



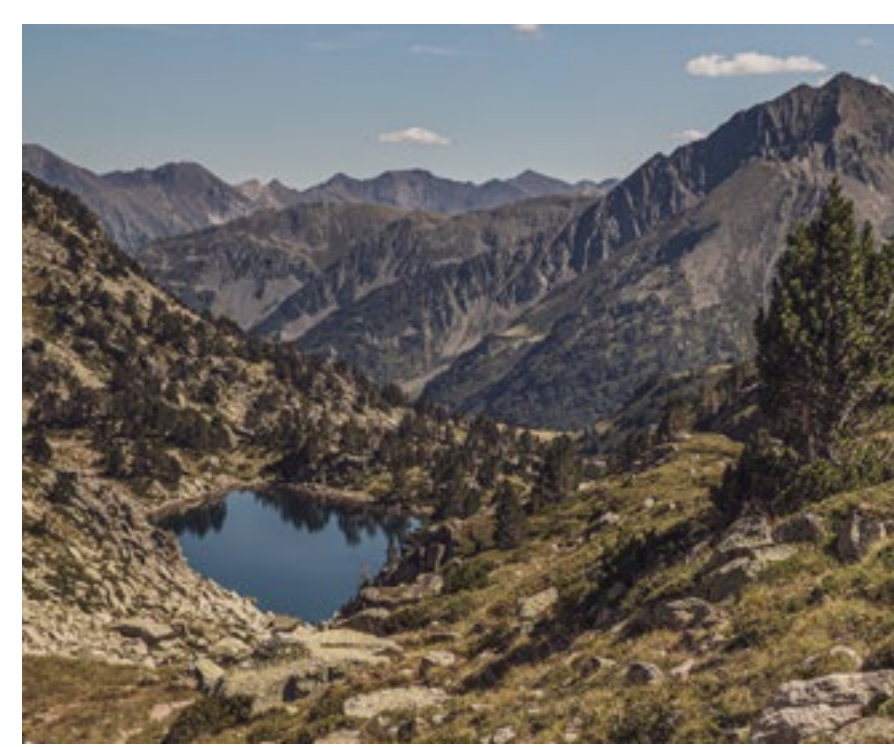
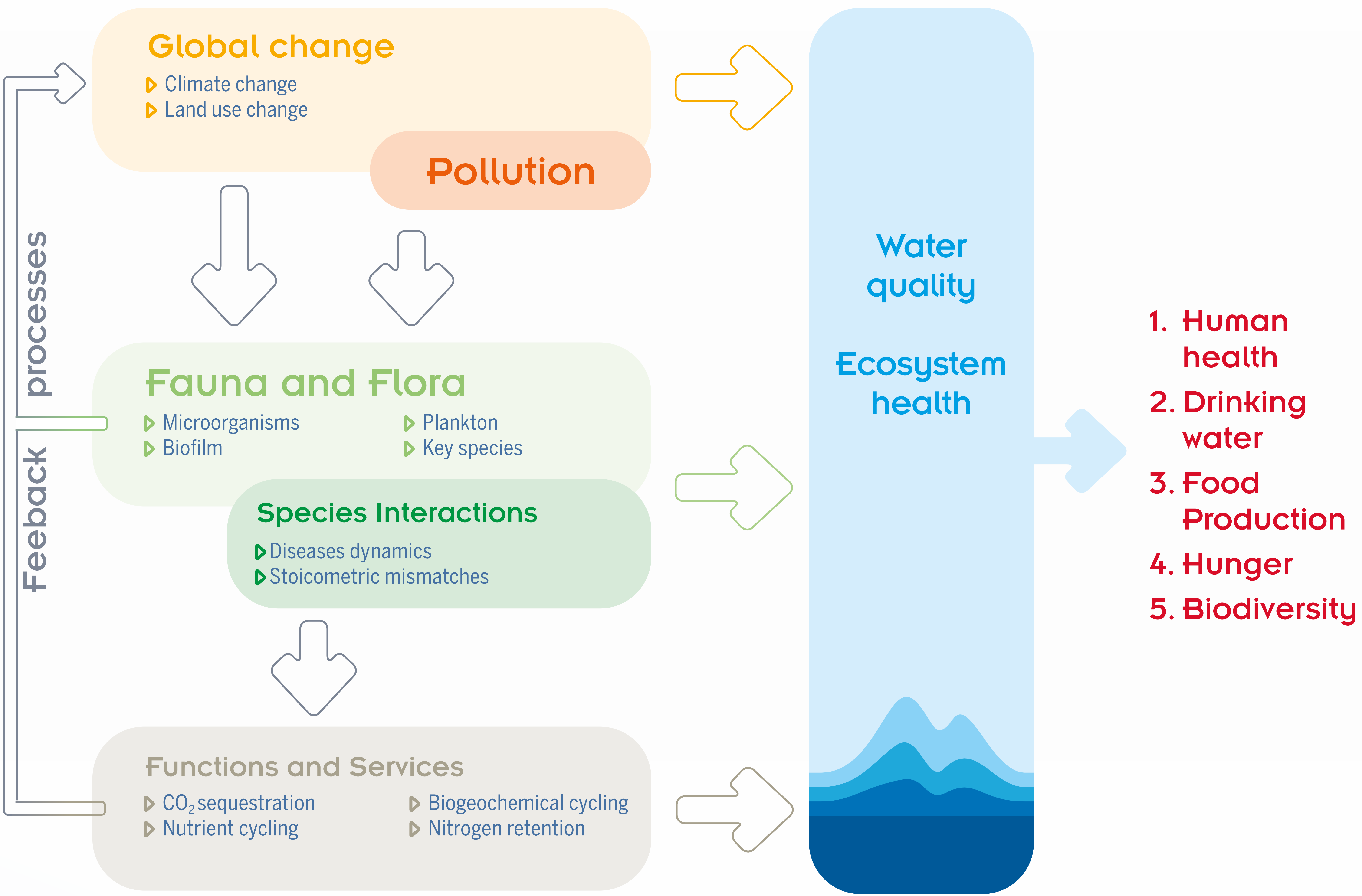
# Mountains – sentinels of change

