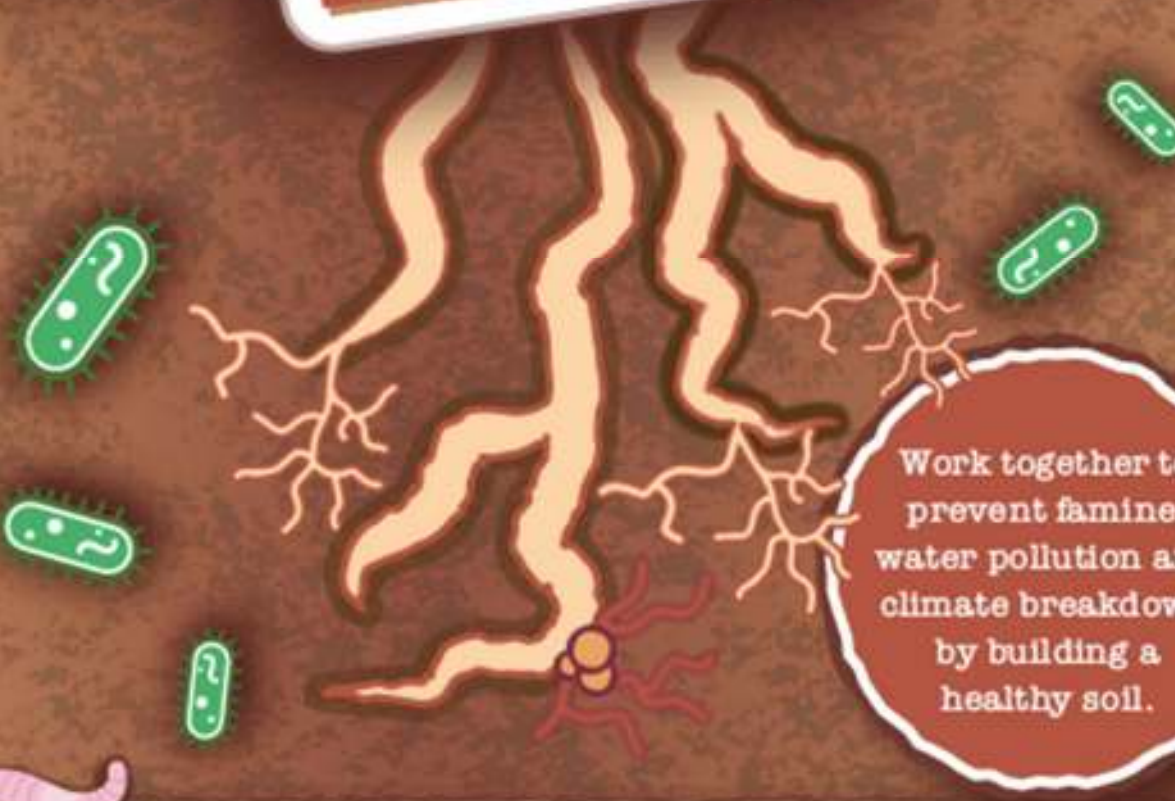


The world is in crisis!

Dirty Matters

The Soil Game



Work together to prevent famine, water pollution and climate breakdown by building a healthy soil.

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Dirty Matters

The Soil Game

The world is in crisis!

Background

The world is in a crisis! Life as we know it, may soon come to a devastating end. We are dealing with a growing population and global food shortages while in the face of climate change, environmental loss, air pollution, and water contamination. The United Nations has proposed a set of goals – the Sustainable Development goals - that if reached, can help overcome these challenges and improve human life on Earth. Countries, political parties, private organizations, scientists and the public have come together to find ways to meet these Sustainable Development Goals. And they have zeroed in on THE SOIL!

The soil is a fragile, living and breathing skin that covers our planet and supports life on Earth. It provides more than 95% of our food and fodder, filters our water, regulates the Earth's temperature, and acts as a powerhouse of carbon storage. Yet, we have been too careless with it. Human activities like deforestation, urbanization, agriculture and pollution have degraded more than one third of the soil on earth. In order to survive, we have to protect what is left!

