# EXPLORING MYCOFI

Mycelial Design Patterns
for Web3 and Beyond

**Exploring MycoFi: Mycelial Design Patterns for Web3 and Beyond** guides readers on an underground exploration into the world wise web of mycelial networks, the most prolific producers of public goods on Earth. This book examines how the evolutionary adaptability of fungi could help us imagine biomimetic alternatives to status-quo economic systems that demand infinite growth on a finite planet.

**MycoFi translates six design patterns of mycelial ecologies to Web3 economies:**

*Network Infrastructure • Fractal Nature • Emergent Coordination*
*Dynamic Flow • Mutual Reciprocity • Polycentric Pluralism*

If there is any hope for a transition away from extraction, domination, and planetary overshoot, towards regeneration, equity, and planetary healing, our economies must be realigned with nature's ecologies - and for that, we can't afford to ignore what mushrooms have to teach us. If we aim to design regenerative economies, what better place to start than with the thriving evolutionary patterns of nature?

"Fungi invite us to participate in a commons-based economy where resources are metabolized, shared, and regenerated simultaneously through the very same process. MycoFi is less about how to imitate them than how to join in the dance."

**Douglas Rushkoff, author and host of Team Human**

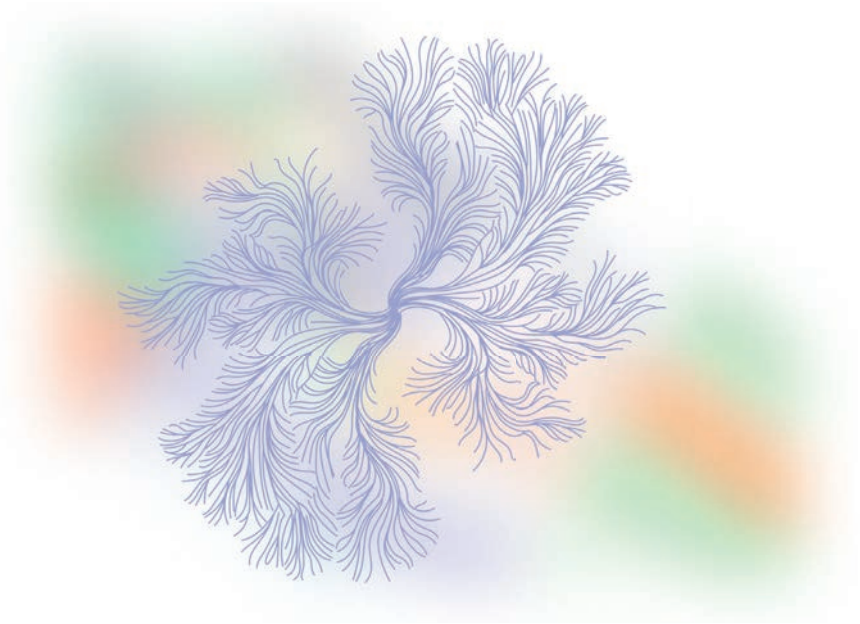
"Nature is a magical long-term, stable code base, with time for revisions and optimization. More recently, our attention spans have gotten shorter and we've forgotten how to listen deeply and pay attention to the truth around us. Hopefully, this work will provide another reminder that the answers have always been there. Let's listen together."

**Amber Case, author of Calm Technology**

"Mycelial networks are the foundation from which natural systems thrive. Obligation networks are the foundation from which social systems thrive. MycoFi is a beautiful recognition of the confluence of the natural and social worlds, of our mutual interdependence, of our obligations to take care of the planet and each other, and of how much more we still have to learn from the humble mushroom."

**Ethan Buchman, co-founder of Cosmos and CEO of Informal Systems**

# EXPLORING MYCOFI



Written by Jeff Emmett & Jessica Zartler

Foreword by Scott Morris

# Exploring MycoFi

## Mycelial Design Patterns for Web3 and Beyond

*A MYCOPUNK PUBLICATION*
*FROM THE GREENPILL NETWORK*

**Coordination by Owocki**

**Design by Laura Helen Winn**

**Illustration by Biux**




*PRODUCED FOR THE GITCOIN ECOSYSTEM*

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“MycoFi beautifully illustrates and underscores that mycelium’s design is borne from the universe. The organization of mycelium is a previously proven evolutionarily successful structure at scales found throughout nature. Its inherent wisdom of sharing resources, building guilds - and thus - communities is an economic and cosmological model for us to depend upon and learn from. From these mycelial-like structures, we have a launching pad for our continued evolution based on cooperation, resilience, and discovery. The very nature of mycelium allows it to evolve and not only respond to catastrophia but to build systems that are highly adaptive and ever-lasting. By learning from mycelium, our species can achieve the next quantum level in our evolution.”

**Paul Stamets, renowned mycologist and author of Mycelium Running**

“Metaphor is a powerful tool for the imagination, giving us the scaffolding to create new structures in our minds. This book lays out a powerful mycelial metaphor to help us reimagine our financial and economic life.”

**Brett Scott, author of CloudMoney and Altered States of Monetary Consciousness**

“This is economics on mushrooms. The fungi kingdom is the banner bearer for regeneration. This book invites us to observe the patterns of deep fungal regeneration as we endeavor to redesign our economic relationships with mutuality, collaboration and regeneration in mind.“

**Greg Landua, co-founder and CEO of Regen Network**

“So glad to see how Mutualist thinking and design are being located from the roots to the emergent horizons. We can be neither pessimists nor optimists - rather be those who toil in the matter at hand committed to that which repairs the world.”

**Sara Horowitz, author of Mutualism: Building the Next Economy from the Ground Up**

“This book takes you on a journey to explore nature’s public goods infrastructure,
and what we can learn for building the socio-technical systems of the future.

Maybe we’ll find out we’ve been Mycopunks all along!”

**Angela Kreitenweis, founder of Token Engineering Academy**

"MycoFi helps us move beyond the representational thinking hindering crypto by drawing on the lessons we can learn from the ancient economic mycelial networks that have run nature for millennia. Mushrooms show us that we are and always have been the inter-connected parts of one organism that must create symbiotic ways of co-existence with ourselves and the rest of the natural world to continue surviving on a planet wrought with man-made degeneration."

**Josh Davila, author of Blockchain Radicals: How Capitalism Ruined Crypto and How to Fix It**

"This book (and the community it emerges from) is a fun and playful way into the tools and mindsets of this practice, recommended especially if you are, perhaps, coming to see yourself as a confluencer, sovereignty guardian, rhizome of diplomatic gardens, steward for Mother Earth and all her children; giver of care, compassion, and integrities; practitioner of trust, choreographer of commoning; or caller of ancient, renewed and emergent memes."

**Tony (OpenTony) Lai, researcher & editor, Stanford Journal of Blockchain Law & Policy**

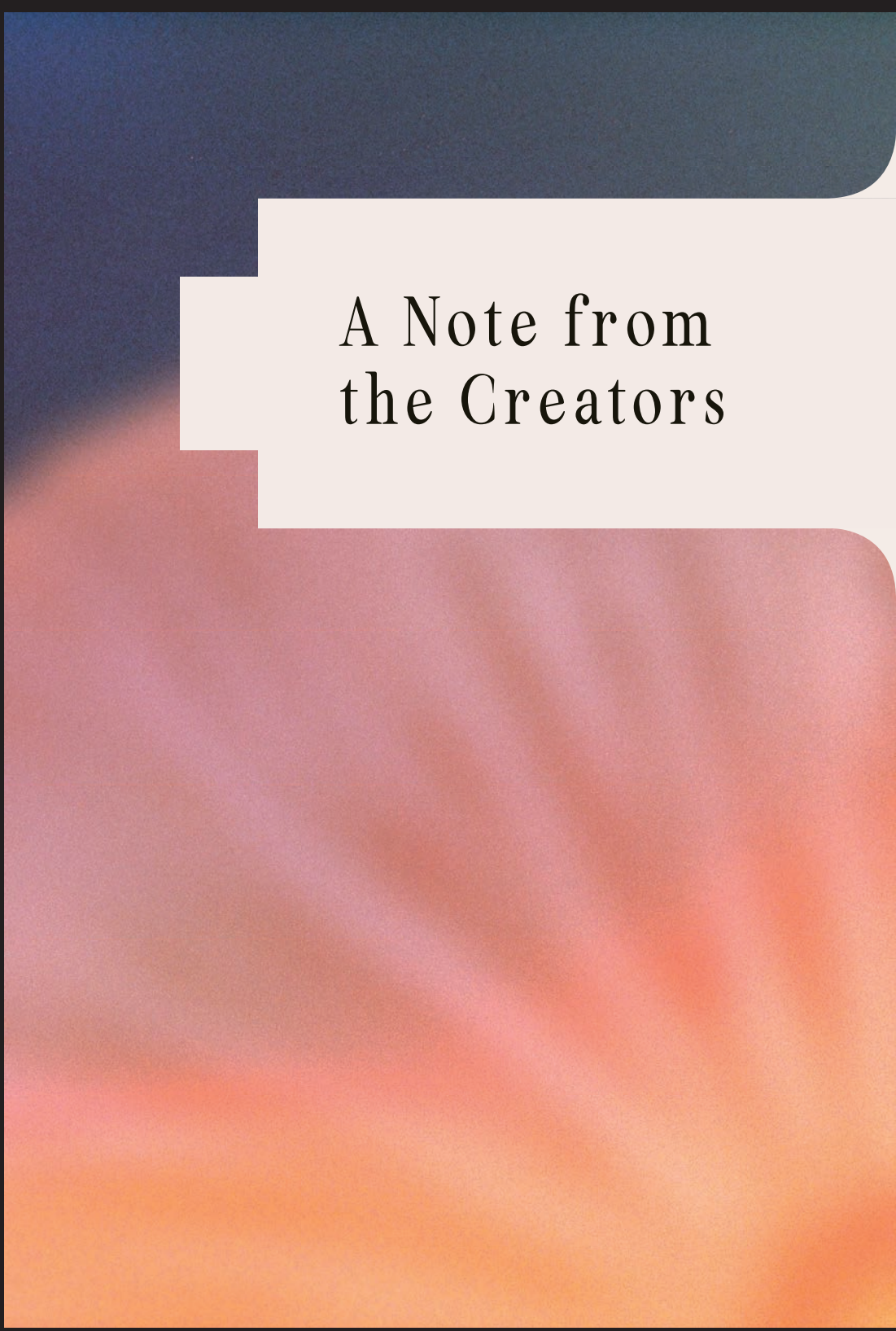
"Great intro to how Web3 networks and other human-made systems can benefit from biomimicry and system thinking."

