SENSORY KINSHIP OF THE THIRD KIND

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Design and photos by Allie ES Wist

WE ARE IN A PIVOTAL MOMENT OF RE-CONSIDERATION AND RE-DEFINITION OF OUR RELATIONS WITH FUNGI.
Propelled by new research, fungi have made their way into public consciousness as a seemingly utopian new design material and chic ecological signifier. While interest in fungi's capability for ecologically responsive world-building is valid, and it's benefits to human health are substantial, the relationship we ultimately maintain with mushrooms is often one of commodification or utility. This eludes the wonderfully ambiguous and complex realities of fungal beings—their otherworldly vibrance in diverse ecosystems.

What might it mean to forge a kind of kinship with fungi that goes beyond their usefulness to humans? How can we playfully attempt new kinds of relationships with them?

Sensory Kinship of the Third Kind is an ongoing artistic research project that considers the potential of multi-sensory engagement with mushrooms and mycelium. In this field guide, we outline our artistic research methods that are accessible to seasoned mushroom enthusiasts and beginners alike. Readers are encouraged to experiment with and speculate about mushrooms, fungal mycelium, and their environments to learn about nonhuman sensing and ecologies. Someof the exercises in this guide use technologies to facilitate creative engagements with fungal life, enabling a deeper understanding of their cryptic communication and sensings. However, most can be adapted to be done without these technologies.

We are sharing these exercises to encourage readers to reconsider how we might come to value and recognize fungal beings, while suggesting a refusal of the commodification and plastification of fungus that fits purely aesthetic or utilitarian agendas.

Our methods are based in theories that interrogate human:nature dichotomies and prompt curiosity for the liveliness present in all beings. Although we encourage learning through interaction, we acknowledge the impossibility of truly understanding nonhuman and ways of knowing.

In her 1988 paper "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," Donna Haraway argues that all knowledge is *situated*—that is, effected by a living being's prior experience, sensory means and ability, and temporal and spatial positioning.[1] Since fungi accrue knowledge from a vastly different position than any human, we emphasize speculation (as opposed to the collecting of objective data) as a valid entry point to understanding fungal worlds.

1 Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (1988).

ARTIST BIOS

Allie ES Wist is an environmental and media artist who writes about sensory studies and the Anthropocene. She has been developing creative practices based in taste, smell, and multi-media installations.

Lisa Schonberg is a composer/percussionist who works with the sounds of insects and their environments, and creates music and sound art for performance, installation, and recording. She is curious about mushrooms as another entangled layer of cryptic soundmakers.

GLOSSARY

FUNGUS (PL. FUNGI) - any member of the group of organisms that includes microorganisms such as yeasts and molds, as well as the more familiar mushrooms. This field guide focuses on fungal forms that produce mushrooms.

MUSHROOM - the fruiting body of a fungus, containing reproductive spores that are dispersed by water, wind, or animals. Usually the most (or only) visible part of a fungus. Mushrooms of some fungi are very short-lived, and are around for mere hours; others, such as for the polyphores, are sturdy and can live for years.

MYCELIUM (PL. MYCELIA) - root-like structure of connected and branching fungal hyphae, which serve as a connective network for communication and transport of nutrients. The mycelium is usually the less conspicuous part of a fungus; the mushroom is a fruiting body that sprouts from the mycelium.

MYCORRHIZA (PL. MYCORRHIZAE) - (myco= fungus; rhiza = root) mycelium that have symbiotic relationships with plants through their root systems, together affecting soil chemistry, nutrient uptake, nutrient availability, and success of the fungus and plant.

SPORE - reproductive element of a fungus

HYPHAE - one of the threads that make up the mycelium of a fungus.

Definitions based on entries from Mirriam-Webster and Wikipedia.

FUNGUS AS A THIRD KIND

THERE IS A SCENE IN THE 1977 FILM *CLOSE ENCOUNTERS OF THE THIRD KIND* IN WHICH HUMANS ATTEMPT TO communicate with extraterrestrials through sound. After learning that witnesses in Northern India heard UFOs signaling with a five-tone series in a major scale, a team of scientists theorized that this sequence—the notes [D-E-C-C-G]—might contain a kind of universal tonality. Importantly, the scientists pivoted away from verbal language and reached out with something more affective and sensory. The film proffers a profound suggestion — that beyond-verbal reaches might help us communicate with nonhumans. What if this were applied to nonhumans already on earth, who often defy our understanding? Composer David Dunn similarly expounds that "music may be … a way of making sense of the world that might help us to refashion our relationship to nonhuman living systems."[1] Our project is founded on this beyond-verbal approach, speculating about beyond-human means of sensory communication.

Director Steven Spielberg based his film title on astronomer Josef Allen Hynek's "close encounter" scale, on which "close encounters of the third kind" are ones in which an extraterrestrial is present with the observer. In our work, we attempt to be *present* with fungi through sensory explorations. Emphasizing their in-betweenness, we also consider fungal beings as a "third kind" in their occupation of liminal spaces between life and death, maintaining a persona that hovers between our world and the underworld of soil.

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1 David Dunn, "Cybernetics, Sound Art and the Sacred" (2004), 5.

Their taxonomic classification eludes common understanding, as they often have a morphological likeness with plants, but a genetic closeness with animals. They deal directly with death and decay, but also help to enrich soil that harbors seeds and the nutrients to sustain new growth. In our exercises, we are fascinated with these ambiguous, liminal ways of fungal being, and encourage open-ended considerations.

Our ability to know and understand fungi is often obstructed by our fear of them or separation from them. Mushrooms provoke disgust and fear as potentially lethal entities who are difficult for us to categorize or identify. Even as we approach a year of working on this project, we notice a lingering hesitation within ourselves when we see a mushroom: a curiosity to touch them, but an unfounded fear to actually make contact. (You can't be poisoned by a lethal mushroom just through touch.) Yet, like our cultural fascination with extraterrestrials, we have a peculiar kind of curiosity for fungi. They materialize out of the earth—out of the detritus of other life—and have powers ranging from extraordinary benefit to lethal ends.