As soil guardians you must restore degraded soil so that is can prevent famine, water pollution and climate breakdown. Healthy soil relies on many soil properties. You will have to travel through the soil matrix and fix these to build a healthy soil that can tackle these global challenges. It is not an easy task but work together and you will tackle these dirty matters.

Number of players: 2-6

Playing time: 40-60 minutes

Age 8+

Game Components

- 48 Soil Power cards
- 18 Event cards
- 6 Character cards
- 6 Turn Guide cards
- 1 playing Board
- 9 Soil Health Tokens
- 6 Character Tokens
- 3 Catastrophe Tokens
- 2 Yield Tracker Tokens

The Anatomy of a Card

There are 3 types of cards:

Character Cards (x6)

These represent the soil organism you will use to navigate the soil and improve it.

Each character has unique abilities and speeds.

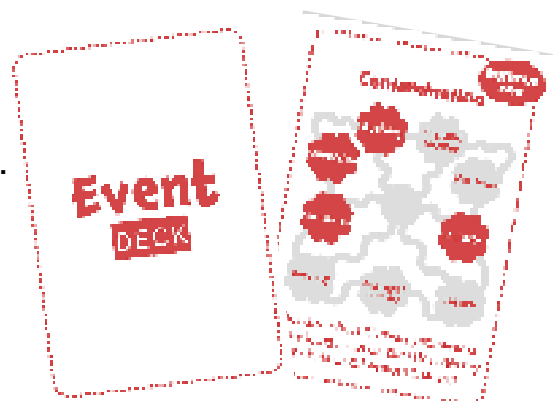


Event Cards (x18)

These cards are played at the start of each round.

For each Soil Property highlighted in red on the card's mini map, move the relevant Soil Health Token by the number indicated in the top right of the card.

The card is then put into the discard pile.

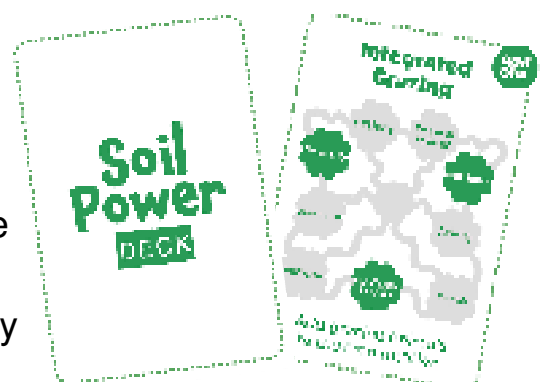


Soil Power Cards (x48)

These cards are used to improve the condition of the soil, allowing it to produce more food.

The Soil Properties are highlighted in green on the card's mini map.

Unlike the Event Cards, Soil Power Cards can only be used to improve one of its affected Soil Property before it is discarded.



The Board



- **Soil Properties:** The soil properties are the 9 “flower” shaped graphics, divided into the three categories – Physical, Chemical and Biological. The numbers on them indicate the Soil Health points.
- **Character Starting Area:** The white space in the centre of the board is where the characters should be at the start of the game.
- **Cascades:** Information about cascades is shown on the left of the board
- **Catastrophes:** Three boxes are shown on the left-hand side to keep track of catastrophes!
- **Catastrophe Symbols:** The three symbols – Famine, Polluted Water and Climate Breakdown are shown in a key on the left of the board
- **Yield Tracker:** The white path depicting a “Start Here” marker and tracker from 0-30, with food targets indicated per round on 16, 18, 21, 25 and 28, with the final goal at 30.

The Aim of the Game

Objective

Work in groups of 2-6 players to make it through 6 rounds of feeding the Earth's population whilst keeping the waters unpolluted and fighting climate change by harnessing the power of soil.

Set-up

For a 6 player game

1. Give each player a **Turn Guide card**
2. Put a **Soil Health Token** at number 2 on each of the **Soil Properties**
3. On the **Yield Tracker** place a **Yield Tracker Token** at 0 and 1 on the first highlighted number (16)
4. Deal one **Character Card** randomly to each player or the players can select their character. If two players are fighting over the same character the winner of Rock, Paper, Scissors gets to keep it and the loser must hang their head in shame and choose another.
5. Shuffle the **Event Card Deck** and place by the board.
6. Shuffle the **Soil Power Card Deck** and deal one card per character card. Place the remaining cards by the board.
7. Every player places their **Character Token(s)** on the white area in middle of board.

