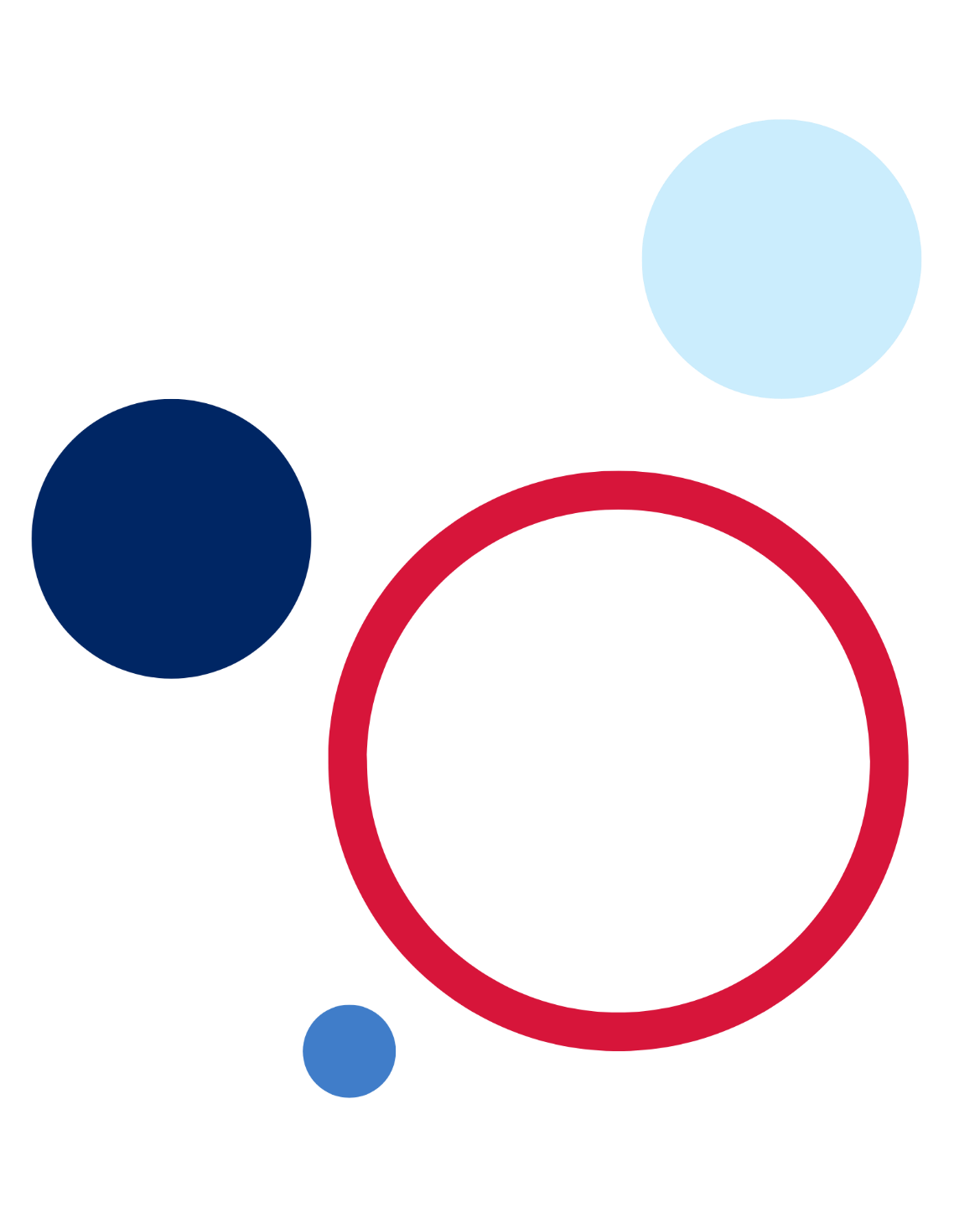
# Biology Stage 6 – learning sequence – RNA and SARS-CoV-2



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## Overview

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

**Description**: this learning sequence is designed for Year 12 students. It ties together concepts from Modules 5, 6 and 7 by investigating the:

* structure of the SARS-CoV-2 virus and how this facilitates its transmission
* role of the RNA genome
* effect of mutation in the RNA genome
* types of vaccines and how they work to prevent disease
* influence of government and economic contexts on the development of mRNA vaccines in Australia.

