LESSON B2
DIFFERENT SOIL TYPES AND LAND USE

MAIN SUBJECTS
Natural sciences / Geography

DURATION
~ Preparation: 15 min
~ Activity: 1h20

AGE GROUP
9-15 years

LEARNING OUTCOMES
Students discover how different types of soil affect the natural ecosystems living within them, and how land is important for the planet and human communities.

Students:
~ Recognise that each part of the planet has a different type of soil.
~ Learn that an ecoregion is defined by its soil and the ecosystem living within it.
~ Discover that animals and human communities depend upon resources provided by ecoregions.
~ Learn how to become advocates for protecting the planet.

KEYWORDS
Land ecosystems, soil, CO_2 uptake, biodiversity, ecosystem services, human needs, indigenous local knowledge

TEACHING METHOD
Documentary analysis

PREPARATION 10 MIN

EQUIPMENT
- Option 1: one computer with an internet access to show a video
- Option 2: **WORKSHEET B2.1** for an offline version.
- **WORKSHEETS B2.2** to **B2.7**
- Optional: **WORKSHEETS B2.8** and **B2.9**

LESSON PREPARATION
- For each group of students (3 to 5 students), print out:
  - → Role cards – **WORKSHEET B2.3**
  - → 1 ecosystem identity card – **WORKSHEET B2.4**
  - → 1 ecosystem portfolio to be chosen by the group – **WORKSHEET B2.5**
- World map with ecoregions, printed in A3 if possible – **WORKSHEET B2.2**
- Print 1 copy of each map of the **WORKSHEET B2.6** to hang on the board (or to display on the digital board)
- For each student: **WORKSHEET B2.7**.

INTRODUCTION 10 MIN

Play the video of Chief Raoni calling on world leaders to protect the Amazon to your students (or distribute and read the text on **WORKSHEET B2.1**).

Initiate a class discussion based on the video or text:
- *Who do you think the man is? Where does he come from? Why is he angry?* Chief Raoni (Raoni Metuktire) is the leader of an indigenous tribe (or root people; first people) called Kayapo, which lives in the Amazon forests in Brazil, in the territory of Capoto-Janira.
- *Why is the forest important to the Raoni Indians?*
- *Is the forest only important to them? What does the Amazon rainforest provide for humanity?*
- *Who else benefits from the forest? Animals?*
- *Were you impressed by the "advocacy"?* (Spend some time explaining what advocacy is) *Do you also think that ecosystems should be protected?*

Then tell the students that they will, in groups, have to defend an ecosystem of the planet. To do this, they will have to **(1) find information on ecosystems** and **(2) make an argument.** Finally, the groups will take turns to defend their ecosystem. While one group is presenting, the other groups should take notes and vote for the one that had the most convincing argument.

BACKGROUND FOR TEACHERS

Indigenous people represent tribes, communities and societies of humans living in various places on Earth. They are called indigenous as they often live a traditional lifestyle based on a **complex and important relationship with their direct natural environment.** Therefore, their environment, the soil and the land have a vital importance for them, providing services like **food, habitat, and tradition.** Indigenous people have a strong and specific knowledge of their environment and all this knowledge, called **Indigenous Local Knowledge,** has great value for mitigation and adaptation strategies regarding climate change, biodiversity and biomes (for further details on this topic, see page 19 of the Scientific Overview).

PROCEDURE 55 MIN

SETTING UP THE DOCUMENTARY ACTIVITY 10 MIN

1. Display **WORKSHEET B2.2** and ask each group of 3 to 5 students to choose which ecosystem they want to work on and defend, according to the numbers. Each group will contain researchers/experts in different fields.

2. Distribute the "expert" role cards to each group and an ecosystem identity card to each student: **WORKSHEETS B2.3** and **B2.4**.

3. Hand out the portfolio corresponding to their ecosystem to each group: **WORKSHEET B2.5**. Post on the board or hand out copies of the world maps for temperature, precipitation and carbon content: **WORKSHEET B2.6**.

4. Before doing the literature search, go over the vocabulary with the students and clarify your instructions:

- Each expert should write down the **characteristics of the soil and climate** on their identity card and then the **contributions or benefits** of their ecosystem, for humans or for animals. The term **"ecosystem service"** is used because the soil and vegetation allow humans to live, eat, heat, play, etc.
- You can reflect for a few minutes with your students on the definition of ecosystem service and ask: *can you give examples of how nature benefits you at your level?*
- Explain that the climatologist can tell us whether an ecosystem is more or less involved in regulating the climate: if the soil has a lot of CO_2 then it helps to regulate the climate. If the soil is destroyed by human activities, the CO_2 will be released into the atmosphere and will contribute to climate change.