Variations

- **2 and 3 players:** Each player gets 2 Character Cards.
- **2 or 4 players:** Remove Climate Change, Desertification, Salinisation, Severe Wildfire and Land Use Change cards from the Event Card Deck. Recommend Character Cards: Earthworm, Mycorrhiza Fungi, Nematodes and Actinomycetes.
- **5 players:** Remove the Climate Change, Desertification and Severe Wildfire cards from the Event Card Deck. Recommend Character Cards: Earthworm, Mycorrhiza Fungi, Nematodes, Actinomycetes and Rhizobia.

Make it harder

Instead of dealing every character a Soil Power Card at the start of the round only take a new card at the start of your turn. This adds another level on unpredictability to the game and necessitates a level of adaptability.

How to Play



The Event Phase

1. At the start of each round turn over one card from the **Event Card Deck**.
2. Adjust the **Soil Health Tokens** of all the **Soil Properties** as indicated on the card.
3. If at any point the **Soil Health Token** of a **Soil Property** reaches 0, then this will trigger a **negative cascade** and each of the **Soil Health Tokens** of the other two **Soil Properties** in the same group (Biological, Chemical, or Physical) also go down by 1 point.

Cascades: Soil is dynamic and there are **complex interactions** between Soil Properties, therefore severely impacting one property can have knock on effects on other properties.

The Mitigation Phase

1. Start by drawing 1 **Soil Power Card** per character card, there is no limit to the number of cards a character can have.
2. The player who most recently got their hands dirty with soil goes first.
 - If playing with two or more character cards, treat each as a distinctive character. You can decide which character goes first and this order remains the same throughout the game. Recommend Mole and Mycorrhiza Fungi to be played first.
3. You may then choose any two of the three actions per character:

Note: You can only improve the **Soil Properties** your **Character Token** is currently occupying with either a **Soil Power Card** or a character's **Special Ability**

- Move your **Character Token** to an adjacent **Soil Property**. The number of soil properties you can pass through is determined by the speed of your character. The starting area does not count as 1 space when moving between properties.
- Use one of the **Special Abilities** as specified on your **Character Card** (each ability can only be used once per round and using both equals two actions)
- Play a **Soil Power Card** to improve the **Soil Property** your **Character Token** is currently occupying (playing two power cards equals two actions).

4. If a **Soil Health Token** reaches 7, then a positive cascade is triggered. Increase the **Soil Health Tokens** by 1 point on the other two **Soil Properties** in the same group (Biological, Chemical, or Physical).
5. Play then proceeds clockwise repeating steps 3, and 4 for each player's character cards.

Example: I play the mole. On my turn I decide to move and carry another character. The mole has a speed of 4. I start in **Acidity**, pick up **Nematode** in **Porosity** (1 space), move through **Abundance** (2 space) drop it in **Diversity** (3 space) and I stop in **Activity** (4 space). I have played my two actions and finished my turn.

How to Play

(continued)



The Yield Phase

1. After each player has carried out their two actions per character it is time to calculate the yield.
2. The yield is determined by how healthy the players have managed to keep the soil. Calculate the yield by adding up the health of each **Soil Property**. The health of each Soil Property is indicated by the number upon which its **Soil Health Tokens** currently sits. Move the **Yield Tracker Token** forward the total number of **Health Points**.
3. As the population increases so too does the **Yield Target** of each round. Failing to reach a **Yield Target** counts as a **Catastrophe**.

The Catastrophes Phase

The world has a level of resilience so it can cope with **three catastrophes** before the collapse of society.

