THE WOOD WIDE WEB

Fungi, Forests, and the Hidden Network Beneath Our Feet

Name: _____ Date: _____ Class: _____

■ **Listen: radiolab.org/podcast/from-tree-to-shining-tree**

Amanita muscaria — mushrooms are just the fruiting body; most of the fungus lives underground

PART 1 — Key Vocabulary

Word	Definition
mycelium	the dense underground web of thin threads that makes up most of a fungus
hyphae	individual microscopic threads of fungal tissue that together form mycelium
mycorrhiza	the partnership between plant roots and fungal threads, benefiting both organisms
symbiosis	a long-term close relationship between two different species
mutualism	a type of symbiosis in which both species benefit
decompose	to break down dead organic matter into simpler substances that return to the soil
photosynthesis	the process plants use to convert sunlight, CO2, and water into sugar and oxygen
carbon	a chemical element found in all living things; trees store large amounts in their wood
nitrogen	a nutrient essential for growth, found in soil, air, and the tissues of living things
spore	a tiny reproductive cell produced by fungi, mosses, and ferns
biodiversity	the variety of different living species found within an ecosystem

ecosystem	a community of living organisms and their physical environment, all interacting
Mother Tree	a large, old, highly connected tree that is a central hub in the fungal network
radioactive tracer	a labelled molecule used by scientists to track how substances move between organisms

PART 2 — Vocabulary Matching

Match each word to its correct definition.

1. mycelium	A. a nutrient essential for growth, found in soil and living tissue
2. mutualism	B. to break down dead matter and return nutrients to the soil
3. decompose	C. the partnership between plant roots and fungal threads
4. Mother Tree	D. a tiny reproductive cell produced by fungi
5. spore	E. a large, old tree that is a central hub in the underground network
6. mycorrhiza	F. a relationship where both species benefit
7. nitrogen	G. the underground web of thin fungal threads

Fill in the blank with the correct vocabulary word.

1. A teaspoon of healthy forest soil can contain miles of _____ .
2. Fungi and tree roots form a partnership called _____ .
3. Simard used a _____ to track carbon moving between trees.
4. A large, old, deeply connected tree is called a _____ .
5. The variety of living things in a healthy old-growth forest is called its _____ .
6. Fungi reproduce by releasing tiny _____ into the air or soil.

Fungal mycelium tunnels beneath tree bark — the visible signature of an underground network

PART 3 — Reading Passage 1: The Hidden Network

■ *Listen along:* ***radiolab.org/podcast/from-tree-to-shining-tree***

What Are Fungi?

Fungi are neither plants nor animals — they belong to their own kingdom. What we call a mushroom is just the fruiting body, like an apple on a tree. The bulk of any fungus lives underground as mycelium: an enormous web of microscopic threads called hyphae. A single teaspoon of healthy forest soil can contain more than eight miles of these threads, weaving through soil particles, dead wood, and the roots of living trees.

The Mycorrhizal Trade

The connection between tree roots and fungal hyphae is called mycorrhiza — a relationship of mutualism. A tree produces sugar through photosynthesis and passes some of it to the fungus. In return, the fungus dramatically extends the tree's reach, pulling in water, phosphorus, nitrogen, and other minerals from hundreds of metres away that the tree cannot access alone.

Suzanne Simard's Discovery

In the 1990s, Canadian forest ecologist Suzanne Simard noticed that replanted logged forests kept dying even when well watered. She suspected the seedlings were missing something invisible: the fungal network that original old-growth trees had built over centuries. To test this, she covered birch trees and Douglas firs with bags of radioactive carbon dioxide. The trees breathed in the labelled gas and built it into their sugars — and she tracked where that carbon went. The result astonished her: carbon moved from birch trees into Douglas firs through the underground fungal network. One Douglas fir was connected to 47 other trees of multiple species. The forest was not a collection of independent competitors — it was a single, deeply interconnected organism.