Fungi's methods of physical reach, through mycorrhizal networks and dispersal of spores, help them to thrive even in the most ruderal of landscapes; they can be found in wastelands, on isolated tree stumps nearly swallowed by the concrete and refuse of city streets, and inside nuclear fallout zones. Although they are essential to the function of ecosystems across bioregions, and visually conspicuous, most fungal labor and energy is hidden temporally and spatially from human sensing. In this cryptic niche, they have been overlooked in mainstream popular science narratives, disproportionate to their ubiquity and importance. There are botany and zoology departments at most universities, but hardly ever a fungal studies program; instead, they are integrated peripherally into other studies.[2]

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2 Peter J Irga, Laura Dominici, and Fraser R Torpy, "The mycological social network a way forward for conservation of fungal biodiversity," *Environmental Conservation* 47, no.

In the past several years, it has been hard to ignore the increase in fungal attention in popular and commercial media. This attention is both focused on mushrooms (their fruiting bodies) and mycelium (their underground transport and communication networks). Fungi have become of-the-moment for a range of applications including package design, construction, clothing material, and as an ingredient for functional foods and beverages. In these applications, they are sometimes rendered into sleek and nearly utopian substrates, such as inspiration for furniture, or as the material for luxury designer bags. This plastification of fungi turns them into hollow forms of ecological awareness,[3] keeping their messy, dirty, and sensory aspects safely at a distance. Furthermore, many of these offerings are available to only those who can afford their high prices, and put forth a false image of consumption being equated with environmental action. Our work has been inspired by many of the initiatives around mushrooms that use actionable and accessible means to bring fungi into lexicons of design, food, and building (see resource list). While accessible and equitable use of fungi does have huge potential in helping us to move towards less impactful ways of living, there persists a lack of common knowledge around fungus in most American's lives otherwise. Focusing on them only as a product doesn't acknowledge the incredible agency and liveliness of fungi *on their own terms.* How far can we extend our curiosity about mushrooms' autonomous existence? Can we truly imagine a mushrooms' inner liveliness, beyond our interest in them as food or medicine?

As ecological artists, we are interested in ways to move beyond spectacle, trend, or commodified aestheticization. Perhaps this popular interest in fungi has primed us for a pivotal moment of re-consideration and re-definition of our relations with them. In a

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4 (2020), 246.

3 Ligaya Mishan, "Mushrooms, the Last Survivors," *New York Times Style Magazine* (18 September 2020) https://www.nytimes.com/2020/09/18/t-magazine/mushrooms-fashion-food-art.html.

recent discussion with New York Mycological Society (NYMS) member Sigrid Jakob, we noted how the precarity of the climate crisis and late-stage capitalism may have driven us to finally recognize the incredible capabilities of mushrooms, some of which may help heal our ecosystems. Jakob suggested that we seek fungus as "something that can be transformative in a moment when we desperately need transformation."

Perhaps fungi is a kind of "third nature," a term outlined by anthropologist Anna Tsing as life that "manages to live despite capitalism," and emerges out of possibility with "temporal polyphony."[4] That is, we can seek the liveliness of mushrooms on their own terms, and in the sites and temporalities from which they emerge. What do mushrooms need, what do they take, what do they offer us, and what can we offer them? Instead of treating mushrooms and mycelium as food or design material—as a thing for humans—we seek forms of relationality that embrace the mushrooms' multiplicities and agency. Using artistic methods that draw on scientific research enables us to embrace these multiplicities while not being limited by the rigidity of science or the subjectivity of art. Following C.P. Snow's concept of an integrated "third culture"[5]—one which necessitates communication between practitioners in both the humanities and the sciences—our methods reject academic binaries and utilize science-informed artistic research that directly engages with the public. Instead of only focusing on fungi's utility, might we accept the complexity of our relationship with fungi, whose lives we ultimately use to prolong our own? We are interested in the kinds of interspecific relations that can be forged through encounters that are primarily ephemeral and embodied.

In setting out to plan this project, we acknowledged how little we

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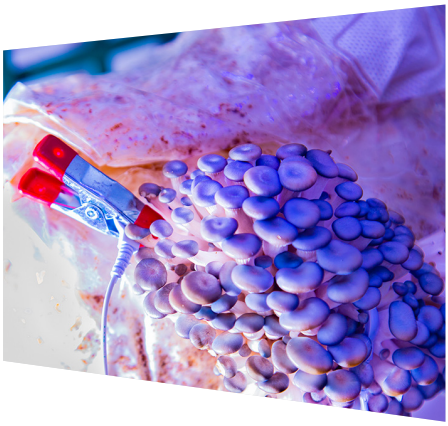
4 Anna Lowenhaupt Tsing, *The Mushroom At the End of the World* (Princeton: Princeton University Press, 2015).

5 C.P. Snow, *Two Cultures and the Scientific Revolution* (Cambridge, U.K.: Cambridge Univ. Press, 1963).



knew about fungi, and have used our creative skills to try and learn about these organisms. As composer Pauline Oliveros urged, we listen and sense at the edges—in places often overlooked or undervalued.[6] Donna Haraway extends this further: "the task is to make kin in lines of inventive connection as a practice of learning to live and die well with each other in a thick present."[7] We offer this field guide as a gift and an invitation for connecting with mushrooms in this thick and embodied present to hear and sense things we might otherwise miss. Since humans lack the physical proximity that mushrooms have with more of their direct symbionts (tree roots, ants, or organic matter in soil), we have created exercises that we hope will allow you to participate in fungal worlds in a sensory capacity.

HOW FAR CAN WE EXTEND OUR CURIOSITY ABOUT MUSHROOMS' AUTONOMOUS EXISTENCE? We might imagine their inner liveliness as the means to which they interact with other entities. This notion of mindedness, as defined by cybernetics scholar Gregory Bateson in his 1979 treatise *Mind and Nature: A*

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6 Oliveros, Pauline. "Quantum Listening: From Practice to Theory (to Practice Practice)" *Music Works* 76 (2000), 74

7 Donna Haraway, *Staying With the Trouble* (Durham: Duke University Press, 2016), 1.

Necessary Unity, exists among nonhumans and humans alike in "patterns of connection" and messaging, that without this context have no meaning regardless of the species.[8] David Dunn has since the 1970s explored this concept through interactive music compositions that reveal the mindedness of nonhumans and environmental matter in general. Dunn's move away from the verbal in order to learn about nonhumans, is central to his work. He points to what we might be missing if we continue to rely so heavily on the verbal as a means to understand nonhumans: "Is it possible to use the very tool through which we construct reality to imagine any other outside of it?"[9] We have been informed by Dunn's work in the design of our exercises in sound - and by extension, smell —which might reveal mindedness among fungal beings through non-verbal means.