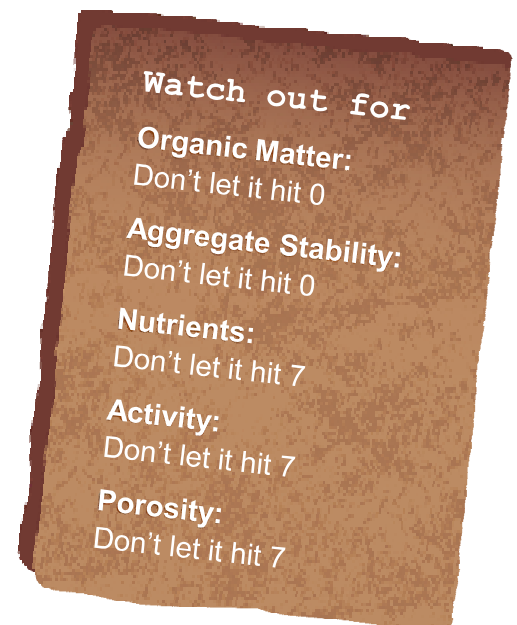
There are three types of catastrophes in this game:

1 Famine:

If at the end of a round you do not reach the yield target, you have failed to produce enough food to feed the growing population. Riots break out in supermarkets, countries declare war over the last bread stick, the sound of rumbling bellies can be heard on the moon.

2 Polluted water: There are three ways to pollute the water in this game:

- **Aggregate stability reaches 0:** The aggregate stability of soil determines how well it holds together. If this drops to 0 soil can no longer hold its shape and easily gets washed or blown into waterways and no one wants to drink mud!
- **Nutrient reaches 7:** When there are more nutrients in the soil than it can hold, some are washed into waterways, triggering an explosion of plant and algal growth. As microscopic organisms decompose them, all the oxygen is consumed so nothing can live there anymore and the water becomes smelly, bubbling and eww!
- **Porosity reaches 7:** Pores, or holes, in the ground are important for plants to grow root through, and exchange nutrients and water, but too high a porosity and the precious water carrying nutrients will wash through the soil too quickly before the plants and soil organisms can use them.



How to Play

(continued)

3 **Climate breakdown:** There are two ways to cause climate breakdown in this game:

- **Organic matter reaches 0:** Soil is the largest terrestrial carbon reservoir, containing approximately 3 times that of the whole atmosphere. The majority of this carbon is locked up as organic matter. Poor land management and land use change degrades this organic matter allowing it to be lost to the atmosphere as the dreaded CO₂.
- **Biological activity reaches 7:** Some soil micro-organisms use soil organic matter as an energy source, recycling it into nutrients that other organisms and plants can use but also breathing out CO₂. The more active the soil micro-organisms the more CO₂ they breathe out.

If any of these **Catastrophes** happened, at the end of the round add a **Catastrophe Token** to the board. If there are 3 **Catastrophe Tokens**, the game is over, do not draw another card. Pack up, go home.... Or, as this is a game, start the game again and do better next time.

At the **start** of next turn, reduce any catastrophic properties at 7 **by 1 point**.

Irreversible soil collapse

If at any point all three of a Soil Properties in a group (biological, chemical, or physical) reach 0 then you failed. You had one job people! Keep the soil healthy. The soil is a complex and interlinking ecosystem, there is a level of resilience but if one group of soil properties collapse so too does the whole ecosystem. End of game.

Winning the Game!

The game is won if you manage to feed the population for 6 rounds without either causing **Irreversible Soil Collapse** or triggering three **Catastrophes**.

If you managed that, congratulations! You clearly feel at home in the soil and would function well as soil organisms. The bugs and worms and other soil inhabitants would be proud.

Give yourselves a pat on the back, you did it!

Hurrah!

P.S. if you had the misfortune to be hit with several extreme events events in a row and the ever growing population starved, do not despair! Try again. Soil degradation can be so severe it takes reduced demands (e.g. less food production) and more time to fix than the game allows.



FAQs



Does moving from the central starting area to a property count as 1 action? Yes

Does the starting point on the board count as 1 space when moving between properties? No, so you can move from, for example, porosity to acidity in one move.

Can characters occupy the same property or move through an occupied property? Yes, unless otherwise stated, for example the Nematode cannot be on the same property as, or pass through a property occupied by, a microbe.

Which characters cards are microbes? All characters with a speed of 1, which are Actinomycetes, Mycorrhiza Fungi and Rhizobia.

Can I move more than once as my two actions? Yes.