AUTONOMOUS RESEARCH TIME 15 MIN

5. Each expert fills in one part of the identity card. Depending on the size of the group, one person can be an expert on several aspects:

- The **climate scientists** search for their information on the board/on the world maps.
- The **soil scientists** look up information on the amount of carbon stored in the soil on the world map.
- The **ecologist, zoologist and anthropologist** must collect information about the ecosystem services in their portfolios.

PRESENTATION TO THE OTHER TEAMS 30 MIN

6. Each group prepares its own "advocacy": it has 2 minutes to convince the class to defend its ecosystem. During this time the students must present the characteristics of their ecosystem and the benefits for humans, but also be convincing! The aim is to make people want to protect the beauty and identity of the ecosystem.

7. Depending on the time available, students can be allowed to do more research on their ecosystem and enrich their argument with photos, videos, drawings, etc.

8. Throughout the presentation, the other students complete the ecosystem services chart: **WORKSHEET B2.7**. Students will then display the completed ID card next to the map on the board.

TEACHER TIP

If you want to assess this lesson, especially the part on advocacy, WORKSHEET B2.8 has an example of a grid that you could use.

WRAP-UP 10 MIN

After listening to all the advocacies and filling in the summary table, ask the class to vote for the most convincing group, both on the basis of the content of the ecosystem, but especially on the quality of the presentation.

End with a global discussion: all ecosystems on the planet are different and all deserve protection without exception. To help with the global discussion, you can use the questions in **WORKSHEET B2.7**.

Think about the place of humans in nature. *Do humans necessarily have a negative influence on nature? What do you think of the customs of the peoples presented in each ecosystem?* To further explore the importance of the local and ancestral knowledge of indigenous peoples, you can watch the OCE video on this topic (duration 3 min).

What all these terrestrial ecosystems have in common is that they are linked to a soil, which has an importance for the climate, but also allows plants to grow. *Do you know how soil is formed and what is in it?* They can look at this in a future session.

OPTIONAL EXTENSION

To explore the link between soil and vegetation, you and your students can create some terrariums that will represent the different ecoregions you can find on Earth. Some guidelines are provided in **WORKSHEET B2.9** and in the OCE video.

CHIEF RAONI IS ADVOCATING

"To everyone who is watching me, I want to say that my commitment to protecting the forest must be heard by all of you because after our generation, others will come, our grandchildren will grow up and we must take care of what remains of the forest so that they too can benefit from it."

Raoni Metuktire, the indigenous leader of Brazil's Kayapó people, has defended the Amazon rainforest for over 4 decades. He's now urging world leaders to protect it from an alarming rise in threats by farmers, loggers, miners, and fires.

"At the rate we're going, we'll soon destroy all of the forest's resources, which will be tragic. How will we breathe? How will future generations breathe? I'm therefore asking all of you who are listening to protect our natural resources so that our grandchildren can continue to live here too. To live, we need nature."

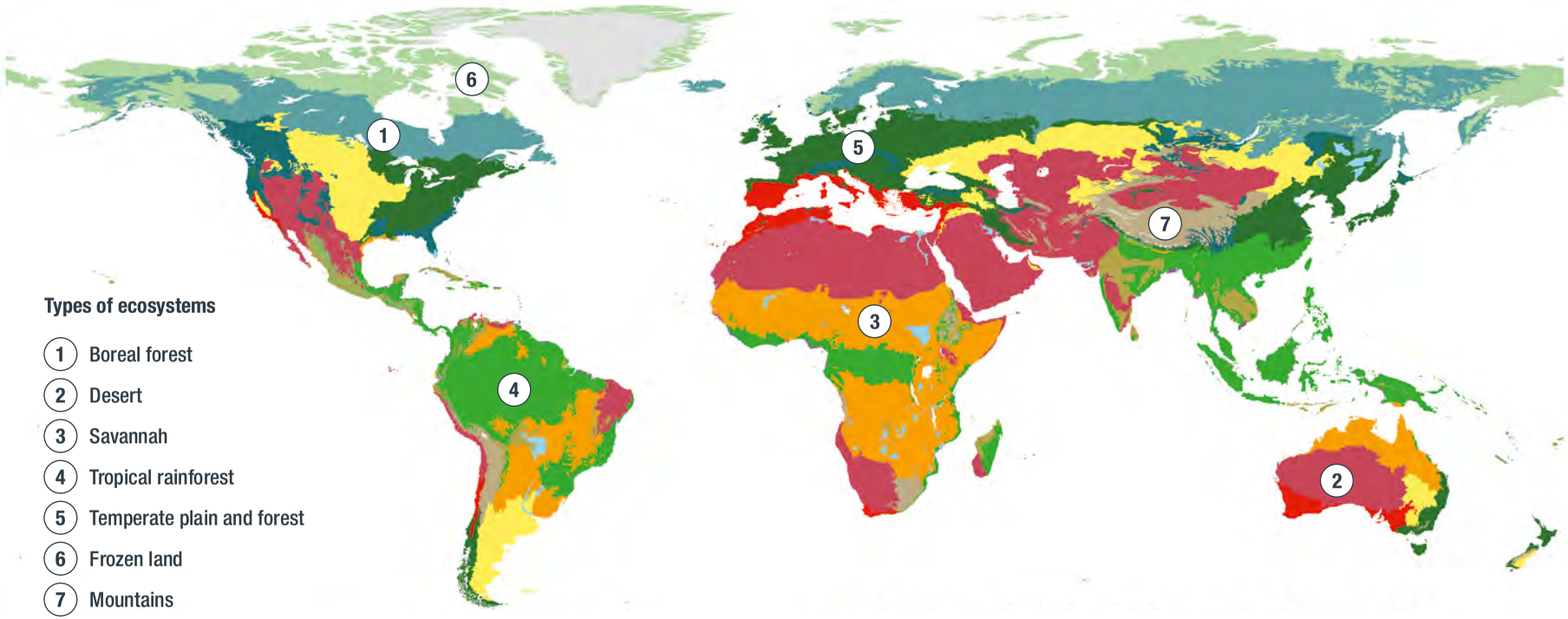
Brazil's 1988 Constitution established the demarcation of indigenous lands. But Chief Raoni is calling on the international community to stop the current encroachment on tribal lands.

