**Maynard Jackson High School**

**AP Environmental Science**

**Project Based Learning Fall 2021**

**Course Expectations and Syllabus**

**Instructor: Andrea Stephens**

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**Google classroom codes:**

**All class resources to include ppts, lectures, activities, and videos will be on the google classroom. Students will submit all completed assignments to the google classroom on or before the assigned due date.**

# Textbook: Digital version on the class website:

# G. Tyler Miller, Living in the Environment, Brooks/Cole Thompson Learning, 15th ed.

# Environmental Science Overview

AP® Environmental Science differs significantly from the usual high school course with respect to the kind of textbook used, range and depth of topics covered, the kind of laboratory work done, and the time and effort required of students. The nine themes, which provide a foundation for the structure of the AP® Environmental Science **(APES)** course are:

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| **Introduction to Course-**  **Project 0** | **1 week** | **Aug 5-13** | **Sustainability** |
| **Project 1** | **5 weeks** | **August 16-Sept 20** | **Ecological Footprint** |
| **Project 2** | **6 weeks** | **Sept 21-October 25** | **My Community Ecology** |
| **Project 3** | **7 weeks** | **October 26-December 7** | **Food Systems** |
| **Project 4** | **6 weeks** | **January 4-February 8** | **Oceans in Actions** |
| **Project 5** | **6 weeks** | **February 9-March 16** | **Global Climate Summit** |
| **Project 6** | **1 week** | **March 16-25** | **Closure** |
| **APES Exam Review** | **1 month** | **March 26-** | **APEs Review-Test date TBD** |
|  |  |  |  |
|  |  | **Dates are subject to pace and flow of class; not set in stone.** |  |

**Goals for the Class:**

1. Students will have an understanding of the interrelationship of all systems on Earth and the impacts of human activities.
2. Prepare students for the AP Exam in May 2021.
3. Students will be college ready.

**Class Materials: Computer for online distant learning.** Each student will be required to keep a notebook, three-ring binder with pockets is preferable, as well as a lab book/journal. C***alculators are allowed on the AP Exam in May.***

**Assignment Due Dates:** All assignments are due on the date communicated by the instructor. ***Late Assignments are not accepted***. I will always give you several days and a weekend to complete assignments. It will not help you succeed in college or career. If there are circumstances beyond your control let me know prior to the due date. This is on an individual case by case basis.

**Unit Packet Assignments:** For each unit, students will be required to print the unit packet and complete the assignments per the google classroom schedule.

**Chapter Vocabulary:** Students will learn approximately 700 vocabulary words related to Environmental Science. Vocabulary is very important to fully understand science. Students are encouraged to make their own flash cards.

**Quizzes(Formative assessments):** There will be quizzes on a regular basis. The quizzes will focus on vocabulary, ppts, lectures and activities for the week. These will take approximately 10-15 minutes of class.

**Unit Exams(Summative assessments):** Exams are a combination of multiple choice questions and one extended response/essay. Assessments will be done digitally using the AP College Board APES classroom.

**Labs / Activities:** Some activities will be relatively short, while others will last for the week. Each activity has different point values based on the length and complexity of the activity. A detailed lab report will be completed following the Populations unit.

# Review for APES exam May 2021 (dates TBD)

# Distance Learning Daily Expectations:

**Be Responsible**

* Be Prepared: Come to class with your supplies and ready to WORK- put in real EFFORT
* Come in to get help from me or your classmates when you need it.
* Do your own work on all assignments. If you copy neither of you will get credit.

**Be Respectful**

* Practice Kindness: Speak kindly to one another ALWAYS
* Everyone in this class is important and will be treated as such
* Use the resources available and electronics appropriately

**Be Reliable**

* Be punctual to class and turn work in ON TIME
* Please participate in class activities and meeting times.
* Work with your virtual group and do work in class

**Academic Integrity:** Cheating (copying someone else’s work or letting someone else copy yours) and plagiarism (copying someone else’s words or ideas and passing them off as your own) are serious offenses, and will result in a zero for that given assignment. If you are unclear about what constitutes cheating or whether a particular behavior is acceptable, please ask.

