

Big idea (age 11-16)

BOE: Organisms and their environments

What's the big idea?

All organisms, including humans, depend on, interact with and affect the environments in which they live and other organisms that live there.

Key concepts

The big idea is developed through a series of **key concepts** at age 11-16, which have been organised into teaching topics as follows.

The numbering gives some guidance about teaching order based on research evidence on learning pathways and on effective sequencing of ideas. However, the teaching order can be tailored for different classes as appropriate.

11-14:

Topic BOE1

Interdependence of organisms

Key concepts:

- BOE1.1 Food chains and food webs
- BOE1.2 Interdependence within ecosystems

Topic BOE2

Organisms in their environments

Key concepts:

- BOE2.1 Ecosystem components and dynamics

Topic BOE3

Biodiversity and human impacts

Key concepts:

- BOE3.1 Biodiversity, conservation and sustainability

14-16:

Topic BOE4

Interdependence of organisms

Key concepts:

- BOE4.1 Trophic levels and biomass transfer

Topic BOE5

Organisms in their environments

Key concepts:

- BOE5.1 Cycling of materials through ecosystems

Topic BOE6

Biodiversity and human impacts

Key concepts:

- BOE6.1 Measuring biodiversity
- BOE6.2 Human interactions with ecosystems: negative and positive

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Learning progression

The science story associated with the big idea develops from age 5 to age 16, and could be summarised as follows:

Science story at age 5-11

Interdependence of organisms

Animals, including humans, get their food by eating plants and other animals. Some animals only eat other animals, and are referred to as carnivores; some animals only eat plants, and are referred to as herbivores; some animals eat both plants and other animals, and are referred to as omnivores.

The feeding relationships between organisms can be represented using food chain diagrams. All food chains start with producers, which make their own food, and also include one or more consumers, which cannot make their own food so have to get it by eating producers or other consumers. Consumers can be predators and prey.

Organisms in their environments

The environment in which an organism lives is called its habitat. There can be daily, seasonal and longer-term changes in the conditions in a habitat, and these changes can affect the organisms that live there in positive and negative ways.

Science story at age 11-14

Interdependence of organisms

Organisms of the same type living in the same place make up a population. Populations of organisms living in the same place interact to make up a community. An ecosystem is made up of a biological community and the physical environment in which the community lives and upon which it depends.

The biological material that makes up the organisms in a population can be referred to as biomass. Biomass is transferred between populations when organisms are eaten. The feeding relationships within a community of organisms can be depicted (modelled) using food chain diagrams to represent transfers of biomass between populations. Two or more interconnected food chains can be depicted using a food web diagram.

Producers make their own food, and all consumers depend upon producers for food. Feeding relationships are one aspect of interdependence within ecosystems. Additional aspects of interdependence include that some producers depend upon consumers to pollinate them and to disperse their seeds, and that all organisms depend upon decomposers to break down dead organic matter.

The size of each population in a community is limited by predation and by competition for food and other resources including space, water, light, shelter, mates, pollinators and seed dispersers. A change in the size of one population will affect the sizes of other populations in the same community.

Organisms in their environments

Conditions may not be the same in all parts of an ecosystem; differences in, for example, the amounts of light, water, shelter and substances in the soil create different habitats in which different populations of organisms live. The locations and sizes of populations within ecosystems can be investigated using basic fieldwork techniques.

The actions of organisms can affect the environmental conditions in a habitat by adding substances to, and removing substances from, the soil, water and air. Some changes can leave individuals within populations, and some entire populations, more or less well adapted to survive and thrive there.

Biodiversity and human impacts

All living organisms within ecosystems are interdependent, including humans. Humans depend upon and benefit from a range of ecosystem services, including the provision of food, materials, fuel and medicines, the breakdown of waste, and benefits such as pleasure. These services arise from the biodiversity of different areas. The biodiversity of a particular area is made up of the diversity of ecosystems, the diversity of organisms living there, and the diversity of genetic information these organisms have.

Human activities can have negative impacts on ecosystems that reduce biodiversity, including activities such as habitat destruction, pollution, overhunting and overfishing. Biodiversity loss threatens human food security and other ecosystem services. Human activities can also have positive impacts on ecosystems that help to protect biodiversity, including through conservation of ecosystems and species, and sustainable use of resources.

Science story at age 14-16

Interdependence of organisms

Populations of consumers depend upon the ability of producers (photosynthetic organisms) to take in carbon from the environment and convert (fix) it into carbohydrates that are used to build biomass and respired to provide energy for life processes. Photosynthetic organisms also play a crucial role in regulating levels of oxygen and carbon dioxide in the atmosphere.

Populations of producers and consumers make up different trophic levels in a food chain. The amount of biomass present in each trophic level is not shown by a food chain diagram, but can be modelled using a pyramid of biomass. Not all of the biomass in a trophic level is passed to higher trophic levels, and this limits the number of organisms that can exist in higher trophic levels as well as the possible number of trophic levels.

Organisms in their environments

Ecosystems are made up of biotic (living) and abiotic (non-living) components. Substances essential to life, including water and carbon, cycle through the biotic and abiotic components of ecosystems. The carbon cycle and the water cycle are essential for life. Microorganisms play a crucial role in the cycling of materials through ecosystems.

The distribution and abundance of organisms in an ecosystem depends on abiotic and biotic factors. Because organisms within a community are interdependent, a change in the size of a population will affect other populations in the same community. The size of one or more populations in a community may be affected if the environmental conditions change, or if a new substance, competitor, predator or pathogen is introduced. Some substances can bioaccumulate in a food chain to toxic concentration, and some substances can cause eutrophication.

The distribution and abundance of organisms, and changing conditions, within an ecosystem can be investigated using techniques including: identification keys; transects and quadrats; capture, mark, release and recapture; sampling indicator species; and using instruments to measure abiotic factors such as temperature, light intensity, soil moisture and pH.

Biodiversity and human impacts

The biodiversity of many areas is being reduced by activities related to increasing human population size, industrialisation and globalisation. Such interactions can result in habitats being damaged or destroyed, populations dying out, and species becoming extinct when conditions change more quickly than they can adapt.

Biologists provide biotechnological and agricultural solutions, including genetic technologies, that can help us to meet the needs of the growing human population. Humans can interact with ecosystems positively by using ecosystem resources in a sustainable way (at the same rate as they can be replaced), and by protecting and conserving biodiversity. This helps to ensure the security of the supply of food, materials and medicines upon which human depend.

Biodiversity can be protected at different levels, including protection of individual species, protection of ecosystems, and control of activities that contribute to global climate change. Decisions about protecting and conserving biodiversity are affected by ecological, economic, moral and political issues at local, national and international levels.