Mountains are home to billions of humans around the world. Mountains also make essential ecosystem services available: acting as water towers of the world, they provide freshwater to many lowland regions for domestic use, irrigation, hydropower, food production or industry.

They provide living space to unique flora and fauna, critical habitat for rare and endangered species, and generally are biodiversity rich.

**Mountains are very fragile environments and are among the regions that are most sensitive to climate change and to the impacts of human activities.**

*A comprehensive research approach to establish mountain freshwater ecosystems as sentinels of global change*



Climate change is a worldwide threat, but its impact on mountains is particularly strong and troubling. High elevation areas tend to experience intensified climate-change induced warming and weather extremes.

Mountains are considered to be **sentinels of change**, since they respond rapidly and intensely to climatic and environmental modifications, with the danger of losing essential services, and risks for well-being of people.



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GLOBAL CHANGE IN MOUNTAIN ECOSYSTEMS

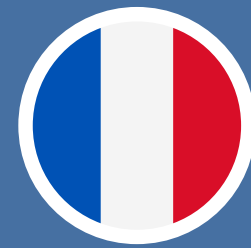
**You have questions?**

Feel free to contact the chair holder



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The project GloMEc will contribute to our understanding of mountain freshwater ecosystems, the services they provide to human society and the risks we face with future changes of these sensitive ecosystems.

[www.p3mountains.org](http://www.p3mountains.org)