# Atlanta Public Schools Grading Scale

# A 90-100 B 80-89 C 70-39 F 0-69

# Student will receive an additional 10 pts to their grade; as long as they maintain a 70 or better average.

# Grade Distribution

# Your grade for each nine-week grading period will be determined using this percentages:

# Summative assessments/Projects: 50%

# Formative(Quizzes/FRQs) assessments: 20%

# Class work/Homework: 30%

# \* There will be multiple choice questions on each test, but most of each will ask you to describe or identify something through short answers and FRQ essays. You’ll need to know the material well — rather than simply being able to recognize it from a range of choices. When studying material, be sure to consider the significance and interrelatedness of content.

j0293240

***Student Information***

***AP Environmental Science***

Please sign this paper below and return it to Ms. Stephens as soon as possible.

You will be given class credit for turning this tomorrow. Start the semester off right, and turn this in!

Student name (please print):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Address:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Home Phone: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_e-mail: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Parent/Guardian Contact Information:*

Guardian #1 Name (please print):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Phone (and best times to call):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

E-mail:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Parent/Guardian Contact Information:

Guardian #2 Name (please print):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Phone (and best times to call):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

E-mail:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sign below and Return to the Instructor:

For parents: I have read and understand the class expectations for this course. I understand that my student is responsible for monitoring grades and informing me of his or her progress in this class. I also know that students will receive printed progress reports approximately once a month, and that grades can be checked online (https://ims.everett.k12.wa.us/)

*Parent Signature*: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *Date:­*­­­­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For students: I have read and understand the class expectations for this course. I understand that my grade is my responsibility, and that it is up to me to monitor and inform my parents/guardians of my progress.

*Student Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:­*­­­­­­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Is there anything you would like me to know about you/your student?**

*Please read and sign lab safety contract on reverse side.*

**General Rules:**

**Lab Safety Contract**

1. Conduct yourself in a responsible manner at all times.
2. You will not be admitted to the lab unless you have completed the required pre-lab. You will receive a mark of “0” for any missed labs due to lack of preparation.
3. Follow all written and verbal instructions carefully. If you do not understand, ask.
4. Your instructor must be present at all times during the lab.
5. Perform only those experiments authorized by the instructor.
6. There is no horseplay, or any type of practical jokes or pranks allowed in the lab, they are dangerous, to you and to everyone.
7. Safety glasses *or* chemical safety goggles and lab aprons are required, as indicated by your instructor, any time chemicals, heat or glassware is used. There are **no** exceptions to this rule.
8. Contact lenses should not be worn in the lab.
9. Dress appropriately: No loose or bulky clothing, jackets, skirts, shorts, dresses, sandals or open-toed shoes are allowed. All long hair must be tied back, and long bangs clipped back. Dangling jewellery, rings and watches should not be worn.
10. Carry out experiments with care and caution. Be aware of your surroundings, observe good housekeeping practices, and keep aisles clear.
11. Never leave experiments unattended. Do not wander the room, distract others, or interfere with the laboratory experiments of others.
12. Be aware of emergency equipment locations, and operating procedures.
13. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments.
14. Do not sit or lean on laboratory tables or counters, as corrosive residue or glass fragments may be present.
15. Know what to do if there is a fire drill during a lab period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
16. No food or beverages are allowed in the lab, or at the lab stations.
17. Dispose of all chemical waste as instructed. Check waste container labels twice before adding your chemical waste to the container.
18. NEVER return unused chemicals to their original container.
19. Acids and bases must be handled with extreme caution. You will be shown the proper method for diluting strong acids. Always **ADD ACID** to water, swirl or stir the solution and be careful of the heat produced, especially with sulphuric acid.
20. Handle all living organisms or preserved biological specimens in a humane manner, and with respect. Dispose of specimens properly, as instructed.
21. When using knives or sharp instruments, always carry the tips and points pointing down and away. Always cut away from your body. Grasp sharp instruments only by the handles, and never try to catch a falling sharp instrument.
22. If you notice any damaged or missing parts to school equipment, inform your instructor immediately otherwise you may be held responsible. Report damaged electrical equipment immediately, do not use it.
23. ALL chemicals, equipment, supplies, and specimens must remain in the lab. Any removal of laboratory items from the lab will result in disciplinary action.
24. REMAIN CALM and REPORT any accident IMMEDIATELY, no matter how minor.