If we are to recognize a mindedness in nonhumans—a self-realization, a state of existing, knowing, and doing—it is essential that we do not base it on human-centered metrics. We must acknowledge that even our well-intended actions to benefit "the environment" are decisions built by priorities and values that are concerned with human presents and human futures. We are concerned with the health of a national forest so we can continue to enjoy its beauty; we want to protect a body of water so we can continue to draw fresh water from it. This is often the narrative in popular media concerning climate change — we are told we should take action to protect nonhumans for the benefit of human futures. In order to look beyond human-centered decision-making, we must contend with how often our valuation of organisms is based in anthropomorphism and personification. The common chain of rationalization seeks to justify respect for a nonhuman species based on how closely its sensing, knowing, and communication resemble our own. Ants are robots,

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8 Gregory. Bateson, *Mind and Nature: A Necessary Unity* (New York: E.P. Dutton, 1979).
9 David Dunn, "Speculations: On the Evolutionary Continuity of Music and Animal Communication Behavior," *Perspectives of New Music* 22, No. 1/2 (Autumn, 1983 - Summer, 1984), 87.

but an octopus is more "intelligent," and thus deserves our preservation efforts. We tend to base measurements of "intelligence" on metrics we find similar to humans: the ability to plan ahead, recognize oneself in a mirror, or use tools. We similarly consider sentience in animals when considering how we value their worth and protection. Author and artist Jenny Odell has articulated how the typical animal rights stance "proceeds solely from the logic that some animals are sentient and can feel pain," but this privileges a human-centered notion of sentience despite ecologies' reliance on *both* sentient and so-called "non-sentient" beings.[10] This privileging, ecologist Chris J. Cuomo writes, "comes out of the assumption that human beings are paradigmatic ethical objects, and that other life-forms are valuable only insofar as they are seen as similar to humans."[11] We suggest that non-sentient fungal ecologies deserve just as much value, respect, and attention as an "intelligent" octopus or bird, and that our ethics around nonhumans may be more open-ended and *affective*.

Recent research on fungal communication has leaned towards a particular kind of personification of mushrooms by suggesting that mushroom signaling might be "language" with "words." (We discuss this research more in the section *Mushroom Language*). Instead of relying on personification, we are interested in embracing the unknown and the unknowable. There is a vast diversity of ways of knowing beyond the human, and it is precisely by deepening our recognition that we cannot know exactly how these organisms sense and communicate that we develop respect for them.

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10 Jenny Odell, *How to Do Nothing: Resisting the Attention Economy* (Brooklyn: Melville House, 2020).

11 Chris J. Cuomo, *Feminism and Ecological Communities: An Ethic of Flourishing* (London: Routledge, 1998).

LISTENING TO SOIL

Soil is fungus's primary habitat. It is home to their mycelial networks, to their complex mycorrhizal systems with plants, and it houses the physical and nutrient support of their mushroom fruiting bodies. Soil is also the home of an unending variety of microbes, invertebrates, and plant species that interact with mushrooms either directly as symbionts, or indirectly by affecting conditions within the soil substrate. Fungi also make their home in decomposing matter and facilitate the breakdown of these materials as they become integrated into the soil—in fallen woody debris, in animal carcasses, in human refuse, and in seeds fallen to the ground. They often live in complex symbioses within soil, such as in the elaborate chambers in the nests of leafcutter ant colonies who feed fungus in order to sustain their colonies on it within these large nests excavated in the soil. In all of these ecological niches, they are exposed to vibratory soundscapes. There are air pockets in soil for sound to pass through as airborne waves, but for the most part, sound is transmitted through soil environments as vibrations, through the soil material itself. Regardless of how they might perceive these vibrations, they certainly are not immune to them.

How might we better understand the soil ecosystems and microhabitats in which fungi grow, live, and sustain life? Can we use our own bodies and technology to listen to a soil habitat? To sonically surveil the material world where fungi carry out most of their existence?

In our practice *Listening to Soil,* we will listen to the soundscape of the soil that mushrooms and their mycelial networks inhabit. This exercise, of listening to the soil soundscape, can encompass a broad range of sounds, including external sounds (such as anthrophony) and those that originated from within the soil. The soil soundscape includes sounds that are ephemeral and those that persist over long periods. It includes sounds of various timbres, volumes, pitches and percussive qualities.

There are two options for this exercise, one that involves technology and one that does not.

Required tools: your ears, bare feet and/or hands; pencil & paper or other note-taking tool.

Optional tools: contact microphone(s), small condenser microphones, Geofón, field recorder, headphones.

Using either microphones and/or our bodies, we can listen to soil, and we can speculate as to how vibrations are sensed by fungal mycelium and mushrooms in their soil habitats. What do they sense of the vibrations of a passing train or truck? Of human footsteps? Of spiders walking by?

Composer Pauline Oliveros outlined ways to listen both globally and locally in her theories of Deep Listening.[1] She challenged practitioners to push themselves to their limits; to become adept at listening as broadly as they could, to as much as possible at once, and then shifting that listening focus more tightly, focusing in on one source. She also encouraged listeners to practice moving between these extremes. We begin with these theories in mind, and apply them to fungal worlds.

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1 Pauline Oliveros, *Deep Listening: A Composer's Sound Practice* (Bloomington: Deep Listening Publications/iUniverse, 2005).

To begin, locate a mushroom body, or a spot where you have previously seen mushrooms grow.

WORKING WITH YOUR BODY:
Close your eyes. Sit with your weight centered on your SITS muscles (your rear). Try and hold your hands and feet as lightly as you can on the soil surface.

Feel for the vibration of sounds that originate outside of the soil environment and are transmitted through the soil as vibrations (for example, traffic, birds, and rain). Feel for geological elements (water, air, wind). Feel for sounds that are produced within the soil environment.

Go through the same steps, but with your ear close to or on the soil surface.

With each step, shift your feeling/listening between highly localized single sound sources to more broadly environmental sonic elements.

WORKING WITH MICROPHONES:
This exercise is intended for use with contact microphones. You will need a good quality field recorder (with substantial pre-amps), an impedance adapter for the contact microphone, and headphones.