**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 5 hours.

## Information for teachers

DNA could be described as THE biological molecule of the first 2 decades of this century. The Human Genome Project, genetically modified crops, DNA testing for forensics, parenthood and screening of embryos have all become part of the public consciousness.

Meanwhile, research on RNA was quietly occurring in laboratories all over the world. The first mRNA vaccines were developed against the deadly Ebola virus, but since that virus is only found in a limited number of African countries, it had no commercial development in the U.S.A. It took the SARS-CoV-2 pandemic to thrust RNA into the public spotlight.

### Introduction

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.

### Outcomes

A student:

* selects and processesappropriate qualitative and quantitative data and information using a range of appropriate media **BIO11/12-4**
* analyses and evaluates primary and secondary data and information **BIO11/12-5**
* communicates scientific understanding using suitable language and terminology for a specific audience or purpose **BIO11/12-7**
* **explains natural genetic change and the use of genetic technologies to induce genetic change BIO12-13**
* analyses infectious diseases 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.

### Learning intentions and success criteria

Students:

* understand the measures used to control infectious diseases.

Students can:

* explain how diseases are transmitted
* describe the adaptations of the coronavirus that facilitates its entry into host cells and transmission between hosts
* explain the role of mutation in producing genetic variation
* describe how new variants of coronavirus arise and discuss the consequences of these variants
* explain the role of vaccines in preventing the spread of disease
* describe how vaccines are made and why they are a safe means of preventing the spread of disease
* assess the role of government and collaboration in the development of a biotechnology in Australia.

**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.

## Teaching and learning activities

### Notes for teachers

Activities 2 to 5 use the BioInteractive videos, [Biology of SARS-CoV-2](https://media.hhmi.org/biointeractive/click/covid/index.html). Additional information for teachers is available in BioInteractive’s [educator materials](https://www.biointeractive.org/sites/default/files/media/file/2021-07/BioSARSCoV-Educator-CL.pdf).

The extension activity 6 uses Gavi’s web pages. Gavi is an international organisation – a global Vaccine Alliance, bringing together public and private sectors with the shared goal of saving lives and protecting people’s health by increasing equitable and sustainable use of vaccines.

Activity 8 uses a video from the Royal Institute of Australia as stimulus material.

### Activity 1: brainstorm

Students brainstorm all the terms they have heard in general conversation, media or social media, used to describe Covid-19. This could be single words, phrases or questions. Place each term on a sticky note. In small groups students place their sticky notes into groups on a piece of butcher’s paper/white board. An [affinity diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/576#.Y_1bzPdNEpc.link) can be used for this activity. Ask the students, ‘What criteria have you used to group your words?’

Ask the students to look at other groupings. Ask the students ‘What are the similarities and differences between their groupings and yours?’

### Activity 2: how does SARS-CoV-2 infect people?

Refer to the affinity diagram to determine if students have grouped together:

* the type of pathogen and its different names
* how the virus is transmitted
* how the virus replicates.

Explain that this video, [Biology of SARS-CoV-2 Infection (2:43)](https://media.hhmi.org/biointeractive/click/covid/infection.html) will address these areas. This video provides clear information and animations that provide students with a sufficient understanding of the structure, transmission and replication of the virus. It would be advisable to watch the video without interruption the first time and then replay, pausing at appropriate times to allow discussion and for students to answer questions.

