Add the MIGHTY MUSHIE

Investigating the Growth of Mushrooms

TEACHER GUIDE

LESSON 4

YEAR 7–8

This resource has been developed by:

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LESSON 4

Investigating the Growth of Mushrooms

LEARNING AREA/ YEAR LEVEL

Science (Year 7–8)

AUSTRALIAN CURRICULUM CONTENT

Develop investigable questions, reasoned predictions and hypotheses to explore scientific models, identify patterns and test relationships (**AC9S7I01, AC9S8I01**)

Plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country/Place (**AC9S7I02**, **AC9S8I02**)

Select and use equipment to generate and record data with precision, using digital tools as appropriate (**AC9S7I03, AC9S8I03**)

Select and construct appropriate representations, including tables, graphs, models and mathematical relationships, to organise and process data and information (**AC9S7I04**, **AC9S8I04**)

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Contents

LESSON OBJECTIVE

Students will learn about:

- The growth traits and rates of a common mushroom.
- The optimal conditions needed for mushroom growth.
- Features of investigations, observing, and recording trends in data.

ATTRIBUTION, CREDIT & SHARING

Primary Industries Education Foundation Australia's resources support and facilitate effective teaching and learning about Australia's food and food industries. We are grateful for the support of our industry and member organisations for assisting in our research efforts and providing industry-specific information and imagery to benefit the development and accuracy of this educational resource.

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Resources and Equipment

1. Access to laptop/digital devices
2. Scissors and glue
3. String for mushroom modelling activity
4. Plasticine/playdough
5. Punnet of mushrooms per group of three or four students, electronic scales
6. **Worksheet 4.1 – Graphing Growth Rates Over Time**
7. **Worksheet 4.2 – How Mushrooms Are Grown**
8. **Worksheet 4.3 – Commercial Mushroom Growing**
9. *Optional – commercial mushroom growing kit*
10. **Worksheet 4.4 – First-Hand Mushroom Growth Data Collection**
11. **Worksheet 4.5 – Scientific Investigation Template**
12. **Worksheet 4.6 – Average Mushroom Mass**
13. **Stimulus 1 – Modelling Mushroom Growth**
14. **Worksheet 4.7 – Graphing Mushroom Growth**

Additional Reading/Resources

The Australian Mushroom Growers' Association provides free mushroom growing kits to schools. Register interest here. If these are not available, there are commercial sites where mushroom growing kits can be purchased. Having a mushroom kit in school is recommended as it allows students to collect first-hand data on mushroom growth rates. Commercial mushroom growing kits are available from a number of online providers.

NOTE: RISK ASSESSMENT IS THE TEACHER'S RESPONSIBILITY

Schools and teachers are responsible for risk amelioration in regard to risks and allergies associated with any kind of practical science work. Software such as www.riskassess.com.au can be used to complete risk assessments.

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Background Information

"The *Agaricus bisporus* mushroom accounts for over 90% of the mushrooms sold in Australia.

Mushrooms have a fascinating production process. They are grown all year round, indoors in highly controlled environments. The mushroom growing rooms contain long growing beds, which are stacked like bunk beds four to ten rows high!

To ensure a good harvest, farmers must care for their mushrooms during the growing process around the clock. Growing mushrooms is both a scientific marvel and a precise art.

A little-known fact is that most of the varieties of mushrooms sold in Australia are the SAME mushroom. The *Agaricus bisporus* is available in two colours — white and swiss brown. The white *Agaricus bisporus* starts off as a little white button mushroom (or a champignon) and every day, it doubles in size. One day it will be a button mushroom, then it grows to be a cup and matures to become a large flat or 'BBQ' mushroom. The same with a Swiss Brown mushroom, which grows to become a large Portobello, it is the same mushroom, just harvested at different ages.

Interestingly, the longer a mushroom is allowed to grow, the more its flavour develops. So, a white button mushroom has a very mild flavour, a 'flat' mushroom has a robust mushroom flavour."

(How Mushrooms Grow – Australian Mushroom Growers, n.d.)

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Lesson Guide

Students will:

- Observe data showing the growth traits and rates of commercial mushrooms.
- Complete questions focused on the growth of mushrooms.
- Change numerical data into graphical representations to identify trends in mushroom growth.
- Use mushroom kits to investigate and observe the growth of mushrooms as a first-hand investigation. Students will identify patterns, use equipment, record data, and construct appropriate representations to record their observations both quantitatively and qualitatively.

STARTER:

1. Students practise graphing growth rate data for two organisms.
2. Distribute **Worksheets 4.1 – Graphing Growth Rates Over Time**.
3. Students plot the provided data and draw lines of best fit from the origin. This can be done on the supplied graphing worksheet, or students can create their own in their science journals/notebooks or with spreadsheet software.
4. Once students have completed the graphing activity, hold a brief question and answer session about what the data shows. Suggested questions:
   - What trends can you see in the data?
   - Are the trends the same for each organism?
   - Are the lines of best fit very close to the data points?
   - What are the similarities and differences between the sets of data?
   - How might farmers use this information?
   - Why are there similarities and differences?
   - What living organisms do you think each of the lines might represent?
5. Explain to the students that they have just plotted the growth rates for a pig and a chicken.
6. Show the students the correct graph for the pig and chicken data.