Place the microphones in or under the leaf litter layer of the soil, or within the soil. Put on the headphones. Be careful not to shift your own body weight or speak, as you will hear this through the microphones and it may obscure other sounds.

Close your eyes. Wait for the microphone to settle - at first you will hear the soil retracting where you might have compressed it. This is an interesting sound in and of itself.

Listen for the vibration of sounds that originate outside of the soil environment and are transmitted through the soil as vibrations (for example, traffic, birds, and rain).

Listen for geological elements (water, air, wind). Listen for sounds that are produced within the soil environment.

Shift your feeling/listening focus between highly localized single sound sources to more broadly environmental sonic elements.

THINGS TO CONSIDER:
How did the soil affect the sounds you heard?

How did it affect sounds you are familiar with from outside the soil?

What nonhumans and humans do you think you heard/felt?

How do you think the mushrooms and/or mycelial might sense these sounds?

How do you think these vibrations differ from those in 2000?

In 1990? In 1930?

How do you think our soil care and anthropogenic soil impacts might affect the fungal sensory experience?

Photo still from video by Jamel Mosley

MUSHROOM LANGUAGE

“Language” is a term most often reserved for humans. It implies a complex system of symbolic and even abstract words or other symbols used for communication. Much scientific and popular narrative assumes that human language is the epitome of sophistication—the measuring stick against which nonhuman species’ communication is assessed. Using this metric, judgments are often made on the levels of intelligence demonstrated through nonhuman language. Applying this logic to mushrooms, we might look for indicators of human-like language as indicators of meaningful communication, as was the case in a recent paper on fungal communication. Adam Adamatzky, a computational researcher, posited that mycelium might, in fact, communicate with something akin to human language. When he measured the oscillations of electrical activity in ghost fungi, Enoki fungi, split gill fungi, and caterpillar fungi, he and his collaborators found that the electrical spikes occurred in clusters and could be manifestations of fungal communication. When they analyzed these electrical spikes as if they were “words,” they found a striking similarity to the distribution and length of words used in human languages.

But what does it mean to suggest mycelium is talking to other parts of itself or to its mushroom bodies? Might we find less anthropocentric ways to appreciate whatever kind of “talking” it is that fungi do, even if we can’t relate to it directly? Adamtzky himself admits the signals could mean nothing at all—the analysis simply provides one way of viewing mushroom electrical activity. But by applying something so resolutely human to fungal networks, he plays into our affinity for anthropomorphism.

Perhaps we can grant fungal networks a new kind of agency by imagining what "words" they are using in their communication. In our work, however, we move away from valuing mushroom communication only in so much as it mirrors our own. In the Mushroom Language exercises we have developed, we suggest both verbal and non-verbal methods of interpreting, sensing, and even "feeling" mushroom electrical signals in order to recognize the bias inherent in human verbal language.

In her book *Braiding Sweetgrass,* ecologist and member of the Citizen Potawatomi Nation Robin Wall Kimmerer, describes how, when referring to ecological entities like mountains or hills, her indigenous language uses something more like a verb. Instead of treating these entities as static nouns, "the hill," their conception of the word is closer to "hilling" or the "process of being and becoming a hill." This encapsulates a larger scale of "being," both spatially and temporally. We think this is a particularly fruitful way to think about mushrooms, too, since "the mushroom" that we observe is simply the fruiting body, or the reproductive organ, of a vast fungal system. It is more of an ongoing process of growth from, through, and in a network of both fungus and fungal symbionts, in an active process, perhaps, of "fungusing." We can also pause here to consider the word "mushrooming," which already has certain connotations in the English language—it is used to describe a type of rapid growth or expansion, often implying a slightly out-of-control blooming quality. We invite you to expand this idea of "mushrooming" as something cyclical and constantly in-process—something both generative and destructive. Instead of a one-directional outward motion, perhaps "mushrooming" is an expansive back-and-forth motion that we can only partially sense through our engagements with mushrooms themselves.

It is useful to think with the idea of paralinguistics—communication that does not involve words. This includes all non-phonemic lan-

guage,[1] such as "gesture, tone of voice, singing, glossolalia, crying, moaning, and laughter."[2] These components of communication may change or clarify meaning or communicate emotion, through intonation, stress, pitch, volume, or similar variables.[3] Dunn has elaborated on how the devaluing of paralinguistics has severely limited our understanding of nonhuman communication systems, and he emphasizes the potential of non-phonemic language to enable this understanding.[4] But paralinguistics are not necessarily limited to any one sense, and here we extend the notion of paralinguistic language to other modes of signaling.

Using a MIDI Sprout or PlantWave (see *Resources* section), you can convert electric impulses produced by mushrooms into MIDI data, and use the PlantWave app or any MIDI-capable digital audio workstation (DAW) to convert this MIDI code into sound. There are also non-proprietary designs available that function similarly. The MIDI code includes information specifying pitch, duration, and rhythm; the specific instrument or synthesizer patch is chosen with the app or DAW. The result is a very subjective representation of "mushroom sound," mediated by the technology and the choices we make with it. If you are familiar with MIDI and DAWs, you also have the option of inputting more variable and responsive MIDI CC data.

When you find mushrooms to monitor, either in the wild, or growing on fruiting blocks, take care in positioning or gently fastening the electric sensors on the mushroom bodies to capture their electrical spikes.

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1 Adapted from the Mirriam-Webster definition, a phoneme is "any of the abstract units of the sonic system of a language."

2 David Dunn, "Listening to the Soundscape and the Necessity of Double Description," (2010), 15.

3 Paralanguage. In "Symbolic Communication." Wikipedia. Accessed 1 Oct 2022. https://en.wikipedia.org/wiki/Symbolic_communication

4 David Dunn, "Speculations: On the Evolutionary Continuity of Music and Animal Communication Behavior," *Perspectives on New Music* 22, No. 1/2 (Autumn, 1983 - Summer, 1984), 87.

Instead of clipping the sensor to the mushroom, you may want to drape it gently over the mushroom's cap, or steady it against the stalk with a stone. Put each sensor on a different mushroom attached to the same substrate, or on different parts of the same mushroom.