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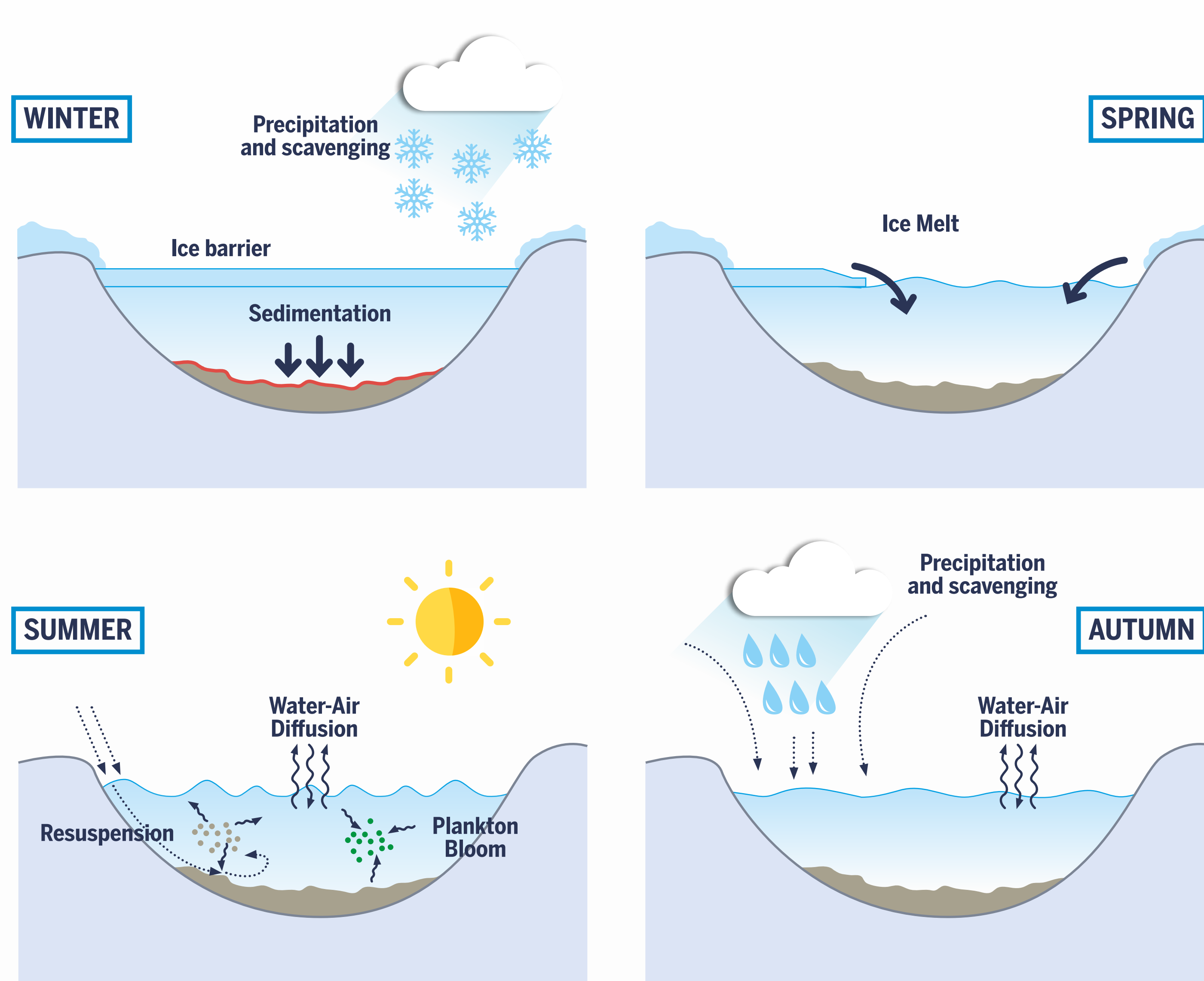