**AGREEMENT:**

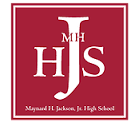
I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, (student’s name) have read and agree to follow all of the safety rules set forth in this contract. I realize that I must obey these rules to ensure my own safety, and the safety of all others in the lab. I will come prepared, follow instructions closely and carefully, and contribute to maintaining a safe environment for everyone to work in. I am aware that any violation of this safety contract or misbehavior on my part may result in being removed from the laboratory setting. I understand discussion about my behavior will take place after the lab has been completed. Any disciplinary consequences are dependent on the severity and/or frequency of my misbehavior.

Student Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_

We feel that parents/guardians need to be informed regarding our effort to maintain a safe science classroom/laboratory environment. Your signature indicates that you have read this contract, are aware of the measures taken to ensure the safety of everyone in the lab, and have discussed the importance of lab safety with your son/daughter.

Parent/Guardian Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_

APES Project Based Learning Crosscutting Curriculum 2021-22



AP Environmental Science Syllabus Project Based Learning-Stephens 2021-22

Course Description

This AP Environmental Science class is intended to meet the same objectives as a first-year college-based course. However, the method of instruction for this course is unique compared to similar courses because we have adopted a project-based learning (PBL) approach. Although PBL may take many forms, our approach involves student investigations and simulations that require students to *think* like scientists, policymakers, farmers, and other adults in real-world settings. Teachers engage students in collaborative problem solving, argumentation, and deep exploration of the concepts and principles of the discipline. The goal for student learning is understanding rather than relying on rote memory to create meaningful learning and knowledge that is **actionable**, **adaptive**,and **transferable**.

Students work collaboratively and individually on tasks and products that are designed to help them succeed at complex, authentic challenges. They alternate between two types of learning: “learning to act” and “acting to learn.” “Learning to act” is a more traditional mode of learning that is done through textbooks and lectures. In contrast, “acting to learn” engages students in projects with real-world goals. This is their opportunity to apply their understanding of topics and grapple with the implications of human actions and responses.

Because challenges in the real world of environmental science rarely draw upon only one topic or short list of objectives, the challenges in this course require students to draw from a broader knowledge base. This gives students the opportunity to learn about the same objectives multiple times during the course through different contexts and perspectives. Our ultimate goal is for students to gain a deeper understanding of these objectives than they would through a more traditional lecture-based course.

Scientific Principles

In addition to addressing the content-based objectives outlined by the College Board, this course will also address several skill-based objectives. Most projects will include supporting activities and a scientific investigation in which students will develop and refine the following skills:

* Students will learn how to design, conduct, and refine scientific investigations using the scientific method.
* Students will learn how to think critically and logically to analyze and interpret experimental data, and revise and reflect on scientific explanations and models using logic and evidence.
* Students will learn how to communicate and defend scientific arguments, explanations, and procedures through oral, written, and visual methods.
* Students will understand and be able to communicate the larger implications and connections behind their explanations and conclusions.
* Students will learn how to identify and communicate sources of unavoidable experimental error and levels of uncertainty about data and explanations.

Course Prerequisites and Requirements

We strongly recommend that students have successfully completed 1 year of biology, 1 year of chemistry, and Algebra 2 before taking this AP Environmental Science course.

Textbook and Readings

The following three commonly used textbooks will support learning in this course:

* Miller, G. Tyler and Scott E. Spoolman. *Living in the Environment: Principles, Connections, and Solutions*. 16thEdition. Belmont, CA: Brooks/Cole, 2010.

We will also use additional reading resources, including newspaper and magazine articles and other online resources.