**Shermin Voshmgir, author of Token Economy**

"MycoFi takes the reader below the surface of Web3 to explore diverse and intricate economic networks. Ecological Economics (generally) and mycelial networks (specifically) share a pluralistic view on value. The same nutrient can be both a waste product when and where it's in excess, and a resource when and where it's necessary for a biochemical process. Moving away from a single notion of value (money) and towards nutrients flowing over physically distributed and biologically diverse networks is a key conceptual shift from neoclassical to ecological economics."

**Michael Zargham, Chief Engineer at BlockScience**

# A Note from the Creators



This book is a creative excursion into the nexus between mushrooms, economics, and technology. It explores six mycelial design patterns and their potential applications to address modern challenges in political economics, using Web3 tools as emancipatory technologies.

Many of the ideas expressed in this book were inspired by countless authors, researchers, and developers, drawing from extensive bodies of research on the fascinating capabilities of mycelium and distributed ledger technologies. This book presents a fungal remix of some of those concepts, oriented toward a Web3 audience. For those interested in further reading, you can find a series of links and references in the appendix.

While we take an optimistic outlook in these pages, we aim to avoid the ìappeal to natureî fallacy ≠the oversimplified perspective that everything natural is good for us. Instead, we seek to identify and unpack useful, pro≠social patterns that could be applied in contexts where they increase collective flourishing.

MycoFi is fundamentally a pluralistic and emergent meme, requiring many voices to interweave a polyphonic chorus ≠ including those who came before, as well as those yet to come. If you feel the call to contribute to the growing folklore of mycelial solutions, we have included information on connecting with communities of change≠makers in the last chapter. We offer this book as one step to an ecology of mind nurtured in the world of mycelial intelligence and all it has to teach us. There is so much more to be written, experienced, and embodied, and we warmly invite you to join in the exploration.

# Foreword

As someone who has been involved in designing and implementing alternative economic systems since 2009, I have developed a special appreciation for ideas and frameworks that accelerate the process of learning how to think in more holistic, integrative, nature≠aligned terms, especially as applied to designing systems for sharing resources intentionally. My earliest work was in community currencies, which have served humanity for ages by doing like the mushrooms do: helping meet local needs with local resources and strengthening communities in times of crisis. In other words, providing #RealValue.

For those curious, the term ìMycoFiî first emerged at an event on Collaborative Finance, aka ìCoFiî in May 2023. Jeff and I were coming up with ideas for session proposals for the participant≠led portions of the agenda when the term emerged as a suggestion based on my combined appreciation for Jeffís legendary love of all things mycelial and the way it juxtaposed the themes of collaborative financial networks and mycelial networks.

This book is simultaneously a light≠hearted, fun introduction to mycelial networks and some of their genuinely surprising capabilities, and a serious invitation to draw inspiration from them as we design the resource coordination networks of the future. In a space that so often seems easily distracted by the shiny, new, and financially lucrative, itís all the more important that we keep a path devoted to the work of designing systems that address the survival≠scale challenges we face as a species.

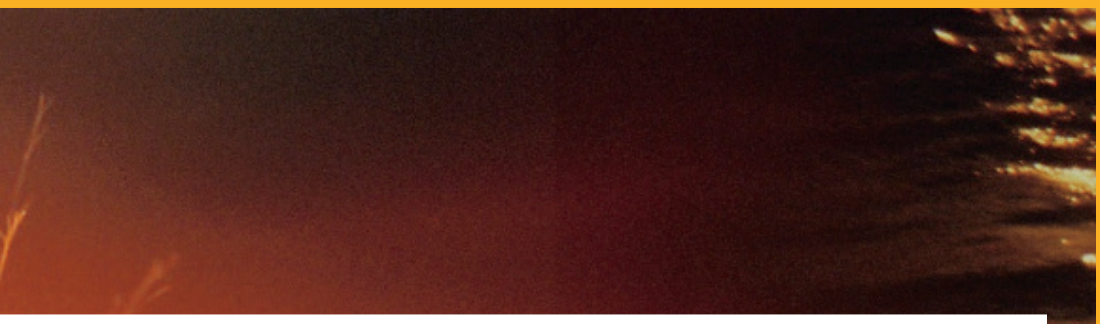
I believe MycoFi is a timely idea because it presents us with a way of thinking about purpose≠based networks and political economic systems which are more rooted in community. I see it as a biomimetic pattern language that helps us gain a better sense of how to rewire the circuitry of our economies so they serve the needs of humanity, the biosphere, and all stakeholders for mutual benefit with the long≠term in mind. If thatís your jam, youíre holding the right book.

Hydrate, meditate, take the green pill, and may the Force be with you always.

Scott Morris
@TheTokenJedi

INTRODUCTION

# Uncovering Natureís Economic Blueprints



## Designing from Fungal Foundations

In our search for regenerative economic design patterns, the answers we seek may be hidden right beneath our feet. Over billions of years of evolution, mushrooms - and the underground mycelial networks to which they belong - have been iterating design patterns for distributed, autonomous infrastructures used for intelligent resource distribution and collective signaling between countless living organisms worldwide. Decades of study into the interaction patterns of mycelial networks in natural ecologies have offered us a glimpse into a cooperative underground world where resources flow dynamically between flora, fauna, and funga to generate thriving ecosystems.[1] If Web3 technology holds the potential to craft new economic paradigms, mycelial design patterns may just show us the way back to a more ecological future.

## Mycelium as Nature's Public Goods Infrastructure

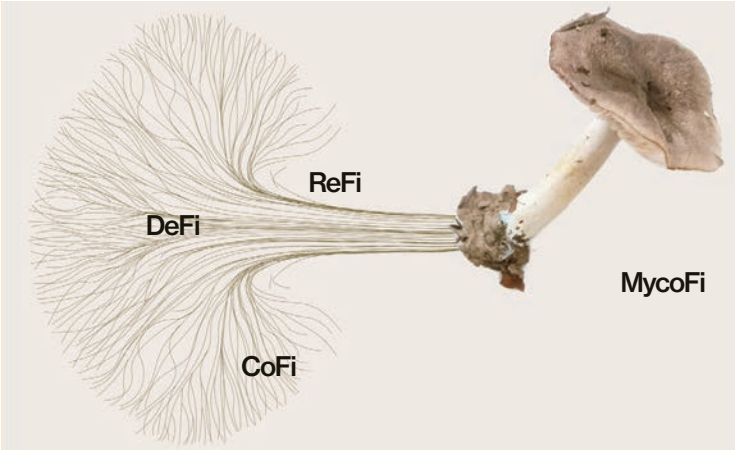
As one of the oldest and largest organisms alive, mycelium is a grand architect of nature. Fungi were among the planet's earliest multicellular lifeforms, and along with their algae symbiotes, they terraformed planet Earth from a ball of cooled magma into the green paradise we know today.[2] Mycelia form underground in a structure of networked tubes, which provide the "pipes" for a large proportion of nutrient distribution within and between most plants worldwide. From the earliest days of life on Earth, fungi have been breaking rock and networking through the soil, building a vast and interconnected mesh across the face of the planet. Like most well-operating public goods infrastructure, they remain underground and almost entirely invisible, even as they serve as a keystone network of species sustaining life on Earth.

## Mushrooms Leak So Much Alpha

Adaptively evolving to shifting climates, food sources, and ecological epochs, mushrooms not only provide essential services for all life on Earth through their distributed infrastructure, but they have demonstrated an evolutionarily honed capability for collective coherence and intelligent resource allocation in genetically diverse collectives. They transact resources using market-like exchange mechanisms with trading partners, address free rider problems in permissionless networks, and take advantage of arbitrage opportunities in the remediation of damaged ecosystems. They display strategies of mutual reciprocity with their trading partners, even keeping stumps and other non-producing members of the forest alive in what is essentially an underground economic support network. If nature has any alpha to guide us toward a flourishing future, perhaps the mushrooms will let us in on the drop.

## MycoFi is Economic Biomimicry

With their pivotal role in the flow of nutrients in natural ecosystems, mycelial networks are the physical medium on which nature's economies run. These organisms offer us a conceptual bridge between economies and ecologies - two realms that we must reconnect to have any chance of surviving on this planet for the long term.




MycoFi is a movement to consciously apply lessons from the mycelial world to cryptoeconomics, and encourage Web3 builders to "think like a mushroom" about the systems they are designing. Incorporating nature's evolutionary design patterns into our economies could alleviate much of the disharmony we see between human economies and nature's ecologies, gesturing towards a future of economic permaculture.[3] This is also the basic premise of ecological economics[4] - that we must move away from singular notions of value and orient our economies to reflect the interdependent coevolution of multiple forms of value flows, just as we see in nature. In that sense, this book can be considered a beginner's guide to ecological economics, seen through the eyes of fungi.

# MycoFi's Memetic Lineage

Memes play an important role in guiding the shape of forthcoming ideas and technology. From Decentralized Finance (DeFi) to Regenerative Finance (ReFi) to Collaborative Finance (CoFi), MycoFi builds on a rich lineage of memetic concepts and open-source tooling.

**DeFi** Decentralized Finance envisions a world beyond the rigid inefficiencies and monoculture of centralized finance, for people to "become their own banks" and start anew in the infinite gardens of Ethereum and other blockchains. DeFi saw the rise of tools like Aave, Balancer, Curve Finance, and Uniswap, where many degen fortunes were made and lost.

**ReFi** Regenerative Finance is a call to use the newfound power of DeFi towards all forms of planetary regeneration, a song of redemption to transmute DeFi degens into ReFi regens. This movement aims to use the magic of token issuance to solve for public goods funding and realign incentives toward positive-sum outcomes. ReFi was led by mystical collectives like Regen Network, ReFiDAO, ReFi Spring, Optimism, Gitcoin, and the GreenPill Network, among many others.