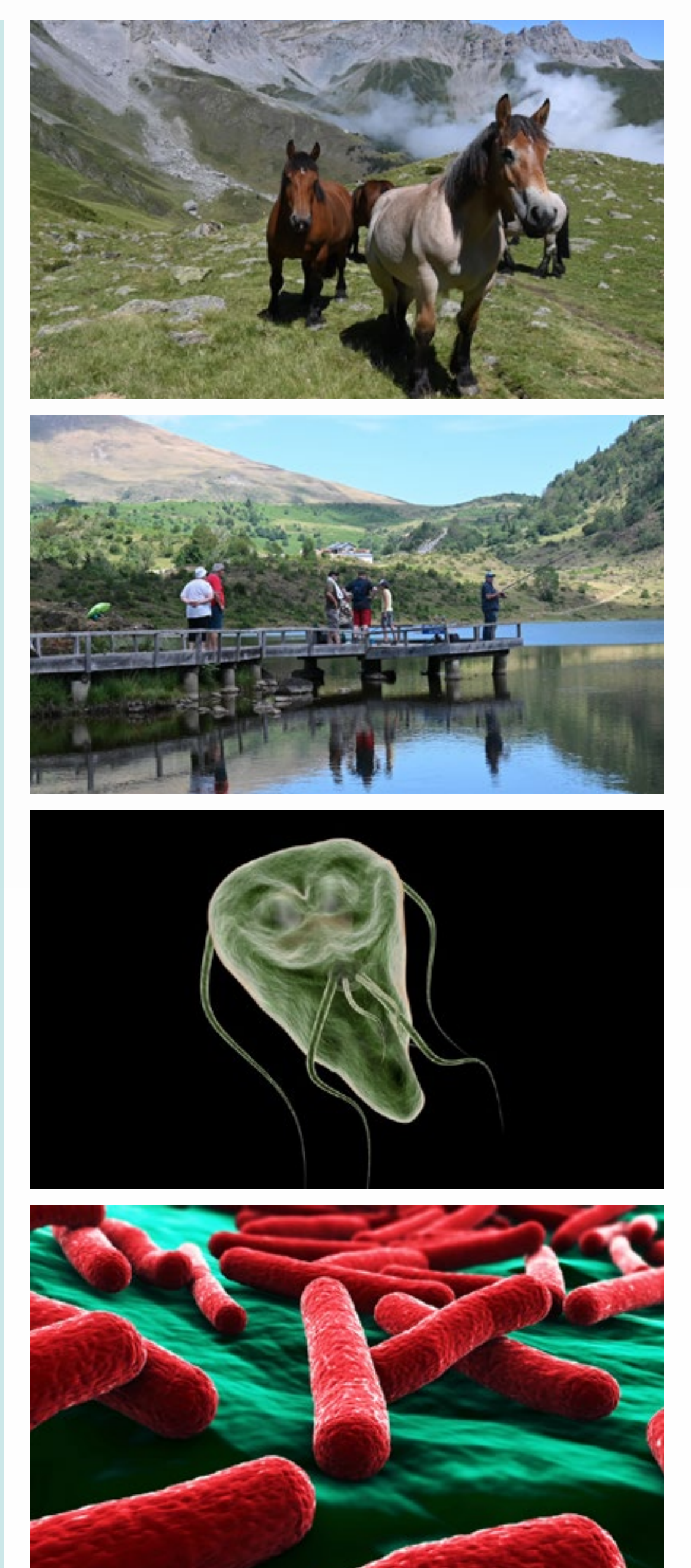