Assessments

Students will have periodic quizzes and a culminating exam at the end of every project except for Project 5: Global Climate Summit, and Project 6: Course Closure. These assessments will include both free-response and multiple-choice questions. They will also complete multiple performance-based assessments in each project that may take the form of debates, negotiations, oral presentations, and presentations of authentic products (e.g., books, pamphlets, etc.), among others.

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| **Project 0: Course Introduction** | |
| **Project Description** | In this project, students use scientific reasoning to determine what happened on Easter Island that led to the collapse of the ecosystem. They practice evaluating hypotheses, creating arguments, and using evidence to explain the concept of the tragedy of the commons, and they apply a model of sustainability to modern-day environmental issues. |
| **Duration** | 1 week |
| **Topics Covered** | ***Impacts of Population Growth:*** Resource use, habitat destruction  ***Population:*** Human population |
| **Labs and Activities** | **Tragedy of the Commons Lab**  Students do a simulated lab of the tragedy of the commons and then brainstorm and evaluate modern-day examples of the tragedy of the commons. |
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| **Additional Resources** | Diamond, J. M.. *Collapse: How societies choose to fail or succeed.* NY, NY: Penguin Books, 2011. |

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| **Project 1: Ecological Footprint** | |
| **Project Description** | In this project, students evaluate their individual resource usage and analyze their impact on the environment. They calculate their family’s ecological footprint (EF) to get a sense of how their choices impact the environment. They delve deeper into some of the components of their family’s overall EF by investigating the impacts of their family's home energy use, water use, transportation habits, and waste generation. Each student decides which component would minimize their family's EF with specific behavioral changes. Students then develop a persuasive oral presentation for their family to explain their motivation for making a change, what kind of behavioral changes need to be made, and what the potential impacts will be. Students also conduct a life cycle analysis (LCA) on commonly used products at home or at school to begin to understand how to use systems thinking as an analytical tool for making sound environmental decisions. Throughout the project, students learn content related to hazardous waste disposal, mineral and fossil-fuel formation, and extraction techniques, including hazardous waste disposal, and mineral and fossil-fuel formation and extraction techniques. Learning goals in this project focus on collection and analysis of data through audits, the proper use and conversion of units, and supporting claims with evidence. |
| **Duration** | 5 weeks |
| **Topics Covered** | ***Earth Systems and Resources:*** Global Water Resources and Use: Industrial and domestic use, conservation; Soil and Soil Dynamics: Rock cycle  ***Land and Water Use:*** Mining; Global Economics: The Tragedy of the Commons  ***Energy Resources and Consumption:*** Energy Concepts:Units, conversions; Fossil Fuel Resources and Use; Energy Conservation: Efficiency  ***Pollution:***Pollution Types: Solid waste disposal (types, disposal, reduction); Impacts on the Environment and Human Health: Hazardous Chemicals in the Environment (types of hazardous waste, disposal, and hazardous chemicals in the environment, relevant laws); Economic Impacts: cost–benefit analysis |
| **Labs and Activities** | **Ecological Footprint Calculation**  Students gather data on their lifestyle and consumption patterns to input into a computer program to calculate their EF (in global acres of land required to support their lifestyle). Students will analyze the results and identify solutions.  **Home Energy and Water Audit Lab**  Students conduct a water and electricity audit for their family. They use these data to calculate their water and electricity use for 1 year; investigate the economic, environmental, and social/cultural implications of these results; and propose a more sustainable alternative.  **Waste Audit Lab**  Students collect their trash (or their classroom’s trash) for 1 day, measure the total amount, and extrapolate how much waste is produced in 1 year. They identify environmental and human health problems associated with waste production and develop resolutions to minimize the environmental impact of waste.  **Transportation Audit Lab**  Students conduct a transportation audit for all members of their family for 1 week. Students calculate fuel economy of the family’s vehicles or other transportation methods and then determine the amount of fuel consumed in 1 year. Additionally, students calculate fuel consumed for air travel. Ultimately, students investigate the economic, environmental, and social/cultural implications of these habits and propose a more sustainable alternative.  **Family Proposal**  Students analyze the information gathered from their goods, waste, transportation, water, and energy audits and determine a key area that will have an impact on reducing their family’s EF. Students develop a persuasive proposal to encourage their families to adopt lifestyle changes and determine methods to quantify their success.  **Life Cycle Analysis**  Students conduct an LCA on a specific product, investigate the sources of raw materials and their environmental impacts, and their disposal practices and environmental impacts. They use the information from the LCA to inform their family proposal. Students then display the LCA on a poster that can be shared with students at their school. |
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| **Additional Resources** | **Field Trips**  Landfill and recycling center, water treatment facility  **Books**  Reeske, Mike and Ireton, Shirley Watt. *Lifecycle of Everyday Stuff.* Natl Science Teachers Assn, 2001.  Ryan, John C. and Durning, Alan Thien. *Story of Stuff: The Secret Lives of Everyday Things.* Sightline Inst, 1997.  **Films**  Gabbert, Laura (Dir.) and Schein, Justin (Dir.). *No Impact Man*. Eden Wurmfeld Films, 2009.  Haney, Bill (Dir.). *The Last Mountain*. Dada Films, 2011.  *Big Ideas for a Small Planet (TV Series).* Sundance Channel, 2007.  Gold, Daniel B. (Dir.) and Helfand, Judith (Dir.). *Blue Vinyl*. HBO, 2002.  Walker, Lucy (Dir.), Jardim, João (Dir.) and Harley, Karen (Dir.). *Wasteland*. O2 Filmes, 2010. |

