

1 – Nutrition in Lichens

Key Concept

- Lichens lack roots, stems, and leaves.
 - They absorb nutrients directly from the **atmosphere** and via **surface entrapment**.
 - The symbiosis:
 - **Mycobiont (fungus)** → absorbs water & minerals.
 - **Phycobiont (alga/cyanobacteria)** → photosynthesis, carbohydrate supply.
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Sources of Nutrition

1. Atmospheric Nutrition

- Rain, dew, fog, and air-borne dust.
- Absorption of gases like **CO₂** , **SO₂** , **NO₂** directly across the thallus.

2. Surface Entrapment

- Rough surfaces of bark, rocks, and soil trap soluble nutrients.
- Organic acids secreted → dissolve minerals.

3. Nitrogen Fixation

- Cyanobacteria in lichens (e.g., *Nostoc*) fix atmospheric **N₂** → amino acids.
 - Important for nutrient-poor ecosystems.
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Nutrient Flow

- **Photobiont** → synthesizes sugars via photosynthesis.
 - **Mycobiont** → provides water, minerals, shelter.
 - Exchange ensures survival in harsh habitats (rocks, deserts, alpine zones).
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Mnemonics

- **“Lichens Eat FAN”**
 - Fog/Dew/Rain
 - Atmospheric gases (CO₂ , SO₂ , NO₂)
 - Nitrogen fixation by cyanobacteria
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Exam Capsule

- Nutrition in lichens is **atmospheric-based**.
- No roots → entirely dependent on **rainwater, dew, fog, air gases**.
- **Cyanobacteria fix nitrogen**.
- Play a key role in **soil formation & ecosystem enrichment**.

2 – Classification of Lichens (By Morphology)

◆ Crustose Lichens (Crust-like)

- Form thin **crusts** on rocks, bark, or soil.
 - **Thallus**: flat, tightly attached → cannot be separated.
 - **Internal structure**: poorly differentiated.
 - Ecological role: **pioneer species** in succession (rock → soil).
 - ☒ Examples: *Graphis*, *Lecanora*, *Rhizocarpon*.
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◆ Foliose Lichens (Leaf-like)

- Thallus resembles **leafy lobes**, loosely attached to substratum by **rhizines**.
 - Upper & lower cortex present → internal differentiation more advanced.
 - Easily peeled off surface.
 - ☒ Examples: *Parmelia*, *Xanthoria*, *Physcia*.
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◆ Fruticose Lichens (Shrub-like)

- **Highly branched, cylindrical** or pendulous thalli.
 - Attached only at the base → erect or hanging.
 - Most advanced morphological type.
 - ☒ Examples: *Cladonia rangiferina* (reindeer moss), *Usnea* (old man's beard).
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◆ Other Forms (Rare/Intermediate)

- **Leprose lichens** → powdery, lacking distinct layers.
 - **Filamentous** → thread-like (e.g., *Cystocoleus*).
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◆ Mnemonics 💡

- **“C-F-F” = Crust, Foliose, Fruticose**
 - Crustose → Crust-like, tightly fixed.
 - Foliose → Flat leafy lobes.
 - Fruticose → Free, branched, shrub-like.
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◆ Exam Capsule 🌀

- **Crustose** → primitive, pioneer colonizers of rocks.

- **Foliose** → leafy, with rhizines for attachment.
- **Fruticose** → most advanced, erect/hanging, cylindrical branches.
- Lichen morphology is **adaptive** to moisture & habitat conditions.

3 – Classification of Lichens (By Internal Structure)

◆ 1. Heteromorous Lichens

- **Well-differentiated thallus** with distinct layers.
 - Layers (top → bottom):
 1. **Upper Cortex** – protective, compact fungal hyphae.
 2. **Algal Layer** – green algae/cyanobacteria; photosynthetic zone.
 3. **Medulla** – loose fungal hyphae for storage & aeration.
 4. **Lower Cortex** – compact fungal tissue with rhizines (attachment).
 - ☒ Examples: *Parmelia*, *Cladonia*, *Xanthoria*.
 - **Adaptive feature** → better protection, water conservation.
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◆ 2. Homoiomorous Lichens

- **No clear differentiation** of layers.
 - Algal cells scattered irregularly throughout fungal tissue.
 - Simpler organization → less protection, more prone to desiccation.
 - ☒ Examples: *Leptogium*, *Collema*.
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◆ Comparative Table

Feature	Heteromorous	Homoiomorous
Layering	Distinct (4 layers)	Absent
Algal Distribution	In defined algal layer	Scattered
Adaptation	Advanced, resistant	Primitive, sensitive
Examples	<i>Parmelia</i> , <i>Cladonia</i>	<i>Collema</i> , <i>Leptogium</i>

◆ Mnemonics

- **Heteromorous = 4 Layers** → “U-A-M-L”
 - Upper cortex
 - Algal layer
 - Medulla
 - Lower cortex
 - **Homoiomorous** → “H = Homogenous” (algae scattered everywhere).
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◆ Exam Capsule 🧠

- **Heteromerous lichens** → advanced, layered, more common.
- **Homoiomorous lichens** → primitive, simple structure.
- Presence/absence of **differentiation** is the key diagnostic feature.

