ECHO

ENGAGING CITIZENS IN SOIL SCIENCE:
THE ROAD TO HEALTHIER SOILS

Deliverable 6.4

"Web-based education kit on soil health"

Co-funded by the European Union

UK Research and Innovation

ECHOSOIL.EU

Project information

Project number	101112869
Project acronym	ECHO
Project name	Engaging Citizens in Soil Science: The Road to Healthier Soils
Call	HORIZON-MISS-2022-SOIL-01
Topic	HORIZON-MISS-2022-SOIL-01-09
Type of Action	HORIZON Research and Innovation Actions
Responsible Service	REA.B.2
Project starting date	01 June 2023
Project duration	48 months

Document Details

Deliverable	D6.4 – Training material on soil health
Work Package	6 – Dissemination and Communication
Task	Subtask 6.3.2 - Training material for students and wider public
Deliverable Type	OTHER
Dissemination Level	PU - Public
Deliverable Lead	RESOIL
Date of publication	18/12/2024

Disclaimer

Funded by the European Union under GA no. 101112869 – ECHO and co-funded by UK Research and Innovation (UKRI).

Short description of the deliverable

This deliverable summarises the work of Task 6 Subtask 6.3.2 which aimed at the creation of a training material for teenage students and the wider public. A web-based educational kit focusing on soil, its structure, functions and ecosystem services, its threats and preservation strategies. The interactive ECHO kit, the so-called “SOILAB Kit for Teens”, includes games, infographics and additional lab sheets and knowledge tools. The “SOILAB Kit for Teens” is based on the SOILAB Kit which was designed by Re Soil Foundation before the ECHO project started, to actively engage primary school students. Additionally, the “SOILAB Kit for Teens” is written in accessible language, making it suitable for younger audiences and for the civil society, to engage with soil science while maintaining scientific accuracy. Beyond basic soil information, the “SOILAB Kit for Teens” delves into critical topics such as soil regeneration and protection, maintaining a positive and proactive vision and encouraging the development of critical thinking and responsible behaviour in natural resource management. What is shown below in the deliverable is a static version of the game which includes the graphical design and the content. The first interactive stages will be published in January, the idea is to make one stage available at a time to increase players’ engagement. We also plan to add in-depth material and some laboratory sheets to provide more material to deepen certain themes and bring learning some of these topics from the screen to practice.

Versioning and contribution history

Version	Date	Modified by	Notes
0.1	October 20, 2024	Margherita Caggiano, Caterina Capri (RESOIL)	Concept draft version
0.2	October 28, 2024	Tanja Mimmo, Claudia Cappello, Luigimaria Borruso (UNIBZ)	Revision of the concept draft
0.3	November 18, 2024	Margherita Caggiano, Caterina Capri (RESOIL)	Full text draft version
0.4	November 19, 2024	Tanja Mimmo, Claudia Cappello (UNIBZ)	Revision of the full text draft version
0.5	November 26, 2024	Elisavet Papadopoulou (AFS)	Revision of the draft version
0.6	November 27, 2024	Kaija Saramäki (ENO, SHab)	Revision of the draft version
1.0	December 13, 2024	Margherita Caggiano, Caterina Capri (RESOIL)	Final version
1.1	December 18, 2024	Margherita Caggiano, Caterina Capri (RESOIL)	Minor changes to the final version

Foreword

Soil is a vital, yet often disregarded, resource that supports life on Earth by providing the foundation for agriculture, forests, and various other natural ecosystems. However, soil degradation is a growing concern around the world, and it can have severe consequences for our planet like reduced crop yields, increased greenhouse gas emissions, and decreased biodiversity. The ECHO project aims to prevent this by bringing together citizens and volunteer scientists from around Europe to work towards a common goal of protecting and preserving our soils, thus contributing to the transition towards healthy soils of the EU Mission: “A Soil Deal for Europe”.

ECHO will generate new data on the health status of EU soils, complementing existing soil mapping and monitoring in EU Member States and Scotland, including the EU Soil Observatory (EUSO). The project will develop and deploy 28 tailor-made citizen science initiatives across EU Member States and Scotland, taking into account different land-uses, soil types, and biogeographical regions, as well as stakeholder needs. With 16 participants from all over Europe, including 10 leading universities and research centres, 4 SMEs, and 2 Foundations, under the coordination of the Free University of Bolzano-Bozen, ECHO will assess 16,500 sites in different climate and biogeographic regions to achieve its ambitious goals.

The project aims to engage citizens in protecting and restoring soils by building their capacities and enhancing their knowledge. Citizens will thereby not only actively contribute to the project’s data collection but also promote soil stewardship and foster behavioural change across the EU. The ECHOREPO, a long-term open access repository with a direct link to the EUSO, will make the citizen science data available for exploitation not only by scientists but also by citizens, policy makers, farmers, landowners and other end-users, providing added value to existing data and other relevant soil monitoring initiatives. ECHOREPO will thus provide valuable information about the state of soil health in various regions, and help citizens make informed decisions about land use and conservation.

We believe that the ECHO project will have a significant impact on soil health and citizen engagement across Europe and become an important step towards protecting and preserving our soil for future generations. By working together, we can ensure that our soil remains healthy and productive, and that we continue to enjoy the many benefits it provides.


ECHO
presents

SOILAB for TEEN

THE WORLD HIDDEN UNDER OUR FEET

Getting to know the secrets of the SOIL to take care of the Planet

an educational kit developed by RE SOIL FOUNDATION

RE SOIL
FOUNDATION
Regeneration for a clean and healthy soil.

ENGAGING CITIZENS IN SOIL SCIENCE: THE ROAD TO HEALTHIER SOILS

Co-funded by the European Union

UK Research and Innovation

Project: ECHO - ENGAGING CITIZENS IN SOIL SCIENCE: THE ROAD TO HEALTHIER SOILS co-funded by the European Union under GA no. 101112869 and co-funded by UK Research and Innovation (UKRI).


A healthy and fertile soil sets the foundations for the health and life of all the living things. Getting to know it, understanding its limits and reducing its consumption, means becoming aware of the ever-growing risk of compromising the fundamental ecosystem services that it provides us with. Such awareness is the premise to take care of it, to avoid its impoverishment and its decay.

ECHO

INDEX

INDEX

INTRO

- **Apple Game**
- InfoGraphic - **Soil composition**

INDEX

1 GAME
THE SOIL IS LIFE

visible and invisible biodiversity of the pedosphere

- InfoGraphic **1 - The biosphere and its regenerative capacity**
- InfoGraphic **2 - Soil fertility is…**

- **SOILAB QUIZ *GAME***

INDEX

A KNOWLEDGE BASE

First level information box

- *(1) what is soil*
- *(2) how did it come about*

Second level information box

- *(1) what is soil*
- *(2) how did it come about*
- *(3) what is it made of*

INDEX

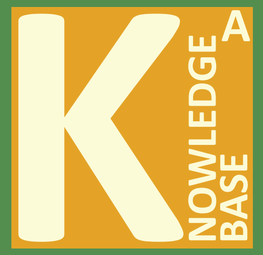
2

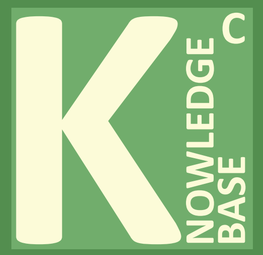
THE SOIL IS FOOD

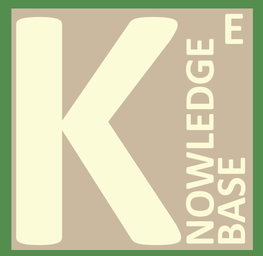
an example of use of the soil: agriculture

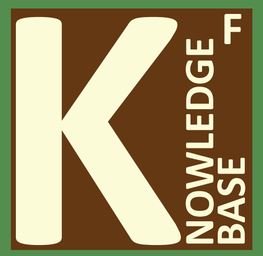
- InfoGraphic **1 - Soil use, on a global scale, for food production**
- **SOILAB UNCOVERS *GAME***

INDEX









B KNOWLEDGE BASE

First level information box

- *(1) who inhabits the soil?*
- *(2) visible and invisible biodiversity*

Second level information box

- *(1) who inhabits the soil?*
- *(2) state oh health of European soils*
- *(3) the relationship between biodiversity, habitat, soil and emissions*
- *(4) focus on the EU Monitoring Law – healthy soils by 2050*

INDEX

3 GAME THE SOIL IS HEALTH

BOTH FOR THE LIVING BEINGS AND FOR THE ENVIRONMENT

The health of the soil in Europe

- InfoGraphic **1 - The soil is a complex system**
- InfoGraphic **2 - The combinations of soil degradation**
- InfoGraphic **3 - Map of soil degradation in Europe**
- InfoGraphic **4 - Carbon in the soil**
- InfoGraphic **5 - The ecological footprint of humans**
- InfoGraphic **6 - Soil consumption**

- **SOILAB CAPTURES *GAME***

INDEX

C KNOWLEDGE BASE

First level information box

- *(1) fertility and storage (SOM and SOC)*
- *(2) the 8 main threats to the soil*

Second level information box

- *(1) a fragile 'skin'*
- *(2) a balanced soil*
- *(3) threats to the soil*

INDEX

4 GAME THE SOIL IS ECONOMY

an example of use of the soil: agriculture

- InfoGraphic **1 - What is soil for? Ecosystem services**
- InfoGraphic **2 - Soil is an essential element of different habitats**

- **SOILAB ROTATES *GAME***

ECHO

INDEX

D KNOWLEDGE BASE

First level information box

- *(1) slow to grow and regenerate - soil, a non-renewable resource*

Second level information box

- *(1) what is soil for*
- *(2) a great climate regulator - Soil, a CO_2 sink*
- *(3) concrete, floods and climate change*

INDEX

5 GAME THE SOIL IS FRAGILE

threats to soil health and subsequent risks

- InfoGraphic - **Soil degradation**
- InfoGraphic - **The eight threats to soil**

- **FIND OUT WITH SOILAB *GAME***

ECHO

INDEX

E KNOWLEDGE BASE

First level information box

- *(1) soil, land or ground?*
- *(2) the other side of agriculture and animal farms: compaction*

Second level information box

(1) soil science: pedology
(2) wildfires and deforestation
(3) a plastic soil

INDEX

6 GAME THE SOIL IS CHOICE

looking for solutions - acting for the soil, what to ask of decision-makers

- InfoGraphic **1 - Soil the foundation of nutrition**
- InfoGraphic **2 - Soil health according to the european union**

- **SOILAB UNCOVERS *GAME***

INDEX

F KNOWLEDGE BASE

First level information box

- *(1) imitate nature, close the circle*
- *(2) from waste cycle to fertile soil*

Second level information box

- *(1) principles of the bio-economy*
- *(2) stopping land consumption*
- *(3) sustainable agriculture*

INDEX

LAB

1. **SOIL COMPACTATION AND AERATION**: *interpreting soil mottling*
2. **"VISUALISING SOIL FERTILITY'** *with hydrogen peroxide*
3. **SOIL PROPERTIES**: *pH Why is it important to measure soil pH?*
4. **INORGANIC CARBON IN SOIL** - *determining the limestone in a soil*
5. **ACTIVE (OR LABILE) CARBON IN THE SOIL**

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Imagine that the Earth was represented by an Apple...

Apple Game 1

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Cut it in four equal pieces: three slices, that represent the seas and the oceans (therefore non-cultivable) are excluded, leaving only one quarter.

Apple Game 2

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Cut it in four equal pieces: three slices, that represent the seas and the oceans (therefore non-cultivable) are excluded, leaving only one quarter.

Apple Game 2

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Cut this slice in half. One half cannot be used for food production: it is made of mountains, deserts, ice slabs and other inadequate types of surface.

Apple Game 3

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Of the remaining part take a quarter and discard the rest. This represents lands that are too rocky, steep, hot, damp, sterile, or occupied by infrastructures such as cities, streets or airports.

Apple Game 4

INTRO

The Earth is like an apple

meaning, how much soil do we have to grow tomorrow's food?

Now peel that small remaining slice: that represents the topsoil, the fertile layer of superficial soil on which depends almost the entire food production in the world. It is tiny and precious, and it is in your hands: its survival depends on you!

(Horizon Europe - Mission Board for soil health and food, Apple Soil Game, Joint Research Centre)

Apple Game 5

INTRO

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meaning, how much soil do we have to grow tomorrow's food?

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(Horizon Europe - Mission Board for soil health and food, Apple Soil Game, Joint Research Centre)

Apple Game 5

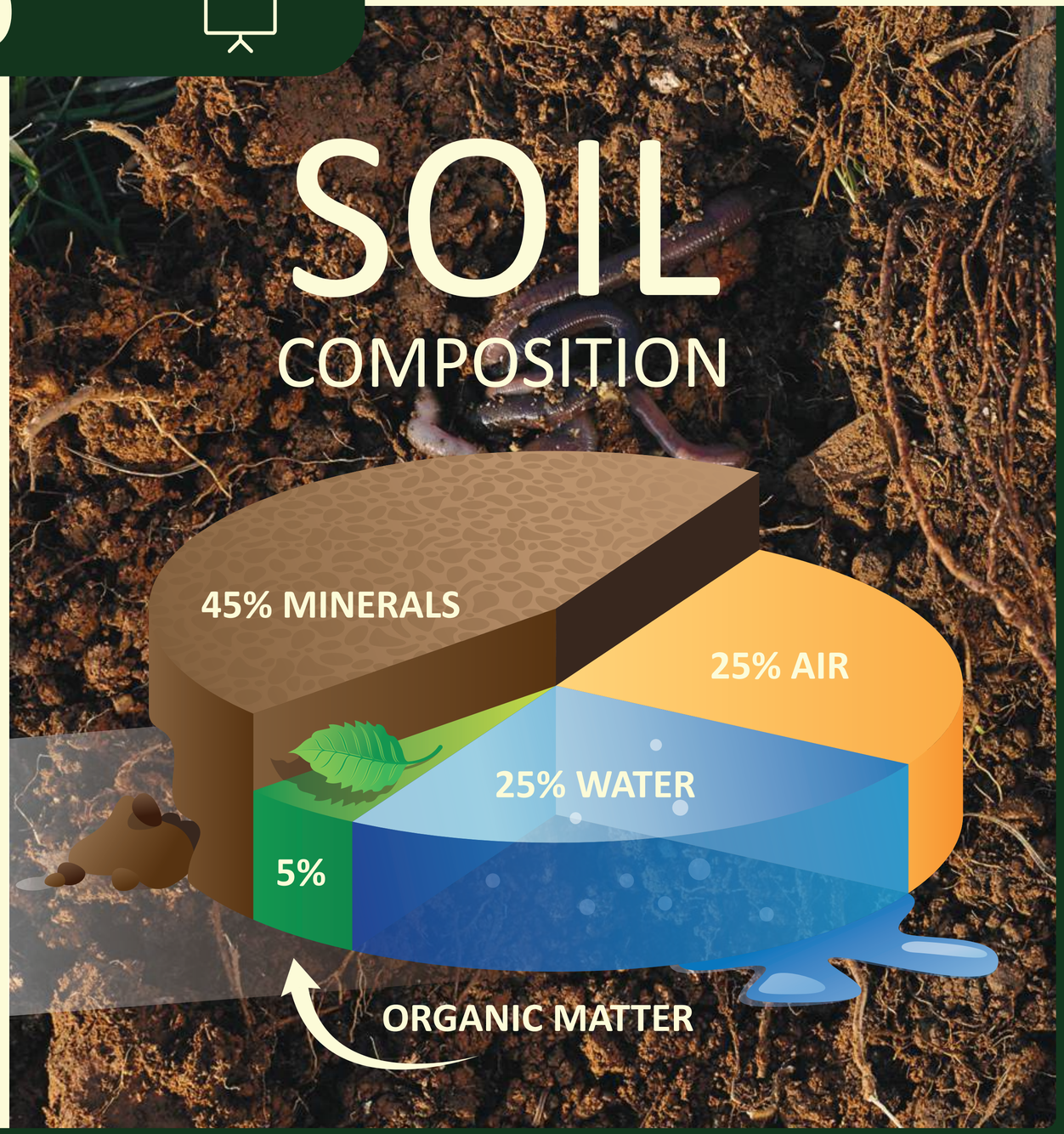
INTRO

The ever-changing soil has been formed over thousands of years. The fertile one contains between 3% and 10% organic matter, ranging in thickness from 2 mm to 20-28 cm, representing only 1% to 6-10% of the total soil.

It takes 2000 years to generate 10 cm of fertile soil,

or humus, the organic component of soil derived from the decomposition of plant and animal organisms. This makes soil a non-renewable resource, essential for life on earth.

If we compare the soil as the ‘factory’ of life, its biotic component - which includes bacteria, fungi and other organisms - represents the set of ‘workers’ who work tirelessly to provide nourishment for all living things. For these reasons it is fundamental to protect it from the decay caused by human activities. Without fertile soil, life could not exist.



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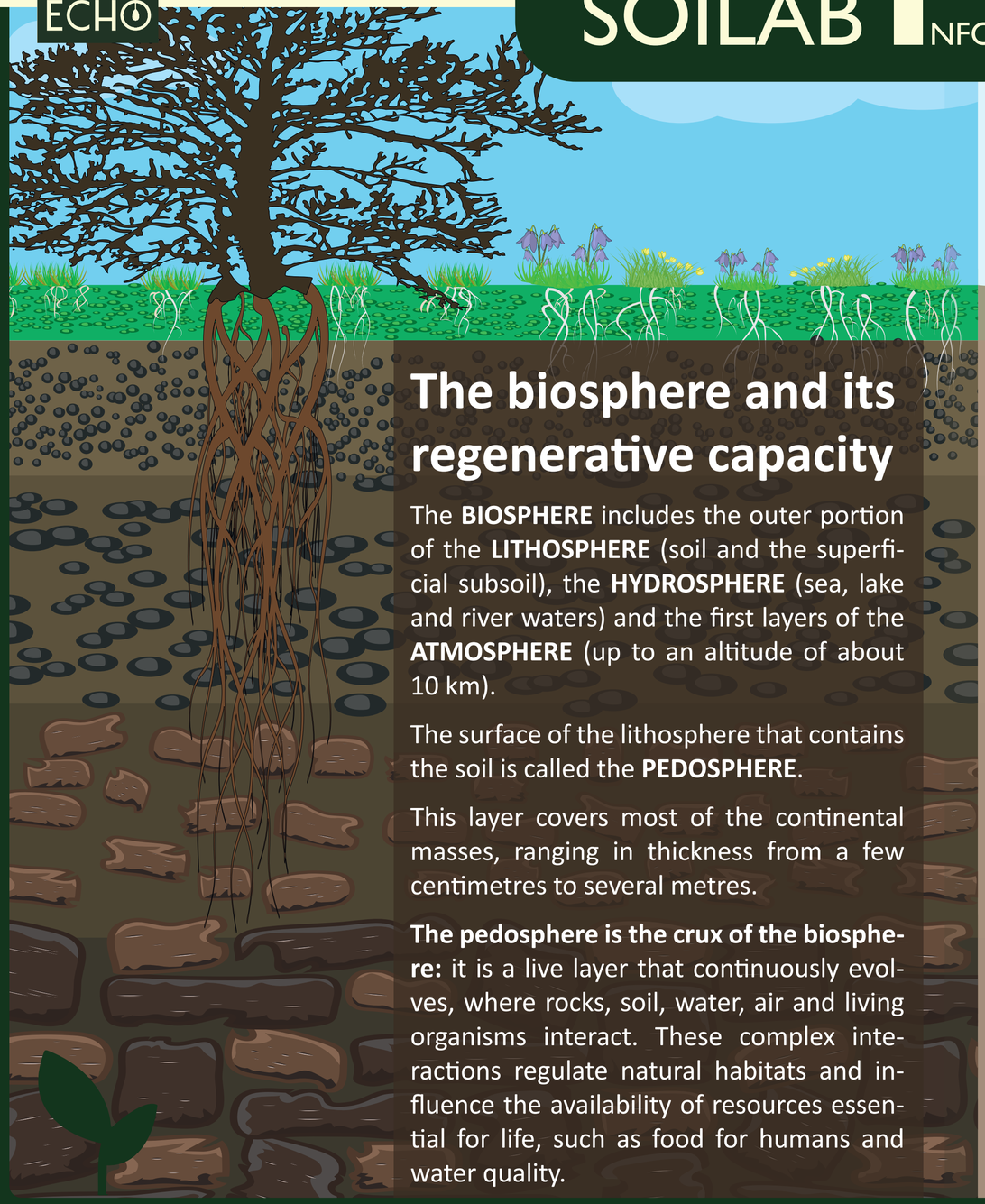
SOILAB QUIZ

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

THE SOIL IS **LIFE**

visible and invisible biodiversity of the pedosphere



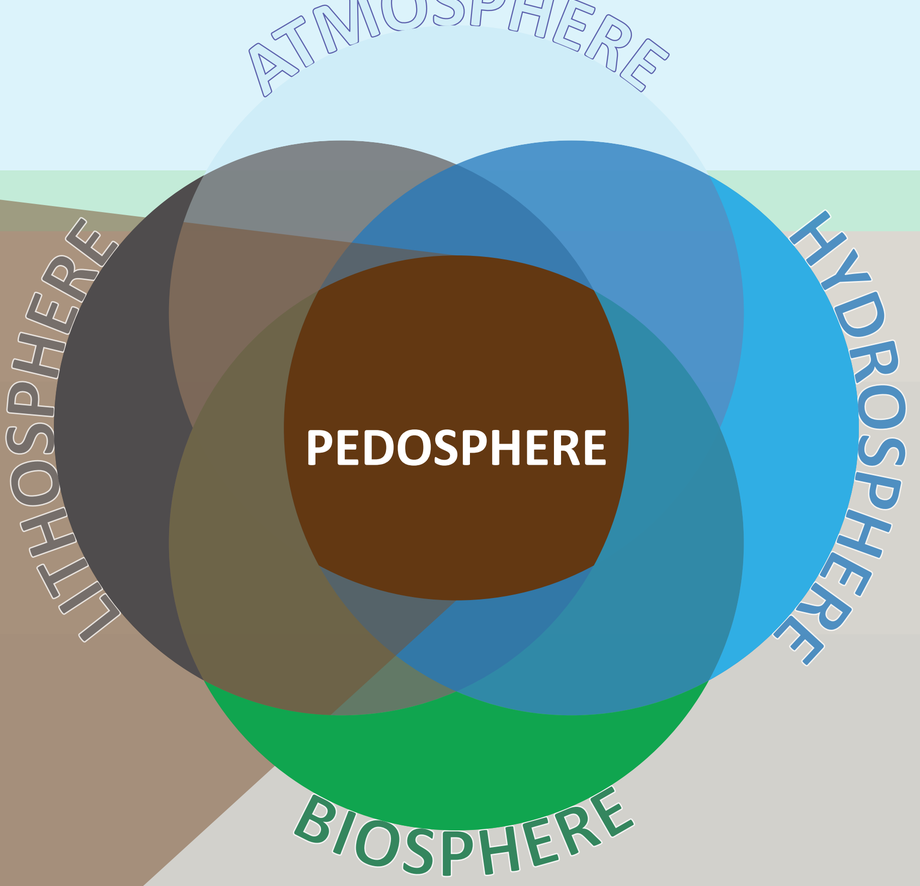
The biosphere and its regenerative capacity

The **BIOSPHERE** includes the outer portion of the **LITHOSPHERE** (soil and the superficial subsoil), the **HYDROSPHERE** (sea, lake and river waters) and the first layers of the **ATMOSPHERE** (up to an altitude of about 10 km).

The surface of the lithosphere that contains the soil is called the **PEDOSPHERE**.

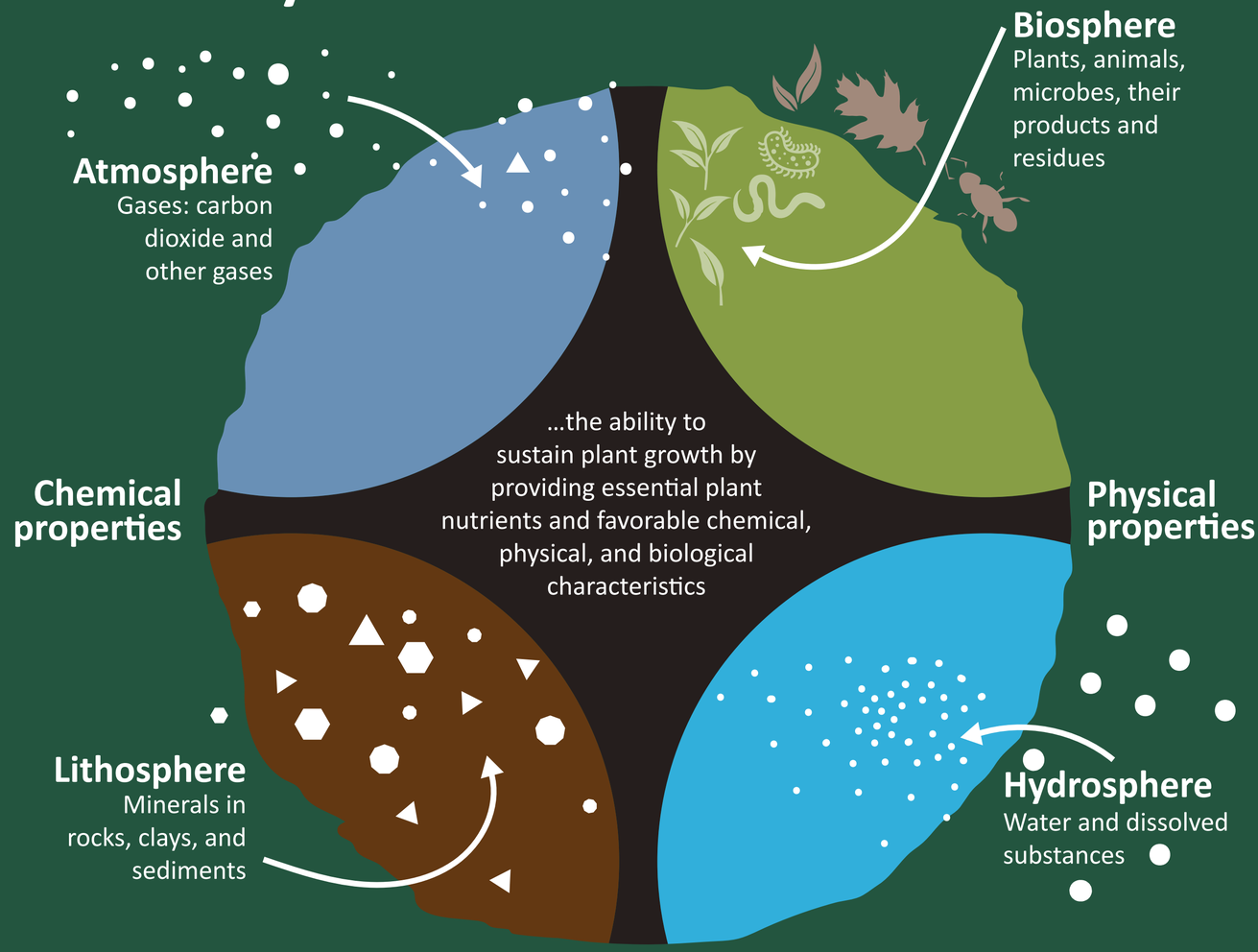
This layer covers most of the continental masses, ranging in thickness from a few centimetres to several metres.

The pedosphere is the crux of the biosphere: it is a live layer that continuously evolves, where rocks, soil, water, air and living organisms interact. These complex interactions regulate natural habitats and influence the availability of resources essential for life, such as food for humans and water quality.



EARTH

Soil fertilty is...



SOILAB QUIZ

topic: defining soil

What is soil?

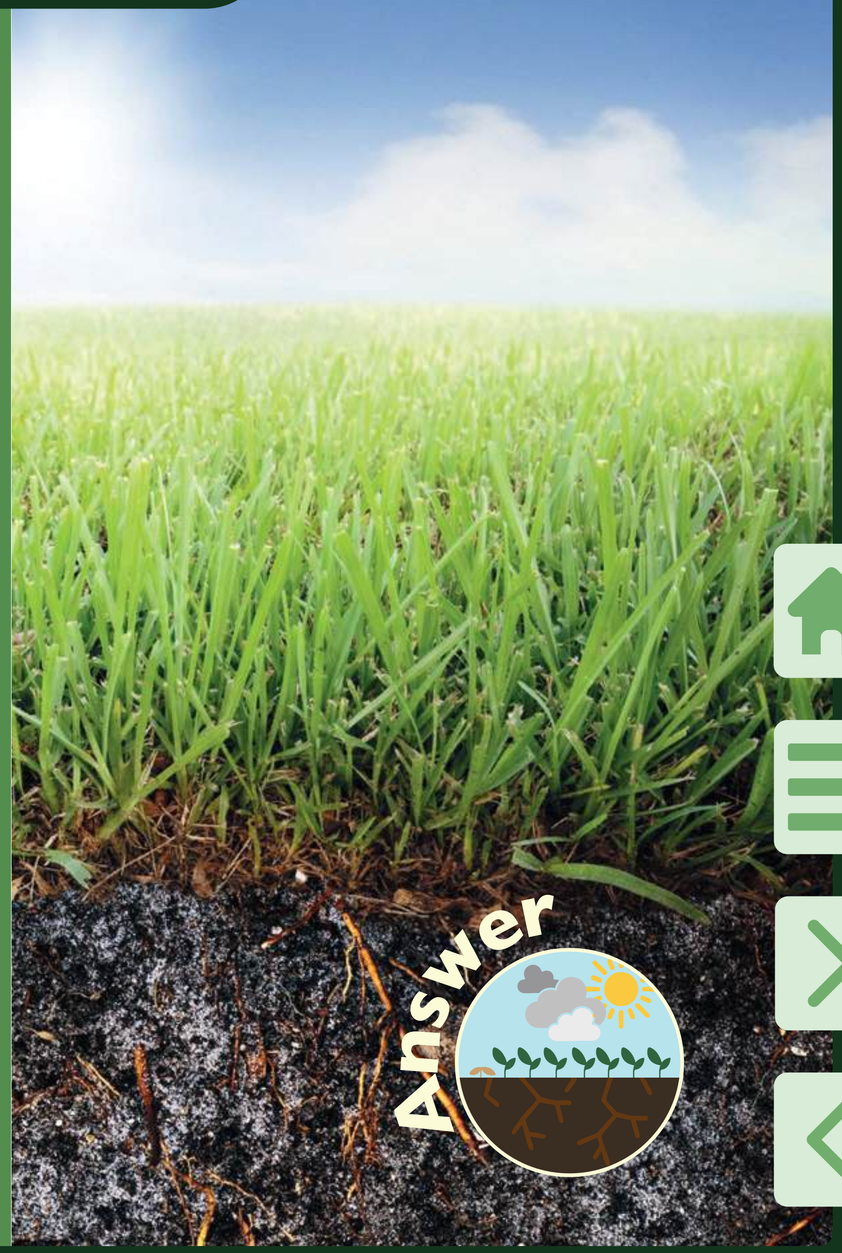
- [ ] the flat surface under our feet
- [ ] a substance, that can vary in size, under the surface
- [ ] the fertile potting soil that we use in agriculture and gardening

What is soil?

- [ ] the flat surface under our feet
- [x] a substance, that can vary in size, under the surface
- [ ] the fertile potting soil that we use in agriculture and gardening

"(According to current scientific knowledge) ... Soil could be the most complex living being. And yet, we treat it like dirt. Soil is an ecosystem made of living beings starting from dead material. It is on its biological relationships that the health and fertility of the soil and, therefore, the survival of most of the terrestrial life on our planet depend'.

(George Monibot - Regenesis : feeding the world without devouring the planet - Allen Lane, 2022).



Soil biodiversity is the result of thousands of years of biogeochemical processes and amounts to the

- [ ] 5-10% of all existing biodiversity on all dry lands
- [ ] 15-20% of all existing biodiversity on all dry lands
- [ ] 25-30% of all existing biodiversity on all dry lands

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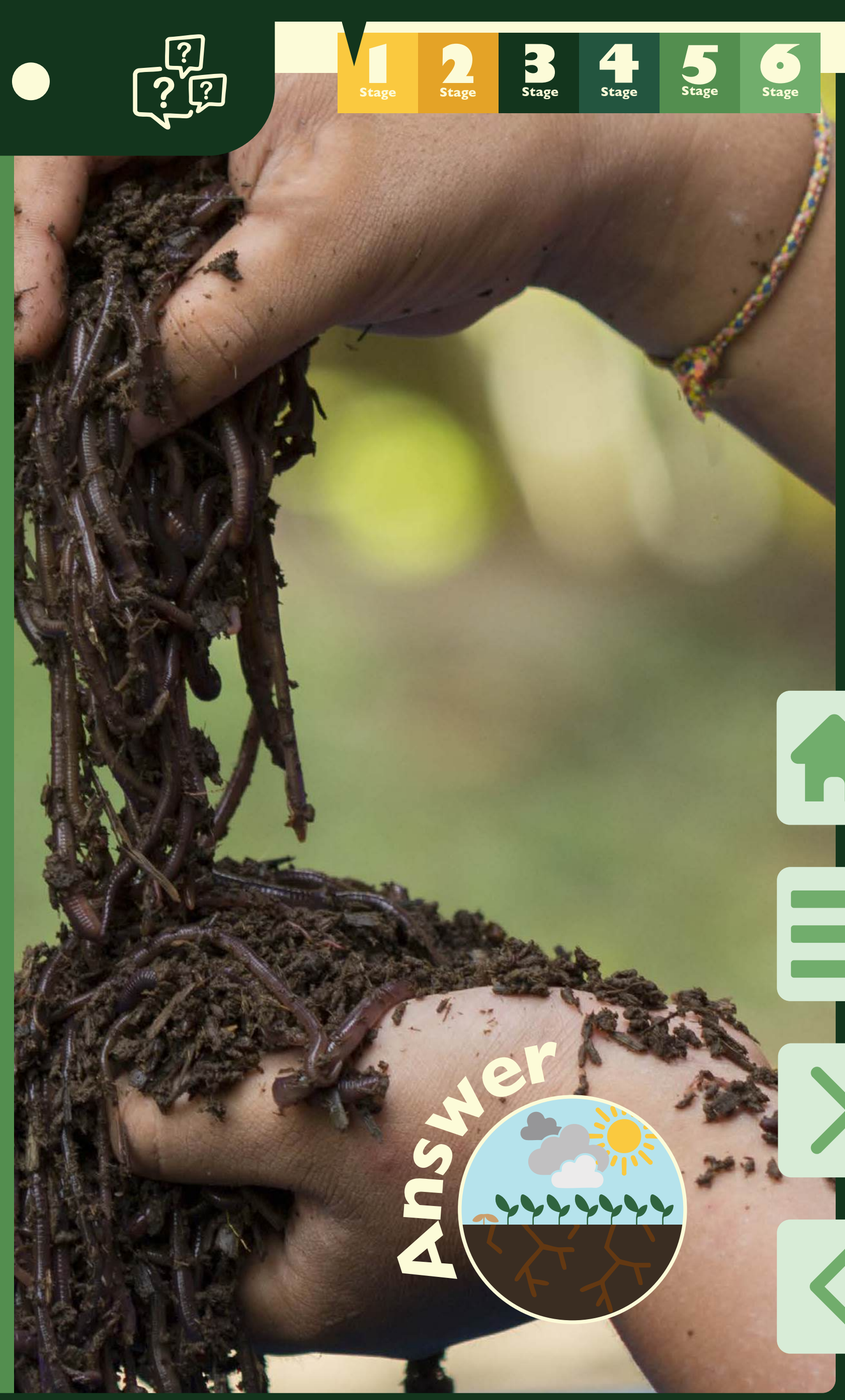
The uppermost layer of soil, the topsoil, is one of the most crowded places for life on the planet. 1.5 kg of life per square meter. In a couple of grams of healthy soil there are more than 9 billion of life units.