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| **Project 2: My Community Ecology** | |
| **Project Description** | In this project, students learn about basic ecology and urban and rural land management by analyzing the site of a proposed development (e.g., planned housing, road creation, etc.) and creating a plan for sustainable development of the site’s natural resources. To create a realistic, informed plan, students learn the basics of ecology through lab activities, guest speakers, conducting research on local ecosystems, and participating in local field trips. |
| **Duration** | 6 Weeks |
| **Topics Covered** | ***The Living World:*** Ecosystem structure; Energy Flow; Ecosystem Diversity; Natural Ecosystem Change; Natural Biogeochemical Cycles  ***Population:*** Population biology concepts; Human Population  ***Land and Water Use:*** Other Land Use (urban land development, public and federal land, sustainable land-use strategies)  ***Pollution:*** Air pollution: water pollution; Economic Impacts: cost–benefit analysis, sustainability  ***Global Change*:** Loss of Biodiversity |
| **Labs and Activities** | **What Does Our Community Look Like Now?**  To make connections to the previous project (Ecological Footprint), students analyze their community as a system, making inferences about its components. Students then create and analyze graphs of population growth curves to understand exponential growth and limiting factors.  **Field Trips to Proposed Development Site/Biological and Ecosystem Services Maps**  Students create a biomap of the proposed development site during a field trip to understand the ecology of the site. On the second trip, students collect data to produce an ecosystem services map of the area. These data will inform the impact report and sustainable development proposal.  **Mark–Recapture Lab**  Students participate in a lab that simulates a population census technique commonly used by ecologists in the field by collecting a random sample of “animals” of a desired species, marking them, and releasing them. They sample once again and calculate a population estimate using a simple ratio.  **Water Quality Testing**  Students use water quality test kits to determine the quality of a local body of water. Students identify and analyze environmental problems, determine possible resolutions to the problems, and think about how the problems could have been prevented.  **Measuring an Ecosystem’s Components and Processes**  Students complete readings and class discussions on federal land use, protected lands, biomes, ecosystem services, and population ecology; and look at Yellowstone as a case study. Students also learn methods for measuring populations, population diversity, and water quality. They visit the development site to collect data and create a map of ecosystem services. There is also a practice free-response question that can be used at the end of this task.  **Impacts of Human Development**  Students read about and discuss urbanization and development. They use the data they collected from the site and their research to create an impact report for the planned development.  **Sustainable Alternatives**  Students read and discuss sustainable development. They work in groups to propose sustainable alternatives to the proposed development site and then present these ideas to the class. |
| **Additional Resources** | **Recommended Guest Speakers**  Ecology professor, restoration ecologist, community resource manager, urban planner |