The mushroom electrical impulses are made audible through this process, and can be perceived by human ears. Essentially, you will be using a type of musical language to translate mushroom communication—or at least, to sense it through a means that is more easily accessible to human sensory systems—listening. Give attention to the character of the sound—listen to the pace, rhythm, melody, and intervals. Do not use words to express your "translation." What can you imagine, or auralize,[5] about the signals' purpose or meaning? What kind of desire, intention, or emotion does the sound evoke? Can you speculate about fungal emotions? Can you express what you hear through your own sound, movement, or visual representation?

If you use a DAW like Ableton Live, you can also analyze mushrooms' electrical signals by viewing the MIDI data in a graphic grid (piano roll). The MIDI Sprout converts the electrical signals to a maximum of 4 pitches. Varying sizes of solid bars will represent the electrical signal duration, rhythm, and intervals over time, providing a visual for the patterns emerging from the mushroom bodies (see images at right). Try using these patterns to "translate" the bars into words or meanings in a speculative and playful way. Might the mushroom be responding to insects, or to a change in nutrients in the soil? Do the patterns evoke a mood or feeling? Instead of using words to describe your translation, can you express it paralinguistically? Can you draw your translation? Or dance it? Can you express it using time and space in other ways?

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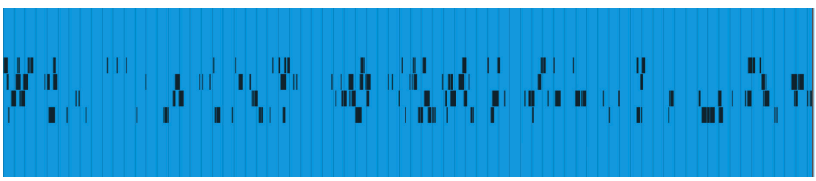
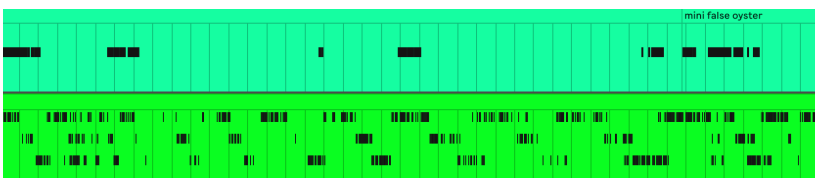
5 Pauline Oliveros, "Auralizing in the Sonosphere: Vocabulary for inner sound and sounding," *Contemporary Music Review* 25, no. 5 (2006), 481-82.

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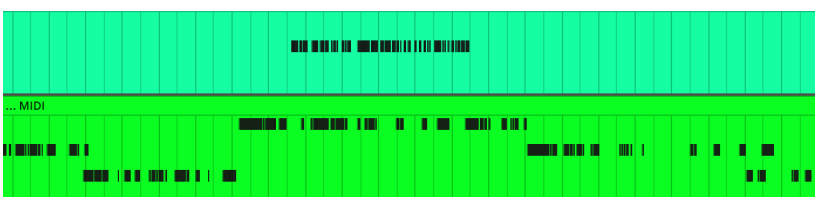

... MIDI

MERLIN
SHELDRAKE

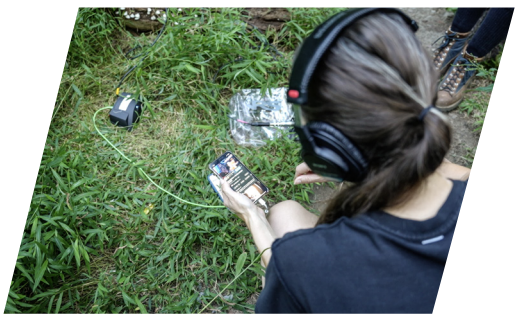
Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures (Random House, 2021).

Mycelium is a living, growing, opportunistic investigation—speculation in bodily form. This tendency is known as developmental "indeterminism": No two mycelial networks are the same. What shape is mycelium? It's like asking what shape water is.

Fungal networks are monitoring a large number of data streams as part of their everyday existence. If we could plug into mycelial networks and interpret the signals they use to process information, we could learn more about what was happening in an ecosystem. Fungi could report changes in soil quality, water purity, pollution, or any other features of the environment that they are sensitive to.

Are network-based life—forms like fungi or slime molds capable of a form of cognition? Can we think of their behavior as intelligent? If other organisms' intelligence didn't look like ours, then how might it appear? Would we even notice it?

SOUNDING INTO SOIL



How is sound affected by the fungal environment? In our practice *Sounding into Soil,* we consider the role of fungal substrates—the soils and other decomposing materials they grow in—as sound processors. The soundscape is the total combination of sounds in any one location created by geological, technological, human and nonhuman biological entities. We usually consider it *as received by humans,* or other vertebrates. In Lisa's insect studies, she considers how sound might reach insects in their own living environments. What if we consider how fungi experience the soundscape? We do not know how or if they sense vibrations, but we know that these vibrations certainly pass through them. The next time you are walking outside and see a mushroom, stop and listen to the soundscape. How do you think the vibrations from those sounds might reach the mushrooms' body - or do they even reach it?

In this exercise, we consider the term "soil" to include both organic material that we typically identify as soil, and its leaf litter layer, as well as materials that are in the process of decomposition to become soil, such as different types of woody debris, rocks, or vegetation.

During our experiments, we record verbal, musical, or otherwise sonic messages and transmit them through soil with a transducer, picking them up through contact mics, and listening to the resulting processed sound. On a recent visit to Peebles State Park in Cohoes, NY, we sent sounds through a substantially decomposed log, and noticed how this substrate filtered the sound. We speculated as to how the small oyster mushrooms growing on this

woody substrate sensed us, and how our own sound was processed by its environment. The soil will, in effect, process our sound, and we will hear our sound-ing through its sonic filtration. In addition to picking up our own sound, the contact microphone will pick up other sounds that are vibrating in the soil. Listening in headphones, we hear a soil soundscape that includes our own. What would you want to communicate to fungi? What would you want to ask them?

If you are interested in carrying out this exercise yourself, it requires some technology. You will need a phone to record your sound, a transducer, amplifier, contact microphone, high quality recorder with strong pre-amps, and headphones to listen back to the resulting soundscape. A transducer is a simple vibratory element that generates sound in the center of a speaker. The transducer we will use will turn the soil environment into a speaker, as if the soil material was the speaker cone.