#### Questions

1. What is SARS-CoV-2 an abbreviation of?

**Suggested answer:** Severe Acute Respiratory Syndrome, Coronavirus 2.

1. What are coronaviruses?

**Suggested answer:** A family of viruses.

1. What is Covid-19?

**Suggested answer:** The disease caused by the virus, SARS-CoV-2

1. What organisms do coronaviruses infect?

**Suggested answer:** Humans and other animals

1. What types of diseases do coronaviruses usually cause in humans?

**Suggested answer:** The common cold and more serious respiratory diseases

1. In what way is the nucleic acid that carries the genome for all coronaviruses different from the genomes in most cells?

**Suggested answer:** Coronaviral genome is RNA. Most cells use DNA.

1. What surrounds the genome in the SARS-CoV-2 virus?

**Suggested answer:** A membrane consisting of lipids and proteins called an envelope.

1. How do the spikes of proteins contribute to the name ‘coronavirus’?

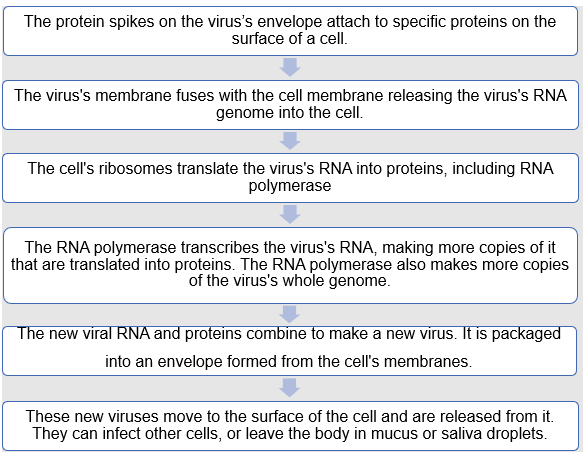
**Suggested answer:** Under a microscope the spike proteins look like a crown.

1. What is the typical mode of transmission for coronaviruses?

**Suggested answer:** Airborne through the mouth or nose.

1. Create a flow chart showing the steps that occur once a coronavirus enters an airway.

**Suggested answer:**



Coronaviruses are not new. In 2002 to2004 an outbreak of SARS occurred. There were 8,098 reported cases of SARS and 774 deaths. This disease was caused by the virus SARS-CoV-1. Scientists have determined that this virus attached to the same proteins (called receptors) on the surface of the cell as SARS-CoV-2. Scientists discovered that the current SARS-CoV-2 is 10 to 20 times more likely to bind to these receptors than the earlier coronavirus was.

1. Predict how this increased chance of binding has affected SARS-CoV-2’s ability to replicate.

**Suggested answer:** SARS-CoV-2 has to bind with the receptors to enter the cell and then replicate. If it is more likely to bind to the receptors, then it is more likely to enter the cell and replicate.Therefore, SARS-CoV-2 is able to replicate much more rapidly than the earlier version of SARS.

### Activity 3: how are new strains of SARS-CoV-2 formed?

Refer to the affinity diagram to determine if students mentioned mutations or strains of the virus such as alpha, delta and omicron. Explain that this video, [SARS-CoV-2 Evolution (2:47)](https://media.hhmi.org/biointeractive/click/covid/evolution.html) explains the process and types of mutation.

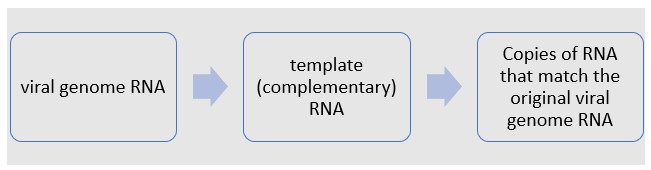
#### Questions

1. Compare the number or proteins encoded by the SARS-CoV-2 genome with those encoded by the human genome.

**Suggested answer**: The SARS-CoV-2 genome codes for 30 proteins. This is less than 0.1% of the proteins encoded by human genomes.

1. Draw a flow chart to show the steps in viral RNA replication.

**Suggested answer:**



1. Explain how the template RNA differs from the viral genome RNA.

**Suggested answer:** The genomic RNA consists of the four nucleotides A, U, C and G. The template RNA is made up of complementary bases. C is complementary to G. A is complementary to U.