CHIEF RAONI IS CALLING FOR MORE ACTION

"I thought about it and concluded that I should ask the international community to help us establish the physical borders of our land so that we can continue to protect it. Many communities live on the banks of the Xingu River, and we want to protect it. This is my message today: we need the support of international leaders to establish the borders of our land."

Extract from the video of Chief Raoni.

MAP SHOWING TERRESTRIAL ECOREGIONS OF THE WORLD



Types of ecosystems

1. Boreal forest
2. Desert
3. Savannah
4. Tropical rainforest
5. Temperate plain and forest
6. Frozen land
7. Mountains

Biome

- Tropical & subtropical moist broadleaf forests
- Tropical & subtropical dry broadleaf forests
- Tropical & subtropical coniferous forests
- Temperate broadleaf & mixed forests
- Temperate conifer forests
- Boreal forests / Taiga
- Tropical & subtropical grasslands, savannas & shrublands
- Temperate grasslands, savannas & shrublands
- Flooded grasslands & savannas
- Montane grasslands & shrublands
- Tundra
- Mediterranean forests, woodlands & scrub
- Deserts & Xeric shrublands
- Mangrove
- Rock & ice

Source: Adapted from Olson et al., Terrestrial ecoregions of the world: A new map of life on Earth. BioScience, Volume 51, Issue 11, November 2001, Pages 933–938

ANTHROPOLOGIST

Study the habits of human societies in relation to the environment.

ZOOLOGIST

Study animal biology and behaviour.

CLIMATOLOGIST

Study the climate (rainfall, temperature...) of an environment.

ECOLOGIST

Study the functionning of an ecosystem (link between soil, plants and animals).

SOIL SCIENTIST

Study soil composition.

Note: here the ecologist and the soil scientist can be the same person.

WORKSHEET B2.4

CURIOUS

Group name: .....

Ecosystem number: .....

Name of the ecosystem: .....

Location: .....

SOIL SCIENTIST

SOIL CHARACTERISTICS

- Name of the soil:
- Carbon stored (in tonnes of carbon per hectare):

CLIMATOLOGIST

CLIMATE

- Temperature (°C):
- Rainfall (mm):

ECOLOGIST

- Describe the ecosystem and identify the benefits it brings

ZOOLOGIST

- Describe the key species and how it interacts with the ecosystem

ANTHROPOLOGIST

- Name the local community. How is it benefiting from the ecosystem?

ECOSYSTEM 1
BOREAL FORESTS IN QUÉBEC, CANADA

The boreal forests, or taiga, grow on *podzol*. They are coniferous forests with many lakes, used for various purposes, for instance, to produce the majority of Quebec's electricity. There is also a lot of mining and wood industry in the boreal forests.

Caribous are large mammals that live in Canada. They migrate between different ecosystems and spend the winter in the boreal forests, where they feed on lichens.

INDIGENOUS PEOPLE AND THE BOREAL FORESTS

"From large game like moose and caribou to smaller mammals such as beaver and rabbit, many common boreal mammals continue to provide food, clothing, and tools for the Indigenous Peoples that reside in the forest. Fish and waterfowl make up significant portions of the diet of many remote communities as well, which are often only accessible by small aircraft. Native trees, shrubs, grasses, lichens, and fungi also feature prominently within Indigenous cultures by providing food, medicine, shelter, and materials."