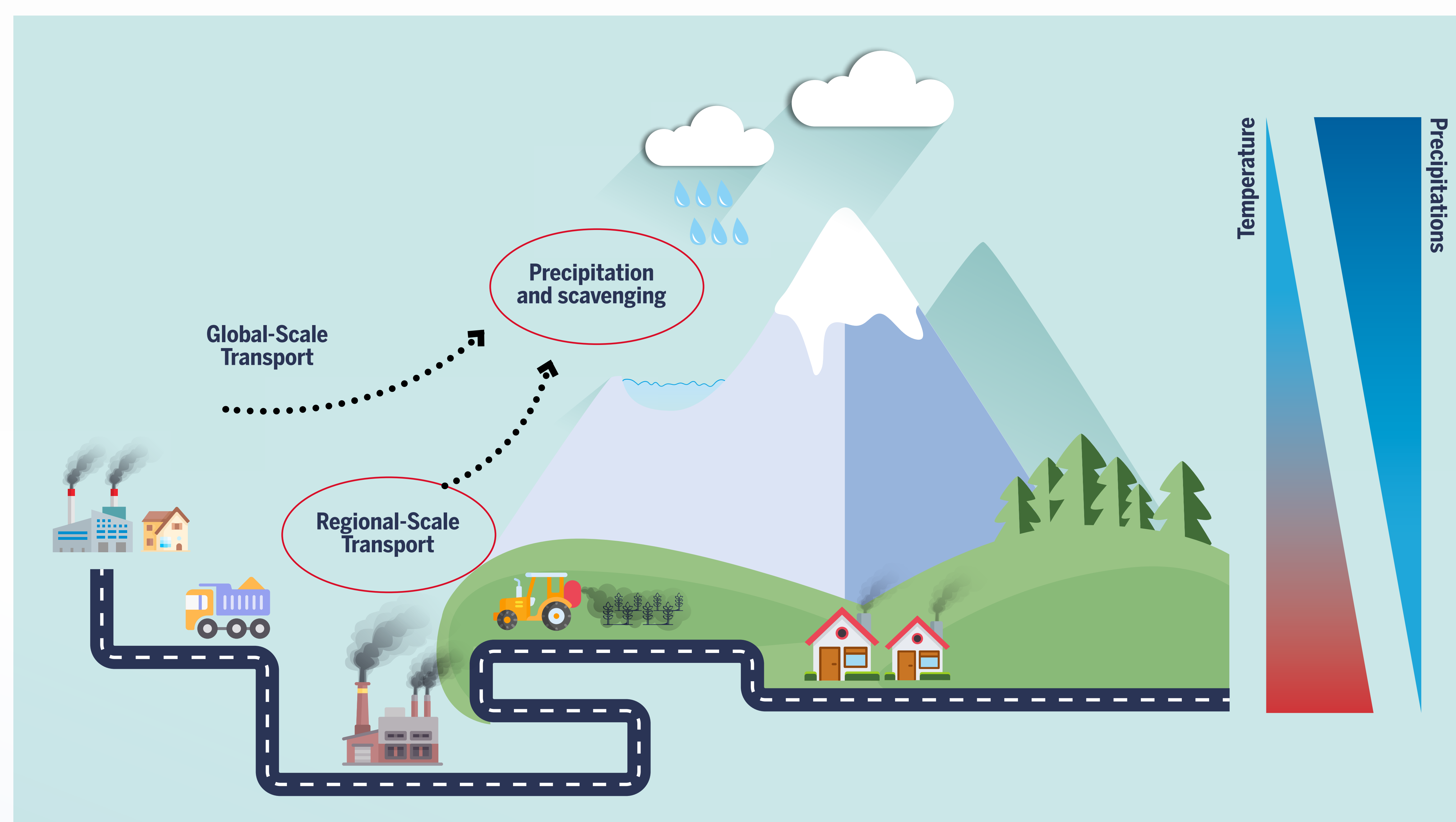
# The main threats to mountains