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| **Project 3: Food Systems** | |
| **Project Description** | Students take on the role of farmers in this project and design and redesign a farm to meet an evolving set of constraints, including economic, environmental, and social/cultural factors. Students begin by designing a farm given basic information on soil and climate. They refine or revise it when asked to also manage potential pests for the particular crops they've chosen. To increase the complexity, they are randomly assigned a client to whom they must sell their crops. Each client has their own set of requirements for the crops or meat they will buy, so students may have to revise their farm to ensure they can make a living by selling to their particular client. They are asked to think about irrigation and water issues when they find out that a river runs through or near their land. Finally, they are asked to consider how economic issues such as farm subsidies and food safety and security laws may impact their farm. By the end of the project, students have a working farm that meets a complex set of real-world constraints. |
| **Duration** | 7 weeks |
| **Topics Covered** | ***Earth Systems and Resources:*** Global Water Resources and Use: agricultural, industrial, and domestic use, surface and groundwater issues, global water problems, water conservation; Soil and Soil Dynamics  ***The Living World:***Ecosystem Structure: biological populations and communities, interactions among species; Energy Flow: photosynthesis and cellular respiration, food webs and trophic levels, ecological pyramids; Ecosystem Diversity; Natural Biogeochemical Cycles  ***Population:*** Population Biology Concepts: population ecology  ***Land and Water Use:*** Agriculture; Rangelands; Other Land Use: sustainable land use strategies; Global Economics: tragedy of the commons  ***Energy Resources and Consumption:*** Renewable energy (biofuels)  ***Global Change:*** Loss of Biodiversity |
| **Labs and Activities** | **Exploring My Foodshed**  Students investigate the origin of commonly eaten food items in their home and calculate the fuel used to transport those foods. Students look at the sustainability of two apples: one organic and one not. They think about the sustainability of their food choices.  **Crop Selection and Soil Quality Lab**  Student groups choose crops for their farm and research growing requirements for these crops. Students analyze the soil quality of a soil sample and learn about soil properties and how to maintain soil fertility. Finally, they apply this information to their crop selection and revise if necessary.  **Pest Invasion**  Students learn about pest management strategies including organic, chemical, and genetically modified organisms. Students revise their original farm design to include a pest management plan given information about native and non-native pests. They are required to consider the environmental and human health advantages and disadvantages of their pest management plan.  **Soil Salinization Lab Analysis**  Students design and conduct a wet lab investigating the impacts of irrigation on soil salinity and the impacts of salinity on seed germination. They learn methods for analyzing and interpreting the experimental data and suggest alternatives to minimize impacts of salinization.  **Food Production Methods Farm Revision**  Students revise their farm design to meet the demands of a specific client who is buying food from them and to ensure that they can sustain their soil resources over the long term. They evaluate the environmental advantages and disadvantages of the farming method they use and suggest more sustainable alternatives.  **Irrigation Plans Revision**  Students learn about irrigation methods and watershed concerns. Students are then shown where the water sources are located in the community and must negotiate with neighbors again to make an irrigation plan. Students present their work. This may be in the form of a gallery walk in class, a written report, a presentation to an audience, or another option of your choice. |
| **Additional Resources** | **Guest Speakers**  Farmer, scientist (to speak on pest management, soil conservation, and sustainable agriculture)  **Field Trips**  Farm or agro-ecology center  **Books**  Carson, Rachel. *Silent Spring.* London: Penguin Books, in association with Hamish Hamilton, 2015.  Pollan, Michael. *The Omnivore’s Dilemma: A Natural History of Four Meals.* NY, NY: Penguin Books, 2016.  **Films**  BBC Worldwide LTD*. The Future of Food: A Looming Crisis*. New York, NY: Films Media Group, 2010 |