The soil is able to create the conditions for such an abundance of life due to its large surface area. In fact, soil is made of:

- [ ] 25% of empty room (air)
- [ ] 50% of empty room (air)
- [ ] 10% of empty room (air)

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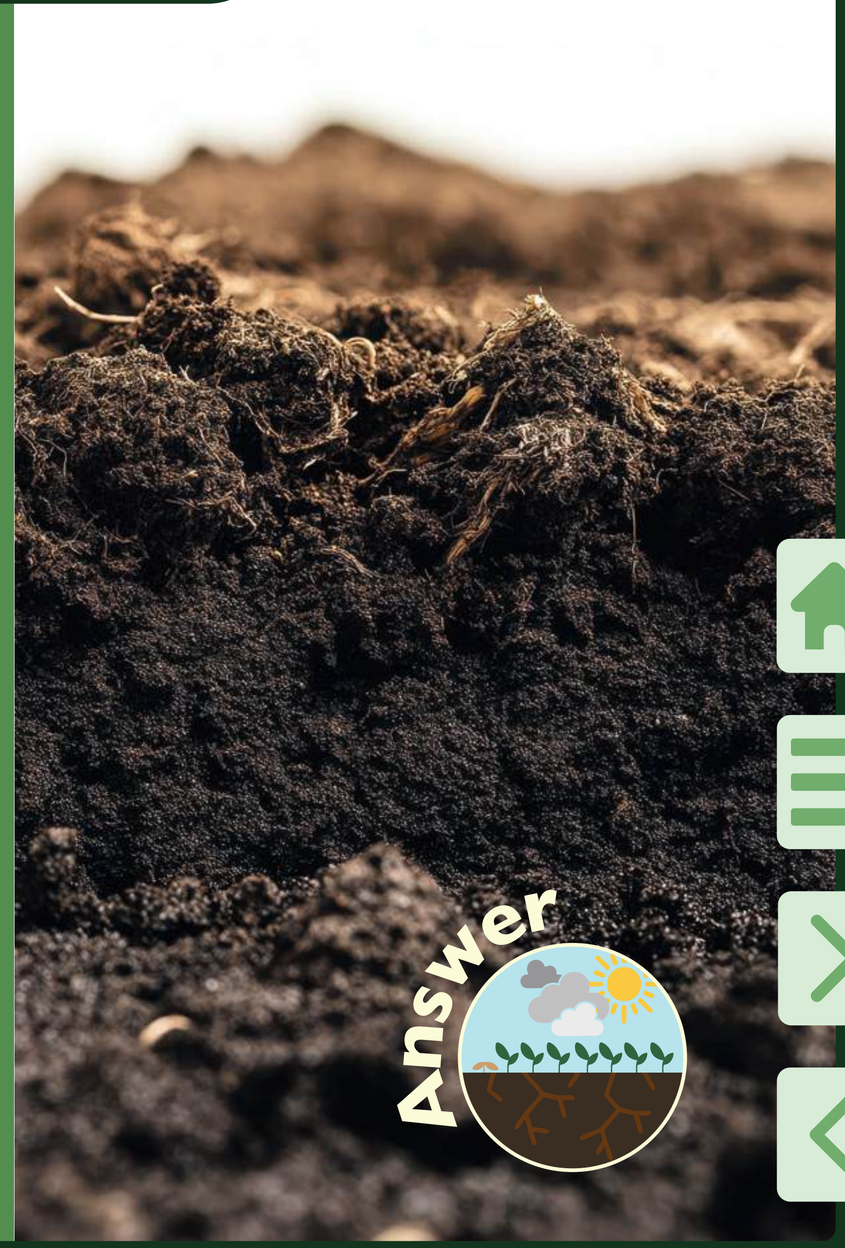
If all the surfaces of the grains of clay, the finest of the three main mineral components of soil, were arranged on a flat surface, a single gram would cover 800m².
Air, present among the various mineral particles in the soil, is vital for the respiration of billions of micro-organisms and bacteria. This air is found trapped in soil porosity, but in compacted or degraded soils, the lack of porosity reduces the possibility of hosting life forms. Furthermore, soil is made of water, which represents a quarter of its volume.



Hyphae are the filamentous of a mycorrhiza fungus, and their life is interconnected to the life of plants. The symbiosis between plants and fungi, whose filaments form the mycelium, occurs through:

- [ ] the mutual transfer of substances and nutrients that plants and fungi alone are unable to find
- [ ] mutual communication between plants
- [ ] notification of obstacles to the penetration of roots

Question

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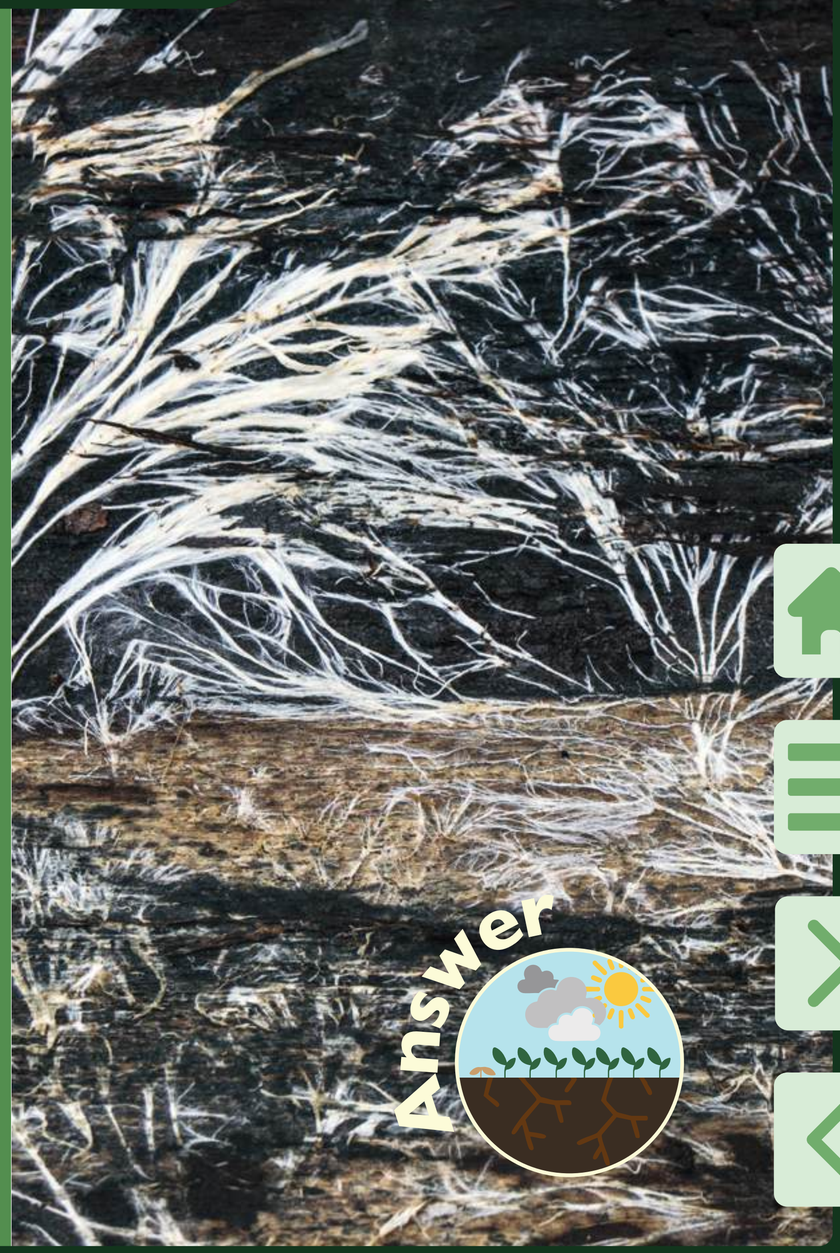
- [ ] mutual communication between plants
- [ ] notification of obstacles to the penetration of roots

Plants supply the fungi with the glucose they produce through photosynthesis , while the fungi feed them with phosphorous, nitrogen, and other elements that they extract from the soil and transport more efficiently than plant roots In a gram of soil you can find approximately one kilometre of fungi filaments, called hyphae. One aspect that is still being investigated is the possibility that plants communicate with each other through fungal mycelium, a fascinating hypothesis but one that has not yet been scientifically proven. The filamentous mycelium of mycorrhizal fungi is essential for the survival of most plants: it is able to obtain nutrients even tens of metres from the roots, reaching spaces that are inaccessible to the roots themselves, which are fifty times larger. Without it 80-90% of plants would not exist.



topic: bacteria

In addition to fungi, plants roots are surrounded by colonies of beneficial bacteria, which play a key role in their health and growth, because:

- [ ] keep insects away from the roots, preventing their attack and damage;
- [ ] in symbiosis with the plant, they produce, for example, growth hormone and (only for certain types of plants such as leguminous plants) convert inert nitrogen in the air into minerals that are essential for protein production;
- [ ] facilitate plants' water absorption.

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5/6

Plants release between 11 and 40 % of the sugars produced by photosynthesis into the area surrounding their roots, called the rhizosphere. This area, that can be compared to 'external intestines' hosts a massive number of bacteria, up to a billion per gram of soil. Sugars provided by plants activate these bacteria, which in return break down complex organic compounds making them available for uptake by the roots. When the soil is impoverished, e.g. due to excessive application of fertilisers, pesticides, ploughing or the use of heavy machinery, biodiversity is reduced. Under these conditions, plants become more vulnerable to pathogen attacks. Bacteria, which are harmful if they are able to proliferate, can compromise plant health. To defend themselves, plants can resort to a kind of "chemical warfare", releasing compounds into the soil that inhibit the development of harmful micro-organisms and favour beneficial ones.

topic: earthworms

The drilosphere is the portion of soil connected to tunnels dug by earthworms. The presence of these curious inhabitants of the soil has among has the following effects:

- [ ] facilitating, thanks to the earthworms' burrows, the increase in soil erosion
- [ ] destroying the thinnest roots of plants
- [ ] shredding animal and plant waste and enriching the humus

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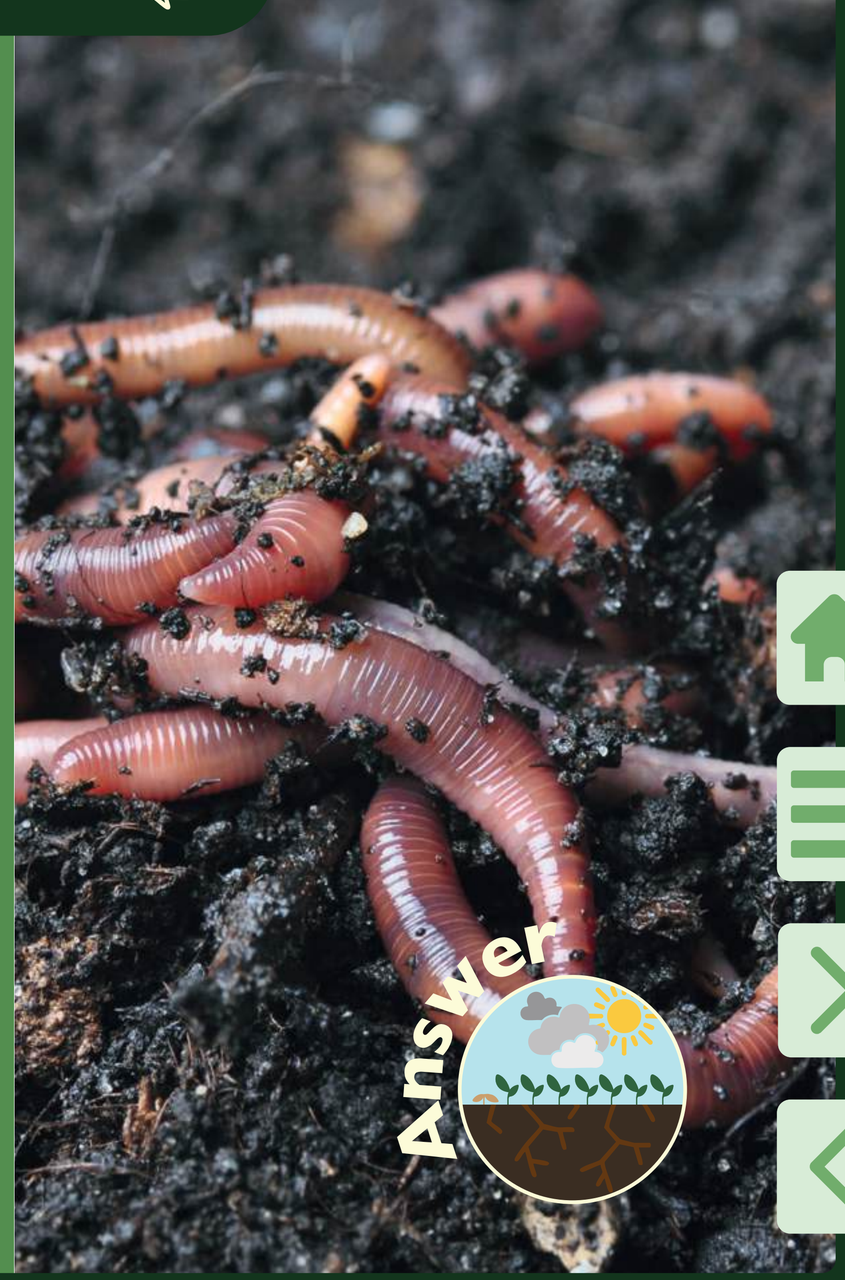
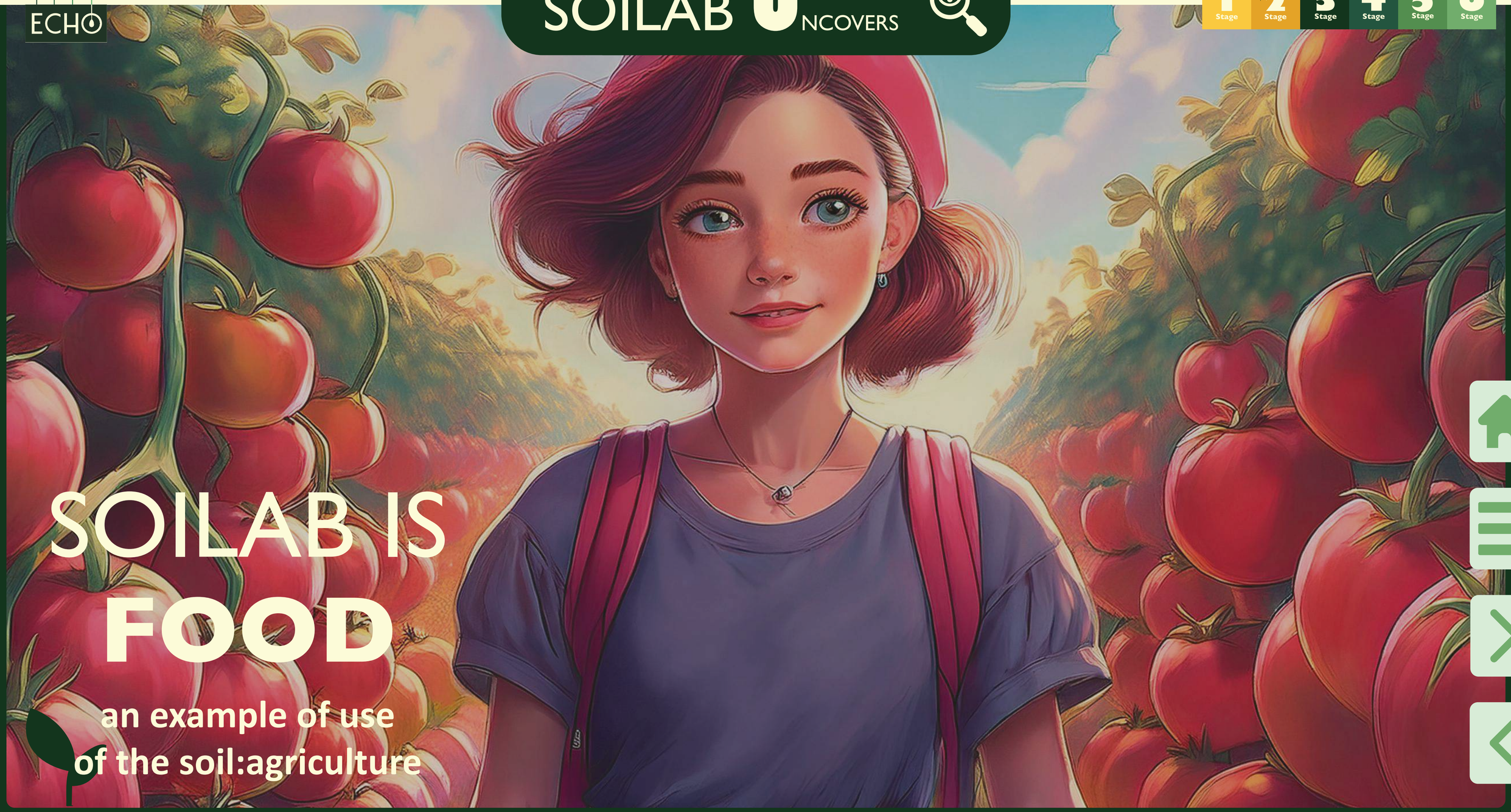
- [x] shredding animal and plant waste and enriching the humus

Earthworms can bring to the surface up to 40 tonnes of soil per hectare per year, playing a unique and irreplaceable role mixing and aerating the soil surface layer. Thanks to the organic material they feed on, their excrement is much richer in minerals than the rest of the soil. By shredding dead plants, earthworms release the nutrients they contain, making them accessible to bacteria and fungi. These, in turn, transform nutrients into forms that can be used by living plants. The presence of earthworms significantly increases the productivity of the soil: in areas where they are present the weight of plants and animals that live on the ground is, on average, 20% more than in areas with a lack of them.



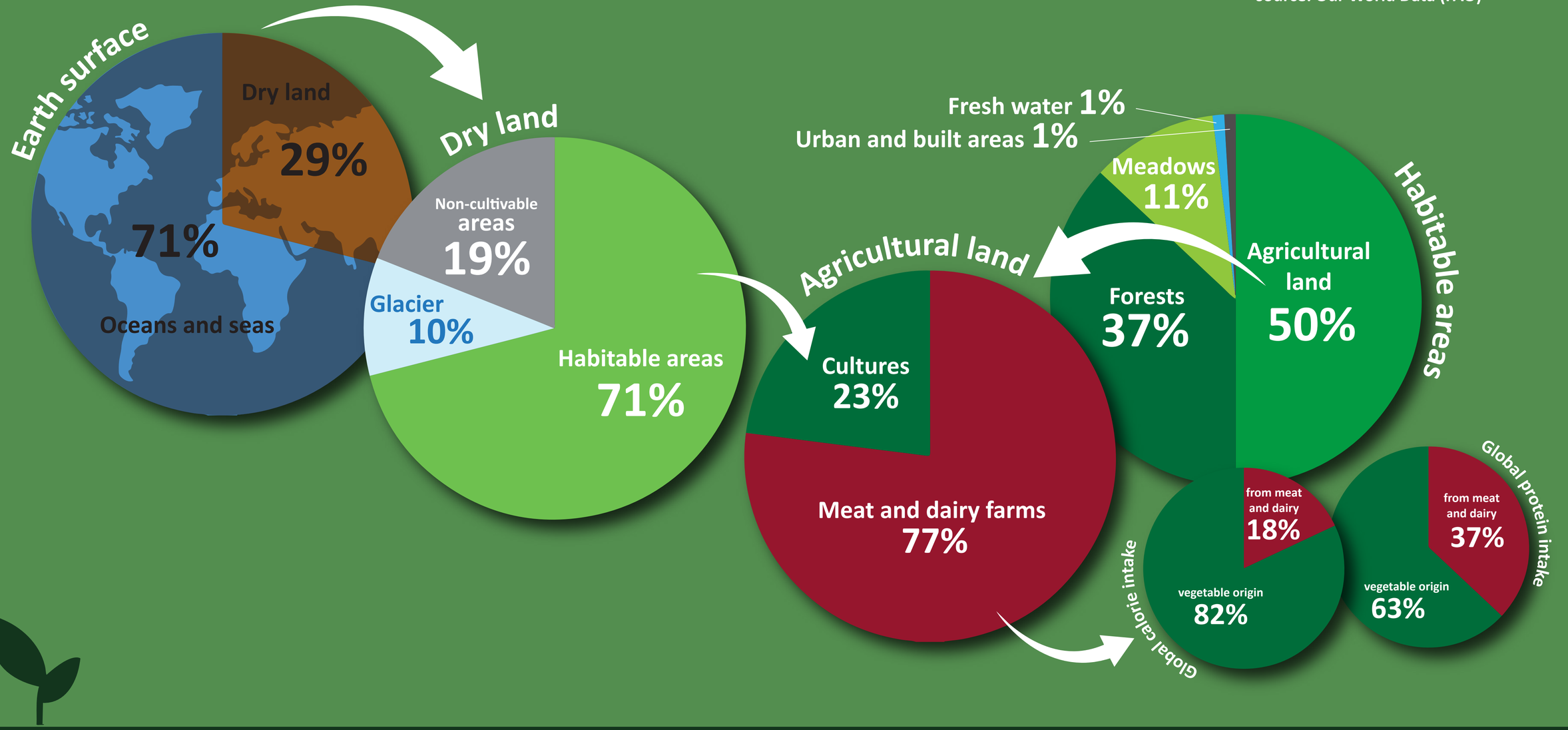


SOILAB IS FOOD

an example of use
of the soil:agriculture

Soil use, on a global scale, for food production

source: Our World Data (FAO)




SOILAB
UNCOVERS

ECHO

SOILAB UNCOVERS • SOIL IS FOOD •

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

The objective of the game is to remove all, or as many as possible, of the 21 hexagonal tiles that cover the image.

How to play:

1. Select a flower: Choose one of the seven flowers depicted on the hexagonal tiles

2. Answer the question: You'll be asked a question. According to your answer, you'll find out how many tiles you can remove.

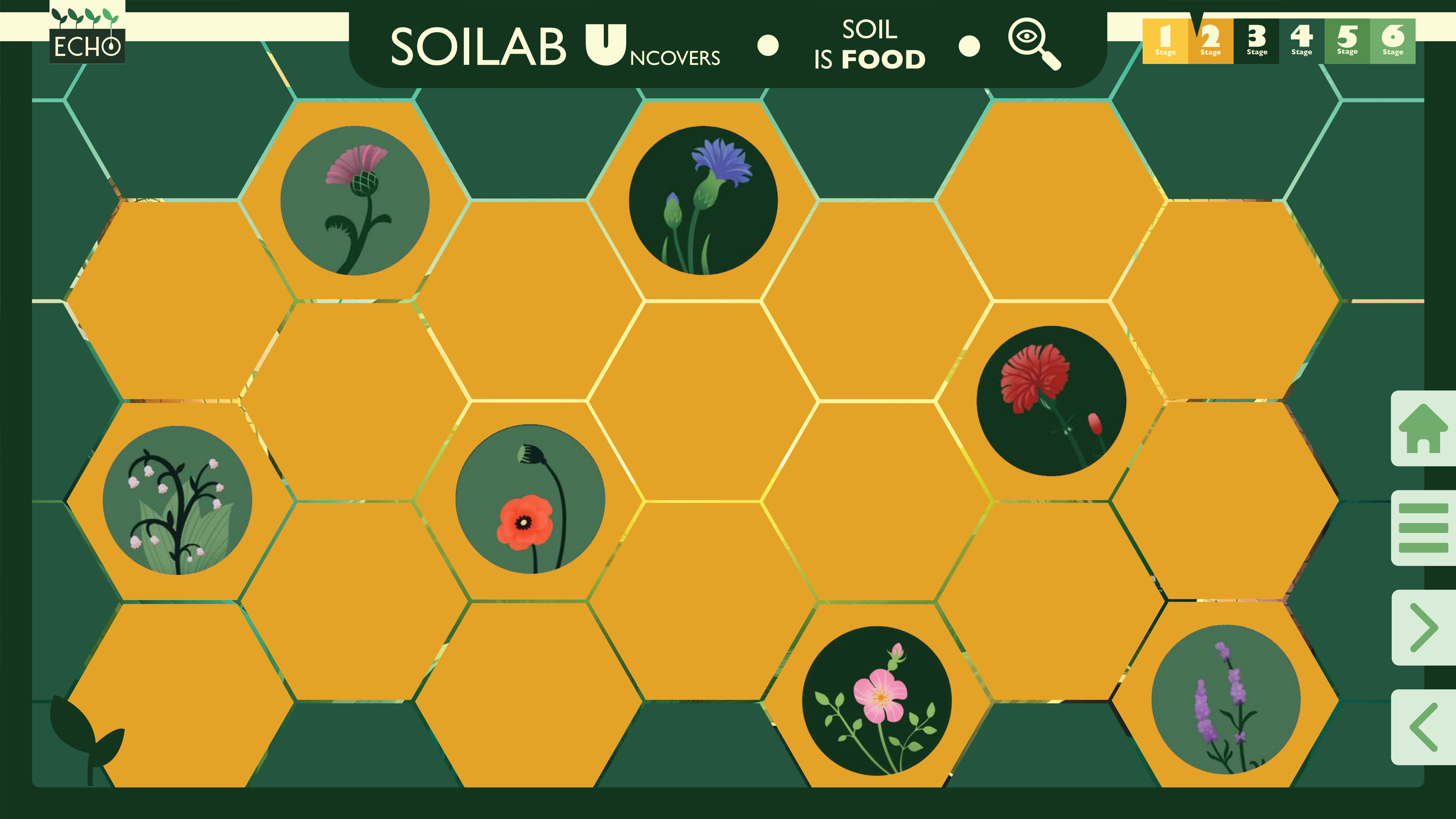
3. Continue the game: After removing the tiles that have been unlocked, select another tile amongst the remaining ones and repeat the process.

The aim is to completely uncover the hidden image, or to remove as many tiles as possible.

START THE CHALLENGE!

Each tile enables a favourable or unfavourable action fundamental for healthy ecosystems, the restoration of biodiversity in the agricultural area and the counteracting of soil degradation, and has precise consequences connected to: the return of certain bio-indicators in the game, such as butterflies*, the maintenance or improvement of the yield of the agricultural crop, the quality of the field products.

A **bio-indicator** is a biological organism or system used to assess changes in the quality of the environment. In other words, it is a biological element that, in response to natural or man-made distress, undergoes measurable changes in its natural state. The EU has chosen butterflies as a bio-indicator on the state of habitats.


ECHO
SOILAB UNCOVERS
SOIL IS FOOD
1 Stage
2 Stage
3 Stage
4 Stage
5 Stage
6 Stage

TOPIC:
monoculture

A

You are a farmer, mainly producing maize. Lately your cultures have been much less productive.

To counter the productivity loss phenomenon, you choose to:

- [ ] **increase synthetic nutrients;**
- [ ] **practise crop diversification, rotation and green manure, partial replacement of synthetic fertilisers with manure and compost, and replacement of plant protection products with biological inputs and products of natural origin whenever possible.**

TOPIC:
monoculture

!

You have chosen to counter the loss of productivity of the soil increasing the use of synthetic nutrients. Apparently you have solved part of the problem.
However, excess nitrates, which are not absorbed by plants, dissolve in the water and follow surface or underground flows. Currently, only 20-30% of the fertilisers that are used are absorbed by plants, and the rest ends up in the environment, causing water and soil pollution.
We can refer to it as eutrophication, a condition of extreme nutrient richness (particularly nitrogen and phosphorous) from natural or man-made sources, such as fertilisers.

YOU HAVE REVEALED ONLY 1 TILE

1x

TOPIC:
monoculture

You have chosen to counter the loss of productivity of the soil using different solutions. It is a longer and more difficult method to solve the issue. But in the medium term it produces better results, both economically and environmentally.

YOU
HAVE
REVEALED 3
HEXAGONAL TILES

3x

TOPIC:
soil erosion

B

In your farm, you witness constant soil degradation, with worrying consequences on the productivity of your fields. In particular, due to increasingly more intense weather events, such as rain and wind, many of your crops are affected by continuous erosion.

To solve the problem you decide:

- [ ] **to access to dedicated funds for farmers who voluntarily decide to comply with regional voluntary integrated production specifications, i.e. comply with specific technical standards for each crop and mandatory plant protection directives In this case those aimed at the ‘conservation and sustainable use of soil’ and those aimed at the sustainable management of meadows and pastures;**
- [ ] **to purchase more land to balance out your productivity losses, choosing land that is naturally less exposed to erosion phenomena.**

TOPIC:
soil erosion

!

You trust in the possibility of cheaply expanding the agricultural area of your farm, but this medium/to long-term solution may not prove particularly useful. Productivity would be compromised anyway.

YOU HAVE REVEALED ONLY 1 TILE

1x

TOPIC:
soil erosion

You've chosen to counter the root-causes of the erosion of your soil. Even though you're aware that, especially in its most intense forms, erosion significantly reduces productivity, and in case of shallow land, it can bring to an irreversible loss of cultivable land.

YOU
HAVE
REVEALED 3
HEXAGONAL TILES

3x

TOPIC:
fertilisers and plant protection

C

Lately you've noticed a growing interest of public opinion and legislations for organic farming. One of your neighbours has also chosen to convert from traditional farming methods to certified organic, over the past four years. This change has enabled them to improve their turnover and reduce the environmental impact of their crops, even if it has led to a decrease in the quantity of their harvests.

You choose:

- ☐ to follow suit, through the total exclusion of the use of synthetic fertilisers and plant protection products, also to achieve certification of your products;
- ☐ not to exclude in advance any type of method, tending instead towards the minimal use of synthetic fertilisers and plant protection products and favouring the use of cultivation practices that prevent pest attacks.

TOPIC:
fertilisers and plant protection

You have chosen organic agriculture. This entails a conversion period, during which the required paperwork for organic certification must be followed. These practices include crop diversification, land rotation, the use of green manure, the replacement of synthetic fertilisers with manure and compost, and the use of biological inputs and products of natural origin instead of traditional pesticides.
Organic farming is an agricultural method that aims to produce food using only natural products and processes, minimising the impact on the environment. This approach focuses on preserving biodiversity, maintaining local ecological balances, preserving soil fertility and protecting water quality.

YOU HAVE REVEALED ONLY 2 TILES

2x

TOPIC:
fertilisers and plant protection

You have chosen sustainable agriculture. This type of agriculture lies between conventional and organic farming and its production system safeguards and enhances natural resources, while ensuring support for a stable rural community and balanced productivity both the short and long term. It is characterised by the limited use of synthetic fertilisers and plant protection products, preferring cultivation techniques that reduce the risk of pest attacks. It doesn't exclude the use of any specific input and is also known as LISA (Low Input Sustainable Agriculture). With the current knowledge, it can be considered a reference model for a responsible agriculture.

YOU HAVE REVEALED 3 HEXAGONAL TILES

3x

TOPIC:
soil
biodiversity

D

You are more aware of the importance of taking better care of the soil health than in the past, especially since you have noticed a significant drop in the yield of your fields. Your generation has developed a different vision to the previous ones, more aware to sustainability. Yet, adopting methods and techniques to safeguard or restore fertility to the soil is not an easy task.

After arguing for long with your family you decide to:

- ☐ rehabilitate and preserve vital soil functions, focusing on improving organic matter in the surface layer. To do so you will adopt practices such as (different cultures that live in the same space), cultures rotation, the use of nitrogen fixating plants and the reduction of the use of external inputs;
- ☐ focus on quantity at low cost in production, making food more accessible to everybody. In this case you'd choose an approach based on intensive use of fertilisers and plant protection products.

TOPIC:
soil
biodiversity

!

There is no doubt that the use of synthetic products can, in the short term, help counteract the signs of soil degradation. However, it is important to consider the long-term effect of an intensive use of such products. Plant protection products are used to control harmful organisms that can affect the health of a plant. There are different types of pesticides, depending on the organisms they are intended to limit: herbicides, fungicides, insecticides and rodenticides. Although pesticides are designed to hit specific targets, it is crucial to be aware of their environmental impact, especially in the case of intensive use. In fact, a part of the products is not absorbed by plants and may end up in the soil, water or air, with effects that may also impact other organisms and affect the quality of products intended for human consumption (this is referred to as bioaccumulation in the food chain).

The abiotic component, like the air, is also impacted by these substances, with effects that vary depending on weather conditions. In particular, rainfalls can modify the soil capacity to absorb pesticides, therefore washing them away.

YOU
HAVE
REVEALED
ONLY 1 TILE
1x

TOPIC:
soil
biodiversity

You have chosen the longer and the more difficult path, but it is the one that will bring good medium terms results. To rehabilitate and preserve vital soil functions, it is fundamental to reduce operations that cause soil compactation, one of the main reasons of soil organic carbon, essential element for the health of the soil and the ecosystem services. A further step is the integration of nutrients through compost from the separate collection of organic waste.

Among the most effective soil protection techniques are cover crops. Plants such as clover, radish, peas, and oats help reduce erosion caused by rainfall and control weed growth. In spring, plant remains are left on the soil, allowing the gradual release of nutrients and enriching the soil's organic substance.

