# Biology Module 7: How are diseases transmitted?



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## Overview

**Stage and Learning Area**: Biology Stage 6

**Description**: this learning sequence addresses the first inquiry question in Module 7 – How are diseases transmitted? The sequence below outlines a variety of activities to address the syllabus content points of this inquiry question and a range of Working Scientifically skills.

**Duration**: while timing will vary based on the mode of delivery, differentiation strategies employed and class or school context, this series of activities should take approximately 2 weeks.

## Information for teachers

### Introduction

Infectious diseases can significantly impact human health and that of other animals and plants. This can have devastating impacts on agricultural production. These impacts are not equal throughout the world. Prevention of infectious diseases relies on limiting transmission of pathogens and is dependent upon a range of biological, economic, social and governance factors. The content focus for this lesson sequence is on causes of infectious disease.

This learning sequence is designed to build skills gradually throughout the task. Teachers may wish to modify the task or focus on specific sections based on their class context, student ability and current mastery of content.

This content also links with other sections of the Biology Stage 6 course, including:

* Module 1: Investigating prokaryotic and eukaryotic cell structures
* Module 4: Impacts of disease in ecosystem relationships
* Module 5: Sexual and asexual reproduction of fungi, protozoans and bacteria
* Modules 5 and 6: The effect a virus can have on DNA replication
* Module 6: Genetic engineering practices to prevent infectious disease
* Module 8: The concepts of epidemiology and the study of disease occurrence in populations and data analysis is a theme that continues into Module 8
* Module 8: The ability of a virus to act as a mutagen to cause cancer for example Human Papillomavirus (HPV).

### Outcomes

A student:

* develops and evaluates questions and hypotheses for scientific investigation **BIO12‑1**
* designs and evaluates investigations in order to obtain primary and secondary data and information **BIO12-2**
* conducts investigations to collect valid and reliable primary and secondary data and information **BIO12-3**
* selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media **BIO12-4**
* analyses infectious disease in terms of cause, transmission, management and the organism's response, including the human immune system **BIO12-14**

[Biology Stage 6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/stage-6-science/biology-2017) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2017.

## Teaching and learning activities

The discovery that infection by a pathogen is the cause of disease was essential to our understanding of disease treatment and prevention. Recognising the mode of transmission is also essential in preventing the spread of infectious disease.

The lesson activities have been designed so that they can be transferred into school-based teaching and learning programs. Reflecting on and evaluating learning activities should be an ongoing process that happens throughout the delivery of this sequence. Teachers should document their evaluation of learning activities in the reflection and evaluation column within their teaching and learning programs.

Learning intentions and success criteria have been included as a guide for teachers.

**Differentiation consideration**: Learning intentions should not be differentiated. All students need access to the same core content, big ideas and concepts. Differentiation should be evident in the success criteria, or the activities/support needed to achieve the success criteria (Wiliam and Leahy 2015). Teachers may co-construct the success criteria with students or adjust them to suit their class context, for example, using the strategies and resources for curriculum planning on the [Planning, programming and assessing 7-12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

General advice for differentiating this content has been provided, however teachers should differentiate lesson activities to meet the school context and individual needs of students. Further advice to support Aboriginal and Torres Strait Islander students, EALD students, students with a disability and/or additional needs and High Potential and gifted students can be found on the [Planning, programming and assessing 7-12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

### Aboriginal pedagogies

This resource has been designed to incorporate Aboriginal pedagogies. Symbols are used to identify where an Aboriginal pedagogy has been included. Further information on Aboriginal pedagogies can be found on the [8 Ways website](https://www.8ways.online/about). It is recommended that professional learning on Aboriginal pedagogies be undertaken before implementation in your classroom.

Figure 1 – 8 Ways Aboriginal Pedagogy framework

8 ways Aboriginal Pedagogy Framework showing the 8 aboriginal pedagogies: 
Non-linear
Non-verbal
Community Links
Story Sharing
Land Links
Deconstruct/Reconstruct
Symbols and Images
Learning Maps

‘8 Aboriginal Ways of Learning’ by Country Western NSW Baakindji, Gamilaraay, Wiradjuri, Yuwaalaraay, Ngiyampaa, Wangkumarra is in the [Public Domain](https://creativecommons.org/publicdomain/mark/1.0/).

This framework belongs to a place, not a person or organisation. They came from Country Western NSW Baakindji, Gamilaraay, Wiradjuri, Yuwaalaraay, Ngiyampaa, Wangkumarra.