In our workshops, we sometimes demonstrate this exercise by playing the 5 tones from *Close Encounters of the Third Kind* through the soil substrate, as a ritual asking for permission, or reaching-out to the fungi and other beings in that world. Next, we each record our sounds, play them through the transducer and amplifier, and listen back.

Consider how our sounds might reach fungi as vibrations.

How might our sounds sit within the soil soundscape? What is their timbre, pitch, duration, and volume relative to the rest of the soil soundscape?

How does the soil as processing unit affect sound?

How do you think a wetter or drier soil would affect it differently? What about a more organically rich soil?

Use the following page to write your thoughts. Send a photo of your thoughts to drummer.schonberg@gmail.com if you would like to share.

CHEMICAL SENSING

What does it mean to sense chemicals in your environment? For fungi, this involves the detection of chemicals in the soil to make sense of weather, ecological conditions, and the status of other organic life in its proximity. Volatile chemicals provide an interface through which fungi exchange information with other organisms, including plants, trees, and insects. The mycelial network as a whole essentially functions as a distributed nose.[1] Fungi mediate a deep stratum of chemical signaling underground in a kind of alien, distributed consciousness.

Humans, like most organisms, can also sense chemicals in our environment. The closest analog we have to fungal chemical sensing is our sense of smell, which is highly sophisticated, but largely overlooked. Humans, in fact, have an acute sense of smell that can "detect virtually all volatile chemicals ever tested,"[2] and supplies us with direct knowledge about our environment. As philosopher David Michael Levin articulates in *The Body's Recollection of Being,* "we must take our thinking 'down' into the body. We must learn to think *through* the body. We must learn to think *with* the body."[3] Smell provides an avenue to doing this kind of "thinking with" our bodies, as mushrooms might.

In the West, sight has been hierarchically considered more

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1 Merlin Sheldrake, *Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures* (New York: Random House, 2021), 28.

2 Sheldrake, 27.

3 David Michael Levin, *The Body's Recollection of Being: Phenomenological Psychology and the Deconstruction of Nihilism* (Oxfordshire: Routledge, 2002), 61.

valuable both in the arts and in obtaining "objective" information about the world. However, scholars have argued that another type of knowing can emerge through sensory encounters,[4] leading to insight regarding the vitality of matter, its connections to the natural world, and the participants' relationality with other entities, human and non. This includes gaining information about air quality, chemical traces, pollution presence, edibility of organisms, and general health or liveliness of an environment. Smell is an intimate and corporeal method for engaging with nonhumans, and for training ourselves to notice the world around us. As sensory mapping practitioner Kate McClean has noted, olfaction allows us to "physically re-experience" an environment "in an altered manner,"[5] essentially producing new knowledge (in this case, about fungal habitats). By engaging this underutilized sense, we open ourselves to the potential for ambiguous ecological truths—embracing the liminality of mushroom existence. Smell *lingers* in the same way that fungal and ecological entanglements do, becoming a perceptual residue linked to both time and memory.

In the exercises below, we suggest using smell to sense volatile chemicals as a speculative analog for how mushrooms sense their world. In his book *Entangled Life,* Merlin Sheldrake also suggests that through smell, "we can participate in the molecular discourse fungi use for much of their existence."[6]

This exercise functions as a gesture to prompt participants to partake in mushrooms' dynamic processes of living and dying, shape-shifting in body and space between mycelial and mushroom forms.

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4 See: Maurice Merleau-Ponty, *Phenomenology of Perception* (Psychology Press, 2002); Tomie Hahn, *Arousing Sense: Recipes for Workshopping Sensory Experience* (Champaign: University of Illinois Press, 2021); and Barry C. Smith, "The Chemical Senses," in *The Oxford Handbook to Philosophy of Perception* (New York: Oxford University Press, 2015).

5 Kate McLean, "Smell Walking and Mapping," *Mundane Methods* (Manchester University Press, 2020), 156–73.

6 Sheldrake, 28.

Reserve at least 30 minutes for this exercise. You should choose a location where mushrooms may grow, even if they are not present at the time. This could be a shaded area of a park, an isolated tree stump on a city block, or an abandoned lot. You will spend this time focusing on smells of your (and our nonhuman companions') environment. This is best done alone, and may require some quiet contemplation. Make sure to take enough time to allow for associations to come up as you sense different aspects of the environment.

There are two note-making options for this exercise: smell mapping and sensory note-making. You can use either or both. As you proceed by chemically sensing your chosen environment, use the following worksheet pages to document your sensations.

In sensory note-taking, your goal is to smell various parts of the environment and mushroom habitat, and document them in qualitative forms. You can think beyond what the smells are commonly known as, coining your own descriptors as you see fit. In fact, it might be better to resist the impulse to name things as you normally would, and let the smell first be a *sensation*.[7] You may choose to use references to past experiences or memories where useful. In some cases, words may not be adequate to describe as you go, and drawing shapes or using colors may better describe the scents you are experiencing. For instance, a triangle may symbolize sour smells, a circle for musty smells, and a square for vegetative smells. You could even describe your smelling experience with sound, recording sonic notes in your smartphone audio recorder.

You may want to start by sense *catching*—allowing yourself to experience sensations that are immediately present or moving by you, including atmosphere smells.[8] From there, you can move to sense *hunting*, where you seek out novel or intriguing materials or

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7 Todd Shalom, *Prompts for Participatory Walks* (Elastic City, 2019), 47.