**CoFi** Collaborative Finance seeks to complement the existing, centralized economic models by proposing systems of mutual obligation clearing, where networked debts cancel each other out in a harmonious cycle. CoFi found resonance in the hearts of those dreaming of a world woven together without an unhealthy addiction to finance. The meme first emerged in the Cosmos ecosystem, appealing to complementary currency activists and crypto commoners already practicing similar tactics.

**MycoFi** It is from these memetic mycelial threads that MycoFi is woven. The concept of mycelial finance beckons us to learn from the ancient wisdom of nature, interlacing economic design patterns with the rhythm of life forms that have adaptively co-evolved over billions of years on this planet. Like spores on the wind, MycoFi first emerged as a playful jest to tickle the CoFi vines but quickly sprouted into its own vibrant memetic tapestry of inspiration for regenerative economic design.

# Mycelial Design Patterns

If we were to ask this ancient, sentient network its secrets, perhaps it would whisper to us of design patterns it has iterated in the depths of deep time, patterns such as:

## Network Infrastructure

*"We are the mycelial networks, the ancient weavers of nature's oldest decentralized web. Our threads stretch across the world, silently sharing resources with all, creating life's sustaining mesh."*

## Fractal Nature

*"In us, the fractal patterns of the cosmos are echoed. With minimal energy, we replicate these universal designs of self-similarity, from the smallest seashell to the vastest galaxy."*

## Adaptive Sense and Response

*"At the edge of the known, we, the mycelium, innovate without requiring permission from our ancient roots. Here we thrive, at the frontier, adapting to the mysteries of life."*

## Dynamic Flow

*"Our network pulses with life, a never-ending flow of resources. Like a symphony, nourishment courses through us, shared freely, never still, never hoarded."*

## Mutual Reciprocity

*"In our world, a delicate balance of give-and-take prevails. We the funga, alongside flora and fauna, partake in a life-sustaining dance, each exchange nurturing the reciprocal cycle of existence."*

## Polycentric Pluralism

*"Within us thrives diversity, a celebration of life's myriad of forms. Responsive and varied, each part of our network contributes its unique voice to the chorus of nature."*

This book will cover each of these patterns in turn, first from a mycelial mindset to understand how mushrooms demonstrate them, then looking at a few myco-mimetic examples of that pattern at work in the Web3 space, and ending with some imaginative provocations of what a more fungal future could look like in Web3 and beyond.

## *MOLOCH ON MUSHROOMS*

Moloch is the god of coordination failures.
Mushrooms are the epitome of coordination in nature.
What would happen to Moloch on mushrooms?

DESIGN PATTERN ONE

# Network Infrastructure

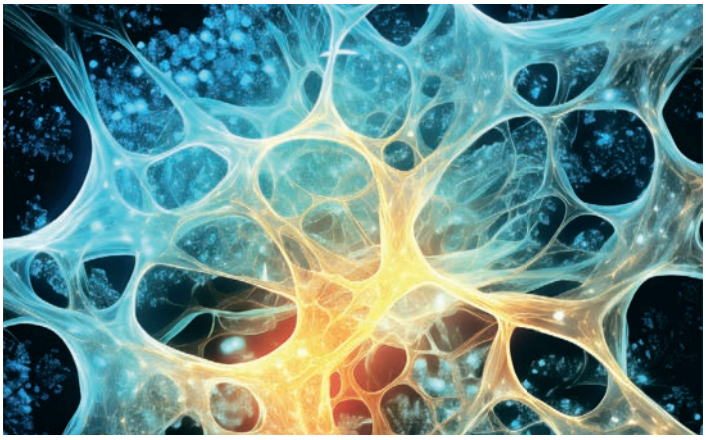
# THE MYCELIAL MINDSET

## Natureís Oldest Networks

When it comes to network infrastructure, mushrooms have no equal. Mycelium is natureís oldest and most interconnected network, one that supports the entirety of life on Earth through the resources and information that flow through its veins. As infrastructures of positive≠sum reciprocity and regeneration tested by untold millennia of natural selection, their patterns are a true gift from our eldest genetic ancestors.

## Networking in the Wood≠Wide≠Web

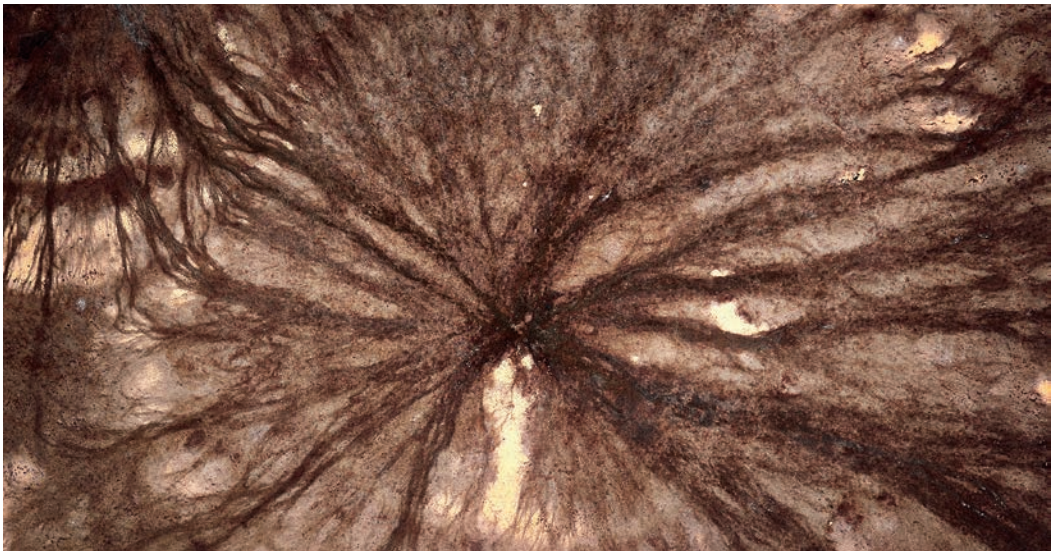
Although mushrooms are often all we see aboveground, fungi are complex entities of underground networks, which grow toadstools much like apple trees grow apples.



Mycelium grows underground by extending thread≠like filaments called hyphae into the soil, which interconnect with other hyphae and network into a mycelial mesh. These connections form with more than 90 percent of trees and plants worldwide, leading biologists to lovingly dub these mycelial networks the ìwood≠wide≠webî. In the language of complex systems and graph theory, the trees are the ìnodesî in this network, and mycelial connections are the ìedgesî in between them.

## MycoFi is the Economy of the Forest

Hyphae are composed of long chains of individual cells, making them like tiny pipes routed all over the planet's surface. These pipes are not just a communication network for the mycelium itself but are also essential for the redistribution of resources from decomposing matter to a host of other lifeforms where they provide life-sustaining nutrition. Mycelial networks have an uncanny ability to sense demand for particular resources across their many interconnections, and intelligently route the supply of nutrients to where they are needed most.



*FUN-GAL FACTS*

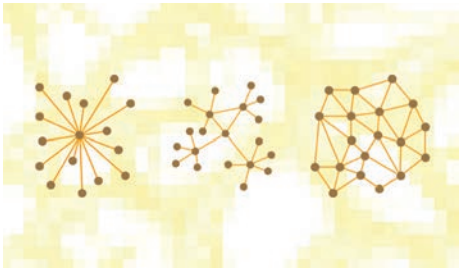
In the realm of natural adaptability, fungi are in a league of their own. They can eat plastic, oil spills, and cigarette butts, and they thrive in environments as diverse as underwater realms, scorching heat, and even outer space.

Remarkably, fungi have even been found flourishing in hostile environments such as fuel tanks and even radioactive zones like Chernobyl. Radiotrophic mushrooms have evolved the astonishing capability to use radioactivity as a power source!

# MYCOFMIMICRY IN WEB3

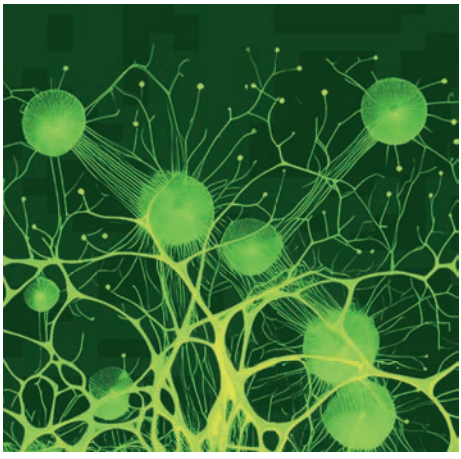
## Blockchains are Coordinative Infrastructures

Bitcoin has been referred to as a mycelial organism.[5] Indeed, one of the core value propositions of blockchain technology is based on the use of distributed network architectures to serve as coordination substrates for new forms of organizing. This offers us a unique opportunity to rethink many of the power asymmetries we see in legacy systems, some of which were the inspiration for blockchain technology in the first place. Every time technology has opened a path toward new coordinative infrastructures ≠from the printing press to the telegraph, to the internet ≠ the world has experienced massive shifts in geopolitical structure. Distributed ledger technology holds the same potential for paradigmatic and socio≠evolutionary shifts.[6]



## DAOs as Digital Fungi

Mammals are more closely related to fungi than to any other kingdom of life. A key difference is that while mammals internalize digestion by putting food into their bodies, mycelia externalize it by putting their bodies into the food, breaking down and consuming the environment around them. Some of the nutrients are absorbed and transported throughout the mycelial network to other organisms, while other nutrients are left to enrich the soil, enabling new life to form and thrive. When a mushroom feasts, it is a communal banquet ≠a public good for the whole ecology.