1. What are errors in the genome replication process called?

**Suggested answer**: Mutations.

1. How can the nucleotide sequence be altered?

**Suggested answer:** A nucleotide can be substituted with a different nucleotide, (a substitution), added in the wrong place (an insertion), or left out (a deletion).

1. How does a virus developing a mutation affect viruses produced by it?

**Suggested answer** When the mutated virus infects another cell, all the new viruses replicated from it will have this same mutation.

1. How could a mutation provide a selective advantage to the virus?

**Suggested answer:** If the mutation helped the virus replicate or infect other cells or host it would provide a selective advantage. The mutant virus would become more common in a population over time.

1. What would be the long-term effect on the virus if a mutation made the virus less effective at replication or infection.

**Suggested answer**: These viruses would become less common in a population over time.

1. Why is it important to track mutations (including neutral mutations) in viruses?

**Suggested answer** Tracking mutations in viruses can help determine where an outbreak started and how it spread. Understanding how virus populations change over time can also help scientists develop treatments and vaccines.

Students investigate the mutations of SARS-CoV-2 that were observed in different states of the USA, by undertaking questions 13 and 14 of the BioInteractive activity on page 4 of [Biology of SARS-CoV-2 Student Worksheet (Version 2)](https://www.biointeractive.org/sites/default/files/media/file/2021-07/BioSARSCov2-StudentWS2-CL.pdf). Students analyse the data to predict the order in which the viruses evolved and justify their prediction.

### Activity 4: how can we detect the presence of SARS-CoV-2?

Return to the affinity diagrams to determine if students have referred to the various tests for SARS-CoV-2. Ask the students if they know what the different tests are detecting.

Students watch the BioInteractive video [Detection (2:22)](https://media.hhmi.org/biointeractive/click/covid/detection.html) and complete the table to show how the presence of the virus is detected.

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Tests for active infection or past infection | What body fluid is tested? | What is detected? |
| **RT-PCR (reverse transcriptase polymerase chain reaction)** | Active | saliva or nasal cells | Pieces of the virus’s RNA genome |
| **RAT (rapid antigen test)** | Active | saliva or nasal cells | Pieces of viral proteins (antigens) |
| **Antibody** | Past infection | blood | Antibodies that are used to fight the virus |

For further information refer to [Coronavirus Testing Basics](https://www.fda.gov/consumers/consumer-updates/coronavirus-testing-basics) and [How do rapid antigen tests work?](https://cosmosmagazine.com/health/rapid-antigen-tests-common-mistakes)

### Activity 5: What is the difference between all those different vaccinations?

Refer to the affinity diagram to identify words and phrases relating to vaccination. Students may want to add more questions or comments now they have viewed the previous videos. View the BioInteractive video [Vaccination (4:30)](https://media.hhmi.org/biointeractive/click/covid/vaccination.html), which gives a clear description of the different types of vaccines.

#### Questions

1. Complete the table to define the terms.

**Suggested answer:**

|  |  |
| --- | --- |
| Term | Description |
| **Viral antigen** | Viral proteins recognised by the immune system |
| **Immune response** | A process triggered by the antigens, which produces many types of immune cells with different roles |
| **B cell** | One type of cell produced by the immune system |
| **Antibody** | Produced by B cells; they bind to antigens, stopping viruses from attaching to and infecting other cells and target the virus for destruction by the body |

1. What are memory B cells?

**Suggested answer:** They are B cells that remain in the body for years protecting the body against that virus.

1. Some people believe that getting a disease is preferable to being vaccinated for the disease. Propose an argument opposing this idea. Alternatively, this belief could be the topic of a class debate.

**Suggested answer**: When you contract a disease, it may take many days or weeks for your immune system to produce enough cells to destroy the virus. In this time, you can become seriously sick and spread the disease to other people. Vaccines deliver harmless antigens into the body to trigger your immune response, including memory B cells and antibodies. If you later become infected with the virus, the immune system has enough memory B cells and antibodies to destroy the virus, preventing you from becoming unwell.

