GROWING MUSHROOMS IN THE CLASSROOM

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She has a background in Environmental Science and teaches VCE Physics.
Danielle has won awards at her school for her innovative practices.

Leonie McGlashan is a teacher with the Department of Education and Training with over ten years experience teaching primary, secondary and adult learners.
Leonie shares her teaching practice with the wider education community via online forums, school and industry projects and conferences.
In 2014 she became a councillor for the Science Teachers' Association Victoria and is involved with their professional development programs.

Fascinated by the form and function of fungi, Peter has devoted decades to delving the many mycological mysteries of the natural world and the diverse range of applications to which humans have applied fungi.

MUSHROOM GLOSSARY

Cap (pileus)	The fleshy part of a mushroom which contains the gills on its underside
Cell	Basic unit of life
Chitin	Tough material made of glucose that forms the cell walls of fungus cells
Dye	A substance used to change the colour of material
Ecosystem	A biological community of interacting organisms and their environment
Enzyme	A protein which catalyses or speeds up a chemical reaction.
Fungi	Heterotrophic organisms that have chitin cell walls.
Gills	Thin folds of tissue beneath the cap of mushrooms on which spores are produced
Hyphae	Microscopic branching filaments which are produced by fungi
Mushroom	The fruiting body of a fungus
Mushroom spawn logs	Lignocellulosic material usually sawdust packed into plastic and inoculated with edible mushroom spawn, used for commercial mushroom production
Mycelium	The main body of fungi made up of interwoven hyphae
Mycoremediation	A process of using fungi to decompose contaminants in the environment
Organism	A life form, or living thing
Sapotrophic nutrition	A type of feeding in which digestive enzymes are secreted outside a cell onto food material followed by absorption of the products
Spore	Specialised cells of fungi that can create another fungus
Stalk (stipe)	The stem which supports the cap of the mushroom
Terrarium	Containers used for growing mushrooms or plants. indoors

GROWING MUSHROOMS IN THE CLASSROOM

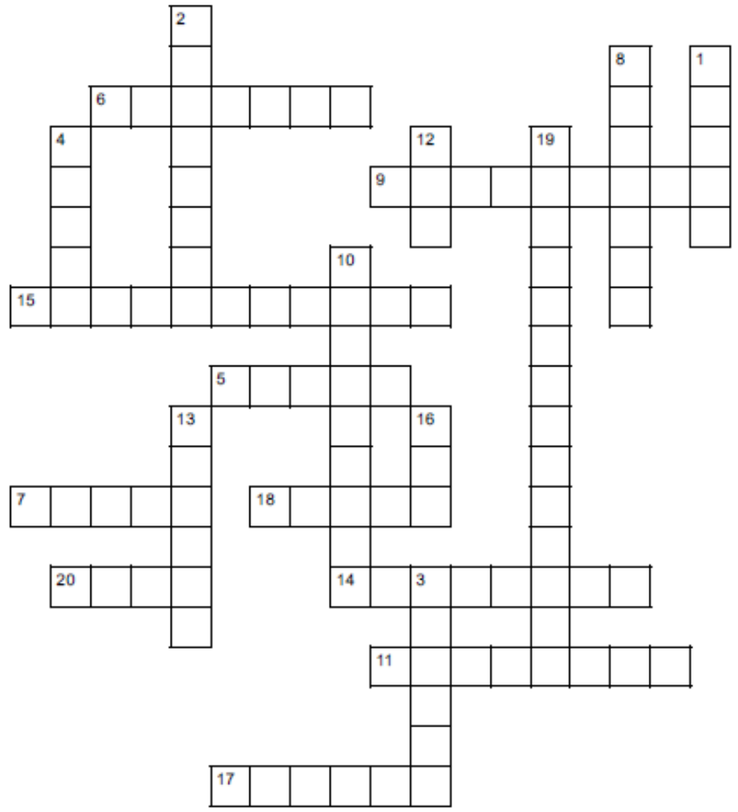
Danielle Dalton

Leonie McGlashan

Peter Wenzel

CONTENTS

MUSHROOM CROSSWORD



Across

5 Specialised cells that can create a fungi.
6 Fungus and plant cells have this organelle.
7 A unicellular fungi used for bread making.
9 A wide circle of mushrooms growing together.
11 Mushrooms make this important nutrient.
14 The study of fungus is called -
15 Mushrooms in ecosystems are -
17 Mushrooms need this gas.
18 Mycelium appears fluffy and -
20 Commercial mushrooms are grown on a -

Down

1 Mushrooms, yeasts and moulds belong to Kingdom
2 Network of hyphae.
3 Fungus cell walls are made of this.
4 The stalk of a mushroom is also called this.
8 The environment of a fungus.
10 Containers that are used for growing mushrooms or plants.
12 A mushroom is mainly made up of a stalk and -
13 Mushrooms usually appear in this season.
16 Oyster mushrooms can be used as food and -
19 A popular edible Asian mushroom -

TEACHING NOTES

Science:

- Students will need to understand the biology of mushrooms and fungus including lifecycle, structures, functions and optimal growing conditions.
- Students develop skills in inoculating paper wastes and monitoring the growth of mycelium.

Technology:

- Use a range of technologies to monitor growth including iPads and dataloggers to monitor growth.
- Use graphic technologies like google sketchup for their large scale mycoremediation design.
- Use arduino and dataloggers to monitor and control growing conditions.