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| **Project 4: Oceans in Action** | |
| **Project Description** | In this project, students take on various roles within a fictional coastal community. Students are all assigned citizen roles and each role has a set of values that students maintain while the community negotiates how to recover from its economic decline. Two different industries—aquaculture and oil drilling—have proposed to operate from the island. Students have to decide whether to bring one, both, or neither of these industries to the island, and if so, under what conditions. Students write a series of short papers from the perspective of their character that indicates how the proposed salmon farm and oil rig may impact the surrounding ocean ecosystem and their community. Students participate in small group discussions to compare and contrast their perspective to those of others in preparation for the culminating Town Council Meeting. At this final performance, students present and debate their perspective and suggest potential alternatives. After the meeting, students develop regulations, or conditions under which an aquaculture or ocean drilling industry may be established in their coastal community. |
| **Duration** | 5–6 weeks |
| **Topics Covered** | ***Earth Systems and Resources:*** Earth science concepts; The Atmosphere: weather and climate, atmospheric circulation and the Coriolis Effect, atmosphere–ocean interactions, ENSO  ***The Living World:*** Ecosystem structure; Energy Flow: food webs and trophic levels; Ecosystem Diversity; Natural Biogeochemical Cycle  ***Population:*** Population Biology Concepts  ***Land and Water Use:*** Mining; Fishing; Global Economics: tragedy of the commons  ***Energy Resources and Consumption:*** Fossil fuels Resources and Use  ***Pollution:*** Pollution Types:Water pollution; Impacts on the Environment and Human Health: hazardous chemicals in the environment; Economic Impacts  ***Global Change:*** Loss of Biodiversity |
| **Labs and Activities** | **Introduction to Island and Population**  Students are assigned citizen roles and learn about their roles and their island community. They introduce themselves and create an initial draft of their Individual Position Paper based on their citizen role’s values. Students also learn how to interpret age-structure diagrams.  **Aquaculture**  Students learn about overfishing and evaluate aquaculture as a potential solution. They debate the pros and cons of aquaculture and write a draft of their Individual Position Paper on the salmon farm proposal based on their current knowledge.  **The Tragedy of the Commons Fishing Game**  Students participate in a small-group simulation activity in which they investigate the use/overuse of common ocean resources by fishers. They then identify and develop possible solutions to the environmental problem of overfishing.  **Offshore Drilling**  Students learn about methods of offshore drilling and debate the advantages and disadvantages of oil drilling. Students also consider the effect of ocean currents and write a new draft of their Individual Position Paper on the offshore drilling proposal based on their new knowledge.  **Nitrogen Pollution in Water Lab**  Students design, conduct, and interpret a lab on cultural eutrophication in which they look at the impact of increased fertilizer concentration on algal growth in closed aquatic systems. They interpret results, identify resolutions, and evaluate the sustainability of these solutions with respect to eutrophication.  **Take a Stand and Speak Your Truth**  Students prepare for the Town Council Meeting by considering their individual position and working collaboratively with other students with a similar outlook. Students run a Town Council Meeting in which participants have the opportunity to present their Group Position Paper and make rebuttals. The goal of this activity is for students to come to a final decision for the island by coming to a consensus, by taking a vote, or by using a judge.  **Supplemental Ocean Science Topics**  Three aspects of the science regarding oceans are not taught in the context of the project—El Niño, La Niña, and upwellings. You can decide alone or with your students which of these topics you would like to investigate more. There is no way to predict what content will be on any given AP exam, so, use your best judgment and your time well at this point in the year.  **Town Council Meeting**  In this culminating activity, students participate in a Town Council Meeting to determine how their hypothetical community should react to the proposal of a salmon farm in their coastal waters. Students are required to adopt a perspective that they may or may not be familiar with prior to the start of the project and argue from that perspective. In the lead-up to this activity, as well as during the Town Council Meeting itself, students learn methods for analyzing and interpreting information. |
| **Additional Resources** | **Guest Speakers**  Fishery worker, fisher, marine ecologist, oceanographer, government official familiar with town hall–style meetings  **Book**  Earle, Sylvia. *The World is Blue.* National Geographic, 2010.  **Film**  Murray, Rupert (Dir.). *The End of the Line.* Docurama, 2009. |