   Answers

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MAIN:

a) How Mushrooms Grow

1. Students take notes and complete a comprehension activity to find information and learn about how mushrooms grow and how they are produced commercially.
2. Distribute copies of **Worksheet 4.2 – How Mushrooms Are Grown**. Either as a class or individually, watch the video about the steps involved in growing a mushroom: The 7 Basic Steps Of Mushroom Cultivation (How Most Mushrooms Are Grown) (10:59).
3. Students take notes on each step of the mushroom growing process.

   Answers
4. Distribute **Worksheet 4.3 – Commercial Mushroom Growing**. Students use the two sources of information, or their own research to answer the comprehension questions.
   - Mountain View Mushrooms | Mushroom Cultivation | Mushroom Production | Utah Farming Business (2:58)
   - Basic Procedures for Agaricus Mushroom Growing

   Answers

b) Optional – Mushroom Growing Kits

1. If a commercial mushroom growing kit is available, students could plan to grow the mushrooms and collect first-hand data in relation to mushroom growth over time. Free mushroom growing kits are available from the Australian Mushroom Growers Association at certain times of the year. Otherwise the cost of a commercial mushroom growing kit may be between $20–50. The total time required to measure the growth of the mushrooms would be around three weeks.
2. Students can use **Worksheet 4.4 – First-Hand Mushroom Growth Data Collection** to record their data, or they can plan this in their science journals/notebooks. Students have the option to use the **Worksheet 4.5 – Scientific Investigation Template** to help formulate a scientific investigation.
3. Suggested independent variables for students to investigate:
   - Temperature
   - Humidity
   - Light
   - Water
   - Carbon Dioxide

4. Suggested dependent variables for students to measure:
   - Mass
   - Height
   - Number
   - Circumference
   - Appearance

c) Modelling Activity

1. In addition to collecting and presenting data of mushroom growth over time, students participate in a modelling activity to create a visual representation of growing mushrooms.
2. Students can use **Worksheet 4.6 – Average Mushroom Mass** to record the mass of the mushrooms, or this can be recorded in their science journals/notebooks.
3. Organise students into groups of three or four. Distribute a punnet of mushrooms to each group, plus an electronic balance.
4. Students measure the mass of each mushroom. Encourage students to measure a large sample size, (at least 10) to reduce the effect of outliers.
5. Students calculate the average mass of an individual mushroom by dividing the total mass of the sampled mushrooms by the number of mushrooms that were sampled.
6. **In the right conditions, a white button mushroom (*Agaricus bisporus*) can double in size in 24 hours.**
7. Using the average mass of an individual mushroom (step 5), students calculate the number of days it would have taken to achieve this mass, if the starting mass had been less than 1 g.

   This is calculated by working backwards:

   - If the final mass is 40 g, then 24 hours before it would have had a mass of 20 g. This represents the growth over one day. 24 hours earlier the mass would have therefore been 10g etc. In the table below the mushroom took six days (144 hours) to reach its final mass of 40 g.

Time (hours/days)	144/6	120/5	96/4	73/3	48/2	24/1	0/0
Mass (g)	40	20	10	5	2.5	1.25	0.625

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8. Students model the growth of a mushroom with craft materials (e.g. playdough) and a piece of string to represent time.
9. Divide the string into equal intervals to represent number of days (or hours) of mushroom growth (mass).
10. Label the start of the string as day zero.
11. Using the craft materials and scales, make a small mushroom of mass less than 1 g and place this model at zero cm.
    - Alternatively, students could use a scale for the mushroom mass e.g. multiply all the masses by five so that it is easier to model the mushroom in the first few days of its growth.
12. Day one should be the distance calculated in step 9 from the start of the string.
13. **Stimulus 1 – Modelling Mushroom Growth** could be used by students as a guide.
14. Encourage students to mould their materials into a representative shape to create model mushrooms showcasing the growth of a mushroom before it is harvested, working towards the end of the piece of string.

d) Graphing Activity

1. Students graph the data from **Worksheet 4.6 – Average Mushroom Mass** using **Worksheet 4.7 – Graphing Mushroom Growth**.
2. Discuss with students any patterns that are observable from graphing the data. The most likely pattern is that of a direct linear relationship between time and mass.
    - What does the data show?
    - Would the mushroom just keep on growing?
    - How might this data be useful to a mushroom grower?

PLENARY:

Students create a poster, or infographic to summarise information about the growth of mushrooms to be displayed in class.