1. Students fill in the first 3 columns of the table from watching the video. While students may be familiar with some brand names, they may not know what type of vaccine each is. You will need to provide guidance for them to complete the fourth column.

**Suggested answer:**

|  |  |  |  |
| --- | --- | --- | --- |
| Type of vaccine | What does the vaccine contain? | How does the vaccine work? | Brand name of vaccine |
| **Inactive whole virus** | The whole virus is weakened or inactivated | The virus doesn’t cause disease, but still contains antigens that trigger an immune response. | Sinovac, Sinopharm |
| **Antigen proteins** | The virus’s spike protein is produced in a laboratory | The spike protein triggers an immune response | Novavax |
| **Genetic instructions – DNA** | The DNA that codes for the spike protein | The DNA is typically delivered using an inactivated adenovirus: a modified virus that can’t multiply or cause disease, but can bring the DNA into your cells. Your cells then transcribe the DNA into mRNA, which is then translated into spike proteins. | CanSino, AstraZeneca, Johnson & Johnson |
| **Genetic instructions - RNA** | Messenger RNA (mRNA) that encodes the spike protein | The mRNA is delivered inside an artificial membrane similar to the cell membrane. When the mRNA enters one of your cells, the cell’s ribosomes translate the mRNA into the spike protein antigen, which triggers an immune response. | Pfizer, Moderna |

1. Some people are concerned that the inactivated viruses, spike proteins, mRNA and DNA can remain in the body and cause disease. Why does this not happen?

**Suggested answer**: An inactivated virus and spike protein (an antigen on the surface of the virus) cannot cause disease. All the material used to deliver the antigens, and the antigens, are removed from the body because the body recognises them as non-self and destroys them. Therefore, they cannot cause disease. It is only your body rapidly producing B cells and antibodies that causes some mild side effects.

1. Why might people need another SARS-CoV-2 vaccination if the SARS-CoV-2 virus mutates?

**Suggested answer**: Vaccines target specific antigens on the virus. If the virus’s antigens change due to mutations, the B cell/antibodies may no longer be able to recognise and target the virus. A new vaccine with antigens from the mutated virus is needed to produce new B cells/antibodies that are able to target the antigens on the mutated virus.

### Activity 6: extension activity

Students read the listed web pages to answer the question below:

* The Vaccine Alliance’s web page [What are nucleic acid vaccines and how could they be used against COVID-19?](https://www.gavi.org/vaccineswork/what-are-nucleic-acid-vaccines-and-how-could-they-be-used-against-covid-19), the linked pages [Whole virus](https://www.gavi.org/vaccineswork/what-are-whole-virus-vaccines-and-how-could-they-be-used-against-covid-19) and [Protein subunit](https://www.gavi.org/vaccineswork/what-are-protein-subunit-vaccines-and-how-could-they-be-used-against-covid-19)
* [How AstraZeneca is made and what it contains](https://www.immune.org.nz/immunisation/programmes/covid-19#:~:text=For%20viral%20vector%20vaccines%2C%20like,process%20for%20the%20AstraZeneca%20vaccine.)
* [Moths and tree bark: How the Novavax vaccine works](https://www.nebraskamed.com/COVID/moths-and-tree-bark-how-the-novavax-vaccine-works#:~:text=The%20Novavax%20method%20uses%20moth,cells%20and%20replicates%20inside%20them.)

For each of the 4 types of vaccines (whole virus, protein subunit, DNA and mRNA), predict the process by which the vaccine would be modified to protect against new SARS-CoV-2 variants. Which vaccine type would be the quickest to modify and make available? Justify your answer.

**Suggested answer:**

Whole virus vaccines: large amounts of the new variant virus need to be produced in cell cultures. The viruses are then soaked in a chemical that binds to their genes, inactivating them while leaving other viral particles intact. They are then mixed with an adjuvant. The inactivated variant would need to be tested to ensure that it does not cause disease but still stimulates an immune response. Development of a new vaccine, going through each of these steps, would take months.