📖 4 – Classification of Lichens (By Fungal Partner)



◆ 1. Ascolichens (≈ 98% lichens)

- **Mycobiont** → Ascomycota (sac fungi).

- **Photobiont** → green algae (*Trebouxia*, *Trentepohlia*) or cyanobacteria (*Nostoc*).
 - **Reproduction:**
 - Asexual → fragmentation, **soredia** (powdery), **isidia** (corticated).
 - Sexual → via **ascocarps**:
 - **Apothecia** → open, disc/cup-shaped (e.g., *Xanthoria*).
 - **Perithecia** → flask-shaped with ostiole (e.g., *Graphis*).
 - **Cleistothecia** → closed, rupture for spore release (e.g., *Calicium*).
 - ☒ Examples: *Parmelia*, *Physcia*, *Cladonia*, *Graphis*.
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◆ 2. Basidiolichens (Rare)

- **Mycobiont** → Basidiomycota (club fungi).
 - Often with **cyanobacteria** (bluish-green tint).
 - **Reproduction** → basidiospores (sexual), fragmentation (asexual).
 - ☒ Examples: *Cora pavonia*, *Dictyonema*.
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◆ 3. Deuterolichens (Imperfect lichens)

- **Mycobiont** → Deuteromycota (no sexual stage).
 - **Reproduction** → asexual only: conidia, fragmentation, soredia.
 - **Thallus** → simple, poorly developed.
 - ☒ Examples: Rare, under molecular studies.
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◆ Mnemonics 💡

- **“ABD” = Lichen Groups**
 - **A**scolichens → Ascocarps
 - **B**asidiolichens → Basidiospores
 - **D**euterolichens → Deuteromycota, no sex
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◆ Exam Capsule 🌀

- **Ascolichens dominate** (≈ 98%).
- **Basidiolichens** → very rare, mostly tropical.

📄 5 – Ascolichens (Structure & Reproduction) 🍄🍄

◆ General Features

- **Mycobiont:** Ascomycota (sac fungi).
- **Photobiont:** Green algae (*Trebouxia*, *Trentepohlia*) or cyanobacteria (*Nostoc*).
- Make up **~98% of lichens**.

- Show all three main thallus types: **crustose**, **foliose**, **fruticose**.
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◆ Reproduction

1. Vegetative / Asexual

- **Fragmentation** → thallus pieces grow independently.
- **Soredia** → algal cell + fungal hyphae, powdery, dispersed by wind/rain.
- **Isidia** → corticated, solid outgrowths; cylindrical or coralloid.

2. Sexual (by Ascomata / Ascocarps)

- **Apothecia**
 - Disc or cup-shaped.
 - Exposed hymenium → asci + paraphyses visible.
 - Example: *Xanthoria*, *Lecanora*.
 - **Perithecia**
 - Flask-shaped, with **ostiole** (opening).
 - Asci formed inside cavity.
 - Example: *Graphis*.
 - **Cleistothecia**
 - Completely enclosed; spores released only on rupture.
 - Example: *Calicium*.
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◆ Importance

- **Soil formation** → secrete acids to weather rocks.
 - **Nitrogen enrichment** → cyanobacterial photobiont fixes N_2 .
 - **Ecological role** → pioneers in succession.
 - **Bioindicators** → highly sensitive to air pollution (SO_2).
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◆ Mnemonics 💡

- **Ascocarp Types** → “A-P-C”
 - **Apothecia** → open cup
 - **Perithecia** → pore/ostiole
 - **Cleistothecia** → closed body
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◆ Exam Capsule 🧠

- **Ascolichens** = dominant type of lichens.
- Reproduction → asexual (soredia, isidia) + sexual (apothecia, perithecia, cleistothecia).
- **Apothecia** = exposed cup; **Perithecia** = flask with ostiole; **Cleistothecia** = closed.
- Sensitive to **air pollution** → **indicator species**.

6 – Basidiolichens 🍄🍄

◆ General Features

- **Mycobiont** → Basidiomycota (club fungi).
- **Photobiont** → Green algae or cyanobacteria.
- Very **rare** group (contrast: Ascolichens dominate).
- Occur mostly in **tropical & subtropical forests** (especially cloud forests).

- Thallus: Crustose, foliose, or fruticose.
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◆ Reproduction

Asexual

- **Fragmentation** → thallus breaks into parts.
- **Soredia & isidia** (vegetative propagules).