Embedding Aboriginal pedagogies enables teachers to include Aboriginal perspectives, while maintaining the focus on core curriculum content. Aboriginal perspectives are not found in Aboriginal content, but in Aboriginal processes. By embedding Aboriginal processes, teachers can contribute to ensuring every Aboriginal child and young person achieves their potential through education as agreed in the [Partnership Agreement with the NSW AECG 2020-2030, Walking Together, Working Together](https://education.nsw.gov.au/teaching-and-learning/aec/aboriginal-education-consultative-group-partnership-agreement). It also supports the [10-Year Plan – Footprints to the Future [PDF 151KB]](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/aec/media/documents/Footprints_to_the_Future.pdf) where all learners and teachers develop an understanding of Aboriginal heritage and culture.

## Lesson sequence

|  |  |  |
| --- | --- | --- |
| Outcomes and/or syllabus content | Teaching and learning activities | Differentiation and/or adjustments |
|  | 1. Introduce the inquiry question by discussing that infectious diseases can significantly impact human health and that of other animals and plants and can have devastating impacts on agricultural production. These impacts are not equal throughout the world. Prevention of infectious diseases relies on limiting transmission of pathogens and is dependent upon a range of biological, economic, social and governance factors. 2. Assist students to create a mind map to highlight and connect key ideas that will be addressed in this inquiry question. In traditional Aboriginal pedagogy, the teacher and learner create ‘a concrete, holistic image of the tasks to be performed. That image serves as an anchor or reference point for the learner’ (Hughes and More 1997). Learning maps are a visual pathway of what students will learn.   Symbol of 8 ways pedagogy - Learning mapsLearning maps | **Teaching and learning activity 2:**  [Online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?cache_id=ebe94) or teacher developed scaffolds may support some students to complete this activity. |
| Describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including: (ACSBL097, ACSBL098, ACSBL116, ACSBL117) classifying different pathogens that cause disease in plants and animals (ACSBL117) | **Learning intention:**   * **to identify causes of infectious disease**   **Success criteria:**   * Identify and describe the different types of pathogens including bacteria, viruses, fungi, prions, protozoans and macro parasites. * Classify each pathogen as microorganisms, macroorganisms and non-cellular pathogens. * Identify diseases caused by the different types if pathogens.   **Teaching and learning activities:**   1. Recalling students’ prior knowledge of cell structure is important to assist in differentiating between different types of pathogens. Conduct a pre-assessment of student learning using a [quick quiz](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?cache_id=ebe94), questioning or all student response systems, eg mini-whiteboards or Kahoot. Students may need to review cell structure or function and prokaryotic and eukaryotic cells from Year 11 Module 1. 2. Develop student understanding of key terms including disease, health, pathogen, infectious and non-infectious. These should be explored with teacher support. Students build their own glossary for this lesson sequence as a large amount of new terminology will be introduced. 3. Students provide peer feedback on glossary of key terms. Students update or adjust their glossaries based on feedback provided. 4. Students construct a table to identify and describe distinguishing features of bacteria, fungi, virus, prions and macroparasites (Bio12-7). Drawing and labelling simple diagrams of each type of pathogen can assist students in understanding the distinguishing features of each. Constructing an appropriate table is a key skill for students to develop.   Symbol of 8 ways pedagogy - symbols and images Symbols and images.   1. Students construct a dichotomous key on the pathogens from their table in activity 4 to further demonstrate their understanding of the distinguishing features of each type of pathogen.   Symbol of 8 ways pedagogy - Deconstruct reconstruct Symbol of 8 ways pedagogy - symbols and images Deconstruct reconstruct and symbols and images.   1. Assessment as learning: present students with sample HSC questions on pathogens to test for understanding. Relevant examples may include:  * Question 21a, [2021 HSC Examination [PDF 1.64MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/c9432b66-4069-4e17-996d-63b84842f38c/2021-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-c9432b66-4069-4e17-996d-63b84842f38c-nZIO5KY) * Question 21b, [2022 HSC Examination [PDF 1MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4d7cc407-6780-4874-82bb-bb530c3791ab/2022-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4d7cc407-6780-4874-82bb-bb530c3791ab-ohVCd9Z)   Explicit guidance in unpacking and responding to a HSC style question or a class discussion of the marking criteria and/or exemplar responses can build student understanding and address any misconceptions.   1. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 4**:  Some students may find it difficult to construct the table and may require teacher guidance. See [Student Resource 1](#_Resource_1:_Classifying) for an example that could be used. Some students may also benefit from completing the first row of the table with support.  **Teaching and learning activity 5:** The [ultimate guide to constructing a dichotomous key (9:15)](https://www.youtube.com/watch?v=pvzoIeWxsI0) can be used to revise this concept if needed. Closed captions should be enabled for students.  **Teaching and learning activity 6:** Students may benefit from brainstorming key terms that could be included within their responses. Encourage students to use the glossary they created earlier in this lesson sequence.  **Teaching and learning activity 7:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including: design and conduct a practical investigation relating to the microbial testing of water or food samples. | **Learning intention:** to identify causes of infectious disease.  **Success criteria:**   * Design and conduct a scientifically valid and reliable experiment. * Write a clear and appropriate scientific method. * Outline methods used for microbial testing of food and water samples. * Identify the difference between bacterial and fungal colonies on agar plates. * Describe methods used to ensure sterile conditions.   **Teaching and learning activities:**   1. This short video on [foodbourne diseases (1:58)](https://education.nationalgeographic.org/resource/foodborne-diseases/) from National Geographic provides a brief overview that can be used to stimulate class discussion. 2. Practical Investigation: students design and conduct a practical investigation relating to the microbial testing of water or food samples. (BIO12-1, BIO12-2, BIO12-3, BIO12-4, BIO12-5, BIO12-7) 3. Students should develop an inquiry question or hypothesis to be addressed and design and conduct the experiment, ensuring they account for accuracy, reliability and validity. 4. Particular attention should be paid to the importance of a control and the use of sterile techniques. 5. Students should conduct a thorough risk assessment for this experiment. **Note:** teachers must follow the guidelines set out in the CSIS package for [safe use of biological materials/organisms/tissues](https://education.nsw.gov.au/inside-the-department/facilities-assets-and-equipment/school-infrastructure-nsw/knowledge/directorates/operations/technical-services/compliance-and-environment/chemical-safety-in-schools/section-3--curriculum-support-documents/3-2-6--safe-use-of-biological-materials-organism-tissues) and complete their own risk assessment for this task. 6. Students submit their final practical report for teacher feedback.   Aboriginal learners may test knowledge non-verbally through experience, introspection and practice, thereby becoming critical thinkers who can judge the validity of new knowledge independently.  Symbol of 8 ways pedagogy - Non-verbalNon-verbal.   1. Students complete a [DARTs activity](https://www.english-efl.com/methodology/methodology-teaching-dart/) using the following texts: 2. [Investigations into Central Coast Salmonella outbreak continue](https://www.health.nsw.gov.au/news/Pages/20221207_02.aspx) 3. [Wet weather blamed for parasites in Sydney’s drinking water](https://www.dailytelegraph.com.au/news/nsw/wet-weather-blamed-for-parasites-in-sydneys-drinking-water/news-story/d51ae3b45ef5db767b8ed6775222e656)   Students begin the activity by coding each text – underlining key terms, circling sections of the text that highlight how transmission has occurred and placing a question mark above any unfamiliar terms.  Have students record any questions they still have at the end of reading both texts. Lead a class discussion on each article, with a focus on how each pathogen was transmitted.   1. Students complete the following practice HSC questions: 2. Question 7, [2020 HSC Examination [PDF 408KB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4b8f9b2c-0b39-42f2-a8a0-b193d2ece6c7/2020-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4b8f9b2c-0b39-42f2-a8a0-b193d2ece6c7-odYrDzC) 3. Question 16, [2021 HSC Examination [PDF 1.64MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/c9432b66-4069-4e17-996d-63b84842f38c/2021-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-c9432b66-4069-4e17-996d-63b84842f38c-nZIO5KY) 4. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 1**: this video does not include closed captions. A transcript should be provided for students if needed. Vocabulary-building discussions can take place during the viewing of this video.  **Teaching and learning activity 2:** Enrichment activity: showcase examples of ‘[Agar Art](https://asm.org/Events/ASM-Agar-Art-Contest/Home)’.  A [report scaffold](#_Resource_2:) has been developed for this investigation to support students in planning their investigation.  Extension: Students could investigate how these tests applied in the food industry.  **Teaching and learning activity 3:** A [‘What in the word’ scaffold](#_Resource_3:_‘What) may support students understanding of challenging vocabulary within the texts.  **Teaching and learning activity 4:** Explicit guidance in unpacking and responding to a HSC style question or a class discussion of the marking criteria and/or exemplar responses can build student understanding and address any misconceptions.  **Teaching and learning activity 5:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including: investigate modes of transmission of infectious diseases, including direct contact, indirect contact and vector transmission. | **Learning intention:**   * To identify causes of infectious disease.   **Success criteria:**   * Discuss methods of disease transmission including direct contact, indirect contact and vectors. * Define zoonotic diseases.   **Teaching and learning activities:**   1. Introduce the story of [John Snow](https://blogs.cdc.gov/publichealthmatters/2017/03/a-legacy-of-disease-detectives/) to highlight the importance of understanding how a disease is transmitted. The Aboriginal process of story sharing aligns with the quality teaching element ‘Narrative’. In a quality teaching context, narrative refers to the use of stories to help bring to life and contextualise lesson content.   