Engineering:

Students will use the design process of ANALYSIS > RESEARCH > PLANNING > DESIGN > EVALUATION> MODIFICATION to work through the project ideas, and make the process more manageable. These process parts can be monitored and assessed to ensure students are on track.

Maths:

- Students will need access to school records of paper wastes and compost/soil costs for a whole calendar year.
- Students need to determine the ratios of water, paper waste and mushroom spawn needed for optimal growing conditions.
- Students will calculate rate of decomposition volume/time for paper wastes.
- Use ratios to scale up mycoremediation system designs for the whole school and include costings.

MUSHROOM GARDEN

Commercial mushroom logs can be used to grow mushrooms in the garden. The logs can be broken up and layered in growing substrates like sterilized cardboard and or straw, or rolled in sterilized newspaper in a trench in a garden bed. In the right conditions mushrooms will grow.

Figure 1. A mushroom garden in a pot

What you need:

- Commercial Mushroom Gardening Kits OR cardboard/newspaper/straw & oyster mushroom spawn logs
- Clean bowl and ladle.
- Garden bed/large pot and tools
- Markers and instructions.
- Watering can and water

What to do:

1. If using a mushroom spawn log unwrap it and place in a clean bowl and using your hands break it into small pieces. Roll the spawn in a thick wet newspaper/paper rolls and then cover in plastic. Store in a dark place for a week.
   OR use a commercial Mushroom Gardening Kit.
1. Dig a trench in a garden bed 25cm wide x 50cm long and 25cm deep or use a large pot filled with one third of soil.
4. Place mushroom spawn roll or Mushroom Gardening Kit in the trench and cover with a 2cm layer of soil or straw. Water very well.
5. Write name, date and mushroom type on a marker and place on trench.

What questions do you have about how mushrooms grow as you observe your mushroom garden over the next few weeks?

What are the answers to the above questions?

TEACHER'S NOTES: Level F-8

OBJECTIVES:

- Learn the how edible mushrooms can be grown in a garden.
- Learn about what mushrooms need to grow.
- Grow mushrooms that can be used for science experiments or eating.

FURTHER ACTIVITY: Create individual mushroom spawn rolls or use small Mushroom gardening kits for growing in a terrarium in the classroom.

RESOURCES: Mushroom Garden worksheet, Mushroom spawn logs, Mushroom gardening kits, newspaper/cardboard, gardening tools, and garden bed, watering can, plastic, and markers (icypole sticks).

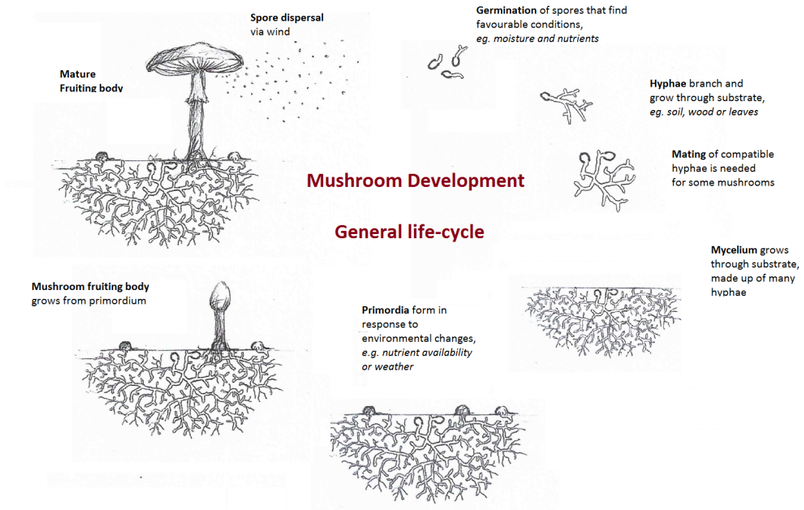
AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
F	Living things have basic needs, including food and water. (ACSSU002)	Science involves observing and asking questions about, and describing changes in objects and events (ACSHE021)	Engage in discussions about observations and represent ideas (ACSIS223)
1-2	Living things live in different places where their needs are met (ACSSU211)	Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE021)	Participate in guided investigations to explore and answer questions (ACSIS025)
3-4	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ASSSU044)	Science involves making predictions and describing patterns and relationships (ACSHE050)	Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS060)
5-6	The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)		With guidance, pose clarifying questions and make predictions about scientific investigations (ACSIS232)
7-8	Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)		Identifying questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

(Australian Curriculum, 2016)

STEM PROJECT: MYCOREMEDIATION @ SCHOOL

Figure 13.



Overview:

Investigate the use of fungus to reclaim school paper wastes which are otherwise removed from the school at a cost. Students will use Science, Technology, Engineering and Maths to work out a way to recycle the school's paper waste into rich composted soil additive.

Duration: 10 week term—one semester.

Key Inquiry Questions:

- How much paper waste (volume) did the school produce last year?
- What was the cost of removing paper waste last year?
- What was the cost of buying soil and compost for the school last year?
- Determine the optimal conditions for oyster mushroom mycelium breaking down paper wastes on a small scale.
- Determine the rate of decomposition of paper wastes by oyster mushroom mycelium using optimal conditions on a small scale.
- Using engineering design elements design a large scale paper waste mycoremediation system with processes for collection, inoculation, decomposition, monitoring growing conditions and harvesting compost for the school.
- Trial the mycoremediation design and processes.
- What science knowledge, maths skills and design process procedures are required for this project?