Protein subunit vaccines: the spike protein (the antigen) on the new variant would need to be identified. The genes coding for the spike protein need to be identified, isolated and put into a vector virus, an insect virus. The vector virus infects moth cells and replicates inside them. The moth cells create lots of spike proteins which are then extracted and purified. Adjuvants are added to make the vaccine produce a stronger immune response. Again, these steps take significant time.

Nucleic acid vaccines – DNA: the DNA that codes for the spike protein on the new variant needs to be determined as above. The DNA is inserted into an inactivated adenovirus which cannot replicate in normal human cells. The recombinant adenovirus is inserted into specialised human cells which allow replication of the recombinant virus in a laboratory. The replicated adenovirus, in the vaccine, delivers the DNA to the human’s cells.

Nucleic acid vaccines mRNA: the mRNA coding for the new variant’s spike protein would need to be identified. The new mRNA is synthesised chemically from a template in a lab. Because there is no need for any bacteria or cells this would be the quickest vaccine to modify. For example, Moderna’s initial covid vaccine took 7 weeks to develop from vaccine design to manufacture to shipment.

### Activity 7: misconceptions

After completing the previous activities, students select a misconception they had, or had heard, about SARS-CoV-2 and COVID-19. Ask students to discuss where some of these misconceptions may have originated and write a brief argument to address the misconception. This could be undertaken using this writing prompt.

As you write your argument do the following:

1. State the explanation that you are trying to support.
2. Include reliable evidence – reliable information from experiments, facts or a reliable source.
3. Explain why the evidence is important and relevant.
4. State the misconception that you are trying to refute.
5. Explain why the misconception is invalid.

If students are unable to provide a misconception, provide this article [Can COVID vaccines shed spike proteins – and is that bad?](https://www.echo.net.au/2021/11/can-covid-vaccines-shed-spike-proteins-and-is-that-bad/) This addresses the misconception that the COVID vaccine’s spike protein will cause the disease.

Students peer-mark this task, determining how well each of the 5 steps are addressed. A scaffold with sentence starters and prompts is provided in student resources. Peer-marking promotes student understanding of their learning and provides opportunities for critical analysis of their own efforts, encouraging them to become more autonomous learners.

### Activity 8: biotechnology – making mRNA in Australia

The video, [Home-grown mRNA: inside the Adelaide facility that can make it (10:13)](https://cosmosmagazine.com/science/engineering/home-grown-mrna-adelaide-facility-biocina-video/) looks at the processes and regulations involved in the production of mRNA products. Links that provide more information are included in the article. Students assess the role of government and collaboration in the development of this biotechnology in Australia. This activity would be particularly beneficial to students who are also studying investigating science, as it links to Module 8.

Your students may benefit from the following guidelines.

A well-structured answer will have:

* a paragraph explaining the role of government in the development of this biotechnology
* a paragraph explaining the role of collaboration in the development of this biotechnology
* a paragraph that demonstrates an assessment.

Remind students that assess means to **make a judgement about the value, quality, outcomes, results.**

**Suggested answer:**

Currently there is nowhere in Australia that makes mRNA vaccine. By Australia purchasing vaccines from overseas, developing nations are missing out in obtaining supplies. BioCina, in Adelaide, has government agency approval to produce substances which go into human bodies. To achieve this the government agencies physically inspect the facility to make sure it complies with all their requirements. (This paragraph explains the role of government)

BioCina has the technology to make the precursors for mRNA vaccines – the first part of the mRNA production process. However, they lack the equipment to turn the mRNA into a vaccine. They need a method of coating it to make it stable and a bottling facility. BioCina currently works with other companies to produce other pharmaceutical products – drugs and vaccines that involve recombinant proteins and antibody fragments. Other facilities have approvals to make other biotechnology products. By collaborating with other companies BioCina believes it could produce 200 million vaccines every few months. (This paragraph explains the role of collaboration)

Australia is a small country in terms of population but has expertise in many areas in research institutions. It is essential for these institutions to work together with industry, and for manufacturers to attain government approval. If this occurs Australia has the capacity to produce a large range of biotechnological products. (This paragraph provides an assessment).