Symbol of 8 ways pedagogy - Story sharing  Story sharing.   1. Teacher led discussion to compare and contrast modes of disease transmission including direct contact, indirect contact and vectors. This [infographic](https://education.nationalgeographic.org/resource/methods-disease-transmission/) from National Geographic provides some useful examples. A discussion of the Covid-19 virus could be used to stimulate discussion and provide examples of the different types if transmission.   Symbol of 8 ways pedagogy - Story sharing Story sharing.   1. Students conduct a practical investigation: Simulating the spread of an infectious disease. Using simple reagents, students simulate the spread of a simple imaginary disease to explore factors that affect the rate of infection, the challenges of epidemiology, and measures which can help prevent the spread of disease.   Symbol of 8 ways pedagogy - Non-verbalNon-verbal.   1. Students complete the BioInteractive tutorial: [Stopping Mosquito-Borne Disease](https://www.biointeractive.org/classroom-resources/stopping-mosquitoborne-disease). 2. Assessment as learning: students complete HSC style questions on disease transmission. 3. Question 4, [2020 HSC Examination [PDF 408KB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4b8f9b2c-0b39-42f2-a8a0-b193d2ece6c7/2020-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4b8f9b2c-0b39-42f2-a8a0-b193d2ece6c7-odYrDzC) 4. Question 21a, [2022 HSC Examination [PDF 1MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4d7cc407-6780-4874-82bb-bb530c3791ab/2022-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4d7cc407-6780-4874-82bb-bb530c3791ab-ohVCd9Z) 5. Question 30, [2022 HSC Examination [PDF 1MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4d7cc407-6780-4874-82bb-bb530c3791ab/2022-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4d7cc407-6780-4874-82bb-bb530c3791ab-ohVCd9Z) 6. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 2:** As an extension activity the process of Zoonosis and examples of zoonotic disease could be investigated.  **Teaching and learning activity 4:** Teacher support or guidance may be needed due to the complex terminology used in this tutorial.  **Teaching and learning activity 5:**  Explicit guidance in unpacking and responding to a HSC style question or a class discussion of the marking criteria and/or exemplar responses can build student understanding and address any misconceptions.  **Teaching and learning activity 6:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including: investigating the transmission of a disease during an epidemic. | **Learning intention:**   * To identify causes of infectious disease.   **Success criteria:**  Define the terms epidemic and pandemic.   * Identify key factors that affect transmission of disease in an epidemic/pandemic. * Describe how transmission of a disease occurs in a pandemic, citing a specific example.   **Teaching and learning activities:**   1. Students construct definitions of the terms epidemic and pandemic, using supporting examples to demonstrate the difference. Studying the etymology of the words can assist students in their understanding.   Symbol of 8 ways pedagogy - Deconstruct reconstruct Deconstruct reconstruct.   1. Students use the online simulation – Interactivate: [Spread of disease](http://www.shodor.org/interactivate/activities/SpreadofDisease/) to investigate transmission of an infectious disease. Students can modify the sick rate, recovery rate, susceptibility rate, population size and other factors to determine how this influences disease transmission in a population. An alternative or additional interactive activity is [Plague Inc.](https://www.ndemiccreations.com/en/22-plague-inc). Following the simulation students respond to the question: Identify key factors that affect transmission of disease in an epidemic or pandemic.   Symbol of 8 ways pedagogy - Non-verbalNon-verbal.   1. Group research activity: Students break into small groups and research an example of an epidemic or pandemic. Students design a presentation that is part of a [gallery walk](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/555#.Yd5Y99Ik-tI.link) to highlight key factors that affect transmission of disease in an epidemic or pandemic. Students can hypothesise as to why particular epidemics did not become pandemics. 2. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 2:** Extension task: [West Nile Virus: Vectors and Hosts Game](https://www.biointeractive.org/classroom-resources/west-nile-virus-vectors-and-hosts-game) and [Ebola: Disease Detectives](https://www.biointeractive.org/classroom-resources/ebola-disease-detectives) from BioInteractive can be used to extend concepts and link to other modules – eg DNA sequencing from Module 5.  **Teaching and learning activity 3:** Teachers may wish to differentiate the group task in several ways including:   * creating a list of epidemics or pandemics to choose from * identifying a series of questions or key points that must be addressed * providing specific texts or websites to assist students in their research * allowing choice in [expression](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning#tabs1) of student research to their peers.   **Teaching and learning activity 4:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Investigate the work of Robert Koch and Louis Pasteur, to explain the causes and transmission of infectious diseases, including:   * Koch’s postulates * Pasteur’s experiments on microbial contamination | **Learning intention:** to investigate the contributions of key scientists to our understanding of disease.  **Success criteria:**   * Describe the work of Pasteur including his work on fermentation, spontaneous generation and vaccination. * Model and describe Pasteur’s experiment to disprove spontaneous generation. * Describe Koch’s contributions to our understanding of disease. * Identify and apply Koch’s postulates to a variety of scenarios.   **Teaching and learning activities:**   1. Introduce this content by watching the following video on [Louis Pasteur (3:17)](https://www.youtube.com/watch?v=OXdbQ1JkX7c). Students use a note-making strategy to summarise the impact Pasteur had on our understanding and management of disease.   Symbol of 8 ways pedagogy - Story sharing Story sharing.   1. Practical investigation: Students plan and conduct Pasteur’s swan neck flask experiment. There is opportunity to address Working Scientifically outcomes BIO12-1, BIO12-2 and BIO12-3 in this investigation. Students should also consider the validity and reliability of their investigation. Conduct a class discussion, provide feedback and revisit any key concepts at the completion of the task to ensure students have successfully met all success criteria for the investigation.   Symbol of 8 ways pedagogy - Non-verbal Non-verbal   1. Teacher explicitly introduces the work of Robert Koch, including an explanation of Koch’s contribution to our understanding of disease and Koch’s postulates. 2. Students construct a flowchart to demonstrate the 4 key steps of Koch’s postulates. Students then apply these postulates to a specific scenario for example, how Barry Marshall applied Koch’s 4 postulates to show that Helicobacter pylori bacteria cause stomach ulcers to check for understanding. An examination style question and sample responses on this content can be found in the [Module 7 HSC question guide [DOCX 948KB]](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Feducation.nsw.gov.au%2Fcontent%2Fdam%2Fmain-education%2Fteaching-and-learning%2Fcurriculum%2Fkey-learning-areas%2Fscience%2Fs-6%2Fhsc-hub%2Fscience-biology-module7-Infectious-disease-s6.docx&wdOrigin=BROWSELINK).   Symbol of 8 ways pedagogy - Deconstruct reconstruct Deconstruct reconstruct.   1. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 1** Enable closed captions for this video.  This is an opportunity to encourage students to share their stories and experiences on disease and disease management.  **Teaching and learning activity 2:** A [scaffold](#_Resource_4:_Pasteur) for this investigation may assist students with planning and conducting this experiment.  **Teaching and learning activity 4:** Extension task: students investigate Fredrich and Relman’s 21st century postulates.  Should students require further opportunities to practice and revise this content, teacher-led unpacking and discussion or independent student completion of the following questions may improve understanding and application of knowledge:   * Question 21b, [2021 HSC Examination [PDF 1.64KB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/c9432b66-4069-4e17-996d-63b84842f38c/2021-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-c9432b66-4069-4e17-996d-63b84842f38c-nZIO5KY) * Question 10 and 11, [2022 HSC Examination [PDF 1MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/4d7cc407-6780-4874-82bb-bb530c3791ab/2022-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-4d7cc407-6780-4874-82bb-bb530c3791ab-ohVCd9Z)   **Teaching and learning activity 5:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Assess the causes and effects of diseases on agricultural production, including but not limited to:   * plant diseases * animal diseases | **Learning intention:** make informed judgements on the impacts of infectious disease.  **Success criteria:**   * Define the term agriculture and describe its importance in Australia. * Identify and describe a disease caused by a plant and animal pathogen and assess its impact on agriculture. * Extract information relating to the causes, effects and impacts of agricultural diseases from primary and secondary sources. * Assess the impact of plant and animal diseases on agriculture.   **Teaching and learning activities:**  **Note:** a detailed lesson sequence including sample responses, marking guidelines and student resources is available on the [Universal Resource Hub](https://resources.education.nsw.gov.au/detail/CUR-JR220610143047).   1. Students engage in a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to discuss what is meant by the term ‘agriculture’ to elicit evidence of prior knowledge. Aboriginal and Torres Strait Islander agriculture and practices should also be discussed to highlight the importance of agriculture in Australia. [Food and fibre production – An Aboriginal Perspective: Stage 5 and 6 Agriculture [PDF 1.66MB]](https://www.nswdpi-schools-program.com/_files/ugd/af7c66_de601df62abf457d819414c389e7b5d1.pdf?index=true) from the Department of Primary Industries provides relevant reference material to support class discussion. Following the activity, students record a definition for the term ‘agriculture’ and engage in a class discussion on the different agricultural industries in their local area and Australia more broadly.   Symbol of 8 ways pedagogy - Land linksLand links   1. Watch the following videos on Panama disease: [Bananas As We Know Them Are Doomed (14:17)](https://www.youtube.com/watch?v=2Bm5NWCMlPo). and ‘Keeping bananas on the table’: [Keeping bananas on the table: The impact of Panama disease to QLD (2:39)](https://www.youtube.com/watch?v=kzoBO95gQYQ&t=1s). Students should be encouraged to make their own notes throughout the videos. Following each video, use questioning techniques to check for understanding. Questions and sample answers can be found in the lesson sequence linked above. 