Many farmers today are adopting conservation agriculture practices, such as minimum tillage. This technique involves working only the first 5-15 cm of the soil, avoiding deep ploughing. Leaving crop residues after harvesting allows organic matter to be retained, reduces erosion and limits carbon dioxide emissions into the atmosphere.

YOU
HAVE
REVEALED 3
HEXAGONAL TILES

3x

TOPIC:
irrigation and drought

E

In agriculture, it is more and more frequent to have dry years during which the need for water is more than the resources available to the community. Soil that is kept moist, by planning the use of water resources in advance, makes it possible to predict the risks associated with droughts but also with floods.

To counter the increasingly more frequent droughts you choose to:

- [ ] change irrigation system;
- [ ] increase the irrigation of the fields to counter droughts phenomena.

TOPIC:
irrigation and drought

In many areas of the EU, in times of drought, the water available for traditional irrigation is no longer sufficient for everyone. To tackle this shortage, many farmers had to change or abandon cultures that need a lot of water.
Failure to invest in water-saving irrigation can result in the inability to cope with increasingly frequent droughts, causing economic, as well as environmental, damage to one's farm.

!

YOU HAVE REVEALED ONLY 1 TILE

1x

TOPIC:
health of the habitats

You have chosen to invest in more efficient irrigation systems, to collect rainwater, use soil moisture sensors and to schedule irrigation during the cooler hours of the day to minimise evaporation loss. Moreover, when possible you use mulching made of vegetable material of biodegradable films.
One of the main causes of the difficulties in coping with drought in agriculture is the still widespread use of inefficient irrigation systems. The efficiency of a system is measured by comparing the amount of water actually used by the crop with the amount withdrawn by the pump. The more inefficient a system is, the less likely it is to achieve significant water saving. In order of efficiency the main irrigation systems are: surface irrigation (with an average efficiency of 25%), gravity (30-40%), sprinkler (70-80%), and drip irrigation (85-90%). Surface and gravity irrigation methods can cause a significant leaching (i.e. loss) of nutrients, which can then reach the water table. Sprinkler systems require a lot of energy, as water is expelled at high pressure. Finally, drip irrigation distributes water in a localised manner, close to the plants, minimising waste.

YOU HAVE REVEALED 3 HEXAGONAL TILES

3x

TOPIC:
health of the habitats

F

To protect biodiversity and soil quality through sustainable farming practices, the EU's Common Agricultural Policy (CAP) requires farmers who wish to receive subsidies to comply with an enhanced set of new environmental and climate-friendly standards, the so-called GAEC (Good Agricultural and Environmental Conditions). Among these, the BCAA 8 standard requires that a minimum amount of arable land is dedicated to non-productive areas.

You choose to comply with EU policies:

- [ ] keeping 4% of your farmland uncultivated or unproductive, especially on steep terrain, border areas between different crops, or small areas of forest, which are already common on small to medium-sized farms;
- [ ] cultivating nitrogen-fixing crops (such as lentils, peas or field beans) and/or catch crops (plants growing between two main crops) on 7% of your farmland.

TOPIC:
health of the habitats

You are among those who, as a result of the waivers obtained after a long debate between EU institutions, professional organisations and citizens, instead of keeping uncultivated or unproductive land on 4% of your intensive arable land, have chosen to cultivate nitrogen-fixing crops (such as lentils, peas or field beans) and/or grow no-tillage intercrops (plants growing between two main crops) on 7% of your farmland. Even though this choice allows you to comply with the EU legislation, it is less efficient to safeguard and restore biodiversity, compared to other practices.

YOU HAVE REVEALED ONLY 1 TILE

1x

TOPIC:
health of the habitats

You have chosen to preserve the grassy spaces near the crops and the strips of soil that act as dividers, to encourage the presence of useful insects and antagonists of harmful ones. In this way, you pay special attention to habitat quality, contributing to biodiversity and natural pest control.

YOU HAVE REVEALED 3 HEXAGONAL TILES

3x

TOPIC:
the help provided by technological innovation

G

Nowadays, new technologies and digitisation seem to offer solutions to many of the problems caused by the excesses of conventional agriculture. However, there are those who prefer to adopt, in a contemporary key, techniques that come from the past and from the best agricultural traditions. This is quite a dilemma, also an economic one, which forces farmers to make precise, sometimes divergent choices.

In your case you choose to:

- ☐ apply for funding to adopt precision farming techniques, which allow plants to be given only what they need, at the right time and place, to reduce the use of synthetic products;
- ☐ adopt conservation agriculture, which focuses on preserving the soil resource, trying, through various techniques, to keep the structure, soil fauna and organic matter intact.

TOPIC:
the help provided by technological innovation

You have chosen precision agriculture, a farm management strategy (both agricultural and livestock) that applies inputs variably, based on actual crop needs and the chemical, physical and biological characteristics of the soil, with the aim of improving yields and the quality of the environment. The goal is producing more, while improving the quality, and respecting environmental sustainability.
This system provides the tools to do the right thing, in the right place, at the right time. It is based on the observation, measurement and response to variables that influence agricultural production (such as soil texture, water content, pH, biological properties and the use of irrigation, seeds, fertilisers used...)
Benefits include: an increase in production and/or product quality, a more efficient and targeted use of inputs such as fertilisers, water, herbicides and pesticides, reducing, therefore, expenses and the protecting natural resources (soil, water), reducing climate-altering emissions and energy consumption during agricultural processes, the preserving soil fertility, reducing human errors and improving working conditions for operators.

YOU HAVE REVEALED 3 HEXAGONAL TILES

3x

TOPIC:
the help provided by technological innovation

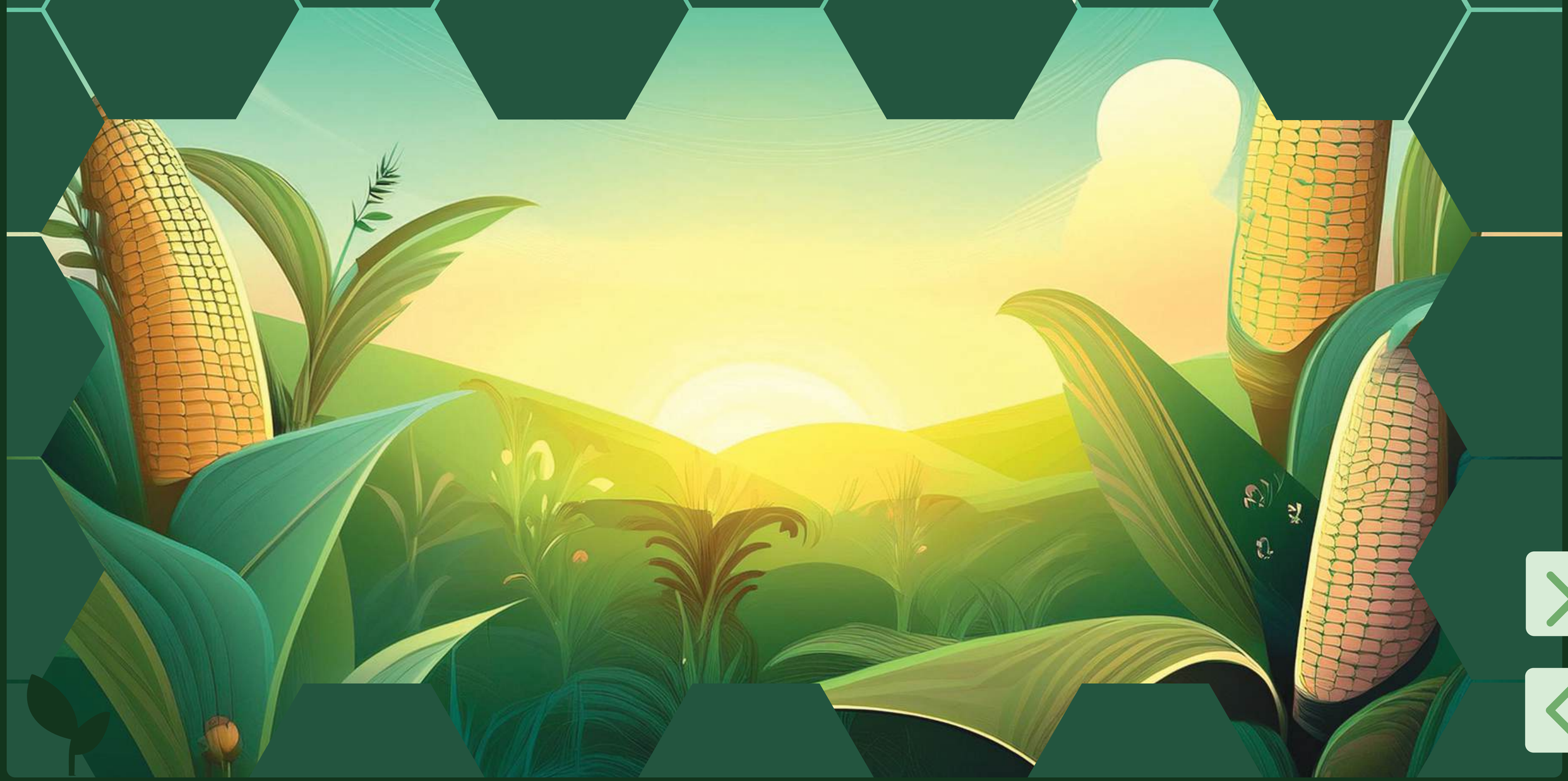
You have chosen conservation agriculture, a technique that includes a number of complementary agronomic practices, such as minimal soil disturbance to preserve structure, soil fauna and organic matter. It also entails permanent soil cover (with cover crops, residues and protective coulters) to protect the soil and reduce weeds, as well as the adoption of diversified crop rotations, which favour soil micro-organisms and combat weeds, pests and plant diseases. Deep tillage, which involves the inversion of soil layers, is replaced by shallow tillage, minimum tillage or sowing on hard ground. These methods counteract organic matter loss, reduce soil erosion and compaction, limit water evaporation, improve soil structure and increase water retention capacity.

The main benefits of this technique are:

- the improvement of organic carbon reserves, biological activity, epigeal and subterranean biodiversity and soil structure;
- the mitigation of climate change effects;
- the reduction of erosion and surface run-off;
- the reduction of labour and energy costs for land preparation and weeding operations;
- the reduction in use of fertilisers and interventions for land recovery.

YOU HAVE REVEALED 3 HEXAGONAL TILES

3x



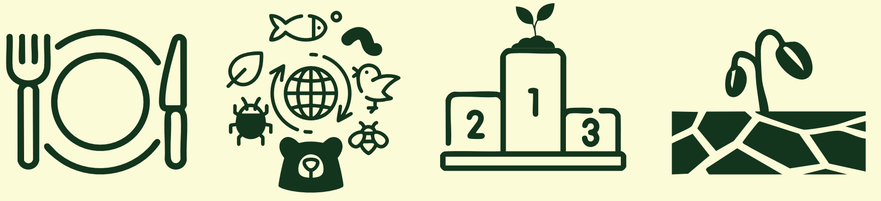

SOIL IS
HEALTH
both for the living beings
and for the environment
the health of the soil in Europe

The soil is a complex system

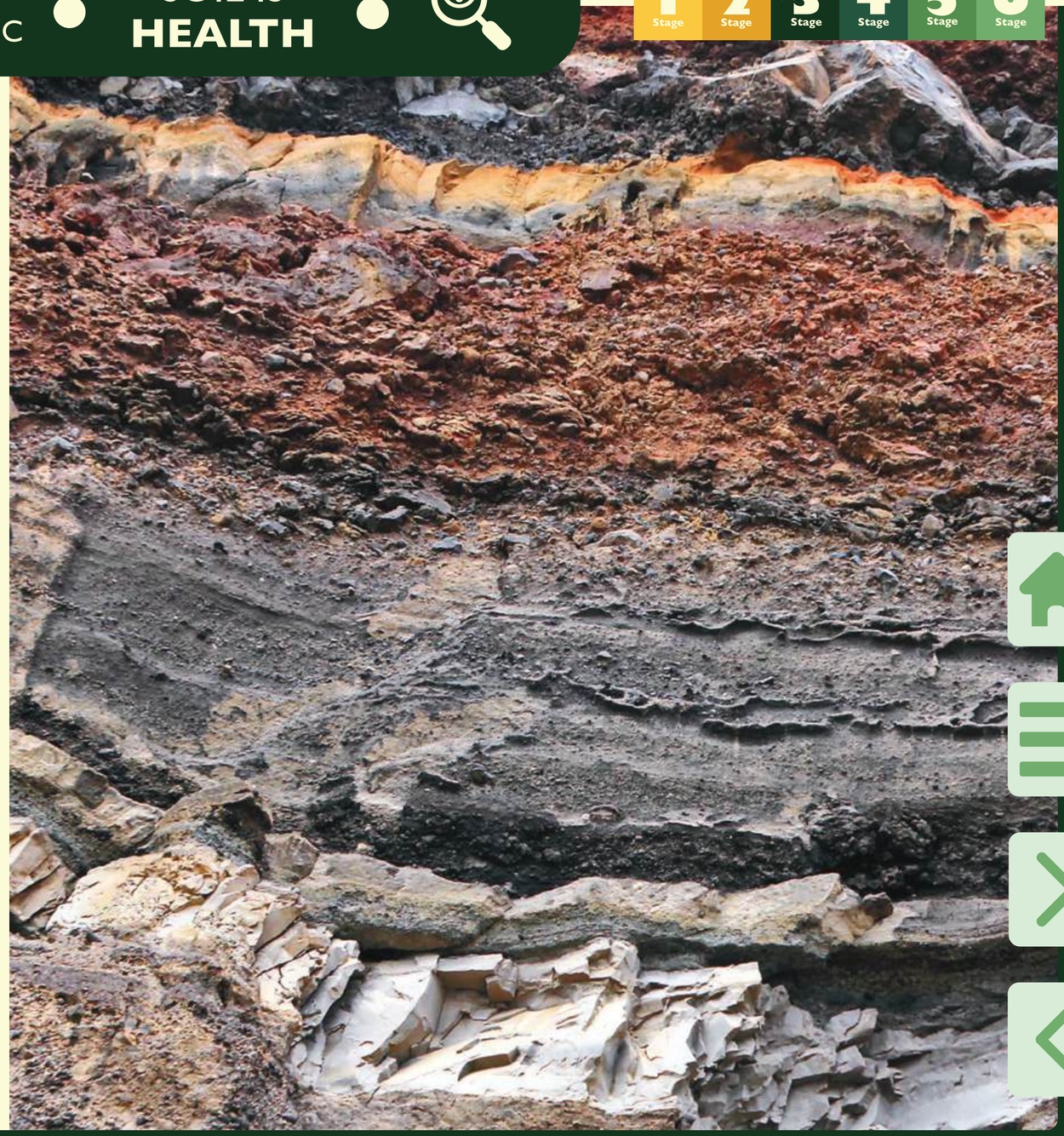
There are thousands of types of soil.

Healthy soils form the basis of 95 % of the food we consume, are home to more than 25 % of the world's biodiversity and represent the largest terrestrial carbon sink on the planet. However, soil is a limited resource and between 60 % and 70 % of the lands in the EU are not in good state. Human beings and our ecosystems depend on soil as a source of food, clean water and habitat. Therefore, it is crucial to protect and restore this non-renewable resource.

EU Mission: A Soil Deal for Europe



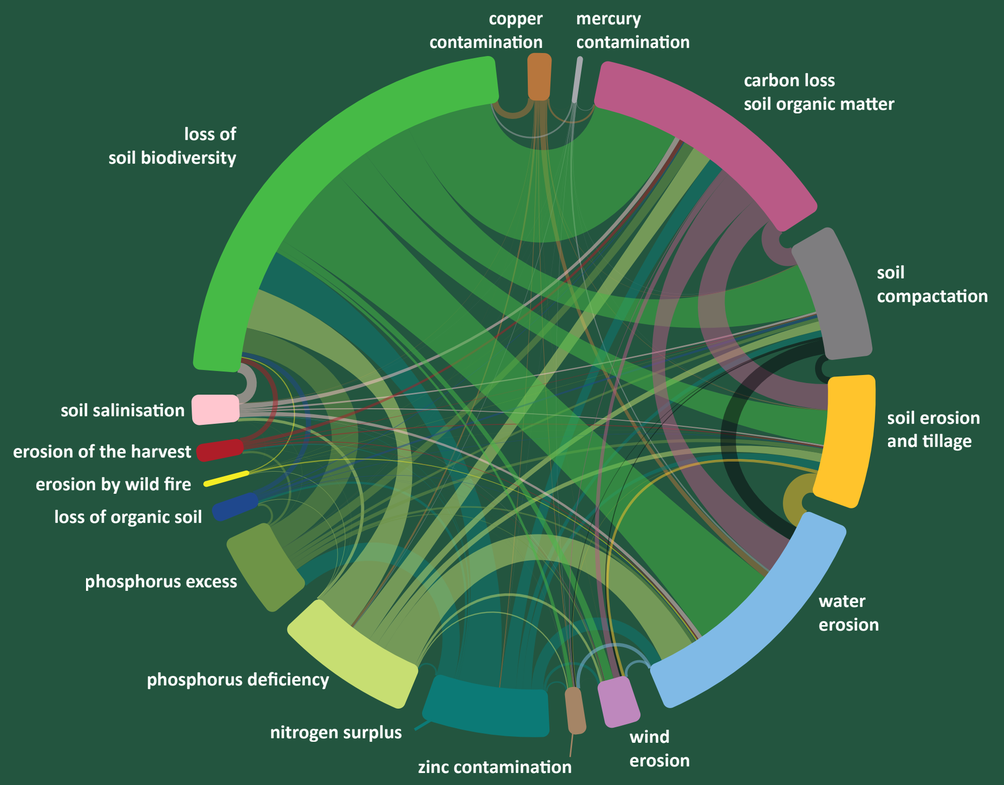
95% **25%** **carbon storage** **60/70%**



The combinations of soil degradation

This diagram provides information on the causes of soil degradation and, in more detail, on the extent of degradation combinations that are expected to happen in the EU. It shows the extension of the area (in hectares) representing the overlap between the pairs of soil degradation processes, as shown in the evidence convergence map. The size of the area that connects two degradations of the soil in the diagram is proportional to the extent of their overlap on the map.

Indicators of soil degradation in Europe



Map of soil degradation in Europe

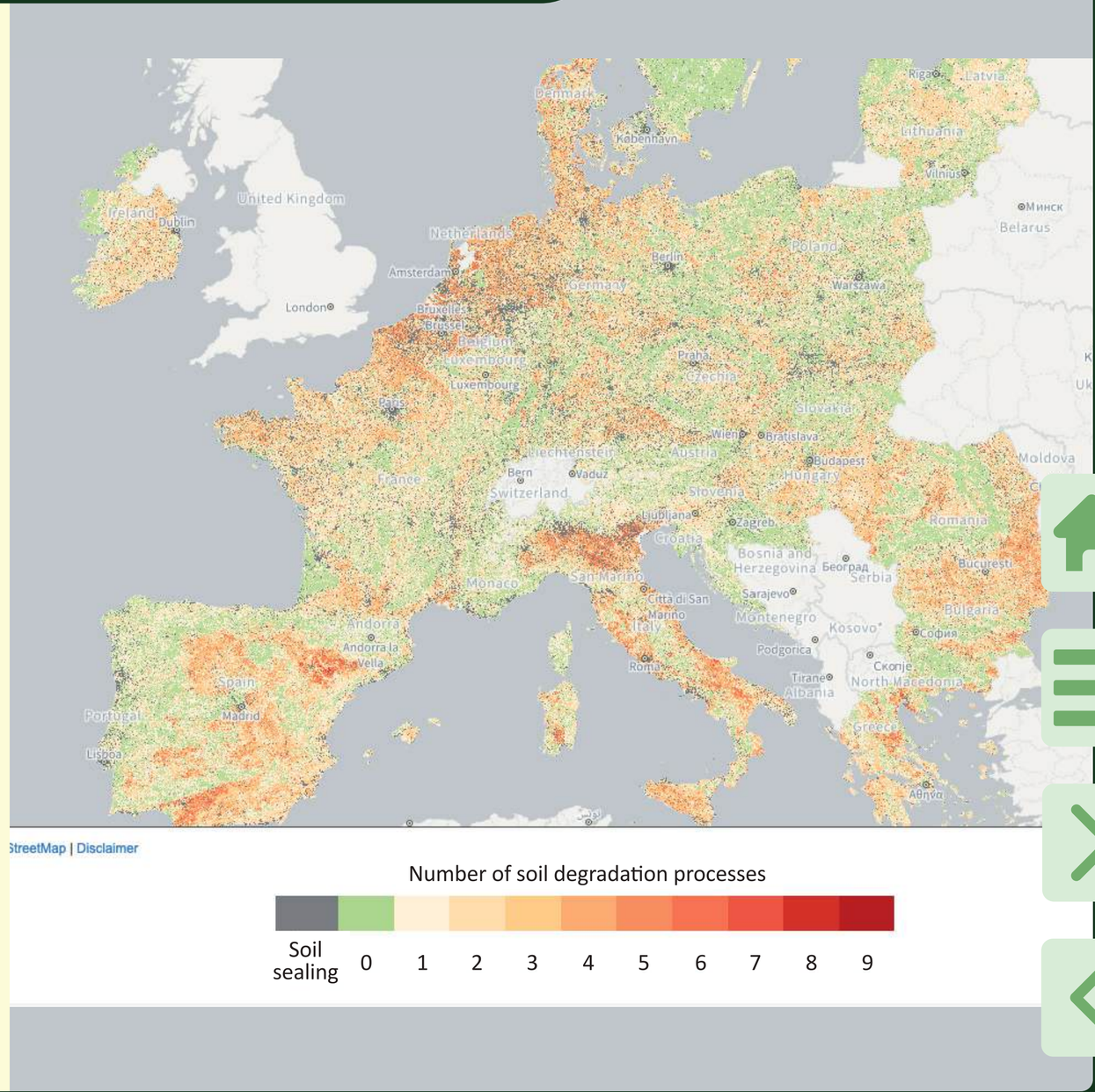
The resolution of the map is 500 metres, i.e. each pixel is 500 m x 500 m. The map provides indications of the possible location of degraded soils in the EU.

For each soil degradation process, thresholds have been established to distinguish healthy from unhealthy soils, based on a combination of scientific estimates and critical limits. These thresholds represent an estimate of the point beyond which most soils can be considered unhealthy or vulnerable to a given process. However, due to the wide range of soil types, some thresholds at the EU level, may entail significant uncertainty.

‘Soil sealing' (grey on the map) represents pixels where the soil is sealed, excluding other types of degradation. The colour range, 0 to 9, applies to unsealed pixels for which data is available. A value of 0 (green on the map) indicates that none of the soil degradation indicators at that pixel exceed the set thresholds. A value of 1 indicates that at least one of the indicators exceeds the threshold, and so on up to 9, which represents the maximum number of simultaneous degradation types found according to current evidence.

This ‘convergence of evidence’ map shows where the scientific evidence points to areas potentially affected by soil degradation processes. In each pixel, the map indicates how many soil degradation processes may be present.

The ecological footprint is a measure of the human consumption needs of the biosphere relative to the capacity of ecosystems to renew themselves.

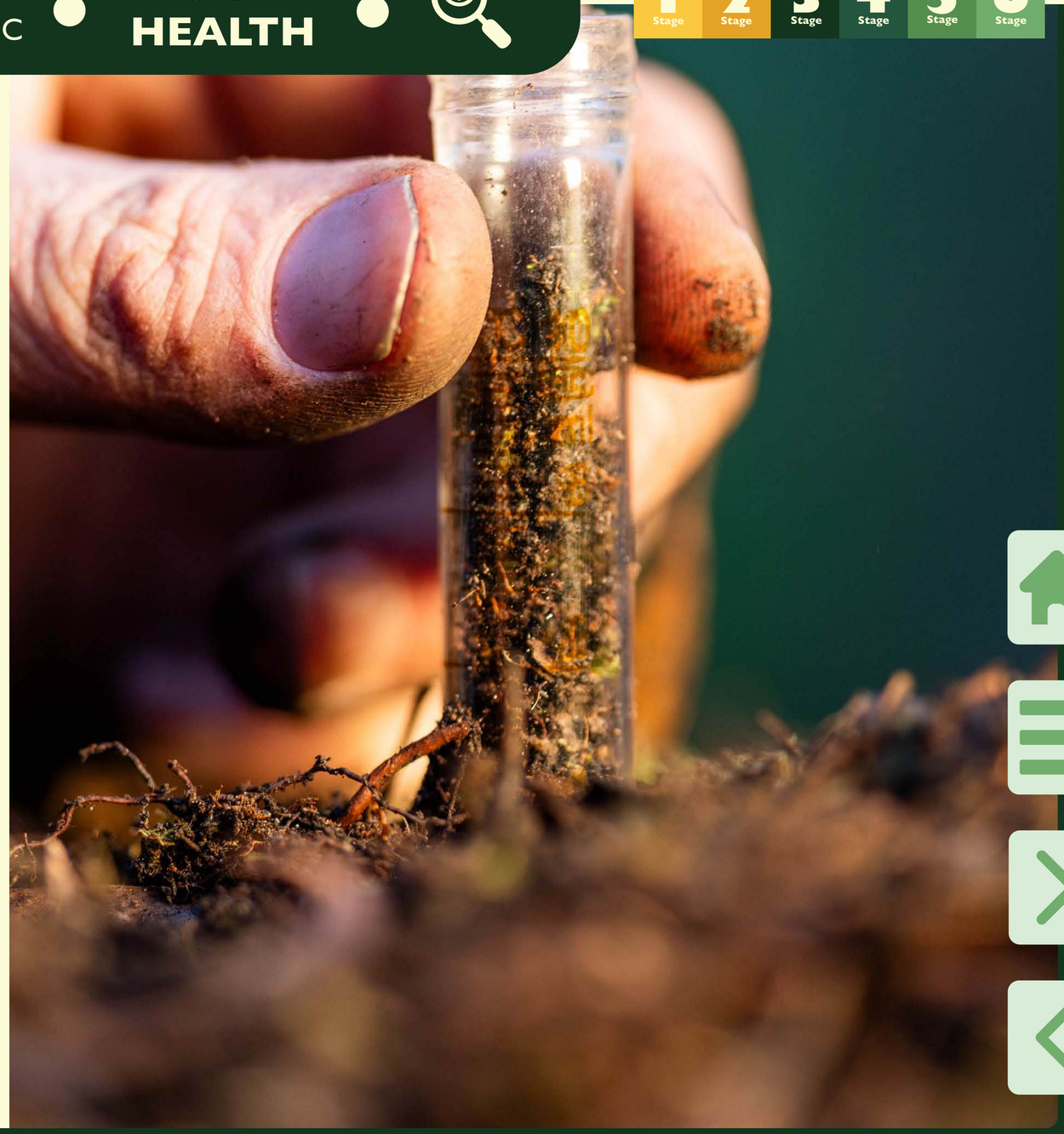


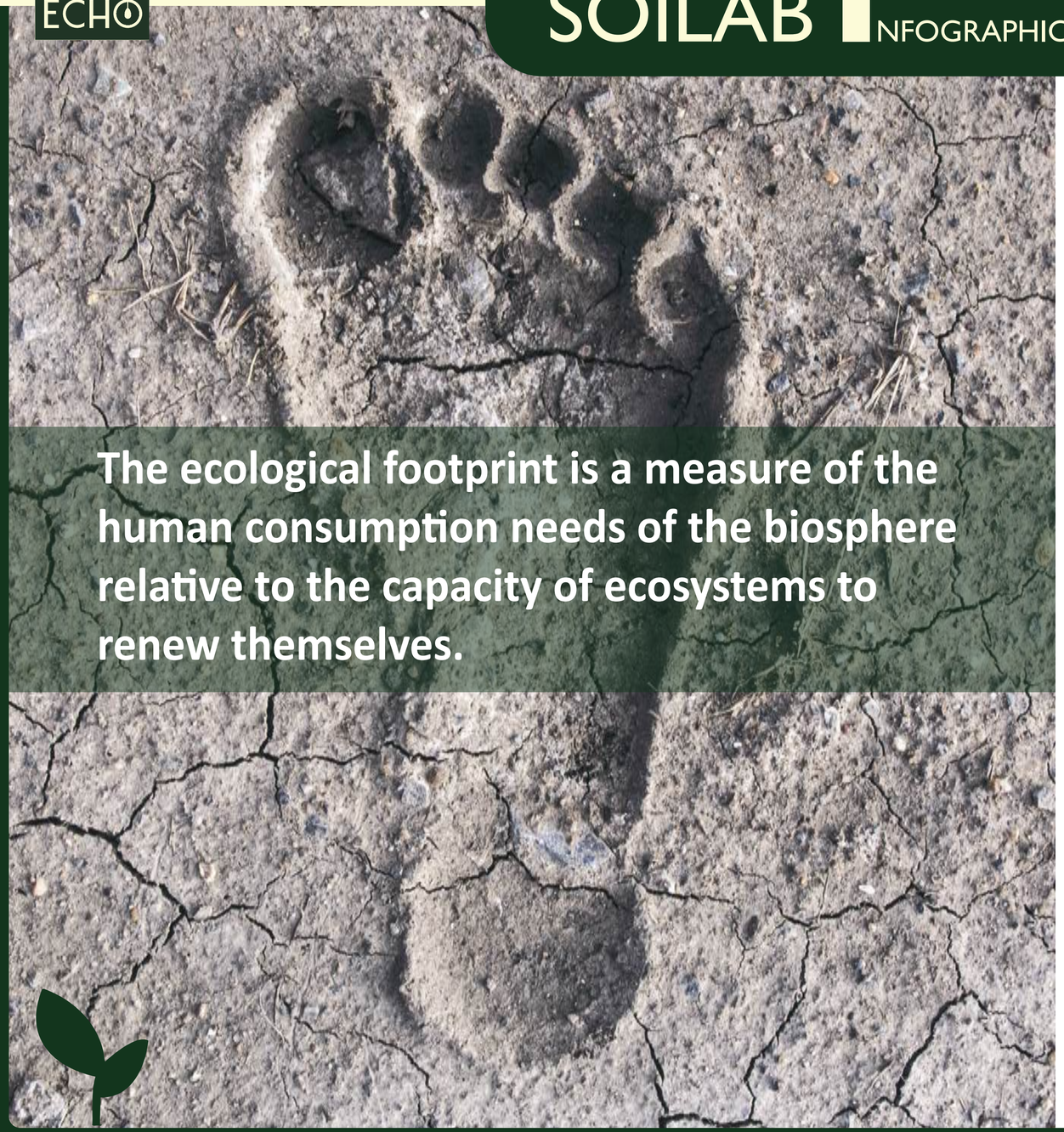
Carbon in the soil

The main index of soil quality and fertility is **Soil Organic Matter (SOM)**. Soils rich in organic matter contain between 3 and 10 %. Over half of the SOM (58%) is made of **Soil Organic Carbon (SOC)**. SOC, which is mainly found in the superficial layers of the soil, represents an amount that is subtracted by the possible presence of carbon in the atmosphere. In this way, it plays a climate-regulating role, as long as it is not prevented from absorbing CO_2.

The amount of carbon stored in the soil depends on its use. For example, a grassland stores 60 times more carbon than a porous urban area, an agricultural area stores 12 times more, a forest 37 times and a wetland 66 times.

Soil is, therefore, a major terrestrial contributor to the fight against global warming and is the largest carbon sink on dry land.



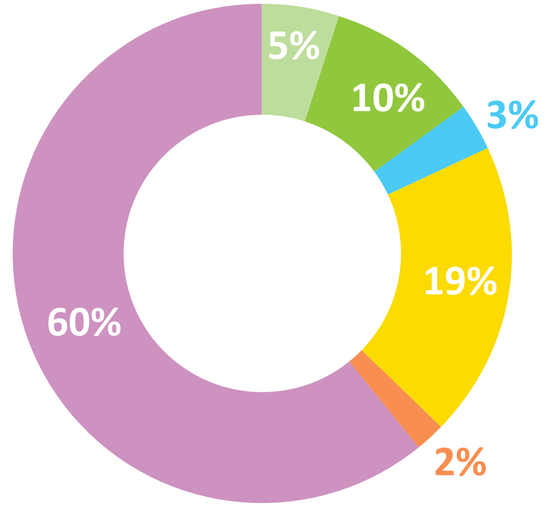


The ecological footprint is a measure of the human consumption needs of the biosphere relative to the capacity of ecosystems to renew themselves.