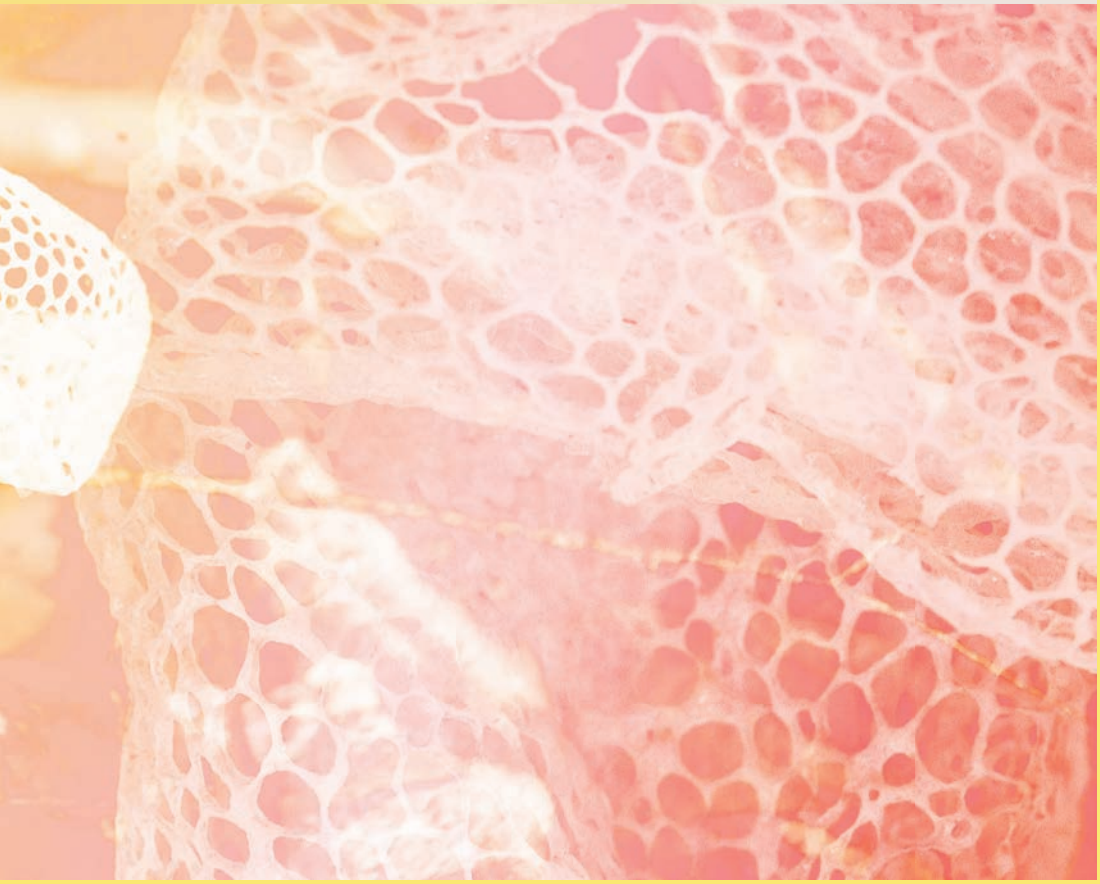
In contrast to ìmammalianî private corporations that enclose resources and intellectual property within the ìboundaries of the firmî, decentralized autonomous organizations (DAOs) could be considered the mycelia of the digital world; they network amongst themselves and expand into emergent collaborations to build shared value through open≠source tooling and an ethos of permissionless participation.

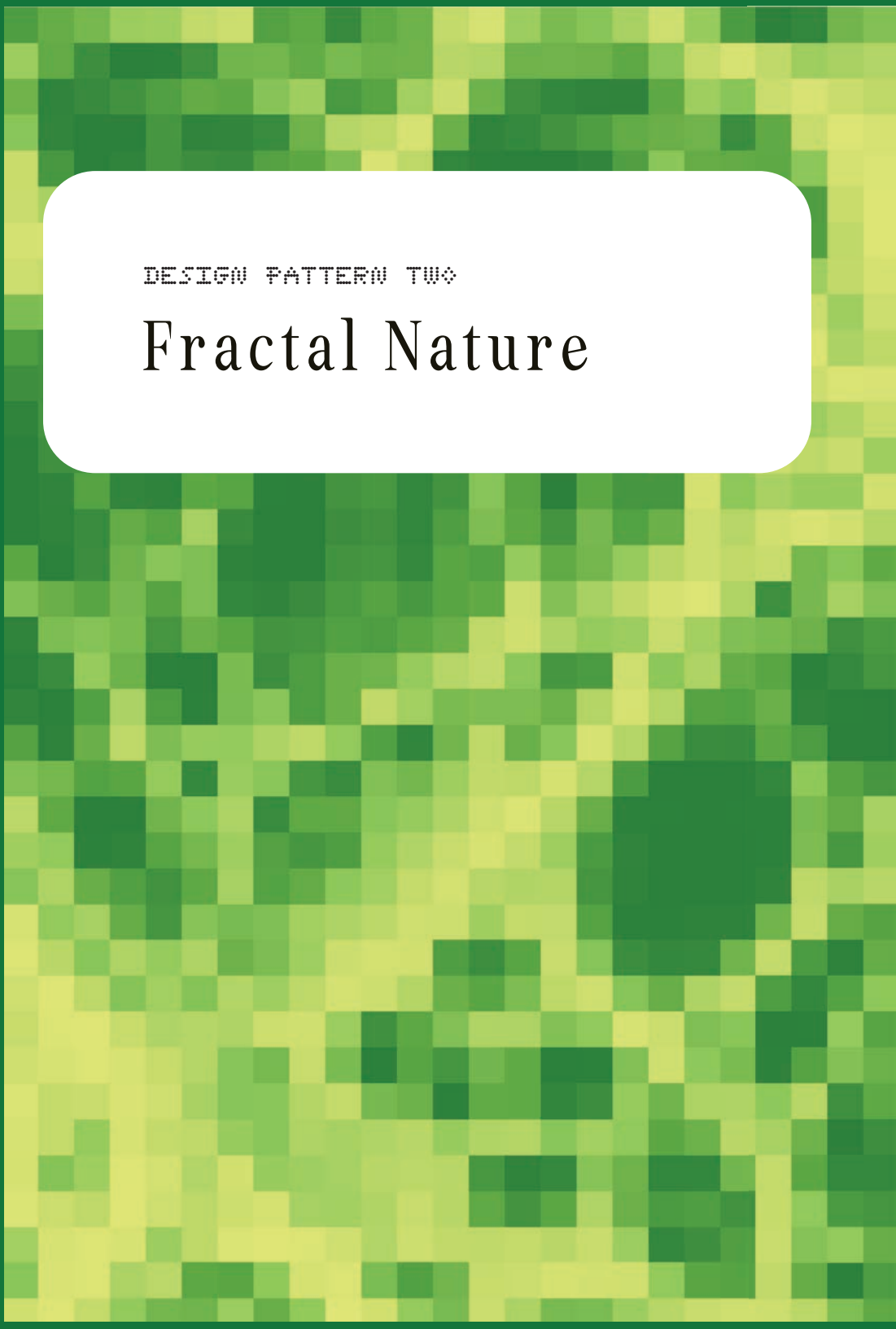
# IMAGINING FUNGAL FUTURES

## Economic Resilience via Mesh Stability

Imagine a future where community economies based on localized production are connected in a vibrant tapestry of interwoven currencies. While a single mycelial thread can be broken with ease, when woven together into a pluralistic mesh, they have vastly greater strength and collective stability. This network infrastructure of economic solidarity helps mitigate the community impacts of financially-driven boom and bust cycles that are so common in the global economy. It also increases community resilience against other unpredictable shocks like pandemics or climate disasters, which are all the more likely in an age of geopolitical uncertainty.

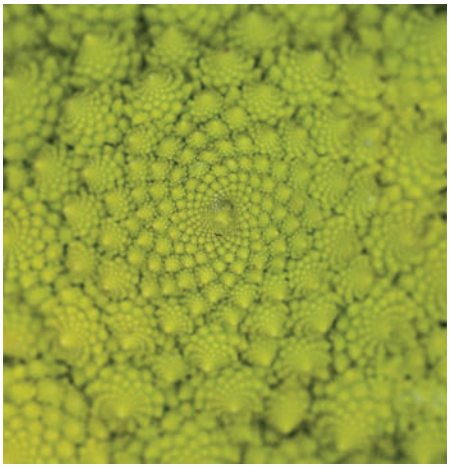
These interconnected economic networks reduce financial risks for creatives and entrepreneurs, for example by giving them access to affordable credit from their community mutual credit systems. Re-localized supply chains prioritize the basic needs of the many over the luxuries of the few, with MycoFi economic mechanisms programmed to ensure that finance remains in service to the production of real value, rather than the other way around.




DESIGN PATTERN TWO
Fractal Nature

## A Universal Constant of Self≠Similarity

If we look across the universe, from the tiniest cells to the most massive stellar bodies, there is one pattern that remains constant ≠fractals. We can see their unfolding symmetry in the designs of nature when we compare the branching



of mycelial hyphae with the branching of neurons in the brain, or when we observe the unfurling pattern of fiddlehead ferns or Romanesco broccoflower. Fractals display self≠similar shapes that can be seen when moving between scales. When you look closer and closer at a fractal, you see a replica of the whole within it.

## Nature's Automation Algorithms

The elegance of nature's designs is due to their fractal nature - an encoded pattern that produces emergent complexity through the repetition of a simple pattern. Design-wise, this enables a highly efficient replication process that allows simple processes to unfold into emergent outcomes - nature's ultimate automation algorithm. In the mycelial lifecycle, spores branch into hyphae, which themselves branch into networks of greater and greater interconnections - a process that results in not only a highly functioning coordinative infrastructure but a beautiful complexity that evolves of its own accord.[7]

*TRANSCENDING THE ILLUSION OF SEPARATION*

The separation between the self and the collective may be a blurrier boundary than we once thought.[8] After all, what is an individual but the culmination of smaller pieces working together as an intelligence greater than the sum of its parts? Are each of our voices not a chorus themselves, speaking for the collective interest of the billions of cells - human, bacterial, fungal - that comprise our "self" in the first place?

When we examine mycelial networks in nature, we see the same relational magic between the part and the whole at work. Is a thriving fungal ecosystem a plethora of genetic individuals fitting specific niches and needs in a collective, or is it one entity connected through a nervous system of distributed mycelia? Can it be both?