Source: Boreal Songbird Initiative.
http://www.borealbirds.org

ECOSYSTEM 2
AUSTRALIAN DESERT

The Australian desert is a part of its vast Outback. Its soil is very poor in organic matter and is called *regosol*.
Uluru (or Ayer's rock) is an isolated mountain in the middle of Australia. It is considered sacred by the local tribes and is an important spiritual part of the Aboriginal cultural heritage.
The outback is very rich in minerals like iron, aluminum, manganese and uranium, leading to a lot of mining in the region.

In the very hot Australian desert, honey pot ants find shelter underground, where they build their large colonies. Only a few forager ants go out to collect food (nectar from the scarce vegetation) in the dry, hot weather. Nectar brought by the foragers is then stored in the abdomen of other ants that have stayed behind in the colony. Thus, the ant colony can survive using their honey stocks, even when it is too hot to go outside.

THE ABORIGINAL PEOPLE IN AUSTRALIA

"Although spinifex country is relatively abundant in kangaroos and emus, in Western Desert areas further north, large game is a more seasonal food source following summer rains. As well as hunting with spears and boomerangs, animals were also caught with elaborate nets strategically placed in feeding and watering habitats. Other favored animal foods included lizards and some snakes.
Insects, especially witchery grubs (the larvae of wood-boring beetles and cossid moths), were a valuable source of protein. Honey ants and the honey of stingless bees were sought after for sweetness."

Source: Australian geographic.
https://www.australiangeographic.com.au/australian-geographic-adventure/adventure/2017/07/surviving-in-the-desert/

ECOSYSTEM 3
SAVANNAH OF THE SERENGETI NATIONAL PARK, TANZANIA

The Serengeti National Park is located in Tanzania, at its border with Kenya. The dry savannah there grows on *lixisol*. Many animals live in the park, which attracts a lot of tourists. Local populations use the wood, soil and water for construction and agriculture, and the land for hunting and fishing, further increasing the pressure on the wildlife.

African elephants from the savannah are the biggest mammals on earth. They eat foliage from trees. In areas with high elephant density, they can cause damage to local agriculture.

THE MAASAI IN TANZANIA

"The Samburu and the Laikipia Maasai have developed traditional/customary natural resource management strategies that they have used to assess, manage and restore ecological zones or regions.
For years, the two communities have used different and unique observations and interpretations such as stars, livestock milk productivity and skin quality, "reading" the intestines of slaughtered animals, wildlife migratory patterns, plant species etc. to predict changes in weather patterns as well as to determine how healthy the environment is. This traditional weather forecasting is still relevant to date and does contribute to drought coping strategies for the pastoralists."

Source: Knowing our lands and resources: indigenous and local knowledge of biodiversity and ecosystem services in Africa. https://unesdoc.unesco.org/ark:/48223/pf0000247461

ECOSYSTEM 4
TROPICAL RAINFOREST OF THE AMAZON, BRASIL

The Amazon rainforest grows on *acrisols*. The soil is very rich in iron and has an orange colour. Because of the large number of trees in this very dense rainforest, the Amazon valley influences and regulates the climate.

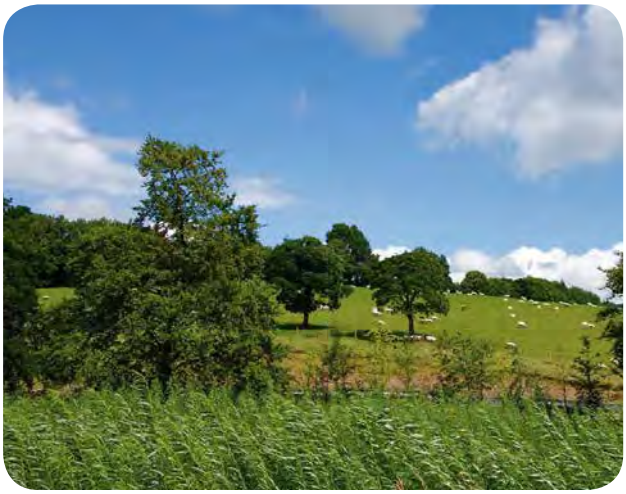
Poison frogs are very common in the Amazon forest. They are poisonous to their predators, and feed on various species of flies that are abundant in the forest. Local communities use the poison of some frogs to make weapons for hunting. It is also used by the pharmaceutical industry to make medicines.

THE WAJAPI IN BRAZIL

"The Wajapi indigenous people live in an area of well-conserved forests, close to the springs of some tributaries of the Jari River in northeastern Brazil. According to the Wajapi, animals in the forest, despite their appearance, are actually human beings with souls. They live in societies that are similar to ours. The trees and most plants are also recipients of human souls, but only the healers or shaman are able to communicate with them. Many of the Wajapi's cultural traits and skills needed for survival in the forest have been passed to them by animals. This perception of the world is the basis of Wajapi knowledge of ecological processes."