Major threats to mountains **include climate change, land use needs, and economic and population growth.** These pressures impact food and water security, the availability of other natural resources, and the very survival of species.

One important threat following from anthropogenic pressures is **the pollution of freshwater with chemical compounds** - a key challenge humanity is facing, as **it is closely linked to climate change** and climate extremes. **Climate extremes play a key role in the re-distribution of chemical pollutants and are assumed to enhance release of pollutants stored in ice, soils or sediments through e.g. flood events.**



A range of other climate variables, such as rainfall, snowfall, length of growth season, and wind patterns may play an important but little understood role in distribution and re-distribution of pollutants.



For example, temperature dependent partitioning between air and atmospheric particles, snow surface, or water droplets determine dry and wet deposition rates that may lead to a fractionation and preferential deposition of different compounds at different altitudes.

**Other threats to mountains include: Pastoralism, Tourism, Fish stocking.**

And as a result from all the threats: Eutrophication – an increased availability of nutrients.

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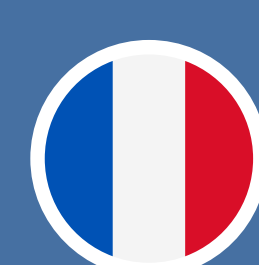
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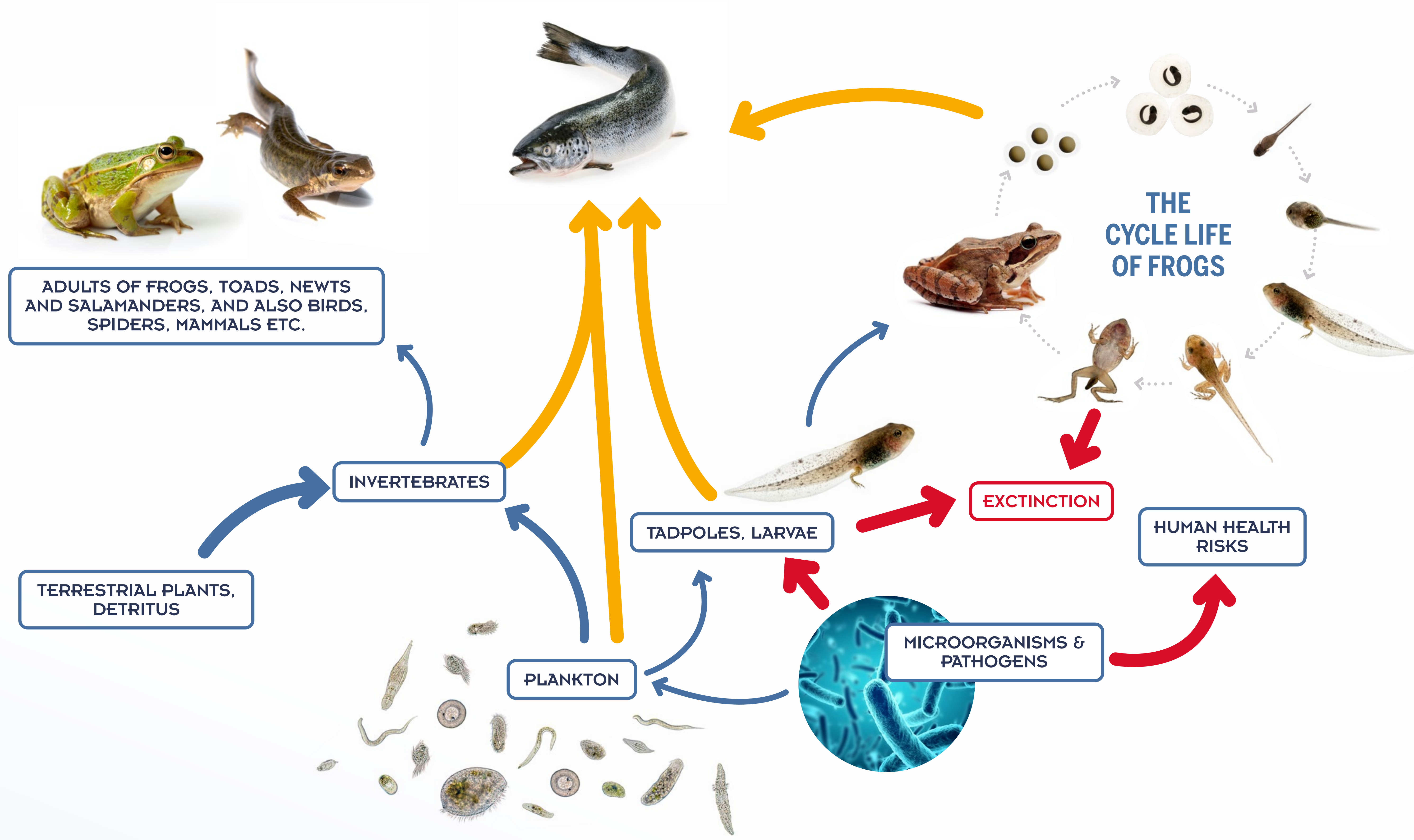
# Dynamics of communities in changing mountain ecosystems

The altered atmospheric processes, driven by climate change, favor local weather extremes and may considerably modify the flux of pollutants globally and in mountain catchments in particular.

**The influx of pollutants together with other impacts of climate change will likely disturb biodiversity across all trophic levels, from microbes, plankton to higher animals with little understood consequences for the whole ecosystem.**

The natural equilibrium then is perturbed and can lead to the increase of pathogens, also critical to human well-being, as e.g. plankton would not be able to control the proliferation of pathogens, such as the bacterium *Escherichia coli* and the protozoan genus *Giardia*. Pathogens can be introduced to mountains through pastoralism, tourism or wind drift.