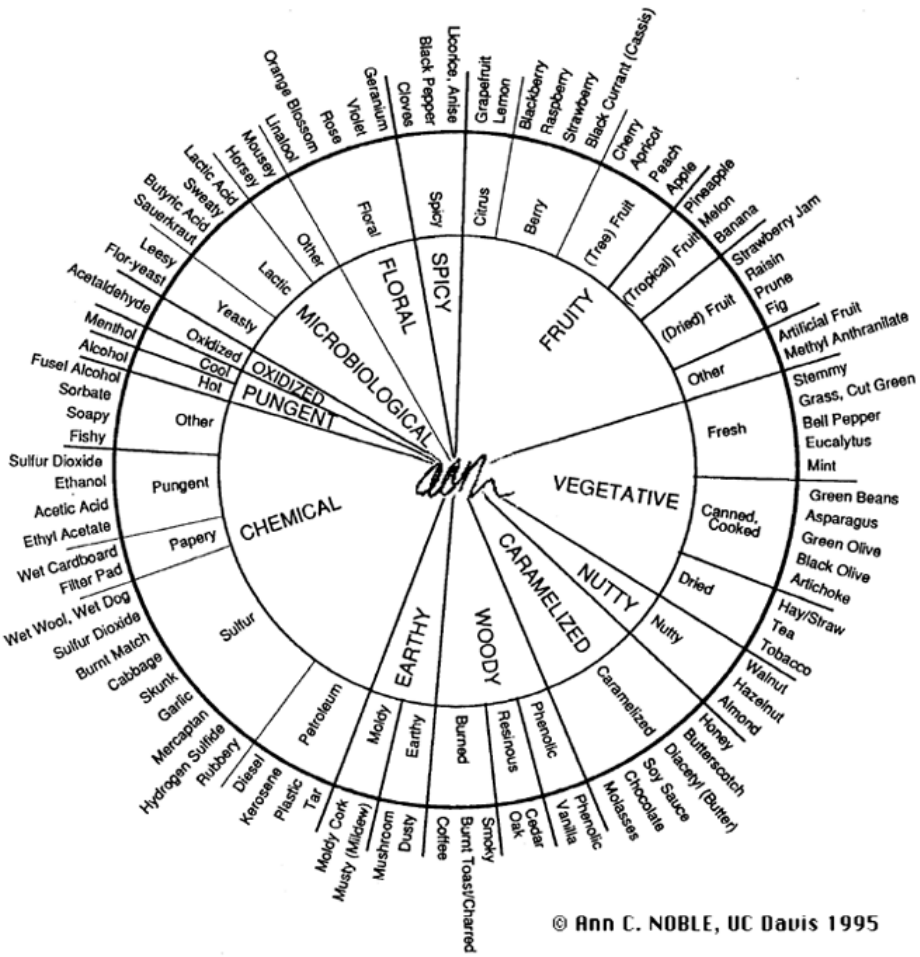
8 The terms sense catching and hunting are sensory tools developed by McLean.

whiffs of air in the space. If your nose gets fatigued, drinking water helps with olfaction. Take at least 5 minutes for each method.

You will want to notice both ambient background smells as well as transient and temporary scents. Smells can be (1) short-lived, such as a burst of exhaust from an engine or a waft from a dumpster; (2) "episodic elements of a smellscape," which recur regularly, like damp soil after a rain; or (3) background, which form a consistent smell of a place.[9] Background smells might be the atmospheric conifer odor from a grove of pines, or the saline smell of a park near the ocean.

Beyond sensing just smell, you will want to note how your body feels during this practice. Take time to also feel textures, temperatures, and bodily sensations before naming a smell. Near the end of your experience, you may want to guess what your body has learned about the place or habitat. Trust fleeting thoughts and moments of nostalgia, emotion or intuition all as "data."

9 McLean, 167.


FRUITY
Citrus
Grapefruit
Lemon
Berry
Blackberry
Raspberry
Strawberry
Black Currant (Cassis)
(Tree) Fruit
Cherry
Apricot
Peach
Apple
(Tropical) Fruit
Pineapple
Melon
Banana
(Dried) Fruit
Strawberry Jam
Raisin
Prune
Fig
Other
Artificial Fruit
Methyl Anthranilate
VEGETATIVE
Fresh
Stemmy
Grass, Cut Green
Bell Pepper
Eucalytus
Mint
Canned, Cooked
Green Beans
Asparagus
Green Olive
Black Olive
Artichoke
Dried
Hay/Straw
Tea
Tobacco
NUTTY
Nutty
Walnut
Hazelnut
Almond
CARAMELIZED
Caramelized
Honey
Butterscotch
Diacetyl (Butter)
Soy Sauce
Chocolate
Molasses
WOODY
Phenolic
Phenolic
Vanilla
Resinous
Cedar
Oak
Burned
Smoky
Burnt Toast/Charred
Coffee
EARTHY
Earthy
Dusty
Moldy
Mushroom
Musty (Mildew)
Moldy Cork
Petroleum
Plastic
Tar
Sulfur
Diesel
Kerosene
Rubbery
Hydrogen Sulfide
Mercaptan
Garlic
Skunk
Cabbage
Burnt Match
Sulfur Dioxide
Wet Wool, Wet Dog
CHEMICAL
Papery
Filter Pad
Wet Cardboard
Ethyl Acetate
Acetic Acid
Ethanol
Sulfur Dioxide
Pungent
Fishy
Soapy
Sorbate
Other
PUNGENT
Hot
Fusel Alcohol
Alcohol
Cool
OXIDIZED
Oxidized
Menthol
Acetaldehyde
Flor-yeast
Yeasty
Leesy
Sauerkraut
Butyric Acid
Sweaty
Lactic Acid
Horsey
Lactic
Other
Mousey
Linalool
MICROBIOLOGICAL
Orange Blossom
Rose
Violet
Geranium
Floral
Cloves
Black Pepper
Licorice, Anise
Spicy
FLORAL
SPICY
© Ann C. NOBLE, UC Davis 1995

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Name this smell:

Source (or guess):

Active ☐ Passive ☐

☐ Background Smell

☐ Short-Lived

Notes / thoughts / emotions / assocations:

Space for smell mapping—draw, write, color, and sketch your smell experience of the mushroom habitat.

ANNA LOWENHAUPT TSING

The Mushroom At the End of the World (Princeton University Press, 2015).

Imagine 'first nature' to mean ecological relations (including humans) and 'second nature' to refer to capitalist transformations of the environment. [I] offer 'third nature,' that is, what manages to live despite capitalism. To even notice third nature, we must evade assumptions that the future is that singular direction ahead. Like virtual particles in a quantum field, multiple futures pop in and out of possibility; third nature emerges within such temporal polyphony.

Mushrooms pull me back into my senses, not just through their riotous colors and smells but because they pop up unexpectedly, reminding me of the good fortune of just happening to be there.

I'm suggesting precarity is the condition of our time—or, to put it an other way, what if our time is ripe for sensing precarity? What if precar ity, indeterminacy, and what we imagine as trivial are the center of the systematicity we seek?