Students who experience explicit teaching practices make greater learning gains than students who do not experience these practices. Explicit teaching recognises that learning is a cumulative and systematic process. Explicit teaching helps students develop sophisticated and well organised ways of thinking, understanding and doing.

[What works best: 2020 update](https://education.nsw.gov.au/about-us/educational-data/cese/publications/research-reports/what-works-best-2020-update)

## Student resources

### Resource 1 – activity 2: How does SARS-CoV-2 infect people? worksheet

Watch the video, [Biology of SARS-CoV-2 Infection (2:43)](https://media.hhmi.org/biointeractive/click/covid/infection.html).

#### Questions

1. What is SARS-CoV-2 an abbreviation of?
2. What are coronaviruses?
3. What is Covid 19?
4. What organisms do coronaviruses infect?
5. What types of diseases do coronaviruses usually cause in humans?
6. In what way is the nucleic acid that carries the genome for all coronaviruses different from the genomes in most cells?
7. What surrounds the genome in the SARS-CoV-2 virus?
8. How do the spikes of proteins contribute to the name ‘coronavirus’?
9. What is the typical mode of transmission for coronaviruses?
10. Draw a flow chart showing the steps that occur once a coronavirus enters an airway.

Coronaviruses are not new. In 2002 to 2004 an outbreak of SARS occurred. There were 8,098 reported cases of SARS and 774 deaths. This disease was caused by the virus SARS-CoV-1. Scientists have determined that this virus attached to the same proteins (called receptors) on the surface of the cell as SARS-CoV-2. Scientists discovered that the current SARS-CoV-2 is 10 to 20 times more likely to bind to these receptors than the earlier coronavirus was.

1. Predict how this increased chance of binding has affected SARS-CoV-2’s ability to replicate.

### Resource 2 – activity 3: How are new strains of SARS-CoV-2 formed? worksheet

Watch the video [SARS-CoV-2 Evolution (2:47)](https://media.hhmi.org/biointeractive/click/covid/evolution.html).

#### Questions

1. Compare the number or proteins encoded by the SARS-CoV-2 genome with those encoded by the human genome.
2. Draw flow chart to show the steps in viral RNA replication.
3. Explain how the template RNA differs from the viral genome RNA.
4. What are errors in the genome replication process called?
5. How can the nucleotide sequence be altered?
6. How does a virus developing a mutation affect viruses produced by it?
7. How could a mutation provide a selective advantage to the virus?
8. What would be the long-term effect on the virus if a mutation made the virus less effective at replication or infection.
9. Why is it important to track mutations (including neutral mutations) in viruses?

### Resource 3 – activity 4: How can we detect the presence of SARS-CoV-2? worksheet

Watch the BioInteractive video [Detection (2:22)](https://media.hhmi.org/biointeractive/click/covid/detection.html) and complete the table to show how the presence of the virus is detected.

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Tests for active infection or past infection | What body fluid is tested? | What is detected? |
| RT- PCR (reverse transcriptase polymerase chain reaction) |  |  |  |
| RAT (rapid antigen test) |  |  |  |
| Antibody |  |  |  |
|  |  |  |  |
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For further information refer to [Coronavirus Testing Basics](https://www.fda.gov/consumers/consumer-updates/coronavirus-testing-basics) and [How do rapid antigen tests work?](https://cosmosmagazine.com/health/rapid-antigen-tests-common-mistakes)

### Resource 4 – activity 5: What is the difference between all those different vaccinations? worksheet

View the BioInteractive video [Vaccination (4:30)](https://media.hhmi.org/biointeractive/click/covid/vaccination.html).