The ecological footprint of humans according to land use

legend

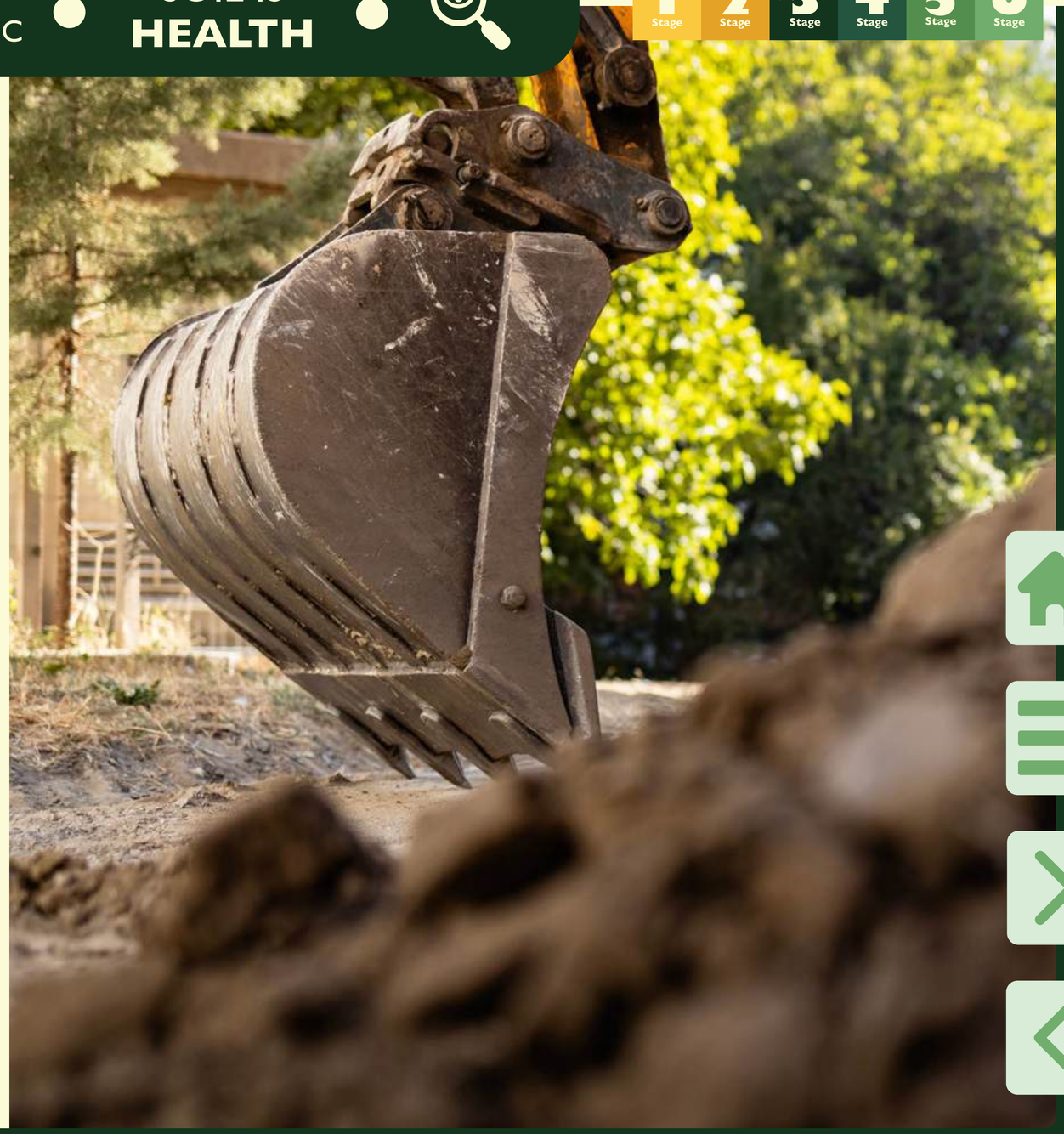
- pastures footprint
- forestry products footprint
- fishing areas footprint
- built-up land footprint
- cultivated land footprint
- carbon footprint
  It measures carbon emissions against the forest areas required to absorb those emissions

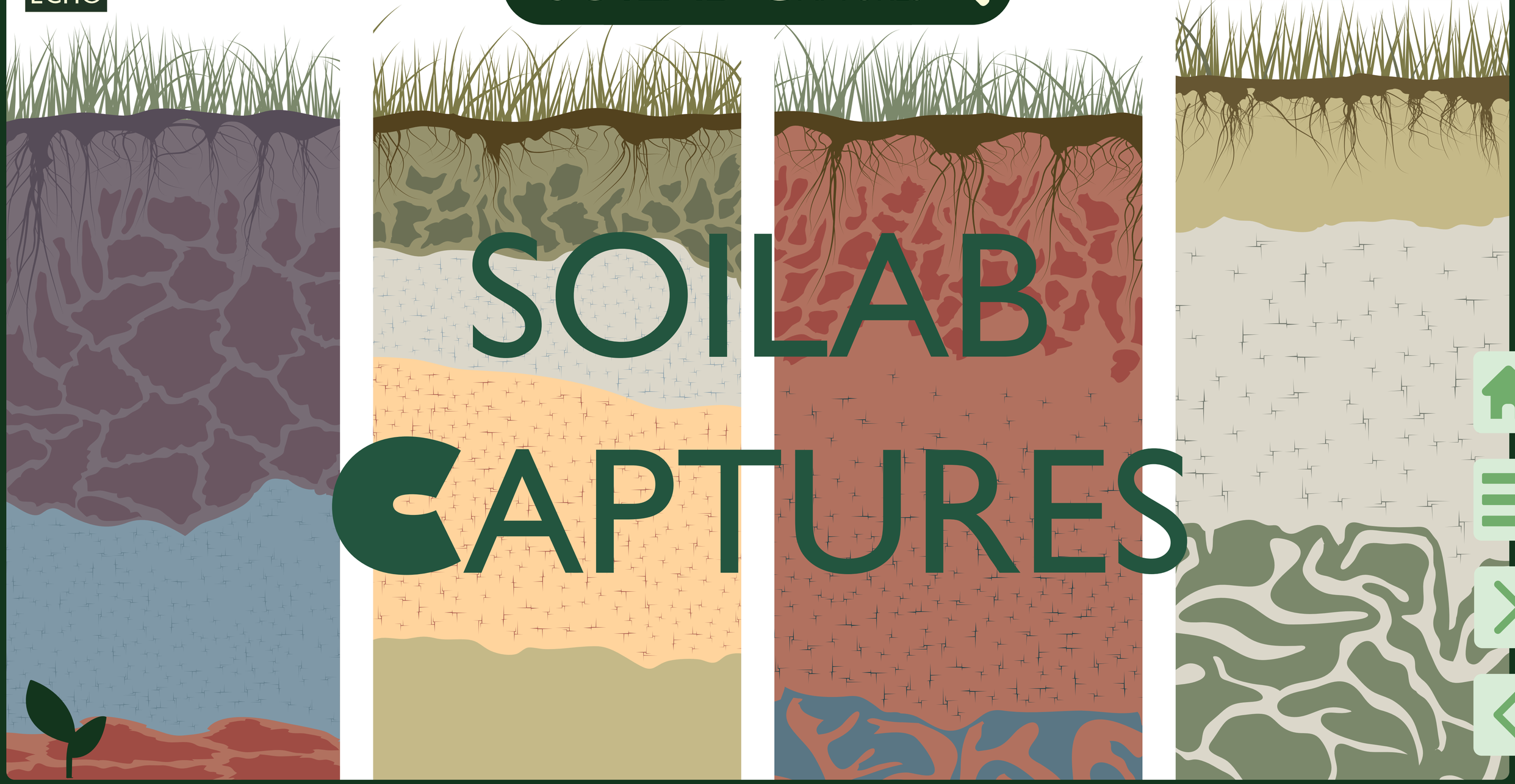


source: Wwf Living Pianet Report 2022

Soil consumption

Soil consumption is a phenomenon associated with the loss of a fundamental environmental resource, due to the occupation of originally agricultural, natural or semi-natural areas as a result of an increase in artificial land cover, linked to settlement, infrastructure and land transformation dynamics. Net soil consumption is assessed through the balance between soil consumption and the increase of agricultural, natural and semi-natural areas due to reclamation, demolition, de-impermeabilisation, renaturation or other interventions.




SOILAB
CAPTURES

ECHO

SOILAB CAPTURES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

land cover

GAMES INSTRUCTIONS

On the screen there are several tiles floating with illustrations that represent different types of soil covering, both in positive and negative contexts. Earn points by catching them in time and win the challenge to get detailed information about the examples of soil covering and the consequences in relation to soil degradation parameters. The tiles represent: (A) man-made areas, such as urban and suburban areas with infrastructure and buildings; (B) agricultural areas, dedicated to crops and livestock; (C) forests and semi-natural areas; (D) wetlands; (E) water bodies; and (F) contaminated sites.

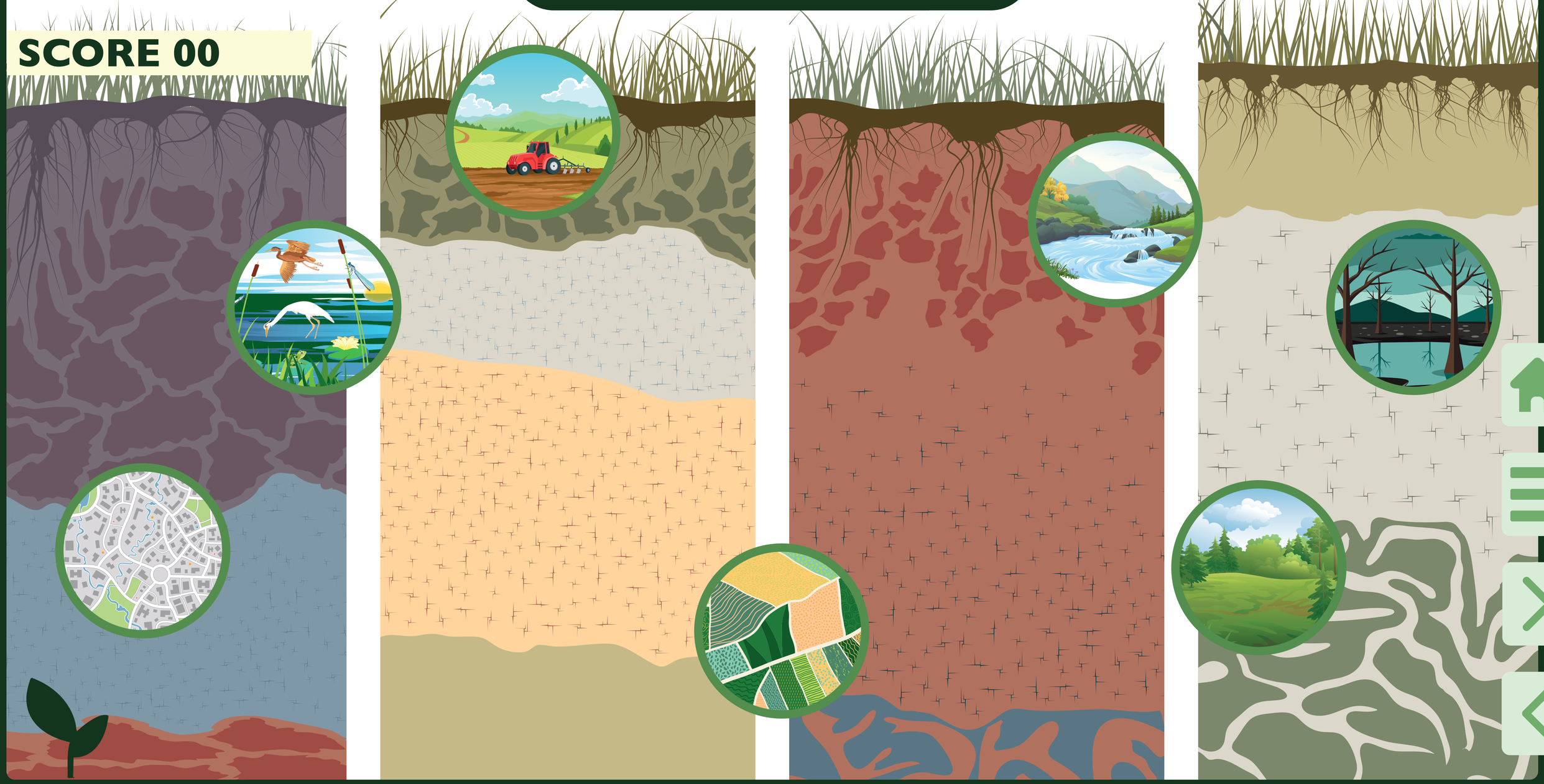
Source: 2007/2/EC directive (G) contaminated sites

ECHO

SOILAB CAPTURES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

SCORE 00



ECHO

SOILAB CAPTURES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

SCORE 00

WOODS AND FORESTS

WOODS AND FORESTS

Deforested and regenerated areas concern changes in vegetation cover. Deforestation generically means the elimination of vegetation in woods and forests. Over the past 80 years, forests in Europe have increased due to the abandonment of marginal agricultural land, especially in the mountains, but have decreased in intensive agricultural areas. Forests cover 39 % of the EU territory, and six Member States (Sweden, Finland, Spain, France, Germany and Poland) concentrate two thirds of the European forest area.

ARTIFICIAL SURFACES

These are those areas of the landscape that have been altered or affected by construction activities, where natural surfaces have been replaced by abiotic (i.e. devoid of living organisms) artificial structures or materials. These are mainly found in urban and suburban areas, where infrastructure, buildings and other man-made constructions are present, but may also include settlements and infrastructure in non-urban areas. Green areas within urban environments should not be considered artificial surfaces. Every year in Europe, an area comparable to the city of Berlin (about 1000 km^2) is covered by buildings and infrastructure, often on land that was previously natural or agricultural, considering that only 13 % of urban development takes place on recycled soil and not on virgin land.

AGRICULTURAL AREAS

In 2020, farms in the EU used 157 million hectares of land for agricultural production, equal to 38 % of the total EU area (source: EU Commission). Approximately 75 % of cultivated land in the EU contains less than 2 % of organic carbon, indicating a significant loss of organic matter in the soil, which is now below the critical threshold of 3 % (source: Joint Research Centre)

Every year, inadequate soil management practices cause erosion and loss of 970 million tonnes of soil, with a negative impact on agricultural productivity estimated at around 1.25 billion Euro per year. In total, soil degradation costs to the EU 50 billion Euro each year.

SEMI-NAUTURAL AREAS

Semi-natural habitats, such as hedges, flower meadows, fallow land, or extensively managed meadows, provide important ecosystem benefits. They can promote biodiversity, support pollinators, reduce soil erosion and help regulate the water cycle.

WATER BODIES

Reducing pressure from agriculture is key to improving the conditions of rivers, lakes, transitional, coastal and marine waters and underground water resources.

This can be achieved through a wider dissemination of sustainable agricultural practices.

Many of the EU's surface and ground waters are not in good condition, and the situation of Europe's regional seas is alarming. Agriculture is a major source of pressure on water resources, due to nutrient and chemical pollution, excessive water withdrawals, changes to natural habitats, water storage and soil drainage.

CONTAMINATED SITES

These are areas of the territory where intense human activity has altered soil, subsoil and water characteristics, creating potential risks to human health. For this reason, such areas require reclamation interventions.

WETLANDS

Lakes, ponds, lagoons, marshes, fountains, resurgences and peat bogs are natural habitats that fall under the category of wetlands. Although these ecosystems take up only a small part of the EU's territory (about 5 %), they play an essential role by providing shelter for wildlife and protecting us from flooding and pollution.

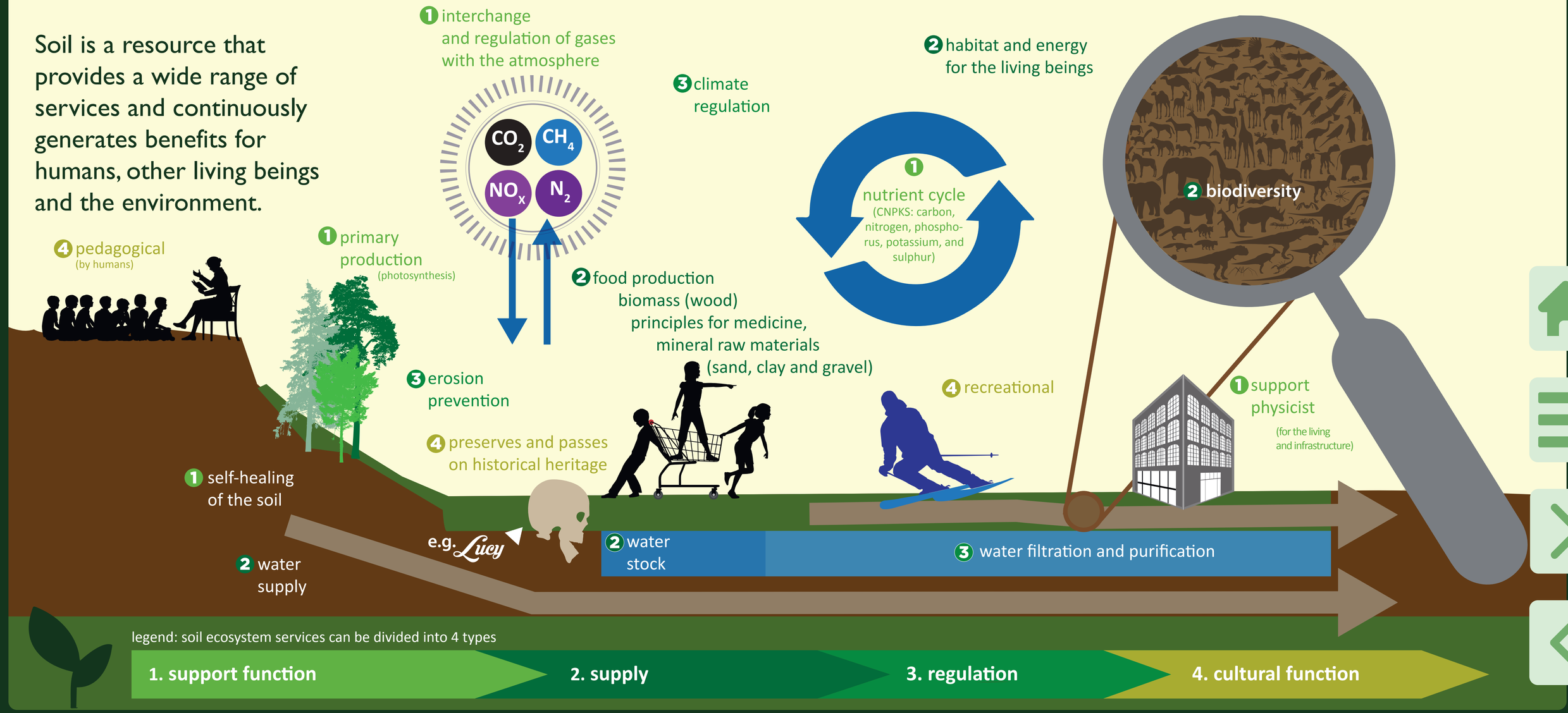
Wetlands also function as ‘carbon sinks’, storing about a third of the world's carbon. However, if degraded or destroyed, they can become sources of large amounts of greenhouse gas emissions, releasing the carbon contained in their soil.


SOIL IS
ECONOMY
ecosystem services

What is soil for? Ecosystem services

(Sources Haygarth P.M. and Ritz K.)

Soil is a resource that provides a wide range of services and continuously generates benefits for humans, other living beings and the environment.

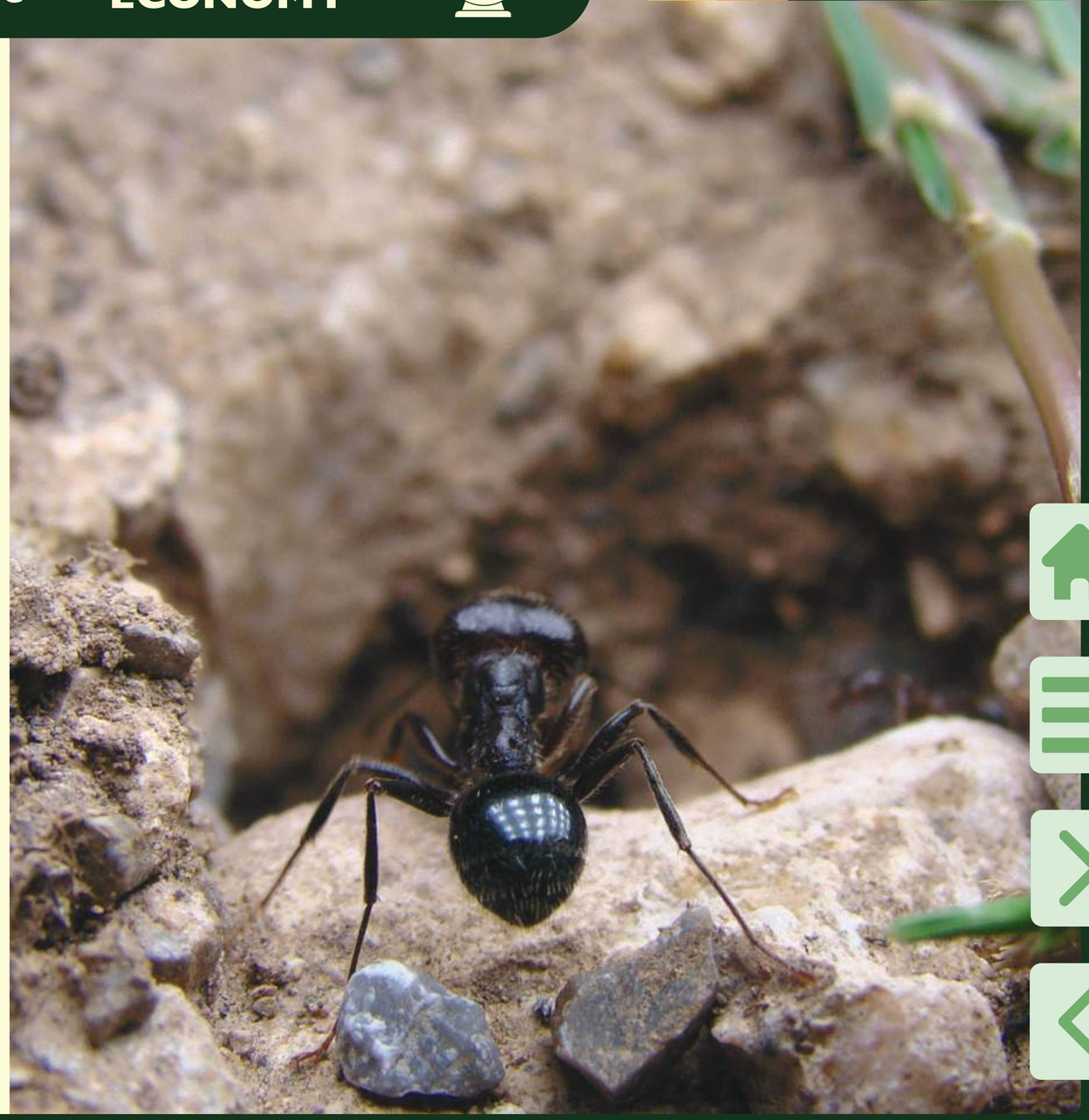


legend: soil ecosystem services can be divided into 4 types

1. support function
2. supply
3. regulation
4. cultural function

Soil is an essential element of different habitats

It is a great environmental infrastructure, which makes life and habitability possible by fulfilling the necessary conditions for living beings. It represents the fundamental capital of nature: without healthy soil, there would be no vegetation or photosynthesis. However, we often focus only on what is above the ground, neglecting what goes on beneath it, in that layer rich with invisible life. It is also important to consider the interactions between the soil and the atmosphere, which are crucial for the balance of ecosystems.



ECHO

SOILAB ROTATES

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

+6
+5
+4
+3
+2
+1
0
-1
-2
-3
-4
-5
-6

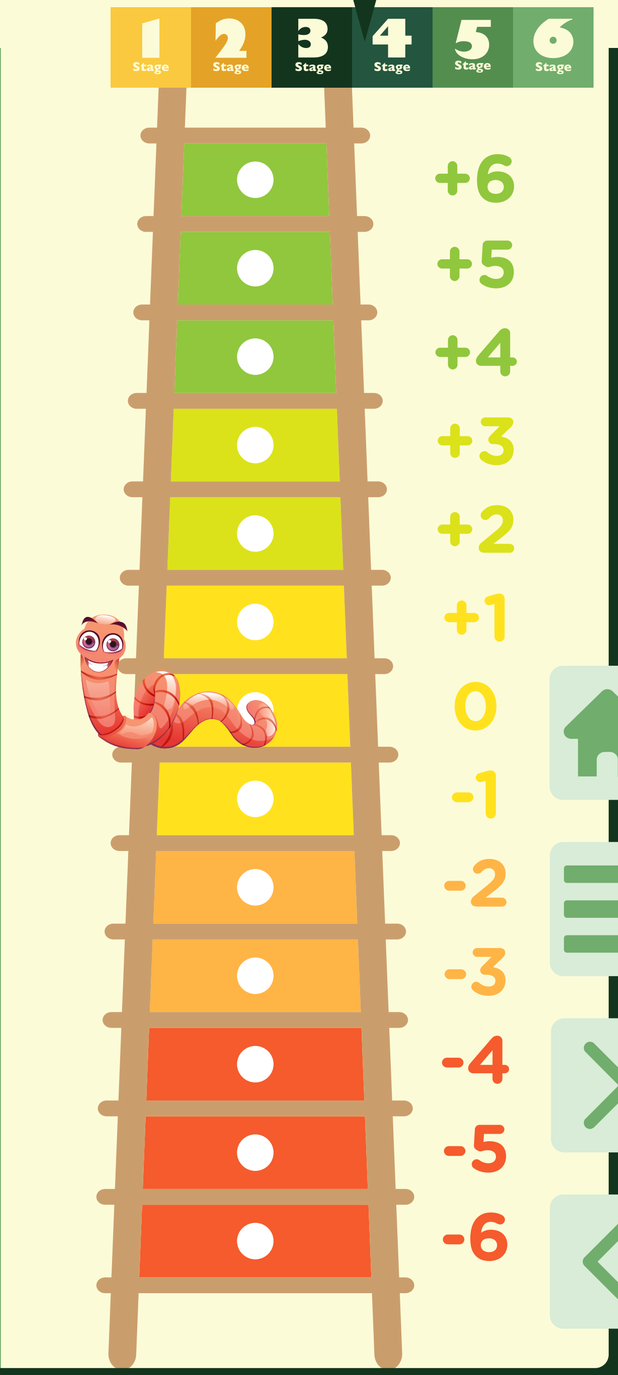
SOILAB ROTATES

TURN THE WHEEL, CLIMB THE LADDER

GAMES INSTRUCTIONS

Operate the wheel with the button and stop it with the button
One of the eight available cards will appear. Each tile, through a short quiz or ‘chance’, **offers content related to soil ecosystem services or functions.** Depending on whether or not the answer given is correct, the place-holder will go up or down one position on the ladder. ‘Chance' cards have a pre-set result (negative or positive).

Once you have solved the quiz, go back to the wheel screen and click on it again to spin it. Although you can stop the game at any time, the goal is to draw all 8 quiz cards, reaching the green-coloured ladder area (you won) and not the red-coloured one (you lost).



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

A

QUIZ

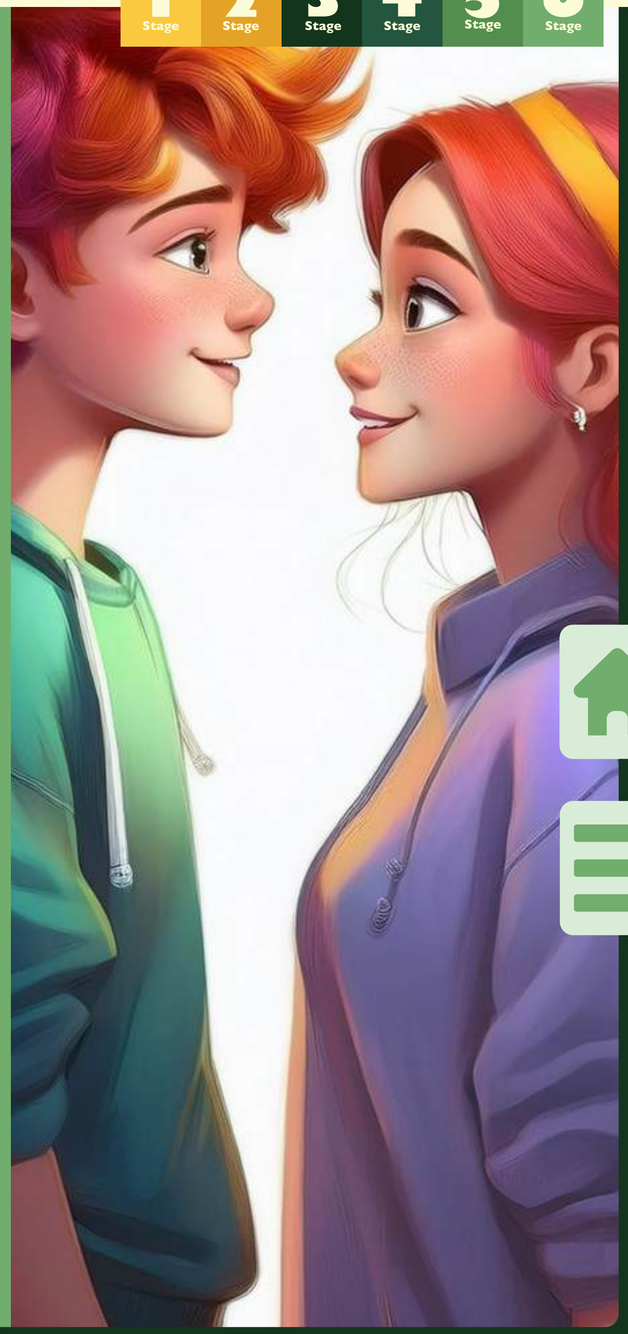
SOIL ECOSYSTEM SERVICES CARD

Does the soil, which naturally contains carbon mainly in the form of organic matter and carbonates, have the capacity to store additional carbon?

A. Yes, soil is a permanent sequestrator of various forms of carbon and captures more carbon than it emits.

B. No, it cannot absorb any more because it already contains too much.

C. Yes, soil can sequester carbon permanently and capture more than it emits, but agricultural soils absorb less carbon than stable grassland. However, intensive farming techniques and high temperatures can turn it into a source of CO_2 emissions and other greenhouse gases.



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

A

QUIZ

SOIL ECOSYSTEM SERVICES CARD

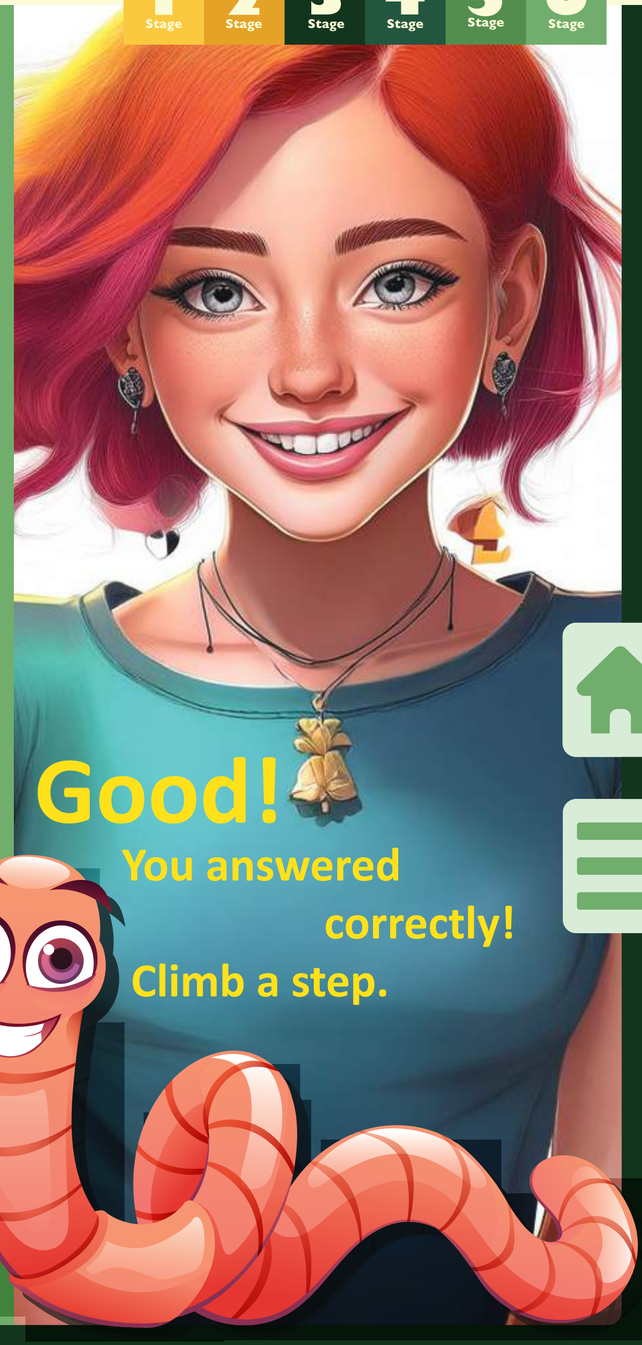
PLAY AGAIN

Does the soil, which naturally contains carbon mainly in the form of organic matter and carbonates, have the capacity to store additional carbon?

A. Yes, soil is a permanent sequestrator of various forms of carbon and captures more carbon than it emits.

B. No, it cannot absorb any more because it already contains too much.

✓ Yes, soil can sequester carbon permanently and capture more than it emits, but agricultural soils absorb less carbon than stable grassland. However, intensive farming techniques and high temperatures can turn it into a source of CO_2 emissions and other greenhouse gases.



ECHO

SOILAB ROTATES

A

QUIZ

SOIL ECOSYSTEM SERVICES CARD

PLAY AGAIN

Does the soil, which naturally contains carbon mainly in the form of organic matter and carbonates, have the capacity to store additional carbon?

✗ Yes, soil is a permanent sequestrator of various forms of carbon and captures more carbon than it emits.

✗ No, it cannot absorb any more because it already contains too much.

