AP Biology

Ecology

Essential Question

How do human interactions affect the environment?

How do communities and ecosystems change, for better or worse, due to biological disruption?

How do species interactions affect the survival of an ecosystem?

Understandings

*Students will understand that:*

Energy is transferred from organism to organism, represented via models of food chains and food webs. Each transfer results in a loss of energy.

Energy transfers and availability limit population sizes.

Populations are controlled by demographic factors, density dependent factors and density independent factors.

Species interact with each other in different ways (symbiosis, predation, competition, coevolution).

Species diversity is essential for both ecosystem and species survival. Alteration of diversity (ex: invasive species, human activities) can drastically impact the system.

Knowledge:

*Students will know:*

Organisms use energy to maintain organization, grow and reproduce (body temperature regulation, metabolism, reproductive strategies)

Changes in energy availability can result in changes in population size and disruptions to ecosystems.

Autotrophs capture energy from physical or chemical sources in the environment (photosynthesis, chemosynthesis) whereas heterotrophs capture energy in carbon compounds made by other organisms.

Populations comprise individual organisms that interact with one another and with the environment.

Organism adaptations related to getting and using energy/matter in particular environment (population growth dynamics)

Population can produce a density of individuals that exceeds system’s resource availability. Limits to growth are due to density dependent and density dependent factors.

Structure of community is measured and described through species composition and species diversity.

Community change over time depends on population interactions. Interactions can be based on accessing matter/energy, predator/prey interactions, trophic cascades, niche portioning, symbioses, competition.

Ecosystems with less parts and little diversity are less resilient to changes in the environment. Keystone species disproportionately affect the ecosystem and when removed, the ecosystem can collapse.

Introduction of invasive species can drastically impact an ecosystem at multiple levels and ways. Uncontrolled population growth and ecosystem changes can result.

Human activities cause changes in ecosystem structure. Distribution of local/global ecosystems change over time. Human impact speeds change at local/global levels.

Skills:

*Students will be able to:*

Use population growth, exponential growth and logistic growth equations to mathematically determine changes in population.

Use Simpson’s Diversity Index to mathematically calculate species diversity.

Analyze data about species diversity and population sizes, including providing reasons for the data and predicting causes or effects of the data upon diversity or populations

Predict effects upon organisms based on interspecific interactions

Model energy transfer through model biotic systems and predict effects on levels when populations are altered

Use mathematical equations for productivity to determine energy availability for ecosystems and predict what happens when productivity is excessive

Model the biogeochemical cycles and predict effects of human activities on the cycles

Predict the effects of human activities on ecosystems.

Determine possible remediation methods to alter the human impact on the environment

Curriculum Standards - 2019 College Board Course & Exam Description

Describe the strategies organisms use to acquire and use energy.

Explain how changes in energy availability affect populations and ecosystems.

Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.

Describe factors that influence growth dynamics of populations.

Explain how the density of a population affects and is determined by resource availability in the environment.

Describe the structure of a community according to its species composition and diversity.

Explain how interactions within and among populations influence community structure.

Explain how community structure is related to energy availability in the environment.

Describe the relationship between ecosystem diversity and its resilience to changes in the environment.

Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long- term structure.

Explain the interaction between the environment and random or preexisting variations in populations.

Explain how invasive species affect ecosystem dynamics.

Describe human activities that lead to changes in ecosystem structure and/ or dynamics.

Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.

Mission Integration

Students will investigate citizen science activities and participate in at least one. They will consider how human behaviors impact the environment and what can be done to mitigate any negative effects.

Performance Task or Design Thinking Culminating Assessment

Transpiration Lab – Student designed Inquiry lab. Students presented with basic procedural process (whole plant method or potometer). Students must choose variable to research, design procedure, perform experiment/collect data, and analyze data. Students will submit a formal lab report, including materials, procedure, data, analysis and discussion using CER format.

Other Evidence (formative assessments, summative assessments)

Quizzes on each chapter

Energy Dynamics “dry lab”

Gorongosa food web activity

Bubble survivorship lab

Lynx eats the Hare graphing and analysis

Population ecology practice problems

Calculating Simpson’s Diversity Index

Case study – Isle Royale

Mastering Biology

Practice Free Response Questions

Unit Test (AP Multiple Choice and FRQs)

Neighborhood field study

Discussions about citizen science

Topic Overview

*Order of topics presented (Calendar)*

Introduction to Ecology

Population Ecology – demography, logistic/exponential growth

Species interactions – competition, exploitation, predation, symbiosis

Diversity measurements – Simpson’s diversity index

Food chains/webs + trophics

Succession

Environmental disruptions

Energy movement through ecosystems – productivity, eutrophication, 10% rule

Nutrient cycling though biogeochemical cycles – oxygen, water, nitrogen, phosphorus

Human impact upon environment – restoration ecology, extinction, endangered species, biodiversity issues, invasive species, climate change, environmental toxins

Learning Plan

*Learning Activities - What experiential or inductive learning will help students to explore the big ideas and questions to achieve desired understandings? for their expected performances?*

Transpiration Lab

Energy Dynamics “dry lab”

Gorongosa food web activity

Bubble survivorship lab

Lynx eats the Hare graphing and analysis

Population ecology practice problems

Simpson’s Diversity Index lab using

POGIL and/or case study

Practice Free Response Questions

Neighborhood Field Study

Citizen Science investigation

Resources

Biology in Focus 2nd edition text

MasteringBiology

Transpiration lab directions + lab report format

Energy Dynamics “dry lab” student handout

Gorongosa food web activity – directions, student analysis, food web cards (laminated)

Bubble survivorship lab – directions, student analysis, bubbles, Excel for graphing

Lynx eats the Hare – directions, data, Excel for graphing, analysis questions

Population ecology practice problems – student and completed versions

Free Response Questions from previous years AP Biology exams (both released and unreleased questions)

Neighborhood Field Study directions

POGIL book from Flinn OR Case Study

Calculating Simpson’s Diversity Index – directions, student analysis, Google Sheets for data recording