Comprehension Questions — Passage 1

1. What is the difference between the mycelium and the mushroom we see above ground?

2. What does the tree give to the fungus in a mycorrhizal relationship? What does it receive?

3. Why were the replanted seedlings dying in the logged forests Simard studied?

4. Describe Simard's radioactive tracer experiment. What did she do and what did she find?

5. How many other trees was one Douglas fir connected to through the fungal network?

6. In your own words, what does Simard's discovery reveal about how a forest works?

Old-growth forest — centuries of mycorrhizal networks connect thousands of trees beneath the soil

PART 4 — Reading Passage 2: Mother Trees, Warnings, and Life

Mother Trees

Simard found that the mycorrhizal network is not random — it is organised around hubs. The largest, oldest trees are the most connected nodes. Simard calls them Mother Trees. These ancient trees actively support young seedlings growing in their shade, passing carbon and water through the fungal network to keep seedlings alive when they cannot photosynthesise enough on their own. Studies show seedlings growing near a Mother Tree survive at dramatically higher rates than those growing in isolation. When a Mother Tree is dying, it floods the network with carbon — passing its accumulated energy to surrounding trees and particularly to its own seedlings. In every measurable sense, it is leaving an inheritance.

Warning Signals

The network carries more than nutrients. When a tree is attacked by insects or disease, it releases chemical warning signals through the fungal web to neighbouring trees, which begin producing defensive chemicals before any attacker reaches them. Simard describes this as like a Paul Revere warning ride — one tree sounds the alarm, and the warning spreads through the network. Trees that receive the warning survive attacks at higher rates.

Salmon, Fungi, and the Sea

One of the most surprising findings connects the ocean to the forest interior. In Pacific Northwest forests, salmon spawn and die. Bears, eagles, and wolves drag salmon carcasses into the forest, where they decompose. The nitrogen from those fish bodies enters the soil, is taken up by the fungal network, and delivered to trees miles from any river. Scientists have detected marine nitrogen in the wood of inland trees — carried there by the fungal network. The salmon, the bears, the fungi, and the trees are all part of a single interconnected system. The boundaries we draw between ocean and forest are mostly inside our own heads.

What Happens When We Cut It Down?

Industrial logging replants trees in neat rows in disturbed soil — without the centuries-old fungal networks that made the original forest function. This is why replanted forests fail at high rates. Simard's research has begun to change forestry policy: some areas now leave the largest Mother Trees standing after logging — not for their timber, but for the underground network they anchor. A forest needs its elders.

True or False

Write **T** for True or **F** for False.

1. ___ Mother Trees are the youngest trees in the forest and least connected to the network.
2. ___ The fungal network allows Mother Trees to pass carbon to struggling seedlings.
3. ___ When a Mother Tree is dying, it hoards all its resources to survive longer.
4. ___ Warning signals can travel through the fungal network from one tree to another.
5. ___ Nitrogen from salmon carcasses can end up inside trees far from any river.
6. ___ Replanted forests grow just as well as old-growth forests because they have fresh soil.
7. ___ Simard's research has influenced some forestry practices to protect Mother Trees.
8. ___ The mycorrhizal network only connects trees of the same species.

Comprehension Questions — Passage 2

1. What is a Mother Tree, and what role does it play in the forest?

2. How do Mother Trees help young seedlings that cannot get enough sunlight?

3. What happens to the resources of a Mother Tree when it is dying?

4. How are warning signals sent through the forest? What effect do they have?

5. Describe the chain of events that carries nitrogen from ocean fish to inland trees.

6. Why do replanted forests often fail, and what solution does Simard's research suggest?

PART 5 — Fill in the Blank

Use the word bank to complete each sentence.

mycelium · Mother Tree · mutualism · nitrogen · radioactive tracer · warning signals · decompose · hyphae

1. The underground web of thin fungal threads is called _____ .

2. Individual threads of fungal tissue are called _____ .

3. The relationship between a tree and a fungus is an example of _____ .

4. Simard used a _____ to track carbon moving between trees.

5. A large, old, highly connected tree is called a _____ .

6. When a tree is attacked, it sends _____ through the network to neighbours.

7. When salmon carcasses _____ in the forest, they release _____ into the soil.

PART 6 — Discussion Questions

Discuss with a partner or your class.