## Food web in lakes and ponds



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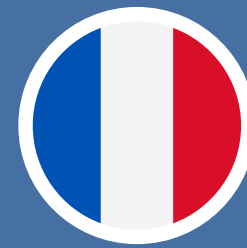
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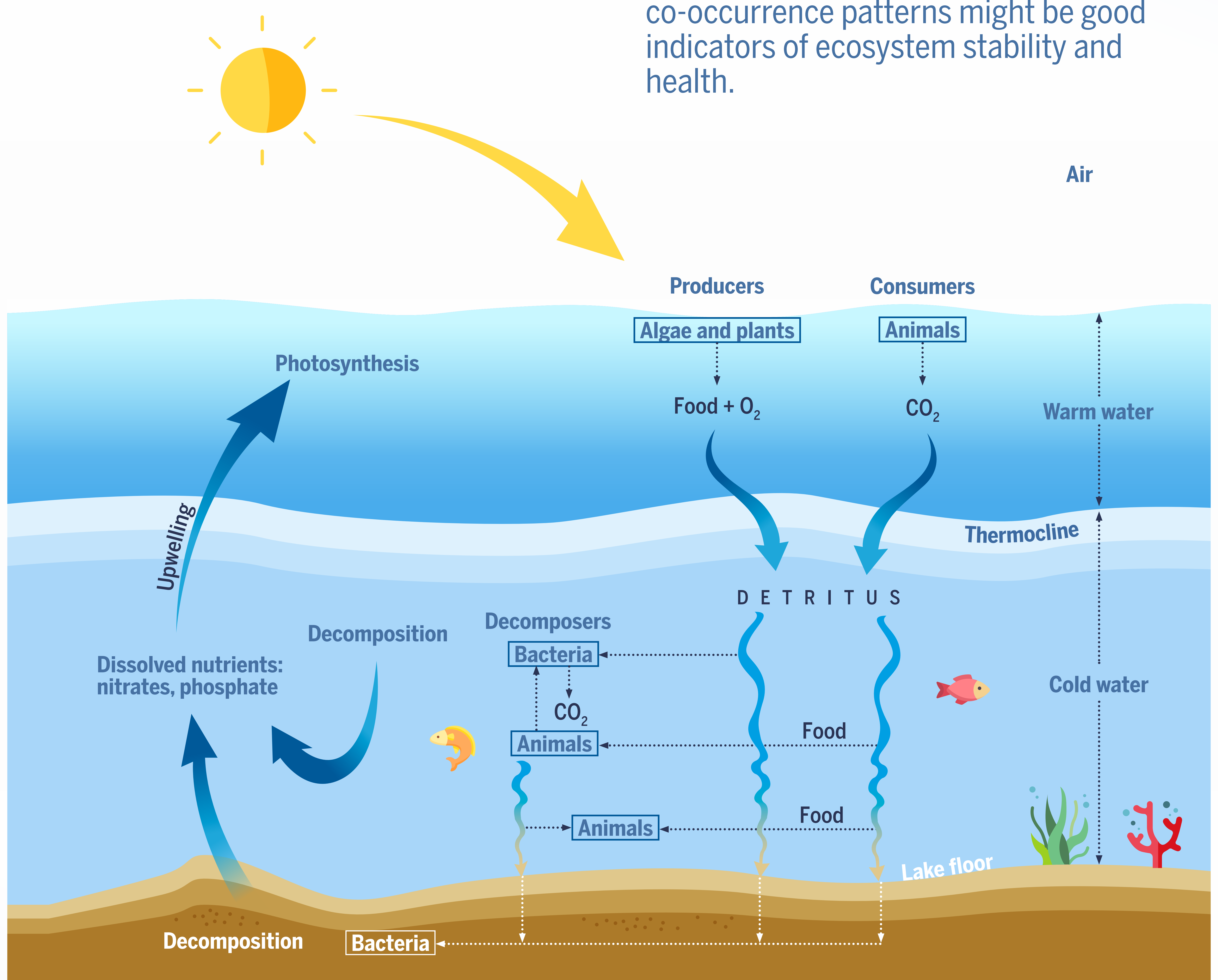
# Microorganisms in mountains

Despite their small size, microorganisms (protists and single-cell eukaryotes) drive important aquatic biogeochemical and nutrient cycles and hold crucial roles within aquatic food webs.

**The microbial communities will be increasingly exposed to higher temperatures and higher levels of pollution**

**due to atmospheric deposition and the higher frequency of hydrological extremes.**

Networks of multiple interacting populations are increasingly considered to be a key part in sustaining multiple ecosystem functions and buffering disturbance and thus these microbial co-occurrence patterns might be good indicators of ecosystem stability and health.



The interactions between microbial species and plankton constitute the base of aquatic food webs and determine the functioning of biogeochemical cycles, accounting for more than half of the global carbon fixation.

**Changes in these interactions and global change impacts on plankton may lead to eutrophication of mountain lakes and changes in ecosystem services and hence impacts on human well-being.**

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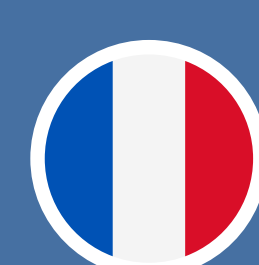
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