TEACHER'S NOTES—Level 7-10

OBJECTIVES:

- Learn how edible mushrooms can be grown from paper wastes.
- Learn what mushrooms need to grow.
- Grow mushrooms that can be used for science experiments and compost.

RESOURCES: Mycoremediation worksheets, Oyster mushroom spawn logs, newspaper/ cardboard, old cotton garments, scissors, plastic containers, markers and water in a spray bottle.

SAFETY: This experiment could produce mushrooms that may contain toxic substances from the material they are grown on, so they not suitable for eating, rather for further experimentation or using the decomposed plant waste as compost.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
7-8	The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)	People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)	Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125)
9	Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)		Plan, select and use appropriate investigation types, including filed work and laboratory experimentation, to collect reliable data, assess risk, and address ethical issues associated with these methods (ACSIS165)
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(Australian Curriculum, 2016)

MUSHROOM STRUCTURES

Mushrooms have many different structures with different functions. The cap and stalk make up the main body of a mushroom. On the underside of the cap are the gills where spores are produced. Mushrooms also have root like structures called hyphae. These microscopic threads form a network called mycelium. They can have other structures including rings and volvas.

Figure 2.

Mushroom Structures

What you need:

- Hand lens
- 3 different types of edible mushrooms

What to do:

1. Examine the mushrooms with a hand lens.
2. Use Figure 2 to locate the different structures of the mushrooms.
3. Name and draw labeled diagrams in the boxes below of the three different mushrooms.

QUESTION: What are the functions of the different parts of a mushroom?

TEACHER'S NOTES: Level F-8

OBJECTIVES:

- Learn about the unique structures of mushrooms and fungus.
- Use hand lens to observe fine surface details of specimens
- Understand how diagrams are constructed and used
- Draw diagrams of specimens

FURTHER QUESTIONS:

1. **Why are mushrooms called fruiting bodies?**
2. **How do mushrooms grow?**

RESOURCES: Mushroom Structures worksheet, edible mushrooms, hand lens, pencils.

SAFETY: Use edible mushrooms samples grown from mushroom spawn logs or bought from shops. Wild mushrooms can be poisonous.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
F-2	Living things have a variety of external features (ACSSU017)	Science involves observing and asking questions about, and describing changes in objects and events (ACSHE021)	Represent and communicate observations and ideas in a variety of ways (ACSIS029)
3-4	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ASSSU044)		Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS060)
5-6	Living things have structural features and adaptations that help them survive in their environment (ACSSU0443)		Communicate ideas, explanations and processes using scientific representations in a variety of ways (ACSIS093)
7-8	Classification helps organise the diverse range of organisms (ACSSU111) Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and re-		Communicate ideas, findings and evidence based solutions to problems using scientific language and representations (ACSIS148)

(Australian Curriculum, 2016)

MYCOREMEDIATION

Results:

Discussion:

Conclusion:

MYCOREMEDIATION

Mushrooms need to live with their food source or substrate. Mushrooms break down substrates into simple nutrients using enzymes. These nutrients are then absorbed through the mycelium. Mushrooms can be used to break down some wastes that can contaminate the environment like synthetic dyes.

Figure 12. Mycelium growing on old socks

Design your own experiment on Mycoremediation

Date:

Title:

Aim:

Hypothesis:

Independent variable:

Dependent variable:

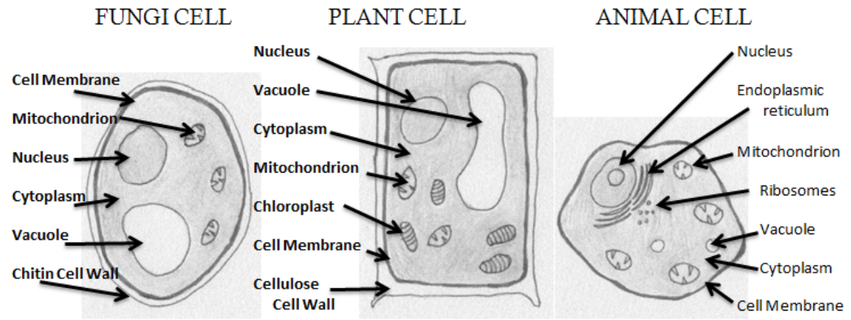
Controlled variable:

Materials:	Method:
	1.
	2.
	3.
	4.
	5.
	6.
	7.
	8.

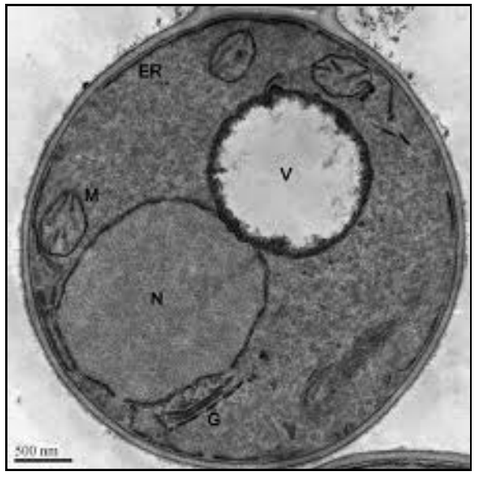
KINGDOM FUNGI

Mushrooms, moulds and single celled fungus like yeasts belong to Kingdom Fungi. Organisms or living things are classified into groups because of the characteristics they share. The first division classifies organisms into five kingdoms according to the characteristics of their cells, which are the basic building blocks of life.