Sexual

- Via **basidia** → produce **basidiospores**.
 - Basidiospores germinate → hyphae fuse with photobiont → new thallus.
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◆ Ecological Role

- **Pioneers** on bark, leaves, soil.
 - Contribute to **nitrogen fixation** when photobiont is cyanobacteria.
 - Involved in **moisture retention** and **nutrient cycling** in forests.
 - Help in colonization of shaded, humid habitats.
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◆ Examples

- *Cora pavonia*
 - *Dictyonema glabratum*
 - *Corella*
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◆ Mnemonics 💡

- **Basidiolichens = “Rare BBC”**
 - **Basidia** → basidiospores
 - **Blue-green** tint (cyanobacteria often present)
 - **Cora, Corella, Dictyonema** = examples
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◆ Exam Capsule 🧠

- **Basidiolichens** → rare, tropical, basidiospores as sexual stage.
- Photobiont often cyanobacteria → nitrogen fixation.
- Mostly foliose or fruticose thalli.
- Examples: *Cora*, *Dictyonema*, *Corella*.

7 – Deuterolichens (Imperfect Lichens)

General Features

- **Mycobiont** → Deuteromycota (Fungi Imperfecti, no known sexual stage).
- Represent the **least common and least studied** type of lichens.
- Thallus: Simple, poorly organized, usually crustose.
- Found mostly in **moist, shaded habitats** (rainforests, bogs, swamps).

Reproduction

- **Only asexual** →
 - **Fragmentation**
 - **Conidia** (asexual fungal spores)
 - **Soredia** (powdery propagules)
 - No sexual structures like ascocarps or basidiocarps.
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◆ Ecological Role

- **Soil stabilizers** → bind loose soil particles.
 - **Nutrient cycling** → decompose organic material.
 - Early colonizers in shaded forest floors.
 - Contribute to **micro-ecosystem development**.
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◆ Examples

- Poorly defined; many lichens temporarily grouped here until DNA studies place them into Asco/Basidiolichens.
 - Considered a **temporary/artificial category**.
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◆ Mnemonics 💡

- **“D = Deuterolichens → D = Defective”**
 - Defective because they lack a sexual stage.
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◆ Exam Capsule 🌀

- **Deuterolichens** = imperfect lichens (no sexual stage).
- Reproduce only asexually (conidia, soredia, fragmentation).
- Thallus simple, poorly organized.
- Considered **artificial grouping** → many later reassigned by molecular phylogeny.

📖 8 – Lichen Reproduction (Asexual vs Sexual) 🍄🧫

◆ 1. Asexual Reproduction (Vegetative / Propagative)

- **Fragmentation** → thallus breaks into small pieces; each piece regenerates.
- **Soredia** →
 - Tiny powdery bodies = algal cell + fungal hyphae.
 - Dispersed by wind, rain.
 - Easily colonize new substrata.
- **Isidia** →
 - Corticated, solid, finger-like outgrowths on thallus.
 - Break off & propagate.

- **Conidia** → asexual fungal spores (rare in lichens).

✓ **Key Point:** Asexual methods dominate; ensure rapid dispersal & survival in harsh conditions.

◆ 2. Sexual Reproduction (via Mycobiont)

- Only **fungal partner** undergoes sexual reproduction.
- **Ascolichens** → form **ascocarps**:
 - **Apothecia** (cup/disc-shaped, open hymenium).
 - **Perithecia** (flask-shaped, ostiole opening).
 - **Cleistothecia** (completely enclosed, spores released by rupture).
- **Basidiolichens** → form **basidiospores** on basidia.
- Photobiont (alga/cyanobacterium) remains **asexual**.

✓ **Key Point:** Sexual cycle ensures **genetic recombination** in fungal partner.

◆ Comparative Table

Feature	Asexual (Vegetative/Propagative)	Sexual (Fungal Partner)
Main Units	Soredia, Isidia, Fragmentation	Ascospores, Basidiospores
Speed of Spread	Fast, mass dispersal	Slow, dependent on spore germination
Involvement of Alga	Yes (carried along in soredia/isidia)	No (fungus alone reproduces sexually)
Genetic Variation	No (clones of parent)	Yes (new recombination in fungus)
Examples	<i>Parmelia</i> (soredia, isidia)	<i>Graphis</i> (perithecia), <i>Xanthoria</i> (apothecia)

◆ Mnemonics

- **Asexual Units = “F-S-I-C”**
 - Fragmentation
 - Soredia
 - Isidia
 - Conidia

- **Sexual Ascocarps = “APC”**

- Apothecia
 - Perithecia
 - Cleistothecia
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◆ **Exam Capsule**

- **Asexual dominates** → ensures dispersal in extreme habitats.
- **Soredia & Isidia** → vegetative propagules carrying both partners.
- **Sexual reproduction** → only fungus participates; alga never reproduces sexually inside lichen.
- **Ascolichens** → ascocarps (apothecia, perithecia, cleistothecia).
- **Basidiolichens** → basidiospores.