Source: WWF.
https://wwf.panda.org/knowledge_hub/where_we_work/amazon/about_the_amazon/people_amazon/

ECOSYSTEM 5
TEMPERATE PLAINS AND FORESTS OF IRELAND



Irish forests and open fields grow on *luvisol*. *Luvisols* are rich in organic matter and are fertile soils that provide nutritious grass for wild and farmed animals.

Wild bees, such as this bumble bee, live in the temperate forests and open fields of Europe, Asia and Northern America. They collect nectar from flowers and transfer pollen from one flower to another, providing the very crucial service of pollination that permits the fertilisation of flowers and, thereby, the production of fruits.

FARMING IN IRELAND

"The country also has a rich tradition of stockmanship and crop husbandry, with farming skills handed down through at least 200 generations. The Ceide Fields on the north Mayo coast contain the remains of a 5,000 year old Stone Age farming landscape of stone walled fields, preserved beneath the growing blanket bog. Research has shown that they were a highly organised community of farmers who worked together on clearing hundreds of acres of forest and dividing the land into fields for cattle rearing."

Source: Ask about Ireland.
http://www.askaboutireland.ie/enfo/sustainable-living/farming-in-ireland-overvi/

ECOSYSTEM 6
THE FROZEN LANDS OF NUNAVUT (CANADA)

Nunavut is covered with snow for a large part of the year. The soil, called *cryosol*, can be frozen and contains permafrost. This permafrost holds a large reserve of natural gas.

Arctic foxes are present in areas of the far north, like Greenland, Iceland and the polar circle. They feed on lemmings, eggs, birds and carcasses left by bears. Their fur changes colour according to the season to help them blend in with their surroundings.

THE INUIT IN THE ARCTIC

"The bowhead whale is the most culturally significant resource harvested on the North Slope. The Inupiat have hunted the bowhead whale for thousands of years and knowledge of subsistence whaling continues to be taught to our children beginning at an early age. These skills include preparing the umiaq, or traditional skin boat, and coping with the dangers while traveling on sea ice to the whaling camps. Preparing the umiaq begins in summer with the harvest of bearded seals and caribou. The women spend much time preparing the bearded seal skins to be used to cover the boat's wooden frame. Caribou sinew are stripped and dried, then later made into thread, which is used to sew the seal skins to cover the umiaq. Passing on this and other knowledge helps to assure the continuation and survival of the Inupiat culture."

Source: Cultural Survival .
https://www.culturalsurvival.org/publications/cultural-survival-quarterly/subsistence-hunting-activities-and-inupiat-eskimo

ECOSYSTEM 7
THE MOUNTAINS IN TIBET

The Himalayas are the largest mountain range in the world. The *leptosol* that is present in that environment is quite poor in organic matter. Himalayan mountains contain many freshwater lakes. Numerous rivers arising from the Himalayan glaciers supply water, and sometimes electricity, to a large population in southern Asia.

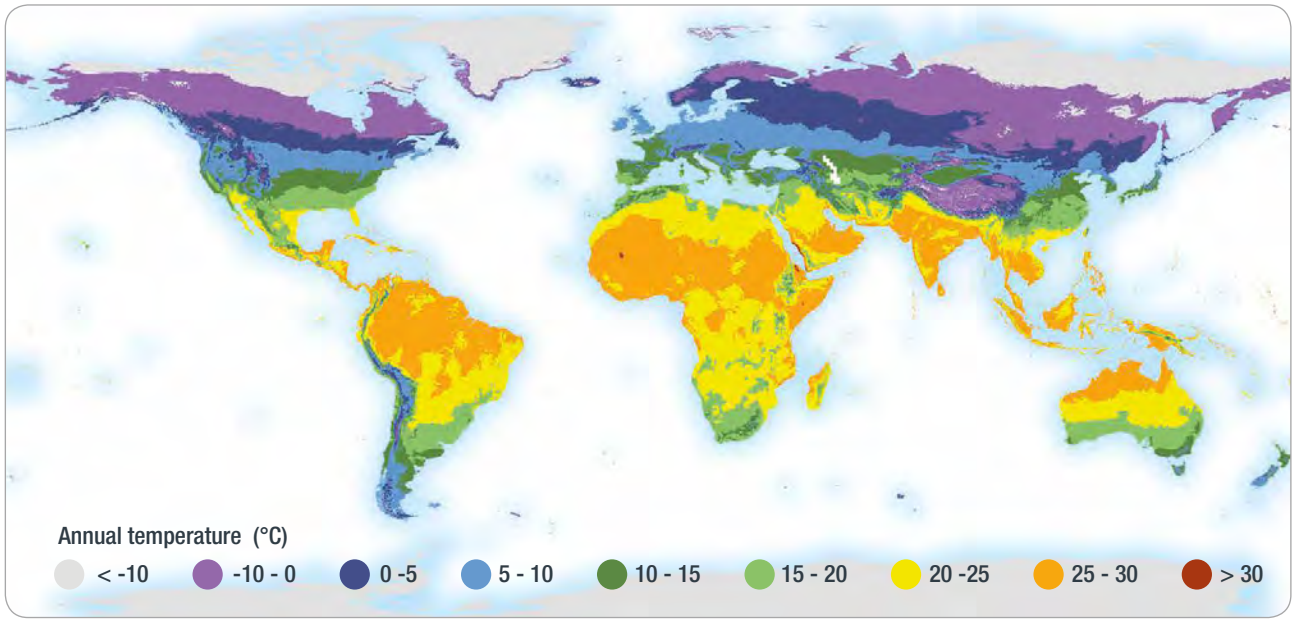
The snow leopard is a top predator of the Himalayan mountains. It eats wild ungulates (such as tahrs, argalis or markhors), but also farmed animals such as sheep.