Figure 3. Fungi, plant and animal cells diagrams.



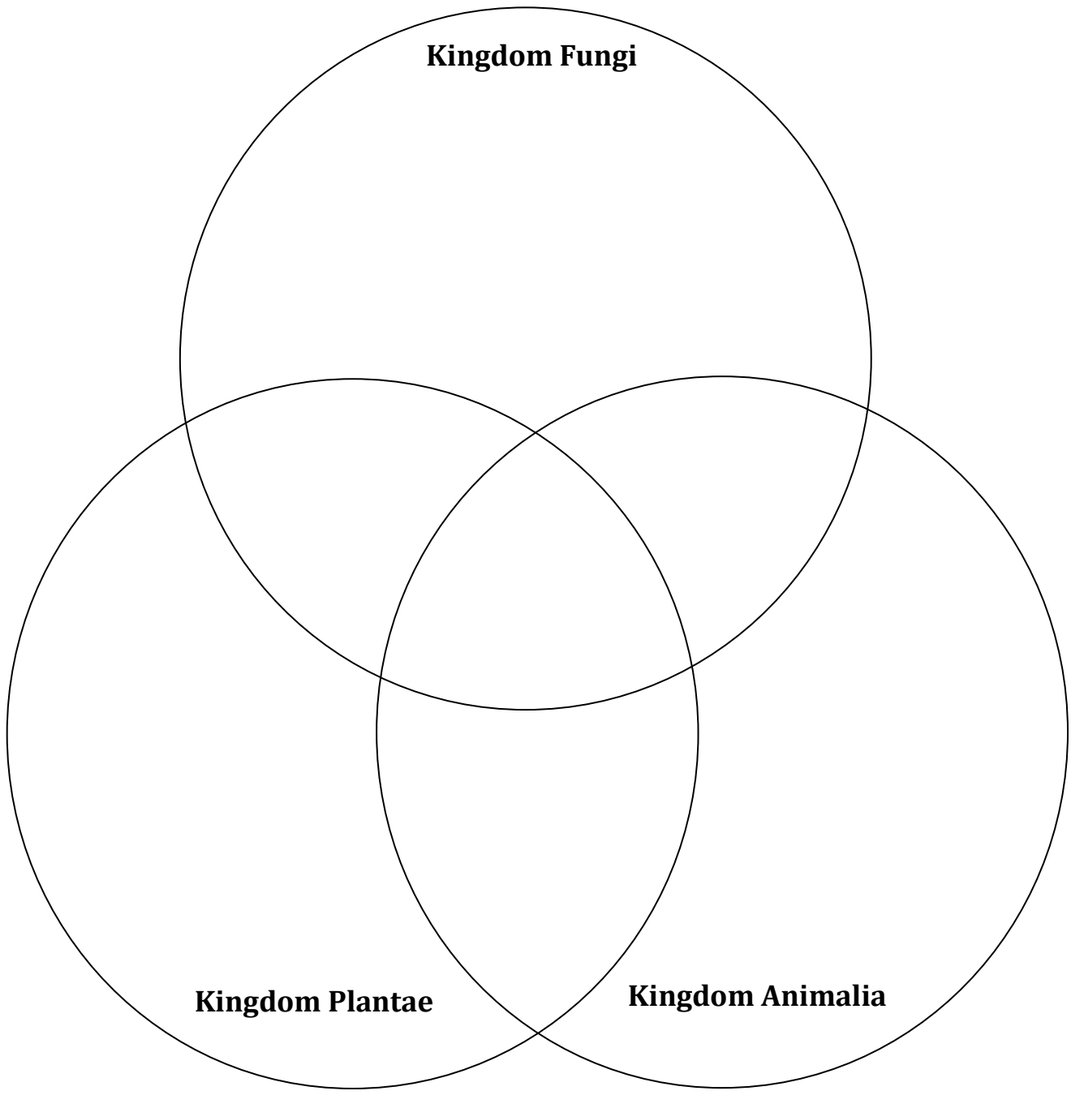
Label the yeast cell's organelles using the letters as clues and Figure 2 .



Question: Explain what are fungi more like? Animals or plants?

KINGDOM FUNGI

The Fungi, Plantae and Animalia Kingdoms have many similarities and differences between them. Organise these into the Venn diagram.



TEACHER'S NOTES: Level F-8

OBJECTIVES:

- Learn the how edible mushrooms can be grown from paper wastes.
- Learn about what mushrooms need to grow.
- Grow mushrooms that can be used for science experiments or eating.

RESOURCES: Sustainability and Mushrooms worksheet, Oyster mushroom spawn logs, newspaper/cardboard, plastic containers, markers and water in a spray bottle.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
F	Living things have basic needs, including food and water. (ACSSU002)	Science involves observing and asking questions about, and describing changes in objects and events (ACSHE021)	Engage in discussions about observations and represent ideas (ACSIS223)
1-2	Living things live in different places where their needs are met (ACSSU211)	Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE021)	Participate in guided investigations to explore and answer questions (ACSIS025)
3-4	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ASSSU044)	Science involves making predictions and describing patterns and relationships (ACSHE050)	Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS060)
5-6	The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)	Science knowledge is used to solve problems and inform personal and community decisions (ASHE083)	With guidance, pose clarifying questions and make predictions about scientific investigations (ACSIS232)
7-8	Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)	Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)	Identifying questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

(Australian Curriculum, 2016)

SUSTAINABILITY & MUSHROOMS

The white threadlike network of mushroom hyphae are called mycelium. Waste from plant materials (lignocellulosic) can be used to grow mycelium for mushroom growing. Fargreen is a social enterprise in Vietnam that uses mushroom growing to help reduce carbon dioxide emissions. Fargreen helps rice farmers to use their waste rice straw for mushroom growing rather than burning it. Farmers can earn extra income from mushroom growing and learn about sustainable farming practices.