2. Conduct an explicit demonstration on unpacking an examination style question and planning a written response.   Symbol of 8 ways pedagogy - Deconstruct reconstruct Deconstruct reconstruct.   1. Students use their notes from the videos and other secondary sources to construct a table on agricultural diseases. [Peer feedback [PDF 237KB]](https://www.aitsl.edu.au/docs/default-source/feedback/aitsl-peer-feedback-stratedy.pdf?sfvrsn=372dec3c_2) can be used following the completion of the table to ensure students have included all relevant information. 2. Students are presented with a question about a hypothetical outbreak of Anthrax in Orange. This can be found in the lesson sequence on the [Universal Resource Hub](https://resources.education.nsw.gov.au/detail/CUR-JR220610143047). This question can be used to assess learning and can be printed or posted to a Learning Management System. After completing the examination style questions, students are provided with the marking guidelines to reflect on, and if necessary, improve their work.   All of the animals, plants and places in land and water carry knowledge and can help us learn. Also, the things we are learning can affect them. Research describes Aboriginal pedagogy as group-oriented, localised and connected to real-life purposes and contexts.  Symbol of 8 ways pedagogy - Land links Symbol of 8 ways pedagogy - Community links  Land links and community links   1. Refer students to the success criteria for this lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 2:** Giving students a choice as to how to demonstrate their thinking and synthesis of the ideas in the videos supports the specific learning needs of high potential and gifted students.  **Teaching and learning activity 4:** EAL/D students or students with additional needs may require support to access secondary sources used for the research aspects of this task. The teacher may wish to provide a list of suitable websites to the students.  Some students may find it difficult to construct the table. The sample table provided can be used as a guide. Students may also benefit from completing the first row of the table with teacher guidance.  Opportunities to extend student thinking may include evaluating the reliability, validity and accuracy of the secondary sources used in their research (see Page 11 of [Evaluating scientific data Stage 4-6 [DOCX 253KB]](https://education.nsw.gov.au/content/dam/main-education/teaching-and-learning/curriculum/key-learning-areas/science/media/documents/evaluating-scientific-data-S4-to-s6.docx) for further support). Students could also be asked to compare and contrast the causes and effects of animal and plant diseases.  **Teaching and learning activity 6:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
| Compare the adaptations of different pathogens that facilitate their entry into and transmission between hosts (ACSBL118) | **Learning intention:** to investigate features of pathogens that aid in their ability to cause disease.  **Success criteria:**   * Define adaptation. * Identify and describe adaptations of pathogens that increase their ability to transmit between organisms or enter organisms.   **Teaching and learning activities:**   1. Students recall the definition of an adaptation from Year 11. 2. Students analyse specific pathogens to identify adaptations as to whether they aid transmission OR entry, for example anthrax and the use of spores. HHMI Biointeractive provides a number of specific examples including [Malaria](https://www.biointeractive.org/classroom-resources/malaria-human-host), [E-Coli](https://www.biointeractive.org/classroom-resources/how-pathogenic-e-coli-infection-begins), [Dengue Virus](https://www.biointeractive.org/classroom-resources/dengue-virus-life-cycle), [HIV](https://www.biointeractive.org/classroom-resources/hiv-life-cycle) and [Rhinovirus](https://www.biointeractive.org/classroom-resources/rhinovirus) evade the immune response to cause infection. 3. Students construct a summary of adaptations that aid transmission or entry. 4. Assessment as learning: Students complete Question 31, [2019 HSC Examination [PDF 2.14MB]](https://educationstandards.nsw.edu.au/wps/wcm/connect/7b264221-6f96-44c5-a1e9-b3e3ca32d029/2019-hsc-biology.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-7b264221-6f96-44c5-a1e9-b3e3ca32d029-nNezTl1) 5. Refer students to the success criteria for this section of the lesson sequence and have students reflect on their achievement. | **Teaching and learning activity 1:** Students may benefit from revisiting key Year 11 content on adaptations.  **Teaching and learning activity 2:** Teachers may wish to focus on a small number of specific examples to build student understanding. Guided questions or scaffolds can be used to assist students in their classification of each adaptation.  **Teaching and learning activity 4:** Explicit guidance in unpacking and responding to a HSC style question or a class discussion of the marking criteria and/or exemplar responses can build student understanding and address any misconceptions.  **Teaching and learning activity 5:** Further support, targeted teacher feedback or explicit instruction may be needed if students have not met any of the Success criteria for the lesson sequence. |
|  | 1. Students refer to their mind map from the start of this lesson sequence. Students can make additions and further connect key ideas from this inquiry question. Students can also reflect on the knowledge gained and their overall understanding of the inquiry question – ‘How are diseases transmitted?’   Symbol of 8 ways pedagogy - Learning maps Learning maps |  |