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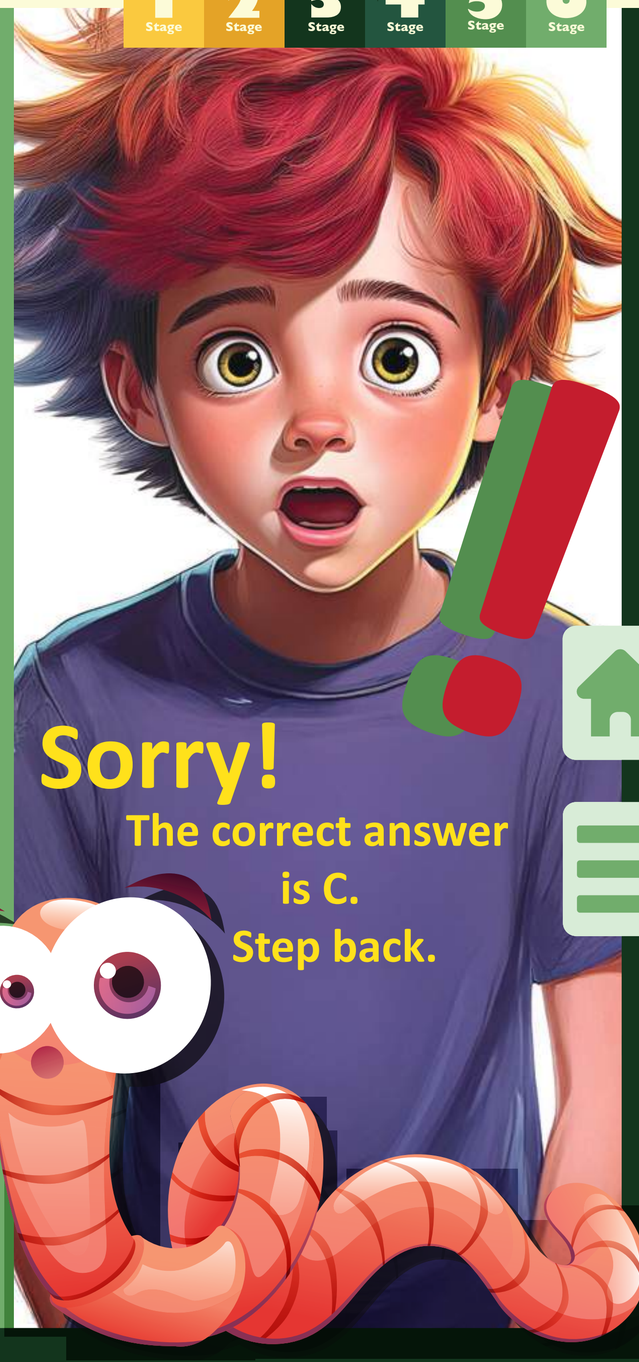
1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

B

QUIZ

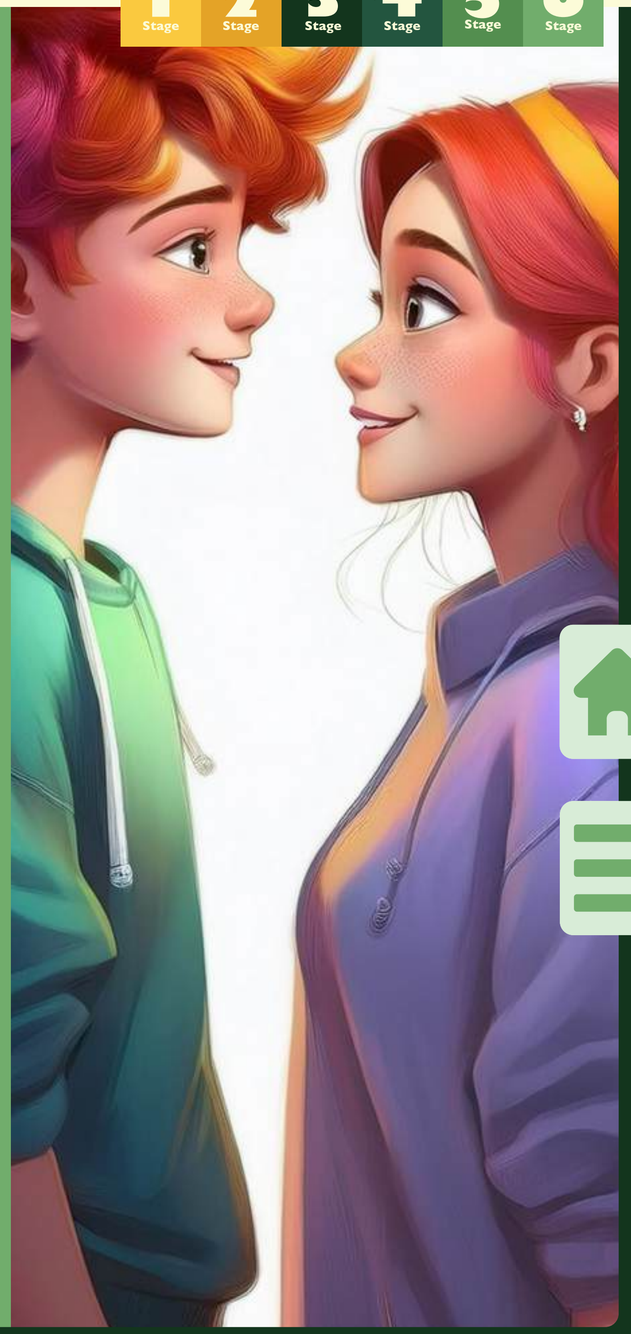
SOIL ECOSYSTEM SERVICES CARD

Soil performs water-related ecosystem functions:

A. **It recycles and purifies water through filtration, retaining it and then gradually releasing it to fungi and plants, and storing it in aquifers (groundwater) for human use.**

B. **It allows surface water run-off, which in some cases can cause erosion.**

C. **It makes water dirty and to make it suitable for drinking it has to be purified in apposite plants.**



ECHO

SOILAB ROTATES

B

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PLAY AGAIN

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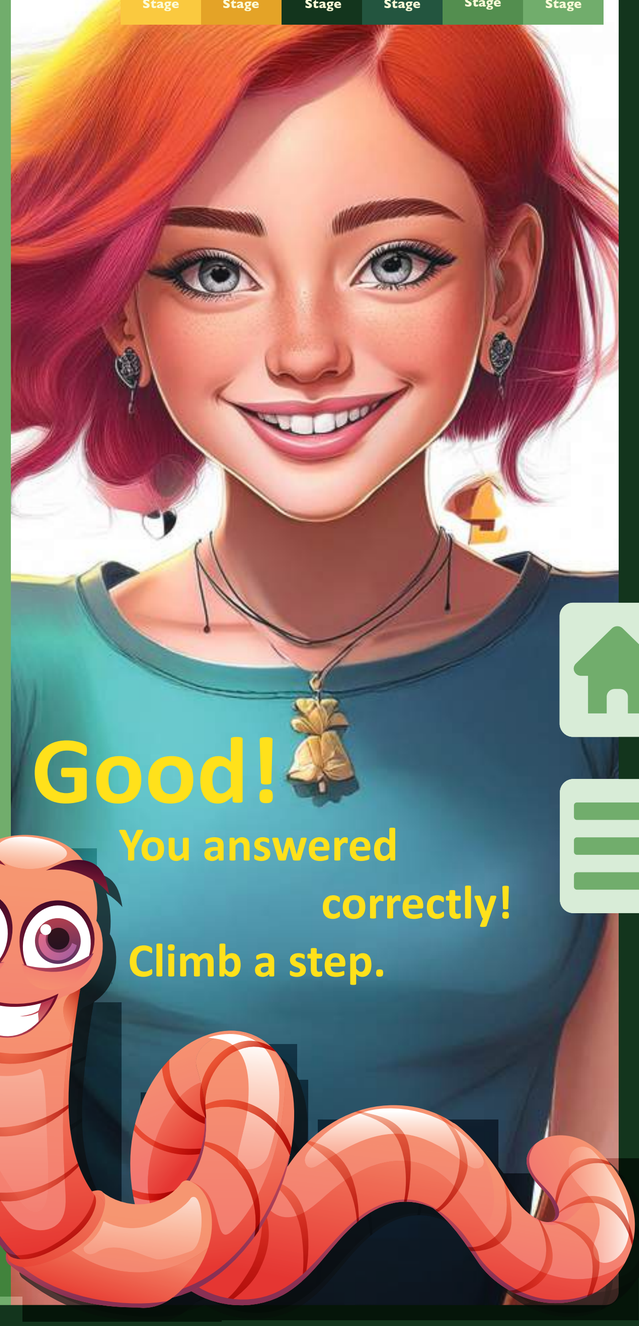

ECHO

SOILAB ROTATES

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PLAY AGAIN

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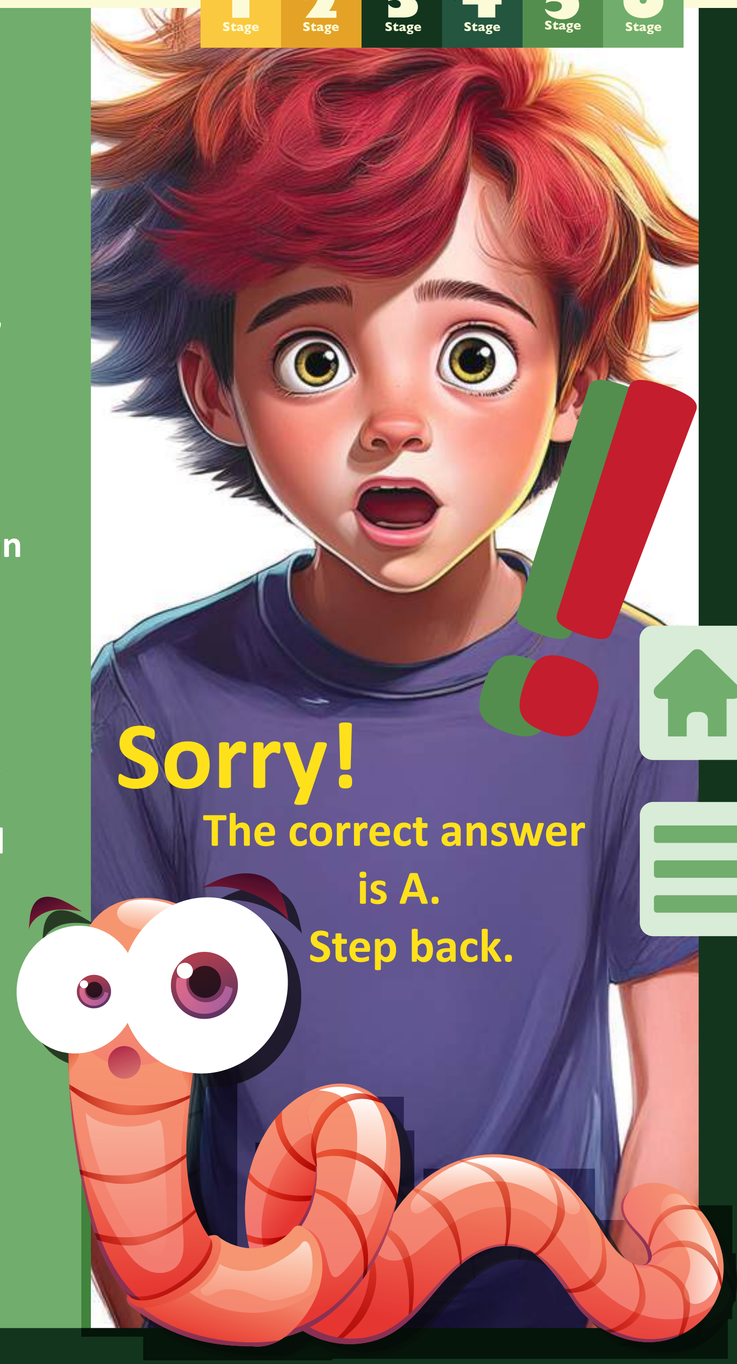


ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

C

QUIZ

SOIL ECOSYSTEM SERVICES

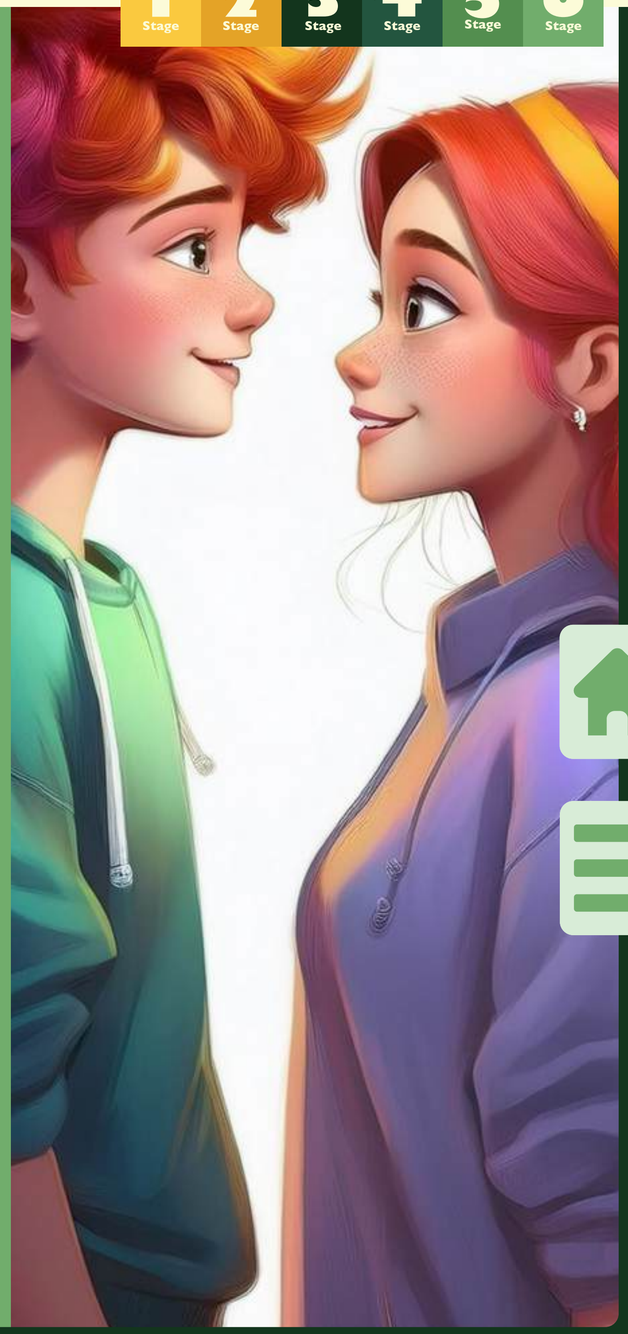
CARD

Soil is a climate regulator because:

A. It stabilises the average temperatures on the Planet.

B. It stores two to three times the amount of carbon in the atmosphere in the form of CO_2.

C. It contributes to the mitigation.



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

C

QUIZ

SOIL ECOSYSTEM SERVICES CARD

Soil is a climate regulator because:

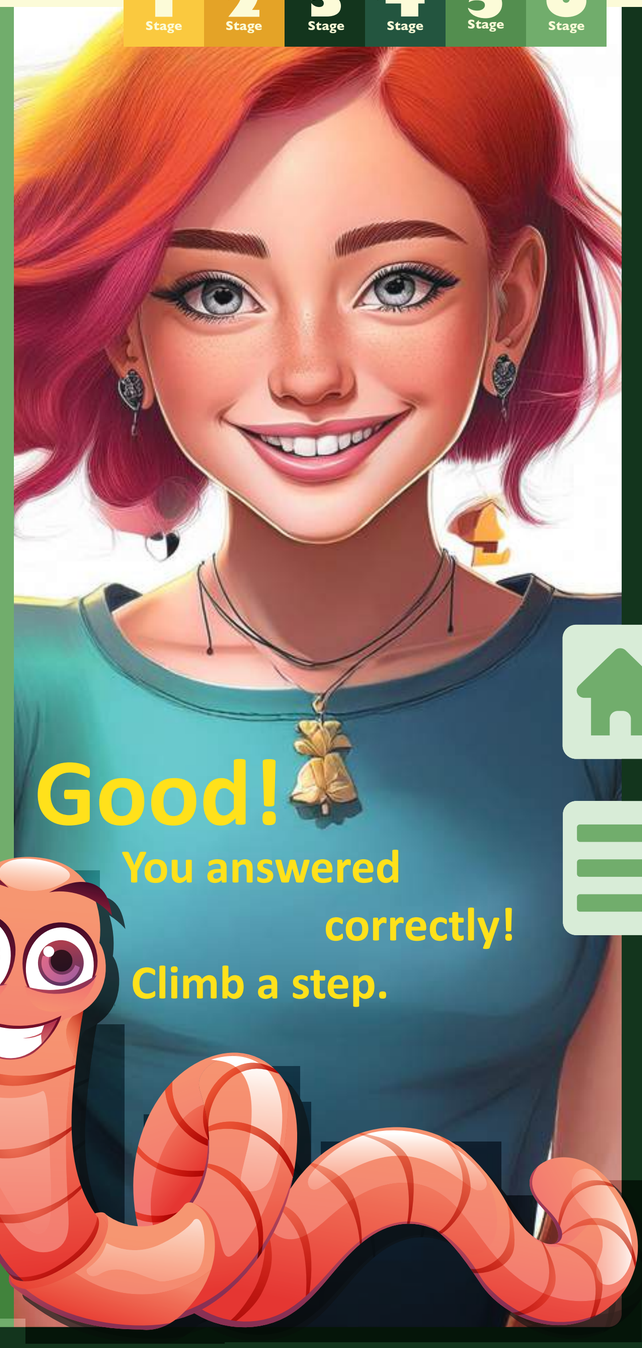
A — **It stabilises the average temperatures on the Planet.**

✓ — **It stores two to three times the amount of carbon in the atmosphere in the form of CO_2.**

C — **It contributes to the mitigation.**

An essential component of soil is Soil Organic Matter (SOM), which consists of 58 % Soil Organic Carbon (SOC). SOC makes up for the 3 to 10 % of the weight of the soil. Thanks to this component, soil is the second largest natural absorber of carbon, after the oceans, surpassing forests and other forms of vegetation in its ability to capture carbon dioxide from the atmosphere.

PLAY AGAIN



ECHO

SOILAB ROTATES

C

QUIZ

SOIL ECOSYSTEM SERVICES CARD

PLAY AGAIN

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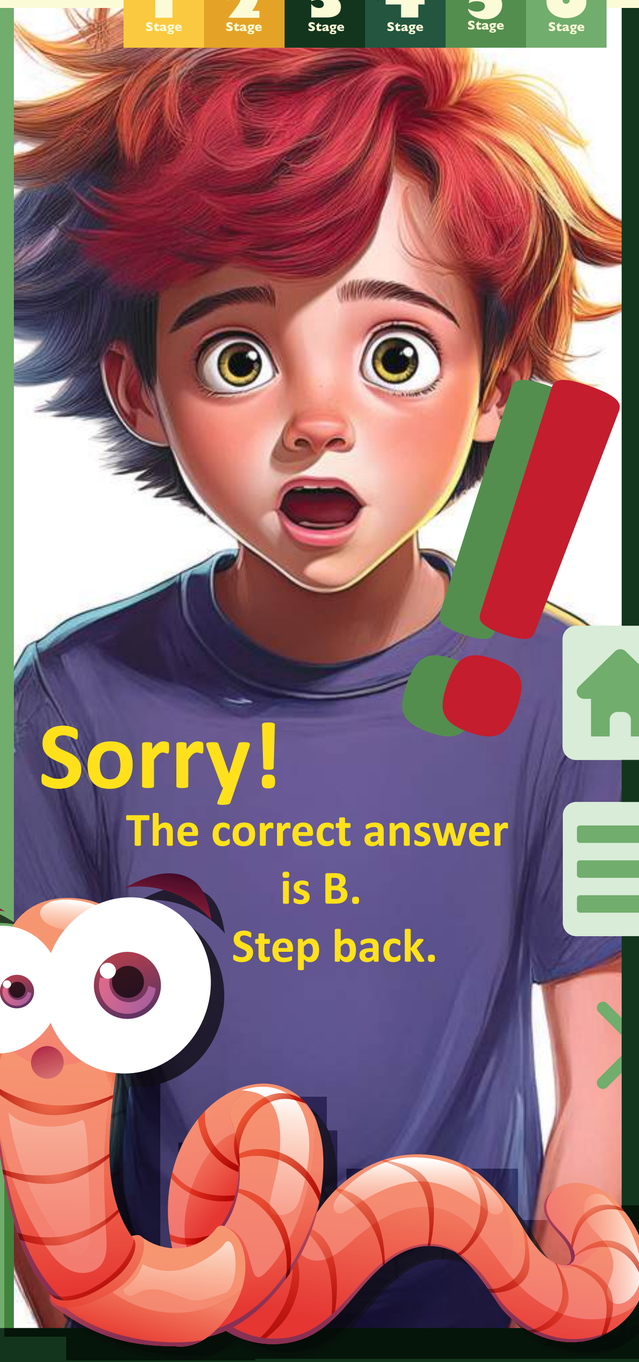


Sorry!

The correct answer is B.
Step back.

ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

D

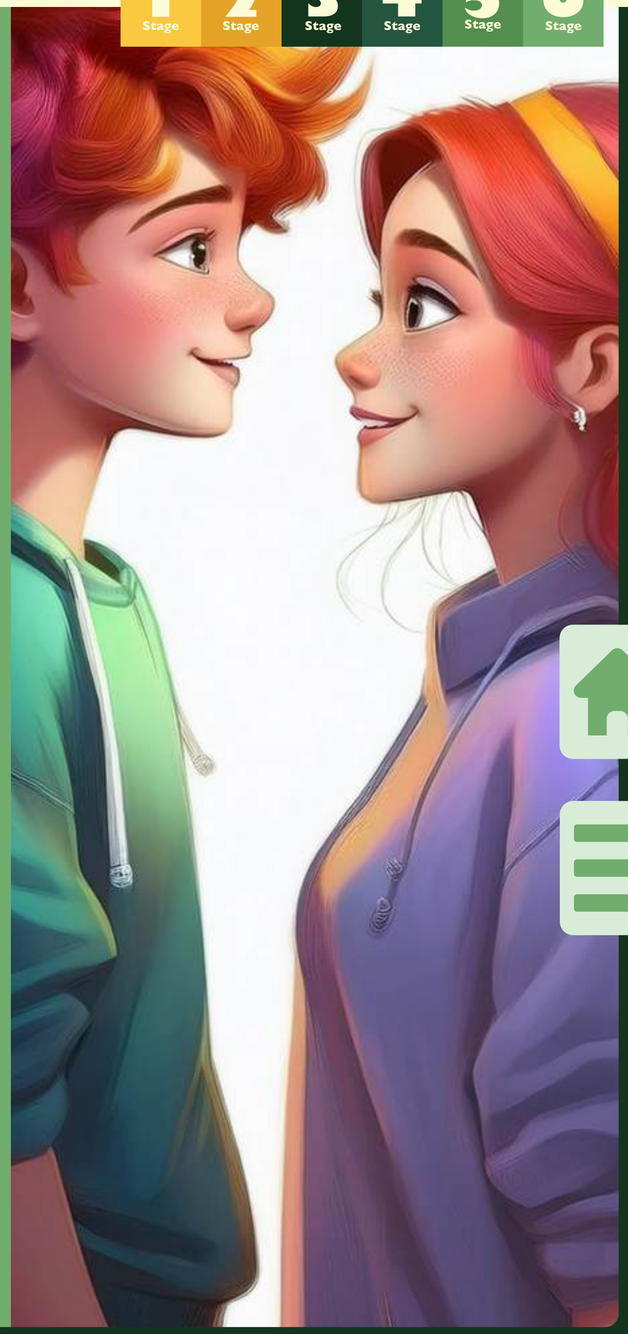
QUIZ

SOIL ECOSYSTEM SERVICES CARD

One of the main ecosystem services is food production. One ecosystem service (e.g. food production in this case) may interfere with another (e.g. climate regulation). Emissions of N_2O (nitrous oxide), a potent greenhouse gas that derives mainly from agriculture (about 70 %), are caused by the use of nitrogenous substances (nutrients), both synthetic and animal (such as manure). Such emissions:

A end up effectively cancelling out the positive contribution of CO_2 absorption by the agricultural crop and cultivated soil, with the risk of reaching a neutral or negative final balance of climate-changing emissions;

B can reduce the positive contribution of CO_2 absorption by crops and soil, with the final balance leading to an increase in climate-changing emissions.



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

D

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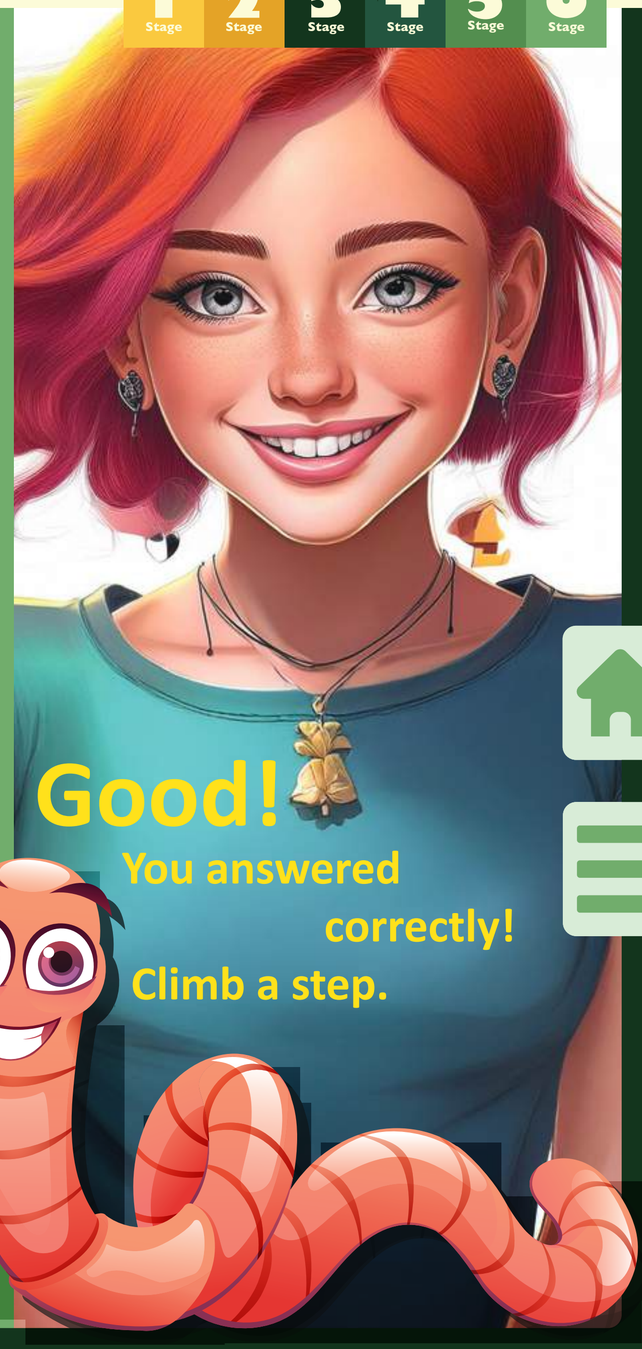
PLAY AGAIN



ECHO

SOILAB ROTATES

D

QUIZ

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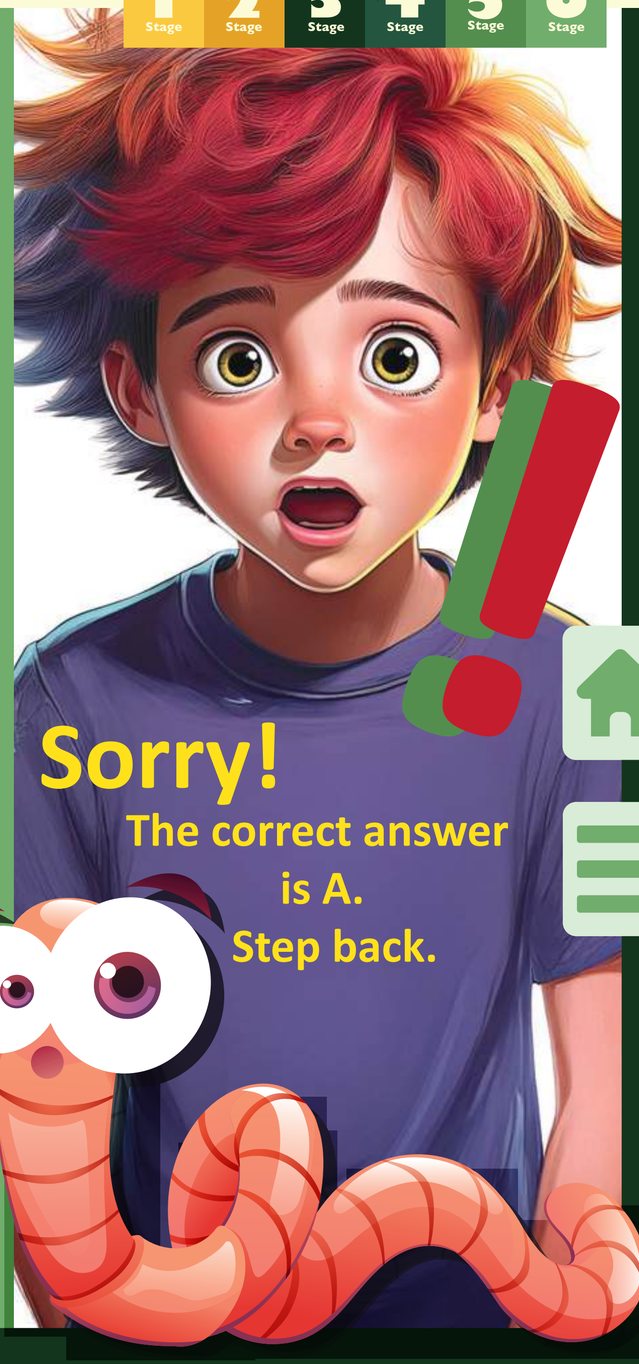
1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage



ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

E

QUIZ

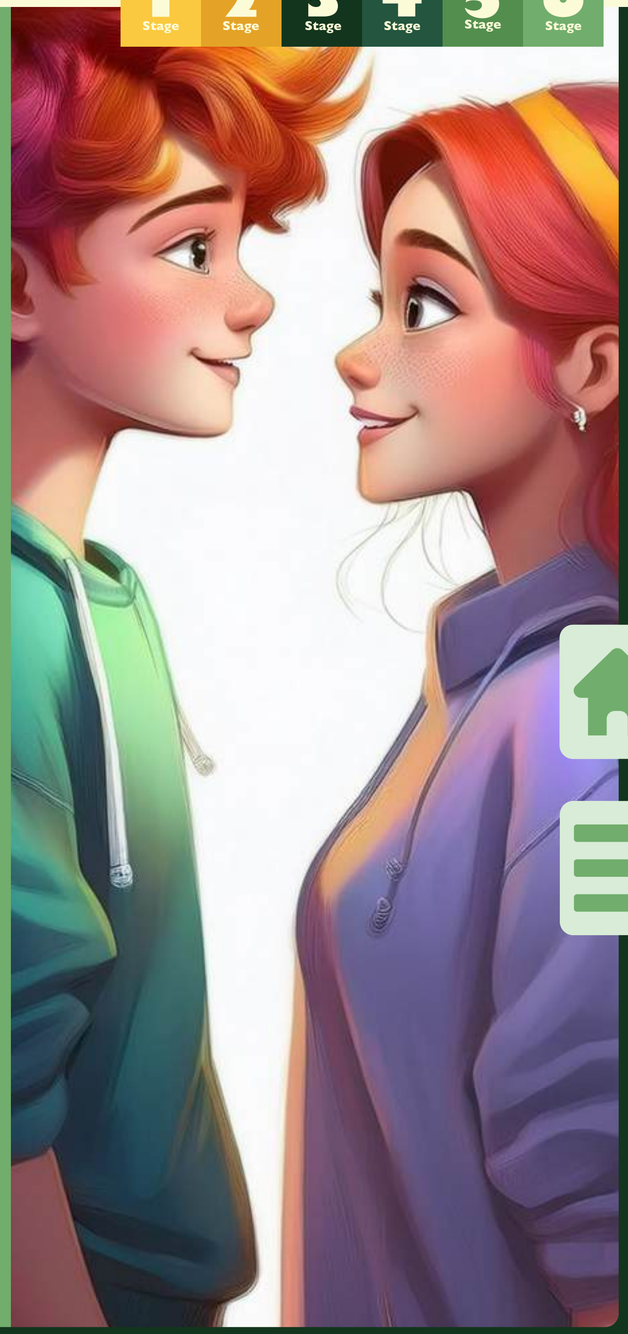
SOIL ECOSYSTEM SERVICES CARD

Ecosystem services are provided when soil health is protected and guaranteed. However, it is important to remember that soil is a non-renewable resource. The main factors contributing to soil formation are the weather, the type of parent rock, geomorphology (i.e. the presence or absence of elevations in the area), living organisms, the action of the atmosphere and time.

A loss of fertile soil of more than one tonne per hectare can be considered irreversible for:

A 50-100 years;

B 2000 years.



ECHO

SOILAB ROTATES

E

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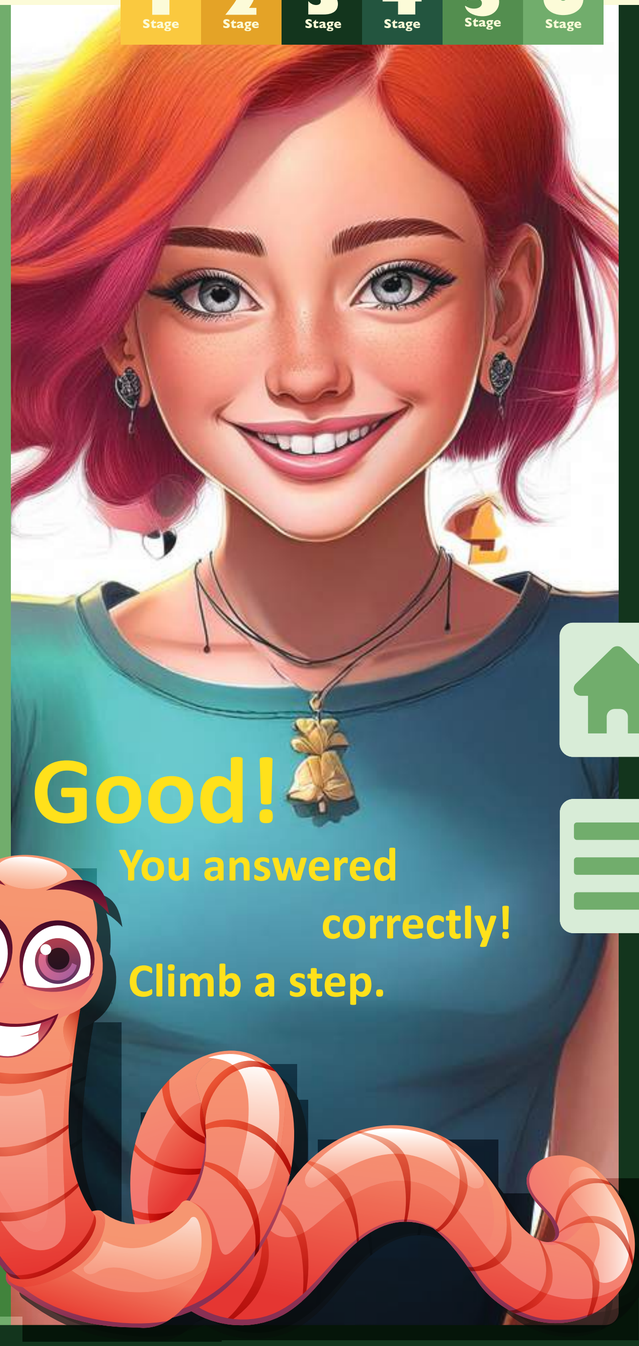
PLAY AGAIN

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



ECHO

SOILAB ROTATES

E

QUIZ

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PLAY AGAIN

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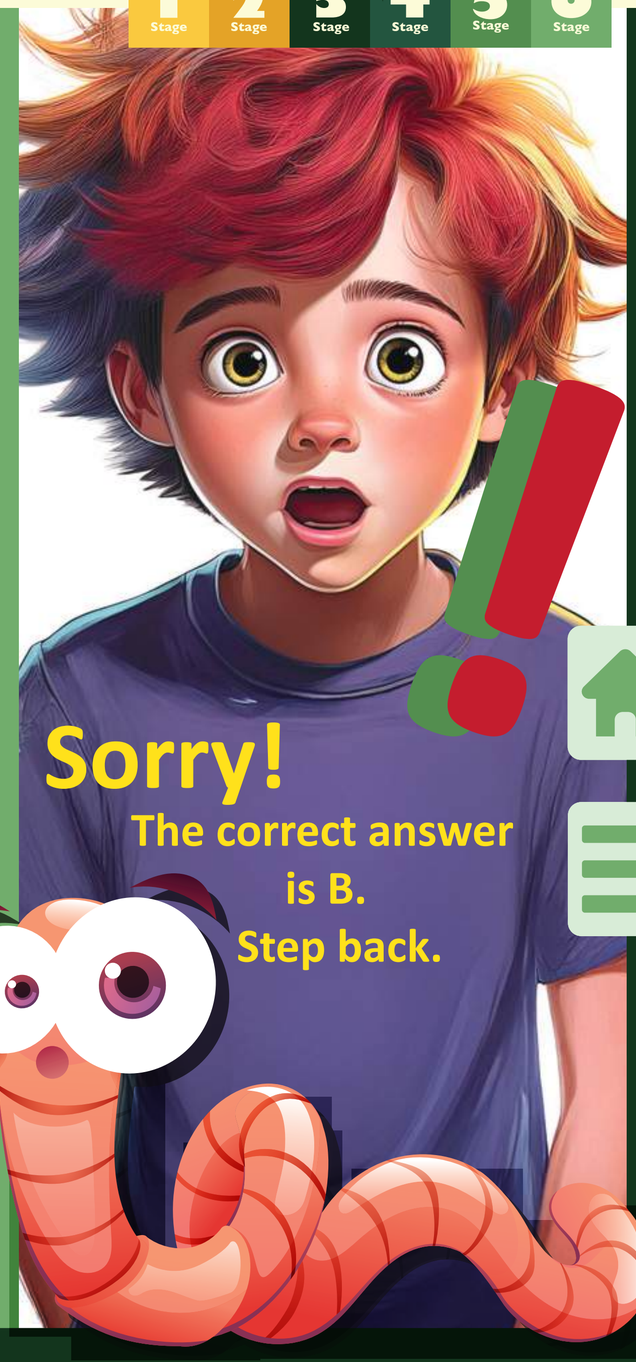


ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

E

NEGATIVE CHANCE

Soil micro-organisms are essential for plant health and play an irreplaceable role. In slightly degraded soils, it is possible to accelerate the regeneration of the bacterial component through various methods, whereas in heavily degraded soils, improvement will never be sufficient to restore a healthy and functional ecosystem. Beyond a certain level of degradation, there is no immediate solution, such as the ‘undo’ key or ‘CTRL+Z’ on our PCs, to restore the soil to its original condition!