Figure 11.
Mycelium growing on cardboard

What you need:

- Oyster mushroom spawn logs
- Bowls and spoons
- Sterilised/pasteurized moist plant materials.
- Clean containers and lids with holes.
- Water in a spray bottle
- Transparent grid

What to do:

1. Empty spawn into a bowl and break apart gently with a spoon spray with water until moist.
2. Fill containers with layers of spawn and plant material packing lightly to ~0.5cm from the top of the container.
3. Store containers at room temperature in a dark place.
4. Observe spawn and record observations weekly.
5 When the spawn has spread to all parts of the container and formed a layer at the top store the container in a cold area to promote fruiting body (mushroom) development.
6. Remove the plastic cover, lift an edge of the filter paper off the container, spray with water and stow in a mushroom terrarium, or shaded area, to develop fruiting bodies.
7. Use the transparent grid to determine the % growth of mycelium each week for 4 weeks.

Questions:

1. What percentage of the plant material was covered in mycelium after 1 week, 2 weeks, 3 weeks, & 4 weeks?
2. What plant wastes in your house could be used to grow mushrooms?
3. What plant wastes at your school could be used to grow mushrooms?
4. How do Fargreen help the environment, the economy and the lives of farmers?

TEACHER'S NOTES: Level 5-8

OBJECTIVES:

- Learn the structures of plant, animal and fungal cells.
- Use diagrams to label a cell's organelles.
- Determine the similarities and differences between plant, animal and fungal cells.
- Use a Venn diagram to graphically represent ideas.

FURTHER ACTIVITY: Use microscopes to examine cell structures of plants, animals and fungus.

RESOURCES: Kingdom Fungi worksheets.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
5-6	Living things have structural features and adaptations that help them survive in their environment		Communicate ideas, explanations and processes using scientific representations in a variety of ways (ACSIS093)
7-8	Classification helps organise the diverse range of organisms (ACSSU111) Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce		Communicate ideas, findings and evidence based solutions to problems using scientific language and representations (ACSIS148)

(Australian Curriculum, 2016)

MUSHROOM TERRARIUM

Mushrooms grow in their food source. Many mushrooms grow in the wild on trees and fallen logs. Edible mushroom are often grown commercially on prepared logs made of sawdust inoculated with mushroom spawn. Using mushroom spawn logs mushrooms can be grown in the classroom in a mushroom terrarium.

Figure 4.

Shiitake mushrooms growing in a terrarium

What you need:

- A clean plastic tub and lid ~70L with holes drilled in the sides and lids for ventilation.
- 1-2 mushroom spawn logs
- Scissors
- Spray bottle

What to do:

1. Follow the mushroom spawn log instructions for preparing to grow.
2. After preparing logs place into the tub.
3. Spray tub sides and logs with a fine water mist daily.
4. Measure mushroom height from pins forming (small bumps on the log) to mushrooms forming.
5. Photograph daily changes with a ruler in the frame.
6. Pick large mushrooms where they touch the log for eating or further investigation.

Results:

Day	Height (mm)

Questions:

1. Describe how your mushrooms changed over time.
2. How many days did it take from pins forming to harvesting mushrooms?
3. How is your mushroom commonly used?

TEACHER'S NOTES: Level 5-9

OBJECTIVES:

- Discover the fungus growing in a particular site or environment
- Identify fungus, substrates and plants.
- Complete a survey of the fungus found and share results with citizen science projects like Fungimap.

RESOURCES: Mushroom Survey worksheets, cameras, access to sites, field guides for mushrooms and plants, a list of local fungus from the Atlas of living Australia website database.

SAFETY: Care must be taken on field trip activities and a risk management plan developed for off school site excursions. Some risks involved include insect and snake bites, tripping and slipping, sun burn and exposure to poor weather conditions. Students should never touch wild fungus as it can be poisonous.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
5-6	Living things have structural features and adaptations that help them survive in their environment (ACSSU0443)	Science knowledge is used to solve problems and inform personal and community decisions (ASHE083)	Communicate ideas, explanations and processes using scientific representations in a variety of ways (ACSIS093)
7-8	Classification helps organise the diverse range of organisms (ACSSU111) Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)	Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)	Communicate ideas, findings and evidence based solutions to problems using scientific language and representations (ACSIS148)
9	Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)		Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

(Australian Curriculum, 2016)

MUSHROOM SURVEY

Student Name (s)	Date:	Time:

Site Name and location:

Fungus	Substrate	Nearby plants

Name and describe this type of environment.

TEACHER'S NOTES: Level F-8

OBJECTIVES:

- Learn the how edible mushrooms are commercially grown
- Learn about different species and uses of mushrooms.
- Learn about what mushrooms need to grow.
- Grow mushrooms that can be used for science experiments or eating.
- Set up a terrarium.