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| **Project 5: Global Climate Summit** | |
| **Project Description** | This project mimics the process and atmosphere of an international environmental summit, such as that of the Conference of the Parties, that is the basis for Climate Convention Framework negotiations. Students take on specific roles as leaders of countries in the world who have all been invited to a global climate summit. Students research factors in their countries, such as population, carbon emissions, resource access, and economy. Using this information, students decide how climate change could affect their country and how their policies could help reduce greenhouse gas emissions. In the final task, students run a global climate summit in class to defend their perspective and ultimately decide who has the responsibility to reduce emissions and how to accomplish this. Throughout this project, students learn how Earth’s climate functions and how it responds to change. Additionally, they explore how societies and economies have contributed to climate change and how they can adapt to such change and prevent additional harm through international economic and legal means. (This project was modified from material written by Catherine Gautier, University of California, Santa Barbara. |
| **Duration** | 5–6 weeks |
| **Topics Covered** | ***Earth Systems and Resources:*** Earth Science Concepts: solar intensity and latitude; The Atmosphere: ocean circulation  ***The Living World:*** Ecosystem Diversity; Natural Ecosystem Change; Natural Biogeochemical Cycles: carbon cycles  ***Population:***Human population  ***Land and Water Use:*** Other Land Use: urban land development; Global Economics  ***Energy Resources and Consumption:*** Energy Consumption; Fossil Fuel Resources and Use: world reserves and global demand, environmental advantages/disadvantages of fossil fuel sources; Nuclear Energy; Hydroelectric Power; Energy Conservation; Renewable Energy  ***Pollution:*** Pollution Types: air pollution; Economic Impacts  ***Global Change****:* Stratospheric Ozone; Global Warming; Loss Of Biodiversity |
| **Labs and Activities** | **Climate Change and Project Overview**  Students learn about the format and goals of a global climate summit and review the Montreal Protocol and Kyoto Protocol examples. Students learn about climate change, are assigned a country, and apply their knowledge of climate change to assess implications for their country.  **Climate Change Dataset Analysis**  Students analyze and interpret several sets of data that may provide evidence of climate change across a variety of scientific disciplines. Students draw conclusions from the data and communicate their results to their classmates.  **Human Population**  Students learn about the influence of human population growth on climate change. Students create a poster describing their country’s population and implications for climate change.  **Energy Consumption Poster and Energy Efficiency of FuelsLab**  Students learn about energy use and how it contributes to greenhouse gas emissions. Students calculate the energy output from different fuel sources in a lab experience. Students also learn about alternative energy sources and create a poster to describe their country’s energy sources.  **Global Climate Summit**  Students create a draft protocol to reduce greenhouse gas emissions and discuss their protocol in the global climate summit, in which they negotiate on behalf of their country. |
| **Additional Resources** | **Guest Speakers**  Population demography professor, Peace Corps volunteer, climate scientist  **Books**  Kamkwamba, William and Mealer, Bryan. *The Boy Who Harnessed the Wind.* Puffin Books, 2016.  Kolbert, Elizabeth. *Field Notes From a Catastrophe.* Bloomsbury, 2006.  **Films**  “World in the Balance: The People Paradox”, *NOVA*. PBS, 2004.  “The Big Energy Gamble”, *NOVA*. PBS, 2009.  Conners, Leila (Dir.) and Conners, Nadia (Dir.). *The 11th Hour.* Appian Way Productions, 2007.  Guggenheim, Davis (Dir.). *An Inconvenient Truth*. Paramount Classics, 2006. |

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| **Project 6: Course Closure** | |
| **Project Description** | This project is a new addition to the course and serves as a “bookend” to the Course Introduction. Students will do some individual reflection on the three lenses of sustainability and some groupwork to synthesize all of the projects and driving questions. The Power of Many activity is a chance for your students to think about and co-create a local, authentic, relevant project at their school or in the community to apply what they have learned in the course and to leave with a sense of practical accomplishment as well. |
| **Duration** | 1 week |
| **Topics Covered** | *Impacts of Population Growth****:***Resource use, habitat destruction |
| **Labs and Activities** | **Power of Many**  The Power of Many activity is a chance for your students to think about and co-create a local, authentic, relevant project at their school or in the community to apply what they have learned. This project is individualized to each classroom/set of students. |