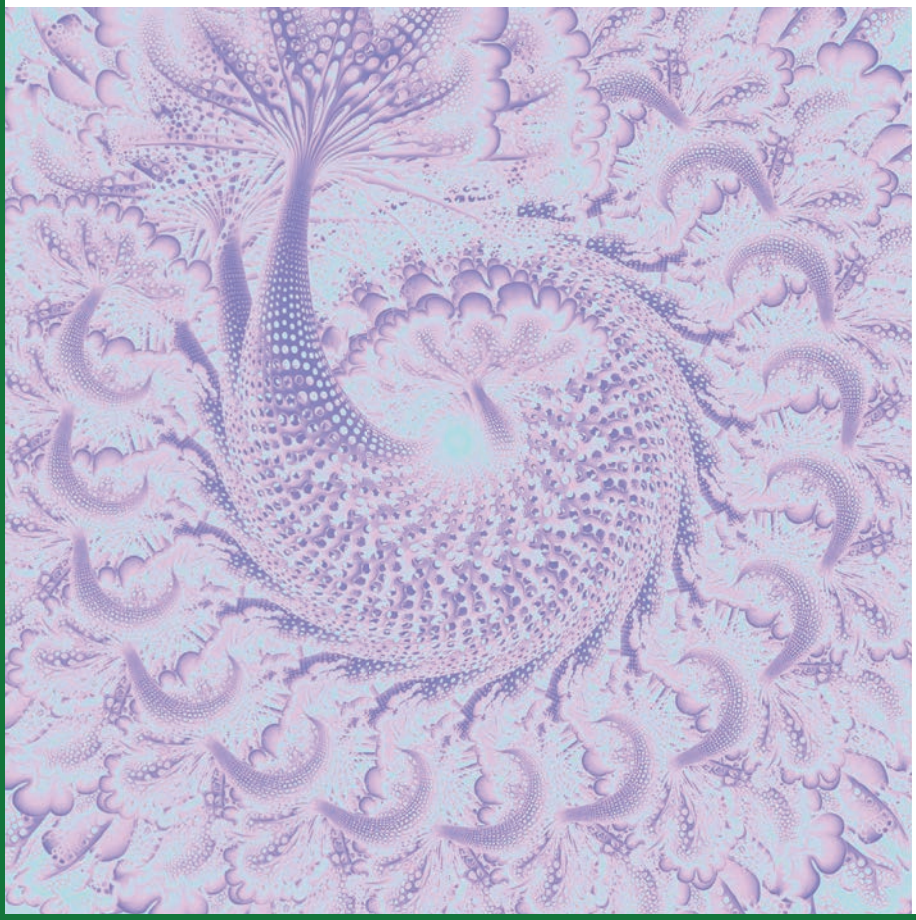
Mushrooms invite us to see beyond the divide between the individual and the collective, to become part of a symphony greater than ourselves.

## Symbiogenesis as a Fractal Scaling Strategy

Symbiogenesis speaks of a prehistoric merger wherein the earliest multi-cellular fungal organisms absorbed a single-celled bacteria into itself, offering protection in exchange for energy production. Over billions of years of specialization, this endosymbiotic merger resulted in the standard arrangement of most living things, whose cells are powered by internal mitochondria. This evolutionary upgrade revolutionized the capacity for cells to serve as stable building blocks for the emergence of higher orders of complexity over many scales - with cells composing into tissues, tissues into organs, and organs into lifeforms that even acquire a consciousness of their own. Symbiogenesis set into motion a chain of fractal evolution, starting from a single cell and resulting in the explosion of complex lifeforms on Earth.

## Smart Contracts & Nested NFTs

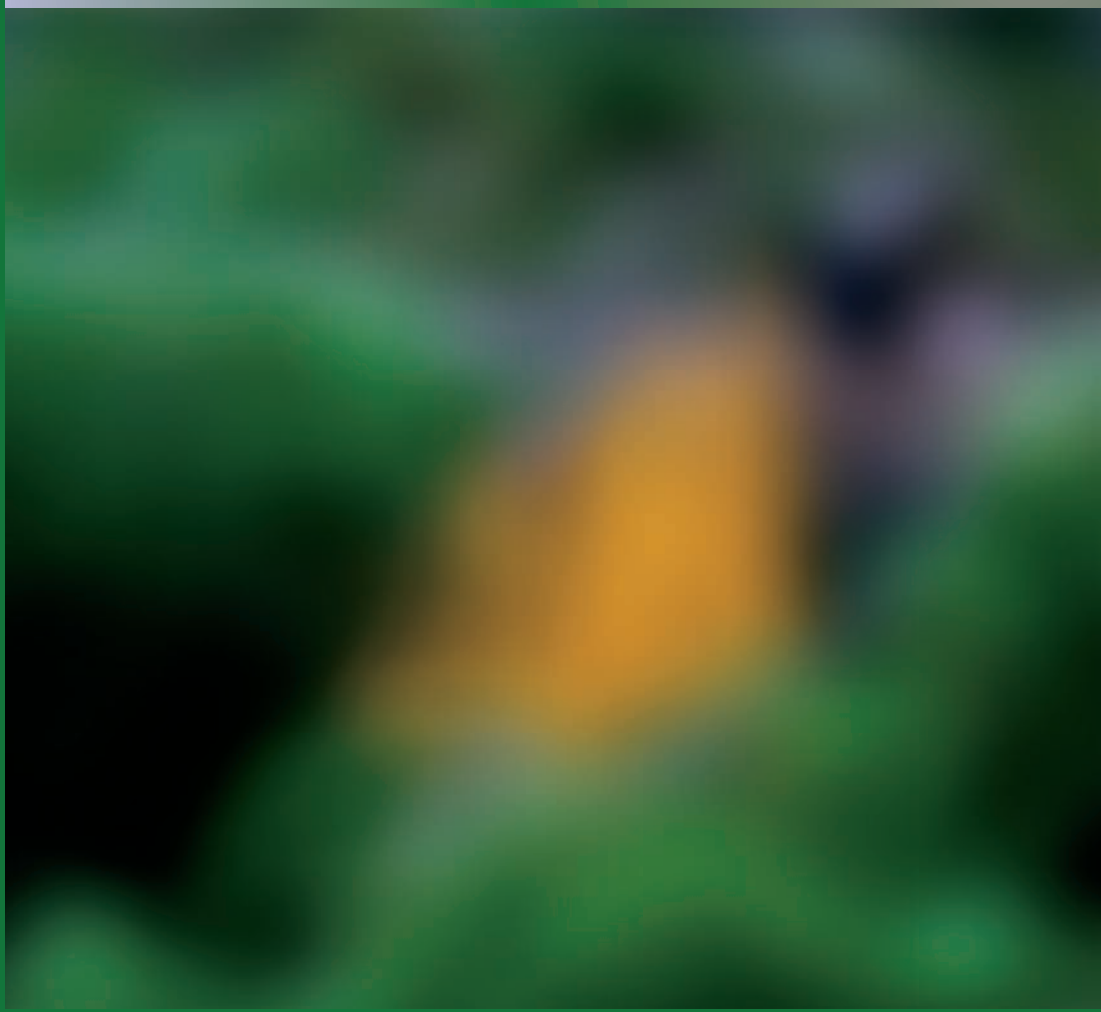
Some blockchain primitives like smart contracts and non≠fungible tokens (NFTs) express similar properties to fungiís fractal potential. Smart contracts are encoded to be self≠executing and permissionless network connectors, enabling more rapid and automated resource exchange. They can be deployed at different layers in an ecosystem of institutional ecologies, and even at various scales ≠within or between individuals, DAOs, or even DAOs of DAOs. The composable nature of these contracts can also support automating operational or repetitive tasks, allowing humans to focus on higher≠order system governance. NFTs can be programmed to own or house other NFTs with rule sets that enable conditional triggers when certain criteria are met. These fractal assemblages can be applied to countless use cases, from tokenizing natural assets to establishing identity and reputation within and between digital communities.



## DAOs All the Way Down

DAOs are another example of fractal possibility in Web3. The same institutional ecologies of governance and economic patterns deployed via smart contracts could be applied on many levels: to DAOs themselves, to workstreams within DAOs functioning as sub-DAOs, or even to groups of DAOs that coordinate as meta-DAOs. Nesting DAOs as functional sub-units allows for skill specialization among members and offers economies of scale in coordinating resources toward collective outcomes. The fractal nature of sub-DAOs can increase autonomy[9] among members to more efficiently explore new areas of innovation and value flow, which feed back to the larger institutional ecology.

# IMAGINING FUNGAL FUTURES



## Endosymbiotic Finance

Imagine a future where the economic power of an organization comes from its own internalized energy, rather than having to rely on outside sources of extractive finance. In the same way that cells absorbed the power-generating capabilities of mitochondria, MycoFi proposes endosymbiotic finance as the process by which organizations internalize the capacity to produce and store their own economic power, rather than having to submit to the high costs of external finance provided by banks. This capability for endogenous credit issuance enables organizations to have tighter feedback loops between their evolving needs for capital and their ability to issue vouchers backed by their own productive capacity. This process of organizational symbiogenesis will see DAOs and other myco-organizations continue to “absorb” the useful functions of finance, steadily reducing the power asymmetries that have allowed external finance to become the proverbial “tail that wags the dog” of the real economy.

DESIGN PATTERN THREE

# Emergent Coordination

# THE MYCELIAL MINDSET

## Edge≠based Intelligence

The nature of fungal networks gives them an incredible capacity for adaptive sense and response to stimuli within their environment. This gives them a knack for emergent coordination in finding food or defending against disease ≠even cancer. Rather than making decisions with a brain at the ìcenterî of the organism and propagating coordination signals to the ìedgesî of the network ≠as you might expect in a hierarchical organization ≠mushrooms show us how advantageous it can be to process information from the edges of the network, where new opportunities and threats are most likely to arise.

## Wisdom of the Crowd

Hyphae are constantly exploring their environment without waiting for direction from some central authority. Every branch of a mycelial network is fully empowered to search for food in any direction, merging with other hyphae along the way. The resulting mesh then doubles down on effective pathways while pruning those less promising, leading to the emergent growth of a network that is intimately adapted to transporting resources through its environment.