FURTHER ACTIVITY: Use spreadsheet software to organize data and generate graphs.

RESOURCES: Mushroom Terrarium worksheet, mushroom spawn logs, spray bottle, 70L plastic tub and lid with holes, rulers.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
F	Living things have basic needs, including food and water. (ACSSU002)	Science involves observing and asking questions about, and describing changes in objects and events (ACSHE021)	Engage in discussions about observations and represent ideas (ACSIS223)
1-2	Living things live in different places where their needs are met (ACSSU211)	Science involves observing, asking questions about, and describing changes in, objects and events (ACSHE021)	Participate in guided investigations to explore and answer questions (ACSIS025)
3-4	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ASSSU044)	Science involves making predictions and describing patterns and relationships (ACSHE050)	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS057)
5-6	The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)		Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS107)
7-8	Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)	People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)	Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS107)

(Australian Curriculum, 2016)

MUSHROOMS VS PLANTS

The similarities and differences between plants and mushrooms can be observed with how they grow in different conditions. In this activity you will observe fungi growing and discover whether plants prefer light or dark conditions.

Figure 5. Plants and mushrooms growing together.

Hypothesis 1: (circle chosen word) (Plants/Mushrooms) will grow best in light whereas (plants/mushrooms) will grow without light.

Hypothesis 2: Both plants and mushrooms need (soil/ water/ light/food) to grow.

Materials: For Mushroom Growing	**Materials: For Plant Growing**
↑ Spray bottle ↑ Ruler or measuring grid ↑ Mushroom spawn logs ↑ Mushroom terrarium ↑ Scissors	↑ Spray bottle ↑ Ruler or measuring grid ↑ Seeds—Beans, peas, or mustard. ↑ Growing media—seed raising mix or paper towel. ↑ Growing containers - small pots/tubs.
Method: 1. Set up mushroom spawn logs in terrariums. 2. Spray the box and spawn logs with a fine mist of water daily. 3. Observe and measure the length of the pins and mushrooms daily. 4. Examine the mushrooms under a dissecting microscope and record observations.	**Method:** 1. Place the growing media in 4 containers and put seeds on top. 2. Spray the seeds with water and stow 2 in dark and 2 in light places. 3. Observe and measure the length of the shoots daily. 4. Examine the shoots under a dissecting microscope and record observations.

MUSHROOM SURVEY

Mushrooms are decomposers in ecosystems. An ecosystem is a place that includes all the organisms there interacting with each other. Surveys can be used to discover and identify fungus in different ecosystems and at different times of the year. The surveys can also be shared with larger citizen science projects like Fungimap.

Figure 10.
Puffballs in the desert

What you need:

- A list of common fungus for the area to be explored from the Atlas of Living Australia.
- Notebooks and pens
- Camera
- Field guide for fungi
- Field guide for plants of the area

What to do:

1. Explore your designated area for mushrooms.
2. Use the list of common fungi and a field guide to identify them.
3. Record the mushroom name or morphgroup in the first column.
4. List what the mushroom is growing on in the second column.
5. List the plants closest to the mushroom in the third column of the survey.
6. Take photographs of the mushrooms found.

TEACHER'S NOTES—Level 7-10

OBJECTIVES:

- Learn about the use of mushrooms to dye material.
- Make a mushroom dye.
- Apply mushroom dyeing to some material samples.
- Explore the chemistry of dyes.

RESOURCES: Mushroom Dyes worksheet, oyster mushrooms, Bunsen burners, cloudy ammonia, large beakers, tripods, bench mats, gauze mats, hot plates, sieves, natural undyed materials.

SAFETY: Take care with Bunsen burner or hot plate use, transferring hot liquids., and follow the precautions of using cloudy ammonia.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
7-8	Chemical change involves substance reacting to form new substances (ACSSU225)	People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE136)	Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125)
9	Chemical reactions involve rearranging atoms to form ne substance; during a chemical reaction mass is not created or destroyed (ACSSU178)		Plan, select and use appropriate investigation types, including filed work and laboratory experimentation, to collect reliable data, assess risk, and address ethical issues associated with these methods (ACSIS165)
10	Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSI187)		Plan, select and use appropriate investigation types, including filed work and laboratory experimentation, to collect reliable data, assess risk, and address ethical issues associated with these methods (ACSIS165)

(Australian Curriculum, 2016)

MUSHROOMS VS PLANTS

Independent Variable:

Dependent Variable:

Controlled Variable:

Results:

DAY	Pin/Mushroom length (mm)	Shoot/Leaf length in dark (mm)	Shoot/Leaf length in light (mm)

Discussion:

1. What day did the pins appear?
2. What part of the mushroom spawn log did the mushrooms grow from? Why?
3. Describe the growth of the plants growing in light compared with the plants growing in the dark. If there was difference in size and appearance what are the reasons for this?
4. What do mushrooms and plants both need to grow?
5. Where do mushrooms get energy to grow?
6. Where do plants get energy to grow?
7. What relationship do mushrooms and plants have in the ecosystem?

Conclusion:

Did the experiment support Hypothesis 1? What evidence do you have?

Did the experiment support Hypothesis 2? What evidence do you have?

How could this experiment be improved?

TEACHER'S NOTES: Level 5-9

OBJECTIVES:

- Form a hypothesis and determine experimental variables.
- Investigate different environmental conditions on the growth of mushrooms and plants.
- Collect and organize data into tables.
- Learn about what mushrooms and plants need to grow.