#### Questions

1. Complete the table to define the terms.

|  |  |
| --- | --- |
| Term | Description |
| Viral antigen |  |
| Immune response |  |
| B cell |  |
| Antibody |  |

1. What are memory B cells?
2. Some people believe that getting a disease is preferable to being vaccinated for the disease. Propose an argument opposing this idea.
3. Fill in the first 3 columns of the table from watching the video.

|  |  |  |  |
| --- | --- | --- | --- |
| Type of vaccine | What does the vaccine contain? | How does the vaccine work? | Brand name of vaccine |
|  |  |  |  |
|  |  |  |  |
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1. Some people are concerned that the inactivated viruses, spike proteins, mRNA and DNA can remain in the body and cause disease. Why does this not happen?
2. Why might people need another SARS-CoV-2 vaccination if the SARS-CoV-2 virus mutates?

Read the listed web pages to answer the question below.

* The Vaccine Alliance’s web page [What are nucleic acid vaccines and how could they be used against COVID-19?](https://www.gavi.org/vaccineswork/what-are-nucleic-acid-vaccines-and-how-could-they-be-used-against-covid-19), the linked pages [Whole virus](https://www.gavi.org/vaccineswork/what-are-whole-virus-vaccines-and-how-could-they-be-used-against-covid-19) and [Protein subunit](https://www.gavi.org/vaccineswork/what-are-protein-subunit-vaccines-and-how-could-they-be-used-against-covid-19)
* [How AstraZeneca is made and what it contains](https://www.immune.org.nz/immunisation/programmes/covid-19#:~:text=For%20viral%20vector%20vaccines%2C%20like,process%20for%20the%20AstraZeneca%20vaccine.)
* [Moths and tree bark: How the Novavax vaccine works](https://www.nebraskamed.com/COVID/moths-and-tree-bark-how-the-novavax-vaccine-works#:~:text=The%20Novavax%20method%20uses%20moth,cells%20and%20replicates%20inside%20them.).

1. For each of the 4 types of vaccines, (whole virus, protein subunit, DNA and mRNA), predict the process by which the vaccine would be modified to protect against new SARS-CoV-2 variants. Which vaccine type would be the quickest to modify and make available? Justify your answer.

#### Misconceptions

Select a misconception you had, or have heard, about SARS-CoV-2 and COVID-19. Write a brief argument (no more than one page) to address the misconception. Use this writing prompt to help structure your answer.

1. State the explanation that you are trying to support.
2. Include reliable evidence – reliable information from experiments, facts or a reliable source.
3. Explain why the evidence is important and relevant.
4. State the misconception that you are trying to refute.
5. Explain why the misconception is invalid.

#### Peer marking scaffold

|  |  |  |
| --- | --- | --- |
| What was done well | What can be improved | Next steps for improvement |
| You did a good job when… | You provide more information on … | Would you consider changing… |
| Something you did well was … | You could get some help with … | A next step for you could be… |
| You are good at … | You need to link evidence about … to … | The next time you could … |
| I like the way you … | You need to work on … | Do you think you could … |
| Another thing you did well was … | The criteria you missed are … | Would you consider adding … |

#### Biotechnology – making mRNA in Australia

View the video, [Home-grown mRNA: inside the Adelaide facility that can make it (10:13)](https://cosmosmagazine.com/science/engineering/home-grown-mrna-adelaide-facility-biocina-video/) that looks at the processes and regulations involved in the production of mRNA products. Assess the role of government and collaboration in the development of this biotechnology in Australia.

A well-structured answer will have:

* a paragraph explanation of the role of government in the development of this biotechnology
* a paragraph explaining the role of collaboration in the development of this biotechnology
* a paragraph that demonstrates an assessment.

Assess means to **make a judgement about the value, quality, outcomes, results.**

## 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, advice or 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 [HSC Professional Learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/hsc-pl). [Stage 6 Literacy in context](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/teaching-and-learning-resources/literacy/stage-6-literacy-in-context-writing/science) provides further advice to teachers to improve student writing.

**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**: Inclusive Education, Multicultural Education, Literacy and Numeracy and 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/about-us/strategies-and-reports/school-excellence-and-accountability/school-excellence/about-sef) 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) 3.2.2, 3.3.2.

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

**Resource**: classroom resource

**Creation date**: 29 July 2022

**Updated:** 13 Feb 2024

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### Further reading

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