## Quorum Sensing and Collective Coherence

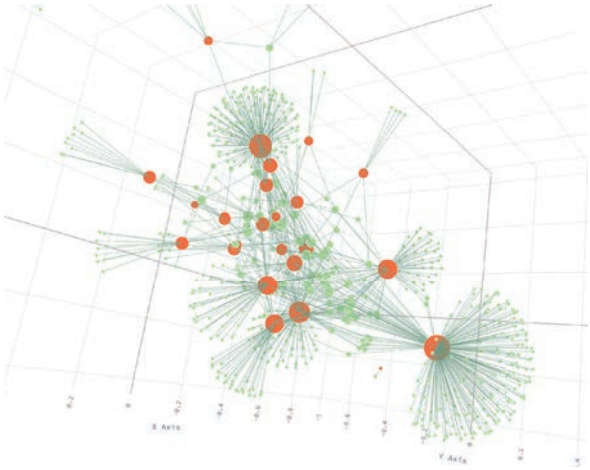
Fungi have also been studied for their incredible capacity for ìquorum sensingî, a tactic for coordinating behavior using various biological and environmental cues.[10] Given their structure as a distributed network of cellular threads, determining where one individual begins and ends is no easy feat. Despite this lack of a decision≠making ìcenterî, mycelia are capable of collectively deciding upon and achieving goals with remarkable creativity and ingenuity. They have even demonstrated the ability to store memory, such as the geographic location of past food sources.[11] Their capacity to store information improves their capability for emergent coordination.

## MYCO≠MIMICRY IN WEB3

## Quadratic Funding

The Gitcoin Grants[13] platform leverages edge≠based intelligence to distribute a large pool of matching funds via Quadratic Funding.[14] The Grants protocol elicits the ìwisdom of the crowdî via individual donations to donorís favorite projects, donations which are then quadratically matched from a central donor pool. With hundreds of thousands of ìsensorsî (donors), the Grants protocol not only takes in signals from the edges of the network to assess worthy projects, but it also quadratically amplifies that signal with matching funds from sponsor organizations ≠the broader the support, the bigger the match.

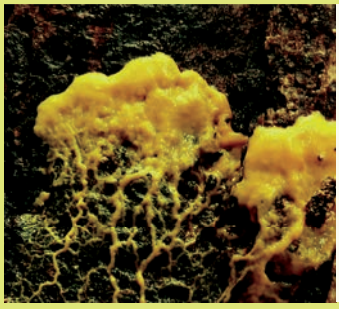
The Grants platform has empowered emergent coordination around the creation of essential tooling and infrastructure on multiple blockchains and continues to expand its funding capacity by supporting grant rounds hosted by diverse communities and token ecosystems.



## Neural Quorum Governance

In collaborations between Stellar Development Foundation[15] and BlockScience[16], Neural Quorum Governance (NQG)[17] is proposed as a composable new method for balancing the specialized knowledge of experts while maintaining broad democratic input. NQG works like a delegated democratic system, but instead of only delegating to one representative, you can designate an anonymized "quorum" of members to vote collectively on your behalf. The quorum members can even be weighted in a "neuron" according to their expertise, past voting history, reputation, or other available parameters. This kind of tooling offers a richer democratic space for the network to source contextually appropriate knowledge and weigh it proportionally in policy decisions, resulting in better emergent decision-making on behalf of the organization.

*THE MOLDY PROFESSOR*



Slime molds, once classified as fungi because of their similar characteristics, are so effective at decision-making that they have even been granted honorary positions at post-secondary institutions, where they have weighed in on the design and validation of rail networks and other policy decisions.[12]

# IMAGINING FUNGAL FUTURES

## Adaptive, Breathing Myco-Organizations

Imagine a future where DAOs have evolved to become emergent myco-organizations, capable of collectively adapting to changes in their environment through the real-time consensus of their constituents. Total Value Flowed has replaced Total Value Locked as a key metric of ecosystemic health. Their dynamic issuance[18] token economies breathe with life, expanding and contracting in supply to accommodate the emergent demand for the real value they produce. This not only allows these myco-organizations to expand their capacity to fund emergent collaborations, but it also allows them to contract safely and predictably, unlike the zombified institutions under late-stage capitalism that can only grow forever until they collapse unpredictably.

DESIGN PATTERN FOUR

# Dynamic Flow

# THE MYCELIAL MINDSET

## Natureís Greatest Arbitrageurs

Contrary to the wealth≠hoarding that is characteristic of fiat economies, mycelial economies are all about flow. All natural ecologies involve flows of resources from one form or location into another, whether they are streams of energy, water, nutrients, or biomass. Fungi induce many of these flows by acting as natureís arbitrageurs, using their extensive networks of hyphal pipes as intelligent distribution infrastructure to move resources from where they are abundant to where they are in higher demand[19] ≠ a conductor of natureís symphony of resources.

## Flows of the Forest

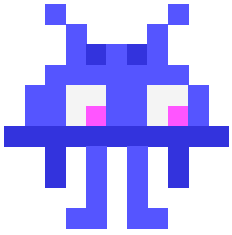
Though it may appear still on the surface, a forest ecosystem is alive with flows. Fungi play a vital role in supporting the health of these ecosystems by continuously exchanging nutrients from the soil with sugars photosynthesized by trees and then distributing those resources throughout their many branches. Along with the flow of nutrients that can provide life≠saving sustenance for neighboring trees or plants that are not able to produce for themselves, plants also pass messages and warnings between one another, increasing the collective immunity of the forest against threats and other environmental factors.[20]

## *CLIMATE CHAMP-IGNONS*

Mushrooms aren't all flow - they are also one of the largest sources of carbon sequestration on the planet! Mushrooms assimilate carbon dioxide from the atmosphere into their hyphae, moving it deep below ground where they lock it into the soil. A recent study estimates that more than 13 billion metric tons of CO2 from terrestrial plants are passed on to underground mycelial networks each year, equivalent to about 36 percent of global fossil fuel emissions![21]

## Dynamic Issuance & Fund Streaming Protocols

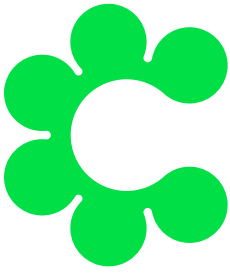
Like mycelial networks, some Web3 builders have realized the importance of the dynamic issuance and real-time circulation of resources in productive ecosystems. Protocols like Inverter Network[22] and Radicle Drips[23] offer the capability to create programmable flows of resources within and between Web3-enabled organizations, like the polycentric circulatory systems of nutrients in an ecology.



These could be used as fund streaming tools to pay DAO contributors based on outcomes, split royalties among creators, or support subscription memberships for open-source dependencies. Flow-based networks offer the capability to keep up with real-time demand for services, and dynamic issuance offers the adaptive capacity for a token economy to respond with a proportional shift in available supply to match.

## Conviction Voting

Flowing resources is one thing, but flowing the governance of those resources is a new realm of exploration recently opened up by blockchain technology. Conviction Voting[24] (CV) is a dynamic governance primitive developed in collaboration between Commons Stack,[25] BlockScience, 1Hive,[26] and the Token Engineering Commons.[27] It aggregates the real-time preference signals of a group of individuals into a measure of collective ìconvictionî towards group priorities, similar to the way neurons power up and fire to form the distributed intelligence of the brain. CV can be used to rank community preferences, distribute funding, or even to dynamically weight the delegation of voting power in DAOs.



# IMAGINING FUNGAL FUTURES

## Vote Streaming in Fluid Democracy

Imagine a future where we could give regular input and feedback to our collective governance processes, and it had a direct and proportional impact on policy-making and resource allocation. Instead of voting once every four years, in a fluid democracy, we vote in real-time on issues that are important to us - or we delegate our clout to people we trust, and then re-delegate if and when those people break our trust. Different policies can pass at varying speeds and the rate of flow or “viscosity” of collective decision-making is now a tunable parameter. Unlocking the dynamic flow of governance over shared resources could level up our societal institutions to enable them to collectively adapt and address the myriad challenges they face.

DESIGN PATTERN FIVE

# Mutual Reciprocity

# THE MYCELIAL MINDSET

## The Relational Exchange of Fungal Finance

Many traditions and indigenous ways of knowing have long recognized that all good things in nature are rooted in reciprocity and relationship. Ongoing research into mycelial relationships with trees and plants suggests that an evolutionary strategy of mutual reciprocity can build stronger, more trusting exchange partnerships.[28]

## Mycorrhizal Solidarity Networks

One of the most mutually beneficial fungi is the mycorrhizal variety, which interconnects with the underground rhizomes of plants. Mycorrhizal relationships are the epitome of solidarity networks in forest ecosystems, not only displaying reciprocity in the exchange of messages and warnings, but also in feeding stumps of trees that can no longer photosynthesize for themselves, allowing them to live on for decades. Mycelium acts like an extended nervous system of the forest, such that trees can even recognize and communicate with kin via their hyphal roots. These networks also enhance disease resistance in forest ecosystems and encourage collective adaptation to threats, increasing their overall systemic resilience.[29]

## Weaving Kingdoms into Partnership

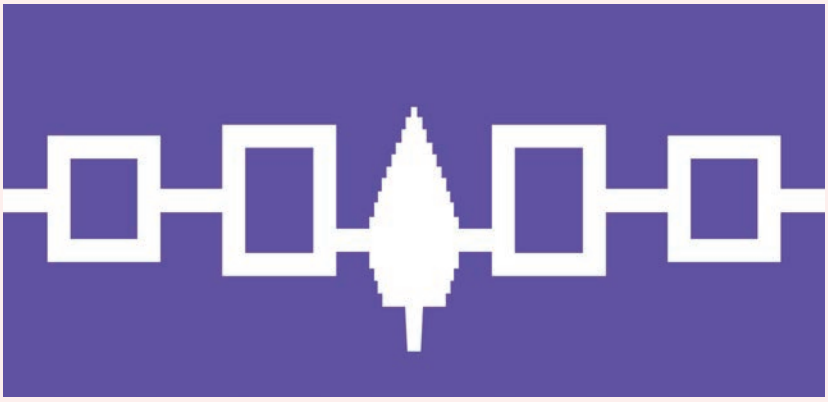
Myceliumís web of mutual support with other organisms is pivotal in natural ecosystems. Roughly three≠quarters of a plantís roots are actually mycelial tendrils, greatly extending the reach and surface area of roots to absorb nutrients. Many trees have even evolved to leave space within their roots for the mycorrhizal hyphae to grow into ≠a display of mutually beneficial relationships between different kingdoms of life.