PLAY AGAIN

We’re sorry!

Go one step back.

ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

F

NEGATIVE CHANCE

As much as the soil offers us countless ecosystem services for free, the soil does not exist for our benefit! It is not meant to help us grow our own food. Like all complex, self-sufficient systems, soil seeks its own natural equilibrium. Sometimes, however, this balance is not compatible with our needs.

PLAY AGAIN

We're sorry!

Go one step back.

ECHO

SOILAB ROTATES

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

H

POSITIVE CHANCE

Among the ecosystem services provided by the soil there is the supply of materials, such as pharmaceutical substances useful to humans. Many antibiotics used in medicine have been developed from bacteria in the soil, particularly in the rhizosphere. This represents one of the new frontiers of research, which is set to grow more and more.

PLAY AGAIN

Well done!
Go one step forward.

SOIL IS FRAGILE

Threats to soil health and subsequent risks

Soil degradation

It is a phenomenon involving the alteration of its conditions, caused mainly by human activity, and manifested in the reduction or loss of biological productivity, biodiversity, of its functions and capacity to provide ecosystem services.

Indicators such as soil cover, water erosion and organic carbon content can be used to monitor soil degradation. This phenomenon is closely related to desertification, which occurs in arid, semi-arid and sub-humid dry areas, and is caused by factors such as climate change and human activities.

ECHO

SOILAB INFOGRAPHIC • SOIL IS FRAGILE •

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

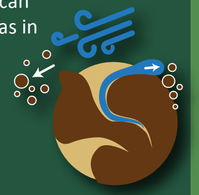
The eight threats to soil

1 SEALING OR WATERPROOFING

It means covering the ground with waterproof materials that partially or totally inhibit the soil's ability to perform its vital functions.They compromise the soil's capacity to be run through by water and to hold a good part of it. Once a soil is covered (by buildings, roads, etc.), it stops absorbing water forever, but in the meantime it does not stop raining!

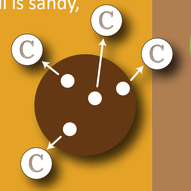
2 EROSION

Every year, 24 billion tonnes of fertile soils disappear worldwide due to the natural effects of wind, running water, ice and gravity. Human activity can aggravate this process, as in the case of deforestation, which increases soil erosion.



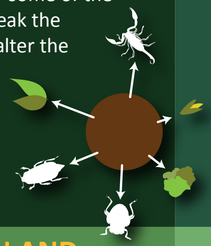
3 IMPOVERISHMENT OF ORGANIC MATTER

The carbon level in the soil must be maintained within certain levels, which differ depending on whether the soil is sandy, loamy or clayey.
Erosion, deforestation, transformation and excessive agricultural use reduce soil carbon levels to the point of making it infertile and incapable of supporting life.



4 LOSS OF BIODIVERSITY

The loss of organic matter or the contamination of a soil with foreign and toxic substances, even for some of the species living in it, can break the eco-systemic chains and alter the balance. If the soil is depopulated, there will also be problems for the species living above ground.

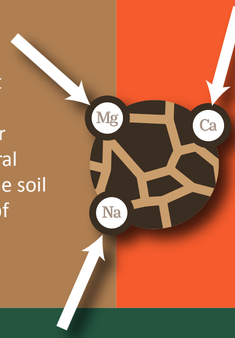


5 CONTAMINATION AND POLLUTION

One of the properties of soils is their porosity, which allows them to absorb water, but also other human-made pollutants. When soil is contaminated, it becomes unusable for agricultural production, as pollutants can be absorbed by plant roots.

6 SALINISATION

Excess salts damage the soil, threatening food production. These salts include common salt (NaCl), but also calcium salts, magnesium, sulphates and other compounds. In addition to natural inputs, salt can accumulate in the soil through irrigation and overuse of fertilisers in agriculture.

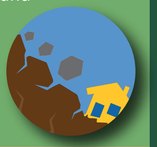


7 COMPACTATION

Soils breathe thanks to their porosity. But, a progressive hardening of the surface, caused, for example, by the repeated passage of tractors, vehicles and trucks, prevents it from 'breathing'. Soil compaction, unlike sealing, is a reversible process that can be recovered with appropriate techniques.

8 LANDSLIDES, ROCKSLIDES, MUDSLIDES AND DETACHMENTS

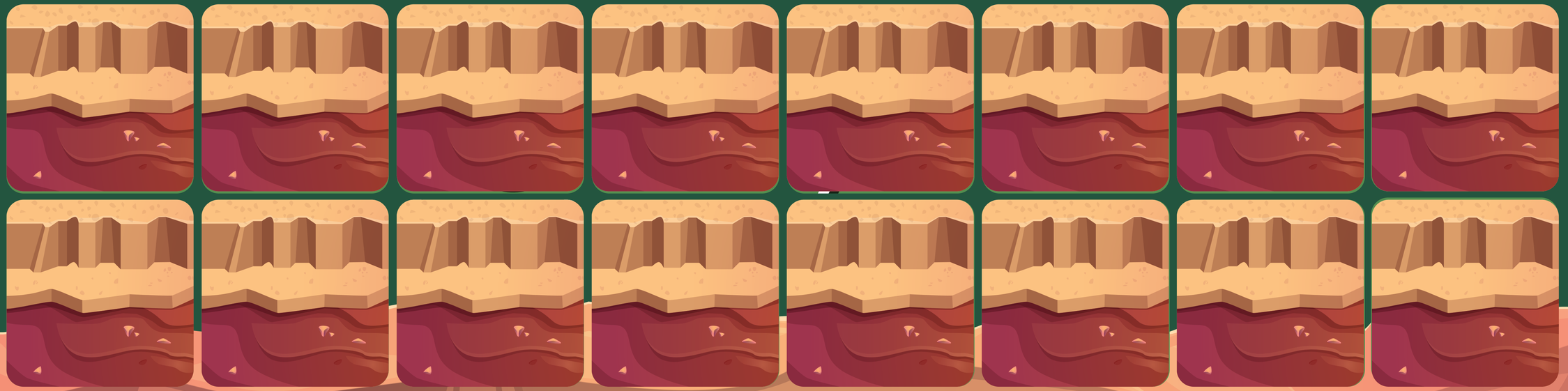
These are the effects of hydrogeological hazards that cause the loss of fertile soil. They are made worse by various practices, such as the neglect of certain agricultural areas or pastures, the afforestation of land with reduced soil depth and, the construction of infrastructure or buildings in areas where it would not be appropriate.



Green threats (2, 6 and 8) represent natural phenomena made worse by human bad behaviour and climate change.

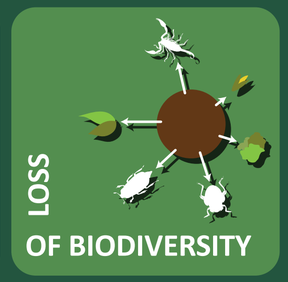
FIND OUT WITH SOILAB

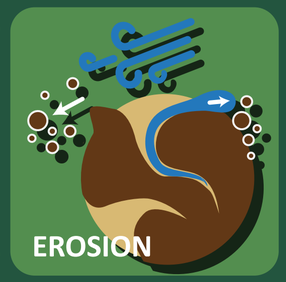
MEMORY WITH 16 CARDS

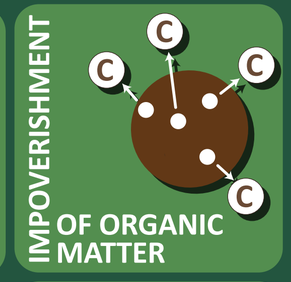


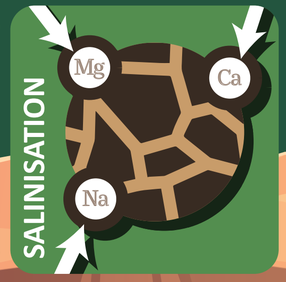
GAMES INSTRUCTIONS

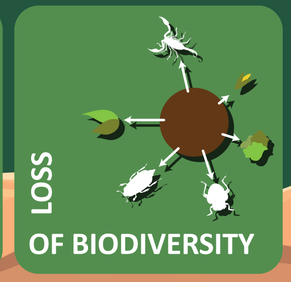
Memory with 16 cards, to be matched two by two, representing eight icons of threats to the soil. Start with all 16 cards uncovered for a few seconds. Next, the cards will turn and must be uncovered two at a time: if matched, they remain uncovered, if not matched, they return covered.

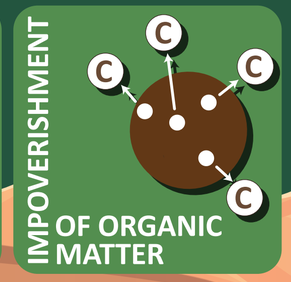


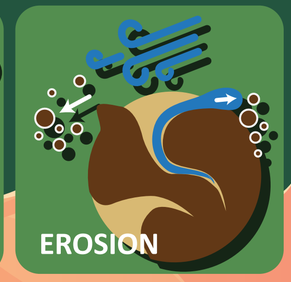












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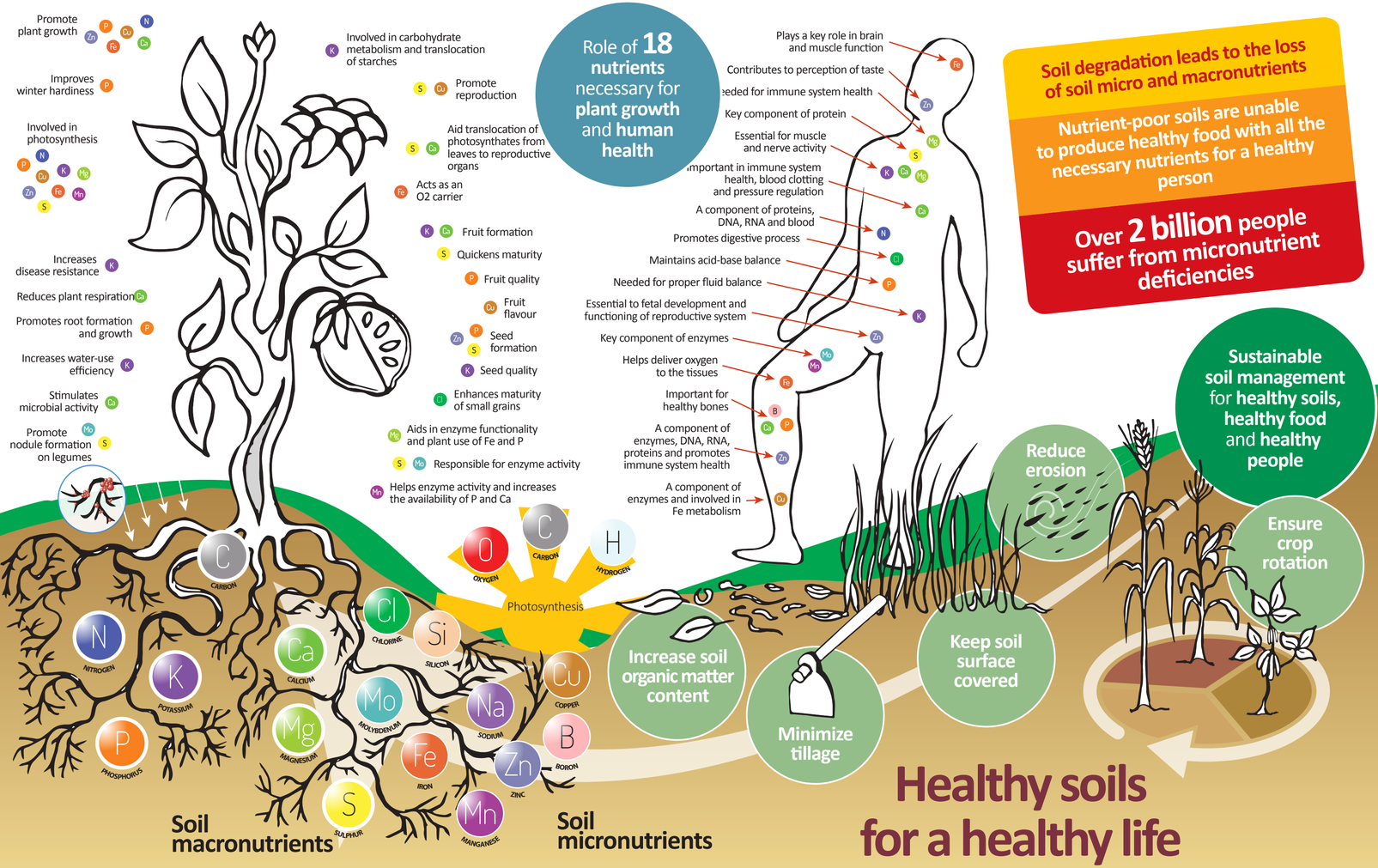
SOIL IS CHOICE

looking for solutions
acting for the soil, what ask to decision-makers

Soil the foundation of nutrition



Food and Agriculture Organization of the United Nations

SOIL HEALTH ACCORDING TO THE EUROPEAN UNION

Europe requires individual member states to **OBLIGATE SOIL HEALTH MONITORING WITH COMMON METHODOLOGIES** (European Soil Monitoring Law)

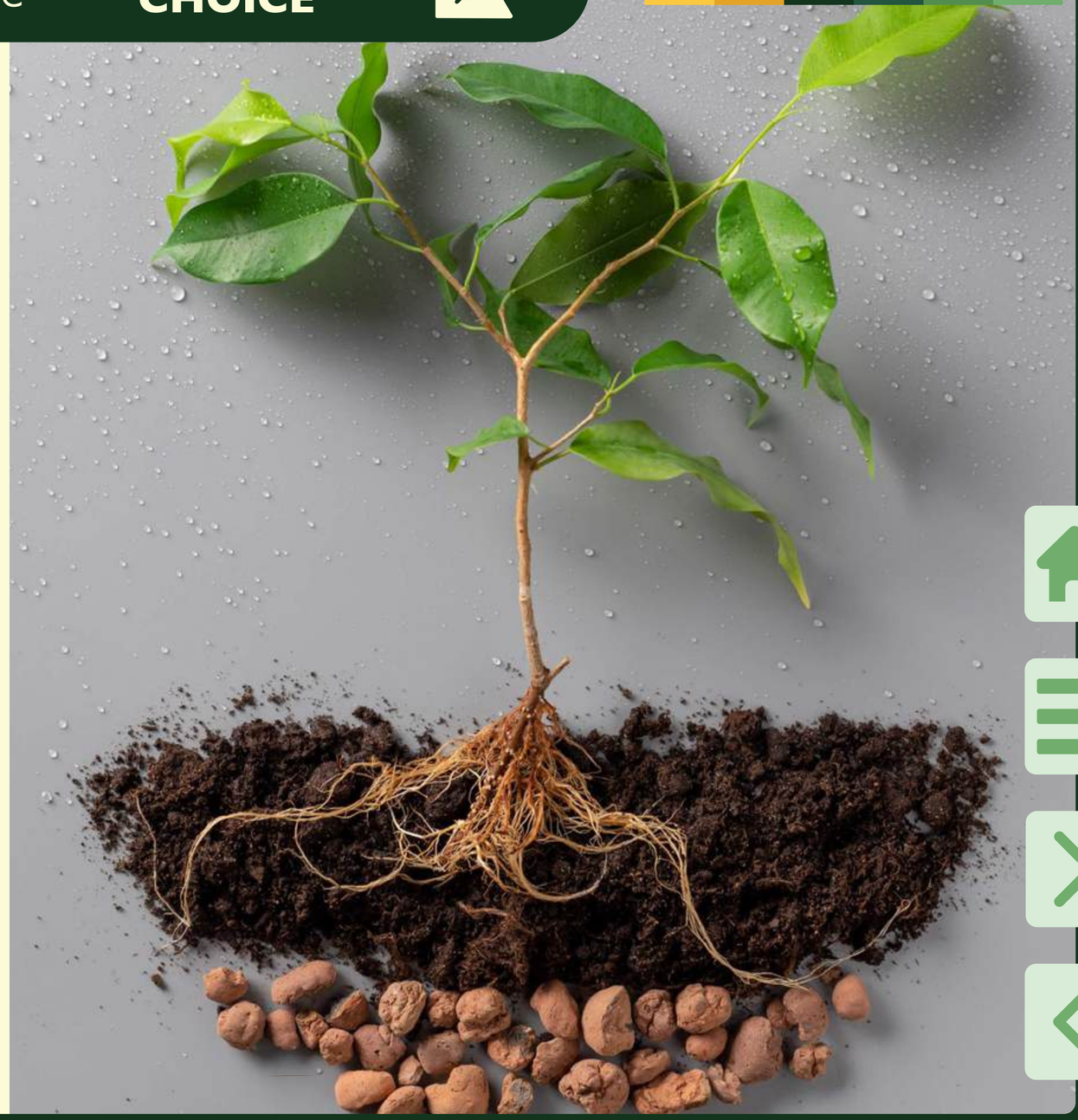
In order to assess the condition of soils in Europe, each member country must focus on a number of key indicators: presence of pollutants, excess of nutrients and salts, vegetation cover, organic carbon content, soil structure including density, lack of compaction, erosion, soil biodiversity, presence of nutrients...

DRAFTING OF NATIONAL NATURE RESTORATION PLANS

They include different actions to:

- remove alien plants on grassland, wetlands and forests;
- re-wet of drained bogs;
- improve of connectivity between habitats;
- reduce or stop the use of pesticides and chemical fertilisers;
- promote the conservation of protected natural areas.

These actions must not jeopardise or put at risk agriculture, fisheries and forestry through their impacts, avoiding wider negative socio-economic effects.




SOILAB
DISCOVER

ECHO

SOILAB DISCOVER

1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage

GAMES INSTRUCTIONS

On your right there is a graphic map of keywords, corresponding to possible solutions that you can choose, according to the local situation, to restore or maintain soil health. By choosing one, the whole group lights up and an animated illustration is displayed, confirming the choice made. Now, you have to choose correctly one of the nine groups of consequences of the action on a grid beside the illustration itself. Simplifications, however, make it possible to see the various levels of intervention and their relationships.

SOIL KEYWORDS

PURCHASING ORGANIC AND SUSTAINABLE PRODUCTS	*STOPPING SOIL CONSUMPTION*	**PLANTING MORE TREES**	*RESOURCES FOR RESEARCH*
FOOD PRODUCTION	**EVERYTHING IS WASTED ON ITS OWN WAY**	*MORE CLIMATE-CHANGING EMISSIONS*	**PRESERVING FORESTS**
CLIMATE CHANGE	*REDUCING POLLUTANTS*	**EATING BETTER**	*GROWING HOUSEPLANTS*
INCREASE IN AGRICULTURAL SURFACE	**SOILS DEGRADATION**	*RAISING AWARENESS KNOWING AGRICULTURE*	**POPULATION INCREASE**
CLIMATE MIGRANTS	*DEFENDING NATURAL PARKS*	**USING MORE NUTRIENTS**	*REGENERATIVE AND SUSTAINABLE AGRICULTURE*
USING COMPOST	**RECYCLING COMPOST**	*PRODUCING LESS WASTE*	**LAWS FOR THE SOIL**

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

DISCOVER

SOIL KEYWORDS

PURCHASING ORGANIC AND SUSTAINABLE PRODUCTS	*STOPPING SOIL CONSUMPTION*	PLANTING MORE TREES	*RESOURCES FOR RESEARCH*
FOOD PRODUCTION	EVERYTHING IS WASTED ON ITS OWN WAY	*MORE CLIMATE-CHANGING EMISSIONS*	PRESERVING FORESTS
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ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

Which theme does the illustration correspond to?

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SPREADING GOOD IDEAS **D.**	SCRAPS AND WASTE **E.**	EATING CONSCIOUSLY **F.**
SOIL AND PLANTS **G.**	OTHER TYPES OF AGRICULTURE **H.**	REGOLATE TO PROTECT **I.**

ECHO

SOILAB DISCOVER

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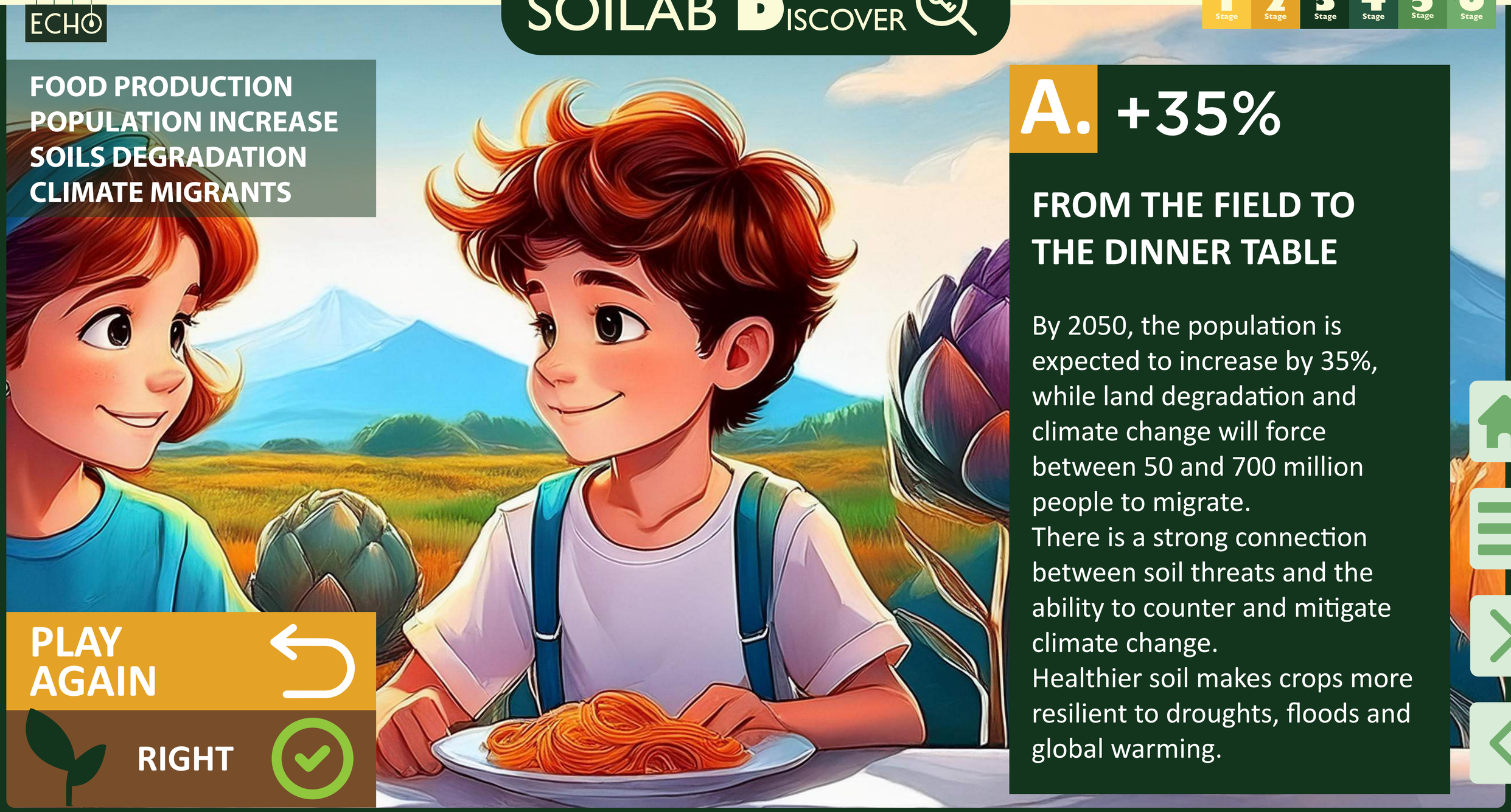
WRONG

ECHO

SOILAB DISCOVER

1 Stage 2 Stage 3 Stage 4 Stage 5 Stage 6 Stage

FOOD PRODUCTION
POPULATION INCREASE
SOILS DEGRADATION
CLIMATE MIGRANTS



PLAY AGAIN

RIGHT

A. +35%

FROM THE FIELD TO THE DINNER TABLE

By 2050, the population is expected to increase by 35%, while land degradation and climate change will force between 50 and 700 million people to migrate.
There is a strong connection between soil threats and the ability to counter and mitigate climate change.
Healthier soil makes crops more resilient to droughts, floods and global warming.

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

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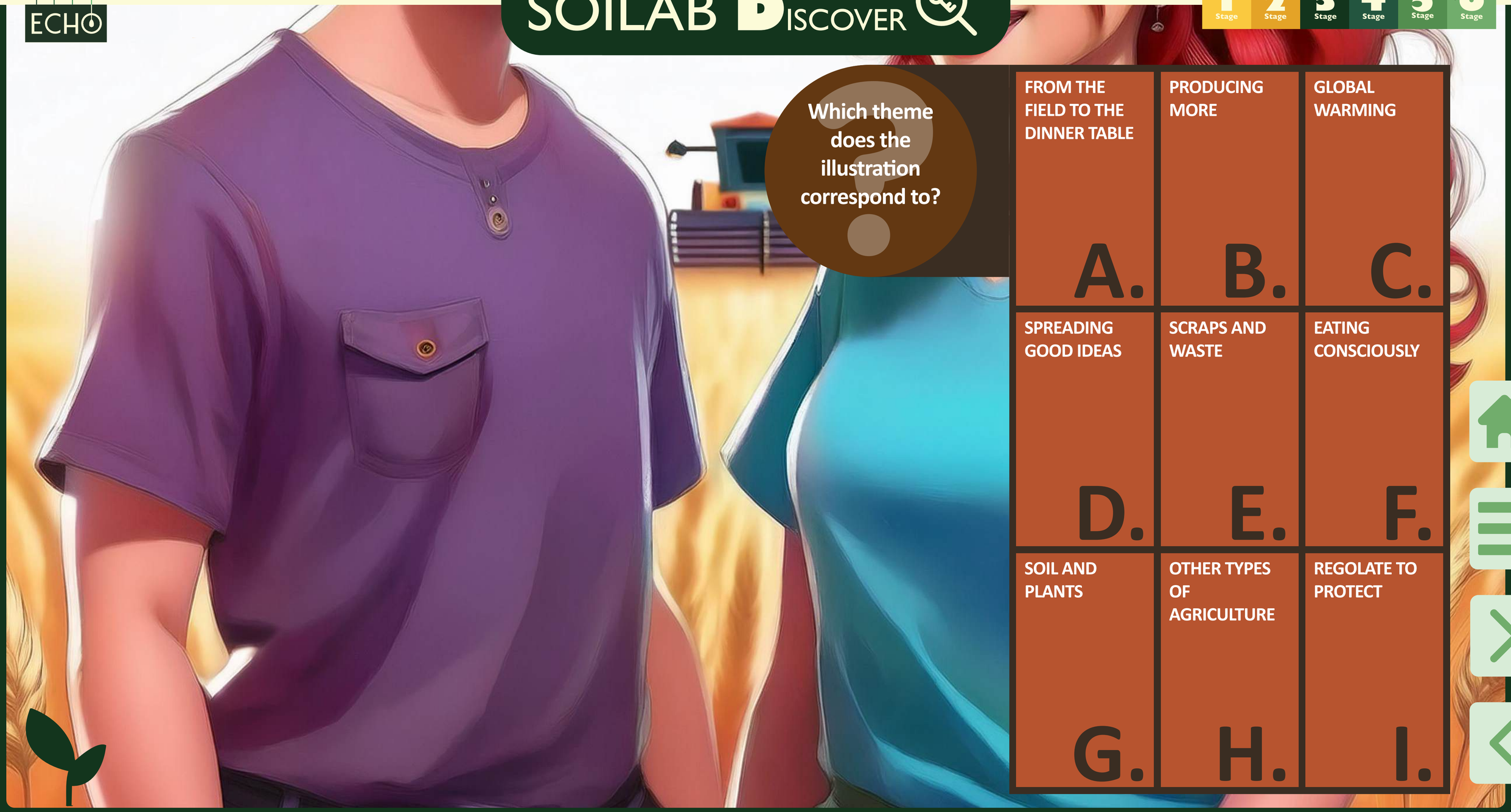

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USING MORE NUTRIENTS INCREASE IN AGRICULTURAL SURFACE

B. 1 billion

PRODUCING MORE

In order to feed the future world population of 2050 (9.7 billion), it is estimated that the application of nitrogen (45-73%), phosphorus (22-46%) and potassium (200-300%) will have to be greatly increased and that more than 1 billion hectares of ‘natural’ land will have to be converted to agricultural soils.

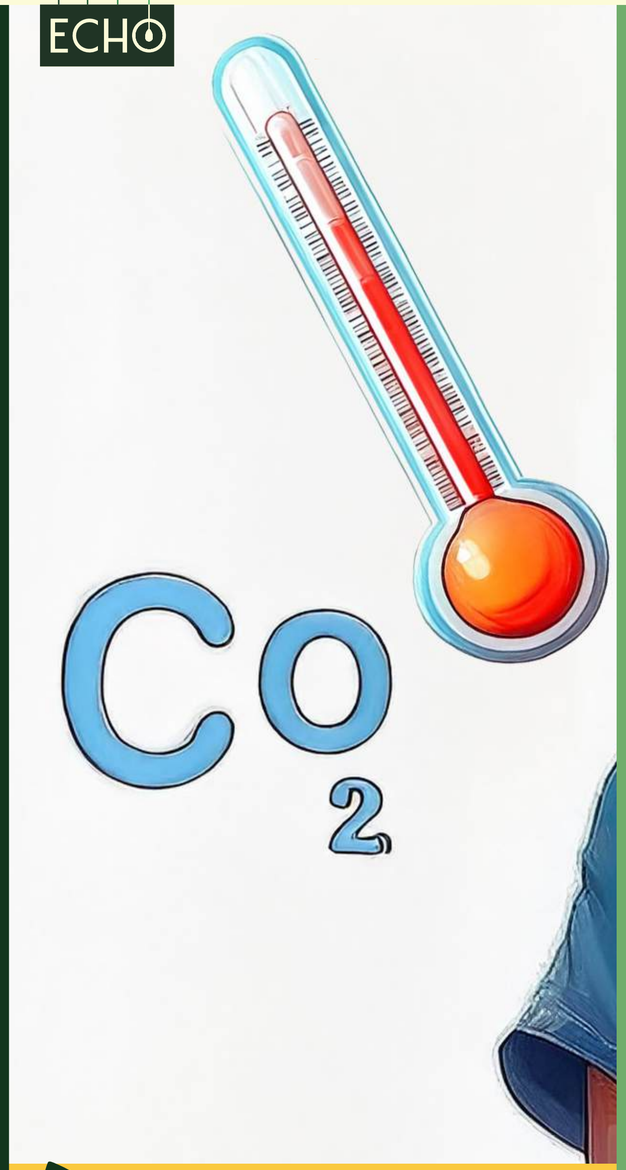
PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



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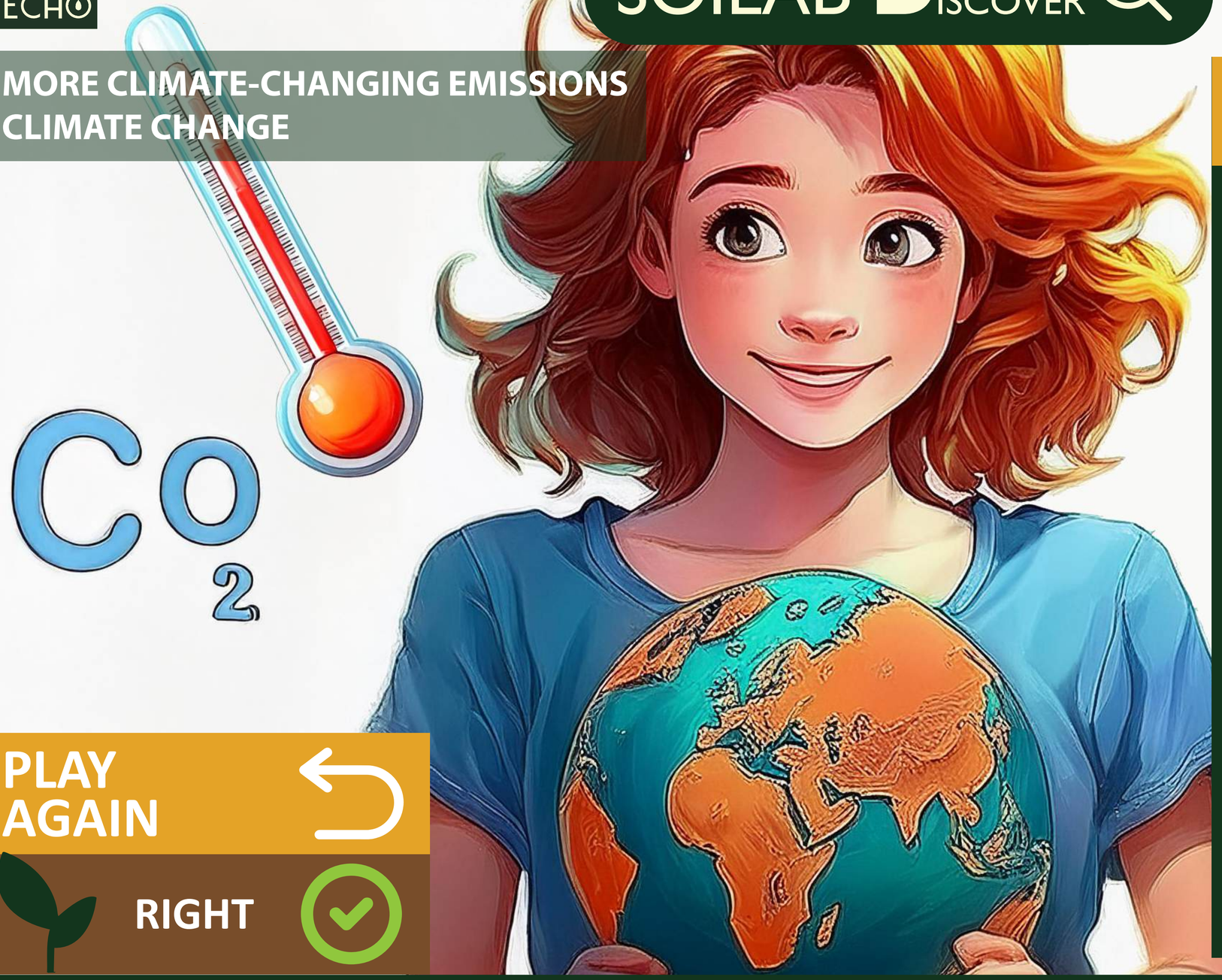
MORE CLIMATE-CHANGING EMISSIONS
CLIMATE CHANGE



C. +30%

GLOBAL WARMING

In 2050, greenhouse gas emissions for food production are expected to increase by 30 %. Already in the present day, the agro-food sector is responsible for about 20 % of greenhouse gases (carbon dioxide, methane, nitrous oxide). Specifically, agriculture, deforestation and land consumption weigh 18.4 %, energy from the food production industry, one %, direct energy used in agriculture (and fishing), weighs 1.7 %.

