer Signature_____ Date_____

Second Reader/Reviewer Printed Name_____
Second Reader/Reviewer Signature _____ Date_____

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