## Student resources

### Resource 1: classifying pathogens

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of Pathogen | Prokaryotic, eukaryotic or non-cellular | Distinguishing features of pathogen | Two diseases caused by pathogen | Simple diagram |
| Bacteria |  |  |  |  |
| Virus |  |  |  |  |
| Fungi |  |  |  |  |
| Protozoan |  |  |  |  |
| Macroparasite |  |  |  |  |
| Prion |  |  |  |  |

### Resource 2: microbes practical investigation

Your task is to design and conduct a practical investigation relating to the microbial testing of water or food samples.

**Some important points:**

* Sterile processes are extremely important during this investigation to ensure valid results.
* Technique is also very important: read the following information on using [inoculating loops](https://www.scienceprofonline.com/microbiology/how-to-use-inoculation-loop-to-transfer-bacteria.html).

Plan and conduct your investigation using the planning tool below:

|  |  |
| --- | --- |
| **Title:** |  |
| **Aim:** |  |

|  |
| --- |
| **Hypothesis** |
|  |
|  |

**Variables** (dependent, independent and controlled) and a control

|  |  |
| --- | --- |
| * Dependent variable: |  |
| * Independent variable: |  |
| * Controlled variables: |  |
| * Controls: |  |

**Materials:**

|  |
| --- |
|  |

**Risk assessment**:

|  |  |  |
| --- | --- | --- |
| Hazard | Risk | Precaution |
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**Method:**

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**Results:** (include a table and graph)

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**Discussion**

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| 1. Justify and evaluate the use of a control in this experiment. |
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| 1. Describe some of the procedures used to prevent the contamination of samples. How could these procedures be improved? |
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| 1. Were your results as you expected? Why or why not? |
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| --- |
| **Conclusion** |
|  |
|  |

**Extension**: How are these tests applied in the food industry?

### Resource 3: ‘What in the word’ vocabulary scaffold

|  |  |
| --- | --- |
| Word: |  |
| Found in: |  |
| Sentence used: |  |
| I think it means: |  |
| Clues I used: |  |
| Dictionary definition: |  |
| It makes me think of: |  |
| Use it in a sentence: |  |

|  |  |
| --- | --- |
| Word: |  |
| Found in: |  |
| Sentence used: |  |
| I think it means: |  |
| Clues I used: |  |
| Dictionary definition: |  |
| It makes me think of: |  |
| Use it in a sentence: |  |

### Resource 4: Pasteur and Spontaneous Generation background information

Whenever food or other organic matter is decaying, it is always found to contain microorganisms. For a long time, people believed that the decaying substance itself brought the microorganisms into existence – this idea was known as ’spontaneous generation’.