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Student Resources

1. **Worksheet 4.1 – Graphing Growth Rates Over Time**
2. **Worksheet 4.2 – How Mushrooms Are Grown**
3. **Worksheet 4.3 – Commercial Mushroom Growing**
4. **Worksheet 4.4 – First-Hand Mushroom Growth Data Collection**
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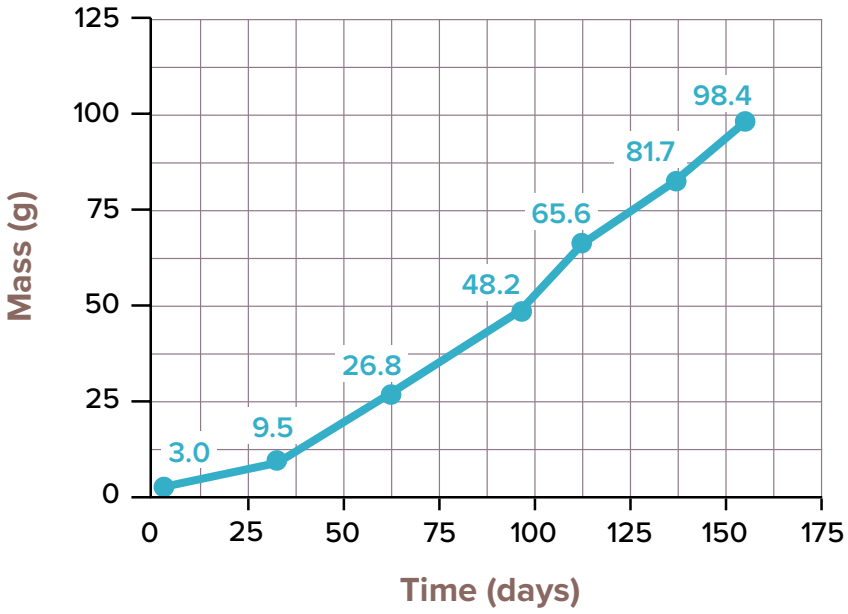
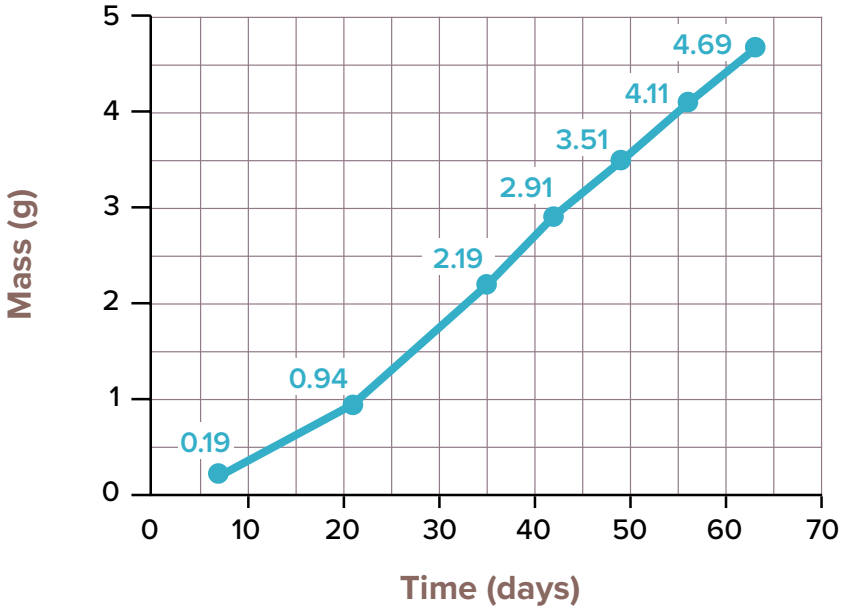
Answers

WORKSHEET 4.1 – Graphing Growth Rates Over Time

1. **Organism 1:** Pig Growth Rates Over Time



2. **Organism 2:** Broiler Growth Rates Over Time



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Answers

WORKSHEET 4.2 – How Mushrooms Are Grown

1. **Mushroom Culture:** Growing the mycelium of a mushroom that has been chosen due to strong genetics on a growth medium such as agar.
2. **Sterilised Grain:** The mycelium is transferred to a sterilised grain where it uses the grain to grow. This is known as grain spawn.
3. **Expanding Spawn:** To be used on a commercial scale, the grain spawn is simply expanded onto more sterilised grain.
4. **Bulk Substrate:** The expanded grain spawn is transferred to a growing medium such as straw, hardwoods, sawdust, and compost. The type will depend on the mushroom.
5. **Colonisation:** The mycelium will use the substrate for energy and nutrition and will grow throughout the substrate.
6. **Pinning:** This is how mushroom growth is induced. External conditions are altered to replicate nature e.g. cooler temperatures and higher humidity.
7. **Fruiting and Harvesting:** Once mushrooms have pinned they can double in size every 24 hours. Substrates can produce multiple crops or 'flushes'.

WORKSHEET 4.3 – Commercial Mushroom Growing

1. Straw, water and poultry litter.
2. About 23–24 days.
3. Air, water.
4. It is to kill undesirable contaminants such as insects, microbes, and pathogens.
5. About 15–17 days.
6. The function of a casing layer is to trigger the mushrooms to switch from a vegetative growth to a reproductive or fruiting growth.
7. Carbon dioxide, temperature, and humidity.

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