

Ecology Learning Framework

Topic	Learning Goals (see below for sample Learning Objectives)
Biological Diversity	What is biodiversity at the genetic, species and functional (niche) level within an area, a biome or on Earth?
	How can you explain the change of biodiversity over short and long (geological) timescales?
	What is the relationship between phenology and biodiversity?
Species/Habitat Interactions	How do species interact with their habitat?
Populations	How can populations be distinguished from one another?
	How do populations change over time?
Matter and Energy in Ecosystems	How does matter and energy move in an ecosystem?
	How do organisms mediate the movement of matter and energy through ecosystems?
	How do organisms obtain and use matter and energy to live and grow?
Interactions within Ecosystems	How are living systems interconnected and interacting?
	How do systems change over time?
Impacts of Humans on Ecosystems	What impacts do humans have on ecosystems?
	What can or do humans do to mitigate negative impacts they have on ecosystems?
Impacts of Ecosystems on Human Health and Well-being	How do humans depend on ecosystems for their health and well-being?

Topic	Learning Goals	Sample Learning Objectives
Biological Diversity	What is biodiversity at the genetic, species and functional (niche) level within an area, a biome or on Earth?	Create a morphological key to identify taxa.
		Use molecular biology techniques identify functional groups of organisms (e.g., soil, stream, human microbiome, ocean water).
		Conduct a biological inventory of a specific habitat.
		Develop and use a biotic index to show the quality of an environment.
		Predict and justify where you would find a specific species in a particular habitat.
	How can you explain the change of biodiversity over short and long (geological) timescales?	Develop an argument that there has been a change in global biodiversity over the last 100 years.
	Explain why there are multiple species of finches in the Galapagos.	
	What is the relationship between phenology and biodiversity?	Collect data and create a phenophase representation for selected species.
		Predict the implications at the local and global scale for observed changes in phenology.
Relate changes in phenology to local and/or global disturbances.		
Species/Habitat Interactions	How do species interact with their habitat?	Compare and contrast a species with a broad range and one with a narrow range.
		Give an example of an environmental gradient, and explain the changes that one would expect to see from one end of the gradient to the other.
		Explain how somebody would depict a gradient graphically.
		Give an example of an indicator species, and explain the practical benefits of knowing that information.
		Provide two explanations for that fact that most species have clumped distributions.
Populations	How can populations be distinguished from one another?	Census a population and describe it in terms of: distribution, size, density, demographics and variation in characteristics (e.g., color, size, amount of pollen, type of prey, or susceptibility to pathogens).
	How do populations change over time?	Graphically, verbally, or quantitatively describe a population

		over time.
		Identify and test a hypothesis about how a population will respond to perturbation.
		Create a model explaining how populations become better adapted to their environment.
		Design an experiment to evaluate the competing hypothesis that a population in a new habitat is under selection or experiencing acclimatization.
Matter and Energy in Ecosystems	How does matter and energy move in an ecosystem?	Compare and contrast matter and energy movement in an ecosystem. (or model)
		Predict the consequences to changes in primary production due to perturbations (e.g., drought, fire, flood, temperature, nutrient changes).
		Generate and interpret carbon cycle models at ecosystem and global scales.
		Evaluate the claims in a current research paper on how a given carbon sequestration method will impact the global carbon cycle.
		Construct a model of the nitrogen cycle in an ecosystem to predict the impact of changes in the microbial community on the system.
	How do organisms mediate the movement of matter and energy through ecosystems?	Explain the mechanisms by which microbial saprobes, parasites, and mutualists influence nutrient cycling.
		Use a model to predict the impact of the loss of a keystone consumer species on the energy flow through an ecosystem.
		Construct an argument that defends the idea that eating lower on a food chain is better for the environment.
		Explain the role of microorganisms in the loss of soil carbon after deforestation or agricultural tillage.
	How do organisms obtain and use matter and energy to live and grow?	Predict and explain the difference in biomass of plants grown in the light or in the dark.
		Compare and contrast the mechanisms by which plants and fungi gain biomass.
		Explain how mass gain and loss differs between active and sedentary consumers.
Interactions within	How are living systems interconnected and	Compare biodiversity among microhabitats (e.g., phyllosphere

Ecosystems	interacting?	v. rhizosphere, human microbiome, coral reefs)
		Predict the abiotic and biotic characteristics of new habitat over the short and long term (e.g., glacial stream, post-fire, old field).
		Choose and use multiple representations (e.g., explanation, graphs, equations, diagrams) to explain how systems are interacting (e.g., Lyme disease system, Isle Royale system, Rabbits in Australia).
	Choose and use multiple representations (e.g., explanation, graphs, equations, diagrams) to explain how organisms are constrained in the number and types of interactions in which they can engage by their evolutionary history (genetic factors) and circumstance (location, temporal variability in environment).	
Ecosystems	How do systems change over time?	Construct a model to explain how the interactions among the biotic and abiotic factors of a system can vary (direction, magnitude, frequency) in space and time.
		Predict and explain the response of disturbance by: -individuals (e.g., acclimation, death, migration) -populations (e.g., adaptation, migration, extinction) -communities and ecosystems (e.g., resiliency, functional redundancy, large changes to ecosystem structure)
Impacts of Humans on Ecosystems	What impacts do humans have on ecosystems?	Using a long term data set (e.g., biodiversity, NPP, dissolved organic matter), examine historical and current trends for a particular habitat and explain how humans have impacted the area.
	What can or do humans do to mitigate negative impacts they have on ecosystems?	Create an environmental impact statement or restoration ecology plan for a specific ecosystem.
Impacts of Ecosystems on Human Health and Well-being	How do humans depend on ecosystems for their health and well-being?	Pick a human health issue and construct an argument tying it to the environment (e.g., water-borne disease, food poisoning, air quality, dioxin, UV radiation).
		Evaluate the claims in a recent paper about the relationship between biodiversity and human disease risk.
		Create a sustainability plan for a managed ecosystem (e.g., agro-ecosystems, forests, urban park).