##### Aim:

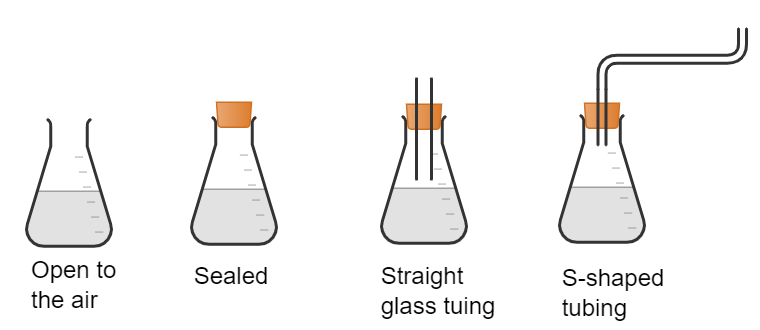
|  |
| --- |
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##### Hypothesis:

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##### Method

1. Place 50mL of nutrient broth into 4 conical flasks, set up as follows:



1. Boil the broth in each flask for 5 minutes, so that steam escapes from each.

**Question** – why is this step important?

|  |
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1. Seal the relevant flasks with their rubber stoppers as soon as possible after boiling.
2. Set the flasks aside and examine them over the following week. Look for any signs of decay, such as the broth in any of the flasks becoming cloudy.

##### Variables

Identify the dependent, independent and controlled variables for this experiment.

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##### Results

Complete the table below, describing your observations for each flask at the end of a week.

|  |  |
| --- | --- |
| Flask | Description of contents |
| Open |  |
| Sealed |  |
| Straight tubing |  |
| S-shaped tubing |  |

##### Discussion

1. Which flasks showed signs of decay? Explain why.

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| --- |
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1. Which flasks showed no signs of decay? Explain why.

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1. What was the purpose of the flask that was completely sealed?

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1. Discuss the significance of Pasteur's results for (a) medicine and (b) industry.

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## Support and alignment

**Resource evaluation and support**: All curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance and effectiveness. For additional support and advice, or to provide feedback, contact the Science Curriculum team by emailing [Science7-12@det.nsw.edu.au](mailto:Science7-12@det.nsw.edu.au).

**Differentiation:** Further advice to support Aboriginal and Torres Strait Islander students, EALD students, students with a disability and/or additional needs and High Potential and gifted students can be found on the [Planning programming and assessing 7-12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

**Assessment**: further advice to support formative assessment is available on the [Planning programming and assessing 7-12](https://education.nsw.gov.au/teaching-and-learning/curriculum/planning-programming-and-assessing-k-12/planning-programming-and-assessing-7-12) webpage.

**Professional learning**: Relevant professional learning is available on the [Science statewide staffroom](https://education.nsw.gov.au/teaching-and-learning/curriculum/statewide-staffrooms) and through the [HSC Professional Learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/hsc-pl) strategy.

**Related resources**: Further resources to support Stage 6 Biology can be found on the [HSC hub](https://www.hschub.nsw.edu.au/) and the [Science Curriculum page](https://education.nsw.gov.au/teaching-and-learning/curriculum/science).

**Consulted with**: Subject matter experts.

**Alignment to system priorities and/or needs**: [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [School Success Model](https://education.nsw.gov.au/public-schools/school-success-model/school-success-model-explained).

**Alignment to the School Excellence Framework**: This resource supports the [School Excellence Framework](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards**: This resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 1.1.2, 1.5.2, 2.2.2, 2.4.2, 2.5.2, 2.6.2, 3.1.2, 3.2.2, 3.3.2, 3.4.2.

**Author**: Science 7-12 Curriculum Team

**Resource**: Lesson sequence

**Creation date**: 17/2/22

**Updated:** 24/1/24

## References

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[Biology Stage 6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/stage-6-science/biology-2017) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2017.

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### Further reading

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