(Source: Climate Watch, the World Resources Institute - 2020)

PLAY AGAIN

RIGHT

ECHO

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DISCOVER

ECHO

SOILAB DISCOVER

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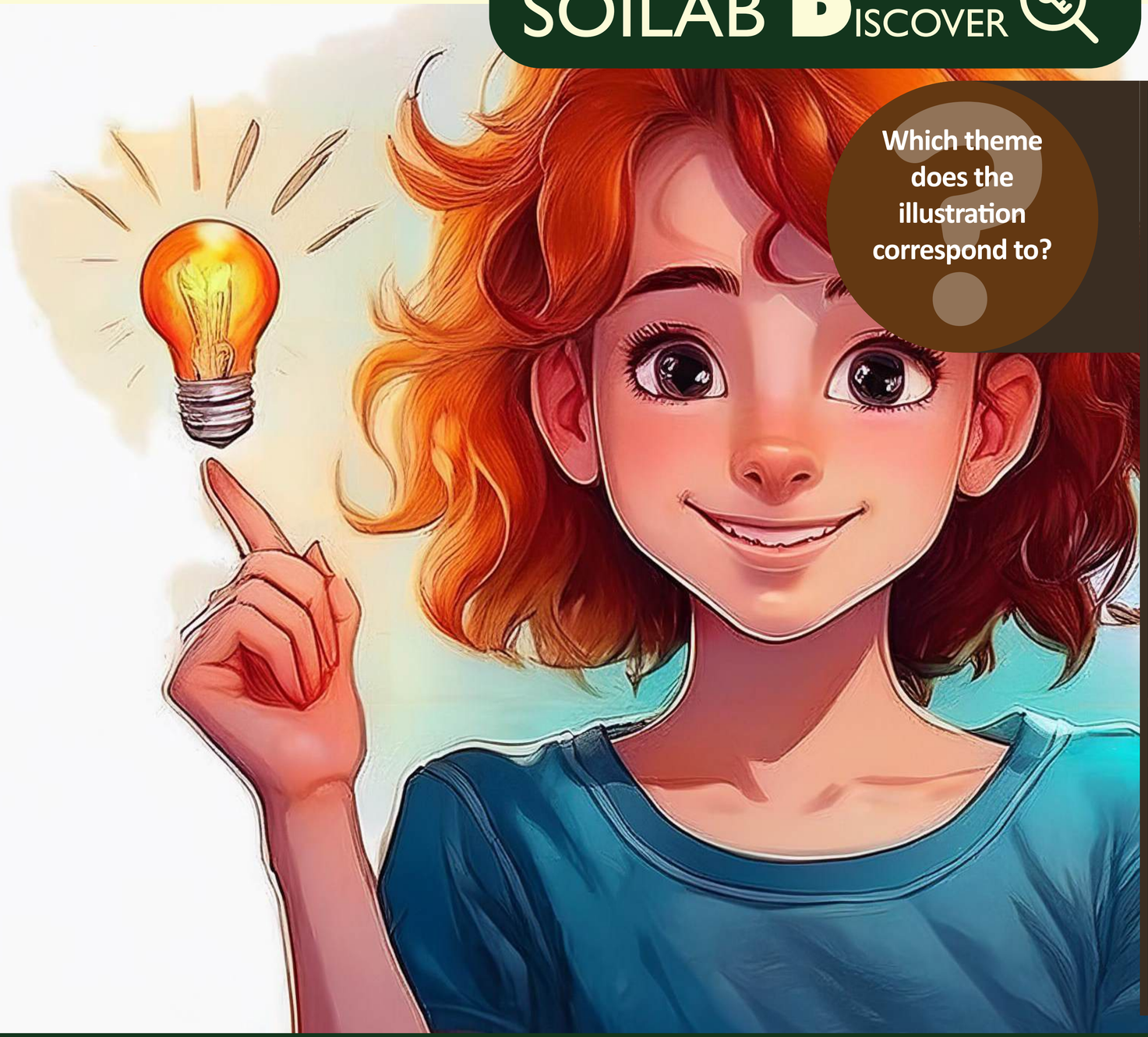

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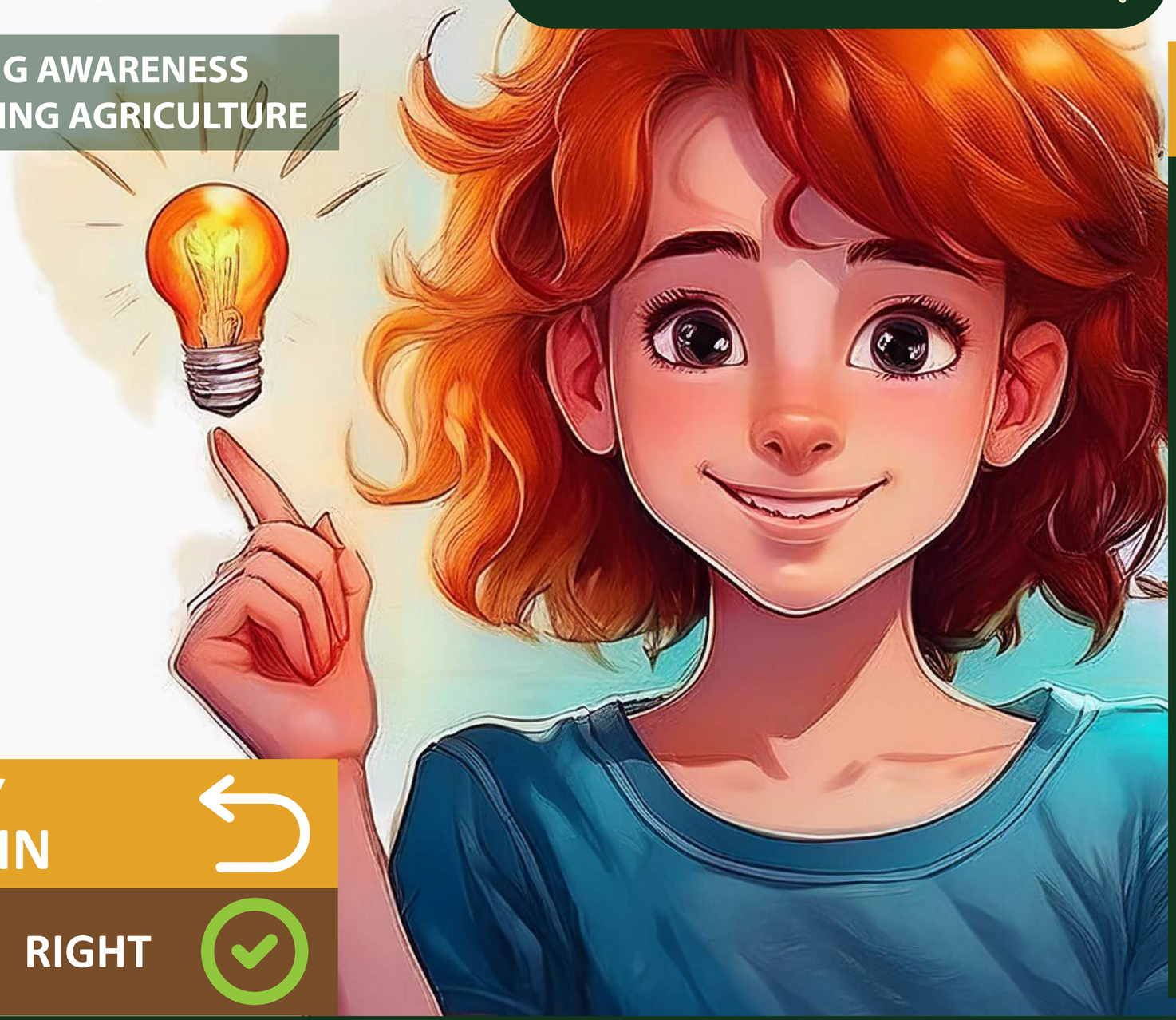
RAISING AWARENESS
KNOWING AGRICULTURE



D. Acting for the soil

SPREADING GOOD IDEAS

What can we do as individuals and as a community?

Spread the word! Talk to your teachers, parents, friends, even local farmers... to spread the message about the importance of the soil resource and how to preserve it. The more we raise awareness, the more we can stop the destruction of our precious Planet!

PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

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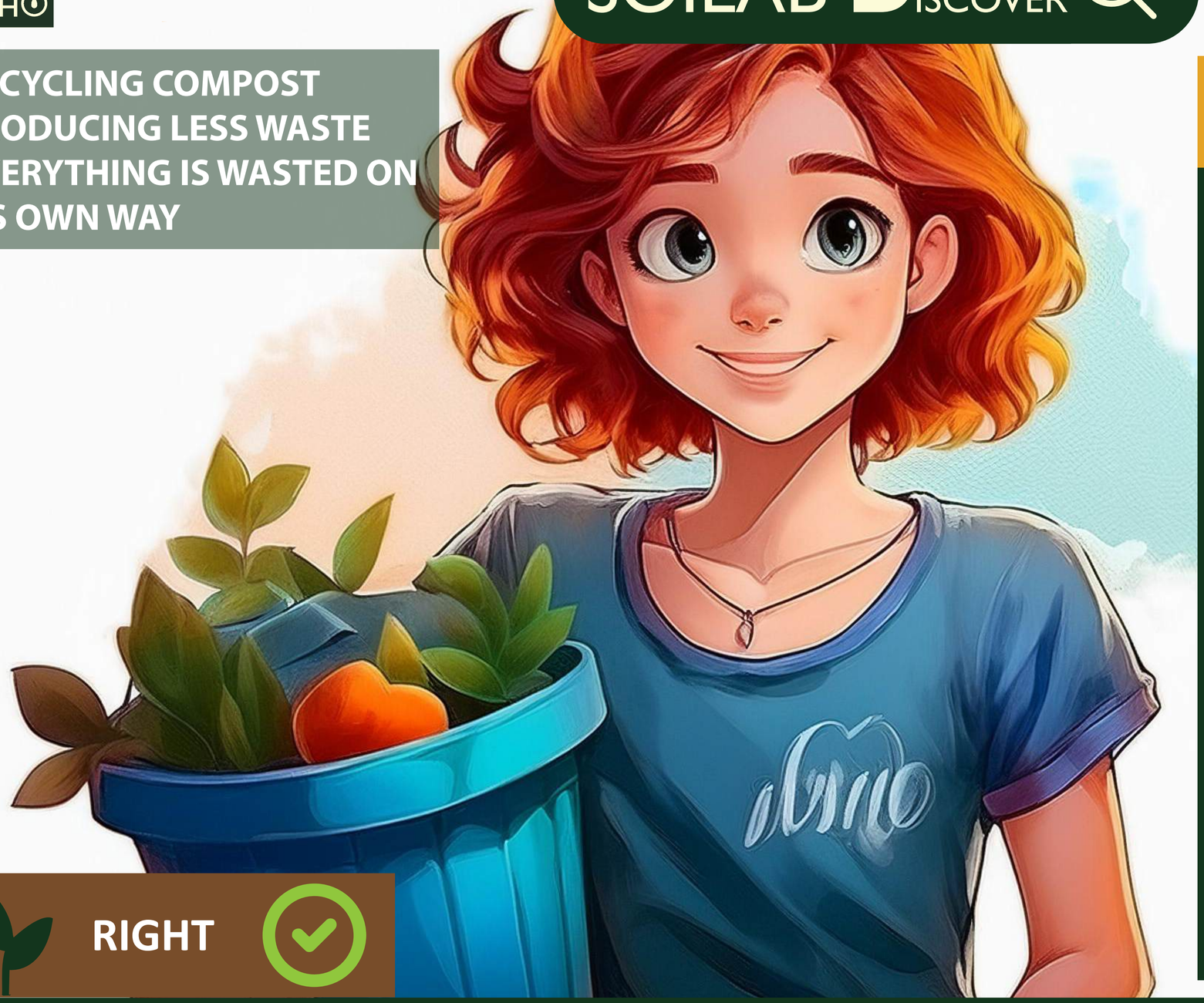
RECYCLING COMPOST
PRODUCING LESS WASTE
EVERYTHING IS WASTED ON
ITS OWN WAY



RIGHT

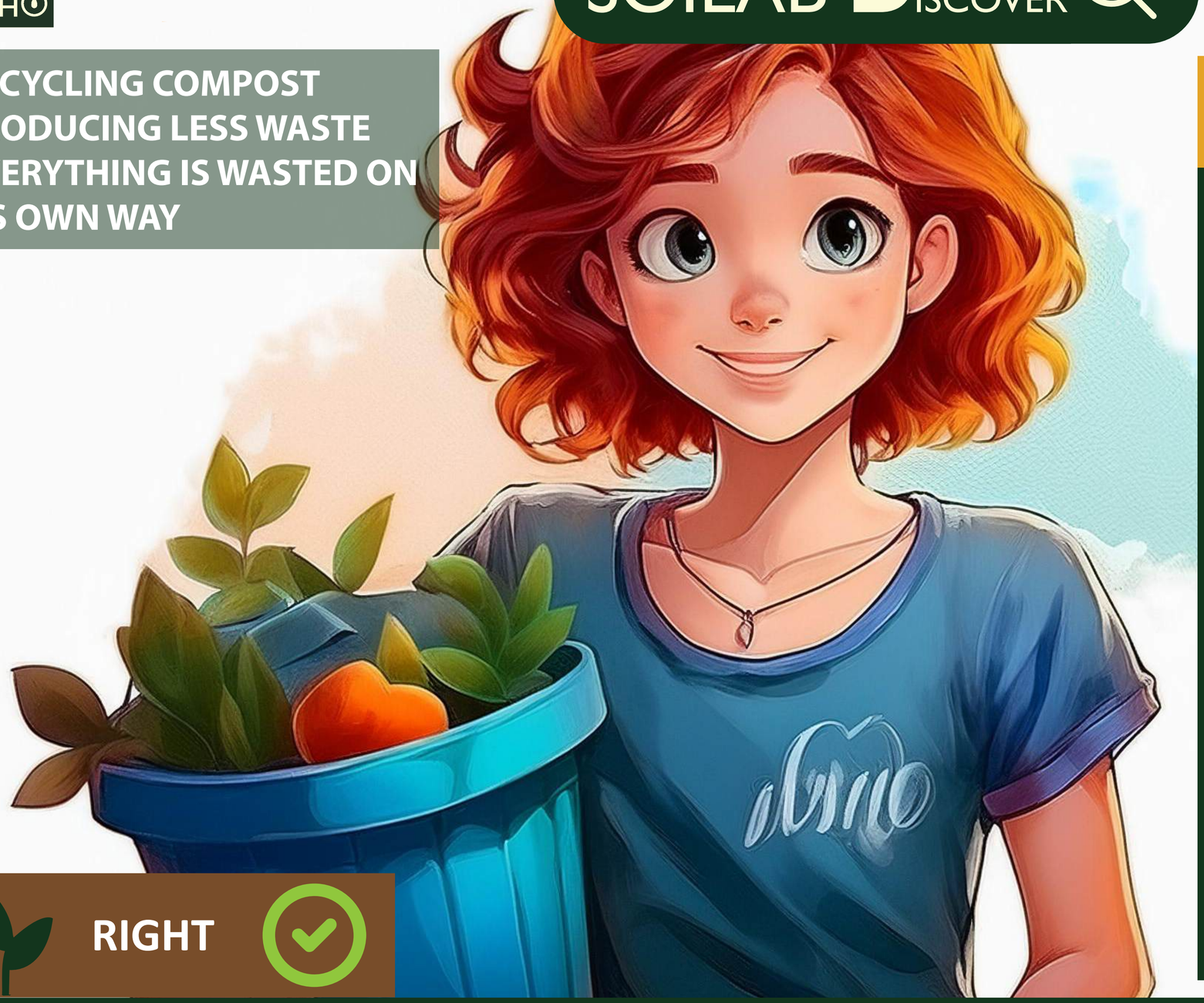
E. Produce less waste

SCRAPS AND WASTE

Buy responsibly, thus producing less food waste. In Europe, food waste reaches 88 million tonnes/year, accounting for about 20% of the total food produced.
Recycle your compost Separate organic waste at home, at school, in the canteen, taking care to separate the waste well so that the final compost is of high quality!
Organic or ‘wet’ waste (waste from households,

to be continued ▶

RECYCLING COMPOST PRODUCING LESS WASTE EVERYTHING IS WASTED ON ITS OWN WAY

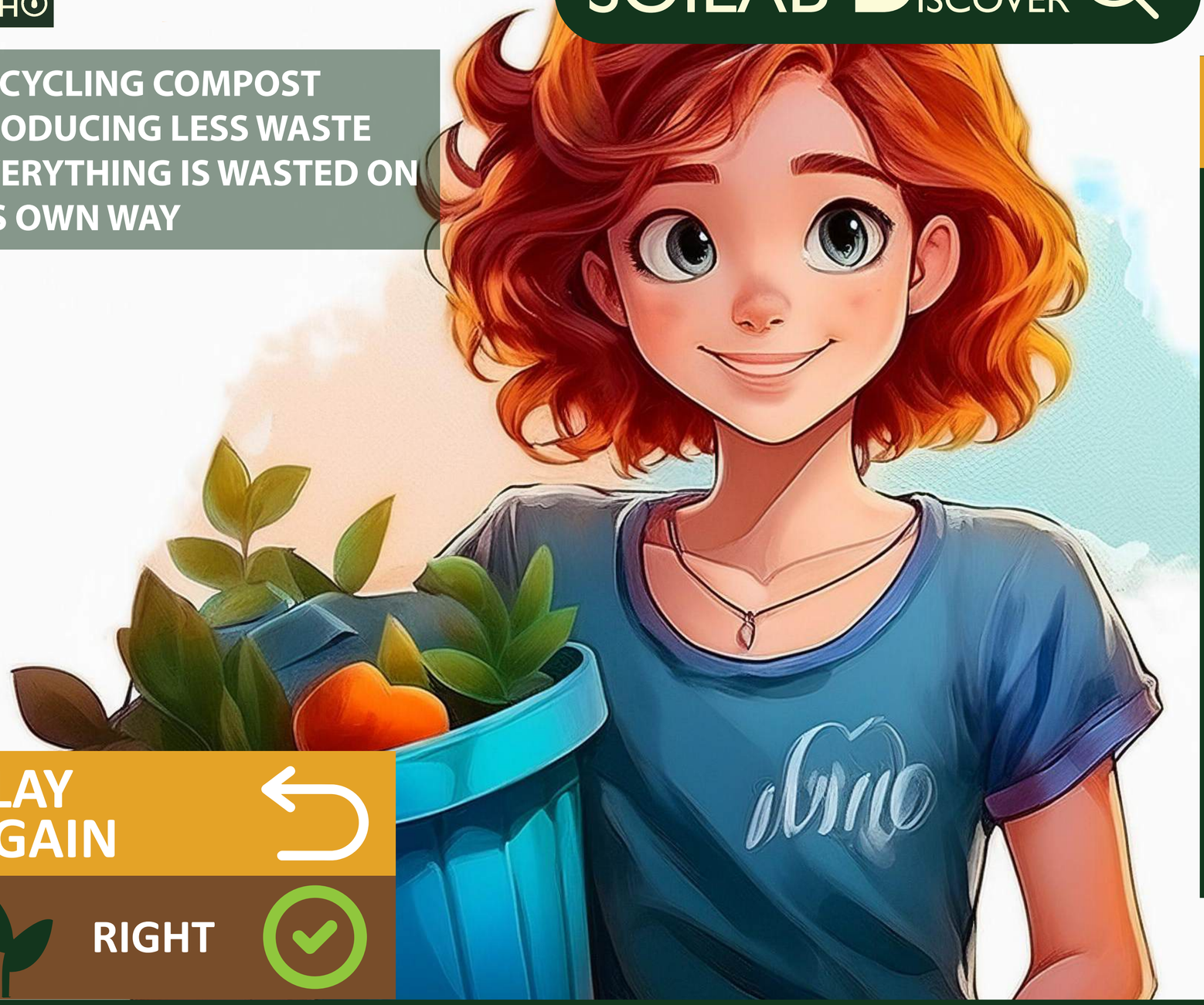


RIGHT

E. restaurants/bars, canteens and markets) can be made into biogas and compost. Compost is an organic fertiliser that can be used to replace synthetic products and improve soil structure and quality.
The composting process is handled by composting plants all over Europe. The use of quality compost in agriculture enables the regeneration and maintenance of soil fertility and the decarbonisation of the atmosphere. For every kg of organic waste as such (73% water) ‘diverted’ from landfill

to be continued ▶

RECYCLING COMPOST PRODUCING LESS WASTE EVERYTHING IS WASTED ON ITS OWN WAY



E. and organically recovered, 1.4 kg of CO_2 equivalent can be retained (a unit of measurement that allows different greenhouse gas emissions with different climate-changing effects to be weighed together).
In Europe, around 96 million tonnes of organic waste are produced in cities, of which 66% is not recycled. However, Italy, collecting 47%, against the European average of 16%, ranks first in Europe for food waste recycling. But more industrial composting plants are needed to process it.

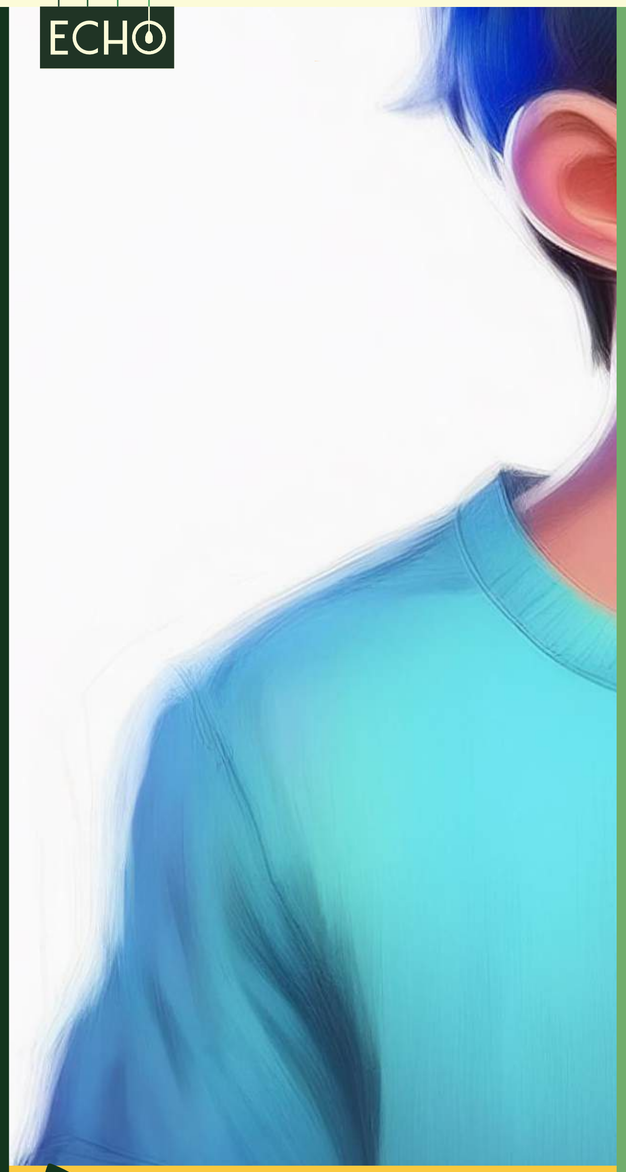
PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



DISCOVER

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ECHO

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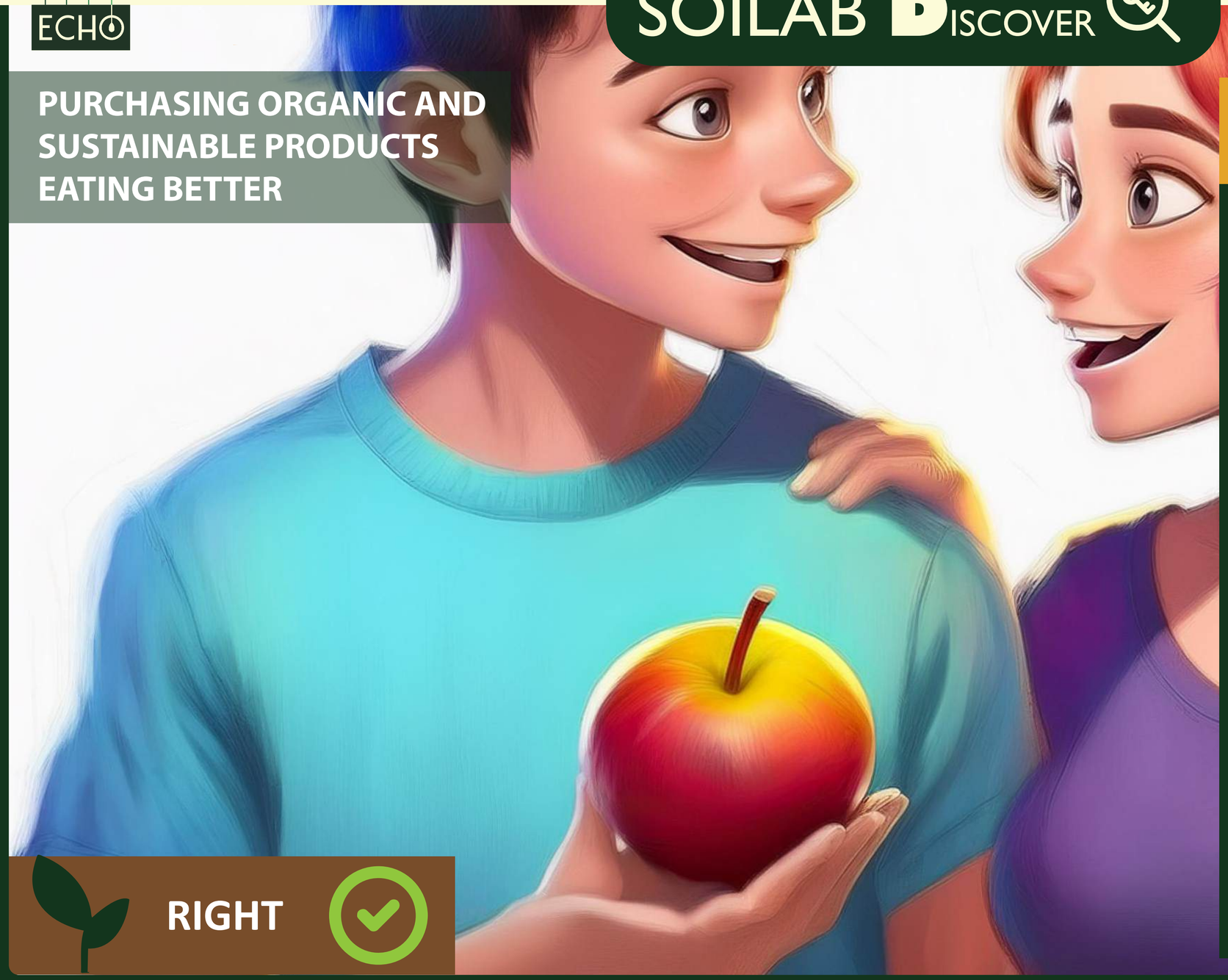
PURCHASING ORGANIC AND SUSTAINABLE PRODUCTS EATING BETTER



RIGHT

F. Eat better!

EATING CONSCIOUSLY

Diversify your eating habits, switching to healthier diets that could save millions of square kilometres of farmland, improve our health, that of the soil, and reduce emissions by 0.7-0.8 Gt of CO_2 equivalent.
Buy more sustainable products
Choose to buy fruit and vegetables from sustainable or organic farming, preferably grown close to home. Over time, this will mean using less pesticides and artificial

to be continued ▶

PURCHASING ORGANIC AND SUSTAINABLE PRODUCTS EATING BETTER

F. fertilisers, fewer high-yield crops that damage soil biodiversity, and fewer impacts related to transporting the food we eat.