## Learning from Mycelial Market Makers

Ongoing research shows that fungi have evolved methods to identify and eliminate free riders from their resource distribution networks and double down on mutually beneficial trade partnerships. They also dynamically adjust their exchange rates for the resources they trade with trees, based on their relative scarcity in one location over another.[30] These mycelial market makers are a fascinating glimpse of resource exchange in nature that could hold many important lessons for us.

### *AN HOMAGE TO INDIGENOUS ECONOMICS*

Indigenous Economics[31] is a field of economic study that explores the resource management practices, theories, and philosophies of indigenous peoples around the globe and throughout history. It builds on the communal values of multigenerational thinking, ecological sustainability, and our intricate connection with the environment. This approach recognizes the importance of maintaining the interconnection and relations between all living things - an economy beyond tokens of value and quantification.



***The Hiawatha Belt of the Haudenosaunee Nation - since fashioned into a flag - carries deep meaning and significance. The wampum belt also functioned as a ledger recording the founding of the Haudenosaunee Confederacy, when five warring nations buried their weapons of war to live in peace.[32]***

Given that animals branched off from fungi in the evolutionary tree of life, mushrooms are one of our closest genetic ancestors, and thus also a part of our indigenous heritage. As with many other topics in this book, there is much more to explore on the deep wisdom of Indigenous Economics. Our intention in bringing this up here is to show gratitude and respect to indigenous peoples and elders for stewarding this wisdom.

MycoFi sees Indigenous Economics and asks: how can we re-root economics in the health and wealth of our planet and all living beings?

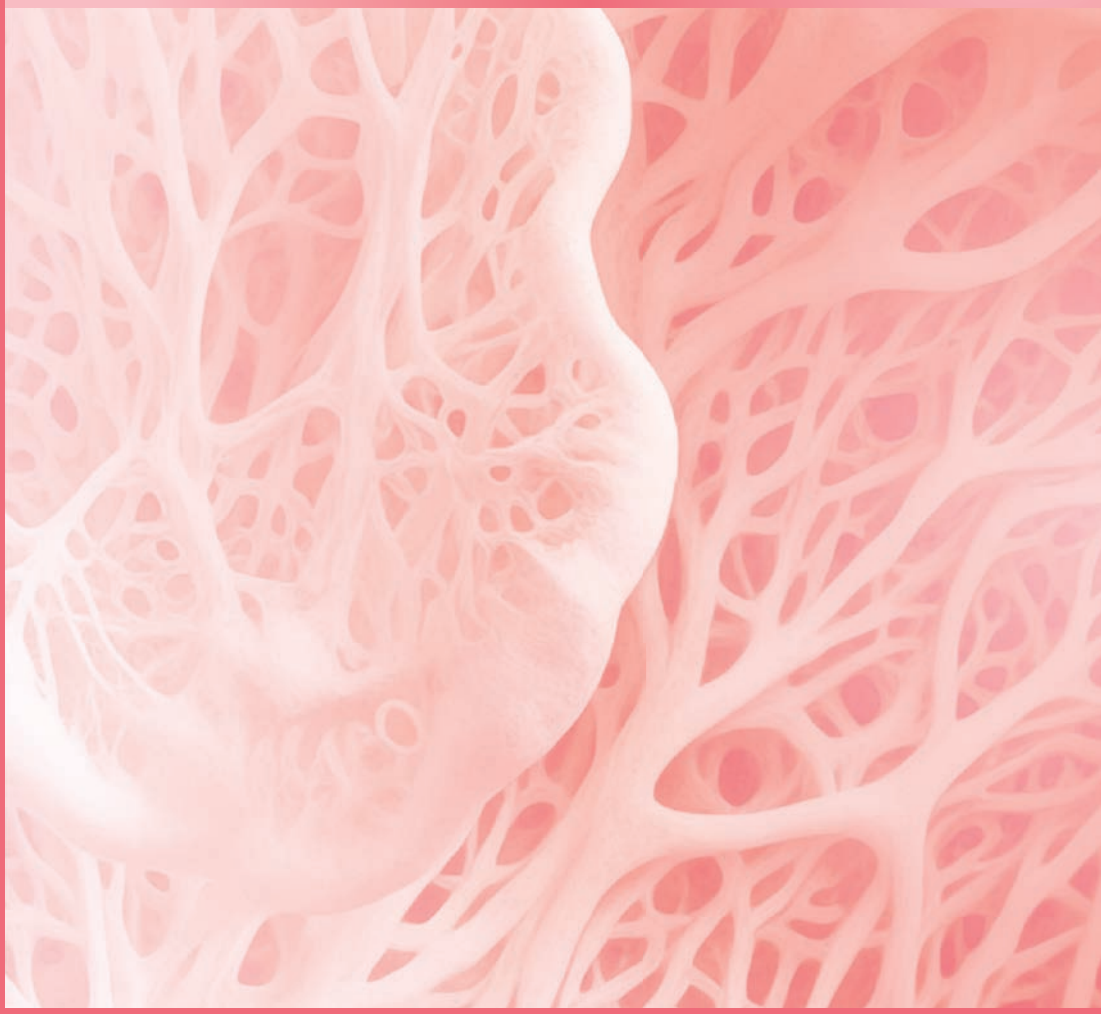
## Collaborative Finance (CoFi)

CoFi[33] is a relatively new meme in the Web3 space, but it is based on practices that have been around for decades. CoFi focuses on creating greater economic efficiency by clearing debts within a network through a harmonious cycle where participantsí obligations cancel each other out without a single token changing hands. This kind of liquidity-saving mechanism paired with mutual credit clearing could save businesses as much as 50 percent of their need for cash to settle those same debts, representing significant savings in terms of operating costs, especially in high interest-rate environments.[34]

## Giveth GIVbacks

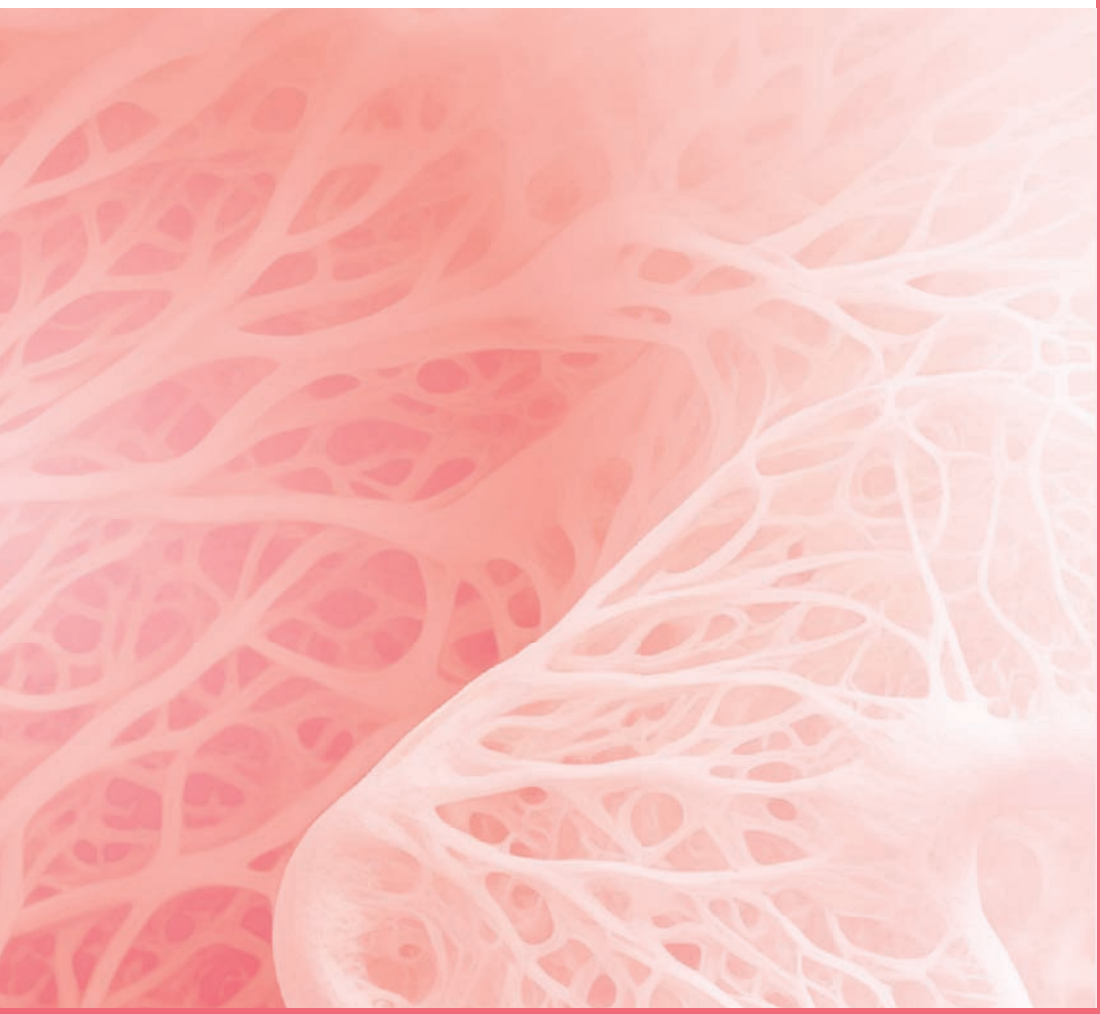
The GIVeconomy aims to reward, empower, and encourage altruism and those who donate to causes on the Giveth platform.[35] This hard-codes reciprocity into an on-chain economic model, much like the network strategies employed by our mycelial kin. The Giveth Galaxy builders have been iterating on a giving economy where those who donate to purpose-driven projects get $GIV tokens in exchange. Giveth participants can also stake their tokens for charity and earn in kind, creating an ecosystem of collective support, abundance, and pro-social value creation.

# IMAGINING FUNGAL FUTURES



## Institutionalized Generosity Networks

Imagine a future where mutual reciprocity can be encoded into the basic economic interaction patterns between us all. Where peer-to-peer mutual credit lines interconnect everyone on the planet, and generosity is institutionalized through networks of mutual aid and pay-it-forward universal basic income (UBI). In this age of material abundance, no one is left wanting food, water, or shelter due to a lack of access to an artificially scarce financial unit. Networks of trust lines between us and our communities are public infrastructure that make access to money no different than access to water or electricity - you just draw what you need from the network, and pay for what you use. Just like the mycelial solidarity network of the forest, in the MycoFi future, our economic systems ensure that everyone's basic needs are met by default.