1. Does knowing that trees share resources change how you think about forests? Why?

2. How is the mycorrhizal network similar to the internet? How is it different?

3. The passage says the boundaries between ocean and forest are 'mostly inside our heads.' What does this mean?

4. If a Mother Tree is so important, should logging companies be required to protect them? Defend your answer.

5. What else might be connected in nature that scientists haven't discovered yet?

Young salmon leaping upstream — their nitrogen-rich bodies eventually feed the trees of the forest

PART 7 — Opinion Essay

Prompt: Suzanne Simard said: 'A forest is much more than what you see.' Using evidence from both reading passages, explain what she means. Why is the hidden world beneath the forest floor so important — for the trees, the animals, and for us? Write at least three paragraphs.

Sources & Further Reading

Academic Articles

Simard, S. W., Perry, D. A., Jones, M. D., et al. (1997). Net transfer of carbon between ectomycorrhizal tree species in the field. *Nature, 388*, 579–582.

Song, Y. Y., et al. (2010). Interplant communication of tomato plants through underground common mycorrhizal networks. *PLoS ONE, 5*(10), e13324.

Beiler, K. J., Durall, D. M., Simard, S. W., et al. (2010). Architecture of the wood-wide web. *New Phytologist, 185*(2), 543–553.

Babikova, Z., et al. (2013). Underground signals carried through common mycelial networks warn neighbouring plants of aphid attack. *Ecology Letters, 16*(7), 835–843.

Books & Podcast

Simard, S. W. (2021). *Finding the Mother Tree*. Alfred A. Knopf. · Sheldrake, M. (2020). *Entangled Life*. Random House. · Wohlleben, P. (2016). *The Hidden Life of Trees*. Greystone Books.

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ANSWER KEY — THE WOOD WIDE WEB

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Part 2 — Vocabulary Matching

1.	G — the underground web of thin fungal threads
2.	F — a relationship where both species benefit
3.	B — to break down dead matter and return nutrients to the soil
4.	E — a large, old tree that is a central hub in the underground network
5.	D — a tiny reproductive cell produced by fungi
6.	C — the partnership between plant roots and fungal threads
7.	A — a nutrient essential for growth, found in soil and living tissue

Part 2 — Fill in the Blank

1.	mycelium
2.	mycorrhiza
3.	radioactive tracer
4.	Mother Tree
5.	biodiversity
6.	spores

Part 3 — Comprehension: The Hidden Network

1.	Mycelium is the vast underground web of threads; the mushroom is just the visible fruiting body (like an apple on a tree).
2.	The tree gives sugar (from photosynthesis). It receives water, phosphorus, nitrogen, and other minerals.
3.	The seedlings were missing the centuries-old fungal networks that supported the original old-growth trees.
4.	She covered trees with bags of radioactive CO_2. Trees breathed it in and built it into their sugars. She tracked where the carbon went and found it moved between tree species through the fungal network.
5.	47 other trees.
6.	A forest is not independent individuals competing — it is a deeply interconnected organism where trees share nutrients and information.

True or False

1.	F
2.	T
3.	F
4.	T
5.	T
6.	F
7.	T
8.	F

Part 4 — Comprehension: Mother Trees, Warnings, and Life

1.	A Mother Tree is a large, old tree that is the most connected hub in the mycorrhizal network. It actively supports seedlings and the surrounding forest community.
2.	They pass carbon and water through the fungal network to seedlings in deep shade that cannot photosynthesise enough to survive alone.
3.	It floods the network with carbon, passing accumulated energy to surrounding trees and its own seedlings — leaving an inheritance.
4.	A tree under attack releases chemical warning signals through the fungal web. Neighbouring trees produce defensive chemicals before any attacker arrives.
5.	Salmon die upstream → bears/eagles/wolves drag carcasses into forest → carcasses decompose → nitrogen enters soil → fungal network delivers nitrogen to trees far from the river.
6.	Replanted forests lack centuries-old fungal networks. Simard's research suggests leaving the largest Mother Trees standing after logging to preserve the network.

Part 5 — Fill in the Blank

1.	mycelium
2.	hyphae
3.	mutualism
4.	radioactive tracer
5.	Mother Tree
6.	warning signals
7.	decompose / nitrogen

Discussion and essay questions are open-ended. Accept well-reasoned responses supported by evidence from the passages.