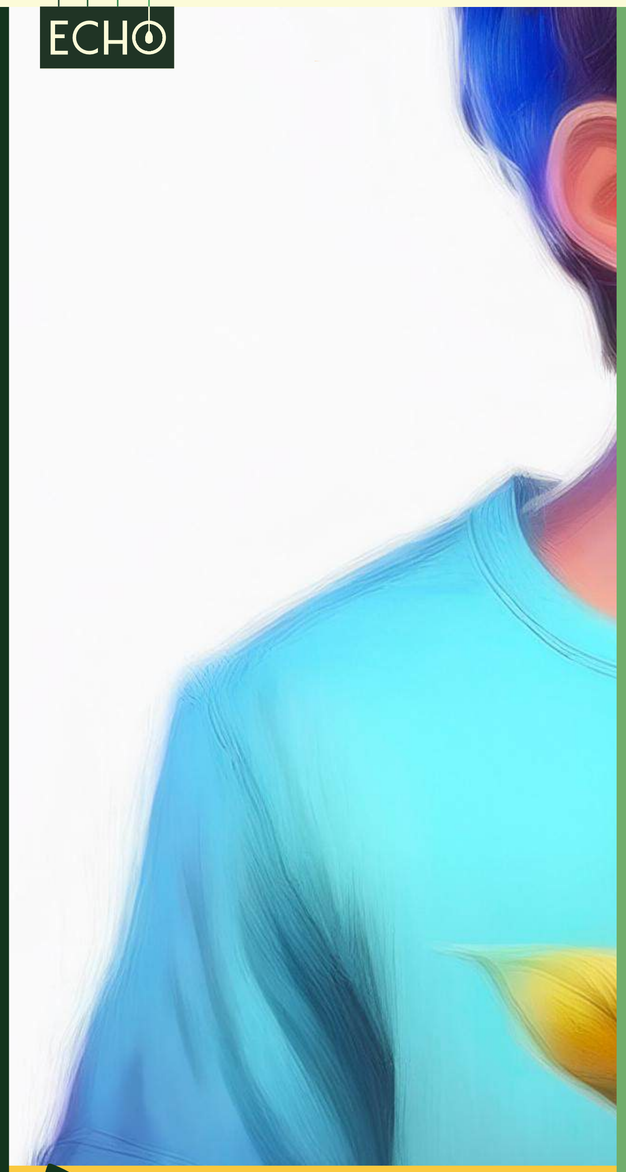
PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



DISCOVER

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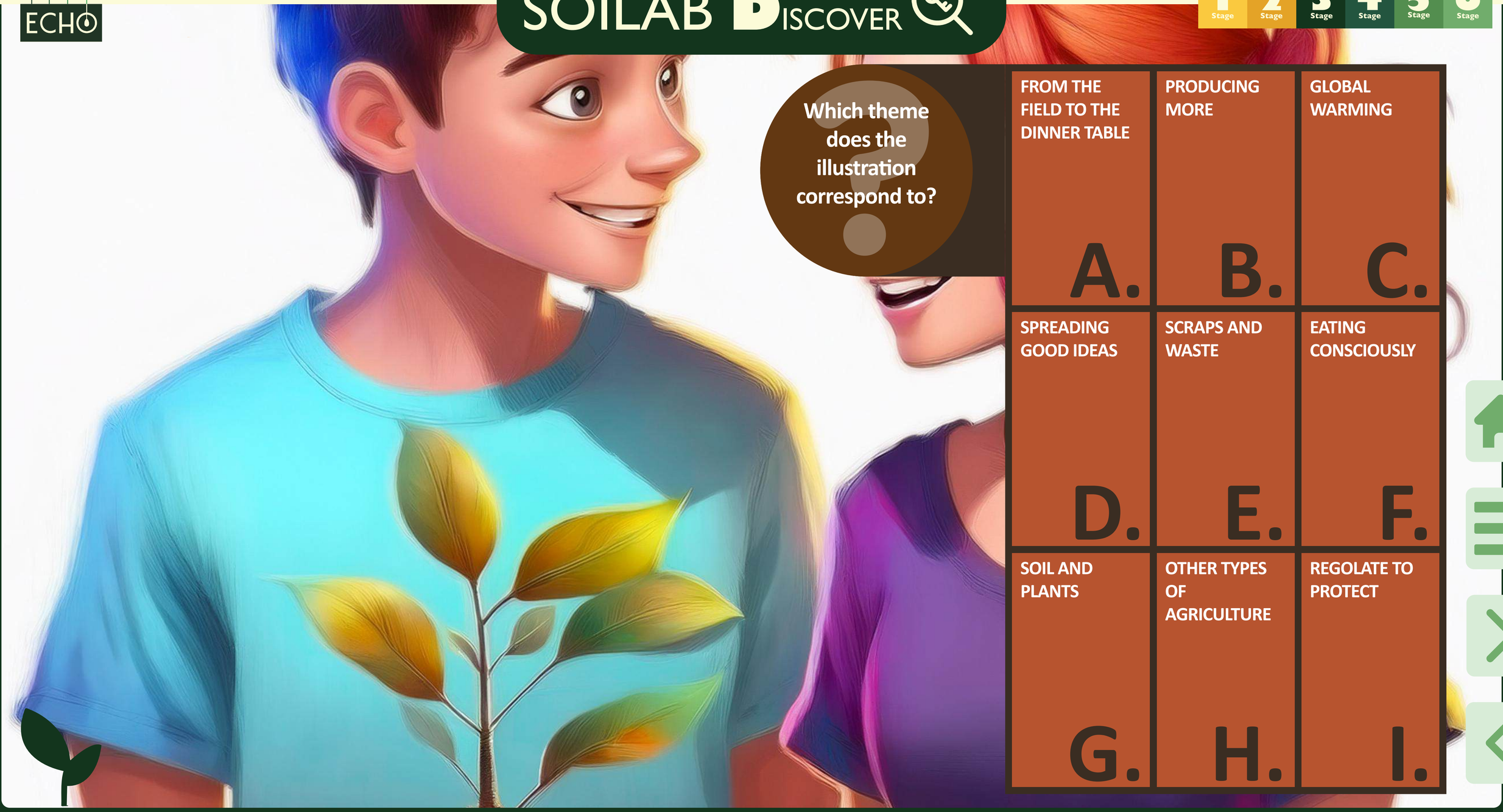

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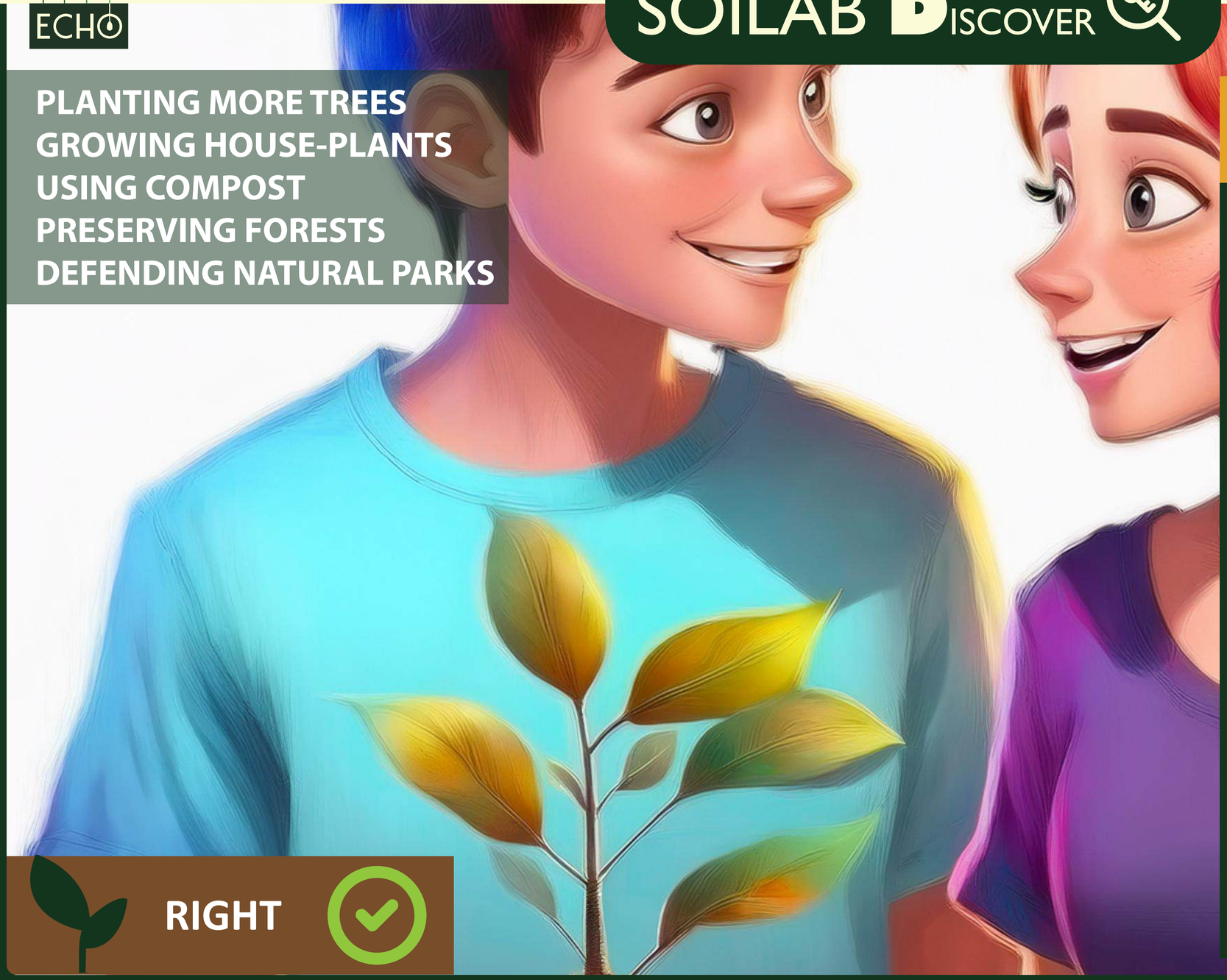
PLANTING MORE TREES
GROWING HOUSE-PLANTS
USING COMPOST
PRESERVING FORESTS
DEFENDING NATURAL PARKS



RIGHT

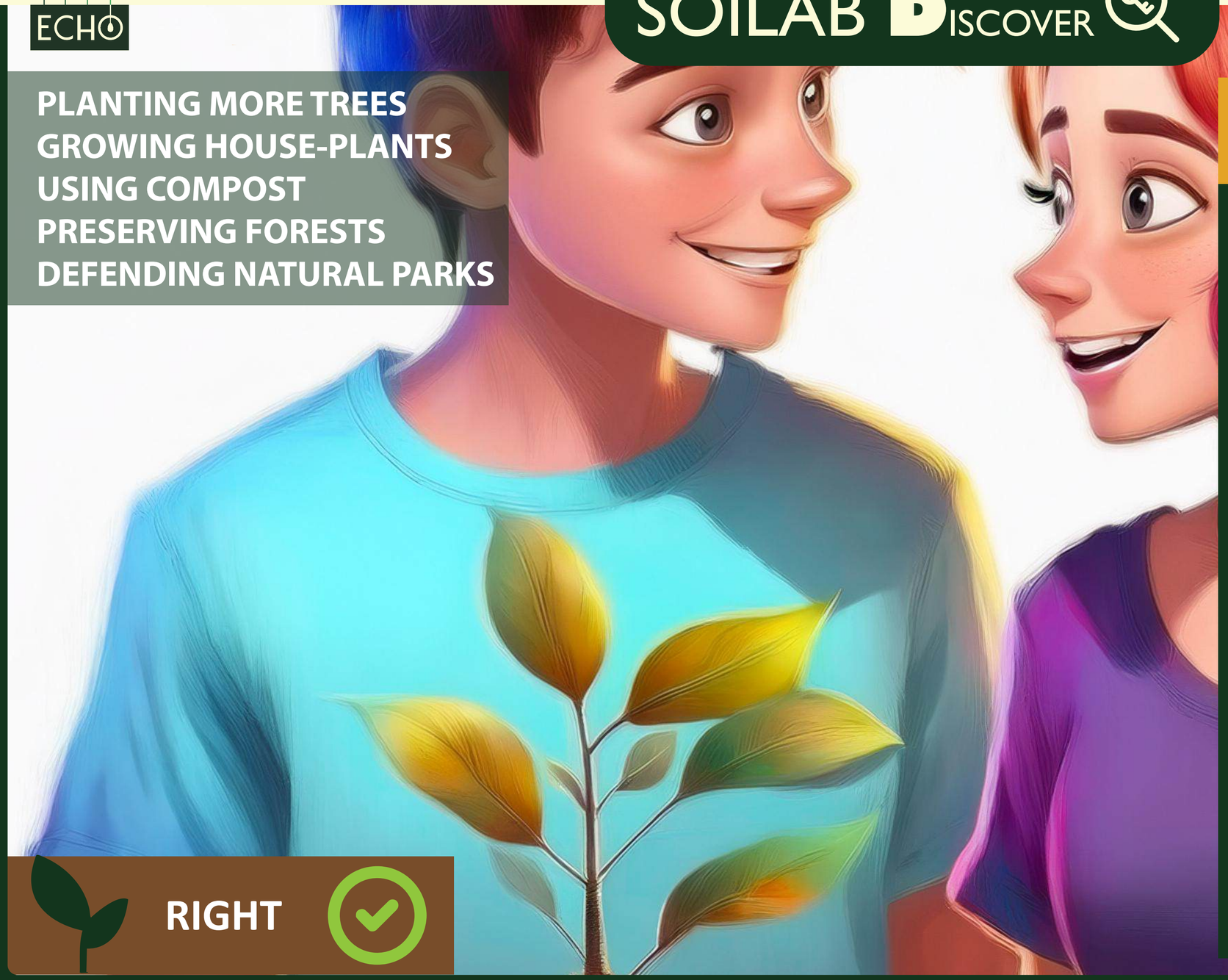
G. Be in nature and grow a green thumb too!

SOIL AND PLANTS

If you live in the city, take every possible opportunity to go and see nature up close: the woods, fields, meadows, plains, hills, mountains, farmsteads, crops, orchards; ask, be curious, get to know the people who live there, find out about their work, taste their produce, especially fruit and vegetables, learn about the characteristics and habits of animals, insects, plants, tell

to be continued ▶

PLANTING MORE TREES
GROWING HOUSE-PLANTS
USING COMPOST
PRESERVING FORESTS
DEFENDING NATURAL PARKS



RIGHT

G. apart one species from the other.

In the garden, in the vegetable garden, for plants on the balcony and at home... find out what kind of fertiliser, compost and seeds are used and favour the use of sustainable products!

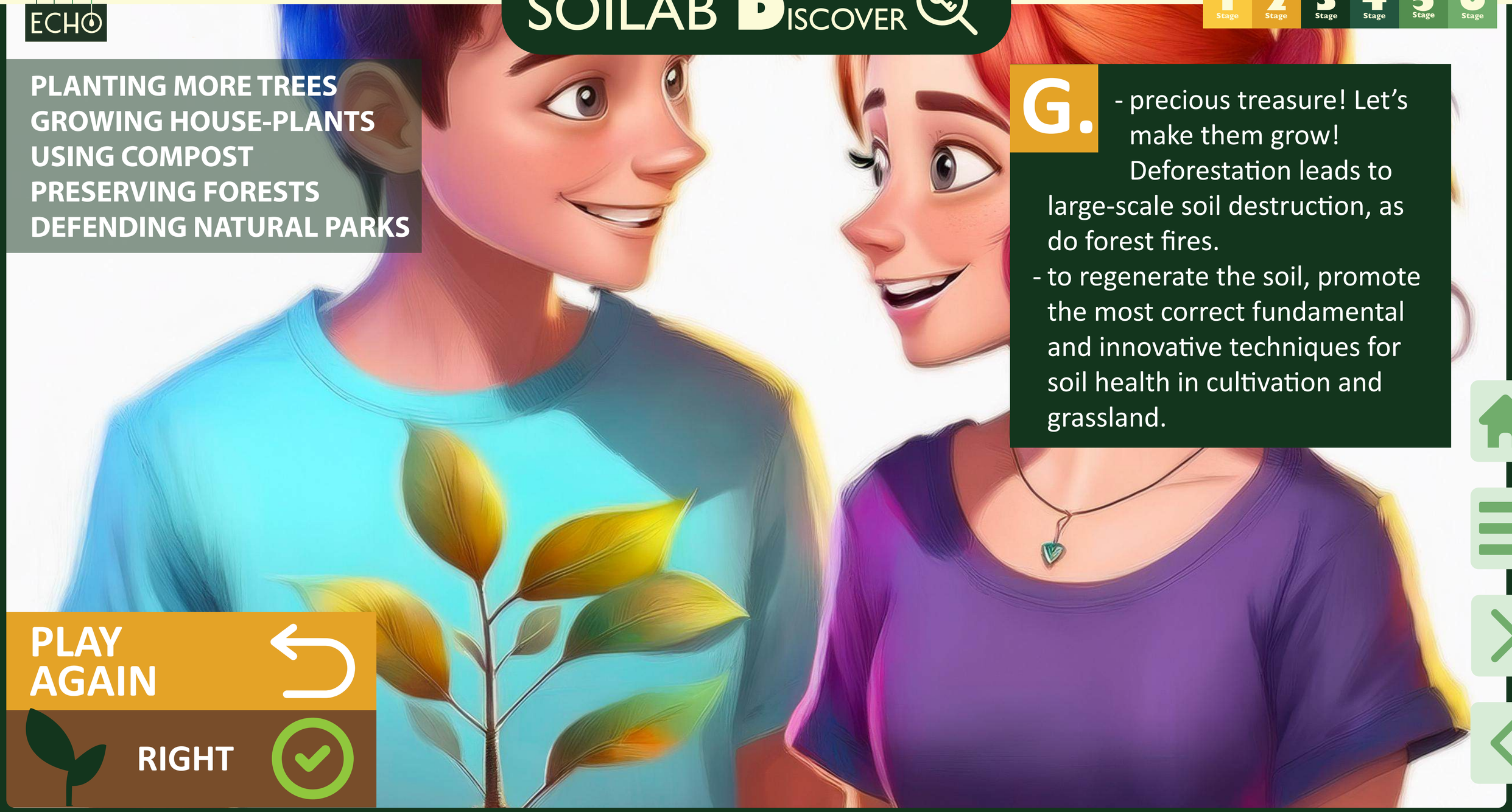
Help planting more trees.

Support tree planting campaigns in your community or school. If there aren't any, start your own!

Ask decision makers to:

- adopt and expand policies to protect and preserve natural areas.
- defend woods and forests, a

to be continued ▶



PLANTING MORE TREES
GROWING HOUSE-PLANTS
USING COMPOST
PRESERVING FORESTS
DEFENDING NATURAL PARKS

G. - precious treasure! Let's make them grow! Deforestation leads to large-scale soil destruction, as do forest fires.
- to regenerate the soil, promote the most correct fundamental and innovative techniques for soil health in cultivation and grassland.

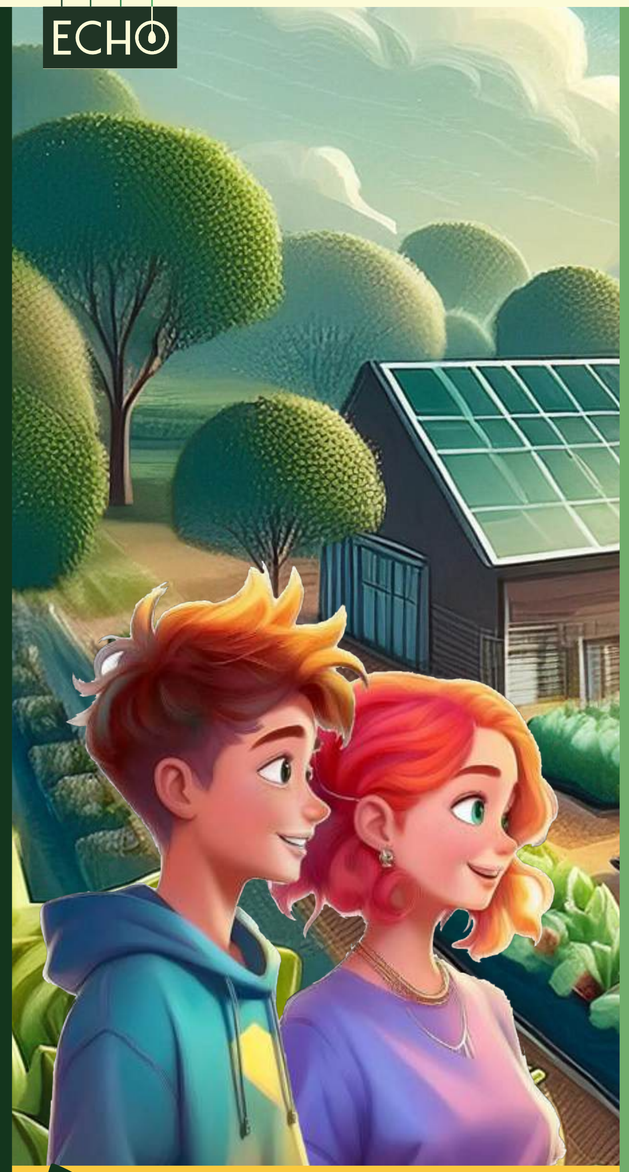
PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



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REGENERATIVE AND SUSTAINABLE AGRICULTURE REDUCING POLLUTANTS

RIGHT

H. OTHER TYPES OF AGRICULTURE

Pollution by plastics, microplastics and other pollutants make the state of soil health even worse. Don't limit yourself to being more careful, you can also use new types products (biodegradable mulching cloths in soil, compostable plant binding threads, biodegradable lubricating oils, etc.).
A regenerative and sustainable agriculture. Spread sustainable practices in agriculture, including innovative ones, focused on soil

to be continued ▶

Lorem

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

REGENERATIVE AND SUSTAINABLE AGRICULTURE REDUCING POLLUTANTS

H. OTHER TYPES OF AGRICULTURE

health, thanks also to the use of technologies resulting from scientific research (more targeted agrochemicals, capable of reacting to new climatic conditions, to insect invasions from other geographical areas, with less toxicity and permanence in the environment...).

PLAY AGAIN

RIGHT

ECHO

SOILAB DISCOVER

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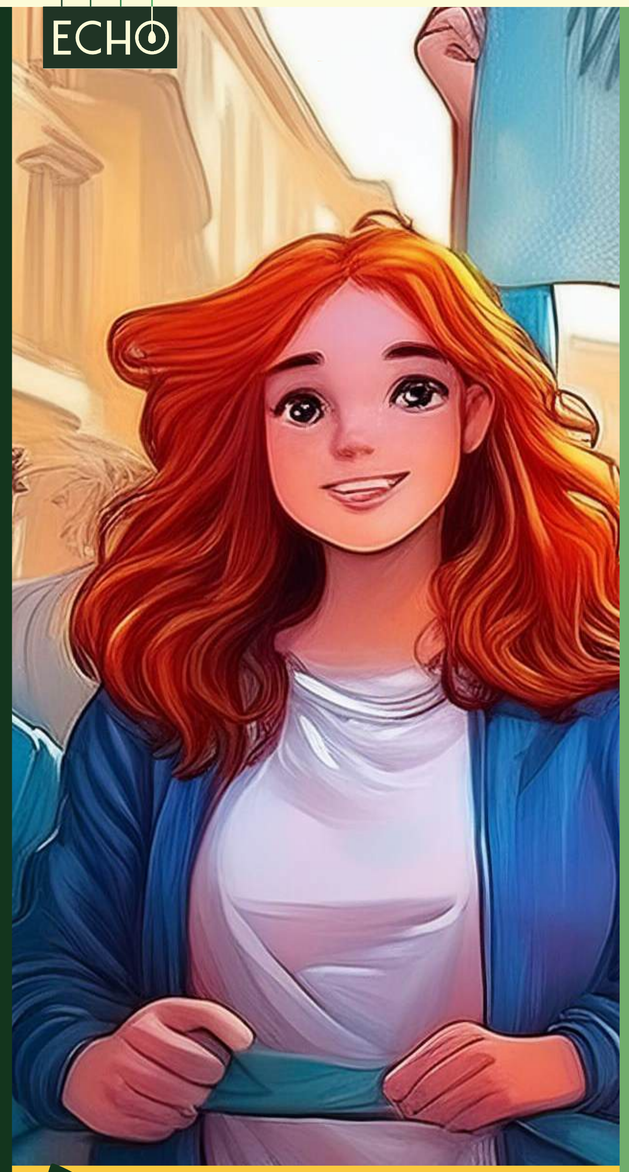

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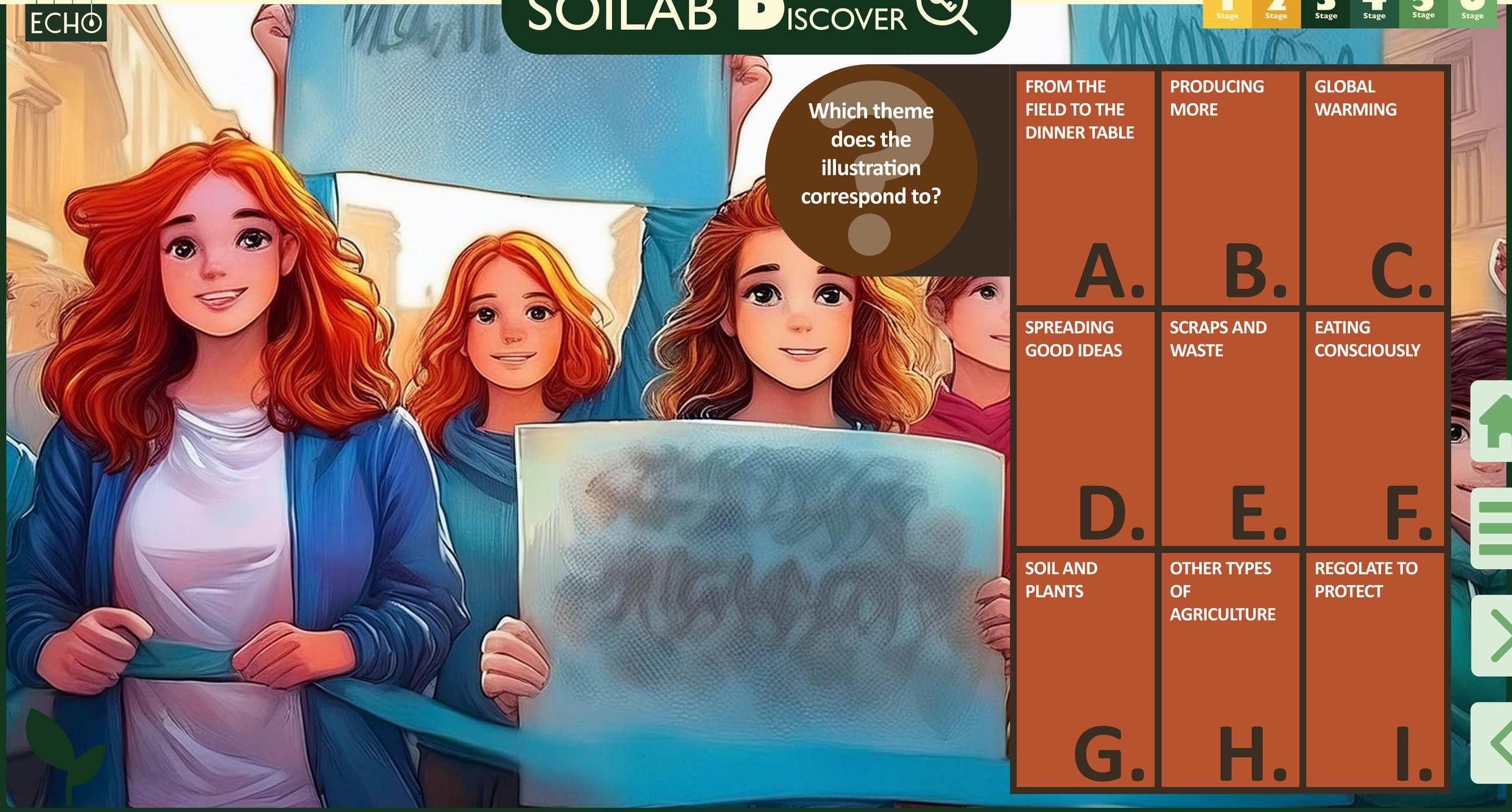
FOOD PRODUCTION	EVERYTHING IS WASTED ON ITS OWN WAY	*MORE CLIMATE-CHANGING EMISSIONS*	PRESERVING FORESTS
CLIMATE CHANGE	*REDUCING POLLUTANTS*	EATING BETTER	*GROWING HOUSEPLANTS*
INCREASE IN AGRICULTURAL SURFACE	SOILS DEGRADATION	*RAISING AWARENESS KNOWING AGRICULTURE*	POPULATION INCREASE
CLIMATE MIGRANTS	*DEFENDING NATURAL PARKS*	USING MORE NUTRIENTS	*REGENERATIVE AND SUSTAINABLE AGRICULTURE*
USING COMPOST	RECYCLING COMPOST	*PRODUCING LESS WASTE*	LAWS FOR THE SOIL

ECHO

SOILAB DISCOVER

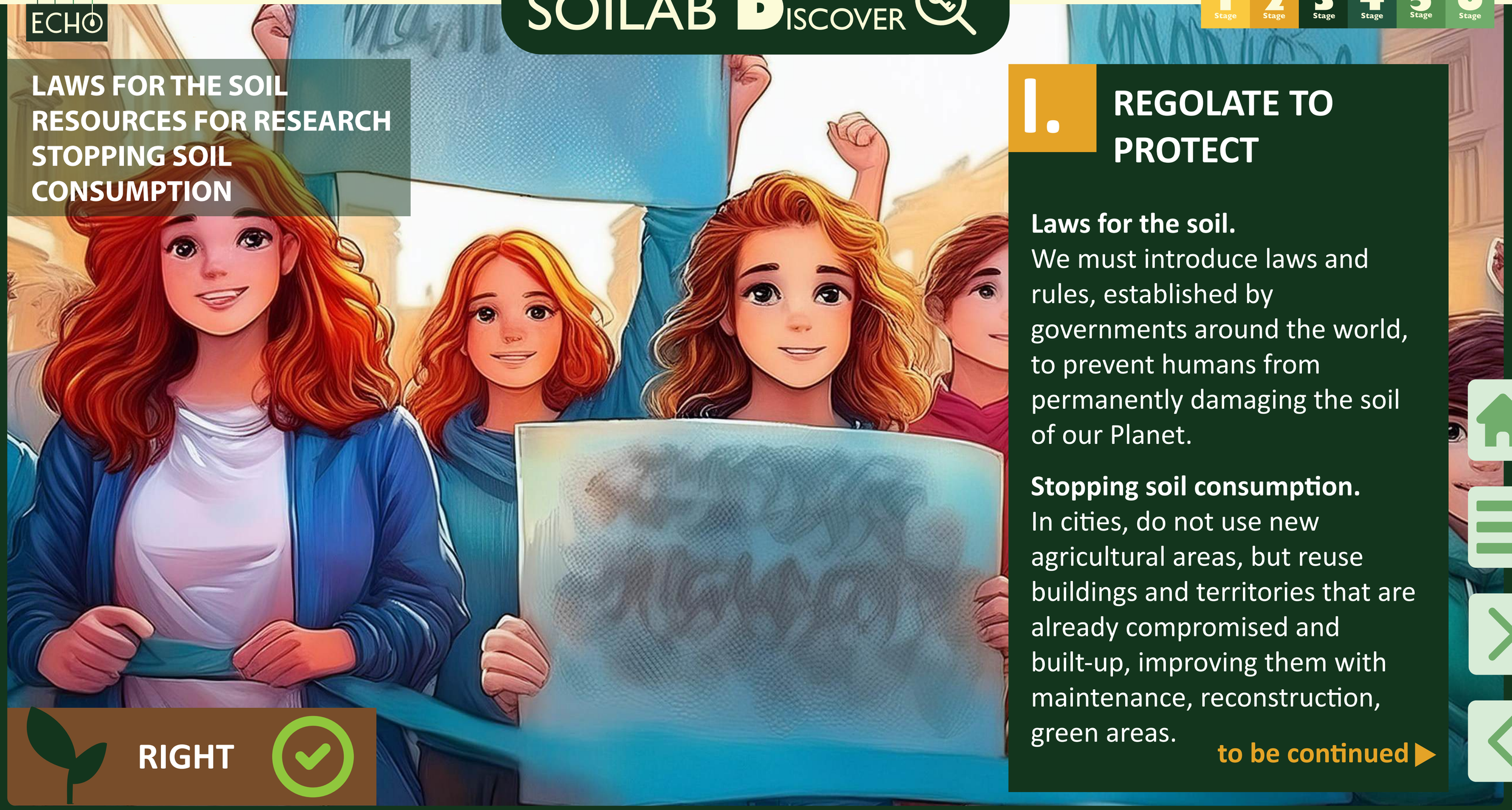
1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage



Which theme does the illustration correspond to?

FROM THE FIELD TO THE DINNER TABLE **A.**	PRODUCING MORE **B.**	GLOBAL WARMING **C.**
SPREADING GOOD IDEAS **D.**	SCRAPS AND WASTE **E.**	EATING CONSCIOUSLY **F.**
SOIL AND PLANTS **G.**	OTHER TYPES OF AGRICULTURE **H.**	REGOLATE TO PROTECT **I.**

LAWS FOR THE SOIL RESOURCES FOR RESEARCH STOPPING SOIL CONSUMPTION



RIGHT

I. REGOLATE TO PROTECT

Laws for the soil.
We must introduce laws and rules, established by governments around the world, to prevent humans from permanently damaging the soil of our Planet.

Stopping soil consumption.
In cities, do not use new agricultural areas, but reuse buildings and territories that are already compromised and built-up, improving them with maintenance, reconstruction, green areas.

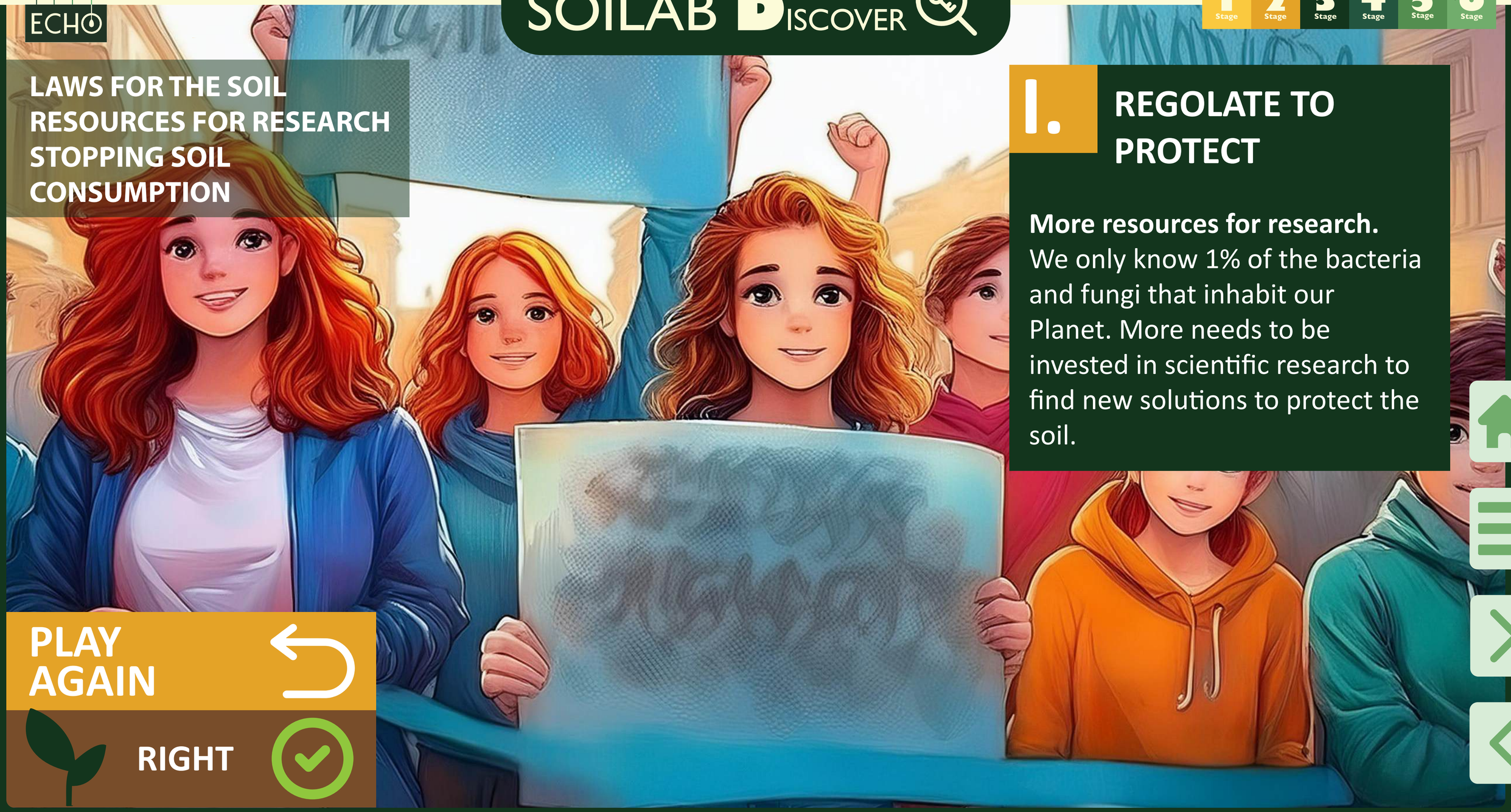
to be continued ▶

ECHO

SOILAB DISCOVER

1 Stage | 2 Stage | 3 Stage | 4 Stage | 5 Stage | 6 Stage

LAWS FOR THE SOIL
RESOURCES FOR RESEARCH
STOPPING SOIL CONSUMPTION



I. REGOLATE TO PROTECT

More resources for research.
We only know 1% of the bacteria and fungi that inhabit our Planet. More needs to be invested in scientific research to find new solutions to protect the soil.

PLAY AGAIN

RIGHT