How many cards can I have in my hand? Unlimited hand size!

Do I have to do two actions per go? No, you can do only one if you really want to, but why would you?

If playing as a 2 player, can we have 3 character cards each? Yes! But follow set-up for 6 player game

Does the Mole need to start and end on the same property to carry a character? No, the mole can pick-up and drop-off the character as it travels through the soil.

Why, when nutrient, activity or porosity are at 7, do they get reduced by 1 on the next round? From a gameplay point it prevents players continuously losing to those crises in the next round(s). From a science point this represents:

- the loss of nutrients from soil as it moves into water,
- the reduction in activity when the organisms deplete their food supply
- the pores in soil collapsing when it becomes too heavy to support itself, for example after heavy rain

If property at seven, does it increase connected properties next round and vice versa? No, the effect only happens once you reach it. But if an event reduces a property from 7 to 6 and you then increase it back to 7, the effect will happen again. Similarly, for when a property reaches 0, the negative cascade will only happen when it reaches 0, but not again if it remains on 0.

Glossary

Abundance

Abundance is the number of individuals per species. The number of earthworms in an agricultural field is commonly used as an indication of soil health: they are sensitive to contaminants and physical disturbances and being relatively big are easy to measure.

Acidity

Acid soils can be considered “sour”, and influences the organisms, including plants, that can live in it. Acidity is measured in units of pH, with 7 being neutral. Most of our crops need to be grown in slightly acidic soils with a pH around 6.5, however intensive crop production and fertiliser use reduces pH below optimal values.

Activity

Activity by soil organisms is important to cycling nutrients, developing soil organic matter and supporting a dynamic soil food web. Without activity, residues from once living organisms would build-up, there would be no nutrients and the ecosystem would collapse.

Aggregate Stability

Aggregates are soil particles and stability is how well those particles hold together. It is important that these soil aggregates are stable, as poorly bound particles are easily carried away by water and wind, causing problems of contamination and soil loss, such as the Great Dust Bowl phenomena that occurred in America and Canada during the 1930s.

Depth

Soil depth is measured from the top of the soil profile to the bedrock, or an obstacle that prevents root growth, and is the volume of soil from where the plants can get water and nutrients. It is estimated that globally we have lost half of our topsoil in the past 150 years.

Diversity

The number of different species present in the soil. Soils with a higher diversity are more likely to be able to cope with harmful events, as there will be a greater chance of a species being present that can reduce the impact of the event, such as breaking down contaminants into harmless substances. For example, woodlice can remove heavy metals such as cadmium, arsenic and lead, and prevent these compounds from poisoning water.

Nutrients

Nutrients are substances necessary for growth. Soils provide nutrients through several ways: (1) decomposing organisms break down organic matter; (2) chemicals breakdown the bedrock at the boundary between soil and rock; (3) specialist biological organisms are able to fix nitrogen from the atmosphere into the soil.

Organic Matter

Soil organic matter is a mix of living and dead organisms in varying states of decay. Organic matter provides essential functions, such as the recycling of nutrients and carbon that living plants and soil organisms can use, and carbon sequestration.

Porosity

Is the amount of space between soil particles, providing areas where soil organisms can live. Activities of burrowing animals, filamentous soil organisms and plant roots connect pores, improving the movement of air, water and nutrients through the soil.

Credits



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This game was part of the project **SDG Engagement: a dirty matter**, which aimed to create two boardgames demonstrating how soil can help achieve the UN Sustainable Development Goals (SDGs) of Zero Hunger, Clean Water, Climate Action and Life on Land.



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Scientific disclaimer – the effects of each card has been researched to ensure scientific accuracy with common trends identified and used. However, soil is complex and the effects of each card can differ between the many soil types that exist. Similarly, the effects of power cards are influenced by its composition, for example biochar can be made from different materials, which influence their impact on the soil. If you decide to try any of the managements shown on the power cards at home, we recommend that you do further research.

The effects depicted in event cards also effect properties not highlighted on the cards, but for playability some effects had to be removed. For example, compaction influences nutrient availability, because there are no pores for nutrients to move through and activity as there is less air in the soil, but to make the game playable, only the most immediate effects of the event were selected.