FURTHER ACTIVITY: Use spreadsheet software to organize data and generate graphs.

RESOURCES: Mushrooms VS Plants worksheets, mushroom spawn logs, mushroom terrarium, seeds, growing media, spray bottle, rulers..

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
5-6	The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)		Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks (ACSIS103)
7-8	Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)		Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS140)
9	Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)		Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165)

(Australian Curriculum, 2016)

MUSHROOM DYES

Some mushrooms can be used for dying textiles. Oyster mushrooms have compounds called that behave as dyes. The dying process for many mushrooms involves boiling mushrooms in an alkaline environment (pH > 8) to extract and fix the dye to the material.

Figure 9. Mushroom dyed wool and cotton

What you need:

- 50g oyster mushrooms
- 25% cloudy ammonia solution
- 2x 500mL beakers
- Hotplate or Bunsen burner, tripod, bench mat, gauze mat and tongs.
- Natural material e.g. calico, raw silk, undyed wool or paper.
- pH paper and butchers paper.
- Sieve or filter paper and funnel

What to do:

1. Boil cloudy ammonia solution and oyster mushrooms together for 10 minutes, then cool for 5 minutes.
2. Measure and record the pH of the solution.
3. Strain the oyster mushrooms and collect the solution.
4. Boil the solution with the natural material for 10 minutes.
5. Remove the material with tongs and dry on butchers paper overnight.
6. Observe the colour differences and record observations.

Questions:

- What are the risks involved with this activity?
- How can these risks be managed?
- What other mushrooms are used to dye material? What colour dye do they make?
- What is the chemical formula and structure of one mushroom dye?
- How do dyes work?

TEACHER'S NOTES—Level 5-8

OBJECTIVES:

- Analyse second hand data and create graphs.
- Investigate different nutrients and their function.

FURTHER ACTIVITY: Cook or prepare these mushrooms for eating with students.

RESOURCES: Mushroom Nutrients worksheets, internet access.

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Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
5-6		Science knowledge is used to solve problems and inform personal and community decisions (ASHE083)	Construct and use a range of representations including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS090)
7-8		Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)	Summarise data from student's own investigations and secondary sources, and use scientific understanding to draw conclusions based on evidence (ACSIS130)

(Australian Curriculum, 2016)

SPORE PRINTS

New fungi grow from spores. Spores are produced on the thin walls of the gills on the underside of a mushroom's cap. When the spores are mature, they fall off the gills and are distributed by air currents. Spore prints can be made by covering a mushroom cap overnight and collecting the fallen spores on the paper or foil underneath. The pattern the spores make on paper/foil looks similar to the pattern of the mushroom's gills.

Figure 6. Spore Prints

What you need:

- Aluminium foil, white or black paper.
- Bowls or beakers
- Sharp knife and board
- An edible mushroom
- Hairspray

What to do:

1. Carefully remove or cut the mushroom cap from the stalk
2. Examine the gills where spores are produced.
3. Put the cap gills facing down on paper or alfoil and cover with a beaker or bowl for a day.
4. Carefully lift the mushroom from the paper or foil and observe the spore print and spray with hairspray to seal the print.

Describe the similarities between the spore print and the mushroom gills.

Draw the spore print and label the gills, cap and stalk.

TEACHER'S NOTES: Level F-8

OBJECTIVES:

- Learn about the function of the cap, gills and spore of mushrooms
- Make a spore print
- Draw diagrams of specimens

RESOURCES: Spore Prints worksheet, edible mushrooms, black/white paper, aluminium foil, hairspray.

SAFETY: Use edible mushrooms samples grown from mushroom spawn logs or bought from shops. Wild mushrooms can be poisonous. Take care with students using hairspray.

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Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
F-2	Living things have a variety of external features (ACSSU017)	Science involves observing and asking questions about, and describing changes in ob-	Represent and communicate observations and ideas in a variety of ways (ACSIS029)
3-4	Living things can be grouped on the basis of observable features and can be distinguished from non-living		Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS060)
5-6	Living things have structural features and adaptations that help them survive in their environment (ACSSU0443)		Communicate ideas, explanations and processes using scientific representations in a variety of ways (ACSIS093)
7-8	Classification helps organise the diverse range of organisms (ACSSU111) Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce		Communicate ideas, findings and evidence based solutions to problems using scientific language and representations (ACSIS148)

(Australian Curriculum, 2016)

MUSHROOM NUTRIENTS

Questions:

1. What is the role of Vitamin K in the body?

2. Why do we need to eat protein?

3. What do we need potassium for?

4. Rank the lowest to highest concentrations of fibre in the mushrooms.

5. Which mushroom has the highest concentration of the nutrients in the table?

MUSHROOM NUTRIENTS

Mushrooms are valuable sources of nutrients for people as well as being delicious. They are especially valued for Vitamin D, Vitamin B2, potassium and protein.

Figure 8. Enoki, shiitake, oyster and maitake mushrooms.