DESIGN PATTERN SIX

# Polycentric Pluralism

# THE MYCELIAL MINDSET

## Diversity Breeds Resilience

Fungal wisdom and evolutionary biology point to diversity and plurality as a key pattern for survival. The mycelial capacity for diversity is beautifully expressed in the jaw≠dropping 20,000+ distinct genders some mushrooms have evolved for reproduction.[36] Genetically unique fungi are densely interconnected with each other and innumerable plants, overlapping and melting into diverse polycentric collectives. They are also capable of impressive localized specialization, with cells being able to spin up unique alchemical capabilities such as defense centers that produce penicillin or other enzymes to battle hostile bacteria in the soil. This makes fungi one of the most resilient lifeforms on the planet.

## Myco≠Economic Permaculture

The mycorrhizal networksí display of economic permaculture holds up a useful mirror to compare with our anthropocentric fiat economies. State≠enforced currency monocultures crowd out other forms of peer≠to≠peer exchange and impose a system of artificial scarcity, which leads to a situation where the private financial system can extract heavy tolls from our inability to transact with each other. In reality, it is the invisible economy, rooted in diversity, generosity, and abundance ≠the networks of mutual aid, obligations, IOUs, credits, favors, and the largely invisible labor of caregivers (predominantly women[37]) ≠that truly makes the world go round.

## Supporting Diverse, Thriving Ecosystems

Forest ecologies contain overlapping layers of interdependent processes carried out by innumerable different species of plants and animals ≠the very definition of polycentrism. Underlying every thriving ecosystem are the mycorrhizal networks ≠luckily, mushrooms never put all of their resources in one hyphal basket. The fungi kingdomís ability to express and exchange different forms of value ensures the dynamic cyclicality of resources being distributed as needed through these ecosystems. True champions of pluralism and diversity, they remind us to maintain heterogeneity and expressivity in our systems ≠not just to survive, but to flourish!

## *NATURE'S MOST PROLIFIC AIRDROP*

Many mushrooms reproduce using spores, tiny packets of genetic information that float through the air like nature's everlasting airdrop. Spores can be launched into the air with the same force as rocketships, where they ride the winds to great heights and even play a crucial role in cloud formation, affecting weather and rainfall patterns worldwide.[38]

# MYCOMIMICRY IN WEB3

## Radical xChange's Plural Voting

Pluralism has been a rallying cry among the Radical xChange[39] community, where Plural Voting[40] (also called Quadratic Voting, or QV) was recently popularized. QV is a voting method that allows voters to express the intensity of their preferences in collective decisions, which can greatly mitigate tyranny of the majority and factional control problems in traditional voting systems. Plural Voting offers an important step into alternative voting systems that could increase the plurality of decision-making in society.

## Community Currencies & Asset Vouchers

Economic pluralism is on full display in the innovative work of Grassroots Economics[41] and Circles Coop[42]. Grassroots Economics is a non-profit foundation working with marginalized communities on Community Asset Vouchers (CAVs). CAVs allow communities to issue vouchers backed by their own production, and to use those to enable greater exchange of goods and services in the local economy. Similarly, Circles UBI allows communities to issue credit amongst each other, in order to enable exchange in the absence of fiat currency. These systems enable communities to incubate locally-led projects and businesses with reduced dependency on scarce national currency and greater resilience against market volatility, innovating on decades of work in complementary currency systems.

# IMAGINING FUNGAL FUTURES

## Collective Flourishing by Expanding Expressivity

Imagine a future where local currencies, as multidimensional expressions of value, can be braided together in synergistic meta-economies. A multitude of locally-centered yet globally connected ecosystems, whose members transact in sovereign economic solidarity. These currencies are designed to align value with values, such that the culmination of economic interactions manifests the outcomes we want to see in the world. Diverse forms of value are expressed through a plurality of options for exchange, breaking through the imposed scarcity of economic monoculture like mushrooms fruiting through asphalt. MycoFi shows us how we might deconstruct the constraints of the past, and embrace the permaculture economic future.

# Join the Mycelial Revolution

## Composting Capitalism

Some say mushrooms are “having a moment”, with interest growing in fungi due to the advances they offer in life-saving medicines, bioremediation, materials sciences, permaculture design, and so much more.[44] But that’s only the tip of the toadstool! The reality is that mushrooms are facilitating a movement, one that is capable of changing the face of entire planets - a continuous revolution they have been instigating since the dawn of multicellular life on Earth. MycoFi offers us the opportunity to leverage fungi’s transformative power to compost the decaying monolith that is late-stage capitalism, decomposing what no longer serves us and transmuting it into new life.[45]

## A Blueprint for Healthier Economics

In these mycelial design patterns, we find not just a blueprint for healthier economics, but a call to join in the dance of evolution; to a melody played on the strings of the universe itself. Rather than “exiting” our legacy systems and increasing our segregation and isolation, MycoFi suggests that we root deeper into our communities to find reconnection and common cause in a mutually abundant future. Much like the mushrooms that appear after forest fires to rehabilitate torched landscapes, MycoFi shows us how we might come together to heal the economic trauma that has been visited upon our damaged societal ecosystems. Mushrooms invite us to chart new paths around the limitations of monoculture currencies, inspiring us to dream in altered states of monetary consciousness.[46]

## Underground Networking Strategy

The fungal strategy is so successful in part because fungi tunnel underground, gathering strength and sharing resources safely out of sight of predators. When the time is right, mushrooms perform another of their impressive miracles. Leveraging hydraulic force and producing powerful digestive enzymes on the tip of the fruiting bodies, mushrooms can push forward with surprising speed through seemingly insurmountable barriers, even fruiting straight through asphalt in a single night. There is a Potawatomi word for the force with which mushrooms exert when they fruit: Puhpowee![47]

## The Puhpowee is Yours!

Now it's your turn. As our mycelial exploration draws to a close, we hope the ideas expressed in this book stick with you like spores of inspiration. Perhaps some of those spores will take root, branch into hyphal tendrils of curiosity, and even mushroom into some form of creative expression, spreading spores of their own through the stories you tell, the actions you take, or the tools you #buidl. Each of us has a part to play in our collective future, and mushrooms show us that together, we have great strength to affect change.

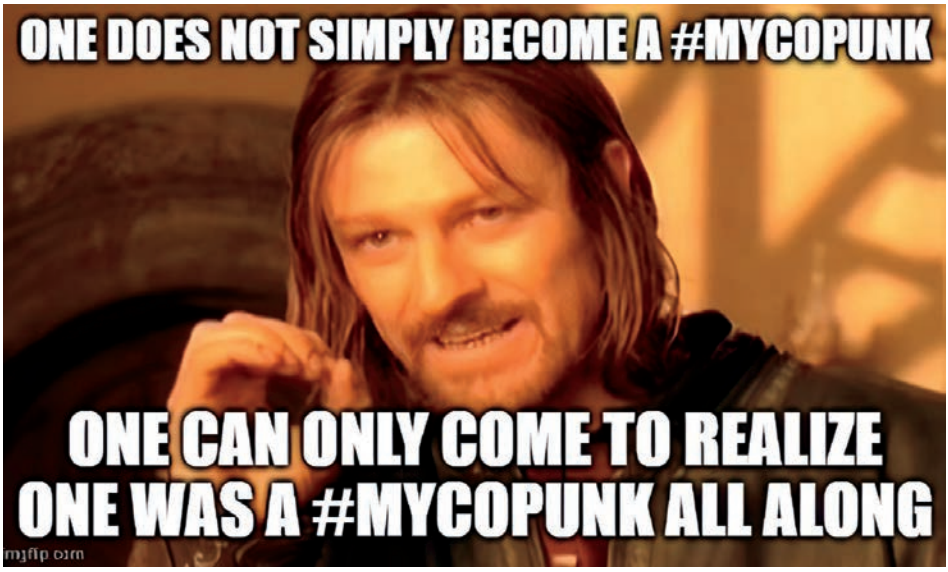
*Root into your body, and feel the coherence of the billions of microscopic organisms that comprise you. Root into your community, and dream of new ways we can merge our voices in collective wisdom. Root into the land, and tread lightly on this precious planet, for she is our great mother and our only home.*

## Let's Get Rooted, Mycopunk

Solarpunk? Lunarpunk? Meet Mycopunk! This liminal aesthetic dissolves and integrates dualism and dichotomy into its pluralist mesh, welcoming regenerative radicals and changemakers of all stripes. If taking part in the mycelial revolution sounds like your vibe, consider this: one does not simply become a Mycopunk. One can only come to realize one was a Mycopunk all along.

**Join the community and contribute your two spores:**

linktr.ee/MycoFi



ONE DOES NOT SIMPLY BECOME A #MYCOPUNK
ONE CAN ONLY COME TO REALIZE
ONE WAS A #MYCOPUNK ALL ALONG


BECOME UNGOVERNABLE

# Gratitude & Acknowledgments

This book would not have been possible without the spread of ideas through a vibrant and interconnected network of changemakers and research colleagues who are too numerous to name, but who have all left their mark on the words in this book.

A special thank you for edits contributed by Scott Morris, Exeunt, Tamara Helenius, OpenTony, Matthew Slater, Cart Reed, and Tineasha Emmett. We are also grateful to the Crypto Commons and CoFi communities for the generative spaces they hold that inspire so much creativity.

We extend our deepest gratitude to the researchers and authors like Paul Stamets, Suzanne Simard, and Merlin Sheldrake who motivated the authors' journeys into the field of mycology. Also for the unending inspiration from Michael Zargham and the multidisciplinary team at BlockScience, whose research continually explores the edges of the known. We would also like to thank all of the projects that were mentioned in this book, including all those we didn't have space to name! There is so much more that could be said about each of these projects and the ecosystems they are evolving in. We've included links in the appendix below so you can continue on deeper explorations.

Thanks to the Lichenpunks for eroding the solid rock of the status quo into fertile soil for imaginative exploration, and to the Mycopunks who emerged to manifest a world of fungal solutions to the challenges of the Anthropocene. And of course, to the mushrooms...without whose regenerative wisdom we might not even exist!

*APPENDIX*

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