TEXT SCORES FOR GETTING TO KNOW MUSHROOMS

MUSHROOM DISTRICTS

Choose a neighborhood in your city.
Choose one street, a block in length.

Search for mushrooms, and for other sensory input that make contact with the ground. Make a note of these. Are there ant nests, with ants leaving chemical and vibratory information? Tree roots? Food vendors, emanating sound and fragrant smells? Pedestrian movements vibrating through the sidewalk and soil? Hydrants, periodically flooding soils? Jackhammers?

For each source of sensory information you notice, make a note of how you imagine it might relate to any mushrooms you observed nearby it. Repeat on an adjacent city block.

What is the character of this city district, and how is it defined, as sensed by its mushrooms?

By Lisa Schonberg

LISTENING TO/ LISTENING WITH

Walk along a park path.

Look at the ground around you, and search for mushrooms. When you notice a mushroom, inhale slowly, and watch them.

Exhale just as slowly, and observe whether they might hear or otherwise feel the vibration of your breath.

Look on soil surfaces for mushrooms until you find one.

Can they feel the vibration of humans walking on the path?

Close your eyes, and listen for mushrooms. How do you think they might sound?

By Lisa Schonberg

MUSHROOM NEWS

Consider how humans are bombarded with continuous news through digital media. Consider how mushrooms may only live for a day or two.

How does time pass between news items for a mushroom?

Find a mushroom. Sit by it for an hour. Become a journalist for fungus. Write a news report every five minutes on events you notice in, on or adjacent to the soil. Put your ear to the ground; what vibrations are moving through the soil? Consider that every five minutes might be a mushroom decade.

Give each five minutes a name that references its most defining moments.

By Lisa Schonberg

FUNGAL EVOCATION

Locate a mushroom in your environment. It is best to find them a few days after a good rain.

Smell the mushroom—note its smell and the smell of the dirt or log its growing in.

Think of descriptors, memories, or similar smells. Conjur a time, a place, a memory.

Record a voice note to send to a friend of this time or place, without telling them the origin of the smell.

By Allie ES Wist

MIDI MUSHROOM POEMS

fungal
missions

from dried spores

colonies obtained
they have been

chosen

biologic POV
content

shown
from the surface

particular condition—

the environment of the enclosed

CO-AUTHORED by polyporaceae mushrooms and Allie ES Wist. MIDI data collected from the polyporaceae was overlaid to select poem text from I. Gomoiu, et al., "Fungal Spores Viability on the International Space Station," Origins of Life and Evolution of Biospheres 46, no. 4 (2016).

spores were
long term

to perform

protocol

microorganisms sense
survival purposes

influence
the activation

and
on board

experiment with,
with,
with, et al.

the roots of soybeans

during Gemini IX

spores of Bacillus Subtilis
et al,

the hypothesis of Panspermia

CO-AUTHORED by polyporaceae mushrooms and Allie ES.Wist. MIDI data collected from the polyporaceae was overlaid to select poem text from I. Gomoiu, et al., "Fungal Spores Viability on the International Space Station," Origins of Life and Evolution of Biospheres 46, no. 4 (2016).

observations favoring
habitable

seeding with life

spacecraft and powerful
until

a variety
below the surface

where

speculation

photographed on

the probe

CO-AUTHORED by polyporaceae mushrooms and Allie ES Wist. MIDI data collected from the polyporaceae in 2021 was overlaid to select poem text from Rhawn Gabriel Joseph, “Life on Venus and the Interplanetary Transfer of Biota From Earth,” Astrophysics and Space Science 364, no. 191 (2019).

hypothesized to be dwelling
subsurface
which
may range

similarities in morphology
may surface
30 seconds after impact

surface,
surface.

they would have been obliterated—
mushroom-shaped rocks

fossilized, or,
current life

hypotheticals,
which evolved, colonizing

alien environments

CO-AUTHORED by polyporaceae mushrooms and Allie ES Wist. MIDI data collected from the polyporaceae in 2021 was overlaid to select poem text from Rhawn Gabriel Joseph, "Life on Venus and the Interplanetary Transfer of Biota From Earth," Astrophysics and Space Science 364, no. 191 (2019).

RESOURCES

MUSHROOM MEDIA:

The Mushroom Speaks, directed by Marion Neumann—
http://themushroomspeaks.ch/en

Fantastic Fungi, a film featuring the work of Paul Stamets—
https://fantasticfungi.com

Ana Tsing's *Fetal Atlas,* an ecological compendium which features several fungus and mushroom entanglements—
https://feralatlas.supdigital.org

WAYS TO ENGAGE WITH MUSHROOMS:

The New York Mycological Society—https://newyorkmyc.org

PlantWave (formerly MIDI Sprout)—https://www.plantwave.com

Smallhold's DIY at-home mushroom growing kits—
https://www.smallhold.com

Collar City Mushrooms—https://collarcitymushrooms.com

Catskill Fungi—https://catskillfungi.com

BOOKS AND ESSAYS:

Merlin Sheldrake, *Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures* (Random House, 2021).

Anna Lowenhaupt Tsing, *The Mushroom At the End of the World* (Princeton University Press, 2015).

Donna Haraway, *Staying With the Trouble* (Durham: Duke University Press, 2016).

Robin Wall Kimmerer, *Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants* (Milkweed Editions, 2013).

Gary Lincoff, *The Complete Mushroom Hunter, Revised* (Quarry Books, 2017).

Paul Stamets, *Mycelium Running: How Mushrooms Can Help Save the World* (Ten Speed Press, 2005).

Doug Bierend, *In Search of Mycotopia: Citizen Science, Fungi Fanatics* (Chelsea Green Publishing, 2021).

Albert Pilát & Otto Ušák, *A Handbook of Mushrooms with 120 Colour Plates from Water Colours* (London: Spring Books, 1951).

Pauline Oliveros, *Deep Listening: A Composer's Sound Practice*, (Deep Listening Publications/iUniverse, 2005).

David Dunn, *Why do Whales and Children Sing?: A Guide to Listening in Nature* (Earth Ear, 1999).

Tomie Hahn, *Arousing Sense: Recipes for Workshopping Sensory Experience* (University of Illinois Press, 2021).

Kate McLean, "Smell Walking and Mapping," *Mundane Methods* (Manchester University Press, 2020), 156–73.