THE CHEPANG PEOPLE IN NEPAL

"Chepang is one of Nepal's most backward indigenous groups. They were originally nomads, but are now embracing a semi-nomadic lifestyle. Chepangs are known for shifting cultivation practice (slash-and-burn agriculture), which is their main source of livelihood. Farming alone is not enough for them to sustain their families, so they also depend on hunting, fishing and collecting Githa and Vyakur (shoots and roots), wild yams, and catching bats and wild birds. […] They worship nature. Their main festival is "Bhui Jyasa"/"Bhumi puja" (a prayer to the land). They also worship Chiuri trees. They extract butter from seeds produced by these trees. Butter trees are often gifted to Chepang daughters when they get married."

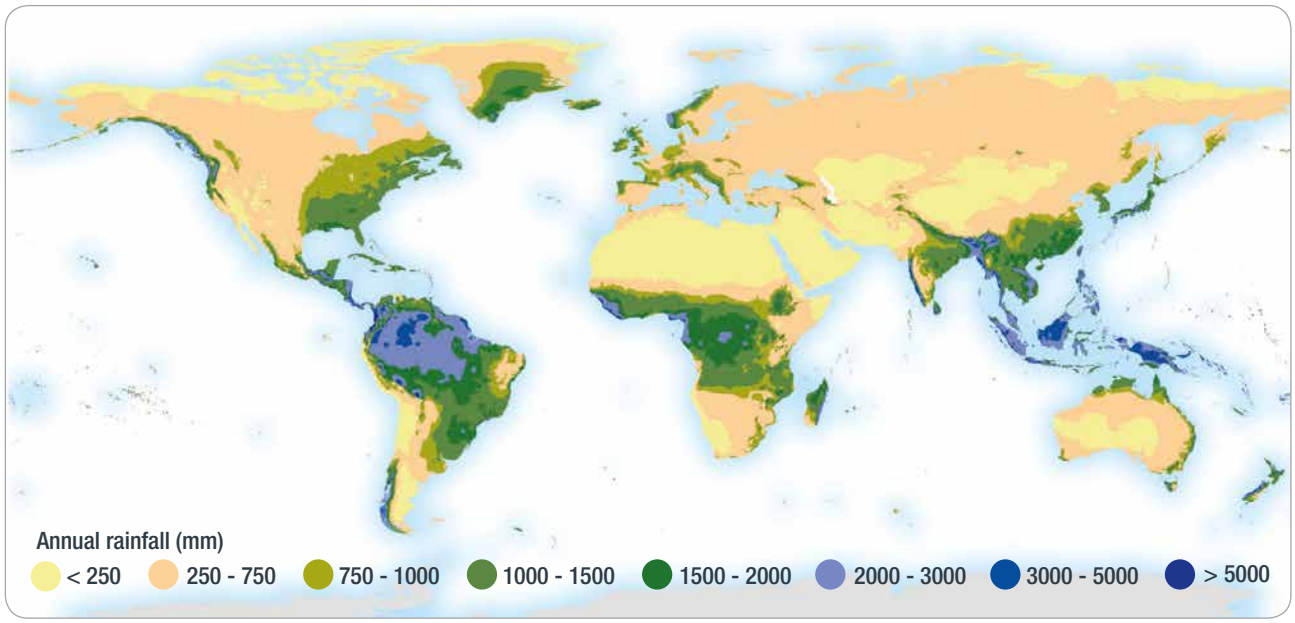
Source: Indigenous voice.
https://www.indigenousvoice.com

MAP SHOWING THE MEAN ANNUAL TEMPERATURES ACROSS THE EARTH (IN °C)



