

Vocabulary

- Aseptate hyphae:** hyphae that do not contain a septum, creating long multinucleated cells.
- Amino acids:** a monomer, the simplest unit of proteins.
- ATP:** adenosine triphosphate, an energy carrying molecule created in the mitochondria.
- Autotroph:** an organism capable of producing its own food using photosynthesis.
- Biomaterials:** Substances that are created or grown to be biodegradable and used in various industries, including medical, construction, packaging, food, etc.
- Carbohydrate:** a polymer, made up of repeating units of simple sugars.
- Cell respiration:** the process by which organisms use oxygen and food to release energy in the form of ATP.
- Chitin:** a type of polysaccharide that makes up the cell wall of mycelium.
- Consumer:** an organism that exists above producers on the food chain.
- Decomposer:** also known as detritivores, an organism that breaks down dead organic material, returning the nutrients to the soil.
- Detritivore:** a type of decomposer that feeds on decaying matter.
- Digestive enzymes:** substances that help break down food through chemical reactions.
- Ecosystem:** a community of organisms interacting with one another and their physical environment.
- Emergent function:** functions that only appear when multiple specialized cells and tissues are working together.
- Environmental sustainability:** occurs when society is meeting its needs while preserving natural resources.
- Eukaryotic cell:** possessing a nucleus and membrane bound organelles.
- Fungi:** kingdom of eukaryotic, multicellular organisms that feed on organic matter.
- Glucose:** a simple sugar which serves as a key energy source in heterotrophs.
- Glycolysis:** the first step of cellular respiration, where glucose is converted into 2 pyruvate molecules.
- Heterotroph:** an organism that satisfies its nutritional needs through feeding on other organisms.
- Hyphae:** extensions or branching filaments of the mycelium network of a fungus.
- Krebs Cycle:** a series of chemical reactions where pyruvate is converted into several energy-carrying molecules that will eventually all be converted to ATP.
- Life cycle:** the series of changes in the life of an organism.
- Microplastic:** the product of broken-down plastic in the environment; small particles that act as a pollutant.
- Monomer:** a simple molecular unit that bonds together to form a polymer.
- Monosaccharide:** one sugar molecule, also known as a monomer.
- Multicellular:** consisting of multiple cells working together.
- Mushroom:** the fruiting body of a fungus, located above ground and produces spores.
- Mycelium:** mainly composed of natural polymers, they are the vegetative part of a fungus organism.
- Mycorrhizal network:** an underground mycelium network that has a symbiosis with neighboring trees and plants.
- Organelle:** specialized structures within a living cell.
- Penicillin:** a group of antibiotics created by a fungus known as *Penicillium chrysogenum*, among others.

- Plastic:** a man-made polymer that can take on many different shapes, flexibilities and strengths.
- Polymer:** a substance that has a molecular structure existing of several simple units bonded together repeatedly.
- Polysaccharide:** a long, polymer chain consisting of simple sugars.
- Producer:** an organism that exists at the bottom of the food chain, supplying the ecosystem with energy created from the sun through photosynthesis.
- Prokaryotic cell:** lacks a membrane bound nucleus and many other organelles.
- Protein:** a polymer, made up of repeating units of amino acids. Serves as a key nutritional source in heterotrophs.
- Protein synthesis:** process by which cellular components and products are created within cells.
- Resin:** a polymer used as an adhesive or glue.
- Saprotroph:** a type of decomposer that secretes digestive enzymes to break down decaying matter, and then absorbs it.
- Septate hyphae:** hyphae that contain a septum, separating each individual cell.
- Spitzenkorper:** a structure of fungal hyphae that directs hyphal growth.
- Substrate:** the substance on which an enzyme acts.
- Symbiosis:** an advantageous interaction between two different organisms.
- Unicellular:** consisting of a single cell.

Curricular Standards

NGSS & Common Core Standards	
Lesson 1: Introduction to fungi	Lesson 2: Fungi life cycle
<p>NGSS.SEP.8 - Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>CCSS.RI.9-10.1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.</p> <p>CCSS.RI.9-10.2. Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.</p> <p>CCSS.SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>CCSS.SL.9-10.1d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.</p> <p>CCSS.L.9-10.4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.</p>	<p>NGSS.CCC.5 - Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</p> <p>NGSS.CCC.5 - Energy drives the cycling of matter within and between systems.</p> <p>CCSS.RH.6-8.7. Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.</p>
Lesson 3: Fungi protein synthesis	Lesson 4: Being multicellular
NGSS.HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting	NGSS.MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either

<p>systems that provide specific functions within multicellular organisms.</p> <p>NGSS.MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.</p>	<p>one cell or many different numbers and types of cells.</p> <p>NGSS.MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.</p>
<p>Lesson 5: The food chain</p>	<p>Lesson 6: Feed the fungi</p>
<p>NGSS.CCC.5 - Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</p> <p>NGSS.CCC.5 - Energy drives the cycling of matter within and between systems.</p>	<p>NGSS.MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.</p> <p>NGSS.CCC.6 - Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</p>
<p>Lesson 7: Cell respiration in fungi</p>	<p>Lesson 8: Problem with plastic</p>
<p>NGSS.HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.</p> <p>NGSS.CCC.1 - Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.</p> <p>NGSS.SEP.2 - Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.</p> <p>NGSS.SEP.3 - Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.</p> <p>NGSS.SEP.3 - Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables.</p>	<p>NGSS.SEP.4 - Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.</p> <p>NGSS.SEP.7 - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.</p> <p>NGSS.SEP.7 - Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.</p> <p>CCSS.SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>CCSS.SL.9-10.1c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.</p>

Lesson 9: Mycelium alternative	Lesson 10: Show what you know
<p>NGSS-MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.</p> <p>NGSS-HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.</p>	<p>NGSS.SEP.1 - Ask questions to clarify and refine a model, an explanation, or an engineering problem.</p> <p>NGSS.SEP.6 - Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p>NGSS.SEP.6 - Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations.</p> <p>NGSS.SEP.7 - Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.</p>