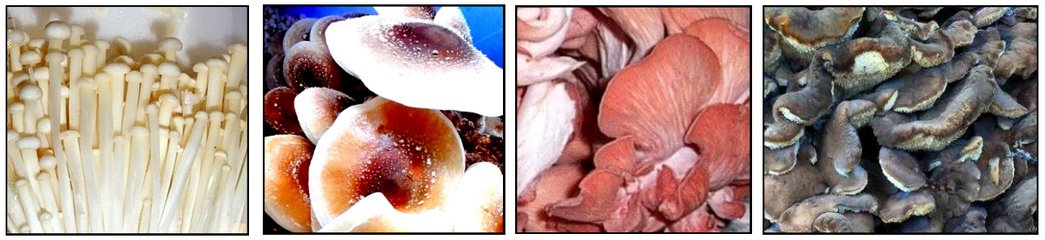
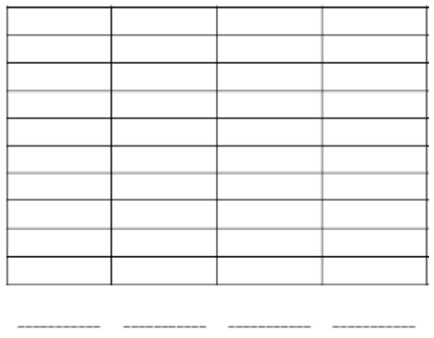


Table. Edible Asian mushroom nutrients.

(United States Department of Agriculture, 2016)

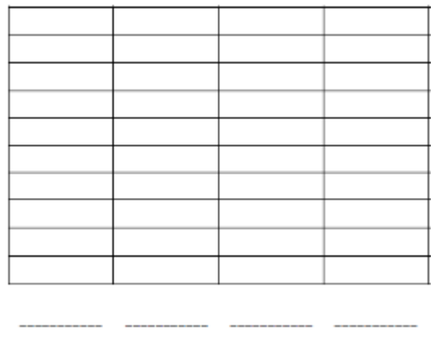
	Daily Value for Teenagers/100g of raw mushroom				
	Protein	**Vitamin D**	**Potassium**	**Riboflavin (Vitamin B2)**	**Fibre**
Enoki	7%	3%	11%	17%	11%
Shiitake	24%	78%	13%	106%	46%
Oyster	8%	15%	48%	29%	9%
Maitake	5%	560%	7%	20%	11%

Graph 1. % Daily Value for protein in mushrooms.



How many grams of shiitake would give you your daily value of protein?

Graph 2. % Daily Value for riboflavin in mushrooms.



How many grams of maitake would give you your daily value of riboflavin?

TISSUE CULTURING

Growing mycelium from fresh mushrooms can be done by taking a small piece of undifferentiated tissue from a mushroom and growing it on potato dextrose agar. Fluffy white mycelium in the right conditions will grow in 1-2 weeks with most common edible mushrooms, however very clean conditions are needed to minimize other contaminants including moulds and bacteria from growing too.

Figure 7. A contaminated tissue culture plate with mycelium growth (left) and mould (right)

What you need:

- Edible mushrooms
- Potato dextrose plates/test tubes and stoppers.
- Dissecting tools and latex gloves
- Isopropyl alcohol in a spray bottle.
- Bunsen burner
- Transparent grid or ruler

What to do:

1. Wash hands, put on gloves and roll up sleeves.
2. Clean, hands and work surfaces with isopropyl alcohol.
3. Sterlise the tweezers in the flame.
4. Pass the mushroom over the flame to clean the surface using tweezers.
5. Gently tear apart a mushroom using your hands through the stalk or cap.
6. Sterilise the scalpel and then cut a small ~ 7mm piece of tissue from the middle of the cap or stalk.
7. Place three pieces onto a plate or one in a test tube.
8. Cover plate or test tube in a dark place at room temperature and observe changes daily up to 2 weeks.

Variables:

Independent Variable:

Dependent Variable:

Controlled Variable:

Hypothesis:

TISSUE CULTURING

Results:

Draw the tissue culture plate to scale using a grid.

Identify the organisms growing on the plate and label the drawing.

Discussion:

1. How did the tissue culture plate change over time?

2. Why can mycelium grow from a mushroom?

3. Describe your plate in terms of the organisms growing on it.

4. If your plate was contaminated with unexpected organisms what was their likely pathway onto the plate?

5. How can your experimental method be improved?

Conclusion: Did the experiment support the Hypothesis? What evidence do you have?

TEACHER'S NOTES—Level 7-10

OBJECTIVES:

- Form a hypothesis and determine experimental variables.
- Propagate mycelium from a mushroom
- Using dissecting tools
- Identify organisms
- Learn about hygienic experimental procedures and tissue culturing.

RESOURCES: Tissue Culturing worksheets, edible mushrooms, dissecting equipment, Bunsen burners, isopropyl alcohol, PDA (potato dextrose agar) plates/tubes.

SAFETY: Careful with Bunsen burner use, and students using dissecting equipment. The plates should also be sealed shut when students do their final observations as some bacterial cultures can be dangerous. Plates should be heat treated after use to sterilization then disposed.

AUSTRALIAN CURRICULUM Version 8.1

Year	Science Understanding	Science as Human Endeavour	Science Inquiry Skills
7-8	Cells are the basic units of living things; they have specialised structures and functions (ACSSU149)		Measure and control variables, select equipment appropriate to the task and collect data with accuracy
9	Multicellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment		Formulate questions or hypothesis that can be investigated scientifically (ACSIS164)
10	Transmission of heritable characteristics from one generation to the next involves DNA and genes		Formulate questions or hypothesis that can be investigated scientifically (ACSIS198)

(Australian Curriculum, 2016)