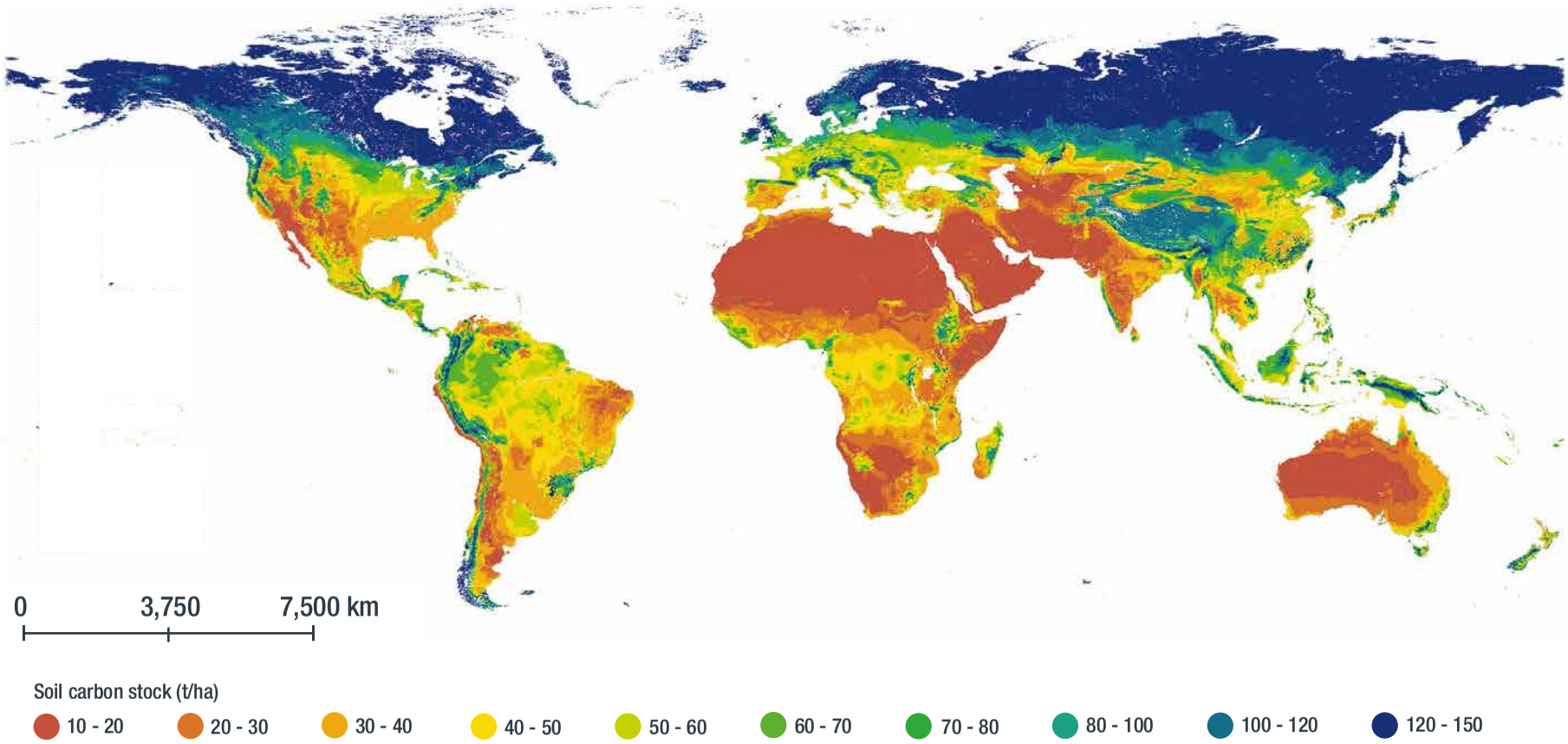
Source: Global Soil Biodiversity Atlas
https://esdac.jrc.ec.europa.eu/public_path/shared_folder/Atlases/JRC_global_soilbio_atlas_high_res-2019-06-13.pdf

MAP SHOWING THE MEAN ANNUAL PRECIPITATION ACROSS THE EARTH (IN MM)



Source: Global Soil Biodiversity Atlas
https://esdac.jrc.ec.europa.eu/public_path/shared_folder/Atlases/JRC_global_soilbio_atlas_high_res-2019-06-13.pdf

WORLD MAP SHOWING THE SOIL CARBON STOCK ACROSS THE EARTH (IN TONNE PER HECTARE)



Source: Soil carbon 4 per 1000, Minasny et al., Geoderma, 2017: https://www.sciencedirect.com/science/article/pii/S0016706117300095

EXPERT

	ECOSYSTEM NAME	CARBON STORED	BENEFITS OF THE ECOSYSTEM	VOTES FOR THE ADVOCACY
1				
2				
3				
4				
5				
6				
7				

Examples of questions:

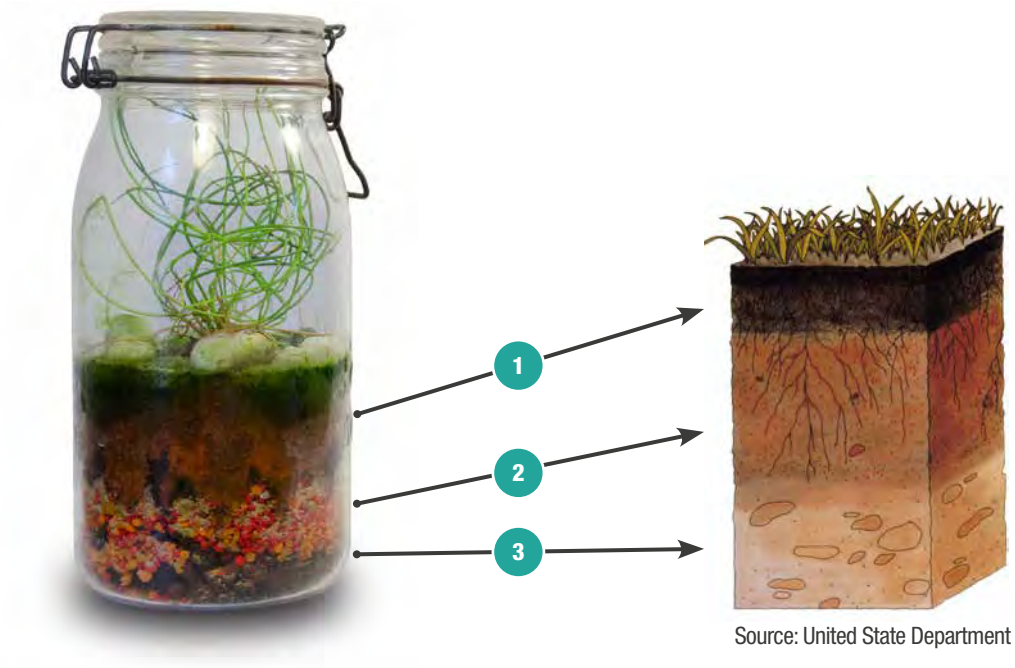
- Name the ecosystems and their associated soils.
- Which soil stores the most CO_2?
- Where are the warmest and coolest regions on the planet?
- Which region has the most rainfall? And the least?
- What are the ecosystem services for animals found in your ecoregion?
- What are the ecosystem services for human communities found in your ecoregion?
- Are there any environmental services or aspects really specific to one ecosystem that are not found in the others?
- Which advocacy did you like best and why?

WORKSHEET B2.8

OPTIONAL: GRID TO ASSESS THE QUALITY OF THE DIFFERENT ADVOCACIES

This grid is given for your information only – you are free to give your own marks.

	SCIENTIFIC CONTENT	WAS THE ADVOCACY ENGAGING?	WAS THE PRESENTATION CLEAR?	ORIGINALITY AND HUMOUR	TOTAL
1					
2					
3					
4					
5					
6					
7					



Source: United State Department of Agriculture (adaptation)

1. **Potting soil (mixture of compost and soil):** rich in organic matter, analogous to litter and humus. This is where the roots will develop. It contains the soil macrofauna (earthworms can be added, for example).
2. **Gravel, sand, clay or coal:** poor in organic matter, allows aeration and contains water. Analogous to clay or sandy soil. Charcoal is not mandatory but it helps to reduce odours.
3. **Pebbles, rock, slate, coarse sand:** mainly minerals and rock. Analogous to bedrock and to the weathered part of bedrock that turns into soil.

ECOREGION	SOIL	PLANTS	COMMENTS
Boreal forest	Poorly developed acidic soil (e.g. heathland), sand and slate	Lichens, mosses (sphagnum), carnivorous plants, fir shoots	Often acidic, wet and cold soils. A bog can be created (mosses and carnivorous plants). Moisten well but do not leave in the heat
Desert	Sand, pebbles and gravel	Cacti and succulents	Little watering, keep warm
Savannah	Potting soil, sand, clay and pebbles	Grasses, small bushes, peanuts	Medium watering, keep warm
Tropical rainforest	Potting soil, humus, gravel	Mosses, epiphytic plants, pothos, orchids	Constant moistening, best is a closed terrarium, keep warm
Temperate forest	Potting soil, sand, gravel	Mosses, lichens, ferns, tree shoots	Medium heat, medium moistening
Arctic zone	Rocks, sand, gravel	Lichens and mosses	Closed terrarium, keep it cold
Mountain	Rocks, acid soil	Little mountainous plants, lichens, mosses	Keep it cold